Physica Scripta. Vol. 56, 446–458, 1997

Energy Levels and Transition Probabilities in Doubly-Ionized Erbium (Er III)

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Received January 15, 1997; accepted in revised form March 19, 1997

PACS Ref: 3220J, 9730

Abstract

The spectrum of Er III reported by Becher (1966) was reanalysed with the support of new predictions of energies and transition probabilities. The number of energy levels was increased from 45 to 115, including two levels of $4f^{11}7s$ and the levels $^3F_3$, $^3F_2$ and $^1G_4$ of the ground configuration $4f^{12}$. All 470 classified lines are reported with transition probabilities for most of them. Several of these lines had not yet been attributed to Er III in the spectrum of the star HR465.

1. Introduction

The initial steps in the analysis of doubly-ionized erbium have been summarized in 1978 in the critical compilation by Martin, Zalubas and Hagan [1] and are briefly recalled here. The main features of Er III had been published by Spector, who reported 137 lines classified by 45 levels including the lowest ones of $4f^{12}$, $4f^{11}6p$, $4f^{11}6s$ and $4f^{11}5d$ [2]. A few corrections and additions resulting from parametric studies of $4f^{11}(5d + 6s)$ [3] and of $4f^{11}6p$ [4] were taken into account in [1]. After 1978, the even levels of Er III were used in a global interpretation of the $4f^N(5d + 6s)$ configurations, but no extension was attempted in the classification [5]. The need for new spectroscopic data in the spectral interpretation of chemically peculiar stars is an incentive for resuming studies in doubly-ionized lanthanides. The first analysis of Dy III was achieved recently [6] and a brief summary of related problems was given in [7]. Moreover erbium is already known to contribute to more than 300 lines in the spectrum of the chemically peculiar star HR 465 [8].

The only available data for extending the analysis of Er III are in the dissertation by Becher [9] which had been kindly put at our disposal by H. M. Crosswhite when Er I and II were analysed [10]. The included linelist comprises about 3800 wavelengths from 2036 to 8725 Å which are reported with intensities in three excitations (microwave discharge, d.c. arc and mild spark). We had noticed already that, in spite of these intensity comparisons, the ionization assignments of [9] were partly erroneous in the long wavelength region. Nevertheless the wavenumber accuracy was good enough for energy level searching as it has been proved by Becher himself who first classified some of the strongest 6s–6p transitions and by van Kleef who found the $^3H_4$ level of $4f^{12}$.

* The laboratoire Aimé Cotton is in association with Université Paris-Sud.

2. New energy levels

We used the computer codes of Bordarier, Bachelier and Sinzelle [11] and those by Cowan [12] for calculating the energy levels in the Slater–Condon approach and for deriving transition probabilities from the eigenvectors in intermediate coupling. The transition probabilities were used as a guide for finding new levels. They compare fairly well with the observed intensities if the comparison runs on a limited range of wavelengths due to at least two facts. Intensity estimates are generally not corrected from plate sensitivity factors and Becher's observations span from ultraviolet to near infrared. The transition probabilities agree better with the intensity figures of Spector, but the linelist of [2] reports classified lines only which limits the comparisons.

The coupling conditions $[(4f^N\alpha S_1, L_1)J_1, nlj_2]J$ are well-obeyed in $4f^{11}6s$ and $4f^{11}6p$ and, due to selection rules, the levels cannot be found from many transitions. This is not true for $4f^{11}5d$ which is far from LS and from $(\alpha J_1 j_2)$ conditions, according to the results of the present theoretical studies.

Only four levels of the ground configuration $4f^{12}$ had been reported earlier. Three new levels, $^3F_3$, $^3F_2$ and $^1G_4$, were found from their strongest predicted transitions with $4f^{11}5d$ and they classify now 24 lines in Table I. The fine structure of ^3H and ^3F intervals are only slightly larger in Er III than they are in $4f^{12}6s^2$ of Er I, which is a usual situation for lanthanides. A total of seven levels made it possible to derive the energy parameters of $4f^{12}$ with limited constraints. All effective parameters α, β, γ of the linear correction for far configuration interaction $\alpha L \cdot (L + 1) + 10\beta G(R7) + 12\gamma G(G2)$ were fixed as well as the ratio of electrostatic parameters E_1/E_3. This led to predictions for the 6 missing levels. The lowest of them ($^1D_2$) is expected near 24 900 cm^{-1} and its determination should not be possible without further observations of the spectrum.

The upper even configuration $4f^{11}6p$ is accurately interpreted with the same Hamiltonian as for other $4f^N6p$ configurations of doubly-ionized lanthanides, configuration mixing effects being taken into account by α, β, γ, and by the correction $\alpha_{TOT} L \cdot (L + 1)$ which is equivalent to a Slatertype parameter F^1(f,p) [13]. The r.m.s. deviation for 35 levels (21 cm^{-1}) is worse than it was in the first study which involved 18 levels built on $4f^{11}\,{}^4I_{15/2,\,13/2,\,11/2}$ only. Nevertheless it is established now that the predicted levels of [4] were about 80 cm^{-1} too low for $4f^{11}(^4I)6p$ and 250 cm^{-1} too low for $4f^{11}(^4F)6p$, which illustrates the difficulties of parametric studies performed with few levels. It is remarkable that all the known levels have (J_1, j_2) first components larger than 50% and that all (J_1, j_2) multiplets given in Table II are separated in energy.

In the odd parity both the flatness of some *J-j* multiplets and the overlap of $4f^{11}5d$ and $4f^{11}6s$ made some difficulties in the identifications, "forbidden" 4f–6s transitions being obviously present. A few undeterminacies of *J*-values were removed with the support of the computed transition probabilities, the calculation of which progressed in parallel with the classification. It is seen from the total percentages of $4f^{11}6s$ components in the eigenfunctions of levels given in Table II, that at least four couples of $4f^{11}6s$ and $4f^{11}5d$ levels mix significantly. This explains the well-defined value of the interaction integral R^3(4f5d,6s4f): $2879 \pm 297\,cm^{-1}$ reported in Table III with other parameters, the direct integral R^2(4f5d,4f6s) being loosely defined and eliminated. From the coefficients of the R^3 parameter in intermediate coupling, the shifts pertaining to this interaction were evaluated. They nowhere exceed 215 cm^{-1} which is large with regard to the r.m.s. deviation of the present study (35 cm^{-1}) but keeps 4f5d–4f6s a small interaction in comparison with others in the lanthanides (for example $5d^2$–5d6s or 5d6p–6s6p). In Table III, the parameters which describe far configuration mixing effects on the terms of l^Nl' (D^3, Y^2, Y^4) are the direct and exchange "forbidden Slater parameters" giving according to the definitions of [12] and α_{TOT} is equivalent to D^1.

Transitions with upper levels above 79 000 cm^{-1} classify weak lines and the correspondence between levels and theoretical energies become ambiguous. For this reason, the odd levels reported in Table II in the range 41 000–50 000 cm^{-1} are attributed qualitative designations only. A successful attempt was made to locate the transition array $4f^{11}(^4I_{15/2})7s$–$4f^{11}(^4I_{15/2})6p$ and the intensity pattern of the seven classified 6p–7s lines fit very well to the theoretical *gA* values. Owing to the very regular trends of the 6s–7s electron jump along the lanthanide period already used in [14], there is no need revising the ionization energy predicted by Sugar and Reader.

