Executive Summary of AIP 2011 Solar, Space & Upper Atmospheric Physicists Survey

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As part of the Solar and Space Physics Decadal Survey process, the Education and Workforce Working Group developed a community survey that was implemented by the American Institute of Physics and funded by a National Science Foundation (NSF) grant. The goals of the survey were to determine the demographics of the field and assess the health of the field. The survey request was sent to 2560 unique email addresses (from the AGU Space Physics and Aeronomy Section, AAS Solar Physics Division, Space Weather Week attendee lists, and NSF PI lists) and we received 1305 responses (51%) of which 1171 indicated that they considered themselves in the field of Solar, Space and Upper Atmospheric Physics and currently work and reside in the US. The survey generated 125 pages of single space responses to a number of open-ended questions. These responses have not yet been systematically analyzed, so this executive summary of the report is preliminary and focuses on demographic statistics.

Of the respondents, 83% were men and 17% women. Most were white (81%), while 13% were Asian or Asian American, with 6% other. The median age of the respondents was 51 years old with a symmetric distribution (the middle 50% were between 40 and 62 years old). Physics was by far the most common undergraduate degree (62%). For those earning their PhDs in 1999 or earlier, Physics was the most common degree field (40%), while the most common degree for those receiving PhDs since 2000 is Space Physics (36%, while Physics dropped to 27%). Almost three-quarters of graduate student support and two-thirds of undergraduate student research support is from NASA or NSF. Nearly three-quarters of recent PhD recipients (receiving their degree since 2000) participated in some form of undergraduate research. About half of the respondents reported that they were involved at some level in K12 education and/or public outreach.

The survey asked a number of Likert-scale questions with the opportunity to elaborate on their answers – two of which are highlighted here. One question asked if they strongly agree, agree, disagree, strongly disagree, or "don't know" regarding the following statement "The next generation of scientific leadership is emerging in my field, and I am confident that they will be able to answer the scientific questions of the next decade." Two-thirds of the respondents agreed or agreed strongly with the statement, while one-quarter disagreed or disagreed strongly. The open ended comments were generally optimistic about the abilities of the next generation, but pessimistic about reduction in funding and NASA missions. Another question asked "What have been the barriers to your career up until this point?" and the responses were divided between men and women. Over 31% (48 of 154) of the written responses from women indicated some form of gender discrimination or lack of family friendly policies as barriers.

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American Institute of Physics
Statistical Research Center

Susan White, Garrett Anderson & Rachel Ivie

Results from the 2011 Survey of Solar, Space & Upper Atmospheric Physicists

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Contents

Results from the 2011 Survey of Solar, Space, and Upper Atmospheric Physicists

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About the Respondents

We received responses from 1,171 individuals who resided in the US at the time of their response; most of the respondents were men (83%, with 17% women) and white. About one respondent in twelve (8%) was a student, and most of the students (96%) were enrolled in a graduate programs). Almost eighty percent of the respondents (79%) were employed; the remaining 13% reported another status (such as retired, seeking employment, or part-time student and full-time employed). Of the ~950 who were employed, 90% were employed full-time as shown in Table 1.

Employment Sector	% of Respondents
Education	46
NASA	9
FFR&DC	13
Other government agencies	14
Government contractors	5
Industry	5
Self-employed	1
Non-profit	5
Other	2

Education includes 2 & 4 year schools, university affiliated research institutes (UARIs), and museums. Four-year schools (33% of all respondents) and UARIs (12% of all respondents) account for most of the respondents in this group.

Table 1: Employment Sector

Table 2 details respondents' racial and ethnic background. The overwhelming majority (81%) is white; but, the percentages of minorities increased among those earning their bachelor's degree more recently. Most of the increase in minority representation comes from an increase in the percentage of Asians and Asian-Americans in the field.

	% of All	Respondents earning Bachelor's degree…	
Race and Ethnicity	Respondents	1999 & Earlier	2000 & Later
Asian or Asian American	13	12	24
Black or African American	1	1	2
Hispanic or Latino	2	1	3
White	81	83	69
Other	3	3	2

Table 2: Race and Ethnicity of Respondents

The median age of respondents is 51 with the middle 50% being between 40 and 62 years old. The mean age is 51.4; this suggests a fairly symmetric distribution with respect to age.

About 85% of the respondents have earned doctorates. Physics was the most commonly-named field for those who earned their doctorate before 2000; space physics was the most commonly named field for those earning their doctorates more recently. Physics was also a very popular undergraduate major. Other fields are shown in Tables 3 and 4 below.

	Respondents earning doctorates …	
Field of Doctorate	1999 & Earlier (%)	2000 & Later (%)
Physics	40	27
Space Physics	22	36
Astronomy / Astrophysics	17	11
Solar Physics	4	10
Engineering	7	9
Other	10	7

Table 3: Field of Doctorate

Field of Bachelor's Degree	% of Respondents
Physics	62
Astronomy / Astrophysics	9
Engineering	9
Other	20

Table 4: Field of Bachelor's Degree

We also asked respondents to tell us in which fields they primarily work and what techniques they primarily use (Tables 5 and 6). Respondents were asked to select two; some selected more than two, while others selected only one.

	Data Analysis (%)	Education & Public Outreach (%)	Engineering (%)	Instrumen-tation (%)	Simulation & Modeling (%)	Other (%)	Total (%)
Data Analysis	11	5	5	24	35	2	73
Education & Public Outreach		1	1	1	2	1	8
Engineering			1	4	4	1	11
Instrumen-tation				1	7	1	30
Simulation & Modeling					12	1	52
Other						2	6

Note: Respondents could select more than one technique. The number in the highlighted blue box on the diagonal represents the percent of respondents who indicated that they use only that technique and no others.

Table 5: Primary Technique Used in Work

	Education & Public Outreach (%)	Engineering (%)	Planetary Science (%)	Solar Physics (%)	Space Engineering (%)	Space Physics (%)	Space Science (%)	Space Weather Operations (%)	Upper Atmospheric Physics (%)	Other Physics (%)	Other (%)	Total (%)
Education & Public Outreach	1	*	*	1	*	2	*	*	1	*	1	6
Engineering		2	*	1	1	1	1	1	1	*	1	8
Planetary Science			1	1	*	3	*	—	1	*	—	6
Solar Physics				15	1	6	2	1	1	1	*	27
Space Engineering					1	1	*	1	*	—	*	5
Space Physics						21	6	3	5	1	*	45
Space Science							2	1	2	*	*	12
Space Weather Operations								2	1	*	*	9
Upper Atmospheric Physics									3	*	*	12
Other Physics										4	*	6
Other											5	8

* - less than 0.5% and — - zero

Respondents could select more than one field.

The number in the highlighted blue box on the diagonal represents the percent of respondents indicating working in that field only.

Table 6: Primary Work Field

Student Support and Outcomes

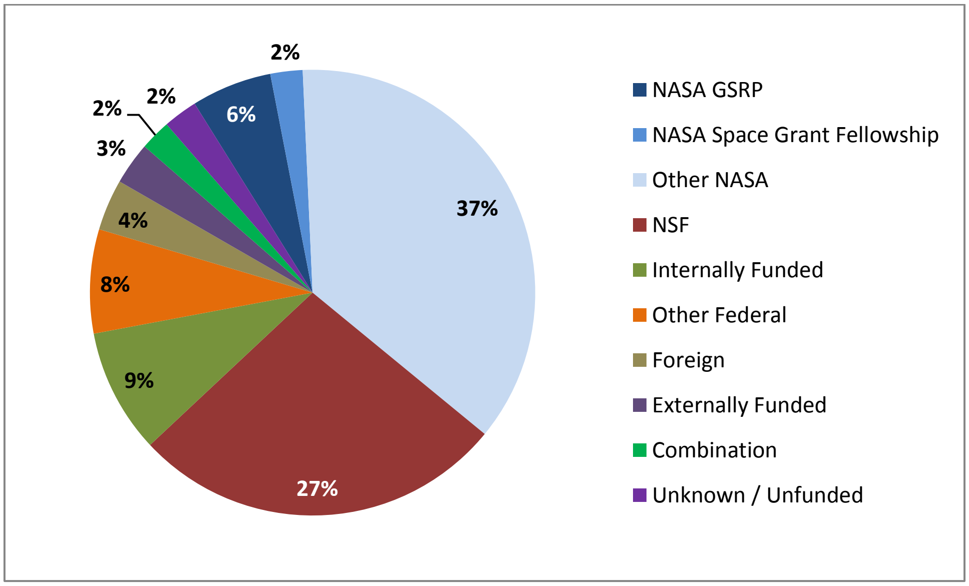
We asked those who had supervised graduate students to tell us about job placement for their three most recent graduates. Some of the respondents had not yet supervised three students who graduated, so they told us about only those who had graduated. There is an issue of timing with these data since we do not know when the students graduated. We have information describing the employment outcomes for 769 graduate students. The results are detailed below.

Employment Outcomes (time frame not specified)	% of Graduates
Research scientist	59
Engineer / Operations Manager	9
Faculty member at school with teaching emphasis	6
Faculty member at school with research emphasis	4
Technical manager	4
Post-doc	3
Other	15

Table 7: Graduate Student Employment Outcomes as Reported by Supervising Faculty Member

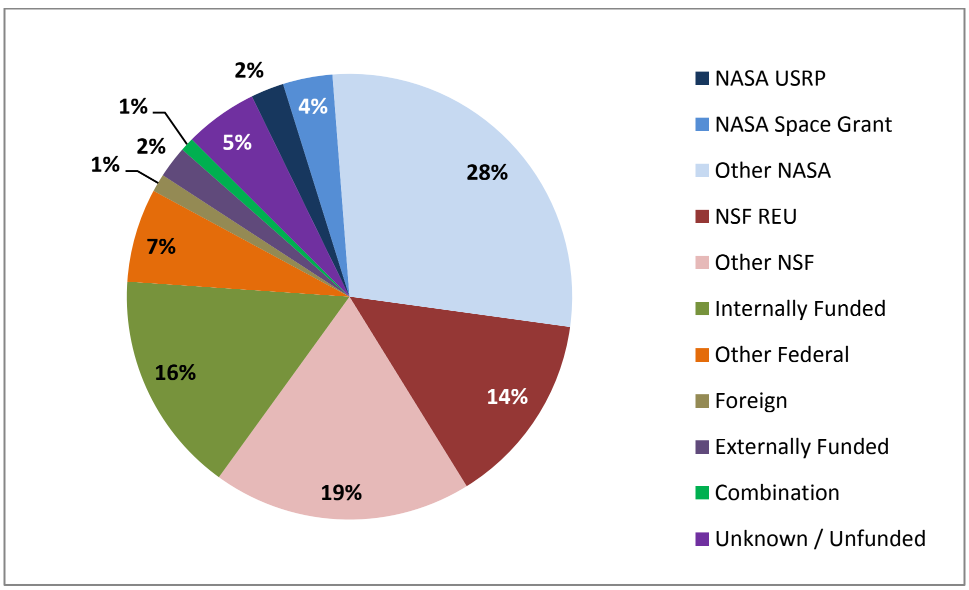
We also have information about sources of funding used to support graduate students and undergraduate students participating in scientific research outside class assignments. Figures 1 and 2 (on the following page) depict the funding sources For graduate student support, almost three-fourths of the funding comes from NASA and NSF. These two agencies account for about two-thirds of the funding to support undergraduate students participating in scientific research outside class assignments. These data are based on responses describing funding for 942 graduate students and for 1,305 undergraduate students. We asked respondents to tell us about funding for their three most recent graduate and three most recent undergraduate students. For respondents who had worked with fewer than three graduate or three undergraduate students, we asked about all of the students with which the respondent had worked. We do not know when these students were enrolled, nor do we know how many are currently students.

Figure 1: Funding Sources for Graduate Students as Reported by Supervising Faculty Members



Notes
Based on responses describing funding sources for 942 graduate students
Internally Funded refers to university, college, or departmental funds; **Other Federal** refers to all other federal programs including military and DoD; **Externally Funded** refers to non-federal funding, including employers; **Combination** refers to a combination of sources which includes some federal funds.
Caveat: We do not know the time-frame for the students referenced above.

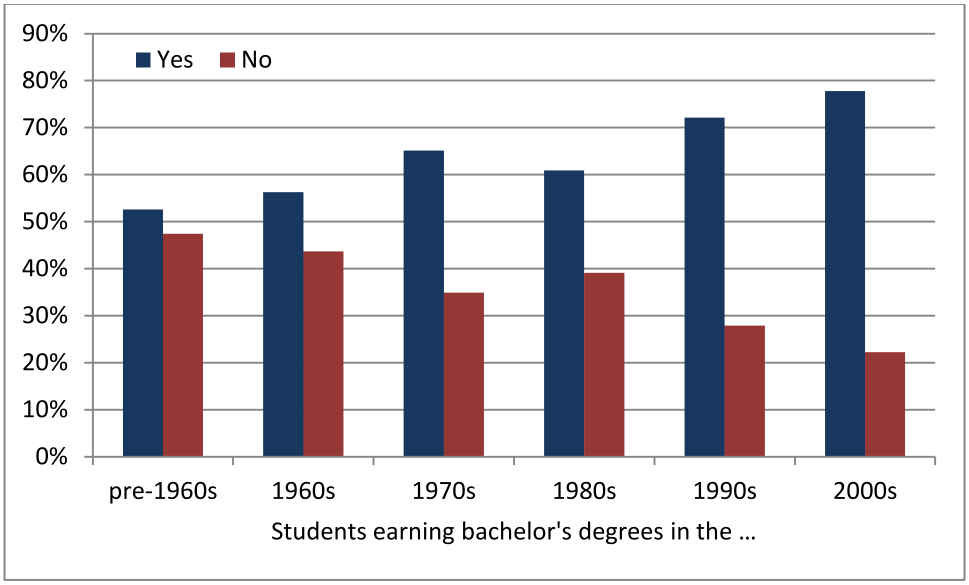
Figure 2: Faculty Members' Reports of Funding Sources for Undergraduate Students Participating in Scientific Research Outside Class Assignments



Notes
Based on responses describing funding sources for 1,305 undergraduate students
Internally Funded refers to university, college, or departmental funds; **Other Federal** refers to all other federal programs including military and DoD; **Externally Funded** refers to non-federal funding, including employers; **Combination** refers to a combination of sources which includes some federal funds.
Caveat: We do not know the time-frame for the students referenced above.

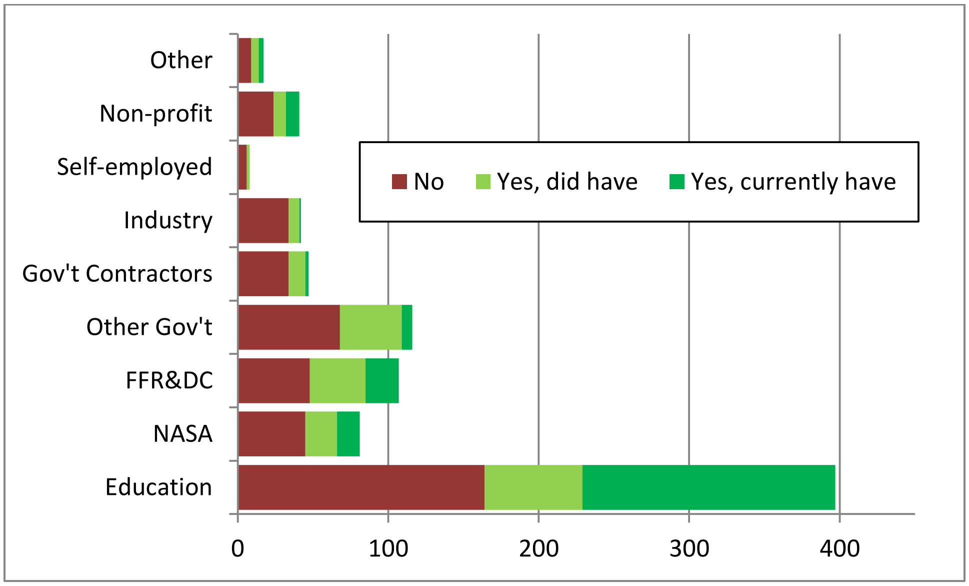
There appears to have been a steady increase in the proportion of undergraduate students participating in scientific research outside class assignments. As seen in Figure 3, just over half of the respondents who graduated before 1960 did so, and over three-fourths of the recent bachelor's degree recipients in the 2000's report having done so. These research experiences can include, but are not limited to, traditional summer REUs.

Figure 3: Respondents' Participation in Scientific Research Outside Class Assignments as Undergraduate Students



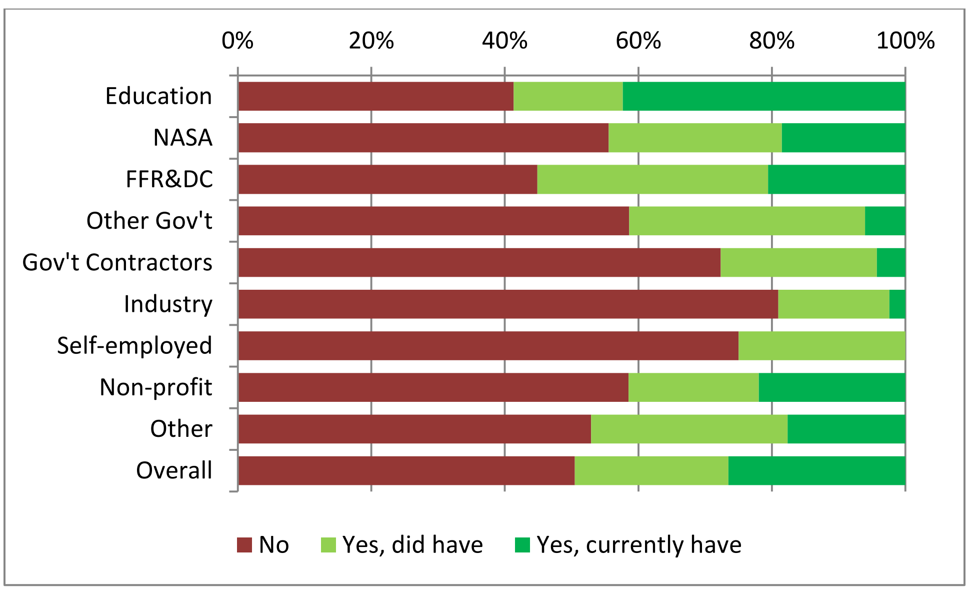
Figures 4 and 5 (on the following page) depict respondents who supervise students in research by employment sector. As seen in Figure 4, most of the respondents who are currently supervising students in research are employed in the education sector. Figure 5 allows for comparisons across sectors, and we see that respondents who are employed in Federally-funded research and development centers (FFR&DCs) have historically been as active in supervising students as those in Education.

Figure 4: Respondents Supervising Student Research by Employment Sector



Education includes 2 & 4 year schools, university affiliated research institutes (UARIs), and museums. Four-year schools (33% of all respondents) and UARIs (12% of all respondents) account for most of the respondents in this group.

Figure 5: Proportion of Respondents Supervising Student Research by Employment Sector



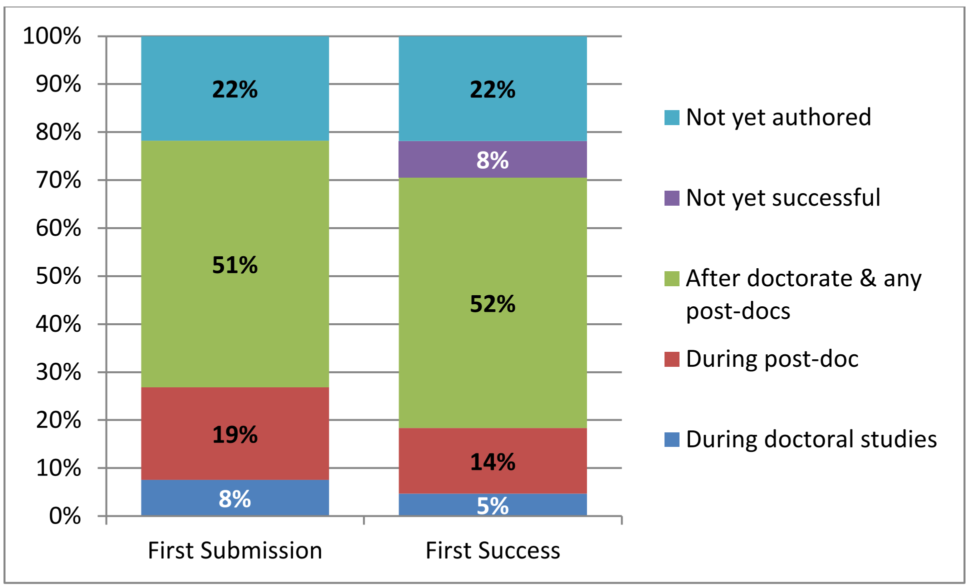
Education includes 2 & 4 year schools, university affiliated research institutes (UARIs), and museums. Four-year schools (33% of all respondents) and UARIs (12% of all respondents) account for most of the respondents in this group.

While it may look surprising to see that 40% of the respondents employed in the Education sector have not supervised students involved in research, note that this means that they are not responsible for supervising graduate students and do not work with undergraduates in research outside class assignments.

Research Funding and Involvement in NASA Missions

We asked respondents to indicate when they first served as primary author for a proposal for grant funding and whether or not the proposal was funded. Figure 6 details the responses. The median time lag for those indicating they had submitted after earning their doctorate and serving any post-docs was 5 years in both cases.

Figure 6: First Submission and First Successful Submission as Primary Author for Grant Funding



Note: The numbers do not sum to 100% for "First Success" due to rounding.

About 83% of the respondents indicated that they were involved in research, and about 78% of these (or about 66% of all of the respondents) received external funding to support their research.

Of those receiving external funding to support their research, 74% received monies from NASA, and an additional 5% reported being named on a NASA-funded project but receiving no funds. NSF funding was supporting research for 46% of the funded researchers; an additional 6% reported being named on an NSF-funded project but receiving no funds. Respondents reported receiving monies from NASA and NSF separately; some received funding from both agencies. We also asked what proportion of their research was supported by these funds. The responses are detailed in Table 8 (following page). Those receiving funding from NASA appear to receive a larger portion of their research support from the agency.

Agency	25th Percentile	Median	75th Percentile
NASA	40	75	100
NSF	20	50	75

Note: Respondents receiving funding from an agency were asked to indicate what percentage of their research funding was provided by that agency; these figures are percentages, not dollar amounts.

Table 8: Percent of Research Funding Received by Funding Agency

We asked respondents about their participation in NASA flight missions over the last ten years. Table 9 outlines the responses for those who reported having worked on a NASA flight mission over the last ten years. About half were involved in some way, but the other half of the respondents reported no involvement in a NASA mission in the last 10 years.

Over the last 10 years, I have ... (select all that apply)	Number
Served as NASA PI	38
Served as NASA Co-I	185
Served as NASA instrument PI	61
Served on NASA PSP	44
Been funded, but not named	236
Participated in some other way	173
Total who were indicated involvement in some way*	519
Total who indicated no involvement in a NASA mission	510

* Respondents could indicate more than one response; this total is all of those who participated in at least one capacity.

Table 9: Worked on NASA Flight Missions over the Last 10 Years

We also asked about proposing flight missions, proposing an instrument on a flight mission, and proposing an instrument on a sub-orbital mission. Tables 10 through 12 (following page) outline the responses to these questions. Respondents were more likely to have proposed a mission than to have proposed an instrument. Most of the respondents have done neither.

Over the last 10 years, I have ... (select all that apply)	Number	Number with Multiple Proposals
Proposed a new NASA space flight mission as PI	64	34
Proposed a new NASA space flight mission as Co-I	246	166
Participated in preparing a proposal for a new NASA space flight mission, but not been named	101	62
Not proposed a new NASA space flight mission	719	

Table 10: Proposed a New NASA Space Flight Mission During the Last 10 Years

Over the last 10 years, I have … (select all that apply)	Number	Number with Multiple Proposals
Proposed an instrument on a space flight mission as PI	42	21
Proposed an instrument on a space flight mission as Co-I	175	122
Participated in preparing a proposal for an instrument on a space flight mission, but not been named	72	40
Not proposed an instrument on a space flight mission	764	

Table 11: Proposed an Instrument on a NASA Space Flight Mission During the Last 10 Years

The distinction between space flight and suborbital missions is important to make. It appears as though respondents were more likely to have proposed instruments on space flight missions than on sub-orbital missions.

Over the last 10 years, I have … (select all that apply)	Number	Number with Multiple Proposals
Proposed an instrument on a NASA sub-orbital mission as PI	38	23
Proposed an instrument on a NASA sub-orbital mission as Co-I	71	43
Participated in preparing a proposal for an instrument on a NASA sub-orbital mission, but not been named	25	12
Not proposed an instrument on a NASA sub-orbital mission	899	

Table 12: Proposed an Instrument on a NASA Sub-Orbital Mission During the Last 10 Years

Finally, we asked about participation on official NASA working groups or subcommittees. The responses are compiled in Table 13.

Over the last 10 years, I have … (select all that apply)	Number
Served on the SMD-wide advisory group (Previously SSAC)	17
Served on the Heliophysics Science Subcommittee (or its predecessors)	46
Served on other working groups or subcommittees	162
Not served in any of these capacities	828

Table 13: Service on NASA Working Groups or Subcommittees During the Last 10 Years

Outlook for the Future

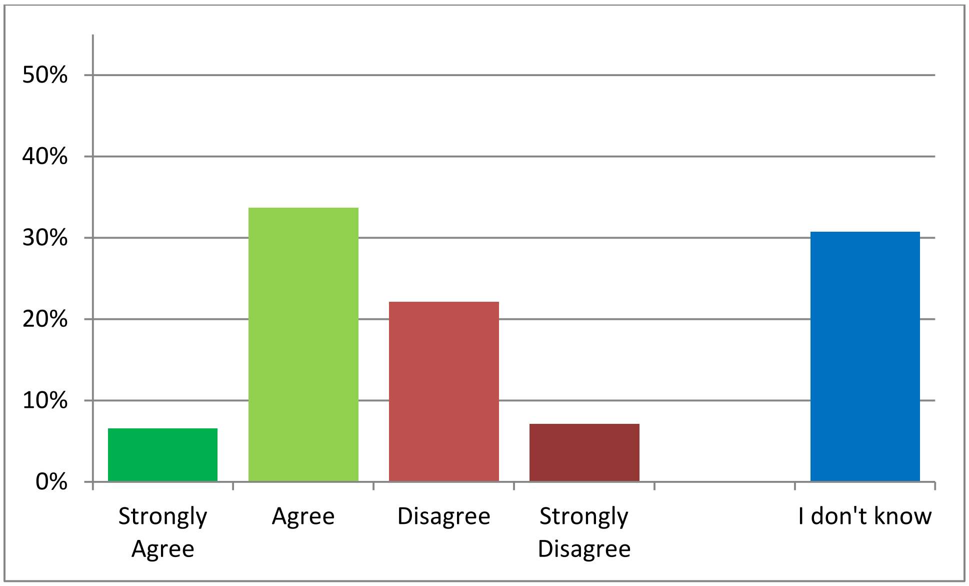
Half of the respondents reported being involved in K-12 education efforts and/or public outreach efforts. The types of activities are described in open-ended responses later in this report. These efforts, of course, will impact future events.

We asked respondents how they felt about the future. Specifically, we asked them to rate their level of agreement with the following statements:

> "There is sufficient capable technical and engineering support for current and future NASA missions."
>
> "The next generation of scientific leadership is emerging in my field, and I am confident that they will be able to answer the scientific questions of the next decade."

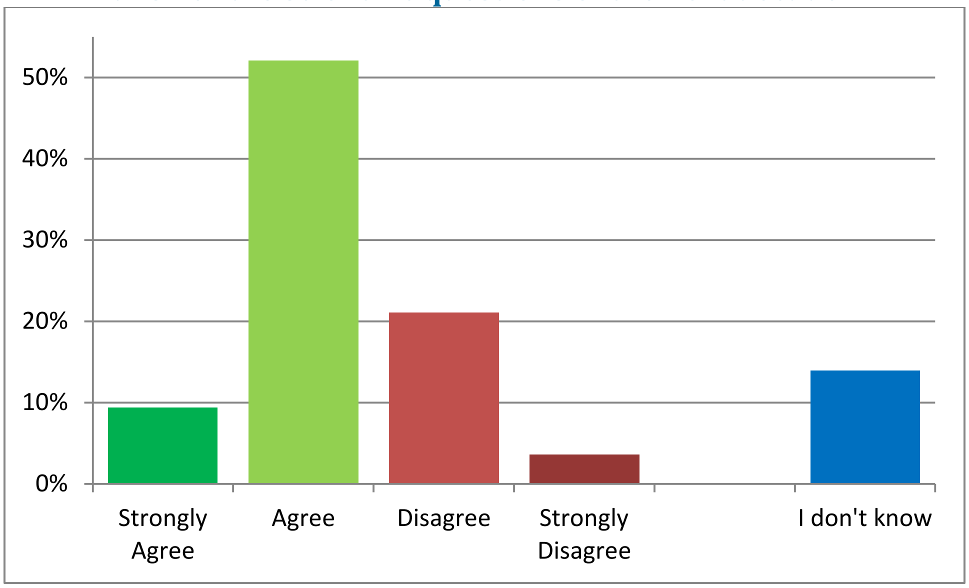
Figures 7 and 8 reveal that respondents are more upbeat about the next generation of scientific leadership than they are about technical and engineering support for current and future NASA missions.

Figure 7: Agreement with "There is sufficient capable technical and engineering support for current and future NASA missions."



Almost one-third of the respondents don't know whether there is sufficient capable technical and engineering support for current and future NASA missions. A look at the open-ended responses given to explain the respondent's level of agreement suggests that the factor driving the response is more closely tied to the existence of future NASA missions than to the sufficiency and capability of support.

Figure 8: Agreement with "The next generation of scientific leadership is emerging in my field, and I am confident that they will be able to answer the scientific questions of the next decade."



Almost two-thirds of the respondents either agree or strongly agree with this statement; one-fourth disagree. A perusal of the open-ended comments reveals that there is a lot of optimism about the abilities of the next generation of science researchers and leaders. At the same time, however, there is a great deal of pessimism about reductions in funding and in NASA missions.

Appendix A: Survey Mechanics

We contacted individuals believed to be associated with solar, space, and upper atmospheric physics. We obtained the membership list of the Space Physics & Aeronomy section of AGU, the membership list of AAS's Solar Physics Division, Space Weather Week 2011 attendees, and a compilation of names that had been PIs on NSF Solar Physics grants. We removed e-mail addresses with international domains.

We initially sent requests to participate to 2,776 unique e-mail addresses. About 4% of these bounced as not deliverable, and another 3%+ declined to participate in the study. Thus, we were left with e-mail addresses for 2,560 individuals. We received responses from 1,305 for a response rate of 51% for the study.

Source	Total Names	Unique Names
AGU SPA	2,327	1,792
AAS SPD	443	198
SWW	288	163
NSF PIs	338	75
		2,228
(plus those) On multiple lists		548
Unique e-mail addresses		2,776
Less bounces		122
Less declines		94
Total requests		2,560
Total responses		1,305
Response rate		51%

Table A1: Name Sources and Response Rate

Seventy-four of the 1,305 respondents answered that they did not reside in the US; sixty did not respond to this question. So, we have 1,171 respondents that answered they did reside in the US.

We cast a wide net in using these 2,776 names. The largest number of names (1,792 unique names; 2,327 total) come from the AGU SPA list. This 2,327 includes 537 people who indicated that solar and heliospheric physics is their primary field; 385 who indicated aernomy; 717 who indicated magnetospheric physics; and, 688 who indicated solar and heliospheric physics is their primary field. The AAS Solar Physics Division is much smaller.

Of the 94 respondents who declined to participate, 32 (34%) indicated that they did not consider themselves to be a solar, space, or upper atmospheric physicist. An additional 15 (16%) noted that they did not currently reside in the US. (We did eliminate e-mail addresses with domains outside the US; however, these respondents could have gmail.com or yahoo.com or similar e-mail addresses.) It is likely that a non-trivial fraction of the 1,255 non-respondents either do not consider themselves to be solar, space, or upper atmospheric physicists or do not reside in the US.

Thus, the response rate among the true target group is likely much higher than the 51% reported above.

Responses to Open-Ended Question about Support for Future NASA Missions

We asked respondents about their level of agreement with the following statement and then asked for an explanation. All responses are reported as received except any identifying information has been omitted.

"There is sufficient capable technical and engineering support for current and future NASA missions."

Responses from those who Strongly Agree

I know of no solar mission that has suffered from a lack of excellent technical and engineering support.

There is an overabundance of capable people who could work successfully on NASA missions. However, experience is another matter. Due to perceived 'low risk', many institutions continue to win competitions again and again despite mediocre to poor performance on numerous past missions. Therefore, the experience base dwindles. This may seem like a paradoxical answer, but I distinguish capability from experience.

sufficient for the relatively small number of missions anticipated

The funding has been taken up by non-teaching oriented institutions as in the past.

Expertise is out there, the problem is devoting it to NASA missions. People need jobs. If they loose NASA-supported jobs, they work at some other technical job and (1) probably earn more money and (2) are unlikely to return to NASA-funded research.

This is related to NASA in- house support

The US educational system produces many more technical and engineering personnel than all areas of Government research can use, but it endlessly tries to raise alarms about "workforce shortages"" in order to get financial support for producing more academic cannon-fodder."

The support is available but is mismanaged.

The shortage is in current and future missions, not a shortage of capable people.

Responses from those who Agree

At least institutions can successfully propose for any mission opportunity.

At my working place there have been sufficient numbers of technicians and scientists around to support and conduct NASA missions, although there has been information regarding redirecting programs and cutting down on costs for manned missions.

At NASA Centers, yes in industry and at universities, no.

Because of the dwindling budget there is much less to do, so less people are required. The future looks grim for future work.

But, that capability is seriously waining.

Comes from my experience as a program manager at HQ - there are a lot of really talented people out there working on NASA missions. The problem is can NASA management let these people do the work and succeed?

Competition for funds is so strong I don't bother to propose. Selection is largely a matter of luck and many capable people are underfunded.

Despite the lack of expertise depth in some areas there will be increasing numbers of new generation interest in space science related endeavors

For the number of missions that look like they will get funded, there's plenty -- and some will probably have to be let go. For all the missions anyone might *like* to fly...of course not.

Funding support is what is missing, not technical and engineering support.

Generally the talent has been available, but maintaining it against dwindling funds for science in the US is a serious problem.

I agree here, however, I feel that there is far too much middle management involvement in NASA Missions

I also feel there is sufficient capability as long as funding is properly provided.

I am concerned NASA doesn't have a SST follow-on. I agree private industry can fill this nich, butNASA needs a sure lift capability to support it's missions.

I anticipate a decline in the number and frequency of NASA science missions so I believe that, in the next 10 years, the number of qualified people who could support such missions exceeds the number of opportunities.

I assume you mean technical and engineering *capability* when you say "support"", as distinguished from financial support"

I believe that a sufficient number of support staff (both technical and engineering staff) probably exist, although their time may not necessarily be allocated/budgeted appropriately to meet all upcoming needs.

I believe that the country's technical support for NASA missions is sufficient what is lacking is NASA's support and lack of hiring of this technical talent, although funding is part of the reason.

I believe that the technical and engineering support is becoming more diverse, but it is still quite capable.

I don't know much about this, but I have not heard anything in the news to suggest that there is not sufficient support for current and future NASA missions.