3. Classified lines and transition probabilities

The classified lines in Table I are reported with transition probabilities *gA* calculated by means of [12] in three separate studies of the arrays $4f^{11}6p$–$4f^{11}7s$, $4f^{12}$–$4f^{11}5d + 4f^{11}6s$, $4f^{11}6p$–$4f^{11}5d + 4f^{11}6s$. Cut-off values of *gA* were chosen to keep about the 1500 strongest lines in the latter array. It explains that some *gA* values given for 4f–5d transitions are smaller than the discarded *gA* values of 6s–6p transitions, the radial dipole transition integrals being (in a.u.) $(4f\,|\,r\,|\,5d) = 1.123$, $(6p\,|\,r\,|\,6s) = -3.271$ and $(6p\,|\,r\,|\,5d) = -2.776$.

The 482 reported transitions correspond to 470 lines, but for several of the 12 doubly-classified lines, the *gA* value should indicate the dominant transition. The average deviation between the measured wavelengths and those derived from the energy levels is 0.004 Å. Some large discrepancies occur for very strong transitions to the ground configuration.

4. Er III in stellar spectra

The third spectrum of erbium is known to be present in the spectra of chemically peculiar stars of the upper main sequence. Aikman, Cowley and Crosswhite [16] find Er III by coincidence statistics in four of five stars with third spectra of the lanthanides. It is probably present in the fifth star as well. HR 465 at the time of its rare earth maximum is particularly well suited for line identification work because of the sharpness of the spectral lines. Moreover, Bidelman's [8] plates have unusually good coverage in the near ultraviolet.

The present analysis has resulted in some thirty modifications of the published identification list for Er III. These changes range from an indication that a previously observed laboratory line is now classified, to entirely new identifications of stellar features. The changes will be incorporated in the electronic list available from the University of Michigan (CRC's home page). They are listed in Table IV.

An open question is described below. The transition between the ground level $4f^{12}\,{}^3H_6$ and the third level with $J = 6$ in $4f^{11}5d$, named $(^4I_{13/2},\ d_{3/2})$ is predicted at 3638.977 Å. It is lacking in both laboratory linelists [2, 9] although its probability is high. The corresponding line in the $4f^{12}6s^2$–$4f^{11}5d5s^2$ transition array of Er I, where the $6s^2$ closed shell does not change the coupling conditions for the lowest multiplets, occurs at 6221 Å. It is the strongest Er I line observed above 5827 Å according to [15]. In the spectrum of HR 465 [8], an intense ($I = 5d$?) unassigned line at 3639.01 Å fits the Er III expected wavelength. For clarifying this point, and for resuming the search for Er III levels on better grounds, new laboratory observations are needed.

Acknowledgements

The authors are indebted to H. M. and H. Crosswhite who kindly provided them with the linelists needed in this study. The first authors are grateful to A. Bachelier and J. Sinzelle who enable them to perform the parametric calculations of Er III at the C.R.I. computer centre of Paris-Sud university. The revision of lanthanide spectra for plasma diagnostic purposes is part of a project supported by the Scientific and Environmental Affairs Division of the North Atlantic Treaty Organization (Grant CRG930793 acknowledged by the first authors.

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Table I. *Classified lines of Er III. The successive columns are: (1) the air wavelength λ_{exp} (in Å) from [9] unless indicated, (2) the intensity, (3) the vacuum wavenumber (in cm^{-1}), (4) the difference $\lambda_{exp} - \lambda_{RITZ}$, λ_{RITZ} being calculated from the levels, (5) the even energy level E^e, (6) the quantum number J^e, (7) the odd energy level E^0 and (8) the quantum number J^0, (9) the labels of both levels as given in Table II (a condensed physical designation), (10) the transition probability gA (in s^{-1}), g being the statistical weight of the upper level; an eventual note is explicited at the end of the Table.*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
6824.295	80	14649.49	0.009	18383.59	4–33033.10	4	1G–d	
6644.005	80	15047.01	−0.004	6969.80	5–22016.80	5	3H–I7d5	2.279 (5)
6488.670	48	15407.22	−0.013	10785.51	4–26192.70	5	3H–I6d3	1.041 (6)
6393.635	80	15636.23	0.037	6969.80	5–22606.12	6	3H–I7d5	2.618 (5)
6302.225	41	15863.02	0.024	10785.51	4–26648.59	4	3H–I5d3	
6153.460	48	16246.52	0.037	13219.80	2–29466.42	3	3F–d	
5988.439	70	16694.22	0.021	55547.30	7–38853.02	6	I7p1–	
5903.279	80	16935.04	−0.004	5081.77	4–22016.80	5	3F–I7d5	1.464 (6)
5881.820	80	16996.83	0.007	12472.55	3–29469.40	4	3F–Id	1.075 (6)
5851.362	46	17085.30	0.007	10785.51	4–27870.83	5	3H–I6d5	3.462 (5)
5621.564	70	17783.71	0.000	18383.59	4–36167.30	3	1G–d	
5570.362	80	17947.17	0.016	18383.59	4–36330.81	5	1G–d	3.519 (5)
5471.313	48	18272.07	−0.018	18383.59	4–36655.60	5	1G–d	
5469.627	80	18277.70	−0.009	12472.55	3–30750.22	4	3F–d	[2]
5350.720	90	18683.88	0.003	10785.51	4–29469.40	4	3H–Id	
5286.634	42	18910.37	0.018	55547.30	7–36636.87	7	I7p1–F4d5	
5255.920	20	19020.87	0.028	10785.51	4–29806.48	5	3H–I5s1	[2]
5204.147	70	19210.09	0.005	10785.51	4–29995.62	5	3H–I5d3	
5200.680	80	19222.90	0.000	6969.80	5–26192.70	5	3H–I6d3	
5200.236	90	19224.54	−0.003	18383.59	4–37608.12	4	1G–d	6.019 (5)
5157.864	47	19382.47	−0.002	65934.64	5–46552.18	5	I5p1–?d	
5145.340	80	19429.65	0.008	12472.55	3–31902.23	4	3F–I4s1	1.201 (6)
4876.062	59	20502.63	0.007	6969.80	5–27472.46	6	3H–I6d3	
4862.333	80	20560.51	0.010	12472.55	3–33033.10	4	3F–d	1.216 (6)
4826.538	41	20713.00	0.022	12472.55	3–33185.64	3	3F–F4d3	
4783.122	80	20901.00	0.006	6969.80	5–27870.83	5	3H–I6d5	3.732 (6)[a]
4749.491	43	21049.00	0.034	67986.38	5–46937.23	4	I6p3–d	
4746.858	41	21060.68	−0.007	10785.51	4–31846.16	3	3H–I4d5	
4735.554	80	21110.95	−0.005	5081.77	4–26192.70	5	3F–I6d3	9.393 (6)
4734.225	70	21116.74	−0.004	10785.51	4–31902.23	4	3H–I4s1	
4694.172	41	21297.05	0.020	68234.37	4–46937.23	4	I4p1–d	
4672.716	41	21394.84	0.031	68332.21	5–46937.23	4	I4p1–d	
4669.915	80	21407.67	0.002	10785.51	4–32193.19	5	3H–I4s1	8.742 (5)
4669.094	80	21411.44	0.002	10785.51	4–32196.96	4	3H–d	1.029 (6)
4612.932	80	21672.11	0.000	55547.30	7–33875.19	6	I7p1–I5d5	
4589.485	47	21782.83	0.006	18383.59	4–40166.45	4	1G–F3s1	
4584.224	70	21807.83	0.023	6969.80	5–28777.74	6	3H–I6d5	8.702 (6)
4579.808	80	21828.86	0.000	10785.51	4–32614.37	5	3H–d	8.357 (5)
4540.722	80	22016.76	0.008	0.00	6–22016.80	5	3H–I7d5	1.181 (6)
4539.198	39	22024.15	−0.004	18383.59	4–40407.72	3	1G–d	
4497.582	80	22227.93	0.006	61493.77	6–39265.81	5	I7p3–	
4493.610	80	22247.58	0.002	10785.51	4–33033.10	4	3H–d	2.082 (6)
4471.890	80	22355.64	0.026	55547.30	7–33191.53	6	I7p1–d	
4463.014	80	22400.10	0.006	10785.51	4–33185.64	3	3H–F4d3	
4443.278	80	22499.59	0.002	6969.80	5–29469.40	4	3H–Id	6.334 (5)
4422.368	80	22605.97	0.029	0.00	6–22606.12	6	3H–I7d5	7.764 (6)
4415.580	52	22640.72	0.006	61493.77	6–38853.02	6	I7p3–	
4386.846	80	22789.02	0.008	5081.77	4–27870.83	5	3F–I6d5	7.373 (6)
4375.880	47	22846.13	0.026	61699.28	7–38853.02	6	I7p3–	
4362.230	70	22917.61	0.030	61699.28	7–38781.51	6	I7p3–	
4362.014	80	22918.75	0.006	10785.51	4–33704.29	5	3H–d	
4356.549	80	22947.50	0.000	13219.80	2–36167.30	3	3F–d	5.371 (6)
4348.926	52	22987.72	0.006	55547.30	7–32559.55	7	I7p1–I5d5	
4341.734	80	23025.80	0.004	6969.80	5–29995.62	5	3H–I5d3	4.799 (6)
4338.234	80	23044.38	0.000	6969.80	5–30014.18	6	3H–I5s1	8.674 (5)
4290.113	80	23302.85	0.007	0.00	6–23302.89	7	3H–I7d5	1.671 (7)[b]
4288.191	80	23313.30	−0.002	6969.80	5–30282.09	6	3H–I5d3	2.381 (6)
4284.687	46	23332.36	−0.006	62598.14	6–39265.81	5	I6p1–	
4266.570	80	23431.43	−0.004	12472.55	3–35903.96	4	3F–F4d	1.162 (6)
4219.151	48	23694.78	−0.005	12472.55	3–36167.30	3	3F–d	
4210.203	38	23745.13	−0.002	62598.14	6–38853.02	6	I6p1–	
4208.465	45	23754.94	−0.018	62607.86	7–38853.02	6	I6p1–	
4203.958	38	23780.41	0.002	6969.80	5–30750.22	4	3H–d	
4197.569	59	23816.60	0.005	62598.14	6–38781.51	6	I6p1–	
4123.447	80	24244.72	0.000	6969.80	5–31214.52	5	3H–d	2.120 (6)