I feel the NASA centers are bloated and inefficient. Private industry and other institutions should become a larger component of Missions and other NASA missions.

I get the sense that there is sufficient technical expertise but insufficient innovation going on to allow new space science breakthroughs

I have had no problem teaming with capable engineering groups to develop instruments and spacecraft.

I might have said "disagree"" a few years ago, but now it looks like NASA is going to be forced to scale back in the current political and economic climate. In that case, I think there is enough such support already."

I think there is a strong technical & scientific base at this time. I think it will disappear rather quickly if NASA budget problems reduce the number of new mission opportunities, especially small missions and joint missions with other agencies.

I worry about the median age of NASA's workforce and what that means for future missions

If anything, there is too much so-called technical support from NASA.

If only the technical and engineering support are concerned, they are sufficient simply because of strong legacy in space instrumentation.

It all depends on the future NASA missions. I believe the people are available and that the funding, and missions, should be adjusted to our economy.

It seems there are plenty of mission-experienced engineers around.

It seems to me this is the "silver lining"" to the conundrum of ""too many PhDs"" given the limited number of tenured positions at academic institutions."

I've never had trouble hiring good talent (and I've hired over 100 in the last 10 years) - and I have had to lay off excellent talent due to funding cuts. The whole we're falling behind concern is a myth. The real problem is losing all the good talent due to lack of funding - they find other things and never come back.

Many still active and the number of flights seems to be getting smaller

More good mission concepts than NASA can fund

My institution graduates a number of students each year with exceptional qualifications to satisfy NASA's needs in the technical and engineering areas involved in NASA's missions. In seeking jobs they do not find strong demand but they certainly do get recruited - not necessarily by employers associated with NASA.

My role with the [name of mission omitted] mission has required me to be at JPL once or twice a week for the last 6 years. Over this time I have worked with numerous competent engineers, planners, and managers and very few people who weren't up to the task. I occasionally disagree with some of the decisions coming out of upper management but there seems to be no shortage of qualified people working in the trenches where they are needed the most.

NASA has folks to support but has to maintain large overhead that hurts govt conractors.

NASA is conservative about technology. They support what has worked in the past. They should support the more risky business of developing new technology.

No involvement since 1991

Our principal problem is sufficient opportunities not skilled people. Smart people will migrate to the opportunities quickly.

Plenty of capability if you outsource to commercial manufacturers and engineering firms.

Plenty of support, not enough money.

Problems are political, not engineering or technical (in my opinion)

Regarding human resources for NASA missions, it appears we have less funding than brains. Phrased another way, money is the limiting reagent, not the number of experts or the quality of their expertise. As a separate matter, the recently increased burdens of additional bureaucratic reporting and certification requirements are becoming barriers to wider participation in development of NASA missions.

Reliance on grants requires a lot of energy be spent on grant writing rather than research.

Right now, there probably is, but we are in danger of losing key personnel and capability from the field without continued flight opportunities.

Since I'm not directly involved with missions I'm cannot really comment too much on technical and engineering support, but I feel that missions might lack some support when it comes to data analysis and supporting modelling efforts

Some concern about sufficient future expertise

Technical and engineering support is the point of the question-not leadership or innovation for current and future missions.

The age of those I encounter leads to a perecption of a lack of young people who are involved but that is likely a result of the type of meetings I attend. I have attended training one summer with an amazingly talented group of grad students. I attend meetings hoping to influence technicians and engineers of the needs of the end user.

The current pipeline has plenty of talent for currently projected missions. For the long term, however, this pipeline could drain rapidly without fiscal support over the next few years.

The people exist, but not the money to employ them.

The problem is not so much the lack of people as the lack on sustainable funding.

The scope of current and future NASA missions will be set by national budget considerations and, once that scope is set, the current size of the space science community will be sufficient to carry that program out.

The talent is coming through the pipeline and retirements are not as expected.

The technical level and workforce capacities are more than appropriate for the projected funding levels. On the other hand, the age distributions in engineering specialties could be better.

There are many excellent scientists and engineers in the NASA mission.

There are plenty of people to fill the limited number of positions that NASA has funding to fill. Until the current Baby Boomers are able to retire (better economy, death) there will not be enough positions for the number of students coming out of universities.

There are very few future missions - perhaps there is too much technical/engineering support for such a meager program

There has been a loss of capability because of cutbacks in the NASA portfolio, but I think that there is still a deep enough reserve in the US if funding is restored.

There is a large infrastructure of scientists. Future NASA missions should have a land-based laboratory component (much cheaper than satellites).

There is a skilled workforce for current missions. However, there is a danger that the workforce may not be available in the future: institutions are always in danger of losing excellent people due to potential funding gaps, with few missions coming along and few opportunities to fill in funding

there is ample trained manpower   there is a shortage of missions

There is an army of seasoned tech & eng support BUT ever decling # of missions unable to support them all

There is an excess of qualified flight program scientists and engineers, and a paucity of available missions.

There is plenty of technical and engineering support at the moment. It is fragile, and in danger of being a lost, or diminished, resource as opportunities and funding decrease. In addition, the highly risk-averse and oversight and paperwork-heavy environment impedes the efficiency of that support.

There is plenty of technical and engineering support, but not enough funds to support important missions

There is probably sufficient capability at the present time, but I am very worried that the number of missions is declining, which will decrease the need for new engineer and technical personnel. It could then become a critical level.

There is some concern that the expertise of older generations will not get passed down to the younger generations due to the difficulty to participate/get funding for missions today.

There is some very high quality support available but not enough in sufficient number, nor in the lower experience levels.

There is sufficient support now, but in the future, there may be a problem. The effects of specialization is degrading our ability to do new work. New engineers and scientists are not well rounded and do not have a solid background in basic physics. They are so specialized they cannot easily communicate with each other.

This has not in my experience been the major problem with mission support.

This is difficult to quantify, but we seem to be able to eventually obtain the expertise needed.

This is only true because of the dedicated efforts of Universities, as supported by NASA, to provide the necessary education and research experience, the future of which could well be called into question at current funding levels for University research.

This is true only because the number of missions that NASA initiates are diminishing.

very open-ended question, but the key concern is level of funding capable engineering support is available, if you can pay for it

We have a lack of projects and not a lack of engineering support

We have capable technical and engineering support but no money for the necessary missions.

While I certainly agree that the support and expertise exist, whether it will continue to be funded by NASA is another issue. I have no doubt about the capacities of NASA engineers and the scientists who support them. My only doubts concern congress and their willingness (or lack thereof) to continue to fund science in general.

With potentail funding cuts on the horizon it is possible that NASA funding for science missions has peaked for the foreseeable future.

With the end of the NASA shuttle program and nationwide high unemployment, there would seem be to an ample supply of capable technical and engineering support workers -- thousands of whom need jobs!

Yes, but it is on the decline.

Yes, there is a sufficient pool of support. I am uncertain as to how well that pool is capable of addressing more ambitious future missions (e.g., post Hubble telescope).

Responses from those who Disagree

a lot of technicians and engineers are moving to more lucrative companies of the private sector.

Aging workforce ...... it will catch up to us in the future.

Apparently the [instrument omitted] has been found to be very difficult to build. This indicates that there is insufficient technical support.

As long as we continue to draw heavily on foreign students for our PhD programs in support of NASA science and engineering, and fall short in recruiting US students in this area I think one answer is no. The question is not unrelated to level of government and private sector support in these areas, which impacts student perception of long term carreer prospects.

budget cuts frequently cause problems for NASA

Capability is being lost due to significant underrepresentation in STEM.

Current capabilities are adequate, but the age of the workforce bodes ill for the future. The national space program does not inspire enough younger members of the workforce. Many of the younger technical support are foreign students.

current researchers in many cases need to be replaced with younger researchers

Currently there is sufficient support but this support is dwindling as people retire and I do not think a new generation is being trained quickly enough.

Discussions at JPL have recounted staff cuts and space science impacts.

Engineering and managerial staff come and go as contractors, since there is no steady flow of new NASA missions. Alot of experienced people retire before their expertise has been transferred to a new generation.

Engineering support is always in short supply.

Few scientists are being trained to carry out space hardware missions.

For future missions, high school education must be improved.

Funding for research support of current and future NASA missions is getting to be quite low relative to what is required to meet the needs and potential of the missions.

Funding levels are way low.

Funding levels should be maintained at a stable minimum.

Funding opportunities keep declining.

Generally, funding has been getting tighter and tighter, with fewer and fewer mission and instrument opportunities. Scientists and engineers have to work on a larger array of opportunities to make ends meet. These pressures limit the technical and engineering support available for NASA missions

Given the current budget climate, and cuts in NASA funding, I question whether there will be people around to support future missions. I think there are probably enough technically qualified people available now, but I do not know how many are out of work and will be lost to the field.

Good technical help is hard to find.

Hard to answer this. There is the engineering capability, but almost no ability to provide NASA mission expertise from existing university personel.

Having worked with NASA contract engineers the basic mechanics of sub-orbital space flight wasn't understood. NASA employees, however, were top notch.

I am a theorist so I do not know first-hand whether there are enough technicians and engineers to support current and future NASA missions. Given the current lack of interest in science and technology careers in the general population, however, I believe there will be a shortage in the US in the near future.

I assume that by support you mean funding. There are limited opportunities for new missions. There is even more limited funding for development of new instrumentation. The rocket program is under funded as a result proposers almost never meet their flight goals, it take more than 3 years to build and fly, they propose again for funding to complete and fly the payload.

I believe that the current funding climate at NASA is putting the agency to an unhealthy situation for future competition on the world stage.

I believe that the primary goal is to put a mission concept together but in many cases there is no money or little money behind these efforts. More disturbing is that when missions are almost ready to be launched they are canceled, see [omitted], and the most significant problem is that even when a mission is launched there is no money for working with the data. This is a real disadvantage for US scientists and we are spending money which allows foreign fellows to do the data analysis excluding many capable US scientists. This will create a bigger problem for the future since young scientists will not be willing to work for a space agency.

I do not think there is sufficient funding to maintain staff for future missions.

I see funding decline

I see the ionospheric and atmospheric physics areas dying under NASA funding. I have worked in the field for 23 years and have never had a NASA grant -- although not for lack of trying. I work for the DoD and see similar trends there too.

I think that science and math in the US is on the decline, and losing creativity due to too many expensive, out of reach projects

I think that the low rate of new missions is making it difficult to retain capable and experienced technical and engineering support, especially at centers awaiting future missions.

I think that there have a number of retirements that have gone unfilled at several NASA centers.

I think there is sufficient support for current missions but am not sure there are enough young people being trained.

I think we are okay for the near term, but I worry about the long term support for NASA missions

I think we have sufficient support for current missions. I don't think we have enough new young scientists and engineers in the pipleine.

I watched a number of good scientists and engineers leave [NASA facility omitted] while I was in grad school as a consequence of increased responsibilities, decreased authority to carry out those responsibilities, and stagnant wages. The lab's performance fell as a result. While some other NASA centers may be doing better (ie [NASA facilities omitted]), the funding stresses placed on the budgets of these institutions as well as the educational institutions funneling the next generation of technical experts bodes ill for securing NASA's position in the future.

I work for NASA [omitted]. We do not have enough capable engineering support for more that 1 mission to be done by Langley, and none of the work even in that case would be in house - we have just enough, maybe, to appropriately monitor and oversee work at an aerospace contractor. There has been a loss over the years of skill and knowledge due to the lack of technical work in house for which NASA was technically responsible for achieving.

I'm not convinced there are enough current and future NASA missions to sufficiently motivate capable and technical engineering studies.

I'm not sure, but I know that students aren't getting the science and math training they need

I'm seeing a strong and disturbing trend of researchers writing for splash and desired results at the expense and to the detriment of careful and meticulous and skeptical science.

In my limited experience, it seems that many of the NASA centers are not technical leaders in the engineering of modern space missions. There seems to be little innovation as well or attempt to develop new technology. The entire process is geared towards risk reduction.

Insufficient funding to support higher education.

Insufficient funds, lack of honest congressional support and understanding of science

It appears to me that the overall technical and engineering capabilities for heliophysics are currently less than 10-25 years ago even though the challenges and opportunities may be greater than ever. More is needed to encourage and support the next generation of scientists and engineers.

It is difficult to maintain competent engineering and technical support at my institution because of limited outside funding support.

It is hard to maintain enough in our university because of the unevenness of funding.

It is my impression the USA is not graduating enough technical and science oriented students.

It is so difficult to win a proposal for a mission that mostly the only people with experience are in their 60's. Instrumentation training is hardly done in universities any more.

Key engineering support and development at Universities has diminished to the point where there is insufficient volume in the pipeline to maintain excellence into the future.

Lack of opportunities for permanent employment in space physics (e.g., tenure-track positions)leads to less stable technical workforce, at least for the science part. And the grant success rate is becoming too low due to inadequate funding.

Level of education is declining. I see people less and less prepared for the challenges ahead.

Looming retirements and NASA's dithering and lack of mission focus are turning away many of the best and brightest

Many active researchers and engineers are at or beyond retirement age, and few younger ones are being groomed to take over leadership roles.

Many retirements upcoming. Not sure of technical expertise remaining. Very few universities training instrument builders.

Missions must be technically ready in the sense of very low risk, but there are not many opportunities to test new detectors, etc.

More funding is needed for scientific research.

More qualified and creative researchers are always needed.

More support needed for reliable missions.

Most graduate students are trained in data analysis or simulation and work with older data sets. Instrument developement can lead to low productivity and difficulties in advancment. Many competent engineers and instrument builders are retiring and not being replaced.

Most of the present set of PIs are at or near retirement and they need to be replaced. Also the students that have gone through to their PhD are no where as well qualified as students in my generation.

My experience is that the supply of trained and experienced researchers is decreasing.

My impression is that we are educating enough theorists, modelers, and data analysts, but that we may be falling short with regard to instrumentalists, i.e. people that can lead the building of space instrumentation.

NASA is underfunded by the government and is continually plagued by large missions going over-budget.

Need more young engineers.

not enough funding

Not enough new blood being inducted into the space physics community, both in theory and instrumentation, especially in energetic particles.

Not so much support for theory and modeling related to NASA missions

Not sufficiently capable to avoid cost over-runs. Also facing a wave of retirements among the most experienced designers and engineers.

Often time, there are alot of support in NASA mission, but I disagree that they are "capable"". There is a lot of expertise that are single stringed and going to retire soon."

Over the years I have seen NASA loose its capabilities in the hardware and project fields. It seems that NASA farms out its missions and I am not sure that NASA can run a hardware program successfully (on time and on budget without compromising the science) any more. Where are NASA run programs? They all seem to be PI led these days.

Personally, I know there is a serious lack of people trained in analyzing [omitted] data - I cannot find trained post-docs. I also believe there is a lack of people trained in instrumentation.

Public perception is that NASA is dying and resting on glories of past missions. That discourages the best and brightest from aspiring to a NASA job in the future.

recent layoffs in NASA are not based on capabilities needed.

Scarcity of Flight Missions makes training new generation of scientists, engineers, technical and management personnel very difficult. This is only going to get worse as time progresses.

Software and tools to perform data intensive research are old, poorly documented and unportable, but funds are not allotted for their improvement since the tools are not the science.

Space and solar physics woefully underrepresented in US academic institutions. Very little training in theory, data, and hardware available to students.

Support for technical staff is sorely lacking. Also, support for development of new engineers to support future instrument development programs is missing.

Support often approaching retirement. Limited funding for new projects does not make the work attractive as a career.

Technical and engineering support for laboratory testing and calibration is insufficient. Simulation and modeling have been emphasized, but not laboratory work.

The amount of diversity -- in both science and engineering -- to support NASA missions is rather thin. There is a need for more universities to actively develop the infrastructure that will allow them to fly instruments and payloads - and to allow them to eventually proposal for full NASA missions. The number of engineering contractors capable of supplying the hardware for space missions should also be broadened. Oftentimes, the same contractors make multiple missions.

The current administration has diluted NASA's objectives to fulfill political and social goals, rather than hard sciences.

The current generation of experts is retiring and there is insufficent funding and employment opportunites to replace them

The current level of funding is static or declining, Until the economy stabilizes, I do not see a change.

The engineering capability at NASA Centers, to perform cost-effective technical oversight, is inadequate. The number of university groups that is capable of developing flight qualified instrumentation has dwindled.

The expertise is available but one must have the funds to pay for them. Without that funding there is no support, internally or externally to one's institution.

The mission rate for Explorers, Discovery, New Frontiers, and Flagship missions is going down.

The percentage of mission funds that goes to actual scientific research has been decreasing.

The present state of K-12 and university education is unsatisfactory for the physical sciences and mathematics.

The sounding rocket program should be better funded to produce well-rounded space scientists, that is, ones who have actually dealt with instrumentation and data analysis and interpretation.

The state of current science education in the US (from primary to graduate school) hinders the future quality of technical and engineering support for NASA missions.

The technical and engineering support that exists in the University community has degraded significantly over the years so that there are currently only a few groups left that can support building missions or significant instrumentation.

The US is losing the technological edge for space research. Missions are underbid and subsequently underfunded and are also subject to political pressures.

The US, in particular, is falling behind in producing students with interest and ability in math and science. We are finding it difficult to staff companies in high tech areas of the US, while many students with liberal arts degrees are unable to find jobs. Building a scientifically literate workforce fills jobs in many tiers.

There are fewer and fewer technical and engineering personel with the hands on experience to deisgn, build, and test flight hardware. This leads to missions which are increasingly expensive compared to how much they cost. The consequence is that NASA spacecraft missions are fewer and more complex. We may end up pricing ourselves out of the business of launching science missions. should and historically have costed.

There are not enough scientists, engineers for future NASA missions that come from the US. Foreign nationals are restricted with export control issues.

There are people filling the roles of technical and engineering support but I am not convinced that these people are sufficiently competent for missions to be successful.

There exists a huge gap for engineers with experience in solar instruments and that understand the challenges in heliophysics. Most have to be trained specifically for solar instrumentation.

There has not been good overview and oversight. [NASA facility omitted] and others are allowed to spend 10s or 100s of millions dollars on potential new programs which experienced old hands once they get involved rapidly realize are unafordable. These preliminary design centers are very biased, become unrealistic with respect to estimating costs. Management gets caught up with program is great if it brings in lots of money and suports lots of people. The current situation with no new Flagship Missions could have been avoided with the right old hands providing oversight. [NASA facility omitted] presently has lost cost creditability. Where do you go from now?

There is an exodus of scientific and technical talent from NASA due to poor moral. This is brought about by lack of funding, governmental mismanagement and the "jobs for the boys"" culture."

There is insufficient funding for research in general

There is insufficient support for data analysis and modeling. New missions are being developed and specified before we know what the data we already have are telling us.

There is little support either for engineering or manpower for University contributed hardware or development of the next generation of instrument PI's.

there is not enough funding to develop key technologies that would help dramatically.

There is not enough regular soft-money funding to support the current work force of scientists. The yo-yo funding situation makes people leave the field for more stable pastures. People should stop enticing others into science when there is no adequate infrastructure to support them once they have become professionals.

There is not sufficient support for innovative work. There is not enough capability for technical management.

There's plenty of computer jocks and theorists, but the cadre of instrument builders is shrinking because of lack of flight opportunities.

These efforts are never fully staffed nor funded. We can always do more

Too few US citizens PhD's in physics and other technical disciplines. Must rely on foreign students who cannot be hired by NASA centers (except [NASA facility omitted]) without at least getting a green card.

Too little finical support for too many non-scientific missions

Too many worthy proposals get turned down

US budget as a whole is going down.

US solar astronomy used to be represented by tenured staff at e.g. [universities omitted]. It is now based mainly at [universities omitted]. The decine of quality of grad students has been masked by Europeans from [universities omitted]. But the key professors there ([names omitted]) have all retired. We have a problem in the making for the quality of scientists available to use NASA and also NSF solar telescopes like ATST.

We are losing our ability to develop space missions and instruments at Universities.

We do not have enough students in the Pipeline to ensure successful domestic workforce levels

We have a serious experience shortfall coming in the near future. We don't have enough engineers & scientists with enough experience to fill the shoes of the retiring NASA staff. And there is no direction for the future of NASAand thus no real assurity for young engineers and scientists to want to join the NASA team.

We see a dwindling pool of researchers proposing instruments for NASA missions.

Responses from those who Strongly Disagree

As a mid-career scientist, I have seen only one short (2 year) period of growth in the field of spacecraft and space science technology, associated with the [project name omitted] project. Funding for technology development has steadily decreased except for that one bit. Students coming in to the field are fewer and of lower quality. Fewer technical accomplishments are occurring as the same or lower resources are used on proposals and paper studies.

because many arguably interesting and important proposals have not been supported.

Due to the recent cutbacks in federal funding, NASA is and will, unfortunately, have to scale back on new missions due to lack of funding.

funding has been declining and there are fewer chances for scientists to become PIs

Funding has decreased and support for data analysis and supporting technology development have sharply decreased.

Funding is tight and missions are few. It is very difficult to maintain an instrument-building group at a university in today's climate.

I do not observe the required tech and engineering support in the pipeline for the planned missions in the face of rapidly aging demographic in these areas.

I have some spaceflight hardware experience from helping with a [omitted] mission, bench tests I did on a spare instrument after the satellite was launched, and some electron detector simulations. My limited hardware experience is a lot more than most of my peers have - many of my peers, as well as many older scientists, have never even touched a piece of spaceflight hardware and they seem to be largely ignorant of instrumental limitations & issues that affect data sets. My institution has built instruments for recent spacecraft missions, but many of the engineers/technicians who worked on these projects were hired only on a temporary basis. Once the instrument was built, most of these engineers and technicians were laid off and they expected that they would need to look outside the aerospace industry for jobs. I would have loved to be involved in building these instruments in order to gain more spaceflight hardware experience, but I was not allowed to participate in the proposals or instrument development even though another member of my department told me that they had been encouraging the PIs to include me. At first I thought this was because I did not have enough hardware experience, but I later learned that this was the first time that many of the people working on these projects had ever done anything like this. I have no idea why my involvement was not wanted. Some people have told me it is because I have not published enough papers, but some of the Co-Is on these projects have fewer first-author publications than I do, so I don't think that is the reason, either. I have heard that NASA is placing more and more restrictions on who can propose instruments/satellite missions or even be included on an instrument team. I follow the Women in Planetary Science group on Facebook and occasionally read the blog of the same name (http://womeninplanetaryscience.wordpress.com/). The woman running this blog, Susan Niebur, made a post on July 7, 2011 about a presentation she gave at the Low Cost Planetary Missions 9 Conference on the lack of scientists who meet NASA's qualifications for proposing to the next AO. She found that only 3 PIs, 11 PSs, and ZERO deputy PIs will be available and under 65 at the next mission selection. This is a very sobering result that is consistent with my experiences working as a scientist in space physics. The older generation of scientists is just not letting many of us in our 30s and 40s become involved in new mission development even though we are practically begging to participate. I don't understand why this is happening, but I do know that when these older scientists retire, there will not be anyone with sufficient experience to take their places as mission/instrument PIs.

I see a strong disconnect between our needs for space science and engineering expertise, as represented in students and faculty to educate and train them, and our ability to fund this activity.

I think NASA is (and has been) operating under tremendous funding constraints. The number of ITM missions has strongly decreased over the past several years, and the level of support from Congress seems minimal. Overall I think the quality of people at NASA is extremely high, and I would like to see more funding provided. I think it is the upcoming generation that will be the most hurt by the lack of opportunities given them.

I work(ed) on an instrument on the [omitted] spacecraft. US participation was monetarily reduced (significantly) in the late-1990's. The spacecraft is still working, producing useful data. Data for [omitted] is now being archived, not utilized. Need I say more.

If the U.S. is to maintain its lead in Space science, we need to aggressively pursue manned missions to the Moon and Mars

Insufficient support of smaller science projects.

Many institutions find it difficult to recruit and retain qualified and capable engineers, and mine is no exception.

Many mission PIs are close to retirement and while there are a number of younger PIs coming through there is not enough of them nor have they all been mentored to the level necessary.

Math, physics, and engineering are difficult fields. Most kids enter college without the background education to enter these fields. Most kids have been able to find jobs in other fields that either make more money or require less work.

Most current missions are underfunded from the start. Many PIs low-ball their estimates for the cost of instrumentation expecting additional funding to come through later.

NASA (and other US S&T is underfunded, and, US education is lagging behind other western countries.

NASA does not provide sufficient support for the analysis of data from its missions.

NASA has developed many bureaucracy layers to be effective in space missions... the agency completely lost its exploration and science spirit of 1960s.

NASA has little or no core funded capability to support organic scientists and engineerswithin NASA. Funding of any project prgmatically depends on an being a part of a a buddy network, despite any thing said to the contrary. In solar physics, you have to be a part of the [name omitted] group or their networked collaborators to be sucessful. Even NASA and NRL scientists depend on them for success

NASA is staffed for the past, not the future. As an experimental physicist, I see very few engineers who are capable of cutting edge work.

NASA is totally mismanaged, as I painfully discovered when I served as [position omitted] at NASA [facility omitted] in the 1990s. What a waste....

NASA needs to focus strictly on space science and development of advanced space propulsion (nuclear thermal, fusion, exotic, etc) and reducing the cost of access to LEO by supporting CCDEV, especially those efforts that focus on fully reusable vehicles, SSTO, or non-rocket methods (e.g. Laser, space elevator, etc). NASA should get out of the business of building EELV rockets or subsidizing contractors that build them. This approach has held up development of space for all and restricted access for a privileged few. Once we have truly reusable access to LEO and in space propulsion that is both high thrust and with ISP's hundreds of times better than chemical propulsion will robust exploration and colonization of space be possible. The best thing NASA can do for space science is STOP buying EELV's and don't buy the SLS! Let the private companies figure out a solution to the launch problem, and let them actually compete on a level playing field.

need more support for theory, modeling and data analysis

Not enough engineers and CMMi has led to many failures due to weak mission and system analysis. Software driven design, instead of functional driven design is a failure. Current agile programming processes do not allow adequate SE oversight

Not enough funding.

Not enough scientists to analyze the data and provide theory/modeling support. We make huge investments in hardware, but do not reap the scientific return.

Over the past 30 years, it seems that in the staffing profile of any given mission the percentage of technical and engineering personnel has significantly declined while the percentage of individuals serving in various management and/or administrative roles has significantly increased. At the same time, you see virtually the SAME individuals--from PIs and CoIs to the various hardware engineers--on every new mission. It seems that various mission/instrument teams formed 30+ years ago, have done almost all NASA-funded missions since then, and have never evolved with new talent that is being trained for the future. This failure to maintain a robust and evolving technical and engineering foundation will be very detrimental to the for future NASA missions. I suspect part of this stagnation is due to Congress's (and NASA's) view that new missions and instruments can be simply bought on an as needed basis--like hiring a carpenter to add an addition onto a home. This "buy-as-you-need"" only approach has little room for error or problems, resulting in extreme risk aversion on the part of NASA management and leading to requirements/desirements that selected PIs and teams already have prior mission experience (""Go with what you know""), and contract award budgets with no room for employing essentially duplicate young scientists/engineers for the purposes of training and skill redundancy."

Satellites are being turned off, and individual research grants are fewer.

STEM pipeline education and training in the U.S. is declining severely.

The failure of NASA to invest in maturing instrument technology for spacefight is the principal cause of SMD's cost overturns.

The infrastructure is not being supported insufficient funding for new technique and instrument development given the current risk-averse posture by NASA ([omitted]).

The lack of missions over the last decade, coupled with the fact that they seem to all fund established ("older"") scientists, means that there will soon be a loss of experience."

The last year has seen severe cut backs across NASA that are causing permanent personnel damage.

The small amount of money for technology development is not reasonable in today's laboratory setting. Also, the federal scale of pay for engineers isn't as attractive as industry.

The stress on manned mission planetary missions has siphoned a lot of the funds for basic science and unmanned flights

There are many entrenched managers, but not enough engineers with practical experience and knowledge of the scientific goals.

There aren't enough NASA missions any more so the younger generation can not gain valuable technical and engineering experience for spacecraft. My guess is that in 10 years the experts will have retired and we won't experienced spacecraft engineers to support new missions.

There is a lack for young scientists in NASA missions. The Co-op program is deaded. There is very little in house science for young scientists.

There is very little effort to conduct laboratory-based work and, consequently, students are not skilled in understanding experimental methods. This is because experimental work is both not supported and seen as too time consuming. Much easier to analyze the data accumulated by previous missions.

This is a long, long discussion - way too much for this survey.

To many middle managers are no longer technically experienced and therefore many decisions ae based on "paper analysis"" instead of good experienced engineering decisions."

Very few opportunities exist even to train students with hands on experience in space flight systems science.

Responses from those saying "I don't know."

All I know about NASA missions is what I see in the public press.

As an agency official, I need to recuse myself from answering this question.

Depends on how many and what NASA missions are planned. There seem to be more scientists than missions at the moment.

Gut feeling is there is insufficient manpower to vigorously pursue future lunar/planetary efforts because of the decline in Engineering graduates by U.S. citizens.

Haven't been involved with NASA.

I am not a solar and space physicist.

I am not active in space or solar physics anymore. I do not follow the field adequately to make an informed judgment.

I am not familiar with NASA.

I am not in the scientific field any longer and don't know

I am not involved in current or future NASA missions.

I am not involved in mission design so really cannot say if there is sufficient expertise. I'm sure there is some, based on the success of recent missions. But I worry for the future.

I am not involved in NASA missions and cannot speak to the support issues.

I at [facility omitted] from [year omitted] until [year omitted], and at [facility omitted] as a contractor from [years omitted]. [facility omitted] had sufficient technical and engineering support, but at [facility omitted], much of the technical and engineering support was contracted out. When contracts changed, there was a repositioning of personnel, and I believe that this greatly disrupted the programs. Personnel were lost in some cases, and in all cases, there was a disruption because peoples lives were in disarray for a period of time (about a year in the case of [omitted]).

I believe sufficient capable technical and engineering support (currently) exists, but doubt it is available, primarily due to budgetary constraints.

I can't understand the sentence. There are too few missions, but probably not too little capacity to support the ones that are funded.

I do not have sufficient interaction with flight programs to make a good judgement.

I do not understand the question. There are enough specialists for sure. And there is not sufficient funding to support these specialists.

I don't consider myself current on the overall status of NASA, however given the funding situation I would be suprised if there was sufficient T&E support.

I don't know what "support"" means in this context. If you mean available qualified personnel, then I agree. If you mean available financial support, then I disagree."

I don't know what the future missions may be.

I don't quite understand the question. Does it mean that given current funding, can we hire people to fill the available jobs? I don't think that I have ever heard of a technical job not having enough applicants, but I am not really familiar with the technical job market.

I don't understand the context of this statement. Do you mean in the nation as a whole, or the particular NASA center assigned the mission project management role, or what?

I don't work on the technical /engineering side of the business

I have been out of touch for most of the past 10 years.

I have little knowledge on this aspect.

I have no idea how many scientists and engineers there are in this country that are capable of working on NASA missions. Nor do I know how many people current and future missions would require. Why would I know that? How would I know that? Does anyone actually know the answer to this question?

I have no way of being able to answer this question

I haven't been connected with any NASA mission work in any way for the last 15 years or so

I haven't been involved enough with technical issues on missions, only science applications, to answer this.

I haven't been involved with NASA missions.

I haven't really studied the issue

I haven't work on space programs

I honestly know very little about the technical and engineering sides of a mission.

I know of several PhD graduates who cannot find steady employment (beyond a postdoc) in their field, yet also know space physics faculty who cannon attract enough students for their research projects.

I no longer have a sufficiently close contact with the programs and community to provide a definitive answer.

I see many people with good ideas competing for ever-decreasing pool of financing.

I would love to participate in a NASA mission but have no idea how to go about getting involved.

If NASA funding continues rapid decline, there will be more than enough. If funding grows, there will be a shortage. There is a lack if information transfer between generations. The experienced people who entered NASA in the 1960's are retiring, and being replaced with entry level people. The recent and current lean budgets do not allow time for teaching and learning.

I'm a pencil and paper theoretician.

I'm an [omitted], at this point I'm not thinking of NASA at all. NASA does what it can, and we all know it is just getting started.

I'm no longer doing research so I don't really know.

I'm not sure I understand the question. There is very inadequate support in terms of money to pay scientists and engineers. There are plenty of unemployed scientists and engineers who could "support"" NASA research, if only they could. "

I'm not close enough to know.

I'm tempted to say "probably"" , but not knowing what NASA's future technical and engineering needs makes it difficult to evaluate this statement."

Insufficient data provided.

It depends on how missions and support are defined.

it depends on how NASA's budget evolves

It is not clear to me what future NASA missions there will be.

It largely depends upon what projects get funded, whether NASA is able to retain current personnel, and whehter you are including those people that do not currently work for NASA.

It seems OK for now, but it is difficult to see the support for future NASA missions

I've been retired for 14 yrs

I've no idea how NASA runs.

I've not been involved with any physics research for over 30 years.

Most of my work has been with industry. The last ten years with restricted programs. NASA was not part of the mix.

Much support exists, but is now in private contractors, and I think that NASA itself does not have enough scientists and engineers. And certainly not enough money for science.

My only information on this matter is hearsay, and mixed hearsay at that.

NASA funding mechanisms are making it increasingly difficult to develop technical support in university environments (rather that involving NASA Centers) so there may be support at present, but it is being killed off for the future.

Not currently working in space physics

Not having been in a position to try to hire such people, I do not have a feel about whether or not they exist.

On one hand there are many scientists who have moved out of space science due to funding contraction and many of them would be thrilled to return - hence there are sufficient for current missions. I am more concerned about the future, since I believe there are fewer students entering relevant fields.

Since NASA doesn't know what its future plans are, it is not possible to answer this question.

Sometimes it feels like there is not, but other times you look at the future funding situation and feel like it would be hard to urge students to go into the field. We'll see.

The following terms are too vague to allow me to make a reasoned judgment: sufficient, capable, technical, engineering, support, current, future, missions.

The question is poorly defined. Science can always use more funding for current NASA missions, but future mission will depend on the level of support available.

The question is too poorly defined

The U.S. fiscal situation and potential re-appropriating funds for JWST means that I am not sure what missions are fully committed.

There are capable technical persons, but not the money to pay them.

There are sufficiently trained people to support current missions but I don't know if they are being supported. Also, there aren't many young people I know who are being trained to support future NASA missions, but my exposure to those who would do this type of training is relatively limited.

There are too many doing a bad job at the NASA centers and there are to few activities going out outside the NASA centers, groups that gets enough of money/volumes to keep a competence lean engineering support. It is outside the NASA centers that new innovative development can be done since bureaucracy and the oversight at the NASA prevents this, it is not cost effective to to the work at the centers, however facilities at the centers might be a valuable resource for developers.

There is much uncertainty about what NASA plans to do, according to my colleages.

There is probably sufficient technical and engineering support at the current time but the financial support is lacking. Moreover, one can expect the technical and engineering expertise to "erode"" over time as the baby boomers begin to retire."

There's not enough support for the astronaut-oriented work, which means that the actual science missions are terribly starved. NASA is too risk averse, to cautious, too expensive for me to devote any time towards.

This depends entirely on when the future NASA missions are successfully developed. I do not believe that the current crop of students are going to want to come to NASA, and therefore we will eventually be left with something less than the "cream-of-the-crop"" to choose from."

This statement depends highly on the number of future NASA missions. In my field there is currently a lull in the activity which risks losing the wealth of experience and expertise gained over NASA's long history. If this lull continues there will not be sufficient capable technical and engineering support.