Table I. *Continued*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
4099.277	48	24387.67	−0.007	5081.77	4–29469.40	4	3F–Id	
4088.566	48	24451.55	−0.012	55547.30	7–31095.82	6	I7p1–I4d3	
4065.037	80	24593.08	−0.002	13219.80	2–37812.87	3	3F–d	1.611 (6)
4012.691	70	24913.89	−0.007	5081.77	4–29995.62	5	3F–I5d3	9.364 (5)
4009.709	80	24932.42	0.002	6969.80	5–31902.23	4	3H–I4s1	1.061 (6)
3978.309	39	25129.20	−0.003	61699.28	7–36570.10	6	I7p3–I4d5	
3977.306	43	25135.54	0.005	12472.55	3–37608.12	4	3F–d	
3972.981	37	25162.90	0.010	61493.77	6–36330.81	5	I7p3–d	
3963.457	70	25223.36	0.005	6969.80	5–32193.19	5	3H–I4s1	1.067 (6)
3962.862	80	25227.15	0.002	6969.80	5–32196.96	4	3H–d	5.931 (6)
3962.862	80	25227.15	0.010	71779.39	5–46552.18	5	I5p3–?d	
3945.166	80	25340.30	0.003	12472.55	3–37812.87	3	3F–d	1.568 (6)
3944.563	48	25344.18	−0.002	13219.80	2–38563.97	2	3F–?d	
3943.009	38	25354.16	0.012	65934.64	5–40580.40	4	I5p1–	
3938.717T		25381.79		10785.51	4–36167.30	3	3H–d	4.376 (6)[c]
3913.504	80	25545.31	−0.001	10785.51	4–36330.81	5	3H–d	6.797 (6)
3898.347	70	25644.63	−0.009	6969.80	5–32614.37	5	3H–d	2.344 (6)
3889.267	54	25704.50	0.000	13219.80	2–38924.30	3	3F–d	2.115 (6)
3854.499	21	25936.36	−0.006	55547.30	7–29610.99	7	I7p1–I6d5	2
3853.585	80	25942.51	0.004	62598.14	6–36655.60	5	I6p1–d5	
3835.724	59	26063.30	0.000	6969.80	5–33033.10	4	3H–d	9.238 (5)
3831.596	45	26091.38	0.006	12472.55	3–38563.97	2	3F–?d	
3825.531	48	26132.70	0.000	5081.77	4–31214.52	5	3F–d	
3816.765	80	26192.76	−0.009	0.00	6–26192.70	5	3H–I6d3	8.282 (6)
3812.552	70	26221.71	0.003	6969.80	5–33191.53	6	3H–d	
3805.935	48	26267.30	−0.003	65934.64	5–39667.36	4	I5p1–F3d3	
3805.935	48	26267.30	0.004	62598.14	6–36330.81	5	I6p1–d	
3779.402	70	26451.70	0.007	12472.55	3–38924.30	3	3F–d	1.550 (6)
3761.163	80	26579.97	0.000	0.00	6–26579.97	7	3H–I6d3	1.791 (7)[d]
3739.422	80	26734.50	−0.001	6969.80	5–33704.29	5	3H–d	8.564 (6)
3738.434	48	26471.57	−0.006	62598.14	6–35856.62	6	I6p1–d	
3734.508	70	26769.68	−0.017	55547.30	7–28777.74	6	I7p1–I6d5	
3727.130	80	26822.67	−0.008	10785.51	4–37608.12	4	3H–d	2.270 (7)
3715.666	80	26905.42	−0.004	6969.80	5–33875.19	6	3H–I5d5	5.908 (6)
3704.931	38	26983.38	0.007	73920.66	5–46937.23	4	I4p3–	
3703.765	48	26991.87	0.004	55547.30	7–28555.40	8	I7p1–I6d5	
3698.901	42	27027.37	−0.001	10785.51	4–37812.87	3	3H–d	
3687.443	48	27111.42	0.000	5081.77	4–32193.19	5	3F–I4s1	
3684.999	48	27129.33	−0.007	67986.38	5–40857.10	5	I6p3–?d	
3676.510	42	27191.97	−0.001	74129.19	4–46937.23	4	I4p3–	
3658.065	59	27329.07	−0.008	68186.11	6–40857.10	5	I6p3–?d	
3639.303	43	27469.96	−0.005	56025.40	8–28555.40	8	I7p1–I6d5	
3638.977T		27472.46		0.00	6–27472.42	6	3H–I6d3	3.711 (7)[e]
3619.718	43	27618.58	0.000	61493.77	6–33875.19	6	I7p3–I5d5	
3592.978	59	27824.13	−0.005	61699.28	7–33875.19	6	I7p3–I5d5	
3586.954	80	27870.85	−0.003	0.00	6–27870.83	5	3H–I6d5	6.860 (6)
3578.693	45	27935.19	−0.003	12472.55	3–40407.72	3	3F–d	
3501.161	80	28553.78	−0.017	18383.59	4–46937.23	4	1G–	
3501.161	80	28553.78	0.001	56025.40	8–27471.61	9	I7p1–I6d5	
3492.747	48	28622.57	−0.006	5081.77	4–33704.29	5	3F–d	
3487.108	41	28668.86	0.008	75221.11	6–46552.18	5	H5p1–?d	
3480.525	80	28723.07	−0.015	62598.14	6–33875.19	6	I6p1–I5d5	
3479.377	80	28732.56	0.013	62607.86	7–33875.19	6	I6p1–I5d5	
3473.914T		28777.74		0.00	6–28777.74	6	3H–I6d5	3.082 (7)[f]
3469.007T		28818.44		0.00	6–28818.44	7	3H–I5d3	1.437 (7)[g]
3461.675	42	28879.48	−0.010	61493.77	6–32614.37	5	I7p3–d	
3460.796	80	28886.82	0.000	6969.80	5–35856.62	6	3H–d	
3455.125	48	28934.23	−0.008	6969.80	5–35903.96	4	3H–F4d	7.910 (6)
3455.125	48	28934.23	−0.001	61493.77	6–32559.55	7	I7p3–I5d5	
3451.179	59	28967.30	0.004	55547.30	7–26579.97	7	I7p1–I6d3	
3423.101	42	29204.90	−0.004	67986.38	5–38781.51	6	I6p3–	
3414.435	59	29279.03	0.001	65934.64	5–36655.60	5	I5p1–d5	
3404.896	59	29361.05	−0.005	6969.80	5–36330.81	5	3H–d	1.691 (6)
3395.673	43	29440.79	−0.001	66077.65	6–36636.87	7	I5p1–F4d5	
3395.247	59	29444.49	0.002	55547.30	7–26102.79	7	I7p1–I6s1	
3395.132	38	29445.49	−0.006	56025.40	8–26579.97	7	I7p1–I6d3	
3391.248	47	29479.21	−0.002	68332.21	5–38853.02	6	I4p1–	
3377.373	46	29600.31	−0.001	6969.80	5–36570.10	6	3H–I4d5	1.566 (6)
3376.160	59	29610.95	0.005	0.00	6–29610.99	7	3H–I6d5	1.872 (6)
3367.631	80	29685.94	−0.016	6969.80	5–36655.60	5	3H–d5	2.303 (7)
3360.729	39	29746.90	−0.007	66077.65	6–36330.81	5	I5p1–d	

Table I. *Continued*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
3353.106	41	29814.52	0.000	76751.75	5–46937.23	4	F4p3–	
3340.992	43	29922.62	−0.001	56025.40	8–26102.79	7	I7p1–I6s1	
3332.862	39	29995.61	0.001	0.00	6–29995.62	5	3H–I5d3	
3327.014	80	30048.34	−0.003	62607.86	7–32559.55	7	I6p1–I5d5	
3325.168	45	30065.02	0.006	55547.30	7–25482.23	8	I7p1–I6d3	
3307.998	80	30221.07	−0.004	66077.65	6–35856.62	6	I5p1–d	
3301.638	38	30279.28	−0.003	61493.77	6–31214.52	5	I7p3–d	
3301.228	NS	30283.04	0.005	0.00	6–30283.09	6	3H–I5d3	4.595 (6)
3287.986	32	30405.00	−0.005	62598.14	6–32193.19	5	I6p1–I4s1	
3264.236	46	30626.21	0.004	68234.37	4–37608.12	4	I4p1–d	
3262.948	48	30638.30	0.002	6969.80	5–37608.12	4	3H–d	4.217 (6)
3243.477	80	30822.21	−0.002	5081.77	4–35903.96	4	3F–F4d	1.020 (7)
3234.645	42	30906.37	0.003	62607.86	7–31701.46	8	I6p1–I5d5	
3214.950	NS	31095.70	0.012	0.00	6–31095.82	6	3H–I4d3	3.982 (6)
3175.743	NS	31479.59	0.001	61493.77	6–30014.18	6	I7p3–I5s1	
3173.454	NS	31502.29	0.003	62598.14	6–31095.8	6	I6p1–I4d3	
3172.470	NS	31512.06	−0.002	62607.86	7–31095.2	6	I6p1–I4d3	
3166.262	120	31573.85	−0.002	5081.77	4–36655.60	5	3F–d5	2.802 (7)
3135.536	41	31883.24	−0.002	6969.80	5–38853.02	6	3H–	
3117.558	48	32067.09	−0.002	68234.37	4–36167.30	3	I4p1–d	9.151 (7)
3100.400	110	32244.48	−0.007	55547.30	7–23302.89	7	I7p1–I7d5	9.556 (7)
3095.458	38	32296.02	−0.001	6969.80	5–39265.81	5	3H–	
3093.632	39	32315.08	−0.003	62598.14	6–30283.09	6	I6p1–I5d3	
3092.701	59	32324.81	−0.004	62607.86	7–30283.09	6	I6p1–I5d3	
3073.537	48	32526.35	0.000	5081.77	4–37608.12	4	3F–d	1.617 (7)
3070.402	48	32559.56	−.001	0.00	6–32559.55	7	3H–I5d5	1.473 (7)
3055.710	48	32716.10	−0.007	61493.77	6–28777.74	6	I7p3–I6d5	
3055.106	80	32722.58	−0.007	56025.40	8–23302.89	7	I7p1–I7d5	
3038.491	39	32901.50	0.004	65934.64	5–33033.10	4	I5p1–d	
3036.640	70	32921.56	−0.002	61699.28	7–28777.74	6	I7p3–I6d5	7.417 (7)
3022.655	41	33073.86	0.001	56025.40	8–22951.53	8	I7p1–I7d5	
2971.227	41	33646.30	0.004	71459.21	4–37812.87	3	I5p3–d	8.846 (7)
2963.186	43	33737.60	0.007	65934.64	5–32196.96	4	I5p1–d	8.181 (7)
2958.644	47	33789.40	0.002	62607.86	7–28818.44	7	I6p1–I5d3	8.194 (7)
2955.935	46	33820.36	0.003	62598.14	6–28777.74	6	I6p1–I6d5	
2920.825	NS	34226.88	−0.006	61699.28	7–27472.46	6	I7p3–I6d3	
2916.116	41	34282.16	−0.006	67986.38	5–33704.29	5	I6p3–d	9.579 (7)
2909.163	41	34364.08	−0.006	75221.11	6–40857.10	5	H5p1–?d	
2909.163	41	34364.08	−0.001	74944.47	5–40580.40	4	H5p1–	1.147 (8)
2906.163	38	34399.56	0.000	71055.16	4–36655.60	5	F4p1–d	9.388 (7)
2900.662	43	34464.79	−0.009	12472.55	3–46937.23	4	3F–	
2890.527	46	34585.62	−0.003	5081.77	4–39667.36	4	3F–F3d3	3.983 (7)
2878.733	100	34727.31	0.000	62598.14	6–27870.83	5	I6p1–I6d5	2.197 (8)
2869.517	40	34838.84	−0.002	65934.64	5–31095.82	6	I5p1–I4d3	8.238 (7)
2849.629	48	35081.98	−0.004	61493.77	6–26411.84	6	I7p3–I6s1	1.592 (8)
2846.592	39	35119.40	−0.007	61699.28	7–26579.97	7	I7p3–I6d3	
2846.080	120	35125.72	−0.003	62598.14	6–27472.46	6	I6p1–I6d3	7.663 (8)
2845.293	120	35135.44	−0.003	62607.86	7–27472.46	6	I6p1–I6d3	3.378 (8)
2844.988	45	35139.21	−0.005	73920.66	5–38781.51	6	I4p3–	
2840.591	47	35193.60	−0.008	71050.12	5–35856.62	6	F4p1–d	2.983 (8)
2833.031	70	35287.51	−0.006	61699.28	7–26411.84	6	I7p3–I6s1	3.414 (8)
2832.674	45	35291.95	−0.003	71459.21	4–36167.30	3	I5p3–d	2.163 (8)
2830.340	100	35321.05	0.002	55547.30	7–20226.22	7	I7p1–I7s1	9.694 (8)
2824.747	110	35390.99	−0.001	61493.77	6–26102.79	7	I7p3–I6s1	7.489 (8)
2816.182	43	35498.61	0.001	5081.77	4–40580.40	4	3F–	1.846 (7)
2811.697	41	35555.24	0.001	71459.21	4–35903.96	4	I5p3–F4d	
2808.634	46	35594.02	−0.006	76174.34	3–40580.40	4	F3p1–	
2808.437	47	35596.51	−0.002	61699.28	7–26102.79	7	I7p3–I6s1	1.573 (8)
2806.584	120	35620.01	−0.001	68234.37	4–32614.37	5	I4p1–d	9.538 (8)
2805.869	120	35629.08	−0.003	55547.30	7–19918.26	8	I7p1–I7d3	1.193 (9)
2804.098	90	35651.58	−0.002	65934.64	5–30283.09	6	I5p1–I5d3	6.315 (8)
2798.896	43	35717.85	−0.001	68332.21	5–32614.37	5	I4p1–d	1.502 (8)
2795.907	48	35756.02	−0.003	71050.12	5–35294.14	4	F4p1–F4s1	1.345 (9)
2795.517	46	35761.02	0.000	71055.16	4–35294.14	4	F4p1–F4s1	6.740 (8)
2795.081	41	35766.60	0.002	76174.34	3–40407.72	3	F3p1–d	4.462 (8)
2795.081	41	35766.60	0.006	10785.51	4–46552.18	5	3H–?d	
2793.296	41	35789.45	−0.002	67986.38	5–32196.96	4	I6p3–d	1.287 (8)
2792.900	42	35794.52	0.003	66077.65	6–30283.09	6	I5p1–I5d3	1.471 (8)
2792.539	59	35799.15	0.002	56025.40	8–20226.22	7	I7p1–I7s1	3.408 (9)
2788.065	45	35856.59	0.002	0.00	6–35856.62	6	3H–d	4.689 (7)
2783.109	48	35920.45	0.001	65934.64	5–30014.18	6	I5p1–I5s1	2.003 (9)