This statement is extremely vaguely worded.

This statement is too vaguely worded for me to agree or disagree with it.

Too general. Question does not make too much sense when asked out of context.

Unfamiliar with details of NASA missions.

While I have the opinion that this is probably a true statement, my Division works primarily on fundamental science and I don't have direct knowledge of NASA resources

While I know that the PIs involved in many future missions are quite capable, I do not know the structure or requisites of the engineering and technical staff at NASA.

With the coming NASA science budget cuts coming along, there are many experienced space scientists who are going nowhere.

You need to be more specific about which NASA missions are involved

Question is too unclear to answer.

Responses to Open-Ended Question about the Next Generation of Scientific Leadership

We asked respondents about their level of agreement with the following statement and then asked for an explanation. All responses are reported as received except any identifying information has been omitted.

"The next generation of scientific leadership is emerging in my field, and I am confident that they will be able to answer the scientific questions of the next decade."

Responses from those who Strongly Agree

Academic success at the upper end of the scale is not a problem in my opinion.

Anecdotally, it appears their is a very bi-modal distribution in engineering and the sciences related to space research. As the 'old timers' retire the next generation (or which I am a part) is taking on new challenges and pushing for new discovery instead of incremental science. Incremental science is a commonly perceived feature of NASA due to their extreme risk posture and heritage methods.

Based on my research collaboration with several young Ph.Ds I think the leadership potential is there, but the political will in the US federal government (and other governments) is in the toilet right now as they try to appease the banks and the private sector. If those people have their way NASA will be privatized and excellence will be a thing of the past.

Ground-based solar physics is a small field and a am aware of several younger folks that have the ability to take leadership positions in the field

I am a very junior scientist, and feel my cohort (and those younger than me) are more than capable scientists who will make progress in answering those questions.

I am part of the "next generation"" and I am confident that my peers are capable and prepared to address the scientific challenges of the next decade."

i am very impressed with the up-coming generation of younger scientists in my field and closely related ones. they already are making remarkable progress in identifying novel approaches to answering long-standing questions, especially in solar physics. if funding remains stable, progress will be made.

I have met students in the Graduate Program at my university, and they are outstanding

I met a lot of these new, emerging leaders while participating in HQ peer reviews.

I see no shortage of brilliant young minds coming into Solar Physics. We got 2 solar physicists making the top 50 Early Career scientists named by the White House.

I work with scientists near retirement but I attend many meetings with younger scientists and as my supervisors' careers wind down, they ignore emerging problems which the younger scientists are eager to tackle.

Just the recent PhD's in solar/space physics from my own university give me great confidence.

My answer applies to young European scientists, not to the US generation

My job is to train my replacements. My replacements are very good.

orking some new younger distinguished scientific leaders emerging across many model and new science disciplines (i.e. cumulative radiation exposure to humans in terrestrial air-flights.

Our graduates are very good.

Students want to be able to do important work

The current group of postdocs and doctoral students I have worked with lead me to believe that we have the ability to pursue the science.

There are many excellent researchers and students coming through the system. My main concern is the limited number of opportunities.

There are many smart and capable leaders in the field.

Well trained with good access to computers and data.

Responses from those who Agree

Able young researchers are coming through the system. Funding agency support, however is very difficult to come by. Scientific progress is being hampered by lack of National support for the sciences.

Agree in the sense that progress will absolutely be made. However, I believe the current system could be much more supportive and productive than it is now.

As a research engineer much of my research is applied. There are fewer opportunities to do truly basic research.

As long as there is funding to support them.

Because many young scientists have a efficient ability.

Budget, budget, budget determines how much can be done in the next decade.

but ... the new generation of leadership is non-US.

But they will be a more diverse and international group of people

But, we need the resources to encourage this growth and the next generation's success.

Despite a general decline in skills, there will always be a few really brilliant researchers in the field (enough for progress to continue)

Fewer NASA missions in heliophysics will not train enough people for future space mission development and execution.

From what I know of the people in my generation in the field they are bright and capable.

Hard to tell but there seem to be enough young scientists in my field to see it continue.

I agree but not strongly-mainly because of the numbers. Fewer are interested.

I agree, but it is a tough road. Funding is tight and the aerospace industry is not innovative as in other fields. The next generation has the passion, but it is easily squelched.

I always feel confident that they will be able to respond to the need of any dire challenge.

I am a theorist. I can see that theoretical investigations to answer scientific questions are becoming increasingly powerful. They are lower cost than experiments and for that reason I can not see that they will be discontinued.

I am confident because the solar specialty has been quite active over the last decade or two.

I am confident in the ability and enthusiasm of American scientists.

I am not sure the field of solar and space physics is preparing the young generation well enough for scientific leadership

I believe that competent young people are being trained. They will rise to leadership positions, through their experience.

I do have some concerns about this, but I do see a lot of young people doing a lot of great work both on current missions and in planning the next missions to be developed.

I do not see as many young scientists in my field as I would like. I believe many are discouraged due to the lack of faculty positions in the field. Also, there is not a strong support in the field by universities evident. This must be fixed for the future of the field to be healthy.

I don't think the level of scientific leadership has become worse, but I don't believe there are as many scientific leaders as there were many years ago - at least in the U.S.

I guess so, but it is not clear how many experiments will be funded by Congress and the NASA administration, so it is hard to guess at the needs

I have considerable worry that intelligent and productive young researchers will be forced to leave the field due to lack of jobs and/or funding.

I have had NO problem finding excellent jobs for my students in this field.

I have to agree, because to think any less adds another layer of discouragement to what I've seen so far -- people entering this field with no logical career path (Air Force Weather in specific for space weather support), certainly none that puts a space weather professional into the senior ranks of the military. We fight a constant battle for funding for research, made all the worse by the fact that we have not improved in sufficient quantity to show value-added for the community against a phenomena that, unlike terrestrial weather, cannot be seen directly. The professionals working in this field have been there for decades now and the next generation seems reluctant to come up against the never-ending frustration of so little progress for something that ultimately is some of the most challenging and rewarding study of all.

I have worked with enough top level scientists in their 30's and 40's to be quite hopeful for the future. You don't need that many to make a real difference.

I hope we will.

I see evidence for outstanding contributions from young investigators in the field. We have hired some of them at our lab and I am confident that they will carry things on very well.

I see strong potential future leadership in people ranging from graduate students to future instrument PIs and mission PIs. Again the problem is likely to be that those people do not have sufficient opportunities to develop skills and experience that would develop their full potential.

In my field of gravitational wave physics, there is a continuous influx of very bright, and very competent, new researchers. The problem is that NASA can not manage its astrophysics program to use them.

In my field, I see plenty of capable and ambitious mid-career scientists who I expect will be able to lead future missions.

In spite of my last response, there are still some good young people entering the field.

In the area of solar corona and solar wind, I believe there are very talented theorists and experimentalists that can work together and be successful. I prefer to limit my response to that research area.

Interaction with graduate students and postdocs whom I've worked with.

It all depends on the scientific questions. I'm sure much progress will be made during the next decade.

It seems that we are lacking in hardware, instrumentation, electronics, etc. expertise. I would say that those efforts are too concentrated at the top places.

It will be important for the new scientific leadership to challenge current understandings and enliven the field with new ideas.

Kids these days. Some students are more capable than others. It has always been that way. Hopefully the capable ones will have the courage to stick around despite fundng uncertainties. Sometimes the smart ones see the handwriting on the wall and move to a different field....

Many of the science questions being posed are the same as those that have been posed for a long time. I do not have great confidence that definitive answers will be obtained in the next decade.

More resources need to be devoted to support science and engineering students.

My experience with graduate students and post-docs at the University suggests that about 1 in 3 really have something to contribute the science. My feeling is that given the number of people getting degrees, we should produce a sufficient number to keep the science and science leadership advancing.

My students have exhibited job knowledge, motivation, and willingness for new learning experiences

NASA and NSF have been very supportive of the next generation of scientists. Educational opportunities have been available. However, we won't have enough missions funded to acquire the data to answer the scientific questions of the next decade.

No reason to expect them to be less competent than previous generations

Not eally sure about this answer though one would hope. Our cross pollination of industry, government and public education needs to have a better foundation

Of course... if there's funding for them to do anything.

Of the PhD graduates that do find employment, almost all are excellent scientists.

Only if they are supported.

Progress continues to be made with the resources at hand.

Scientific discourse is active. The field is healthy.

See previous statement. I hope this is true and that they have the resources necessary to do the job. I encourage them them to seek out the end user for input.

Seems that way. I have no data

Solar physics would benefit from more students at top-tier universities.

Some clear leaders, but not enough

Some new missions may do so

Some weakness in theory and modeling

Space era is coming, and more and more mysteries will be more likely to be uncovered with the support from advanced technologies.

Space physics seems to be a field of choice for most of the grad students coming to our institution. Many foreign students are now getting into related jobs in their home countries. Caveat: the transition into decent long term supported positions to build up a career is not easy.

The degree of emergence is proportional to the perceived activity Presently it is low and thus the leadership role is transferred to groups in other countries.

The education system is still sound, but funding needs to be increased

The emerging scientific leadership is commensurate with the level of support for my field.

The leadership is emerging but they need solid technical support.

The one's who are coming through are very good and will push the field forward although constrained by difficult times for funding

The potential is there. There are many bright young researchers that can provide leadership.

The same answer as before.

The science capability is far stronger than the engineering capability.

The scientific leaders of the future are in their 30s and early 40s, and they are an impressive group. They are mentoring grad students and post-docs, some of whom are also very good. The question is, will the good ones stay in the field? That depends on the future opportunities.

The support these young folks will need is faltering.

The talent remains available so far, but the lack of opportunities to create new talent and retain existing talent is a problem. Having the resources to attack important scientific questions in the future is perhaps a greater problem.

The uncertainty in funding streams makes it difficult for planning for the future and attracting young scientists.

The young researchers are certainly capable, but I think they see budget problems looming and are not sure that they should aim for pure science for their future or at least maybe not in the US.

There are a decent number of good people. Unfortunately, there are also some not so good people.

There are a few individuals, but I would not characterize it as a "generation."" I do believe, that given sufficient resources, they will be able to lead inquiry into the most important questions for the next decade."

there are but they are mostly foreign nationals and the US is loosing its edge in science and engineering.

There are good students and younger scientists, but not many flight opportunities ahead.

There are insufficient jobs for people who are graduating. They are not getting the chance to be in responsible positions.

There are leaders but the funding of their support is minimumal.

There are lots of good people in the field. However, the future looks bleak with regard to retaining those people. If they are lost, it will both leave a hole in capability, and serve as a deterrent to strong talent choosing this field.

There are many able scientists, but they may be limited by resources (funds) and the political financial situation of the country.

There are plenty of good young scientists in the field.

There are some excellent people coming dorward, but probably not as many as necessary/desirable

There are very capable young scientists in my field.

there are very capable younger scientists in the field

There is a great deal of talent in the younger generation of space scientists.

There is a talented younger generation emerging in the solar physics community and I am confident they will continue to make discoveries and lead the field.

There is good young talent emerging from within my laboratory to answer these scientific questions

There is rapid progress and an excellent pool. However, I am not certain future discoveries will happen in the US.

They will be the ones to ask the questions, and it seems unlikely that they will aks questions that they don't expect to be able to answer. So far, I am not impressed with the quality of the questions that are currently being asked.

We have great students: smart, creative, energetic, but not in sufficient quantities to run NASA for the future years. We need more folk with hands on experience to run large NASA programs. Not more administrators.

We have many talented young people who can do what you say, BUT can we get them employed and keep them in the field?

We have some very capable people in the field, but severe pressure is mounting on the community that could cause problems in the near and mid-term. I am hopeful that our emerging leadership is able to confront these problems.

With diminishing career opportunities we will be generally short handed to tackle old or new problems.

You don't ask what nationality the next generation of scientific leadership will be. I think other countries (and this includes the Europeans, the Chinese, the Indians, the Australians, and others) are catching up quickly with the US. I think the US is still number one, but the number of opportunities here in the US has decreased during my career. I think the US produces very creative people, but I have seen the lack of support for science too many times and too close up to think that this will not have a ripple effect.

Responses from those who Disagree

A significant portion of people of my generation are struggling to make it in the field as anything but postdocs and a few have left research and others are planning to. This is particularly true if I restrict myself to people in US (some foreigners who would like to work in US leave due to visa restriction and lack of opportunities in US vs. Europe or China).

Although, progress is being made Solar Physics needs a stronger and more focused effort to (re-)establish solar astronomy at universities and train the next generation.

Answer some but not all, and inevitably new questions emerge

As an educator and researcher, I am struggling. As an example, we can no longer provide sufficient true PhD level courses to foster the next generation.

As funding for US S&T decreases, and with long term jobs in science decreasing, I can't help but conclude that over the long haul the potency of the US in science and technology is decreasing.

As stated above, there is a very limited money for science and in many cases NASA approved science Co-Is who put substantial effort into designing a mission have to compete for science money. It is a huge mistake that there is no room to put Phase E money for science in the original proposals.All these discourages young people to enter to space physics with starting modest salary and rather go to work for well-paid jobs in other fields.

At the university level there is little ability for bright students to help in NASA matters, at least in the solar and space physics discipline. The NASA capability seems to be oriented primarily to getting projects completed in big laboratory settings.

Because everybody is working on proposals for survival, not enough time is spent on research itself.

Being in my early career, I see a lot of nepotism in the allocation of funding amongst senior and well-connected individuals. This appears to be a negative inertia for advancement.

Concerned that sufficient funding will exist through the next decade.

Current students seem to lack many of the critical thining skills required, and a Bachelor's degree is worth less than it was 20 years ago.

Dark matter etc.

Decreasing numbers means decreasing experience.

Does anybody even know what the questions are? There is too much emphasis on "synergy."" This tends to create ""group-think"" and reduces the competition between ideas."

Drawing from both US and foreign scientists, there should be appropriate leadership.

Education and training is desperately lacking in the US and it no longer has the economical strength or political stability to attract foreign talent.

Even if we have good young scientific leadership emerge, given the expected cuts in NASA, NSF and DoD funding, how are they going to have cutting edge science and technology resources to answer the questions that always appear at the intersection of various disciplines?

Far too few experimentalists are graduating and it is essential that leadership have the experience of building hardware.

Few young solar physicists are remaining in the field.

Fewer students are entering my field, as indicated by the number of students participating in my field of research.

Focus of scientists has changed. Too much administrative work time and not enough research time. Also collaboration between colleagues is weak. Also, funding agencies such as NASA don't look properly at academic programs their money goes to. Case in point, [school omitted] physics program has routinely and intentionally sabotaged careers of graduate students and they still receive much funding without any question or external review (other than accreditation)

Funding cuts to sub-orbital and small space flight missions in the last decade have reduced the field of qualified PIs and technical personnel to the point where I think that there is risk of losing our lead in unmanned space exploration in the US

Funding levels are low and flight opportunities are rare. I worry about the loss of expertise for flight mission design in the future.

Go to an American univeristy and see who is in the S&E fields.

I agree the leadership is emerging, but I disagree that they will be able to answer the scientific questions because we are losing our satellite-mission experience. This is both at the scientific-PI level but more importantly among the engineering staff that builds the instruments and rockets.

I am afraid the level of training of graduate students in the field is not great. There are some very talented individuals, but they are in a minority.

I am concerned about the over-emphasis on data analysis and numerical simulation, at the expense of instrumental hardware development and hard analytic theory.

I am concerned that too few students are getting experience with space flight hardware. Modeling efforts, while vital for understanding the physics of space processes and easier to assign to a student, are not sufficient for continued progress in the field. There does not seem to be a strong chain of qualified instrument PIs.

I am not sure I see an upcoming generation of instrumental and hardware PIs comparable to the past.

I am somewhat pessimistic about this, given the rarity of good theorists and instrumentalists coming up and the downward trend in NASA funding. In addition my field is struggling to maintain or expand its presence at universities, the only place where students are exposed to the options they have for future careers.

I am worried about how difficult it is to get grants funded lately, and that we will lose talented young people from the field for this reason.

I believe that current levels of funding will seriously undermine our ability to address meaningful scientific questions over the next decade.

I believe too little emphasis in science and technology with our current government and private industry does not allow deep thought into scientific research the nation's focus is too short-termed.

I disagree because there are few scientists who are working in the field of atmospheric measurements. It seems all the PhD's coming out these days work on modeling or theory. Few if any seem to work on hardware. Our entire field (atmospheric, heliospheric, space science etc) is observationally driven. There are simply too few flight missions for students to get involved at the instrument level, and of those missions that do exist, they take much longer for a student to participate in during a normal graduate school career.

I do not believe that we will be able to answer the fundamental open questions of solar physics within the next decade.

I do not think there are enough solar physics/space physics students or postdocs

I don't completely disagree, but I worry that through the lack of science funding that many potential leaders will leave the field due to monetary pressures.

I don't question the capability of young scientists. I do question the capability of the US to support them. Most Americans no longer believe in using empirical evidence for decision making. Science then becomes irrelevant.

I don't see a high level of innovative thinking more of retrench and save what we have now

I don't think that NASA is doing a particularly good job of identifying the next generation of leaders.

I feel there is not enough financial support to explore more theoretical and fundamental research before thinking of technology development research to make the emerging scientific leaders to be able to answer questions of the next decade

I find that a disturbingly large fraction of the work I see done in my field at the present time is careless, and occasionally simply incorrect. I base this assessment on papers which have passed through the peer review process, as well as proposals I have reviewed. This seems to permeate all levels of my field. I do see some selected individuals who I believe will provide good scientific leadership in the next decade, but I would judge them to be more the exception than the norm.

I see more people leaving the field than entering. I also am not seeing sufficient transfer of capability to a new generation, because of the funding issues.

I sense that the emerging science leadership is more concerned with continuing their level of activity motivated by "important science problems"" rather than motivated by well posed science questions. It is not simple to construct a well posed science question and the current graduate education does not seem to do a good job of demonstrating to students how to do so."

I think much of the research is not along productive/imaginative lines, we have many major questions still unanswered from several decades past, so I don't expect any miracles in the next decade

I think that the people are capable enough, but that there will be seriously insufficient NASA funding to successfully address most of the important scientific questions.

I think the statement is true in areas driven primarily by computer modeling. I think it is extremely untrue in areas requiring actually physical experimentation and or measurements.

I think there are fewer graduates that stay in the field because of a lack of job opportunities.

I think there is important instrumentation that is lacking. For example, ACE is retiring, we need something at L1 to tell us the current solar wind plasma parameters.

I'm not sure if positions will be available for them.

In kinetic theory my generation does not have a comprehensive and historically informed viewpoint. We are focused on codes and do not have time or stable funding situations to risk ventures outside of our specialized domain.

In more than 15 years in science and more than 10+propasals rejected (most of them no clear argument - why?), does not make me confident that proper filtration system is in place to attract talant.

In my career, I've learned that every answer opens up new questions.

In the field of plasma and high energy density physics, not space physics.

Instrument builders are not there in solar physics.

insufficient number of students entering physics as a career

It appears that the whole magnetospheric community, theorists and experia menters alike, is trying to prove the magnetic reconnection theory, nothing else. This is not healthy way for any scientic field progresses.

IT does not seem like the next generation is prepared to answer the questions in high energy astrophysics. The reason being that the funding is elsewhere.

It is difficult to draw top talent into the graduate stream given the uncertainties in research funding and career prospects.

It is my impression that current science expertise and leadership overall is less than what is critically needed to meet forthcoming scientific challenges. Heliophysics (a.k.a. space physics) is a major opportunity area for new NASA investment with potential payoff in both basic science and applications (space weather, etc.). Enhanced undergraduate and graduate education in plasma physics and space physics are both needed.

It is unclear how many new young researchers are following permanent careers in solar and space physics, but my experience in searching for qualified postdocs suggests that there are not enough young scientists being trained in the field and continuing to pursue a career in the field.

It's really impossible to "answer"" most questions, only to learn more about the physics. "

Lack of funding will kill this field off.

many Ph.D.s, but few with leadership skills.

Most of the training in graduate school is in data analysis, but this assumes the data flows from the sky. I am very concerned that we are not training people who can build things. The people who build things now are in their 50's and older, and they have been treated poorly --- universities don't hire them b/c they do not produce papers, and they spend decades writing losing proposals. Younger people watching this would be crazy to go into such an uncertain business.

My major concern is that individual investigators in basic research are discriminated against in favor of "team"" approaches."

My students and postdocs are finding the barriers to becoming an independent scientist higher than 30 years ago when I started. Positions are more competitive, funding is tight... young people are stuck in postdoc positions and ultimately leaving the field.

New generation of scientists generally lack solid theoretical background. All they do is data analysis (which requires least amount of solid theory), numerical modeling (which is in a way, an experiment that must be interpreted in terms of theory), and when engaged in theory, they only do so at an elementary level. To answer some basic science questions, the community must emphasize theory. Unfortunately, however, there is too much emphasize in building instruments, flying missions, and too little emphasis in theoretical training.

No, the critical thinking is having issue. There is more of a "follow the leader"" mentality."

Only if funding is available to keep them working so that they don't leave the field

Only people who have been given project management opportunities during their graduate years really thrive in the current system. These people tend to be very specialized. They will probably answer some of the specific questions that are posed nowadays (as they have been directed to work on the hardware required to answer them!), but they are not necessarily the most well-rounded scientists.

Prospects are poor for qualified personnel and the job prospects have hit rock bottom in NASA

Re-inventing "solutions"" and ""answers"" is my concern. I am concerned about the team mentality and the 'not invented here', caused by funding and priority concerns. Only secure and well-funded groups, I believe, can afford the scientific process of persuing and recognizing past research."

Science is taking a back seat to phenomenological modelling and quasi-engineering space activities such as Space Weather. There are not enough students pursuing fundamental questions in space physics.

science shoestring funding and accompanying competitiveness lets only the most agressive, "political"" leadership emerge."

Scientific politics has become the dominant motivator for the majority of those considered to be in the scientific leadership.

See my response to the above question

See previous answer.

See previous response

See previous. Rigor is not being rewarded. Careful science is impossible on short-term funding cycles.

See question 28. [previous question]

Space physics seems to suffer from dwindling student interest. My graduae electrical engineering department was also interested to scale it back to advance more modern curricula, such as nanotechnology. There are still good leaders and extremely capable scientists, but my suspicion is that the field as a whole will contract when the senior generation retires.

The next decade may not include appropriate and necessary missions to advance knowledge sufficiently

The answer to this question is highly dependent on the funding priorities set by NASA. As an example, a number of the highest priority missions from the most recent planetary decadal survey have a very low probability of being funded due to budget constraints and large cost overruns of existing projects. If these missions do not get funded then it will be difficult to answer the science questions of the next decade.

The area of Space Weather including solar physics and geophysical responses has not advanced significantly from the late 1960's, despite a number of successful ground and space based sensors. There is still a disconnect between the science and benefit to the public.

The current level of support is not enough for keeping the same level of scientific excellence.

the emerging leadership is very talented but will be hampered by a lack of leadership and support at the highest levels of NASA and the government.

The field is more driven by funding and publicity than a desire to do things right.

The fund provider (government) does not seems interested in science, and I do not expect the kind of scientific leadership that it used to be florrish.

The instrument development is concentrated in a very few places, and the PIs are few in number with few new people being trained for leadership roles. Most people are trained in data analysis.

The most important scientific questions of the next decade require an understanding of how geospace functions as a system. This is actually true in general for all of the geosciences. There is considerable resistance to any shifting of funds into areas that support this type of research. The community wants to continue focused process studies. Moving outside these traditional areas introduces uncertainty in their own funding and requires changes in the way they do research. Research that doesn't involve incremental advances on successful programs already underway doesn't fare well on proposal review panels. Proposal review panels are largely discipline focused. To be successful in moving into system level studies requires that the current program of focused process studies remain strong but some small portion of the program be redirected to global system-level efforts. This type of change in the way research is done requires vision in the agencies and some top-down direction. NSF has recently put in place a number of programs that attempt to move in the direction of system-science and innovation but these are directed agency-wide and not focused on space physics.

The new generation tends to be too superficial. It's easy to generate impressive looking output from data and numerical simulations, but the physical understanding is lacking.

The next generation of scientific leaders cannot find permanent jobs, and are abandoning the field.

the number of PhD students in my laboratory keeps decreasing year after year

The number of scientists below 40 years of age has not reached critical mass. Some are leaving the field because they find no clear or viable career path.

The old guard is select in who they allow to express an opinion or who they will endorse. They pick who will be the new leaders.

The questions are there and more arise constantly. However, the funding is not there to address them and thus attract good people to address them. Good people are there in the academic system, but they will go where they can get support for their work - i.e. the biological sciences, computer sciences.

The questions don't get answered, they just generate more questions. The state of knowledge will progress, however, as it always does. Sometimes the period of advancement extends well beyond a decade and depends on advances in technology, as well as other factors.

The U.S. is under supporting the STEM workforce. This is happening at all levels of the pipeline. It is particularly happening to under-represented groups (women and minorities)

The USA is losing its way in science education and institutional management. I think the origin of these problems lies in poor K-12 and undergraduate education.

There are strong biases as careers progress.

There are too few truly outstanding aeronomers.

There has been a substantial drop off in young Ph.D.s pursuing careers in stellar atmospheres and solar physics.

There is a move to large groups and large databases, and I am concerned that quantitative analysis (confrontation of observation and theory) is falling by the wayside. Students are being trained in statistics, and much physics is vanishing.

There is a new generation, yes, but the funding situation is getting tighter.

There is an insufficient number of new missions being intitated to transfer the necessary engineering knowledge from the current (retireing) workforce to the workforce of the future. If funding is expanded in the future, there will not be enough skilled individuals to build the required missions.

There is no strong support and encouragement for young scientists in my field. I am afraid that after a few years, there may not be many people left in the field.

There is not enough funding to perform the needed research

There is not likely to be sufficient funding to address the scientific quesitons of the next decade.

There is to few flight possibility (both small scale and large) and a philosophy failure is not a option preventing young people to be full hands on experience throughout all phases in a project. The few we teach today only sees a small part of it. This results in the new generations do not have broad enough skills and know the knowledge to now when to cut corners and when not to do it. There fore because of this it is more like that we get even more bureaucracy and increased cost on our missions because the new generation do not now how to do it lean quick. Also, without the possibility to frequent launch instruments the skill to understand instrument development is lost. And the developers should be scientists so that the science goal is the primary focus of the development, if industry would be the primary providers to our instruments it would be disaster for the quality of the science.

There seem to be few new ideas in terrestrial space physics.

There seems to be too much reliance on computer simulations, not enough depth and hands-on experience.

They won't be American scientists

To many of the post-docs going into the fields covered by this survey do not have the training needed to treat the physics associated with these fields. Many are astronomy students who tend to follow the pack or they only have a superficial knowledge of the issues being discussed. A lot of them are re-inventing the wheel.

U.S. public education has lowered the scientific bar so low that we cannot compete with other nations that take their education more seriously and competitively.

We are falling behind faster than satellites plunge to earth

We are graduating a reasonable number of PhDs, but few of them have significant instrument experience. In part, this is because the suborbital program is languishing.

We don't even have one undergraduate student in my field at our institution.

Yes to the first half sentence, no to the second. I see many of the strongest students going into other areas of physics. Media attention helps, for example the awarding of the Nobel Prize in Physics in the field of dark energy, at the same time that ESA has chosen two missions, Solar Orbiter and one pertaining to dark energy. I'm hopeful that the NASA Radiation Belts Storms Probe launch next year, coincident with approach to the upcoming maximum in solar activity, will attract public attention an interest in understanding the connection between solar activity and near earth 'space weather'.

Responses from those who Strongly Disagree

Science funding is being reduced at colleges and K-12.

Again, I doubt that the next generation will be interested in NASA.

Almost no independent theorists. A successful field must have both theory and experiment.

As funding for doing science as part of mission work erodes, SR&T funding opportunities are also eroding while the grant proposal process continues to be bogged down in paperwork on both the NASA and research organization sides due to pernicious reporting requirements. The field is begin chocked and starved leaving little incentive to go into it.

Due to the baby boom and the current economical downturn, there are no jobs for early career scientists. Older scientists do not retire so there is no money to hire young people. Younger scientist must take jobs doing whatever they can to pay the bills. As a result they/we don't get the experience to become leaders in our fields. When the boomer generation dies off, there will be few with the appropriate experience to take over leadership.

I don't know of anyone with "vision"" of where we should go or how to get there."

I feel that the older generations of scientists do not want those of us in our 30s and 40s to be involved in leadership of our field, with the exception of 1 or 2 hand-picked individuals that seem to have a very prominent, older scientist backing them. Whenever I asked about participating on community panels like the NASA Roadmap, I was told I was too young and should let the more experienced scientists worry about these things. My current supervisor has repeatedly recommended me for NASA review panels over the last several years. I have also asked about participating on these panels, but I am always told no. To this date, I have never participated in a NASA or NSF review panel. The reasons given to me range from "You're too young"" to ""You don't have broad enough experience for this panel."" I have published papers using [types of data omitted] data from [data sources omitted]. My papers have examined processes in [specifics omitted]. I have some hardware experience from a sounding rocket and satellite instrument testing, and have been involved in efforts to archive data online. How can my experience not be broad enough? Many scientists who are younger than me did their Ph.D. thesis on one region of the magnetosphere, using one specific data set, and after graduation all of their research has basically been on the same topic. These young scientists have been asked to participate on panels and committees, so I don't understand why I am not wanted. I always hear how hard it is to fill these review panels, so why is it that someone who volunteers and is willing to serve is unwelcome? My supervisor and my co-workers have discussed this often, and they don't understand it either. I know that I am not alone in my frustration, as these sentiments were echoed in a recent EOS articles by Michael Mendillo (Eos Trans. AGU, 90, 35, doi:10.1029/2009EO350003, 2009 Eos Trans. AGU, 91, 4, doi:10.1029/2010EO040005, 2010). The response to the initial Mendillo article by David Stern (Eos Trans. AGU, 91, 4, doi:10.1029/2010EO040004, 2010) made it pretty clear that the real reason is that the older generations of scientists view those of us currently in our 30s and 40s as a bunch of no-talent losers who are not worth their time. I think that scientists like David Stern would rather see our field whither away into oblivion than allow a woman like me to take on a leadership role to ensure the future of space physics research. "

It continues to be the same people researching the same things.

Many scientists I know are leaving because science is becoming an artistic pursuit, as opposed to a search for truth. Was told by a former mentor and [school omitted] professor that "you can draw any conclusion you want from data, it's not about truth it's about self-expression, artistry"". This has infected science and engineering to such a degree that in my opinion we risk widespread failure as a civilization. If truth is subjective, it's okay to cherry pick data, it's okay to sign off on a verification report that shows it doesn't meet spec, our equipment has always worked before. I have seen these attitudes reach epidemic proportions in aerospace and science."

NASA doesn't seem to want to fund astrophysics and my area of atmospheric physics is not in the decadal roadmap for Earth science.

Since many fonds have been and will be going to those proposals that have given and will give wrong answers to the scientific questions.

Space physics is in stagnation… new leaders are needed.

The last generation has not relinquished their leadership positions to allow the next generation to begin taking over.

The major resources are still controlled by a small group of very senior scientists.

The next generation mostly hasn't had any flight experience. They will be relearning the lessons of the past with limited resources.

The number of faculty at the major research universities has suffered severe erosion. This is limiting the number of excellent students entering the field.

The recent grant-funding collapse at NASA will drive new researchers away from space science.

The scientific leadership in my field is today coming from an ever-aging population. While there is some replenishment of workers, the numbers are not adequate.

There is no investment being made in my field to allow the next generation of scientific leadership to be trained.

Too many current "leaders"" are (like me) too old, with few mid-career individuals as there were 20-25 years ago."

When attending heliophysics conferences, I notice that the number of young emerging Phds are very few. The field is dominated by older (over 50) scientists. Also,there are only a handful of universities that offer Phd's in solar physics.

Responses from those saying "I don't know."

Again, I am out of touch with the field

Again, I don't understand the question. If you mean, are there capable young scientists, then I agree. If you mean, will they be employed, which will be necessary for answering scientific questions, then I don't know.

Again, there are emerging leaders, but if there is insufficient funds to support them, then they will not be able to answer the scientific questions of the next decade.

Difficult to say. The fraction of students with hardware experience is decreasing dramatically.

Don't really understand what is meant here by the next generation...

Funding for new NASA missions is now very tight. It is not clear to me that the necessary solar physics space mission can be flown in the next decade.

Funding scientific leadership is a "national"" obligation, but does not seem to be a ""national"" priority given our economic crisis. US situation is bad, and the European situation appears to be no better. I believe that the potential for the next generation, even the current generation, to answer many of the scientific challenges of the coming decades--but providing adequate funding seems to be the biggest hurdle."

I am confident that they will be able to 'tackle' these questions, but 'answers' may not be forthcoming during their careers.

I am currently working in a numebr of fields, at least a few of them are under de facto control of NASA personnel, who are terribly resistant to change or questioning of the status quo, and in addition there is little or no funding to address the existing issues. Further, much of the information is either old NASA data, or proprietary information of corporations, kept as trade secrets.

I am impressed with their capabilities though I often find that they like originality and physical insight.

I am no longer sufficient close to the field to provide a definitive answer.

I am not a solar and space physicist.

I am not in the field any longer and don't have a sense of this matter

I do not think there are many who know anything about what I do. The shapes I make are generally not available and cannot be invision by the mind, that is why I do them.

I have been retired for several years and am not up on the scientific leaders of today or tomorrow.

I have reduced my involvement with Heliophysics and am working primarily in Radio Astronomy. So I am not as familiar with the emerging leadership as I would normally be.

if the trends follow the past 10 years, aeronomy will not get any missions from NASA.

If we knew the scientific questions of the next decade we would be doing well. It is not entirely clear how to approach dark matter and dark energy issues.

I'm no longer doing research and have not attended a scientific meeting in several years, so I don't know.

Insufficient data provided.

It is hard to say. the consensus is that people tend to work together in a big group, and it is easier to get funded that way. The advantage is to get things done for big missions. The disadvantage is the scientific new ideas are hard to come out from the big group.

I've lost touch with the current state of solar physics I haven't worked in or had much contact with anybody in the field in over 35 years.

Many people are doing good work, but few providing scientific leadership.

may be

not close enough to research to answer this question

Not engaged in scientific research for several decades now.

Only if they are able to look outside the box and consider truly interesting and unsolved problems rather than adding more data points to the same overworked problems.

Scientific questions aren't answered by "scientific leadership."" They're answered by individual scientists, from the bottom up."

See previous answer

Sorry. I don't have the proper statistics at my finger tips to answer this question and I don't have the time to research it.

Statement is stupid. Sounds like politicians' rhetoric.

The brightest young people I have worked with are not particularly attacted to science because the job market is terrible and employers like Google offer very attactive salaries and freedom for intellectual pursuits.

The field will no doubt be changing. I think traditional space physics as a science discipline will decline. The space weather side will focus more on the real applications and engineering issues therein. On the science side it is hard to compete with the search for life on other planets, etc.

The next big scientific discovery appears to be directly dependent on the next big technological discovery, which is dependent on the current scientific discoveries. It's chaotic, and I have no idea where it will go.

There are many in the next generation that are great and fill me with confidence, and a significant number that make me less confident.

There are too many "soft money"" positions. Sustained firm & core positions within national labs is ethereal. With the current federal government budget crisis, aand even the soft monies positions evaporating, basic sustenance for the next generation is elusive."

There are too many uncertainties to know what the next decade's scientific questions will be.