Table I. *Continued*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
2782.440	38	35929.07	0.002	71785.72	6–35856.62	6	I5p3–d	
2781.669	46	35939.03	−0.001	65934.64	5–29995.62	5	I5p1–I5d3	7.705 (8)
2780.405	47	35955.37	−0.005	75221.11	6–39265.81	5	H5p1–	
2776.347	48	36007.93	−0.003	76174.34	3–40166.45	4	F3p1–F3s1	1.346 (9)
2775.556	48	36018.18	−.001	62598.14	6–26579.97	7	I6p1–I6d3	4.072 (8)
2774.805	48	36027.93	−0.003	62607.86	7–26579.97	7	I6p1–I6d3	1.168 (9)
2773.785	48	36041.18	0.000	68234.37	4–32193.19	5	I4p1–I4s1	1.184 (9)
2772.073	48	36063.44	0.002	66077.65	6–30014.18	6	I5p1–I5s1	1.549 (9)
2771.361	42	36072.71	−0.006	76480.35	4–40407.72	3	F3p1–d	8.871 (8)
2770.643	41	36082.05	−0.001	66077.65	6–29995.62	5	I5p1–I5d3	
2770.481	39	36084.16	−0.001	67986.38	5–31902.23	4	I6p3–I4s1	1.757 (8)
2768.715	48	36107.17	−0.002	56025.40	8–19918.26	8	I7p1–I7d3	7.895 (8)
2767.360	48	36124.85	−0.005	71050.12	5–34925.33	5	F4p1–F4s1	1.489 (9)
2767.106	48	36128.17	−0.001	65934.64	5–29806.48	5	I5p1–I5s1	5.432 (8)
2766.976	48	36129.87	−0.003	71055.16	4–34925.33	5	F4p1–F4s1	1.521 (9)
2766.562	48	36135.28	−0.002	68332.21	5–32196.96	4	I4p1–d	9.003 (8)
2766.273	48	36139.05	−0.002	68332.21	5–32193.19	5	I4p1–I4s1	1.011 (9)
2764.442	48	36162.98	−0.001	74944.47	5–38781.51	6	H5p1–	2.508 (9)
2764.281	39	36165.09	−0.002	71459.21	4–35294.14	4	I5p3–F4s1	2.779 (8)
2762.659	48	36186.32	−0.001	62598.14	6–26411.84	6	I6p1–I6s1	8.357 (8)
2761.915	59	36196.07	−0.004	62607.86	7–26411.84	6	I6p1–I6s1	2.844 (9)
2759.226	70	36231.34	0.000	55547.30	7–19315.96	8	I7p1–I7s1	3.587 (9)
2756.196	70	36271.17	0.000	66077.65	6–29806.48	5	I5p1–I5s1	2.696 (9)
2752.957	47	36313.84	0.004	76480.35	4–40166.45	4	F3p1–F3s1	7.823 (8)
2751.567	48	36332.18	−0.003	68234.4	4–31902.23	4	I4p1–I4s1	1.075 (9)
2748.848	48	36368.12	−0.002	75221.11	6–38853.02	6	H5p1–	8.733 (8)
2746.032	48	36405.42	0.002	62598.14	6–26192.70	5	I6p1–I6d3	1.084 (9)
2744.183	48	36429.95	0.002	68332.21	5–31902.23	4	I4p1–I4s1	1.485 (9)
2743.456	47	36439.60	0.000	75221.11	6–38781.51	6	H5p1–	1.574 (9)
2741.417	46	36466.70	−0.003	66077.65	6–29610.99	7	I5p1–I6d5	3.559 (8)
2740.018	41	36485.32	−0.005	71779.39	5–35294.14	4	I5p3–F4s1	
2739.266	70	36495.33	0.002	62598.14	6–26102.79	7	I6p1–I6s1	2.897 (9)
2738.534	70	36505.08	−0.001	62607.86	7–26102.79	7	I6p1–I6s1	1.574 (9)
2737.334	42	36521.09	−0.001	74129.19	4–37608.12	4	I4p3–d	
2736.375	43	36533.88	0.000	71459.21	4–34925.33	5	I5p3–F4s1	
2727.287	42	36655.62	−0.001	0.00	6–36655.60	5	3H–d5	3.140 (7)
2723.288	120	36709.44	0.000	56025.40	8–19315.96	8	I7p1–I7s1	2.839 (9)
2715.628	48	36812.99	0.000	76480.35	4–39667.36	4	F3p1–F3d3	8.490 (8)
2712.601	38	36854.07	−0.001	71779.39	5–34925.33	5	I5p3–F4s1	2.164 (8)
2703.987	41	36971.46	0.009	68186.11	6–31214.52	5	I6p3–d	
2700.456	42	37019.81	0.003	68234.37	4–31214.52	5	I4p1–d	2.511 (8)
2698.359	120	37048.57	0.001	56025.40	8–18976.82	9	I7p1–I7d3	2.477 (9)
2693.334	80	37117.69	0.000	68332.21	5–31214.52	5	I4p1–d	8.708 (8)
2692.766	120	37125.52	0.008	62607.86	7–25482.23	8	I6p1–I6d3	2.113 (9)
2690.867	39	37151.71	−0.010	77318.02	3–40166.45	4	F4p3–F3s1	
2684.747	100	37236.40	−0.001	68332.21	5–31095.82	6	I4p1–I4d3	1.552 (9)
2683.100	100	37259.26	−0.004	66077.65	6–28818.44	7	I5p1–I5d3	1.321 (9)
2682.684	43	37265.04	0.001	73920.66	5–36655.60	5	I4p3–d5	6.365 (8)
2680.172	48	37299.96	−0.004	66077.65	6–28777.74	6	I5p1–I6d5	4.964 (8)
2666.872	38	37485.97	−0.002	76751.75	5–39265.81	5	F4p3–	
2651.502	43	37703.25	0.003	67986.38	5–30283.09	6	I6p3–I5d3	4.478 (8)
2647.872	38	37754.93	−0.001	71459.21	4–33704.29	5	I5p3–d	3.545 (8)
2640.621	48	37858.60	−0.001	71050.12	5–33191.53	6	F4p1–d	9.064 (8)
2639.858	47	37869.55	−0.002	71055.16	4–33185.64	3	F4p1–F4d3	6.010 (8)
2637.778	80	37899.40	0.000	55547.30	7–17647.90	7	I7p1–I7d3	1.234 (9)
2637.527	39	37903.02	0.000	68186.11	6–30283.09	6	I6p3–I5d3	
2637.444	48	37904.20	0.000	71779.39	5–33875.19	6	I5p3–I5d5	7.099 (8)
2637.007	48	37910.48	0.004	71785.72	6–33875.19	6	I5p3–I5d5	8.443 (8)
2633.440	39	37961.83	−0.013	10785.51	4–48747.15	5	3H–?d	2.558 (7)
2633.440	39	37961.83	0.004	74129.19	4–36167.30	3	I4p3–d	3.886 (8)
2632.861	41	37970.18	0.004	76751.75	5–38781.51	6	F4p3–	
2631.439	42	37990.70	0.004	67986.38	5–29995.62	5	I6p3–I5d3	3.985 (8)
2627.018	42	38054.63	0.001	76978.95	4–38924.30	3	F4p3–d	2.191 (8)
2626.377	59	38063.91	−0.007	65934.64	5–27870.83	5	I5p1–I6d5	2.776 (8)
2626.377	59	38063.91	0.009	73920.66	5–35856.62	6	I4p3–d	9.813 (8)
2625.604	45	38075.11	−0.001	71779.39	5–33704.29	5	I5p3–d	6.791 (8)
2625.204	41	38080.91	0.000	61032.44	9–22951.53	8	I7p3–I7d5	1.309 (8)
2618.949	45	38171.86	0.005	68186.11	6–30014.18	6	I6p3–I5s1	3.664 (8)
2618.402	40	38179.83	0.005	67986.38	5–29806.48	5	I6p3–I5s1	1.497 (8)
2617.649	59	38190.83	0.003	61493.77	6–23302.89	7	I7p3–I7d5	4.677 (8)
2614.536	47	38236.29	0.000	61539.18	8–23302.89	7	I7p3–I7d5	1.681 (8)