There is first rate scientific talent available. The question is whether the space program will continue at a productive level.

There seems to be a very ironic situation developing: Many high skilled PHD astronomers/solar physicists are unemployed but we probably don't have enough technical support for future missions and projects (like ATST).

This is very difficult to answer, since you have framed this as a tautology. There is always a new generation, and they are always answering the questions of the day. I would say that very interesting new stuff and new capabilities are always emerging, and the next years will certainly be exciting.

While I see some leadership developing in certain science areas, I see very little entering the academic arena and building a properly long term presence in academic institutions.

Will they be able to provide cost creditability?

Worked for industry, which rarely paves the way scientifically speaking.

Responses to Open-Ended Question about Educational and Outreach Efforts

We asked respondents who participate in efforts to support K-12 education and / or public outreach to tell us about those efforts. All responses are reported as received except any identifying information has been omitted.

- Giving talks in my child's class. - Preparing and presenting space weather material at lab-sponsored open houses and outreach events.

I regularly organize heliophysics presentations at Local Middle Schools and Boys and Girls Clubs and Science Ambassador for a national organization that promotes minorities in physics.

Visitor center displays, public talks and observatory tours, hiring of high school summer employees

1) I was hired by [omitted] to develop an online test-prep course for teachers who need to pass a test to become certified to teach science in [state omitted]. (The course is free and self-taught and parts of it are online already.) 2) I am a Project Supervisor for student projects in the [program name omitted] program. 3) I wrote [specifics about books omitted]. 4) I assist the science teacher at my daughter's school. I've given a lecture to 5th grade students and I assist with Astronomy Night every year. 5) In the past, I wrote articles about physics or astronomy for magazines like Star Date.

1. Public library demonstrations and talks about Mars missions and science 2. Career Days at a local public High School about Planetary Scientists

100% of my time for the last 8 years has been in education. I specialize in mathematics resources through my [name omitted] website which is funded by NASA/SMD and supported by NASA mission EPO programs.

A few talks at small colleges and at local organizations

A required component of the NASA mission that I am responsible for.

AAUW, and service on advisory committees for the [school omitted]

About once a year I give a one-hour lecture to teachers attending a summer school in space physics.

actively participate in the Engineering Open House (grades 5--10), show my radar system to students. Serve as a science/engineering resource at a K-8 school near my home.

Advising undergraduate students for MMS EPO (SMART) program.

[name omitted] workforce development interships for high school students public talks observatory tours talks at schools public lectures work with TV - US&international supervise students, graduate and undergraduate

am supporting heliophysics epo efforts thru the nasa heliophysics forum and [mission omitted] mission epo colleague interactions

Annual congressional visits occasional talks in colleges

Annually we put on workshops in [omitted] for children between the ages of 5-12. We welcome the adults too who accompany their children by having activities for them. We do solar observations with a telescope and night observations too.

As a graduate student I assisted my advisor with his efforts to paint sun dials on middle-school play grounds and to host star parties for middle school students. Since then I have given multiple talks at high local high schools about space physics, tsunamis, and the ionosphere. I have also participated in a middle-school education program in climate change. I also volunteer as [omitted] at [omitted], giving [omitted] presentations about kelp forests, coral reefs, and the impact of human activity on the underwater environment.

As a NASA Project Scientist, I'm often invited to speak or interact with K-12 in classroom and informal settings.

As a NASA scientist, I participated in Chandra public outreach.

As a project scientist, I'm responsible for spending in this area, and for scientific guidance of the efforts of all those involved.

As a proponent of upgraded physical facilities and high quality teaching for a boarding school.

As an attendee at [omitted] meetings, I encourage the annual [omitted] Research Experience for Undergraduate (REU) program. Recently gave a space weather seminar to reunion/commencement weekend attendees at my undergraduate college.

As feasible, I provide some light science presentations to school children. The efforts are directed at fun educational and amazing facts/demonstrations that may be remembered long after the presentation and spark interest in physics or science.

As part of the NASA MMS mission.

As project scientist for [omitted], I have overseen efforts, and in many cases developed materials for, outreach end education. Materials include visual, digital, and a Braille book.

As system engineer promoting the development of a new form of robotics, I worked with 35 students (graduate and undergraduate) as part of the NASA robotics academy, and did a fair amount of teaching and public speaking.

As the only physics instructor at my 2-year community college, I make an effort to communicate my Space Weather knowledge to the local K-12 science educators. Generally through scheduled get-togethers where the teachers are awarded professional development time.

Astro project

Astronomical Observatory at the [school omitted]

At the request of teachers, visits to Middle and High Schools to encourage students to seek college education in the Geosciences

Attend classes and be available for questions.

attend Spaceweather Week NOAA Boulder CO. Suggested Spaceweather for Aviators Page, requested more information on magnetic flux from solar events, requested more information and studies on pre flare solar quake data.

Bay area science in schools program

be a tour guide

Career day talks at elementary schools

Chair of [omitted]. Frequent speaker at middle and high school classrooms. Winer of the [omitted].

classroom presentations at local elementary school, balloon launches

Classroom visits to discuss stars for a 2 - 6th grade summer course. Educational outreach event with Girl and Boy Scouts at the local observatory. Public presentations on NASA at the University.

coach math olumpics

[specific activities and offices omitted]

Co-director of NSF REU program (8-10 students each summer). Co-director of NSF Research Experiences for Teachers program (4 K-12 teachers each summer). Focused high school summer research projects. Author and on-camera host for video podcast series on space weather sponsored by NASA. Children's discovery museum technical lead for space weather and radio wave interactive exhibit. Tours of large observatory. Public lectures on space weather and upper atmospheric physics. Media appearances on radio, TV.

CO-I of a NASA EPO center. Work with high school and middle school teachers to incorporate heliophysics in curriculum. Gave general public lectures and tours of our institute.

Co-I on [school omitted] participation in NASA Space Grant Consortium visits to local schools to discuss Space Weather, gave talk at National Air & Space Museum

Co-investigator on NASA Space Grant to [school omitted] Faculty Member of the interdisciplinary [school omitted] Get Away Special program Physics Department SPS team has been extremely effective in outreach Physics/astronomy/space

Collaborating with the local school close to our research facility in a remote part of [omitted].

Collaborator on a NASA outreach grant. My role is to mainly discuss my research with educators and discuss ways to bring interesting science to the classroom.

Community seminars.

[omitted] Programs to introduce children to computers and innovation Also science fairs.

conducted tours, demonstrations, lunch meetings, presentations at schools

Contribute to [omitted] for middle school students.

Coordinate/organize the annual participation of my department in a science fair at an underserved community, annually participate in various "career days"" at high school, middle school and elementary school level, and offer career advice in an informal setting at numerous events throughout the year."

Creation of [name omitted] web site Participation Sally Ride Festival Public lectures and school visits

Currently I am helping a local school establish a robotics club. I have talked to student groups about space science and climate change.

Currently mentoring a high school student in a local program for gifted students.

Currently refurbishing a public exhibit at the [facility omitted]. Also, public lectures and development of web-based content for [facility omitted].

Data visualization for [omitted]. Occasional activities with education groups. Operate a blog on my own time dealing with pseudo-science issues in astronomy.

Develop scientific materials for outreach purposes, as well as assisting in organizing and planning workshops and meetings. Was involved in outreach activities during [omitted], a NASA grant to [omitted], and -Participated in science retreat with high school teachers in [omitted]. -Participated in [omitted] open house 2009-2010. - Participated in Star lab presentation at [omitted] elementary school.

Developed educational material on space weather and its effects as well as displays of continuously updating real-time space weather information for a major internet project. Participated as a panelist in two different NASA press releases on space physics topics, broadcasted from NASA headquarters.

developing exhibits for the general public organizing STEM conference for middle school girls scientific mentoring of undergraduate students

Developing Space Weather Training Modules

development of the [facility omitted] visitor center (25,000 K-12 students/year). also formal careeer day participation at high schools.

Director of a student space engineering lab, numerous community outreach efforts, teacher training

Director of NASA Space Grant activities for University. Develop Astronomy/ Space Physics curricula. Supervise Observatory-related public outreach programs for the University

During graduate school I was funded under a GK-12 initiative. I have also participated in outreach efforts for my departments in grad school, and as a postdoc at NASA GSFC.

[work position omitted]

Each summer I mentor a gifted high school student on a project supporting astronaut radiation risk management

[specific activities omitted]

Eclipse projects

[work position omitted] until 3 years ago. Active with [activities omitted]. Extensive history of talks to K-12, as well as sporadic on-air appearances.

Educational lecturer at high schools. High School student mentors.

Elementary school outreach as guest speaker also planning observing night (astro). [omitted] panelist.

Engagement with K-3 lectures on space science. Engagement with underrepresented groups (NSBE) by providing lectures on space science and recruiting.

Engineering State

Expanding Your Horizons (various capacities), talks at K-5, mentor to 8th grader, speaker at teacher outreach program

Expanding Your Horizons Solar Week Presentations to visiting students

Facility tours and open houses.

For several years, I mentored/supervised high school and college undergraduate summer interns later, as one of a [omitted], answered questions on solar science, astronomy, and physics sent in by students and the public and offered guidance on two high school science-fair projects. This year at a [omitted] open house, I showed [omitted] movies and answered questions for about 8 hours (on my own time. I've visited a few elementary classrooms and one K-5(!) after-school class, to talk about and show pictures of the Sun or do science demos and experiments with the students (also on my own time). When I worked full time, I often purchased materials to send to needy elementary school classrooms.

For the last 8 years I have been actively involvedin the ASTRO NOVA astronomer-teacher partneship program

For those missions successfully proposed, I have provided supporting material to the EPO lead.

Frequent speaking at schools, from kindergarten through university.

Fund EPO people out of my grants

Funded formal and informal education projects since 1988. Two major NASA cooperative agreements. Millions of people impacted through museum kiosks, planetarium shows, educational software

Gave a talk to a 2nd grade class.

Gave lectures at the [omitted] workshop, an outreach summer program at [omitted] for high school science teachers in [omitted].

Gave presentations for my organizations teacher outreach programs.

gave science lectures to K-12 students

Gave talks at local high school, county-wide astronomy club.

Girl scout presentations, k-12 presentations, public openhouses

Give a lectures at 8th grade students

Give presentations in K-12 classrooms. Mentor students in math in 9-12 after school. With undergraduate students, build and launch rockets with elementary students.

Give presentations on activities performed during work supporting the [omitted] Program ([omitted])

Give talks

Give talks and presentations at local schools and organizations. Also provide tours of our labs and department

give talks at grade school and judge high school science fairs

give talks at local high school

GIve talks. Sponsor exhibits in museums.

Giving public lectures at schools and other venues.

giving public lectures, presentations to elementary/middle school students, public tours

Giving talks at k-12 schools

Giving tours

Going to elementary schools and presenting space topics and projects, working with librarians to educate them on space science and give them project ideas to work on with students

Guest lectures on "Space Physics"" at local schools."

Guest speaker for HS physics classes and meteorology clubs.

Hands-on, laboratory projects. High altitude balloons and very small satellites.

Have given several public lectures at local astronomy clubs

Have had supplementary EPO grants funded after NASA research grants

Have regularly taught education to Civil Air Patrol cadets (page 12 to 18). Spoke once to a middle school group on Newton's laws.

Have worked mostly with trying to educate elementary/high school teachers.

Helped create images for use in planetarium exhibit I gave presentations and workshops on the sun and the makeup of light at events focused on keeping girls in math and science during their jr. and sr. high school years.

Helped Prepare a Brochure. Answered questions from students and the public.

helped start the [omitted] program, which brought in a set of primary- and secondary-level teachers to educate them about space physics issues and help them develop ways to incorporate those facts into their curricula.

Helped with the [omitted] program at SwRI and the [omitted] program in [omitted].

High school tutoring, astronomical observations for the public, Lectures/seminars on astronomy and physics

Hosted high-school students visiting the lab.

I am a Co-I on a three-year NASA grant to pursue EPO in Heliophysics in [omitted]

I am a Co-I on the [omitted] and contribute to EPO activities on [omitted]

I am a lecturer for the NASA [omitted] program. This program is aimed towards [omitted] public school students to generate interest in Science and Mathematics.

I am a major funded contributor to the [omitted] Education and Public Outreach Program.

I am a retired [military] teaching high school physics, chemistry, astronomy and mathematics. I also particpate in JPL's Solar System Ambassador and [office omitted] of the [omitted] Chapter of AAPT.

I am a volunteer of EPO at National Institute of Aerospace located at Hampton, VA.

I am an in-classroom astronomer partner in the Project Astro program sponsored by the Astronomical Society of the Pacific.

I am department Chair and I oversee several outreach programs (planetarium, "Physics on the Road"", community involvement) in which department faculty and staff participate. We also have a physics teacher education degree program, which involves service learning projects."

I am Deputy Director for [omitted] Outreach for [omitted] I chair the [omitted], which has just been awarded an [omitted] grant.

I am faculty advisor to our university's Society of Women Engineers with many outreach activities. I also started the first IEEE Women in Engineering affinity group for our area and hosted guest speakers as activities.

I am part of the STEREO program which has an outreach program, and I have given a talk to an amateur astronomy club on related topics

I am program manager for the University NanoSatellite Program that involves both graduate and undergraduate student teams and requires K-12 outreach.

I am regularly involved with various schools and museums teaching students from different educational and cultural backgrounds.

I am the EPO lead for [omitted]. I was the EPO lead for [omitted].

I am working on a K-12 math program based on applied physics. The idea is that the physics will draw the interest to learn the math. I believe astronomy is an optimum medium that demonstrates every area of physic and is always exciting for young people to participate in. Astronomy can be a hobby the students take with them the rest of their lives.

I attend weekly meetings at which there are discussions related to the teaching of K-12 science and mathematics. Other members of the group are developing teaching materials and doing research on teaching methods and their efficacy.

I coach for science olympiads.

I co-coordinate the [omitted] outreach program, which conducts 25-30 public appearances per year (mostly to elementary, junior high, and senior high schools), with a sum total of several thousand attendees per year.

I did a radio Interview on [omitted]. Appearance on the television program [omitted] produced for New

I do informal education outreach mostly to the general public, and via certain programs to select K-12 groups as well.

I do math programs for elementary school classes, primarily directed at about 4th grade students. I also am preparing educational materials for invasive plant management in [omitted] National Park. It is not specifically directed at any particular age level.

I do summer classes for those childern interested in space engineering

I educate pilots and flight attendants on the risks to operations and health caused by space weather. On how to gather and evaluate the information necessary to make operational decisions to minimize risk. I educate members of government and business on these issues as well.

I frequently assist the heliophysics education team at [omitted] (e.g., proposal evaluation, Red Team, etc.), and have served as mentor for summer students five times in the past ten years.

I fund outreach and participate through the Missions I am PI for.

I give lectures about solar physics for community groups, and teach a class on solar observing at a nearby national park.

I give outreach talks to schools, scouts, observatories, etc. and help with displays for state fairs, science centers, etc.

I give public talks at a local amateur astronomy clubs, give popular talks on astronomy and space science in my community, and organization activities like star-gazing sessions when requested.

I give talks to students and do hands on activities at science museums.

I go into the classroom at the local elementary school and give talks/labs on various topics including geology (hand specimen identification), planetary science, oceanography, and meterology. Some of these talks are single classroom and some are grade-wide assemblies in the auditorium. Hands-on work and demonstartions require a smaller audience while lecture style presentations can be done with larger groups. In addition, I read to the kindergarden classes once or twice a month.

I had previously encouraged three educational institutions, [institution names omitted] to participate in designing and building a nano-satellite. All three institutions responses were underwhelming.

I have a high school program ([name and url omitted]) and built a laboratory for high school science which includes a plasma physics device

I have a supplemental E/PO award appended to a research award from NASA.

I have been a guest scientist at after-school science clubs for girls in grades 3-5.

I have been E/PO Lead, Worked on supplements ([omitted]) and Co-I on [omitted]

I have been interviewed several times by the news media. I have also presented my research findings at conferences where most of the participants were not familiar with space weather.

I have been the chair of the [omitted] Committee, which has a Professional Development, Outreach and Education subcommittee. I participate in the activities of this subcommittee, which includes science fair and student science competitions

I have been the Director and Manager for a [omitted] as well as PI and Co-I for a number of NASA education grants.

I have designed and produced EPO materials for the [omitted] Program, and several environmental satellite missions.

I have directed various college level amd K-12 observing sessioms at three different observatories.

I have done short presentations and demonstrations for my children's elementary school classes.

I have established an outreach program in the Physics Department at [school name omitted]. It began in 2005 with a $10k grant from APS, and continues to be self-sustaining now.

I have given a few lectures to elementry students on space physics.

I have given a few talks at local middle schools.

I have given a talk at a local high school and college, demonstrated a dry ice comet and other lab demos. I have helped PIs mentor high school, college and graduate students. I have also helped to mentor postdocs.

I have given outreach talks for astronomy clubs and high school groups. I have been involved with exhibit development and presentations at a local children's museum.

I have given presentations about my work to elementary school classes and an after school group.

I have given presentations to many schools about what Space Physics is all about. I have also participated in mant of NASA [omitted]'s events on E/PO since 2009.

I have given public lectures and participated in open-house lab outreach activities.

I have given public lectures on space science. I have participated in middle school summer camp at [omitted].

I have given talks to various groups, most recently a summer program for inner city children.

I have gone into schools to give planetarium shows, I have given talks on the [omitted] mission to high school students, and I have given public talks on solar and space physics

I have had E/PO grants associated with two science proposals, and developed modules for high-school and middle-school teachers.

I have had several television journalists interview me, visit my lab, and show this on various science documentary programs (National Geographic, Discovery Channel). My grad students have visitd local high schools and conducted tours for high school students of my lab.

I have helped supply data and presentations for display at the [omitted] planetarium, which is used for the education of students of all ages as well as for public outreach.

I have implemented an exhibit at the [omitted] for viewing space weather in 3D. Also done numerous trips to schools and other programs to discuss life as a scientist.

I have made visits (in person, and by web) to K-12 classrooms to talk about space science and life as a scientist.

I have managed, as [omitted], the [omitted] Program for the past [omitted] years

I have mentored high school students through a [omitted] ([omitted] school district) program called [omitted]

I have NASA SR&T Supplement and NSF REU and RET support as well as NSF EHR grants (such as GK12 and Geoscience Education). I primarily work with k12 science professional development programs.

I have run and participated in science fairs, gone into classrooms and performed scientific demos, offered free science and math tutoring, helped run the [omitted] Conference, I am a Teaching Assitant, as well as an Eagle scout (through which I have performed numerous community service projects).

I have substituted for a high school physics teacher on maternity leave. I have participated in an outreach program sponsored by the [museum name omitted]. I have made financial contributions to various outreach programs of the American Association of Physics Teachers.

I have talked to students visiting on a field trip, and I have prepared tutorials for browsing mission data through web-based tools.

I have worked with third grade students for Project [omitted].

I help to run a Math/Science effort at the local elementary school each year. Support career day at the same elementary school, and am a judge for the science fair. I also help with outreach efforts run at NASA.

I help write and edit education and public outreach material for a NASA flight mission. This includes material for the mission website, presentations for teacher workshops, student activities and lesson plans. I have presented at Space Camp and Space Academy events for middle school students held at my institution. I have participated in a science demonstration at a local daycare.

I helped develop the Galileoscope refractor kit for the International Year of Astronomy and worked on several other IYA2009 projects. I coordinate several EPO projects for the [omitted] (it's part of my job). I help out at a local high-school observatory. I write popular articles for magazines.

I maintain several web sites which contain information of public interest.

I make presentations about space science at the elementary, middle and high schools which my children attend

I mentor science fair students, tutor middle school kids in math, and helped with a video project for middle school girls.

I occasionally give public talks.

I participate and lead astronomy open house observations.

I participate in "clinics"" for high-school STEM teachers, ""club"" type activities for high-school students, and run special summer classes for high-school students."

I participate in a summer scholar program that brings both undergraduates and graduate students to our lab to work on research projects over the summer.

I participate in science-based communal societies, visit schools, have conducted tours of scientific facilities and have participated in a number of press releases.

I participate in Solar Week run out of [omitted]. Also have made presentations at [omitted] for various solar outreach activities.

I perform at the university where I am employed geared toward elementary and middle school children. The workshops involve concepts in electricity, magnetism, light and the use of solar telescopes to allow the kids to see features on the sun's photosphere. Generally, the activities are very hands-on through the use of simple laboratory equipment like pith balls, hand held spectroscopes,magnets, etc.

I proposed an EPO as part of my grants and gave several public lectures as well as training Voyager embassadors

I regularily lecture on astronomy in public and private schools.

I regularly volunteer time at local schools. I work regularly on educational outreach in Africa also. I do LOTS of outreach stuff each year and have done so consistently over the last 20 years.

I run a college observatory with 4 public night programs per year for the community. I also do occasional trips to local schools with college telescopes.

I serve as judge in an annual regional science fair for middle and high school students.

I speak and do demos in classrooms.

I support Graduate students in making presentations to schools and local youth groups.

I supported high school senior interns at NASA [omitted].

I teach a physics lab in a homeschooling group right now.

I teach astronomy to students majoring in secondary education I gave lectures in space science/astronomy to elementary school students. I participated in public outreach in the Astronomy Day.

I usually judge elementary and high school science fairs in my home community.

I volunteer in our local elementary school science lab.

I was director of two research institutes and promoted outreach effort by the staff.

I was involved with multiple outreach programs to K-12 schools during my undergraduate career, mostly through the Society of Physics Students and Sigma Pi Sigma (Physics honor society). In graduate school, I founded [omitted], bringing K-12 students here in the US into contact with partner schools overseas. I also conducted several K-12 classroom visits through the Dept. of Aerospace Engineering Sciences and [omitted].

I was mentor of several high school summer interns.

I was PI for and directed the pilot site for a statewide implementation of a hands-on K-12 science and math reform program. This was an administrative position within the university and not a part of a space science research program.

I won an E/PO proposal to build a museum kiosk. I participate in an E/PO program to teach science by building simple radio telescope kits.

I work with a unversity student group dedicated to space and they have K-12 outreach programs. We also have an informal continuing education program through some of our balloon flight programs that involves life long learners of all ages.

I work with students. Give talks about Space Weather. Give tours of the NOAA Space Weather Prediction Center.

I work with the Girl Scouts to provide a program in Space and Planetary Science. I have worked with local groups to present Space Weather to students. I have attended Career days a local schools.

I work with the [omitted] PAO and EPO offices on behalf of [omitted].

I work with The Radio Jove Project -- a NASA sponsored program for K-14 students and individuals to learn science via radio astronomy. I also advise the astronomy club and support school visits with demos, public stargazing, and school group visits to campus.

I work with two programs linked to my University. 1) Summer PREP (PRefreshman Engineering Program) and 2) Project Lead the Way.

I worked on the science and engineering challenge in [omitted] as well as the HSC study day and experiment fest. I have also given radio interviews and public lectures about my research and the space physics field.

I worked with the National Geographic Jason Project to develop text books and multi-media curriculum

I'm a guest lecuture at the local high school about 1/yr

In 1995 I built, with NSF support, a small observatory in our town near [omitted]. For 3 yrs, I organized a summer school for 9-14 yr olds there with NASA Outreach funding.

In an official capacity, I organize press conferences, media telecons and press releases for [omitted], and I support E/PO activities within the agency. I also answer media requests as assigned.

In association with my grants we apply for EPO activities and when founded I support our activities

In class demonstrations and discussions

In my group we develop software for K-12 for maths and science and a large number of AP courses including physics maths calculus biology economice abd statistics

Informal E/PO involving public events with hands-on educational science activities for families distribution of solar images and information through classrooms, textbooks, TV/movie media, and public venues such as museums working to include students in the scientific community.

Informal education regarding space flight hardware in general ("Robots in Space""), the THEMIS mission launch, and general astronomy topics (phases of the Moon)."

Instituional lead on a long list of K-12 STEM initiatives, as well as principal on industry-university programs like Scince Olympiad

Interacting with our organization's education and outreach office.

Interaction with local middle- and high-school students on their junior/senior projects and science fair judging.

Interactive outreach activities, public talks, large and small group activities.

Interviews for radio and TV, both in the USA and overseas

It is done jointly with our new planetarium

I've been participating in GIFT workshops

I've led several supplemental E/PO investigations associated with my sounding rocket mission, and am also currently involved in E/PO for the IRIS mission.

I've recently started volunteering at the Adler Planetarium in Chicago, working with a project called Far Horizons. The goal is to involve high school and college students in high-altitude ballooning projects.

judge for local area science fairs, and a couple of national ones more than ten years ago.

Judge for Science Fairs

Judging at Science Fairs

Judging school science fairs. Getting scientists to interact with retirees. Giving talks about the solar wind to nin-scientific groups.

K-12 outreach in the classroom, public lectures, occasional undergraduate or graduate lecture.

[omitted] has run a summer program ([omitted]) to teach K-12 teachers about space science. This includes lectures and hands-on activities. The teachers then develop lesson plans and teach space science to their students.

lectures

Lectures at local high schools (~2x/ year), host highschool participants and observers for my [omitted] class in which we launch balloons as a class project.

Lectures at local libraries on NASA science results.

Lectures for the general public. Mentoring high school science teachers for summer research projects.

lectures in K-12 classrooms

Lectures to the general public, talks to elementary and middle schools, worked with middle school science teachers on lesson plan formulation

Local outreach primarily to middle and high schools. Currently this accomplished primarily through NASA Space Grant in the area of [omitted].

Local science fairs/festivals Outreach activities at Meetings/Workshops Visiting schools

Long time lecturer on AAS's Shapley Lecture program.

Made numerous presentation to elementary school classes about research in Antarctica.

[omitted] Mission project-level E/PO

mainly talks to elementary school children, most recently concerning scale model solar systems.

Maintain a website on solar sail technology

Making presentations in a class room, explaining aspects of solar physics in a seminar-like situation

Managed the [omitted] Outreach Team ([omitted]) for the [omitted] Space Grant Consortium. Currently working on E/PO products and presentation for the Solar Dynamics Observatory.

Manning NOAA booths. Working with local elementary students. Providing outreach materials to elementary schools.

Massive - online science literacy, professional development for teachers, public speaking,...

Meet with local High School teachers and we are planning a summer workshop. Give talks during bi-monthly planetarium shows and for High School visiting classes.

Mentor for High School Robotics Team

Mentor high school students in summer programs. Serve on the Board of Directors of the Long Island Science Center, a small museum dedicated to MS&T education activities.

Mentored a high school student. Mentored an REU undergraduate student Given talks to high school students.

Mentoring a high school student who used satellite data downloaded from online archives in her science fair project, hands-on presentations for local K-12 students, a public talk for a group of professional women, participation in online question & answer sessions with K-12 students.

Mentoring high scholl students in science projects

Mentoring my grandchildren in math, science, language arts, history at the middle school and high school levels

Middle school girls science program in [omitted] presentations at elementary schools presentations to students visiting lab mentoring of high school student internships

Mission EPO program development, teacher training, museum outreach.

[omitted] Space Grant Consortium, [omitted] Museum Science days, Science Olympiads, "communicating science to the public"" pilot program at [omitted] University"

Mostly hiring high school students, under the STEM program, to work in my Space Physics Research Laboratory during summer months. Encouraging these students to pursue training in STEM area.

Mostly informal talks at schools, participating in SolarWeek, science-fair judging

Museum presentations, classroom visits, science festivals

museum talks

Museums Schools RET (Research Experience for Teachers) Educational videos Press conference, article in a New Scientist (science for general public)

My [omitted] mission has an active EPO program. I give public lectures and talks at schools.

NASA Education supplement NASA mission outreach Article in [omitted]

NASA mission E/PO, other program as the opportunity arises

NSF Science Nation research highlight Astro-bulletin at American Museum of Natural History NY Provided simulation data for planetarium show "Journey to the stars"""

Numerous presentations. Space Camp, Von Braun Astronomical Society Astronomy Day, a local Boys & Girls Club, local MENSA presentation, undergraduate physics department seminars, supporting student tours of our labs, supporting a science presentation to the [omitted] rotary club in [omitted], web chats, Great American Moonbuggy Race, planetarium shows, supporting student science fairs, and supporting summer intern poster judging.

observatory open house, visits to schools

Occasional

Occasional public lectures, general-interest articles, and participation in on-line discussions.

occasional public talks

occasional talks at local elementary and middle schools

Occasional volunteer for APS outreach programs. Usually, on-line communication with high school students.

Often do outreach and speak publicly

One of our NSF awards has a substantial EPO component involving students, joint academic appointments, and public awareness components using both NSF and external funding

Open House School visits Science Fair Social events

Organizing [omitted] Astronomy Festival. Manage [omitted] observatory with many public outreach activities.

Our department holds monthly public open houses at our campus observatory and planetarium.

Outreach presentations on human space flight, based around my flight on [omitted] and ISS research

Outreach programs through museums

Part of our NSF Center. Outreach in the community near our college.

Participate annually as judge for [omitted] science fair. Also support and provide K-12 teachers with research experience during the summer on the [omitted] program.

participate in NASA [omitted] events

Participate in Spacegrant activities through my institution. Participate in NASA funded E/PO activities associated with active missions.

participate in the education and public outreach committee of AAS/SPD

Participate in training sessions for Solar System Ambassadors occasional classroom talks occasional tour guide at JPL

Participate the Open House efforts

Participated as a presenter in Sally Ride Festival Ongoing scientist participant in Solar Week Giving various talks at area middle/elementary schools

Participated in a student rocket launch as well as through an NSF grant

Participated in a workshop for teachers associated with the [omitted] mission.

Participated in AGU press conference about AF_sponsored space flight mission

Participated in Expand Your Horizons, Earth Explorers, Science Open Houses, Science Fairs, visit K-12 and community college classrooms

participated in the department of phyiscs [omitted] science' outreach program as a graduate student at [omitted]

Participated the STEM program. Participated the K-12 program

Participated with several company-sponsored or endorsed high-school level Math competitions and Science Fairs

part-time diversity advocate

Personal appearances at Middle schools to describe my experiences as a space scientist with particular emphasis on my experiences in [omitted].

physics Day for elementary and middle school classes

Physics is Phun shows at elementary schools and for home-schoolers. Observatory open houses for students and general public. Science Fair judge and mentor for middle and high school.

PI on an E/PO supplememt to my NASA/[omitted] grant. Participated in a press conference on my work. Had four press releases on my work. Was interviewed by radio, Physics Today, and other news media about my research. Guest lecturer at [omitted] College for a diverse audience three times. Host for high school students and teachers visiting our lab two times.

Popular articles, documentary films

Present classes at Sally Ride Science Festival. Judge local science fairs. Present at AAUW all day girls technical conferences.

Present guest lectures at local Grade Schools and High Schools. Host REU Summer students

presentation to K-12 science teachers, video conferences on projects with middle school science kids, public talks and lectures

Presentation to librarians (NASA EPO program) on lunar science and LRO mission, interview on local cable access astronomy program on LRO mission and results.

Presentations and seminars with teachers and students

Presentations at son's school. Nothing official.

Presentations in local schools on Astronomy. Web-pages on Solar Physics.

Presentations in local schools. Tours of our laboratories.

Presentations to students

Presented hand-on physics experiments at Expanding Your Horizon conferences (6-8 grade girls) to encourage them to study math and sciences.

Presenter at Sally Ride Festivals since 2007

primarily- 1) visiting schools and giving talks 2) updating exhibits at Arecibo Observatory visitor center 3) lecturing and performing demonstrations to groups of k-12 students 4) producing brochures

Primarily a "Citizen Science"" project getting the public involved in viewing/analyzing mission data and making their own discoveries in this data. Most of this is done through a single project web site, with ""promotional"" assistance from the NASA mission project HQ and through Twitter, etc. "

Primarily education and outreach within the community I support to remind them of the need for space weather. Outside of work it's education and outreach in my childrens' elementary school.

Producing educational materials

Professional development for in-service middle and high school science teachers, classroom and community science presentations, Science fair, Science Olympiad

Project [omitted], [omitted] Science Bowl at [omitted], [omitted].org, ad-hoc efforts

Project Astro, NASA educational supplements, Advocacy at school and district level

Project Director for Space Grant Pprogram in our state student teams to build and fly BalloonSat experiments K-12 teacher enhancement programs college senior design programs

Provide lecture and interactive demonstrations to primary and secondary schools regarding space environments and engineering.

provide material to NCAR science displays.

Provide talks within the local communities I've lived in

Provide technical support to undergrad research program application process.

Provided tour and discussed engineering as a career with high school student at office. Boy Scout merit badge advisor on multiple topics.

Public facing data disseminating websites and related tools (e.g. tutorials).

Public lectures

public lectures teacher support

Public lectures, articles

Public lectures, observatory tours, school visits, meeting booths. Organized projects, coordinated staff, encouraged others.

Public outreach at local observatory

public talks

Public talks & outreach seminars

Public talks (all levels), radio and television interviews

Public talks at Lowell Observatory, answering questions from the public, and am presently writing a book for high school students about how ages are determined in science.

public talks, classroom presentations

public talks, public night at local telescope

Publication of monthly journal of electronics and scientific research and history.

Publish relevant articles and news stories.

Read to grades pre-K to grade 3 as a Kiwanis volunteer.

Recently, I started an online science magazine mainly targeting the high school students, covering all the fundamental science topics. This is still in its infancy, planning to expand and launch a print edition in the near future.

Regular public talks, participation in public viewing, K-12 programs and class presentations.

REU mentor, public talks, activities at museums

REU Program Mentor, co-director Producer of DVD on Space Science [omitted] Science advisor for programs with the [omitted]

REU/RET NSF programs

reviewing and supporting NASA mission E/PO plans

Science fair judge. Informational tours about my work for high school students.

Science fair judge. Volunteer tutor in math and science.

Science fair judging.

Science Fair, American Indian Research Program

Science fairs judge in [omitted]. Donate funds for science fair awards,[omitted]. Served in a panel Nation at Risk report.Panel on Senior Exit Proposals,[omitted]

Science Fairs, Classroom engagement, Mentoring

Science talks. School visits. Workshop participation.

Scientific tours of research facilities, provide interviews to local media (print and television), serve as mentor for K-12 science students.

Serve on SPD Education/Public Outreach Committee. Earlier NASA grants included E/PO component. I am active in writing books and other science outreach to the general public.

served as a judge in a highschool science fair

Served as science educator for middle school students of the [school omitted]

Served as technical advisor/consultant to NASA [omitted] Summer School PostDocs, and to NASA funded PIs in radiation biology

set up opportunities for students to participate in nasa programs

Short presentations to local groups

Since [year omitted], I have worked with the NASA/[omitted] Education and Public Outreach (E/PO) Office on various activities such as school and visitor presentations, E/PO product development, and student mentoring. NASA Space Science Educational Review Panel, [years omitted]

Since [year omitted] after I got the faculty position I have annually participated on "Women of Aviation"" and ""Women of mathematics"" events to incourage middle-school girls to pursue careers in science and technology. During my post doc years in [omitted] I collaborated with [omitted] organization to help creating an interactive forum for high school kids to learn about careers in physics and engineering. I was interviewed about my space physics work and they created a fun animation movie-cartoon about [omitted]. I am a physics professor so I teach basic physics courses for engineers and I utilize my space physics research background to create nice in-class examples and projects for students. I also teach graduate students a course ""Advanced Space Physics"" where I teach both plasma physics and space physics applications of plasma physics."

[omitted] Program at [omitted

Space Weather outreach -- to serious customers primarily, but also students at all levels, the media, and the general public.