Table I. *Continued*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
2606.010	42	38361.38	0.006	76174.34	3–37812.87	3	F3p1–d	3.538 (8)
2605.130	39	38374.34	0.002	74944.47	5–36570.10	6	H5p1–I4d5	2.913 (8)
2604.916	80	38377.49	0.001	56025.40	8–17647.90	7	I7p1–I7d3	6.100 (8)
2603.815	39	38393.72	0.000	77318.02	3–38924.30	3	F4p3–d	3.558 (8)
2603.633	60	38396.40	−0.001	61699.28	7–23302.89	7	I7p3–I7d5	1.615 (9)
2601.637	41	38425.86	0.018	71459.21	4–33033.10	4	I5p3–d	2.766 (8)
2600.965	59	38435.79	−0.003	71050.12	5–32614.37	5	F4p1–d	9.048 (8)
2599.183	45	38462.13	0.003	65934.64	5–27472.46	6	I5p1–I6d3	2.499 (8)
2598.404	59	38473.67	0.001	68084.68	7–29610.99	7	I6p3–I6d5	8.734 (8)
2595.489	59	38516.87	0.007	67986.38	5–29469.40	4	I6p3–Id	5.608 (8)
2592.203	39	38565.69	−0.012	75221.11	6–36655.60	5	H5p1–d5	2.923 (8)
2591.839	90	38571.10	−0.005	55547.30	7–16976.28	6	I7p1–I7d3	1.982 (9)
2591.570	80	38575.12	0.000	68186.11	6–29610.99	7	I6p3–I6d5	1.062 (9)
2590.970	46	38584.05	0.013	75221.11	6–36636.87	7	H5p1–F4d5	
2590.727	80	38587.66	−0.001	61539.18	8–22951.53	8	I7p3–I7d5	1.452 (9)
2590.727	80	38587.66	0.013	71779.39	5–33191.53	6	I5p3–d	
2589.548	NS	38605.23	−0.002	66077.65	6–27472.46	6	I5p1–I6d3	1.644 (8)
2588.985	59	38613.62	0.003	74944.47	5–36300.81	5	H5p1–d	6.474 (8)
2588.124	42	38626.48	0.003	73920.66	5–35294.14	4	I4p3–F4s1	
2585.384	41	38667.40	0.005	76480.35	4–37812.87	3	F3p1–d	
2580.123	41	38746.24	0.003	71779.39	5–33033.10	4	I5p3–d	1.574 (8)
2580.024	80	38747.74	0.001	61699.28	7–22951.53	8	I7p3–I7d5	1.379 (9)
2579.603	59	38754.05	0.000	77318.02	3–38563.97	2	F4p3–?d	
2578.889	59	38764.79	0.012	68234.37	4–29469.40	4	I4p1–Id	2.761 (8)
2578.687	80	38767.82	0.009	68234.37	4–29466.42	3	I4p1–Id	6.668 (8)
2573.031	59	38853.04	−0.001	0.00	6–38853.02	6	3H–	
2573.031	59	38853.04	0.008	71050.12	5–32196.96	4	F4p1–d	
2572.441	48	38861.94	0.002	71055.16	4–32193.19	5	F4p1–I4s1	2.248 (8)
2571.194	47	38880.79	0.002	67699.20	8–28818.44	7	I6p3–I5d3	1.060 (8)
2570.746	80	38887.56	−0.002	61493.77	6–22606.12	6	I7p3–I7d5	1.177 (9)
2565.199	80	38971.65	0.005	71531.27	7–32559.55	7	I5p3–I5d5	9.590 (8)
2560.668	48	39040.61	−0.006	74944.47	5–35903.96	4	H5p1–F4d	1.707 (8)
2557.227	80	39093.13	−0.006	61699.28	7–22606.12	6	I7p3–I7d5	7.999 (8)
2553.920	80	39143.75	−0.008	76751.75	5–37608.12	4	F4p3–d	
2553.920	80	39143.75	0.003	67699.20	8–28555.40	8	I6p3–I6d5	1.112 (9)
2552.535	39	39164.99	0.002	71779.39	5–32614.37	5	I5p3–d	
2552.470	43	39165.98	0.006	76978.95	4–37812.87	3	F4p3–d	2.003 (8)
2550.008	45	39203.79	0.005	74129.19	4–34925.33	5	I4p3–F4s1	
2549.698	41	39208.57	0.005	67986.38	5–28777.74	6	I6p3–I6d5	1.495 (8)
2548.557	80	39226.11	0.004	71785.72	6–32559.55	7	I5p3–I5d5	1.626 (9)
2546.213	45	39262.23	0.001	71459.21	4–32196.96	4	I5p3–d	
2545.953	80	39266.24	0.000	68084.68	7–28818.44	7	I6p3–I5d3	5.974 (8)
2544.673	80	39285.99	0.004	65934.64	5–26648.4	4	I5p1–I5d3	1.024 (9)
2543.320	59	39306.89	0.003	68084.68	7–28777.76	6	I6p3–I6d5	3.831 (8)
2540.909	80	39344.17	0.000	61032.44	9–21688.27	9	I7p3–I7d5	1.105 (9)
2539.600	46	39364.45	0.002	75221.11	6–35856.62	6	H5p1–d	
2539.192	48	39370.79	0.002	76978.95	4–37608.12	4	F4p3–d	2.651 (8)
2563.775	80	39408.29	0.005	68186.11	6–28777.76	6	I6p3–I6d5	8.651 (8)
2532.367	80	39476.88	0.006	61493.77	6–22016.80	5	I7p3–I7d5	1.899 (9)
2531.037	70	39497.62	0.004	66077.65	6–26579.97	7	I5p1–I6d3	3.016 (8)
2529.431	70	39522.69	0.007	65934.64	5–26411.84	6	I5p1–I6s1	5.233 (8)
2529.020	80	39529.12	0.010	68084.68	7–28555.40	8	I6p3–I6d5	2.073 (9)
2527.243	46	39556.92	0.004	71459.21	4–31902.23	4	I5p3–I4s1	1.303 (8)
2525.613	42	39582.44	−0.004	6969.80	5–46552.18	5	3H–?d	
2525.613	42	39582.44	−0.001	71779.39	5–32196.96	4	I5p3–d	1.647 (8)
2523.662	41	39613.04	0.001	71459.21	4–31846.16	3	I5p3–I4d5	3.826 (8)
2521.293	40	39650.26	0.004	74944.47	5–35294.14	4	H5p1–F4s1	1.632 (8)
2520.310	59	39665.73	0.005	66077.65	6–26411.84	6	I5p1–I6s1	2.358 (8)
2515.486	48	39741.79	0.010	65934.64	5–26192.70	5	I5p1–I6d3	2.104 (8)
2509.926	80	39829.82	−0.001	71531.27	7–31701.46	8	I5p3–I5d5	3.308 (9)
2509.563	54	39835.57	0.002	71050.12	5–31214.52	5	F4p1–d	1.934 (8)
2509.245	46	39840.63	0.001	71055.16	4–31214.52	5	F4p1–d	1.408 (8)
2508.597	80	39850.92	−0.001	61539.18	8–21688.27	9	I7p3–I7d5	2.581 (9)
2501.281	46	39967.48	−0.003	6969.80	5–46937.23	4	3H–	
2500.824	42	39974.77	0.006	66077.65	6–26102.79	7	I5p1–I6s1	
2498.053	48	40019.11	0.002	74944.47	5–34925.33	5	H5p1–F4s1	2.937 (8)
2494.910	46	40069.53	−0.012	76724.94	6–36655.60	5	F4p3–d5	
2493.756	70	40088.07	0.000	76724.94	6–36636.87	7	F4p3–F4d5	2.407 (9)
2492.050	70	40115.51	0.003	67986.38	5–27870.83	5	I6p3–I6d5	3.383 (8)
2489.936	43	40149.56	−0.001	76480.35	4–36330.81	5	F3p1–d	
2489.606	59	40154.88	−0.002	76724.94	6–36570.10	6	F4p3–I4d5	6.309 (8)