Speak to groups of Seniors at retirement homes to local Astronomy societies, to individual classes at local schools.

Sponsor NSF REU student, participate in community outreach

Started a [omitted] Summer School for Graduate Students

State wide middle school and high school robotics program. K-12 science outreach in classrooms.

STEM initiatives at my 4-year college state-level programs to integrate HS and college curricula.

STEM to local schools, voluntarily.

Strong supporter o education and outeach in NOAA - expanded funding and staffing for the education office. Write OpEds and editorials supporting.

Submitted (unsuccessfully) several NASA proposals for K12 and outreach. These have included organizations such as SciQuest, US Space and Rocket Center. Speak at multiple public forums etc. Bring schools and public into labs and centers (easily done since I am a director of center and also chair of physics dept).

summer intern mentor

Supplemental outreach award to a NASA grant, primarily developing web-based content for public outreach.

support inner city STEM club

support staff who are full time EPO support AAS and AGU public events public lectures at regional astronomy clubs

Support Student/Teacher day at APS [omitted] conference

Supporting outreach professionals with data products and descriptions. Occasional public talks.

Talk about space research with satellites to grade schoolers.

Talk with my childrens' classes.

Talks at local Elementary and High Schools

talks at local schools, involved high school interns in research, public observatory tours

Talks at schools

Talks to local schools, talks to public in local area

Talks, working with EPO groups, develop of materials, consulting

Teach at Jr. High

Teach in a historical black university

teacher workshops

Teacher workshops, public lectures, student activities, teacher conferences

Teaching undergraduate students. Presenting Seminars, Giving public talks at the local planetarium. Public press releases

teams of students visit 5th grade classs

Textbook writing, popular writing, talks to educators.

The Department of Physics at the University of [omitted] has a Physics Day. My group set up a booth discussing how optical instrumentation relates to upper atmospheric physics.

[omitted] E/PO. I direct student research at the high school level using [omitted] data from our [omitted] ground-based [omitted]. I also am a [omitted], one of [omitted] selected for the [omitted]. I have presented at NSTA and other conferences on [omitted], and am now also doing so on [omitted].

Tours of the space weather prediction center lectures to local students and amateur radio groups

Tours, public presentations, mentoring of secondary school teachers and students.

tutoring underprivileged kids science fair judge

Twice PI on NSF REU grant, several E&PO activities as part of successful NASA grants

Use of advance model rockets that carried instruments that fell to Earth via parachute as dropsondes. Wrote one State grant to work with elementary schools and was associated with the Toyota Tapestry Grant doing the same thing.

Various opportunities as they arrise.

various: [omitted] Prize past president [omitted] organizer of symposia at AAS, IAU, and AAAS meetings past chair of [omitted], etc.

visit local K-12 schools presenting mission specific information tailored to their educational level.

Visit middle schools once or twice a year to discuss the space environment and science in general.

Visit rural schools present public lectures participate in E/PO proposals PI on E/PO proposals and grants

Visit schools to give lectures.

Visit schools to inspire K-12 students. Work with K-12 teachers to give them a better understanding of science. Review education material for NASA.

Visited schools for Career days

Vist schools and observatories - but it's been less lately

volunteer at the local boys and girls club to do space science/physics demonstrations, visit near by minority institutions to recruit minorities into space/solar physics, submitted a EPOS NASA proposal intended to diversify solar-heliophysics.

Volunteer at the Udvar-Hazy center in DC

Volunteer for events such as the USA Science and Engineering Festival

volunteer for FIRST events (Robotics and Lego League), speak at schools about what a scientist does

Volunteer in ASTRO NOVA, a New Jersey based project to bring astronomers into grade school classrooms, [omitted] fellow at [omitted]. [omitted; related to fellowhip] is a project bringing graduate students of computation, science, and math backgrounds into inner-city classrooms to complement their curriculum with real-world applications and research insights. Regularly participate in Star Parties for grade school students through university's Astronomy Club.

volunteer speaker for Encouraging Change by Helping Others (ECHO) for NASA FIRST program

Volunteer work in the local community via the American Chemical Society and the local hands-on science center (Sci-Quest.org)

We are responsible for the development, deployment and evaluation of all E/PO programs related to the [omitted] as well as collaborating on any combined efforts within in [omitted] and the [omitted] Forum.

We have a program in my lab for high school students to work as research assistants. The NASA instrument for which I am PI sponsors a number of programs at a local science museum.

We have produced a series of podcasts available on web. I have presented talks to such groups as computer security, high schools. I have been involved with museum projects and demonstrations. I have served on panels and have participated in news conferences. I have worked with high school teachers through the RET program. I have served as a thesis advisor for an undergraduate.

We run a Physics is Phun program at local schools and youth clubs.

We run an outreach program for high school students in the month of July that brings them into our research. I also hire motivated high school students to work with me in the summers.

web sites, data browsing tools, sonification software

When a NASA contractor, worked with the [omitted] program. As a [omitted] Federal Employee, at times responsible for web content, tours, press releases, and media interviews.

Wind mission EPO program

work with 1 REU every year. Give lectures for REU and RET programs. Contribute to EPO activities at my institution.

Work with 5th grade students at local science/math magnet school. Organizing physics olympics for local high school students.

work with instructors and students at local high schools

Work with local elementary school on a basic level helping them to appreciate science.

Work with writers on news articles about my research, several interviews with magazine media, chaired conference at [omitted] with significant EPO components.

Worked summers at a historical park explaining the aurora to tourists, Worked with an educational group (math in a cultural context) designing math curriculum for 6th graders. It included physics concepts and scientific thinking.

worked with disabled students had a press release

Worked with high-school teachers to develop space-weather teaching module.

worked with local high school. Helped create a solar observatory at a high school

Worked with NASA-sponsored outreach activities, mostly K-12.

Worked with the [omitted] Institute ([years omitted]), also with the [omitted] Museum on their Teachers' training programs ([year omitted])

Working with K-12 teachers to promote student involvement in upcoming cubesat and ISS missions.

Working with undergraduates and graduates on space science research topics to fulfill degree requirements. Additionally, have worked with high school physics instructors to encourage hands on physics studies associated with space science research.

Workshops for teachers on physics, astronomy, energy topics. Demonstrations (astronomy--solar system related) with school groups from elementary and middle school

work-sponsored presentations at local elementary and high schools

Written and presented planetarium programs, lectured at schools, created educational DVD, arranged tours of the labs, participated in Boys and Girls Club programs, participated in internet classes, organized and presented teacher workshops, presented to Girl and Boy Scout leaders, written educational webpages.

Wrote text for public WWW sites, maintain instrument imagery and video on WWW site, answer questions from the public via email

Responses to Open-Ended Questions about Success and Barriers to Success

Respondents were asked two open-ended questions about their careers:

What has helped you succeed in your career up to this point? [Success]
What have been the barriers to your career up to this point? [Barriers]

Responses to both of these questions are provided below by the sex of the respondent. All responses are reported as received except any identifying information has been omitted.

Responses from Women

Success	Barriers
(1) Ambition (2) Good mentors (3) Luck	A Ph.D. from a non-US university
(1) Enjoyment in my work (2) Family support (3) Support from my mentor presently working in scientific research (4) Bull-headedness (5) Occasional creative insights	(1) Catch-22: No available funding for research that is even mildly controversial. The last proposal (very good) was not funded b/c someone didn't believe in the usefulness of the measuring technique...I can't demonstrate its usefulness beyond a shadow of a doubt without some funding. (2) Because of #1, I'm trying to scramble for a backup. Am presently working on a lab experiment out of my field potentially establishing myself in a new field. In addition to that, the present funding predictions for NASA/NSF does not indicate that there will be any change in the present situation. I am pursuing the credentials I need for a complete change in career should I fail to secure funding when this current grant runs out. (3) When I was in grad school, I had an advisor deliberately try to flunk me out.
* Enthusiasm for the subject matter *Support groups outside work, in places where the work community was tough for women *supportive sub-communities within overall biased work community * Sense of humor * Awareness / understanding of historic trends and individuals of women and traditionally under-represented groups * being able to be part of building a little "revolutionary"" inter-disciplinary group (radically cutting-edge methods. It tended to attract a broad spectrum of people plus I had the satisfaction of helping to build towards something new * having strong confidence in my own really brilliant (if definitely quirky) skills and insights."	* All the traditional strong unconscious bias in groups that traditionally exclude women * The fewer but ore senior members who are consciously biased * what historians Laurel Thatcher Ulrich and Margaret W. Rossiter term 'using gender as an expression or to express power relationships in a culture" -- that is, having even small bits of social interactions, or science breakthroughs or struggles, interpreted only as having to do with the power-status of key male figures and/or interpreted as sexual in really silly but also far-reaching ways * Times when I did not have my sense of humor and took such foolishness personally * jobs where I had no [none, zero, zilch] colleagues at approximately my level or older in the entire group. (However senior colleagues psouses were often helpful.) * For me, the disproportionate time women spend being both 'super-scientists' and 'super-colleagues' may (but may not) have contributed to my debilitating chronic illness."
A good working environment which allows me to balance work and family requirements. Good supervisors which are good listeners and mentors.	I assume my wrong background in civil engineering and the part time working.

Success	Barriers
A supportive spouse.	Children and the stigma of working mothers. Pregnancy and young children have slowed down my travel and ability to work in the evenings.
A wonderful mentor, and not being afraid to take risks	There was one Director of an institution that I used to work at- he tried to hold me back
Academic journals and NASA data, which are publicaly open.	A lack of long-term job which I can plan long-term research.
Access to meetings in my field where I can discuss problems and research opportunities with colleagues.	Not having as much training in writing peer reviewed articles as in writing articles for conference proceedings. Not having ideas supported that later became of interest when proposed by others and not sticking up for them myself.
Adaptability!	Closed community of space physicists associated with [name of mission omitted] mission. Unduly harsh anonymous referee reports. Lack of mentorship.
Advisors in undergraduate and graduate school	None.
attractive research topics in magnetic reconnection	
Being a woman in the field of space physics in the sixties and seventies was particularly difficult in [country omitted], where I was born. Coming to the US as an NRC-post doc and staying on helped tremendously. Beyond that it is hard work, commitment and passion for one's field of research.	Barriers have been gender discrimination and a personal health issue which has left me with chronic and constant severe pain.
being associated with an active group of research colleagues and being funded reasonably well.	no external barriers
Being on a strong instrument team with many collaborators.	Diminishing funding levels from NASA and a need to constantly propose small projects to survive.
Being surrounded by great colleagues.	Balancing family, work, and work travel.
being too stubborn to quit.	lack of jobs in scientific fields Lack of network connections Lack of appreciation and funding in public outreach Lack of adequate communication of career potential Lack of a centralized place to go to find out about careers Poor training in writing grants and papers
Bosses who refused to be mainstream thinkers, people who recognized the impact of what we were doing and were willing to fight for it, being in the right place at the right time when the work needed to be done and working hard for something I knew had impacts far beyond the community I was working for.	Money, priorities that lay elsewhere, apathy and an unwillingness to see that investment in scientific work such as this has exceptionally positive "unintended consequences."
Communicating with other research scientists to know what they are doing, what is current in my field. Learning new skills.	Lack of funding for basic research, budgetary restrictions.
Computer skills,computer programming education, support from mentors	lack of female mentors can make progress difficult
Creativity, perserverence, serendipity, and intelligence	NASA funding, Challenger tragedy, sexism in the workplace
Curiosity and determination.	None.

Success	Barriers
Dedication, persistence and luck.	Funding cuts (and more competition for the same amount of money), soft money job, and uncertainty about the future of space science.
determination	gender discrimination
Educational opportunities available to full-time employees at my organization.	Finding external funding is challenging.
Encouragement to seek independent funding for and pursue my own research interests, even while I was a PhD student at [school name omitted] planning to go to [school name omitted] for a postdoc.	There is a government agency tendency to favor established researchers vs. taking a chance on bright young people. I encountered some of this early on, but also encountered people willing to take a chance with a lot of encouragement.
Enthusiastic advisers who had interesting, NSF and NASA-funded research projects. Early-career funding through NSF.	Flat budgets in recent years (particularly at NASA), gender issues in academia
Excellent advisors along the way.	Not much.
Excellent mentoring by advisors and professionals, research fellowship opportunities and funding, networking and conference opportunities	Limited job opportunities (number of opportunies and where opportunities are located)
Excellent mentors	Management that had different visions for my career than I did
excellent mentors	my career goals and family goals are incompatible
Excellent mentors and good luck.	The difficulty of obtaining external research funding.
excellent mentors, excellent work habits, good luck	long workdays are difficult for a mother competitive atmosphere difficult for women
Flexibility - willingness to shift gears and change what I'm working on and to learn new things. Collaboration.	The work I'd rather be doing isn't always available.
Flexibility and perserverance also time management and the assistance of my parents in looking after my children when I went to conferences.	Being female, and tied to a husband who I loved, but who preferred not to travel, or to move jobs so I could have one. On the other hand, when the kids went to college finally, he tolerated that I went to work at [place name omitted] for several years.
Funding	Funding
Good connections - I was lucky to study under the right people in order to do some good research, and they supported me when I transitioned over to defense work.	Infrequent opportunities for career advancement. During my 3 years as a postdoc, there were only a handful of faculty positions that I could have applied to. I didn't want a life on soft money for the next 10 years.
good education and physics background in undergraduate study	leadership skills
Good language (writing, speaking, teaching) skills and excellent mentors.	Time management between home/family activities and research/teaching demands.
Good mentoring	Engineering mentality dominating scientific mentality in mission instrument groups.
Good mentors	Family obligations
Good mentors	Staff reductions from insufficient funding have resulted in much higher workloads that reduce publication output. Paperwork has also increased.

Success	Barriers
Good mentors and advisors attending smaller scientific workshops strong physics-based graduate course work	The lack of stability and tenured positions to enter into after the post-doc career path is discouraging. The lack of family-friendly policies for post-docs is also difficult. For example, a typical post-doc position does not allow for maternity leave.
good mentors and senor scientist trusting my work and giving me opportunities	
Good mentors and willingness to work hard.	In recent years, lack of research funds.
Good mentors, a supportive working environment, and hard work.	Bearing and raising children in my personal life.
good mentors, luck	2-body problem
Good mentors, talented colleagues, great science opportunities, enlightened employment practices, extremely supportive spouse.	Funding concerns
Good mentorship by my university, graduate school and postdoctoral advisers has been critical to my success. Finding mentors who helped me develop as a researcher, were supportive of me, made sufficient time to help me, gave me career advice and helped me find my next job was the biggest benefit.	Being able to get the job I want has been dependent largely on availability of funding.
Good science, hard work and charisma.	Funding. Work opportunity. Lack of supervision. No teaching opportunity.
Good scintific research enviroment	Not enough funding
good supervisor and mentor strong self-motivation a very good environment during graduate study	
Graduate school opportunity to work on a [type of project omitted] project, allowing me to experience all aspects of research (hardware, data analysis). Opportunity to work on proposals as a graduate student and postdoc. Opportunities to collaborate with senior scientists and to work on major missions, both in a hardware and data role. Willingness of my institution to allow me to work part time so that I can also support my children and their activities.	
Great advisor. Supportive colleagues at current job. REU program as an undergrad.	Being a woman pursuing a physics degree (undergrad)----only female physics student. Poor post-doc supervision. Poor management. Limited funding opportunities for science. In the overall community there is a select group who seems to always be chosen for committees, talks at conferences, asked for opinions, and funded for research.
Great mentoring by my Ph.D. advisor and by my senior colleagues	no experience writing grant proposals before starting as a faculty member
Great mentors and financial support.	I could use more training in how to write grant proposals.
Great university environment Great graduate research advisor Solar group at my university	Available Postdoctoral funding
hard work	being female, foreign accent, inside politics
hard work and ability to learn things on my own.	I have a good depth of knowledge but not as much breath.

Success	Barriers
Hard work and determination	None
hard work and enthusiasm	not sure there have been many
Hard work and interest in the field and being in a unversity environment	Up to this point I have been very lucky. Last year the main barriers were closing the institute [name of institute omitted] and not enough state funding to continue developing our educational material for [names of specific groups omitted].
Hard work and mentor-ship. My phd advisor who is a great mentor played (still does play) a great role in my career today.	none
Hard work, flexibility and supporting colleagues	To a very slight degree, being a woman
Hard work, good luck, great advisors	
hard work, NASA programs for graduate students	arrogant males
Hard work.	Difficulty in obtaining funding for research.
Having excellent collaborators and colleagues who serve as mentors.	Heavy teaching load underprepared students.
Having my husband be a [type of position omitted]	Lack of a PhD
Having the opportunities (Summer schools, supporting funds, scholarships, etc.)and support from my academic adviser.	Faculty in authority not performing their duties properly, also not fulfilling the responsibilities of their positions, especially, when it comes to students.
helpful mentors	sexual harassment, bias
helping of my family	marrige
High motivation, personal investment, scientific exchange during conferences, internationnal collabration, the opportunity to travel, good relationship with people I work with.	No barriers yet

Success	Barriers
Honestly, I don't feel that my career has been successful at all. I am currently employed and have decent health/retirement benefits, but that is about all I can say. I am totally funded through soft money, and currently I am not a PI or Co-I on any grants. I am completely dependent upon my faculty supervisor for funding. With the exception of one small [name of grant omitted] grant that I received 9 years ago, all of my proposals to NASA and the NSF have been rejected. My supervisor and I have repeatedly revised rejected proposals according to the panel's recommendations and re-submitted them, with no success. This year, I tried submitting proposals on two completely different topics that I have never studied before. Unfortunately, based upon the current funding available for these programs and my past lack of success, we are not very optimistic about the chances of these proposals getting funded. I have applied to faculty positions at small colleges and what few NASA civil servant positions that have been advertised in the last few years with no success. Even though my current supervisor, my post-doctoral advisor, and Ph.D. thesis advisor have been happy with my work and have told me that I write good papers, I do not feel respected by the rest of the scientific community. The only time anyone other than my supervisor or co-workers has told me I do good work is when they are trying to get me to review a paper or proposal. I have had to endure verbal attacks at conferences by an older, male scientist who took issue with [topic omitted]. Although most of my co-workers are supportive and helpful, I recently had a bad experience with [omitted]. He [details omitted]. I am paid less than some of my male co-workers with similar skills & experience. I can't tell if my career advancement problems are due to sexism or if there is just something wrong with me. I probably should not be so open about these things in this survey, as our field is so small and has so few women that it would not be too difficult to figure out who I am. However, I have reached the point where the future looks very bleak and I just don't care. I don't know if it is worth continuing to do [area omitted] research or if I should just start looking for jobs in the aerospace industry.	Sexism and older, male scientists who refuse to let women like me in [age range omitted] start to take on more responsibility and greater leadership roles in our field have held back my career. It seems as though there has never been enough funding to support all of the experienced scientists in our field. This situation appears to be getting worse and worse due to funding cutbacks, older scientists who refuse to retire [omitted], and the large numbers of graduate students receiving Ph.D.s in space physics. Once you are out of school, and have done post-docs for a few years, there do not seem to be many tenure-track faculty or permanent civil servant positions available. The few positions advertised are so specific in their requirements, that I think the hiring institutions probably already know who they want before running the advertisement. When a less specific job opening is announced, it often turns out to be a "fishing expedition"" just to see who is out there, and there is not really an opening available. Even soft-money research scientist or research associate positions are uncommon, as faculty members would rather hire cheaper post-docs or graduate students who work for low pay and receive few benefits. Everyone tells me that to get a better job, I need to publish more papers or get more hardware experience. I have tried to do both, but it hasn't helped. Opportunities to work on spaceflight hardware are rare and people don't seem to think I am capable of working on these projects for some reason. I have more first-author publications than some of my male co-workers, but that doesn't seem to matter, either. "

Success	Barriers
Honestly, perseverance has been the most important thing. Improving my writing using the [number omitted] books below has been critical. [names of books omitted] Having a broad physics and space science background has also allowed me to keep a steady amount of work because I can work a wide range of topics. However, I'm not known as the to go to person for one key topic so there is not as much glory when you keep changing topics. Early on teaching myself [omitted] got me some jobs as a student and helped me get my post doc since I could quickly create [omitted].	I think that being know for data analysis has held me back. Other post docs and young researchers that did hardware work seem to get promoted past me, and it has only been recently since I improved my writing that I have started to catch up. It didn't seem to matter that others were also doing support work and obtained their funding from coworkers and did not win their own money. What seemed to matter was that they were working with the hardware. They did not out publish me or bring in more money. In fact I think I helped bring in more money being a Co-I and helping to do senior review proposals. I think that at times being a woman was a disadvantage because most of my bosses are men and they seem to identify with the men better. I did not feel like they didn't like me because I was a woman. I felt like they thought of the guys first, or they would assume I couldn't do something that I really could do. I have seen similar problems with guys that do data analysis and with guys that the bosses thought were not aggressive enough. It seemed like they just assumed I wasn't aggressive enough because I was a woman. I had also seen that once a guy was deemed to be not aggressive enough they would miss out on opportunities as well. Now whenever I run into people at work I ask them what they are working on to figure out if there is a collaboration I can establish. I also go to the AGU meeting with a list of people I want to talk to on various topics. I improved my writing and finally became a PI on a [omitted] proposal. I have formal rules about finding work. I do not volunteer to help anyone unless it involves being a co-author, a co-I, and funding. Even when I help my boss' students I make sure I am a co-author on the student's paper. I try to maximize the number of things I can put on my resume year round. That of course means I sometimes have to say no to people, negotiate myself, or recruit my boss to negotiate on my behalf.
I am very smart, but ran into a hostile climate in graduate school [omitted] I survived by sheer persistence. My first postdoc experience in [area] was horrible. I quit [omitted] for [omitted] and tried to do [omitted] research. When I entered the work force in [field omitted], I was lucky to have a couple of good mentors.	gender discrimination, hostile climate, indifferent supervisors and advisors.

Success	Barriers
I genuinely like people and am able to organize campaign-like efforts to analyze [omitted] that are not directly funded outside of the work that participants are doing on their own grants. I know many people in the community over the whole range of discipline areas and keep up on their work. I perform leadership roles in international programs that seek to combine research efforts among different nations to accelerate progress. In this mode, I am able to make progress on [omitted]. However, it is very difficult to follow this path rather than the standard focus on furthering your own research program and getting out a large number of short papers.	I am trying to work on [omitted] questions, which I regard to be the next scientific frontier. The standard criteria for success in our field were not designed to promote this type of [omitted]. These type of projects take longer. The papers are more complicated and longer with many more co-authors. There are really no appropriate journals within which to publish the results. Evaluations and promotions depend upon many short papers with little time spent on them. Proposals that have a broad focus do not fare well in review panels. Innovation does not fare well in review panels either. Incremental advances on well understood discipline specific processes satisfy the review criteria best. The advice is to make the research you do conform to the current structure.
I have had multiple careers, so not sure.	Indecision/ lack of guidance from Masters advisor
I no longer work in solar physics.	Lack of flexibility in location Discrimination due to gender Low wage due to gender
I was brought into the field by a professor who really loved his work and who has supported me as a student, colleague, and now friend. It made all the difference to have someone I could go to with any question.	My writing ability
I'm bright and a quick learner. I like doing research.	not well connected in my field. not subject myself to peer pressure and go with the flow when it comes to scientific issues.
I'm not sure how to answer this question since I do not really have a career in solar or space physics. I left the field after my Ph.D. My success as a [omitted] is due to a variety of factors, including my excellent high school, undergraduate, and graduate education (which included [omitted]), the opportunities I had to participate in research as an undergraduate, my personal doggedness (determination) in the face of difficulties, my willingness to network informally and keep in touch with people, my people skills (not really developed at all until I left grad school!), and the support of some of my professors (some of which was to counteract the negative effect of other professors).	A well-publicized problem I had with [omitted] while I was a graduate student in [omitted] effectively squashed my plans to pursue research. [omitted]
Incredibly supportive thesis supervisor that allowed me to pursue topics outside his main area of interest. Support from and collaboration with both young and senior scientists in the field. Ability to write successful proposals.	Inability to be PI in my current [omitted]. Having children.
internships and supportive mentors in undergraduate and graduate school	bureaucratic and administrative obstacles
intrinsic motivation, quality education, supervisors who allow me to try to manage projects myself, participating in communities of practice and reflective practice	[omitted] as lab managers who don't understand inquiry, isolation during research projects, difficulties raising family in an academic setting

Success	Barriers
I've worked with the [omitted]. The opporunities that [omitted] has provided for me, through exposure and collaborations with the leading scientists in my field, has helped me tremendously.	I feel that a major barrier has been my gender. Despite getting my Ph.D. I still feel as though I don't belong in the field. I hope that with more women in science it will be easier for the next generation.
Joining with a group of people that I wanted to work with and supported my studies in their field	
learning, improving my skills, collaborating	funding
Love for the field. Wouldn't be happy anywhere else. Too bad science is not an appreciated field by most of the population.	Gender discrimination, xenophobia.
Luck and a good collaborative team (or two or three).	Short-term soft money lack of permanent positions (** in the geographic area I need to be in due to family constraints **), lack of students/postdocs being trained in the sub-areas I need.
Luck and knowing the right people.	My own lack of self-confidence, low publishing rate, and inability to win proposals.
Luck and the guidance of good mentors.	Diminishing funding in the field. Increased competition for [omitted] and funds.
Lucky timing in relation to [activity omitted] and flexibility and support provided by my current research group (to allow balance between family and work demands).	No real barriers. The biggest issue is the trade off made between time/energy spent on work vs that spent on family-related issues. I have made choices that benefited my family but held back my career
Many teacher supervisor teach me about the solar physics and the way to study. My parents also help me for the university's tuition costs.	My English skill.
Mentoring has been the most critical factor.	Discrimination, isolation, bias.
Mentoring I has received from my postdoc supervisors and graduate adviser.	Interdisciplinary barriers - evaluation criteria are very different lack of opportunities that go across traditional disciplinary boundaries
Mentors	Managers
MENTORS!! I had a great grad school mentor who was there when I needed him, but not when I didn't, introduced me to people in the field, and sent me on conferences with him at first, then alone after that.	Especially in my post doc, which is only 2 years, I have to spend a significant portion of my time [length omitted] trying to find my next job instead of focusing on wrapping up the stuff I am doing now.
mentors, education,	lack of job opportunities
mentorship	not enough faculty positions in top universities
My advisor during my Phd study and the awareness of field development along the research.	to build up the network in the field
My interdisciplinary education background	N/A
My mentor in [place omitted] and my first US supervisor, as well as my [omitted] sponsor. Since [year omitted] I am on my own with no help.	Continuous proposal writing which takes time away from publishing results.
My mentors (specifically my M.S. thesis mentor) have been the primary reason for my success so far. Without them I would no longer be in physics at all. My first employer has also been essential in my success.	Social Isolation, lack of preparation, poor computer programming skills, personal problems.
My persistence.	The funding situation of tenure and other permanent positions was and is the main barrier.

Success	Barriers
My professors at the [place omitted], the good people at [place omitted], and my family. I love my job and the great community that we are.	At some point, my origin and my gender. Not anymore.
NASA grants, open minded professors and PIs for funded NASA missions	I ahve pursued a PhD as a parttime student. Most educational instutitions do not accept parttime PhD students who needs to work fulltime. [omitted] was great about supporting through the parttime graduate student program. Educational institutions are often nto so open minded.
NASA's funding support	Instability and uncertainty of soft money, lots of pressure in getting grants, spent more time in writing proposals than doing research due to very low success rate, have to write proposals again and again
Networking	No
No comments.	I chose to leave science for a while for family and recently, came back to the field. That I had to leave at some point and I could come back when I was strongly determined points to the state of the entire system of scientific research.

Success	**Barriers**
Not listening what I cannot do	As a soft money person, the main barrier presently is the mental distress to not know if I can support me 10 years from now. [omitted] - hence 10 years from now my chances to get any security is even smaller. The possibility to swap career becomes harder and harder so if I should swap carers I should do it now, even if I presently have money. This result in me more to focus on how to know that I at least have a high probability for security 2 years in advance (it takes ~1 year to sell a house and I cannot live with wondering when should I put it on the market since I have to move, hence the wish to know 2 year in advance if I have salary or not) It is also a question if I am doing the right thing, I am trying to effect the field with propose new missions, work on future mission and instrument development. But since I am on soft money, I perhaps should not use up my time on this because if I have to move what I am doing now is useless since I will not be able to take the support staff and facilities with me. So, I probably should not engage in missions or instruments nor my try to impact how research institute is operated but I should only focusing on writing papers and write proposals to NSF and NASA. That would give me greater possibilities to get a fix position. Which is sad because I would really want to impact my field with develop excellent instrument and missions. Another problem as a soft money person is when my mission or instrument is selected I need to slow down my effort on my [omitted] proposal to focus on the mission/instrument. With NASA benign more and more stricter with the grands are finish after 3 years (no none-cost extension) I have difficult to meet my commitment on the mission/instrument. [omitted]
Nothing	Too many old farts
NSF funding	lack of mentoring active harassment
Opportunities to get funding to support my research ideas.	Reduction in NASA and NSF funding.
Opportunities to lead and have increasing responsibility	Sexism and corruption/cronyism. The main issue is that many science and engineering fields are male dominated where the unwritten rule is to do whatever someone in power says, even if it's wrong- if you stand up for what's right and blow the whistle on corruption- you are the problem because you didn't stand up for the boys club like they cover for each other.
organizational skills, communication skills, hard work, luck	lack of the right education for the positions I have held

Success	Barriers
outstanding research opportunities as an undergraduate and graduate student, outstanding mentorship both as a graduate student and afterwards, generally collegial attitude in our field.	I have been very lucky and dont' think I have had many barriers, however, I do feel that I have sacrificed my personal life to some extent in order to succeed. In other words, personal life could have set up some barriers (having children) but I have chosen to not allow it to be.
People who believe in me, from my father, teachers, professors, my husband, co-workers. I assist with E/PO to let kids know I believe in them.	Lack of brains. I'd do a lot better if I was smart. Seriously, when I was young, science was a man's job. That didn't inhibit me but it did have an effect on me.
Perserverance analytical skills	Unreasonable expectations in undergraduate and graduate school some sexism in graduate school failure to get a good grounding in experimental techniques
perseverance	being married to a [omitted] scientist in the same field, being female, raising a family, frequent tendency of scientists and agency folks to say they care about education but then not actually follow through, re-inventing the wheel tendency of community and "not invented here" syndrome
Perseverance and having good mentors.	Being female, lack of funding
Perseverance I guess. But I do not really feel like I am having a career at all.	Background in my home country. Late start into a new field and a new country after completion of my PhD. And... well, what do I know, I am just a woman.
Perseverance, not listening to naysayers, and having the flexibility to continue looking for new routes in to the field.	Not a lot of career counseling at the university for science majors. I was not aware of the opportunities available to me.
persistance and hard work, I was also lucky to have an extraordinary Ph.D advisor and a great post doctoral advisor.	I was told by a male professor that I should change fields when I was a master student in physics in [country omitted]. I moved to US to obtain a Ph.D and have been successful so far.
persistence and some luck	living on soft money and being part of a two career couple
Persistence to work on projects that are interesting.	Not getting funded can feel very down. Without sufficient funding, I feel isolation. I do not have much interaction with the rest of the solar community. Perhaps this is a big barrier. But I am overcoming it.
Persistence. Curiosity.	Number of hours in a day.
Persistence. Humor. Love of puzzles. Imagination. Good mentors.	Overcommitment.
Ph D education	Lack of institutional support
Realizing I didn't want to be a research scientist, and that despite not doing anything related to my PhD, my degree is a ticket to open many doors.	Not being: Male, ex-military nor an MBA. There's no question you have to be at least 2 of the 3. Not to mention being effectively fired [when] I had a child.
Scholarship with good specialists in the field.	Funding for postdoc projects.
scientific interest good colleagues and collaborators	lack of a competent research mentor early in my career
Strong basic physics and math background and learned problem solving and analytical skills. Creativity, teamwork, and persistense	Family commitments and obligations (children and two-career issues)
Stubbornness.	Biases within the system.

Success	Barriers
support from a good mentor relatively early on - and a mentor is a real supporter - not just something you can assign.	Isolation
support from colleagues	at universities: prejudice against women
Support from family and friends but not much help from scientists in the field. I would have grown alot more with the proper guidance. I am hoping that I can do for others what was not done for me.	Lack of interest in my career and helping me to set goals that would have given me the greatest opportunity to succeed in research and leadership.
Support from my advisor.	Find funding to support myself.
support from my employer [name omitted]	Individuals in supervisory positions that did not see my potential
Support from other scientists.	I do think that I have faced some ... some ... discrimination being female. I don't think I received significant enough training to deal with all male environments which in many cases I have had to work in. Even now, I am often the only female in most meetings. There is a different set of dynamics when it is a mixed group versus an all-male group.
Supportive colleagues	
Supportive work environment and mentoring	Established networks
Tenacity/stubbornness, working with excellent colleagues, good writing skills, joy in learning	gaps in education on certain subjects, personality (perfectionism, [health issue omitted]), constant need to write proposals for full salary, occasional encounters with sexism
The support of active leading scientists in the field.	The time I chose to stop my scientific career to build family instead of career objectives.
The support of my undergraduate and [name omitted] advisors as well as my parents and partner. Also the financial support of scholarships. If I wasn't able to get paid throughout my masters and PhD I would not have been able to continue in the field.	Some degree of sexism and xenophobia while studying in [country omitted]. Also the lack of funding available for hiring post docs. I have had a number of people say that they would like to hire me if they had money, but currently do not.
versatility and patience. Networking with colleagues	Gender biases. Lack of available jobs in my subdiscipline in my geographic area.
Very good mentors and the opportunity to submit proposals on my own and laboratory experience. Also, I have been on [number omitted] high-altitude balloon campaigns -- a great opportunity to learn how to do research science.	Began to write my own proposals very late in my career. The training for proposal writing was completely missing from my early career.
Wonderful thesis and post-doc advisors.	Too difficult to get research funding
working hard and not giving up	not sufficient funding available
working hard supervising open mind	shy and not social enough language is not good enough not write as much as I should be
Working hard. Sujpportive husband. Luck.	I can't complain.
Working in a large lab with easy access to lots of expertise in my field	It has been difficult to combine family and work. This career requires lots of travel (to scientific meetings etc.) to "stay in the game. Since having children I have traveled less and have become less visible."
working on the research topics that I am interested	Language

Success	Barriers
	Difficult to obtain funding having to relocate for a job
	Funding
	Lack of funding.

Responses from Men

Success	Barrier
(1) Being able to participate in research as an undergraduate, (2) being funded for a NASA GSRP, (3) having an excellent PhD adviser	Limited opportunity for direct involvement with space missions.
(1) I received a good high school education. I benefited from state and federal support for research and education in solar and heliospheric physics, as well as NSF, NASA, and DOD Research Opportunities,	None of any importance.
(1) the times (I matured in an era where there was more enthusiasm for space science than there is now), (2) the people (I was fortunate to meet and collaborate with excellent people)	(1) infrequent appropriate opportunities to propose (2) decreasing overall funding pools to propose to
(1)I have had a good education in nuclear physics and space-plasma physics. (2) I worked for a company that had a world class space-physics program and had more instruments in space than any other institution. (3) I used my knowledge of nuclear explosions that I acquired while working at Los Alamos to develop models of the trapped radiation belts produced by high-altitude nuclear explosions.	Even though I worked about 10 hours a day 6 days a week, I did not have enough time to address all the questions I envisioned.
1) Interest. 2) A very supportive boss/mentor, who gives credit to those responsible for the work, regardless of their position. 3) Being a research group that is an integral part of the scientific community. 4) Working on spaceflight instrument teams.	1) I do not have a PhD (I am rectifying that now) 2) I did not major in physics as an undergraduate
1) An excellent graduate education in theoretical MHD. 2) Freedom to choose my topics in my early career. 3) Long-term visits at other, often overseas, institutions.	None that were not of my own making or personal nature.
1) my own persistence, 2) several external mentors stepping in at critical moments with opportunities, 3) several program managers funding me at critical times during my career.	various layers of university culture not being familiar with the field nor willing to support it (at least initially). Lack of infrastructure to develop a program in an environment where such a program never existed.
1) Strong graduate preparation 2) Perseverance 3) Luck	Having an academic spouse and prioritizing my family (I'm not complaining, I'm happy with my choice)
1) Stubbornness. 2) Attention to detail. But had I emphasized the networking and hand-waving part, I would probably be further along.	Lack of networking, lack of project management opportunities. The best opportunities in the US seem to be handed out at the graduate student level: a foreign-born data analyst coming to the US after his PhD has a longer way to go (not mentioning ITAR and similar issues).

Success	Barrier
1. Outstanding mentoring at the graduate student and Post-doc levels 2. Timely & excellent opportunities with spacecraft mission data analysis as a graduate student (Pioneer Venus) 3. Exceptional opportunities with usage of government supercomputers (NCAR, NAS)	1. Lack of theoretical-specific academic positions for which to apply
1. Contacts within NASA 2. Ability to adapt to new and current areas opened in space physics	1. Lack of sufficient funding for data analysis
1. Fear of failure and a survival instinct, to be honest. 2. Support from a couple senior researchers who have provided some important opportunities.	I have one complaint, but it is significant: the frustration experienced with poor proposal reviews and/or funding decisions that appear to be arbitrary.
1. Insights and encouragements from my thesis adviser and postdoc mentor 2. A very stimulating research environment, with researchers working on many different disciplines. 3. Colleagues that are very accessible and willing to share ideas. 4. Interesting problems.	Resources and time stretched very thin by demands not necessarily related to research. Each of these demands are important for community or for personal research. But the accumulative effects, especially if coming constantly and/or simultaneously could be distracting and stressful, and negatively impact research. After all, the primary focus of a scientist should be science.
1. My career has benefited hugely from the lucky coincidence of being a college freshman when Sputnik flew. Financial support flooded in, unlike recent decades and decades to come. 2. I was lucky to be on one of the Skylab teams, well-funded, ground-breaking stuff. Early career arc was near vertical with so much unique data suddenly papers were accepted as submitted, and editors pleaded for more.	Lack of funding, especially competing for space weather funding in an organization staffed and run by meteorologists and oceanographers.
1. Strong support from my mentors (thesis, postdoc, and current supervisors). 2. To be part of a world-leading research group in heliophysics. 3. availability of funding, mostly graduate fellowships.	None
1. The need of my employer (NASA) to identify and understand the environment in which spacecraft operate and its effects on hardware and astronauts. 2. Tenacity and ingenuity in pursuing hardware development, data analysis, and modeling. 3. Encouragement and excellent mentoring from senior scientists and engineers at NASA.	1. Politics 2. Lack of adequate funding
1. training, support of colleagues, facilities, computer time, hard work, physical insight, luck	resistance to new ideas
1. understand the questions and issues that fit my expertise. 2. hard work and good results.	Language and cultural background.
A well known PhD advisor	Lack of brilliance
A broad educational background.	Inadequate operational funding. Agencies like to build facilities but have little interest in them afterwards.
A broad knowledge of physics and how it is applied. Having the capability to design instrumentation and do analysis to study physical systems.	Need for better networking opportunities.

Success	Barrier
A broadbased technical education with significant hands on experience and my strong interpersonal gifts.	Some of my personal choices about employment.
A certain amount of perseverance (or stubbornness). Being in the right place at the right time.	No great barriers I didn't really want to be an instrument PI. Preparing the winning proposal would have been a barrier.
A desire to have any project/organization that I am involved in succeed, and the courage to speak up when I find problems that may prevent such success.	There have been no barriers, only hurdles, including poor management and inadequate communications skills.
A desire to work with others and a willingness to share ideas. Opportunities to work on new missions. Excellent colleagues!	
A flexible, relaxed working environment, and knowledgeable and supportive colleagues. My own desire to do something different and not being afraid to stick my head above the crowd.	Limited funding availability, particularly the inability to apply for/receive NSF funding due to agency restrictions
A good advisor.	N/A
A good education and an invigorating work environment.	Old age.
A good education and working hard.	Getting external funding.
A good Ph.D advisor and graduate training. An ability to write in a clear and understandable way. Computer skills.	Lack of permanent jobs available. Unwillingness to move very frequently or to areas of the country that I find undesirable. Slowness in publishing/finishing research projects.
A good working relationship with my colleagues.	Congressional funding.
A large number of mentors at various stages of my career.	I have not faced any significant barriers, but needed to be flexible with where I was going to live.
A liberal arts education. A very good graduate advisor. A supportive family.	This is a very difficult and broad field and synthesizing all the knowledge and concepts necessary to make advances is a big challenge.
A NASA small explorer mission provided my first job opportunity as a postdoc. Winning a suborbital investigation was pivotal in landing a tenure track faculty position. My first successful launch was pivotal in earning tenure. Also, participation in teaching and E/PO early in my postdoctoral years provided experience that was very helpful to me in developing as a teacher. Now, another NASA SMEX is giving me my first co-I role in an orbital mission.	Broadly speaking, it is administrative difficulties that come with PI or Co-I work, ranging from ITAR to bureaucracy at the state level (I am at a public university). I accept that leadership comes with responsibility, but feel that too much of my time is diverted from scientific productivity.
A patient and interested mentor and sufficient funding.	
A strong science background from my undergraduate studies, coupled with analysis techniques learned in school and during my career.	Shrinking government expenditure on research coupled with a lack of vision for applying the results of research in the commercial sector.
A strong work ethic and good practical education, both academic and non-academic.	It has been nearly impossible to become a PI on anything.
A sufficiently broad educational base, continued learning, a willingness to be flexible in choosing research projects, and a commitment to making those projects successful	Funding difficulties

Success	Barrier
A very good thesis advisor. Being in the right place at the right time.	None
A very supportive mentor.	Trying to find my own scientific direction. What research questions do I want to answer?
A very thorough education in plasma physics, as well as excellent mentors at the graduate and postdoctoral levels.	There is a VERY strong resistance to new ideas in many areas of space physics, and I have fought hard against these prevailing (and often archaic) ideas. Without a strong backing by my mentors (who are in astrophysics and plasma physics), I would probably not have stayed in space physics. Unlike in astrophysics and plasma physics where new ideas and fresh thinking are often highly regarded, my experience in the space physics community is that many "experts"""" in the field do not want to consider new ideas. I do not know the underlying cause of these attitudes, but from personal experience I know that they are widespread in space physics."""
A wide range of experiences (instrumentation, debugging, instrument design, data analysis, science), the ability to learn new skills as needed, the ability to think outside the box	lack of funding sources.
ability to adapt and learn quickly	no barriers
Ability to address contemporary scientific problems, a critical mass in my peer community, mix of NSF and NASA opportunities, and a certain amount of luck.	As an investigator who collaborates with NASA suborbital rocket missions. 1) Availability of funds to support major instrument development. Issue is not just cost of equipment but also cost of personnel to do robust development and deployment (e.g., wind temperature lidars, high resolution radars). 2) Access to space is very limited.
ability to build things..experimental hardware..hands on experience	lack of PhD closes certain doors in academia....
Ability to explain complicated info in English.	The attitude that you must have a PhD to work in the field. Few people with technical credentials know how to lead.
ability to try new things and seek guidance/mentoring	lack of understanding of the difficulty of real-life problems by those in control of budgets and scheduling
Ability to work and perform all duties during my graduate years, design, electronics, computing, etc.	None I can think of
Ability to write, ability to network, luck.	Funding.
Academic advising in a research setting.	Unrelated and unmotivated education in the classroom.
Academic training in an excellent plasma physics department, and participation in active space physics research, from the beginning of my graduate studies.	Pursuit of funding for progressive scientific projects.

Success	Barrier
Access to successful (employed) space physicists who were willing to share the ups and downs of their career path and provide encouragement.	1) simply finding employment and funding in the field if you are not placed on the 'preferred track' to post-docs and tenure by management. 2) If you fall off the career path, e.g., but taking parental leave or missing a funding opportunity it's hard to get back on. 3) Year-to-year funding of multi-year projects, e.g. a space mission makes the required long-term planning difficult to rely on.
Access to thoughtful colleagues supportive management open access to various data sets personal determination.	Government bureaucracy lack of sharing amongst competing research groups restrictive usage terms of various upper atmospheric models lack of documentation and consistency in the application of magnetic coordinate systems.
Active participation in space weather operations while serving in the US Air Force, plus interaction with space physics research community during that period.	my job in industry offers limited opportunity to keep up with latest state of space sciences.
Actually, continued access to Arecibo Observatory.	Having a critical mass of associates and students in my department.
Adaptability and willingness to jump into areas of research that I'm not trained in. Grit and a high tolerance for pain.	Far too few positions available in my early career. Closed-mindedness of grant funding agencies when I was doing Space Physics (which I'm not anymore). At this point in my career, the largest barrier are too many calls on my time, from administrative overhead, that derail me from my primary research work.
Adaptability,support of mission scientists and collaborators	Constantly shifting priorities, resource limitations
adequate external funding from NASA (but now in serious trouble), laboratory support/resources and internal funding (but funding is also decreasing), outstanding colleagues at my institution, my own enthusiasm, a supportive family	No substantial barriers
Advice and support from collaborators, proposal writing skills and success in getting funding through proposals, ability to conceive new ideas and interpretations about how things work, social and leadership skills originally acquired from earlier military experience, personal commitment to achieving key milestones, PhD exams, proposal submission, publications, strong interests in cross-disciplinary research, e.g. astrobiology.	Negative attitudes from a very few senior scientists, NASA cancellation or deferral of mission-related projects that I and other had invested much time and effort in.
Advise from Graduate advisor, getting sole source contracts from DOD	What I want to do is often several years ahead of what the community is interested in doing
Advising and the faculty that surrounded my during graduate school.	

Success	Barrier
Although my interest in solar-terrestrial geophysics was very intense at an early age, my career in this field has been minimal my earning positions have all been in other fields. In fact, I never was supported for my PhD in space physics by the [omitted] I worked there as a "volunteer"" for four years, before finally going to [omitted]. I'm convinced that only a very few can earn a living wage in a space physics field now. "	Not enough job opportunities. Most of the funding is federal, and this funding is insufficient to continue basic research.
An active research community that makes opportunities for students to learn and be involved.	Lack of obvious channels for locating job opportunities.
An excellent education & an ability to write effective proposals	lack of colleagues at my university
An excellent education at good universities and the good fortune to obtain a postdoc and later permanent position in a research group that was at the forefront of solar and space research.	None.
An innovative mind and hard work.	No regrets that I created the position I wanted as a science entrepreneur.But in my early career the difficulty of finding a faculty position somewhere I wanted to live was frustrating.
An open mind.	None. I have been fortunate.
Apart from my own abilities, support from colleagues and the company where I work. Funding from NASA and NSF and the Canadian Space Agency.	Working on too many different projects at the same time. Over-commitment
Applying my knowledge of optics in collaboration with interesting colleagues.	Had to follow funding opportunities, but things seemed to work out. Having a broad range of interests and finding good people to work with always helped.
As a part of my engineering education, I have worked on problems related to atmosphere, ionosphere, magnetosphere and radar probing of these regions. About two decades ago, I switched from a research to a defense-industry career. I have found that the geophysics, radar and signal processing background acquired during my graduate studies and research work has allowed me to tackle some very interesting problem areas.	Switching between research and industry is like starting all over!
Association with NSO at Kitt Peak and Sac Peak and Goddard Spaceflight Center.	None
Attendance at a top notch university (U of Michigan), which raised the bar personally for me. It also helped to have the personality defect of trying to be an overachiever. Finally, time in the USAF refined my work ethic.	Idon't believe we are not given sufficient responsibility at an early enough age...and fewer mentoriing opportunities exist these days. It also doesn't help that the space physics community and universities primarily embrace first principles approaches, rather than a mix with data driven and adaptive approaches both on the academic and government sides.
availability of funds for basic research, especially for planning of space missions	Lack of funding for analysis of data obtained from space flights
Availability of good mentors and adequate funding.	Myself.
Available funding.	lack of funding.

Success	Barrier
Background/education, courage, luck, and very hard every-day work.	I left my birth country and had to start over my science career in the United States.
Being a competent researcher with strong programming fundamentals	People have no idea what I'm talking about
Being a part of a team (Air Force) and teaching at the Air Force Academy.	N/A
Being able to see the big picture, and work across "traditional"" disciplines. "	Work-family balance.
Being able to win my own science proposals. Also, by working with a small, dedicated team of scientists who are also able to win science grants as well as larger instrument proposals.	There are too few opportunities at NASA. There are also no longer funding opportunities from the military branches for science-based experiments on board spacecraft. Last, ITAR makes working with foreign space agencies difficult at best.
Being adaptable to apply my training to a very wide variety of problems and fields.	Inadequate preparation by graduate adviser for 1st job after graduate school.
Being associated with large spacecraft missions	Not having enough mobility for new opportunities
being at the right place at the right time	no major barriers
Being employed at a first rate research organization and collaborating with extremely talented scientists. Mentoring by more senior scientists was important in my early career.	Difficulties in obtaining funding for the next generation space based instruments needed to advance solar research.
Being flexible about research opportunities and surrounding myself with talented colleagues	Decreases in research funding and University politics.
Being flexible and having programming experience.	
Being flexible and not tied to research in one particular sub field	non-US citizenship and working at a national lab on space missions
Being flexible and successful at transferring skills.	Language (I'm not an English native speaker) has been one but not so much nowadays.
Being flexible in career goals	
Being flexible.	Running out of money on a particular line of research before the work is done.
being good at what I do	being taken for granted
Being in the right place at the right time to participate in significant exploration missions.	Largely self-constructed. I'm not a "climb the ladder"" sort of person."
Being in the right place at the right time: near the beginning of the civil space program. Being involved in both science and engineering throughout my career. Being in an environment that was problem rich, both applied and pure research.	None in so far as I can recall. I have been very fortunate over many years in having creative and collaborative and encouraging colleagues and collaborators.
Being inquisitive	No
Being offered unique opportunities	Unwillingness of established scientists to make space for new comers lack of ability/education/whatever
Being stubborn and just refusing to give up.	N/A
Being willing to change research topics. My degree was in solar convection MHD/dynamo theory. I am now working on coronal physics. I'll soon be working on chromospheric physics. Keep moving or you will drown .	I worked at institutions in 4 different time zones during my early career. This is very hard on family life. In the '90s there were almost no faculty positions in solar physics. I have always been on soft money. It is pretty stressful.

Success	Barrier
Being willing to take on challenges and work outside my "comfort zone."""	Lack of funds in the field, and the relatively small size of the community when competing for large projects. Lack of good students.
Blogging (seriously!)	Having kids.
Brains and luck.	faculty politics
breadth of interests, skills, and judgment in experimental and theoretical science.	No significant barriers until collapse of NASA and NSF grant funding beginning about 3 years ago.
Broad basic science education in high school and undergraduate program.	My own limitations.
Broad general training in physics, numerical analysis and software development. Willingness to work hard and start over in a new field when I had to.	Nothing significant.
Broad training and experience as a precision measurements expert.	NASA has failed to manage its Astrophysics Program to budget and schedule. This will decimate US participation in dark energy research, exoplanets and gravitational-wave astrophysics, as well as wreak havoc on the careers of researchers in those fields.
Broad training in astrophysics in general with a physics basis.	
Broad, interdisciplinary research interests. Successful proposal writing.	
Broadening my interests and experience rather than becoming increasingly experienced in an ever narrowing specialty willingness to learn new areas that may only tangentially relate to my previous areas of expertise willingness to do hands on work, ask LOTS of questions, and learn systems down to very low levels of detail continuous self-learning willingness to investigate entirely new technologies to improve current projects working as a member of teams rather than alone or only in a leadership role.	Not having education/training at the doctoral level family requirements and time commitments a great disdain for using "insider"" connections or backroom dealings to advance my projects or career."
Can't think of anything.	
Challenges to better understand the working of Sun.	
Close contact with research scientists at the national labs from undergraduate days	Weak appreciation of actual science/physics in the community
Collaborations with excellent colleagues	No barriers. Needless to say, some very excellent proposals that I wrote were not funded -- but the best ideas were eventually funded
Collaborations with other scientists. Increasing interest in space weather research.	Lack of support for basic research using analytical techniques. Heavy emphasis on engineering type projects rather than scientific discovery of how natural phenomena work.
Colleague and mentors in the field.	Not enough funded NASA missions to work on.
Colleagues and peers. My PhD supervisor ([name omitted]). The close collaboration between the University of Colorado's CIRES and the NOAA's Space Weather Prediction Center.	Initially the long process to get my USA residence and later Citizenship. The funding competition.
Colleagues at work, opportunities to attend meetings/workshops	

Success	Barrier
Colleagues in my research community.	Conflicting demands of a research-oriented career and family life. A research scientist must travel a great deal (to conferences, workshops, invited presentations, experimental campaigns, etc) and this is hard on family life.
College and post-graduate education. Self-motivation and dedication.	Communication skills and personality.
Combination of hard work and luck.	Don't know.
Communication and PR skills, beside doing good science. Working in the right places.	The ignorance about space and solar physics among most of the astrophysics community.
Competence, reliability, integrity, flexibility.	Not obtaining a Ph.D. Laziness. Easily distracted.
Computer skill	
Concentrating on actual research. Minimizing spending time in useless meetings.	Lack of permanent positions in my geographical area.
connections and networking with colleagues, curiosity and continuous learning	lack of good graduate students
consistency, job stability	scientists and engineers are sometimes difficult to communicate with, which prevents effective interaction with teams.
continued learning	too much proposal writing
Cooperation with the graduate students in my cohort at [school omitted]. Inspiration from [name omitted].	None significant.
cooperation, confidence, communication, action.	I am not sure.
Copious support from my advisors/supervisors and colleagues.	Mostly my own procrastination and lack of initiative.
Creativity, active, passion, getting along with other scientists.	Language
Critical thinking abilities.	Inertial leadership... not open to new areas of thought, and fixated on the differences between federal and private industry employees.
Cross-disciplinary knowledge in astrophysics and information technology.	Having to rely solely on soft money.
Curiosity	Available funding
curiosity	lack of teamwork and mentor-ship
Curiosity and a strong desire to learn new things...the internet is also instrumental in this process as well.	I have encountered very few if any barriers thus far in my career.
Curiosity and enjoyment of research. I wanted to understand how things work.	Bureaucracy
Curiosity, determination, hard work and long hours, good luck	
Curiosity, perseverance, hard work, intelligence, dedication to scientific integrity, and above all the guidance of mentors who embody all of the above.	Nothing major. Excessive bureaucracy, perhaps, and NASA's obsession with manned space-flight at the expense of scientific research utilizing robotic spacecraft.
Curiosity. Selection of relevant problems diligence in their pursuit.	Shallow-thinking management and/or their ulterior motives. NOT lack of funding.
Dedication	Changes of workplace

Success	Barrier
Dedication, perseverance, excellent mentors and supervisors, and a little bit of luck	No major barrier has hampered my career so far
Desire to be in the field. Also, a good general understnading of basic physics and engineering.	Some companies require a Master's degree for work in their R&D facilities. Without one, it is extreemly difficult to get past the HR filter regardless of the background/skills of the applicant. This is the primary reason for getting a Master's degree late in my career.
Detailed Physical Analysis Skills	Health
Determination	Lack of long-term NASA planning and funding (cf ESA)
Determination	That there are too many people looking for a limited number of positions.
Determination against prevailing ideas	Unwillingness to accept different ideas
Determination and a willingness to build consensus with partners	Space weather is a minor area of responsibility for meteorological service providers e.g. NOAA, USAF. Therefore it is continuously underfunded and under-resourced. This limits my ability to achieve my objectives as a specialist in space weather.
Determination and marginally adequate funding.	As an experimental space physicist, a lack of opportunities for space missions in my discipline has hampered my progress. Also, lack of coordination between NASA and DoD programs.
Determination and the ability to look at things differently.	Not sure there have been any barriers except for lack of time.
Determination and the support of my mentors.	Lack of visibility in a specific discipline due to broad research background. Not being a US citizen.
Determination, a willingness to work hard, and the support of my faculty advisors who always belived in me even when I doubted myself.	
Determination.	Access to funding for research.
Diligence, perseverance, ingenuity, ability to communicate, and the pleasure to explore unknown.	Inefficient and old management system and science discovery systems.
Diligence, perseverance, intelligence, faith.	It's gotten harder to get funding, so I need to spend increased time writing proposals.
Diligence, persistence, flexibility, dogged determination	I needed better networking skills with peers.
discipline and determination	ethnic background
Discretionary time to explore	Time consuming protocols

Success	Barrier
Disregarding the many disappointments, doing what I deemed necessary. Having a good PhD advisor at [school omitted]. Getting an Academy of Science postdoctoral appointment in a Federal laboratory. Attaining a physics professorship (even though in a 5th tier "teaching" university where most of my time goes to teach general education classes to unprepared and disinterested students who have to take this "awful and boring" science to fulfill graduation requirements...)"	Yes, many: Jealousy by colleagues much senior to me (I never retaliated), Incompetent reviews of proposals (as I myself clearly saw when I ran the NASA [program name omitted] program in [place omitted] in the [years omitted]), NASA waste of resources on make-believe hoobla "programs" at the whim of administrators who did not know anything better. Gross waste of fiscal resources: example: I could have traveled to a Asian city for $999 with 5-days hotel and one buffet mean per day -- but NASA had to use another external accounting institution (with another 200% overhead), and using high-cost airfare and very-high-cost hotel for a total of near $30,000. That one incident is TYPICAL of government waste. Having wasted so much, at NASA HQ we had to "explain" why there were so few and small grants actually funded. SEEING NASA FROM THE INSIDE WAS MOST REVEALING. "
Diverse background. I have degrees in EE, Phys., and math.	Written communication. Since English is not my first language, I have a problem selling my ideas in a written form. This was a major barrier for getting my proposals funded.
Diversity of problems	Funding, and expectation of administrators.
doctoral and post doctoral mentors, hard work.	None
DoD support and training.	Decreased funding.
Dogged tenacity and 60+ hour work weeks.	Managers with more interest in their own careers than in supporting the scientific creativity of their staff.
Doing science rather than bureaucra'z'y.	As soon as bureaucrats take over "managing"" scientific research, then there many barriers appear to ruin any science career."
Doing the kinds of things that I enjoy doing - having a job that I prefer to do.	Perhaps unwillingness to dedicate my time solely to career advancement.
drive, curiosity and a positive attitude	the recession
Due diligence.	Gaining internal support from my company that I am employed with.
Early exposure to space science research	We spend a lot time writing what we consider our master proposal (every time I do this I feel this way) and it doesn't get funded. I try three times but if it doesn't get funded I abandoned that idea but I can't recover the "wasted"" time."
Early in my career I had the support of my institution to branch out and learn new fields.	It is difficult to aggregate enough funding to cover oneself and a team to tackle challenging research problems. The success rate for proposals is decreasing and the amount of coverage available from each proposal is also decreasing. It seems harder and harder to persist on small grants.
Early research experience as an undergraduate, NASA funding as a graduate student, postdoctoral fellowships, NSF funding at FFRDC as a junior scientist.	Elimination of NSF base funding at FFRDC as a junior scientist, and lack of NASA funding opportunities for solar-stellar research.

Success	Barrier
education and mentors	unreasonable workloads at the university level...teaching, research and public service account for more than 100% of my workload and yet are required at this state university.
Education, general intelligence, communications skills	
education, success and enjoyment	too many other brilliant people in the same field
Education.	Funding.
Encouragement and support of colleagues. NASA funding (mostly from Chandra GO program) for solar system and stellar work.	Very few long term employment opportunities in Solar Physics. I was very lucky to get a faculty job in the field. No success obtaining NSF funding or NASA funding for Solar research projects.
Endurance.	Funding.
Enthusiasm	Few of signifigance
Enthusiasm for science. Supportive supervisors. Technical as well as communication skills.	Leadership skills. However, this is not from any lack or failure of education - it is more of a personality trait. Furthermore - it is not a significant barrier - I have achieved much of what I have set out to achieve.
enthusiasm, cross-discipline coordination and understanding	
ESA and NASA space missions, financial support, support and understanding from my family, support and advises from colleagues and employers	no barriers
Excellent advising.	
Excellent education and association with competent researchers who could win proposals.	NASA 'Old Boy Network" which retained control of flight opportunities for entrenched experimenters."
Excellent mentoring by my graduate and postdoctoral advisors, along with freedom to pursue research topics of interest. NSF CEDAR and aeronomy communities, and NSF support, have also made my career possible, from MS thesis research through postdoc and present support.	I am extremely grateful that my career has progressed smoothly to date, although my research efforts have sometimes been slowed by other obligations and limited time.
Excellent mentoring Dedication Luck	Potential lack of funding
Excellent mentors and opportunities.	Increasing bureaucratic burdens by funding agencies that consume time from research without adding significant value.
Excellent mentors, a lot of work, working on big problems when the time was ready for them, being at the right spot at the right time	So far I was lucky and did not hit substantial barriers
Excellent mentors.	Limited funding opportunities.
Excellent supervisors	Relatively few job opportunities
Excellent teachers and university environments	Less university industry interaction than I would like.
Excellent teaching and support.	Delays in proposal considerations.

Success	Barrier
Excellent University instructors. Strong, well-funded helpful mentors. Long-term, steadily funded missions, primarily Galileo and Cassini. Flexible career plans, and a spouse willing to travel.	Overproduction of PhD scientists has created a situation where maybe 10% of proposals are funded. There are a handful of hard-money jobs created each year, and these are mostly for people who want to produce additional PhD scientists to add to the glut. (I was very fortunate to find a traditional science teaching job that lets me do research and that does not require an endless stream of proposals). Our field urgently needs steady jobs, probably civil service slots, so productive people aren't forced to re-apply for their jobs 5 times a year, which is an incredible waste of time and talent.
Excellent writing skills and the ability to clearly and simply explain things to my colleagues who are not experts in my particularly subfield.	
Excellent,broad education in physics, both undergraduate and graduate and opportunity to personally participate in space physics experiments	None
Excruciatingly hard work	Limited career opportunities and research funding.
Experience, success in obtaining and explaining space data, support from capable colleagues.	None
experienced and willing mentors	Coming from an outside field. The space science community is generally closed and fairly incestuous. Researchers are fairly intolerant of hearing solutions to their problems that do not come from inside the community, even if they are well known outside it.
Exposure to widely diverse topics and deep concentration in primary areas of physics, math and computer science.	Financial support of basic research. Few companies currently engage in "basic"" research--that is left to the National Labs and academia. Budgets everywhere are tight and only projetc/problems with more ""immediate"" needs can be addressed."
External support for graduate education. Connections of graduate school factory to Government entities supporting the field. Attendance at relevant conferences.	Stovepiping of US efforts in Space Weather.
Extremely good mentoring and advising.	None.
faculty support	very high expectations
Family support and encouragement.	Limited funding and opportunities.
Financial support and determination.	Obtaining funding. Obtaining data.
Finding faculty willing to supervise my research as a student and postdoc and being rather successful in obtaining funding from NASA in my early career as a postdoc.	Having to work to put myself through school as an undergraduate. Having enough time to carry out research as a university faculty member and administrator.
First and foremost: being open to research possibilities. Second and a very emerging item for me: actively seeking out collaborations to build our local expertise. My university has no prior experience in solar physics, but I've decided to build the capability to conduct solar physics research out of my own interest.	Time. Time commitments for a university professor are many. The requirement to teach and perform service functions is a strong barrier to conducting more research, which is what I would prefer to do.

Success	Barrier
First and foremost: good mentoring. Excellent foundational education in writing/grammar. Seizing opportunities when they present themselves -- no fear!	N/A
First it was excellent teachers in my undergraduate physics program. In graduate school I got lucky and worked with an advisor who deeply cared about encouraging both my research and career progress.	I met my wife just after beginning graduate school in and was married a few years later. About halfway through my PhD it became abundantly clear that choosing an academic degree/career was extremely limiting in terms of job security for the next 10 years (i.e. needing 1-2 postdocs before even thinking of a tenure track job) and even more limiting in terms of being able to live in a desirable location. This didn't matter much going into graduate school but does significantly now that I have a family.
First, as to the last question, space physics did not exist when I was in graduate school. For this question, the luck of being in space physics early.	Nothing much
Flexibility	Funding
Flexibility	Well, I left space physics 11 years ago. This was an enormous disappointment. It was simply too difficult to support a family on one post-doc salary. Now I work in the financial world, but I miss physics.
Flexibility	
flexibility and ability to learn quickly good software skills good communication skills confidence	low selection rates for proposal opportunities
Flexibility and pre-existing knowledge. I came to physics with an extensive background in computer science and IT. Much of my productivity comes from knowing easy solutions to problems outside of the domain of most physicists.	My previously acquired skills have kept me so busy that I've had a hard time dedicating enough time to focus on academics and moving forward with a PhD.
Focus in my field of interest - physics.	nothing.
Focusing on doing publication quality work and limiting effort in E/PO and other activities	Funding
Fortunate encounters with suitable mentors, mainly my thesis advisor and my first "boss"" when I took a position in industry."	My own personality. (I am too reticent about speaking up with contrary opinions or my own ideas.) Shortage of academic positions.
Funding for research.	
GEM	supervisors who rather have you as a work slave than helping you in your career
General education provided by physics curriculum. Flexibility to approach very diverse set of problems.	Constant struggle for funding.
Generous and wise mentors. Determination and perseverance.	Difficulty in obtaining adequate funding, largely due to inadequate levels of funding at NASA and NSF.
Getting into the field at the start as a theorist and staying ahead of measurements	None really, I've been quite fortunate in pursuing whatever has interested me
good (universal) education,persistence, curiosity	none
Good advisors and mentors have been the most helpful.	
Good advisors and mentors.	Poor supervisors within research institutes.

Success	Barrier
Good and generous mentors.	People with little talent and great ambition.
Good basic physics education. Good writing (still trying to improve)! Recognizing that a proposal is a totally different thing than a paper. Basic career advancement skills such as writing a resume and interviewing. Even though I have never formally interviewed for any professional position I have held (always knew my employer beforehand), the concept of impression management is extremely important in places like meetings. Public speaking.	Lack of mentoring with respect to career skills in graduate school: I was not encouraged to write papers, I was not encouraged to write proposals. My writing skills took a long time to develop. My thesis project turned out not to be a growth area (though I am still pushing proposals at NASA!), so I had to start over in a new sub-field after I graduated. My thesis project was a space mission with a 20-year timeline (blame the Shuttle), for which I finished the analysis. There was only 1 major scientific publication on the results of that project (so far). The first author was (naturally) the PI. As a result, my first first-author paper was from work I did in another subfield 3 years after graduating (11 years after entering grad school). Hopefully I am a "late bloomer!"""
good choices	have not been many. probably too many interests.
Good colleagues and support staff plus an relatively stable funding environment.	Time ...... not enough of it to do everything.
good colleagues, good project choices, decent institutional support	Proposals not funded because it seems too large a step, and/or hasn't been done before
Good communication skills Good closure skills (writing papers) Support and collaboration with colleagues	Lack of sufficient available funding Lack of undergraduate students in solar physics
good contacts formed early in career (e.g. early 1970s AGU meetings) flexibility and curiosity - willingness to move into new research areas	none, really - I've been lucky and have enjoyed a fully-employed, rewarding career
Good education. Learning English from early on. Earning a Ph.D. from [school omitted]. Being good at what I am doing. Finding good collaborators.	Not being a PI on any major grant. This limits my ability to determine the direction of research and to hire good people. On the other hand, being a PI requires a lot of investment and administration which would take away a lot of time from research.
Good financial support, excellent colleagues, superb data	None really
Good financial support, good instructors and mentors, good balance in life, good motivation to succeed, good curiosity to seek answers, and a few good beers (not necessarily in this order) :)	My biggest barrier is the lack of success in external funding for my research. Of course it is very competitive, and I need to improve my publications. I would like to see more funding for analysis of NASA mission data. I would like to see mid-level grants awarded, say $50K - $100K.
Good fortune to be with a yeasty mix of folks	none
Good fortune, good colleagues, and good friends.	Funding and the time required to obtain it.
Good friends	My own inadequacies
Good graduate formation. Niche specialization and support from my post-doctoral supervisor which allowed me to get successful awards early on.	Small research institute in my field. Hard to make collaborations. Hard to be Co-I on proposals from people from other institutions. Lack of understanding of what makes a successful proposals until I served in my first panel.
good grounding in physics	

Success	**Barrier**
Good grounding in physics, math in (non-US) high school. Excellent university education (BSc) at highly rated (non-US) institution followed by post-doc that covered several areas of space/magnetospheric physics and helped to make contacts at other institutions, which led to employment at NASA as a contractor. Fortunate to have been able to propose and obtain multiple grants to cover salary (as Co-I with NASA PI), though the situation has become more difficult in the last year or two. Interesting and fruitful collaborations with other researchers at NASA and other institutions.	Non US citizenship then, having gained citizenship, a change in NASA hiring policy favoring recent PhDs rather than more established researchers blocked an opportunity for a civil service post that was on offer. Being a NASA contractor employed by a University, tend to be treated as a second class person by NASA and the University. In particular little opportunity for promotion in the university system. Hence, university rank (assistant research scientist) has little relationship to scientific productivity (~150+ published papers). Chose not to move around and pursue alternative employment/opportunities because wife has (or had!) a better paying job on a high-profile NASA project, and because of her local family ties.
Good institutional support.	Lack of leadership training in early career.
Good managers who know how to submit and win proposals, excellent coworkers with whom I get along and with whom I can do great work, and competency and strong work ethic in getting quality work done. Let us not discount luck that mostly kept me employed.	Brief stumbling block (of 3 years duration) when tenor of government funding for my private industry work departed from my field. In other words, an interruption in desire and willingness to fund my area of research.
Good mentor as thesis advisor.	no
Good mentoring	None.
Good mentoring and a stimulating work environment.	A dearth of faculty positions for those with a solar physics background.
Good mentoring and people who like working with me.	not getting Ph.D, joining a failed start-up computer company, joining an environmental analysis company before coming back to astronomy
Good mentoring during graduate school and during postdoctoral years.	Increasingly difficult channels of funding and fewer opportunities to propose for funding.
Good mentoring with opportunities for science and management.	Extraordinary time spent on proposal writing.
Good mentoring, entrepreneurial efforts to get funding, hard work	significant opportunity cost in getting funding, NASA canceling of several missions right at point of launch
Good mentoring, opportunities to work on flight programs.	Lack of sufficient opportunity to lead Instruments on flight missions.
Good mentors	
Good mentors (engineers, scientists, and managers), counseling and therapy, choosing to persue instrument design and fabrication over observational work.	Insufficient flexibility in job titles at [school omitted].
Good mentors and strong funding	None
good mentors funding	funding
Good mentors in the field.	Poor funding and, recently, no leadership from above.
Good mentors in the start, good research partners thereafter. Created a good name for me and my company that others want to have us involved.	Funding
Good mentors, hard work, and most of all, luck.	My own scientific limitations. But not many "barriers"", except for lack of positions."

Success	Barrier
Good mentors, rigorous education, luck	Lack of positions, balancing family-work and having to move around
good mentors, strong background in physics, open and inclusive management techniques	none
Good mentors. Imagination.	Insufficient funding. Too few missions. There is a need for more small missions instead of mainly the grand, every ten years, missions. NOTE: The above does not give a complete picture of my research as two substantial (multi-million dollar) instrument projects, one where I was PI, the other Co-I, were jointly funded with or through NASA by other agencies (NOAA and DoD). I did not include these in the mission section and the best I could do was a WAG on the percent NASA supported.
good mentorship	difficulty in getting funded
Good mentorship and good opportunities for funding and collaboration.	Proposals getting rejected for ridiculous reasons, mostly due to people who are outside our field who review such proposals, that do not understand the content in any depth.
Good mentorship and hard work.	
Good mentorship during my early career - especially from my postdoc advisors and first supervisors. Also received considerable mentorship from a more established scientist who took an interest in my research, and taught me a lot about formulating more ambitious ideas, and how to write effective research proposals to sell these ideas.	The cost of doing research have gone up considerably, but budgets have not kept pace with this inflation.
Good mentorship, personal persistence, and an understanding of the fundamental principles and critical thinking that was taught and encouraged during my undergraduate career.	A lack of teaching and university research positions that keep in mind that experimental space research may not yield as many papers as theoretical work in the area, or work that relies on experimental data of others.
Good partners and luck. And funding from NSF to develop space missions.	The infrastructure required to build space missions is large. Getting a subset of that running in a sustainable manner so that education, research, an flight can occur is very difficult. And a prime challenge is funding. Our industry/government partners take a majority of the funds. In my opinion, there is efficient use of space-dedicated funding to centers.
Good preparation luck	employer culture funding
good support as results of cold war. Right choice of location and colleagues. Good background and ability to take advantage of opportunities. Much support from faculty colleagues.	My own psychological limitations and my desires to do other things than work.
Good support from supervisors	
good thesis advisor	not enough funding
Good training and advisors.	Sidetracked by other duties.
Good training in basic physics and a period of healthy funding for reseasrch.	My own personal limitations in the pursuit of physics.

Success	Barrier
Good training in general physics, plasma and space physics theory, and methods to solve partial differential equations numerically and analytically. Support of my research from my fellow space scientists in scientific journal reviews, proposal panels, and with funding. Encouragement by my Ph. D. supervisor to present research results at international conferences and in international scientific peer reviewed journals during my Ph. D. studies, not to mention guidance on how to do research. Encouragement to submit proposals by my first postdoctoral supervisor. The opportunity to cooperate everyday with some of the best space physicists locally when I go to work everyday.	My own personal limitations in terms of ability and personality.
good training in undergrad, grad, postdocs	
good undergrad training in physics an undergrad research position, which resulted in additional mentoring beyond the classroom REU experience after graduating then excellent graduate training and finally access to NASA funding for Guest Observer programs on a variety of solar and stellar missions, and success in obtaining NSF funds to support ground-based solar work.	no major barriers so far.
Graduate advisors (research, thesis). Supervisors for my postdoc. Colleagues.	Apparent lack of open faculty positions in my field and at colleges or universities where I would like to work. Apparent lack of small grants to which I believe I could apply successfully, or lack of time to pursue such applications given that I am already supported well by my supervisor(s) to do current work.
Graduate coursework in mathematics.	Extremely low pay for postdoc. Extreme difficulty in getting a tenure track faculty position.
Graduate school professors serendipity (chance favors the prepared mind)	None
Great advising and research in undergrad. The welcoming environment in solar and space physics. The high density of related research in [place omitted].	Graduate research advisor isn't very supportive of my desire to become more integrated into the community as a whole. Time management is also a challenge as a graduate student, but that's not news.
Great advisors and mentors	lack of knowledge about job opportunities and career paths. I think grad. schools need to do a better job of informing students about alternate (non-academic) career paths
Great colleagues and teachers	Only real barrier, which we all much junp over, was a rigorous geaduate education. But I had none of the barriers our society imposes on, say, minorities and women.
Great graduate advisor.	Arcane promotion rules. Our lab's rules are written to mirror faculty promotion guidelines, so they do not quite fit the description of a soft-money researcher like me. It was a challenge to make the promotion committee see my accomplishments in the right light, but eventually I succeeded.

Success	Barrier
great interest to Science	difficult to find a steady position
Great mentors	The past 15 years has seen considerable decline in the support of the Federal government for science and engineering research and education. Not at all the same as my early career.
Great mentors, networking with professionals through conferences such as the AMS National Conference, Space Weather Workshop run by SWPC, Northeastern Storms Conference etc. A great scientist is formed everytime a good scientist takes a mentee under their wing.	Money. This is an obvious yet unfortunate truth in our society today. My undergraduate degrees are in Meteorology and Applied Math, while currently I am pursuing a Master's of Space Physics, so the change in focus between undergrad and graduate studies has been a barrier as well.
Great mentors.	None
Great students at my institution.	None
Hard and careful work, association with competent colleagues, continued funding	Too many other commitments in the University
hard work	adequate funding
hard work	n/a
Hard work	Red tape
Hard work	senior scientists that are checked out
hard work	spoken English language
Hard work	The changing NASA long-term policy
Hard Work	
hard work	
Hard work & willingness to learn	None
hard work and a little luck	did not receive as much mentoring as I could have.
Hard work and analytical skills.	Language and cultural background.
hard work and coming up with the right questions that attract funding	too little funding, poor/no mentoring
Hard work and confidence on myself	Hard to define
hard work and connections.	Funding
Hard work and curiosity.	Funding difficulties.
Hard work and curiosity.	Keeping up with a research field well enough to pose new problems.
Hard work and good connections.	Out of date policies at my institution. Lack of available resources from funding agencies.
Hard work and good luck!	None
hard work and good mentors	none
Hard work and grasping opportunities as they arose	Limited job market in particular cities
Hard work and long hours. Also some luck. Forming collaborations with other competent people.	None that I can identify. Mostly of my own making.
Hard work and luck?	
hard work and network of supporting people/scientists	funding and lack of more permanent positions
hard work and staying focused on big picture	institutional politics

Success	Barrier
Hard work and the skill to captalize on lucky breaks.	I have never worked in a strong research group. I was always isolated or had my own small group. The strongest groups get the big opportunities.
Hard work and the willingness to try new ideas.	To much unnecessary paperwork being used by NASA today. I understand the need for traceability etc. but the overwhelming need by the current NASA system for paperwork is harming the very reason the space work began. I began working on space projects with the Apollo mission and I cannot imagine us getting to the moon today with the layers of paperwork required for any mission we currently fly.
Hard work and unwillingness to give up.	The funding situation for the most part. I have not received support from my PhD dissertation supervisor.
Hard work breadth and depth of support from my institution	Too few flight opportunities and NASA's habit of choosing PI's from a short list of previous PI's.
Hard work!	Age discrimination.
Hard work!	Nothing in particular.
Hard work, brainpower.	None
Hard work, flexibility, the ability to learn new skills, and to juggle many different projects at one time.	10 years ago, my career was a bit stalled by the fact that I was a long-term soft-money scientist with NASA, and was unable to propose as PI. I went to NASA [facility omitted] to break out of that rut, and that was successful.
Hard Work, good opportunities for doing research, people skills	none
Hard work, good training.	Funding hard to get.
Hard work, intelligence, a good "nose"" for what is important"	The usual bureaucratic nonsense, especially the erratic way the government makes funding decisions.
Hard work, luck, and a positive attitude.	
Hard work, maybe talent	
Hard work, mentoring by others, and luck.	Unpredictability of grant funding does not help.
Hard work, past and continuing education, mentoring, contacts and connections	None really
hard work, skill, ability	
Hard work, sticking to my goals	The limited number of mission opportunities
Hard work, strong support from my advisers and mentors, and the generosity of my collaborators	None
Hard work, teamwork	none
Hard work, willingness to learn new topics, assistance from colleagues and associates	Excessive administrative tasks.
Hard work,commitment to personal goals and family support	None, I had a rewarding career
Hard work.	Ever more challenging funding environment.
Hard work.	Ignorance by many others.
Hard work.	Limited funding.
Hard work. Good mentors.	Bureaucracy

Success	Barrier
Hard Work. My mentors tried to ruin my career and keep me out of the field.	The Principal Investigators that were assigned as my mentors and advisors.
Hard work. Vision. Good luck.	No
hard working	not easily recognized/ communicating with established figures in the field.
hard working	
Having a broad background and willingness to try and learn new subjects.	
Having a faculty appointment at a PhD granting institution.	The difficulty of coordinating family time and professional time.
Having a goal.	Regulations, administrative hurdles, and wrong judgment.
Having a strategic plan for pursuing research, as well as previous mentors, colleagues, students, and some luck.	Early on was a lack of a good senior mentor on the non-science aspects (proposals, contacts, agency politics, etc.).
Having an engineering degree to fall back on as space physics budget cuts unfolded. Having had a position with an Air Force space physics group that still had some of the aura of its glory days. Having worked in one of the preeminent space plasma physics groups in graduate school.	Diminished collective U.S. national interest in keeping space physics programs alive. Disconnects between applied research and pure research in the field. Research community lack of interest in sensor technology and space technology development as standalone research.
Having good ideas and being able to execute them, Making strong relationships with influential, like-minded technocrats, staying away from political power struggles tangent to scientific progress.	In a declining financial support environment, increased accomplishment can only happen when efficiency increases. Instead, scientists and engineers are compelled to spend time on increasingly inefficient government and institutional processes.
Having good mentors and development of contacts within a NASA Center.	My lack of agressivenes in persuing working relationships with personnel at other institutions. I should have attended more scientific meetings in the past.
Having had the opportunities to work hard and doing so. Mentorship, especially in research practices, paper writing, and grant writing. Keeping up with the literature. Going to conferences and talking with people to come up with research questions that are of interest to the community. Availability of funding. And luck.	Moving between many different places at different career stages is emotionally draining and has made me consider leaving research in the past. I'm also overcommitted and split between too many different projects. I've lacked mentorship for certain parts of the research process that people advising me have not been able to help with much. I'm entering a soft money staff scientist position soon and will be required to eventually fund large parts of my own salary.
Having multiple degrees - BS in Physics, MS in meteorology, and PhD in Atmospheric Sciences. this has enabled me to draw funding from NASA's earth and space science programs, in theory, observations, technology development, and over the range of the entire sensible atmosphere from troposphere to upper thermosphere and everything in between.	NASA center and directorate management who are no longer technically proficient and do not understand science nor are they capable of competently judging between competing ideas for future work. Twenty years ago all branch and directorate management were also practicing scientists. Now none are, and some are even MBA's who have no business (pardon the pun) making technical decisions.
Having secure positions throughout my career	none

Success	Barrier
Having well-known and often cited publications.	Too little funding. Too many proposals turned down due to reviews with incorrect statements. Review panel system that does not work. Coin toss would work better. Very poor mentoring and supervision at one prior employer.
Help and advice from colleagues	no formal PhD education in space physics
Helpful and supportive colleagues Luck.	Funding short-sighted NASA administration, especially with regard to "targeted"" or ""engineering"" programmatic goals at the expense of working toward scientific understanding."
Helpful mentors and colleagues, crazy single-minded dedication to work, too many too-long days, stubborn and perhaps stupid perseverance, and what I think is probably sheer luck in getting funding.	Lack of understanding and penetration of old-boy networks at government agencies and laboratories, difficulty/impossibility in creating positions for new faculty at my institution, institutional bureaucracy inhibiting progress in funded research projects, lack of consistency in federal funding of research.
Helpful mentors who were generous with their knowledge and time. The educational background I received in my physics and astrophysics studies. A willingness to work hard, well beyond a 9-5 schedule.	None more important than my own bounded skill set.
high level of education and curiosity	
High level of support and encouragement by peers	lack of formal training in space physics
High pain threshold, strong focus on scientific results, imagination to see where the field is heading, good luck, outstanding students, access to exceptional facilities....	Limits on personal energy.
Humor. Excellent thesis advisors at the [school omitted]	Bureaucracy and paperwork. Overemphasis on processes rather than product.
I am an military/airline pilot and do not receive income from my work in this field.	
I am lucky to be working in a unique laboratory environment that addresses the fundamentals of electromagnetic packet propagation. Also, my mentor has been recognized the contributions and has always been fair in the "author order"" in our publications."	The collapse of the Soviet Union led to postdoc jobs going to former Soviet scientists. It was a classic supply-demand problem: very capable and fully trained scientists became cheaper to hire and were more productive than green, wet-behind-the-ears American postdocs. Consequently, universities are now faced with a gap in expertise: the old generation is retiring and the faculty is filled with professors at the beginning of their careers. The new barrier is the loss of funding for basic research and the emphasis on funding large "collaborative"" projects. There is no more funding for small groups. Plus for years, there has been a reluctance to fully fund researchers in the belief that they should have gotten faculty positions. Yet, the bulk of the work is done by researchers but agencies are reluctant to fund more than two-months salary at a time. This means that researchers have to have 6 grants going simultaneously. This is just not possible."
I am not a solar and space physicist.	I am not a solar and space physicist.

Success	Barrier
I am not working in the field I trained in, solar physics, and have not for 35 years. I discovered while teaching undergraduate physics and undergraduate and graduate astronomy at a university that I was not suited to a life in academe. Since then, I've been working in a variety of fields related to modeling and simulation in satellite orbital mechanics and analysis of gravity fields of the Earth (physical geodesy), and related software development. I have almost no formal training related to my present work, but the years I spent in college and graduate school taught me how to educate myself in fields new to me, usually with the help and guidance of co-workers.	Most of the work I've done in the last 35 years has been on U. S government contracts held by aerospace industry employers. The ups and downs have all been related to whether or not contracts in my area of "expertise"" were awarded to my employers and funded. "
I believe that my strong undergraduate education, especially the mathematics, gave me the flexibility to work in a variety of fields.	poor management and academic politics
I believe that very good high school math and physics teachers started me on a successful career. I feel like my undergraduate education was very good, and I had a very good advisor for my doctoral dissertation, although he was not actually a faculty member at the university which conferred my degree. The mentoring of several more senior researchers in my field has also helped since I completed my last postdoc.	I would very much like to be employed at a university, with a greater opportunity to teach and interact with students. I feel like there is a lack of support for those kinds of positions. In addition, although a substantial fraction of my support comes from NASA, the process of getting funding from NASA is not efficient, including the extreme delays in obtaining funding and the reporting requirements. (In these regards, I find the NSF to be much better.) I have also been involved in writing pipeline code for the [omitted] mission, which I believe has turned into a detriment to my career. The development of the code has not been adequately supported, and it has been poorly managed, so that I have wasted substantial amounts of time on it, with no tangible results.
I benefited by being able to work on instrumentation and data analysis as an undergraduate and graduate student.	Professional jealousy
I can't answer this fully but it includes job opportunities, colleagues, mission involvement, data availability, mentors, education, professional development, etc.	There have been challenges but no insurmountable barriers.
I currently assist others with their proposals in all fields of space science. My special talent for this application is the unique interdisciplinary breadth of my career area - space physics. This skill has been substantially enhanced by my parallel background in philosophy, which contributes to critical thinking, methodology, creativity and innovation, and sustained attention to human issues of ethics, values and meaning.	I was drafted out of graduate school during the Vietnam-war era, which delayed my PhD program by several years. Then, substantial reductions in space science research funding and available positions in the 1970's (past-Apollo reductions) and early 1980's seriously limited career options.
I do not do solar or space physics in my career but I work at a location that does this. I am an IT person.	
I don't believe I've been successful in my career up to this point.	Education. Poor skill set. Poor supervisors. Lack of focus. Fear.

Success	Barrier
I don't feel I succeed.	I have not participated in the main stream (topics, instruments, etc.)
I don't understand the question.	Mostly the temporal limitation of post-doc contracts and the lack of a sufficient number of available permanent positions (note that this refers mainly to Europe I did move to the US only one year ago).
I had a solid laboratory physics education, and then I had the chance to transition into space plasma physics at a Max-Planck-Insitut. I had a good mentor and excellent engineers, when I took the challenge to build my first space instrument.	
I had some good mentors, but more importantly, I had an extended period of reliable funding that allowed me to engage in methodical study. Such niceties are rapidly disappearing. Too often, the next grant is what consumes one now.	A glut of university professors when I started looking for work. So, I had to be outside a university. More importantly now, the constant need to sacrifice one grant for the pursuit of the next one. Funding mechanisms are totally screwed up.
I have always had good mentors and managers at work. Up until recently I worked for a company that was serious about being in the space science business. That has changed recently as my company was bought and has reorganized.	Current barriers include the company's diminishing interest in pursuing NASA business.
I have had the fortune of being mentored or being surrounding by scientifically talented individuals.	
I have left space physics I suspect any answer I would give for my present field of study (high energy density physics and laser plasma interaction) is not a relevant question for a survey in solar physics.	
I have not selected either solar or space physics as a career, and am surprised that the survey did not check this point at its onset.	Budget shortfalls.
I have not succeeded in my career. I am barely holding on due to blood-mindedness.	Lack of funding, political mismanagement and the "jobs for the boys"" culture."
I have worked in many fields, not just solar. I have worked in the GR, fusion program, space physics, astrophysics, and solar. Where my interests led me I worked.	Most of the barriers I have had to deal with have been associated with bad decisions by senior NASA management or DoD management. Usually they involved poor judgement concerning the scientific purpose of a mission or a project. For example, NASA cancelled a number of programs which had involved a significant fraction of my professional career and that of my PIs. Now NASA is doing these same missions for considerably more $. I'm glad I have a board physics background and can move around easily.
I left solar physics as a career about 15 - 20 years ago.	Not exactly a barrier, but more interesting work elsewhere.
I like space science.	No any founding since 2007.
I love my work	Difficulty in getting funds. Same as everyone else who answered this survey. Thank goodness I dont have to rely on NASA funds and never did

Success	Barrier
I love the work and I'm not without some skill in doing so. Excellent colleagues. Family support.	I wish I had more time to do the work. Personal conflicts, family obligations. Grant writing with low selection rates slows things down.
I ma not sure how to answer this question. I am in a mainly teaching position now, but I do research with students, so my research background is a key to my success.	Nothing unusual. I got stuck on my thesis research at various points. Tenure came relatively painlessly. So far so good.
I say interest and hard work. Others say I was just born with the talent.	?
I started out as an R&D manager in the US Air Force, then started working on a NASA project at a university as a subsystem manager prior to moving to NASA HQ.	None.

Success	Barrier
I think the main source of success in my career has stemmed from a couple of things, each of which have further branches/sources. The first source is opportunity. I had the opportunity to earn grants/scholarships to college and I succeeded in doing so. Once in college, I was again given the opportunity to earn an appointment at a university for a doctoral degree. Again, I was successful in earning that opportunity. In graduate school, my undergraduate thesis advisor's former doctoral advisor gave me another opportunity for a summer research position. Once again, I capitalized on the opportunity given to me. The second source of my success has been hard work. When I entered graduate school, I had no illusions about my intelligence or capacities. I knew the only thing I had control over was my work ethic. I knew I could work harder than any of my peers, and I did so. I worked 100 and even 120 hours per week at times during graduate school. I worked harder than my peers and I earned a permanent position directly out of graduate school at NASA [omitted]. All of the opportunities that I mentioned previously were dealt with in a similar fashion. I was given many of the most important opportunities in my life because I worked so hard. The third source of my success is definitely my doctoral advisor. I quickly found that I was well ahead of my peers when attending conferences or meetings. I was not only more aware of the topics being discussed, I was able to participate in discussions. She helped me to write a successful NASA Earth and Space Science Fellowship proposal, which paid for three years of my graduate career. She has also been instrumental in helping me to write all of my peer-reviewed publications. The last source of my success is curiosity. I am specifically referring to the curiosity that provokes one to ask questions. I have never been afraid to ask questions. Though I often assumed that I was making a fool of myself or convincing my peers of my ignorance and stupidity, I have found that my questions had the opposite effect. Asking questions also has the adverse side effect of making you stand out in a crowd. This, I am sure, has led to numerous opportunities that I may not even be aware of. In short, my curiosity and work ethic led to my having numerous opportunities, which were increased and capitalized upon by having a very successful doctoral advisor.	I think the most prominent barriers in my career have been psychological. [omitted] As you might imagine, my experiences have had negative consequences on my psychology. They did teach me an important lesson though that when it comes down to it, you are truly on your own. Most people I meet never learn that type of self-reliance, let alone have it thrown upon their shoulders when they are two. So while these experiences have caused significant difficulties in my capacity to concentrate, they have also given me incredible independence and a high threshold for pain. I am inclined to think that these experiences have helped with my work ethic."
I wa fortunate to have a great scientist as my PhD Thesis adviser.	Nothing particular.

Success	Barrier
I was able to obatain an excellent postdoctoral appointment. I was able to obtain grant support from NASA and NSF, early and often. I got involved with some new NASA missions that provided support, visibility, and data to analyze.	Lack of new space flight opportunities.
I was able to start working in solar and space physics after having worked for many years on plasma physics and the fusion program. It was critical that the NASA proposal review panels were willing to fund a person who was somewhat of an outsider. This gave me entry into the field for the first time and I have now been a major contributor to the field for many years.	The funding levels for NASA and the NSF have been static with the result that much more time has to be spent on writing grant proposals. The success rate for NASA and NSF has been dropping. Canceling a program like the NASA GI program in 2010 causes severe problems, especially for younger scientists. The small amount of funding that goes into R&A should not be used to solve NASA's larger scale funding shortfalls.
I was formerly an astrophysicists workng with COBE and other mission data, but ca 1996 opportunities to continue my research in these areas as a full time researcher declined markedly, so I adopted half time education (IMAGE mission) and half time research (NSF grant), which later evolved into full time education work and successful grant support.	Lack of an academic position.
I was fortunate to be a part of the TIMED/GUVI mission which launched in 2001 just as I was starting graduate school. I had real data to work with as I learned about space physics and I found more applications with UV remote sensing missions with Air Force satellites. Support from postdoc and young investigator grants have also helped tremendously.	It is hard to develop new ideas because the space industry (NASA) is so risk averse. The only instruments and programs that get funded have very high TRL levels and low risk, so we just cling to existing missions and technologies and try to milk them for all they are worth. That approach will not help us solve the problems of the next decade. NASA and NSF need to encourage risk-taking and innovation.
I was fortunate to enter graduate school 1 year after Sputnik when resources for space research were expanding exponentially. When I graduated in 1962 opportunities were so plentiful that I had a number of attractive job offers. Given the circumstances of that era (that continued up until perhaps 1990) I was blessed by not having to compete for very limited opportunities. I stress, my career success had more to do with the circumstances of the time rather than any particular wisdom or exceptional capability on my part.	None of any significance.
I was lucky to join a group out of graduate school that was young and had good ideas and good leadership. I have contributed to this group's success all through my career and am now one of its leaders.	My own writer's block, meaning I have not published papers that I should have.

Success	Barrier
I'm a smart guy with good physical insight. And my university colleagues have been helpful people, not a bunch of prima donnas.	A prior place of employment ([name omitted]), which was a bunch of prima donnas who enjoyed ridiculing the work of others. And my current institution puts too much emphasis on how much money one brings in. Pencil and paper people like myself can't bring in as much as people building flight hardware, and are not given equal recognition based on scientific contributions.
I'm not sure I have succeeded in my career yet.	
immigration to the US	1) Funding tends to be going to the same groups of people. 2) Program managers feel or are forced to be coming up with new artificial "cross- or multi-disciplinary"" programs to justify funding, instead of just funding excellence."
In order of importance: A good education Computer skills Flexibility Ability to get along with a wide range of people - social skills Not giving up The fact that the funding was always there, so I could concentrate on the problems at hand.	Not being smart enough. Bureaucracy to get resources Proposal writing
industry experience.	funding for new technologies/techniques, established scientists that stand in the way of new ideas.
Inspiring individuals while a student.	Lack of available funding support.
Institutional support / benign neglect	Negligent training (in the plasma fusion community).
Intense collaboration with senior scientists and other faculty, including former advisors. Mentoring of undergraduate and HS students. Diverse international projects focusing on joint geospace system investigations, which encourage team building.	Lack of funding! Lack of funding! Slow transitions to retirement status of senior personnel. Institutional reluctance to allow young first time PIs on proposals.
Intention and persistence.	Time to do the work.
Interaction with colleagues. A fair amount of luck.	Increasing difficulty to find external support.
Interest in Space Physics and hard work	Funding
Interest in the field and nice, friendly research community.	Promotion opportunity and very low salary and benefits, compared to industry and other fields.
Interest of mentors and opportunity to develop my own research program	Self-interest of supervisors
interests	debug code
International conferences and meetings have been instrumental in supporting me and providing motivation to continue and succeed in my field. I have also been very lucky to have worked with several great advisors, both academic and professional.	Nothing notable. I'm not looking forward to having to deal with "soft money"" for the rest of my career, though."
Internships, research experience, summer schools (e.g., Planetary Science Summer School)	
Involvement is a NASA project that allowed me to stay on beyond the post-doctoral term. Participation as Co-I in several successful funding proposals to NASA and NSF.	My own personality (not outgoing, energetic to move up).

Success	Barrier
I've been lucky to have good mentors in undergraduate, graduate school who provided good opportunities for research. In my professional career I've been able to work with many NASA programs providing opportunities to use a broad range of technical skills.	Access to funding for projects that are out of scope of interest for the projects I support.
Joining a university department that is more interested in the development of their young faculty than what is usual although they really are not a heavily financially endowed department.	Not enough funding to pursue certain avenues in an efficient manner.
keeping up with the space physics literature so that I know where the problems are.	Not having enough knowledge of electronics so I have to rely on others.
knowing people. i don't mean that i received special treatment, but that people in the field know me and my work so that reviewers of my papers and grants can be sure that my work is good.	
Knowledge of computing	None
knowledge of optical instruments	Lack of good ideas on my part.
Knowledge of physics	My disorganization
Knowledge of physics fundamentals	Typecasting
LANL	funding
Large number of practical applications needing solutions. Creative application of techniques developed in other fields to problems in this field.	Bureaucratic processes, especially funding uncertainty and distribution--even when we have funds, they are not available in a timely manner.
Learning to work on a broad range of problems in data analysis, modeling, theory.	Limited funding for small NASA grants.
long hours and luck	lack of institutional support
Lots of good luck and just enough smarts to recognize it.	Bureaucracy and parochialism
Lots of success in my chosen scientific endeavors.	Funding.
lots of things: my steadfast determination, my talent, my parents	the way science is organized in the US
Lot's of work. Keeping it real.	None.
Love of science hard work (some) excellent role models good development of communication skills from a liberal arts undergraduate program	Very inadequate thesis adviser
Luck	Bad Luck
Luck is where opportunity meets preparation. I had explored ray-tracing while doing gamma-radiation transport and my gamma-ray astronomy training was useful for understanding solar and geospace data.	frustrations in submitting proposals as a contractor at a NASA center.
Luck, needs of USAF, and secondary major in computer science. Mainframe expertise made transition to early PC's easier.	none
Luck, timing, ...and a little hard work	NSF funding
Luck.	Bad Luck.
Luck. Hard work.	None really, but more funding always helps.

Success	**Barrier**
Maintaining a Working Schedule of 7-24-365 and being given appropriate opportunities for participation in pioneering missions as a result of being selected as a PI along with carefully selected and directed co-workers and younger colleagues who shared my enthusiasm and work habits.	None except for the few missions for which I was not selected as PI but for which I had proposed.
Major NASA missions	Variable emphasis of important topics, which may not be aligned with my own interests
Making sure my software, data products and research methods are distributed widely to the community, and well documented.	Bad management.
Many impressive mentors and collaborators	Few
Many very good mentors willing to take a chance.	
Many wonderful collaborators.	Insufficient hours in the week.
Meeting and getting to know people	Unavailability of long-term funding and/or permanent positions
Mentor.	Few opportunities for a more stable job
Mentored by excellent scientists	None
mentoring	
Mentoring by creative individuals	Hardly any
Mentoring by my major professors at the undergraduate, master's degree and doctoral degree levels interest in electronics and amateur radio since age 14 years mentoring by supervisors during post-doctoral research mentoring by supervisors and program managers during career as a civilian DoD researcher 1981 to 2007 experience teaching physics, astronomy, mathematics, and general science during my teaching positions at the secondary school and university levels two-year teaching position as a [omitted] in Asia	Hurdles--not barriers--circa 1972 when physics employment was in some lean years--several graduate students were advised by Professors of the (then)difficult job prospects in academia ... and urged to keep their options open ....
Mentoring by my undergraduate professors, my PhD research professor, my postdoctoral research experience, and research collaboration with my colleagues, students, and postdocs. Secure research postion as a NASA civil service scientist.	Insufficient NASA funding of supporting reseach (data analysis, theory, and modeling) and technology development (suborbital-flight instrument projects) in solar and heliospheric physics.
Mentoring by senior scientists	Limited funding and mission opportunities
Mentoring by senior scientists, coupled with a lot of hard work and perseverance in the face of funding difficulties.	
Mentors	Barriers to original thinking and research imposed from above in government organization
Mentors being invited to collaborations being invited to contribute to existing research grants gap-filling teaching invitations.	Lately, getting proposals constantly turned down due to overall lack of funding being passed over by more aggressive colleagues
Mentors and opportunities for interesting research	available funding for research projects and availability of capable students
Mentors during my USAF career	USAF job opportunities

Success	Barrier
mentors, friends in the field, hard work.	citizenship (not a US citizen), low pay and thus heavy burden in supporting family, stress from work, insecure in job, virtually no university faculty position openings in the past years.
mentorship	funding
Mentorship by experienced researchers. Travel to professional meetings and collaboration with other researchers.	The typical grants awarded by NASA and NSF fund have not kept pace with the costs of hiring scientific and support staff.
Mentorship from professors and more experienced researchers. Also, luck.	Following the money.
Mentorship in the field while I was in the Air Force.	Cometition with terrestrial requirements.
Merit-based advancement opportunities, when available.	Very few job opportunities within the field.
Mobility, work ethic, ingenuity, luck.	Unethical behaviors of (some) supervisors, competitors, colleagues. Also, lack of funding opportunities for instrument development, in particular in heliospheric science, which suborbital does not serve.
Money and being surrounded by hard working, highly trained PHYSICISTS not solar scientists	None
Most important works were carried out while I was visiting institutions outside US.	
Most of my early research career was spent in an excellent university space physics group with a strong emphasis on building great instruments. I had an outstanding thesis advisors and was surrounded by very motivated and bright theorists, experimentalists, and engineers. I tried very hard.	none really.
Mostly hard work, supportive and cooperative colleagues.	My own education did not prepare me well for the science topics I eventually undertook. I work in an isolated facility, and we do not have sufficient access to student and technical support.
Motivations, Enthusiasms, Perseverance	None
Much help from contacts made as an undergraduate and related contacts.	Difficulty in finding an adviser in graduate school, which resulted in not getting a degree or experience in the area of strongest interest. This was followed by a surfeit of applicants for available positions. Much of my career was spent programming and getting data for computer programs for others.
My ability not to back down from a challenge.	Acceptance within industry. Current job listings list "engineering, physics or similar degree."" Yet these positions are only hiring engineers."
My background in chemistry and physics was useful. Study outside of my Ph.D thesis topic even when doing my dissertation. I was lucky to be in an area with a lot of research in Space Physics.	Since I am retired, that is a somewhat irrelevant question. Working in a government laboratory things were quite different. Most of the years we didn't have to seek outside money, but had to convince our superiors that our work with space and atmospheric science was important to the mission.

Success	Barrier
My career has been greatly helped by fortuitous circumstances and opportunities, and senior scientists (especially my enthusiastic graduate advisor) that encouraged (and supported) me to take advantage of such opportunities.	The main barrier has been the difficulty of obtaining funds to pursue a research idea.
My colleagues	funding
My computer skills	
my dedication of study	I have any feeling of barrier yet
My educational background. Ability to communicate well.	None
my effort	language
My expertise in laboratory plasma experiments that relate to both solar & plasma physics with application to a broad area.	Working in a cross-disciplinary area of solar & plasma physics has its own unique challenges and it does not get enough credit when it comes to the career advancement.
My fascination with the subject and the support of the good people I work with.	Primarily the naivete to believe that space weather operational missions can thrive under the umbrella of terrestrial weather missions and the current space industry (big defense contractors). That and the choice of institutions that don't really value scientific research.
My father's fascination by the Universe	The nature of my research requires massive hight performance computing resources. Whenever I reach some upper barrier in computing resources, it affects my work.
My field is scientific computing. The good colleagues and wide range of problems a national laboratory environment helped substantially.	
My graduate advisor.	Outside distractions.
My graduate studies at Rice University in Professor [name omitted]'s laboratory.	None worth mentioning.
My high school physics teacher and my Ph.D thesis adviser were very supportive.	Being on the research track at the University I am currently at, rather than being a tenured faculty member, has been difficult since even though I have been promoted according to the same standards as a faculty member and am supposed to be at an equivalent level. I really have no voice and have no control over my position. I am never consulted about departmental or university issues and also have no job security whatsoever, even though my research grants, which pay my salary, bring in a fairly large overhead (54%).
My high school science teachers' foundation of learning and problem solving. A sense of loyalty and committemnt to a larger team and a direction/vision from my leadership.	Fragmented funding. Leadership changes with no vision.
My interests towards space physics solid training in math and physics during under- and graduate schools Inspiring Advisors.	More and more difficulty to obtain science grants for young scientists and few chance for young scientists to serve in panels

Success	Barrier
My own hard work, and the recommendations of my professors	Lack of stable funding to carry out fundamental work.
My own institution, NASA funding for most of my career, NSF funding recently early sabbaticals that got me connected with major research institutions.	Being the only solar physicist at an undergraduate institution. However, my career goes beyond solar physics, and other aspects (education, outreach) have been enhanced by my institutional affiliation.
My own interest	I am a foreigner in US
my passion for astrophysics	none
My PhD advisor made direct contacts to help me get my first position. My interpersonal skills, learned during my 3 years as an industrial engineer, have helped enormously.	The number of activities one is expected to juggle as a university professor constitute a barrier toward my research goals.
my physics background, the excitement of the then newly emerging field of space physics, a stimulating set of colleagues, new physics problems to solve, the design of new instrumentation required for space physics research, and adequate support to attack these problems.	politics played at administrative and management levels
My research experience as a graduate student and during my post-doc. Also, the teaching that I did as a graduate student.	Competition with more experienced colleagues.
My strengths include a deep dedication to ethical behavior, leadership skills, and a commitment to do my best. If a challenge tests an area of weakness such as limited experience or knowledge, then I will extend myself to work through the challenge to achieve a successful completion. I have a strong determination to work through obstacles, and I am motivated by a desire to achieve a successful completion of any task attempted.	Due to the current economic climate I have been unable to find employment in my field.
My strong desire from an early age to learn physics, all the way up to the research level. It was ALWAYS my motivation. By the time I finished my Ph.D., my interest in pure research was gone, but my desire to still do physics in some capacity led me into teaching at the community college level.	My Ph.D. thesis!!!
My strong interest in doing space research	None
My supervisor (postdoc mentor) ensured that I was well trained in proposal writing. He has gone out of his way to include me in new collaborations and projects.	My status as a non-resident alien has prevented me from taking several work opportunities up to this point.
My thesis advisor helped me so much and the AAS SPD gave me many opportunities to communicate with other experts.	It is too hard to answer this question.
NASA database, inspiring the idea etc. Computer capability, from desktop PC to supercomputers	language
NASA Fellowship	Insufficient funding

Success	**Barrier**
NASA grant as grad student mentoring of senior scientists hard work good luck	Bureaucracy within Dept of Defense where I spent most of my career. Non-scientific managers make decisions which affect scientific work based on non-scientific concerns.
NASA support, university support, good colleagues and students.	More administrative work than I'd like as department Chair...
Necessity, curiosity and retrospection. NASA and any number of other systems based upon current radiation "Knowledge"" or model results, are obviously greatly over estimating the real radiation dose in space, and see no problem. Radiation tolerance costs money, probably in a more than linear growth law. Money is being wasted and jobs are being lost because of excessive radiation hardness."	The lack of readily available information on what the real radiation dose levels are. There are arguments over a few percent difference in radiation modeling software over an orbit, when the models differ by orders of magnitude.
Networking	Funding
Networking with older scientists	Lack of funding for young scientists
Networking with successful people.	The lack of faculty jobs and the economic crash in 2007.
networking, hard work, good luck, terrific collaborators	
Never became true solar or space physics discipline type of scientists. I have atmospheric science discipline Masters Degree and self-interest brought me into space weather. I see new arena of commerce and daily future operations in near-space depending heavily on space weather impacts on operations that will be need to be understood with alternative work-arounds to mitigate its' effects.	Lack of data sharing between classified and unclas side but being retired military in these arenas I understand their dilemma. Despite that there needs to be some special effort for more data release and collaboration to help out science community.
No other choice and encouraging advisors.	Funding not enough. Current employer is not really interested in promoting employees but like to keep as employees.
Not giving up. Willingness to move to get a job.	US visas (not American). Journals not realizing that needing to understand how the data was analyzed is as important as the results of the data.
not stopping	funding, employment opportunities
Not very much successful at this point, but I think my optimistic character helped me to stay in this academic field.	No barrier but my own limited talent
NSF, ONR, AFOSR, and NASA funding for my graduate and post-doctoral work. My graduate and postdoc advisers have been extremely involved in, dedicated to, and supportive of my work.	Funding. This is not a problem yet, but I am concerned. Availability of faculty positions is also a concern. Geography and family---my wife and are originally from the Midwest, but most positions are in the East and West.
Obtaining funding.	Lack of tenure track or permanent research positions.
Occasionally changing fields (slightly, at least).	Only my own lack of organization or self-management skills :-(
Open mind about space science how it imapacts our society which is very electronics dependent.	Jealous professors or Ph.D.s who don't want to help or answer questions. Self-center people who do not work as team members but to satisfy their own inflated egos.

Success	**Barrier**
Opportunities and funding provided by NSO base funds, NSF and NASA grants. Mentoring by senior staff. Collaborations with other scientists. Working with students in engineering and science fields.	tremendous amount of time spent on administrative functions
Opportunities given me by the United States Air Force.	None.
Opportunities to work with mission data, supportive academic environment	
Opportunities were available.	None.
Opportunities where success was possible.	There were no significant barriers while my career was developing.
opportunity to work with leaders in the field	lack of tenure track positions, lack of funding
Outstanding research opportunities and collaboration as a graduate student.	None
Outstanding support from colleagues.	That I changed fields from chemical physics to space physics.
Parents who valued higher education, excellent high school and college, my ability to develop honorable and extensive collaborations.	At a DOD laboratory, I am barred from going to NSF for support. But as a radio astronomer, my work is ground based, so NASA is also tough for me. It is hard for us to get foreign nationals into our lab, so many foreign postdocs and graduate students that want to come work with me are turned away.
Partially dumb luck, I think, but also the contacts in the solar physics community I made while a graduate student.	
Participation in the NSF undergraduate research program	Me mostly. Funding challenges have on occasion steered my career. Loss of funding to the research group supporting my graduate studies affected my ability to obtain a PhD.
passion	English
Patience as well as enjoying collaboration with talented people.	None.
Paying close attention to whar research was being done that had the potential of growth.	
Perserverence, hard work, and luck and the ability to consistently fill a need.	Occasional strong personalities who did not understand (or disagreed with) what I was doing in early years. In later years, it has not been popular to be at a university doing individual research with ever-decreasing funding for this type research.
perseverance	colleagues that consider science as a competition
perseverance patience hard work	Probably a lack of ability together with unfavorable "old boy networks"", secret pacts, under the table deals and cronyism."
Perseverance and luck	Presently, making production. In space science, lack of a reliable source of funding and cometment

Success	Barrier
perseverance, good grasp of general physics and life principles, honesty, not clinging too tightly to my own ideas about how things have to go, only carrying my mistakes around long enough to learn from them, figuring out when to speak up and when to keep my mouth shut (difficult :-)	difficult managers - figuring out how to deal with difficult managers should be one of the keys on the last bullet
Perseverance, sustained long hours, and a desire to give back to the nation and the community	Poor people managers, and poor mentorship.
Perseverance.	Again in industry, research and development was not well supported, in my experience. Most investigations (contracted research and development ... CRADs) were tied to currents programs and only funded for a period of less than a year. Even when successful, it was rare for the technology to be integrated. I did research advanced optical computing technology with focus on NASA missions, but NASA never had funding to push new technology into programs. Too risky.
Perseverance.	Lack of funding and programs has caused me to veer into other fields.
Perseverance. Also, seeking out and maintaining collaborations with like-minded scientists. Good students help.	Being at a 4-year college (my choice) means that I only work with undergraduates. The scale of my operation is more limited than if I were at a research university.
Perseverance. Strong graduate education. Great graduate advisor.	None that weren't of my own making.
persistence	Lack of connections in early career
Persistence	Lack of funding
persistence and expanding into new research areas	being a young researcher with no one higher up backing me up and/or promoting me.
Persistence and hard-working	
Persistence in the face of adverse social conditions at work.	Very poor mentoring from the "Apollo generation"" who have the perception that everything was easy for them because they're such geniuses when in fact it was easy for them because they had unlimited funds thrown at them during the crucial early phases of their careers. They heard nothing but ""yes"", we hear nothing but ""no""."
persistence, commitment to honesty, hard work, and a strong dislike for the increasing dominance of scientific politics	None
Persistence, curiosity, excellent support from those I've worked with, luck.	So far I seem unable to write a winning proposal. The bureaucratic process involved with designing and building space flight hardware has vastly increased the price of innovation therefore severely limited the amount of innovation possible.
Persistence, good choices of publishable research projects, and excellent support at my research institution.	My own intellectual limitations.

Success	Barrier
Persistence, hard work, sometimes ignoring the advice of others and going against the crowd, being suspicious of the paradigm.	The solar community pays too much attention to numerical models and old analtyic models and pays too little attention to what has been learned in the lab.
Persistence. Curiosity. Effort. Being familiar with shortcomings of previous research. ETC.	U.S. immigration policies: NRC/NPP postdoc allowed only J visa & being married to a U.S. citizen disallowed J, thus had to wait about 9 months for green card and work authorization presently naturalized. JPL's proposal policies precluded PI status as a postdoc (Science PI was allowed, but not the subsequent money control). As an experimentalist, joining collaborative efforts with modellers of flight data. ETC.
Persistence. I wrote the first successful [type of code omitted] code back in the late 'sixties first: to determine [omitted] from that source, and second: to calculate [omitted]. The literature on accelerator shielding, and radiation transport theory were extremely helpful.	None that I can think of.
Persistence. Commitment. A really good education.	Lack of support from my home institution. Lack of funding in the suborbital program.
Persistent to what you can and want to do based on available resources	I could not build a reasonable size of group so that we will be able to do research more systematically
perspiration and luck	
PhD research at [school omitted]	Midstream mission cancellations by NASA--CRAF, Equator, etc.
Practical experience including working with military users and their applications i.e., getting outside of the academic environment.	Stability of various projects and programs that I've worked on.
Prayer and Hard Work	Time
Primarily proposal funding by the NSF.	In later years, inability to get funding as an individual investigator with a couple of graduate students.
Primarily, my PhD thesis adviser, my postdoc adviser (who's now my current boss).	There are not many targeted faculty hires in my research area (solar physics), and solar physicists do not seem to fare well in competition for hires that are not targeted.
Privilege, education and chance. By sheer dumb luck I was born white and male and of slightly above-average intelligence. And a bit of stubbornness.	I actually care more about my family than my career. This has made it difficult to follow a more favorable career path. I'd rather be a tenured astronomy professor at a small college, but those gigs require you to go where the position is available rather than move close to where your aging and ailing parents/in-laws live. Also, the small colleges don't pay as much, though I'd be willing to live on less if we lived somewhere cheaper.
Proactive approach, pursuing opportunities, flexibility, hard work.	Limited NASA missions in geospace or upper atmospheric science.
Proactive engagement in conferences, workshops. Sustained effort following research ideas.	Limited career opportunities beyond postdoc. Limited funding opportunities during previous jobs outside the US.

Success	Barrier
proactive stance, luck, hard work and dedication	not enough time in the day
Proper references.	Getting my foot in the door.
Proper scientific environment, from my side my modeling ability	I am non US born, came to the US later in my career, so could not pursue typical career
PSSC physics in high school and the NASA funding in the 1960's, and higher education.	Up and down funding within NASA, and the changing directions of NASA programs.
Pure curiosity and enthusiasm to explain space impacts to space operations.	Government red-tape, fickle funding, and initial hesitancy of physics community at large to accept space "weather"" as a separate career path."
Pursuing degrees in various disciplines (engineering, physics, and geophysics). Staying abreast of technology. Teaching experience.	
Question probably not applicable to me. My career has been outside physical research for several decades (engaged in various other fields, including quality assurance, security/safety, management, retirement plan administration).	No barriers--opportunities in industry outside of physical research essentially led me out of a scientific research career.
Realization that hard work can eventually be rewarded by sense of accomplishment and sufficient remuneration that allows relief from hunger.	Political correctness interference with science.
Research freedom and encouragement, NASA [omitted] (2.5 years)	Funding insufficient
research funding	
Rigorous attention to scientific detail, development of writing and communication skills, willingness to continue learning, keeping up with the literature and learning the historical literature, and devotion to the pursuit of basic science rather than institutional financial health.	Unstable, unpredictable, and inadequate funding, and the consequent need to spend an excessive amount of time writing proposals bureacratic requirements.
Rigorous mathematics and physics preparation from undergraduate through postdoc work and fortunate mentoring and support.	Having a broad range of interests and expertise versus a specific focus, and finding ways to leverage my breadth of interests.
Running	Funding
Science	Country I lived before
Science fairs, Science fairs, Science fairs, and excellent mentors!	I am now into the "age barrier""--being over 55 has begun to be very telling on my long term job prospects."
Scientific creativity, and the availability of several NASA-funded missions to employ me and to be sources of grant money for personal research.	Sometimes, inadequate NASA funding, or pressure on projects to do more for less money.
Scientific curiosity	My own scientific capability
Scientific curiosity and the desire to explore	insufficient support from home institute
Secure government-funded livlihood assisted by my wife's support....working with very capable, congenial, colleagues.....dogged peer-reviewed publication efforts.	Infrequent and (in my view) biased negative peer reviews. I say 'infrequent' because most reviews were positive and constructive.
Senior scientists supported my career at important points. I also think I was lucky in many respects.	I can't think of any.

Success	Barrier
several mentors	university rules preventing research staff from being PI's
Several things have helped me to succeed up to this point. 1) Access to funding, 2) Access to high quality data from the Cassini and other missions, 3) Excellent tutelage from senior members of the field, 4) my ability to work in the laboratory and my desire to work on instrumentation.	Members of the scientific community that are not collaborative, some of which are secretive, and somewhat vindictive. The desire to compete rather than collaborate with members of the community hurts the science in general.
sheer luck	none
Solid background, Diligence, outstanding instructions from supervisors, and valuable discussions and idea exchanges with colleagues	(1) Limited positions in our field (2) Not good current situation to obtain grant support to do interesting scientific researches
Solid mentoring.	Demographics - age creep of ongoing principle investigators.
Solid mentoring. Good support network.	Reviewers that hold grudges.
Solid theoretical background	Age and lack of faculty position openings in my field of reserach
Solid top-tier undergraduate institution. Wise choice of Ph.D. institution. Inspiring mentorship at the Ph.D. and post-doc levels. Wise choice for post-doc institution. Breadth of interests and research. Strong initiative.	Lack of sustained government investment in science. Lack of academic positions in the discipline.
Solid, fundamental physics and general problem solving training, along with good communication skills (writing, talking, presenting)	Government funding of science and basic research
Some background in mechanical and electronic engineering was necessary for experimental physics.	Funding cutoff led to early retirement and pursuit of further involvement through independent contractor/consultant status.
Some good skills, generous mentoring from some very talented senior scientists, good speaking abilities.	It always helps to be smarter!
Sound knowledge of Physics and accumulating further skills at visitor stays at various institutions.	Short time funding for theoretical research projects, which makes it difficult to enter the faculty path at a university/research institution.
Stable external funding	Uncertain funding
Staying focused on the important things, while allowing the smaller details to get less attention.	Time.
Steadily increasing engagement with a network of collaborators (direct and otherwise) in my and related disciplines.	Overcommitted time and effort on an ongoing basis.
Strong and broad technical skills with comprehensive physics training.	The close network of NASA mission planning teams that make it difficult to get involved from "outside"""
Strong background in fundamental physics. Supportive family to allow me to complete Ph.D. thesis.	Ridiculous hurdles you have to jump through to get a teaching job. Thesis advisor not a strong advocate post degree completion.
STRONG BACKGROUND IN MATHEMATICS AND A WANT TO SUCCEED.	PROPOSAL COMPETITION HAS INCREASED MARKEDLY IN LAST FEW YEARS! LACK OF JOBS AND FUNDING WITHIN THE UK.
Strong collaborations	shortage of flight opportunities

Success	Barrier
Strong family support, work ethic and intellectual curiosity. Undergraduate scholarship in Physics and first undergraduate research adviser in space physics also opened doors to the field.	Difficulty in "breaking into"" the community of hardware developers. The risk adverse nature of space flight makes the path for outsiders very difficult if not impossible."
Strong mentors	Ability to receive and maintain sufficient funding.
Strong mentorship in grad school. Being too stubborn to quit.	Lack of funding support for space physics coupled with paucity of funds supporting research involving undergraduates.
Strong motivation,broad background in physics, the privilege of working with excellent postdoctoral colleagues and students, and good luck!	
Strong physics and math undergrad, rigorous and in-depth PhD coursework in space physics, excellent PhD advisor who let me lead many aspects of our projects.	Tenure-track faculty positions for space physicists are very few and highly competitive.
Strong research group, good mentoring, adequate support, interesting opportunities.	Soft-money uncertainty. Limited opportunity for research staff at university.
Strong skill set developed during graduate school, good physical intuition, and creativity.	Securing funding and management responsibilities
Strong support from dedicated scientists who care about nurturing young scientists. Our field has plenty of people committed to supporting the younger generations.	Honestly, none. I was fortunate to get a civil service position before the tight squeeze on grant dollars hit. The success rate for proposals seems to have dropped from one in three to a one in ten.
Strong support from my advisor, both scientific and financial. Building collaborations with more experienced scientists. Travel to conferences and workshops.	Writer's block Lack of flexibility in job location/accommodations due to young children
Strong support from supervisors and collaborations with community members	difficulty in obtaining funding
Strong theoretical skills that aren't prevalent in space physics, where the primary tools are blind simulation.	Faculty positions that require demonstration of funding (grants) but post-doc positions that don't allow grant writing.
Strong undergraduate program in engineering sciences at [school omitted]. excellent postdoctoral training at [school omitted] excellent background in applied mathematics the good fortune to have some superb collaborators the ability to be an effective teacher a good brain hard work some lucky breaks a supportive wife and family.	No significant ones.
Strong work ethic, good collaborators, good contacts in my field.	Funding, opportunities for permanent positions, funding stability.
Stubborn persistence Network of friends and colleagues who can share ideas and similar experiences.	Funding Administrative red tape and policy My own laziness with regard to research
stubbornness. Also, I like teaching.	the fact that teaching is undervalued, and research is over-rewarded. also, there's no leverage. I'm alone at my university no colleagues in my field.
study hard, work hard	bad economic situation currently

Success	Barrier
Successful funding which allowed me to pursue my interests in space science problem solving, instrument design/building and experiment execution. Managing and directing technical staff. Writing research results and having them published in peer reviewed journals.	There are more scientists in the field of space science than there is money to support them.
Support and guidance from senior members of the field.	Funding.
support from excellent mentors ability to communicate clearly (write and speak) having a number of excellent undergraduate students to mentor	if any, lack of time! (mixing careers as educator and researcher, and dedicating sufficient time to family)
Support from great supervisors. Interdisciplinary work on many different aspects of space weather.	Not being a US citizen.
Support from my advisors (both in graduate school and as a postdoc) has been extremely important in fostering and encouraging my interest in space physics. Also, NASA educational programs have certainly helped me to learn more about the culture of the space physics communitiy, and the opportunities to contribute to space science and exploration. I was a participant in (and beneficiary of) the following educational programs, which were primarily funded by NASA: the NASA Ames Astrobiology Academy [year omitted], the NASA Johnson Space Center Cooperative Education Program [years omitted], the JPL Planetary Science Summer School [year omitted], the NASA Graduate Student Research Program [years omitted]. Each of these programs contributed greatly to my development as a space scientist, and arrival at my current position as a postdoctoral researcher at NASA [omitted]. I strongly recommend that funding for these programs, and programs like them, be maintained as a way to foster a strong workforce of space scientists.	I have not experience any significant barriers.
Support from NASA and NSF has been critical. I have also had to work incredibly hard and persevere to continue to move forward.	Yes, I had a very poor education prior to entering graduate school. This was particularly the case in mathematics. The second big thing is the cultural divides that exist in the U.S. I think that race makes a difference but not in the way that people usually think of it. I think that people are very comfortable working with persons like themselves and thus some people are more connected to the inside resources and information than are others. I think that for me this has been a barrier. Likewise, I think that social undercurrents in our society bleed through into the culture of science. For example, I notice many colleagues who get their names on publications although they are only peripherally involved in projects. In my case, this never happens. I have talked with other minorities who are "culturally minority"" who claim a similar experience."

Success	Barrier
Support from NASA sponsored E/PO programs.	None
Support from senior scientists	Changing funding policies unpredictably.
Support from the Office of Naval Research	Early, it was my University's policy on who qualify as PI that was the major barrier.
Support of colleagues and submitting proposals again and again.	Nothing significant.
Support of colleagues, both locally and elsewhere in the world support by institutional management and technical resources support by the American taxpayer.	Federal bureaucracy inevitable conflicts between work and family life
Support of mentors	
Supported medium and small space missions, suborbital flights, and community connections.	Lack of sustained and dedicated funding for scientific analysis of data from satellite missions beyond the initial proposal Extreme competition for funding from major sponsors.
Supportive encouraging mentors. Hard work.	Highly competitive environment for limited research funding opportunities.
Supportive mentors and colleagues and being in environments which support new ideas and young scientists taking initiatives. This includes environments supporting the concept of scientists becoming PIs at early stages of their career.	I have been at at least one place where there were severe restrictions on being a PI, and I ultimately had to leave this institution. I think now there is increased competition for proposals which is becoming a problem for saturating the agencies, especially for independent research organizations with no base funding.
Surrounded by excellent mentors and opportunities to pursue new ideas.	Not enough time to do scientific research.
Sustained funding, a strong institution, and luck.	inept review panels. Particularly with regard to instrument and mission proposals, there are very few well qualified reviewers out there. It is a difficult task to find experts in what amount to esoteric fields. The review process badly needs to be revised to allow communication between panels and proposers during the review process, so that unsupportable criticisms may be addressed prior to a final evaluation of the proposal. This would allow a non-specialist to make a well informed evaluation, rather than guessing and getting it wrong. Another barrier, especially in Heliophysics, has been lack of a dedicated program for instrument and technology development. It holds back researchers, and it holds back the field. A third barrier is the age of the field. In space physics, especially at earth, we are past the age of discovery. It is hard to sell science that does not promise exciting and novel results, and in space physics, most of the low-hanging fruit has been picked. It is not clear to me how much a future this field holds in an age of constricting budgets and 20 second sound bites.
Talants, efforts, and luck	unfair competition
talent	politics

Success	**Barrier**
Talent, hard work, the ability to work well in teams and to lead teams, communication skills.	Aversion of academic astronomy departments to solar physics: there are not enough faculty positions in solar.
Tantalizing question. An abiding interest, support from family and colleagues, and yes, chance, all play an important part.	Not being career minded, two migrations (to new continents) and throwing away two tenures to "start over"". "
Teacher (solar physicist) undergraduate	None until Congress killed the unmanned space program
Teachers and colleagues. Operational experience gained in the Air Force, NOAA and NASA.	Being pigeon-holed as an "ops guy""."
Teaching	tenure
Teaching Assistantship provided stable funding, patient advisor, personal contacts with people in the plasma physics community, attending conferences, WSGC space grant.	not many. meeting departmental course requirements in a department dominated by pure math, teaching duties, health problems.
Technical skills, ability to focus, be organized, be able to collaborate and work well with superiors and colleagues	Lack of professorships in plasma physics. Question of how to credibly propose small, university scale experiments in a day where experiments are getting very big and expensive, all the action is on the big machines.
Technical training and collaborations with other scientists.	The influx of new scientists in the field has put stress on science budgets that are not increasing. Proposal success rates have gone down to levels where it may be necessary to leave the field to remain employed. Additionally, US funding agencies (NASA and NSF) do not distinguish between US citizen scientists and non-citizen residence. Perhaps it is time to provide affirmative action preferences for US citizen scientists for US funding of science to maintain a US competitive edge in science.
Tenacity and good mentors.	Colleagues unwilling to think out of the box. People who simply can't deal with new ideas or new ways of doing things.
Tenacity, support of others, good luck, a modicum of talent.	No barriers, personally. I have been dismayed by the dysfunctional state of the way ground based science in general, and solar/helio science in particular, is funded.
The ability and willingness to learn quickly. I have a Ph.D ADB, but left when I realized that there was virtually no chance of working in the field. I have retrained about 12 times in my life...and taught myself engineering and computer science on the fly.	Race consciousness has been a real stumbling block. The work force is balkanized. It is convienient to style yourself "oppressed"". To do that, you need an oppressor. White males really catch it. However, now, different groups prey on each other. This is very damaging!"
The ability to analyze and synthesize solutions to new and unanticipated problems - a general outcome of a good graduate program.	With a PhD you can be boxed in by people who think you are a specialist in the field rather than a generalist with the ability to think deeply.

Success	Barrier
The ability to identify and persue interesting unexplained phenomena. This is especially important in a "young"" field like space physics, with many unsolved questions."	A lack of funding has been the biggest stumbling block. When I graduated, there were basically NO academic postdoc positions advertised. Everything I persued was with a government/FFRDC entity. I was lucky to have landed a position in that environment.
The availability of national obseerving facilities like KPNO and CTIO.	Lack of good students and postdocs.
The availability of student loans at a low rate has definitely made it possible to continue my education, as has been the availability of scholarships, grants, work-study programs, and fellowships. Interaction with a variety of scientists, as initiated through scientific meetings has helped in the research phase of my career.	No obstacles from institutions or persons have slowed my career down.
The collaboration and encouragement of colleagues, especially at my institution.	Poor-quailty reviews at funding agencies from mis-informed or inattentive reviewers. To a lesser extent, the same holds true for peer-reviewed journals.
The collaboration and support of outstanding scientists in my field.	The lack of popularity of my field in the university community.
The connection between my research and its relevance to society. The ability to engage a talented engineering team to address the problems at hand.	Long gaps between experiment opportunities make it hard to retain engineering expertise in a small university group. The lack of activity also repels good students and thus academic impact is reduced.
The deep knowledge of physics and hard work.	The biggest barrier that I see, and this is not only for me, is the corrapt system of funding in the solar and space research.
The examples mentor have set for me and the leadership principles they taught me.	Lack of leadership in operational space weather research. There is a great need for qualified and quantified requirements for space weather, but the everyone says it's the other guy responsibility to do/fund it operations says the researchers should do it and the researchers say operations should do it resulting in nothing getting done. Both need to come together to define specific, quantified and tested requirements
The frequent discussions with some most prestige scientists in my field	Often distracted by considering funding support
The funding environment was favorable during the beginning years of my career. There was more than one potential source of research funding.	No outstanding barriers.
The general interest and facination about space and space travel.	Hassels over VISA issues. Now that I am a US citizen it is no longer an issue.
The general overview & hands-on experience gained during my undergraduate training served well to prepare me for my career in telescope engineering and operations.	The lack of national funding and public support of the sciences, and in particular astronomy, is an ever present obstacle.
The guidance and support of professors and the scientists I have worked with since my graduate school days have been very important.	I don't believe that I have had any barriers.

Success	Barrier
The image of an exciting scientific field a very generous Fellowship from North American Aviation, Corp. (Rockwell International) mentors who placed trust in me a community college ([name omitted]) that provided excellent management courses the willingness of personnel from different U.S. government agencies to work together on common goals.	I cannot think of any. (Or anybody!)
The interest in research in space plasma physics as well as availability of excellent in situ wave and particle measurements keep me active in the field.	There is no recognition for the good work by people like us working in NASA as University scientists. There is no recognition by the employer and there is no financial or promotional opportunities.
The liberal opportunities in the US for funding curiousity-driven research. It is wonderful.	None
The most important thing has been the acquired skills necessary to write good proposals. The second most important thing has been to always be ready to learn new things.	The biggest dangers to my career are the funding uncertainties for science in general, and for NASA and NSF in particular.
The most important thing I think has been coming into the field from other disciplines (atomic/plasma physics, astrophysics), so I had different ideas from others.	Coming into the field from other disciplines, and getting ideas accepted.
The NSF grants that I have received have been critical to my success.	None. I have been very fortunate.
The older generation of people in this field who have supported me and believed that I could accomplish certain tasks.	Internal management and local politics...not being members of certain clicks.
The opportunity and support to develop new instruments and participate in NASA missions, working with a small core staff of professionals and strong graduate and undergraduate students, and the opportunity to serve as the chief scientist of a NASA mission.	Occasional setbacks when missions were canceled or proposals not selected
The opportunity offered by ground-based studies to carry out space-related research (at that time, cosmic rays) in developing countries (I studied in Argentina)	My career spans from 1952 to the present in several developing and advanced countries. This would require a much too long answer. For the beginning period, see [citation omitted].
The opportunity to apply personal initiative in meaningful ways and to be heard. Quality individuals create environments supportive of personal scientific development and advacement. Society enables or disables creation of such environments.	Well meaning, but excesses in mandated training, security, and accounting. The devaluation of science as evidenced by managing science to create political return and pushing science to predict return on investment.
The people I have worked with have been the driving force behind my success in solar and space physics.	There is always the problem of time - I want to spend more time doing research than my duties allow of me.
The support of my present research institution	None
The support of various mentors throughout my education and postdocs. A supportive environment at my current University.	Figuring out what aspects of being a scientist I don't enjoy.

Success	Barrier
The will to succeed despite any problems. I was trained in mechanical engineering, optics, basic physics, computer modeling, data analysis, and atmospheric physics -- I use all of these in my career.	Inability to break into the NASA programs. When I first started out, there seemed to be an old boys network in play at NASA. That has disappeared but has been replaced by other biases. NASA funding is geared toward NASA and universities.
The willingness of senior scientists to propose new instrumentation for solar physics.	Limited availability of mentoring. Limited understanding among colleagues of the importance of instrumentation to astronomical research.
There has been increasingly effective organization of NASA headquarters and the field centers, including the creation of full-fledged Heliophysics organizations within the Science Directorate. My field was once splintered and scattered among Earth Science, Astrophysics, and Planetary Exploration, but is now able to hold its own as a discipline with a strong sense of purpose to understand the evolution, dynamic weather, and climatic destiny of the Heliosphere and its contained planets.	Congressional politics plays an important but somewhat arbitrary and capricious role in decisions about space missions and the awarding of work assignments.
This is a very general question. I would say hard work and continued grant funding are absolutely essential. It is extremely difficult for older researchers to obtain grant money. Expertise must be maintained through active reading of the scientific literature and meeting attendance.	Grant money is extremely difficult to obtain for researchers with no tenure. Multiple grants are needed for 100% support, and the competition for funding is great. The standards of proposal reviews vary and there is no opportunity for interaction or response to proposal review decisions. Budgets for each grant are limited.
tireless toil	funding
To be able to predict what programs were going proceed and which were unrealistic from either cost or technology standpoint. Also to be able to come up with management approaches which allowed the best utilization of Univ., NASA Centers. and industry capabilities.	Nome.
Too lengthy to discuss - ambition, the right people supporting me, the areas of interest, being adaptable, ...	Difficult to say - have been able to take advantage of most opportunities.
Training and experience in atmospheric science, especially in numerical modeling and data assimilation.	Openness and willingness to accept the advances in the other field to help this field
Undergraduate physics classes that refined my ability to take data and a question, and then find a way to use the data to answer the question.	none
Undergraduate research experience, an experimental PhD, and good mentors along the way.	Inability to break into NASA-PI-driven grants perception from university reviewers that industry shouldn't do fundamental research

Success	Barrier
Unfortunately, I did not succeed in a career in space physics, and I very much wanted to. In high school, I was trying to study the changes in D-region electron densities caused by solar flares. I built small low-frequency radio receivers and made visible observation of the sun. For this work, I was given awards at local science fairs in [state omitted], and then at the International Science and Engineering Fair in [year omitted]. There was no science fair in my school districe, and my teacher, who was a family friend, encouraged me to enter these science fairs. But after high school, I guess I just did not know how to proceed. I selected schools that had good physics and engineering programs. My graduation period was at the end of the Viet-Nam war, and I saw many young men being treated badly upon returning from the war. Now this seems that it does not have anything to do with space-physics, but I wante to, in some way, serve my country,. . . so I tried to go to [school and year omitted]. I was [omitted], so I went to [school omitted] to study physics. I then reapplied to [school and year omitted] and I graduated from there in [year omitted]. My experience at [schools omitted] were very very satisfying, but I studied physics (astronomy too at [school omitted]), but I did not know what to do to study space physics. I served in the Army as an officer from 1979-1984, then I left the Army to go back to graduate school. I was at the [school and years omitted]. During all of this time, from 1975-1984, I was still trying to study solar flares as a hobby using the small radio receiver that I made. the [omitted] had the largest infrared telescope, prior to the [omitted] telescopes, and my career path shifted from my interest in space physics to infrared astronomy. My [omitted] experience helped me at [omitted], where I built up the [omitted] observatory. My interest in space physics really helped a lot when I worked on the solar instruments for the GOES program from [years omitted]. Currently, I am [omitted], working at [omitted] on high spatial resolution imaging.	As I mentioned in question (31), I just did not know how to go into the field of space physics. When it was time to go to college, I knew that I had to take physics, but I sort of lumped space physics into the field of astronomy, and the field of space physics got lost for me during my years of training as an undergraduate and graduate student. If I could have stayed in space-physics, I believe that I could have been a great scientist because I loved the field so much.
Uninterrupted funding from NSF	NASA still too unpredictable in terms of continuing mission philosophy. Political decisions as opposed to science driven decisions.
Versatility (I'm only peripherally involved in solar physics, having spent my career at a not-for-profit contract research organization mostly doing other kinds of work).	Failure to attain Ph.D., but not a major shortcoming where I ended up.
very effective graduate school advisors	funding limitations
Very lucky with first job. Of course ability, but many people in field have that quality.	Really none

Success	Barrier
Very supportive lab chiefs and external government department heads	My own screw ups
What I have done I was compelled to do.	Unimaginative agency management.
While in grad school: The desire to not give up on what I started and to learn skills useful to my future. Reasons why i started in physics: The desire to travel to space, to other planets, other stars. The desire to learn about space and space travel. The desire to understand and develop methods of superluminal travel and communication to enable interstellar colonization and hopefully to make contact with another intelligent being.	Lack of truly visionary projects to enable large scale development of space. Imagine all the science that could be done if we could send people on ships massing 1000's of metric tons propelled by nuclear propulsion to the outer planets, quickly, instead of a few probes. We gave up on space when we discontinued NERVA and the development of better engines, instead settling on a shuttle that was dangerous and orders of magnitude too expensive to operate and hardly reusable. We would never have needed to subject astronauts to pointless tests of the effects or microgravity if we'd just build ships and stations large enough to spin! NASA could have accomplished so much more by now if they had proceeded outward from Apollo rather than merely returning to LEO. The science that NASA has done since Apollo was good, but it could have been many orders of magnitude better. The entire manned presence in space since Apollo has been a waste of time.
Willing to relocate to different countries	
Willingness to work hard	There were no barriers while I was still working
Wonderful mentors and dumb luck, along with a naive certitude that I'll get through this.	My talents, and family commitments.
Wonderful opportunities, starting at the [school omitted] even before I graduated from [school omitted].	Diminishing opportunity.
work	none
Work and creativity.	People create their own barriers.
Work!	
Working closely with more experienced scientists.	My own feelings of ineptitude.
Working for the giants in space science. And working for a very supportive institution.	Flat or reduced funding for science.
working hard	Before people recognize my name, it is hard for me to get the chance of oral presentation, especially in AGU meeting.
Working hard, proposing often, and being an experimentalist.	The biggest barrier was early in my career when it appeared that there was some bias in proposal selection towards known, established researchers. Since I am now in that group, this has gone away.
Working in a national lab environment where I am free to explore interesting questions and ideas. Also, being able to collaborate with some very smart people.	Short-sighted managers who don't have long-term goals.
working in the same field since the graduate study	Weak communication skill (English is my second language).

Success	Barrier
Working incredibly hard. Developing my ability to manage and lead. Developing a broad research and technical experience.	Not enough funding available to support research in my field. Not enough funding to support students and postdocs
Working on rocket data while a student in the Space Physics lab at [school and year omitted].	None.
Working with brilliant senior scientists closely in my field	proposal writing is a waste of time.
Working with excellent colleagues	1. Myself 2. The increased competition in my relatively narrow discipline (compared to for example Planetary Sciences).
Working with excellent co-workers.	Trying to work with dishonest co-workers.
Working with excellent people strong basic education networking with community.	Not working in 'politically correct' fields.
Working with good people on interesting projects at an institution that strongly supports our work.	None
working with good scientists	none
working with world class scientists	occasional funding crises
working with world-class colleagues	rarity of flight opportunities long spacing between missions
Writing clearly.	None
Writing mission proposals has focused my attention on the significance and impact of my research.	The funding of NASA grants is too small (per grant) and too oversubscribed
You want this in 73 characters or less?	None
Yuri Gagarin being launched into space on 12 April 1961, A very "friendly"" free education system in the UK during my schooling years, and from grad school onward the availability of cutting edge space research programs that I could participate in."	NONE
	1) Insufficient/inadequate availability of funding 2) Dysfunctional peer-review system 3) Institutional bureaucracy.
	Bureauocracy
	Difficult to get funding for daring and out-of-the-box ideas
	employer who was not as concerned about the subject.
	Funding problems
	Inability to successfully network beyond a close core of collaborators.
	Lack of jobs. Institutional barriers.
	lack of sufficient research funding
	limited funding
	None
	Physical distance between my University and NASA. NASA program office with an agenda that didn't include my research.
	The amount of time spent writing proposals has detracted from my research

Success	Barrier
	Weak leadership and supervision
Education	
interest and time	