Table I. *Continued*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
2487.949	70	40181.63	0.001	76751.75	5– 36570.10	6	F4p3–I4d5	1.225 (9)
2485.111	70	40227.51	0.005	67699.20	8– 27471.61	9	I6p3–I6d5	3.837 (9)
2482.464	45	40270.40	−0.001	76174.34	3– 35903.96	4	F3p1–F4d	4.977 (8)
2480.645	46	40299.94	−0.003	71050.12	5– 30750.22	4	F4p1–d	2.270 (8)
2480.336	59	40304.95	−0.001	71055.16	4– 30750.22	4	F4p1–d	4.996 (8)
2479.704	70	40315.22	0.004	68186.11	6– 27870.83	5	I6p3–I6d5	7.258 (8)
2476.818	43	40362.19	0.003	73395.34	3– 33033.10	4	I4p3–d	1.532 (8)
2473.215	59	40420.98	−0.002	76751.75	5– 36330.81	5	F4p3–d	5.757 (8)
2467.542	43	40513.90	0.001	67986.38	5– 27472.46	6	I6p3–I6d3	
2464.610	70	40562.11	0.000	61032.44	9– 20570.33	10	I7p3–I7d5	4.358 (9)
2463.740	59	40576.43	−0.002	76480.35	4– 35903.96	4	F3p1–F4d	2.886 (8))
2461.566	41	40612.26	−0.003	68084.68	7– 27472.46	6	I6p3–I6d3	
2459.391	42	40648.18	−0.002	76978.95	4– 36330.81	5	F4p3–d	2.955 (8)
2454.542	48	40728.47	−0.001	73919.99	6– 33191.53	6	I4p3–d	4.692 (8)
2454.502	48	40729.14	−0.001	73920.66	5– 33191.53	6	I4p3–d	3.945 (8)
2446.815	43	40857.08	0.001	0.00	6– 40857.10	5	3H–?d	1.980 (7)
2445.433	48	40880.17	0.002	76174.34	3– 35294.14	4	F3p1–F4s1	4.770 (8)
2439.441	41	40980.58	−0.008	81837.54	4– 40857.10	5	F3p3–?d	2.729 (8)
2436.148	48	41035.97	−0.002	71050.12	5– 30014.18	6	F4p1–I5s1	
2434.680	54	41060.71	−0.003	61539.18	8–102599.84	8	I7p3–I77s	2.624 (9)
2432.590	59	41095.98	0.007	74129.19	4– 33033.10	4	I4p3–d	3.674 (8)
2431.513	70	41114.19	−0.001	61032.44	9– 19918.26	8	I7p3–I7d3	9.967 (8)
2431.215	40	41119.21	0.001	67699.20	8– 26579.97	7	I6p3–I6d3	
2427.260	59	41186.22	−0.001	76480.35	4– 35294.14	4	F3p1–F4s1	4.833 (8)
2426.542	70	41198.40	−0.001	73395.34	3– 32196.96	4	I4p3–d	9.143 (8)
2425.582	54	41214.71	−0.004	61699.28	7–102913.92	7	I7p3–I77s	2.708 (9)
2423.878	59	41243.67	−0.002	71050.12	5– 29806.48	5	F4p1–I5s1	4.019 (8)
2423.588	70	41248.62	0.004	71055.16	4– 29806.48	5	F4p1–I5s1	1.216 (9)
2422.471	80	41267.63	−0.005	61493.77	6– 20226.22	7	I7p3–I7s1	5.228 (9)
2420.242	70	41305.64	−0.001	73919.99	6– 32614.37	5	I4p3–d	1.925 (9)
2420.204T	Bl			73920.66	5– 32614.37	5	I5p3–d	1.764 (9)
2419.818	80	41312.88	0.005	61539.18	8– 20226.22	7	I7p3–I7s1	3.471 (9)
2418.359	70	41337.80	−0.001	67986.38	5– 26648.59	4	I6p3–I5d3	5.581 (8)
2416.202	42	41374.70	0.002	61539.18	8–102913.92	7	I7p3–I77s	1.704 (9)
2413.911	48	41413.95	0.006	77318.02	3– 35903.96	4	F4p3–F4d	3.051 (8)
2413.552	48	41420.12	0.002	61493.77	6–102913.92	7	I7p3–I77s	2.543 (9)
2412.993	70	41429.71	0.006	81837.54	4– 40407.72	3	F3p3–d	
2411.977	70	41447.16	0.000	80712.97	6– 39265.81	5	H5p3–	
2411.369	70	41457.61	0.000	76751.75	5– 35294.14	4	F4p3–F4s1	2.158 (9)
2411.031	41	41463.43	0.009	71459.21	4– 29995.62	5	I5p3–I5d3	
2410.630	45	41470.32	0.005	5081.77	4– 46552.18	5	3F–?d	
2410.472	75	41473.04	0.001	61699.28	7– 20226.22	7	I7p3–I7s1	5.415 (9)
2409.308	70	41493.08	0.002	73395.34	3– 31902.23	4	I4p3–I4s1	2.578 (9)
2409.125	41	41496.23	0.004	71779.39	5– 30283.09	6	I5p3–I5d3	
2408.746	59	41502.76	−0.008	71785.72	6– 30283.09	6	I5p3–I5d3	4.827 (8)
2407.911	70	41517.14	−0.003	71531.27	7– 30014.18	6	I5p3–I5s1	6.839 (9)
2405.717	70	41555.01	0.001	76480.35	4– 34925.33	5	F3p1–F4s1	2.314 (8)
2404.998	48	41567.42	−0.001	61032.44	9–102599.84	8	I7p3–I77s	4.965 (9)
2404.586	70	41574.56	−0.001	67986.38	5– 26411.85	6	I6p3–I6s1	4.897 (9)
2403.763	70	41588.78	−0.002	71055.16	4– 29466.42	3	F4p1–Id	2.024 (8)
2403.320	75	41596.45	−0.002	67699.20	8– 26102.79	7	I6p3–I6s1	8.960 (9)
2402.760	59	41606.14	0.000	68186.11	6– 26579.97	7	I6p3–I6d3	3.698 (8)
2400.071	70	41652.75	−0.001	71459.21	4– 29806.48	5	I5p3–I5s1	3.287 (9)
2399.018	59	41671.03	0.003	81837.54	4– 40166.45	4	F3p3–F3s1	
2398.913	59	41672.87	−0.002	68084.68	7– 26411.84	6	I6p3–I6s1	2.912 (9)
2398.226	70	41684.79	0.001	76978.95	4– 35294.14	4	F4p3–F4s1	3.064 (9)
2396.404	70	41716.48	0.000	61032.44	9– 19315.96	8	I7p3–I7s1	9.268 (9)
2395.986	46	41723.76	−0.003	73920.66	5– 32196.96	4	I4p3–d	
2395.813	70	41726.78	0.001	73919.99	6– 32193.19	5	I4p3–I4s1	4.732 (9)
2393.609	70	41765.20	0.001	71779.39	5– 30014.18	6	I5p3–I5s1	1.491 (9)
2393.258	70	41771.32	0.013	71785.72	6– 30014.18	6	I5p3–I5s1	3.986 (9)
2393.083	70	41774.37	−0.006	68186.11	6– 26411.84	6	I6p3–I6s1	4.909 (9)
2392.921	40	41777.20	0.009	6969.80	5– 48747.15	5	3H–?d	
2392.708	45	41780.92	0.006	61699.28	7– 19918.26	8	I7p3–I7d3	
2392.546	46	41783.76	0.001	71779.39	5– 29995.62	5	I5p3–I5d3	6.385 (8)
2391.970	70	41793.81	−0.007	67986.38	5– 26192.70	5	I6p3–I6d3	3.063 (8)
2391.637	70	41799.63	−0.001	76724.94	6– 34925.33	5	F4p3–F4s1	6.584 (9)
2390.109	70	41826.34	0.005	76751.75	5– 34925.33	5	F4p3–F4s1	2.421 (9)
2388.191	59	41859.95	0.000	80712.97	6– 38853.02	6	H5p3–	
2385.254	43	41911.48	−0.006	74944.47	5– 33033.10	4	H5p1–d	
2384.755	38	41920.25	0.002	71531.27	7– 29610.99	7	I5p3–I6d5	

Table I. *Continued*

(1)	(2)	(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)
2384.755	38	41920.25	0.007	68332.21	5– 26411.84	6	I4p1–I6s1	1.526 (8)
2384.114	59	41931.51	−0.003	80712.97	6– 38781.51	6	H5p3–	
2384.072	59	41932.25	−0.001	74129.19	4– 32196.96	4	I4p3–d	3.891 (8)
2383.855	70	41936.07	−0.004	74129.19	4– 32193.19	5	I4p3–I4s1	1.694 (9)
2381.756	59	41973.02	−0.006	71779.39	5– 29806.48	5	I5p3–I5s1	3.257 (9)
2381.402	59	41979.26	−0.001	71785.72	6– 29806.48	5	I5p3–I5s1	2.150 (9)
2381.250	59	41981.94	−0.003	68084.68	7– 26102.79	7	I6p3–I6s1	4.994 (9)
2380.804	48	41989.81	0.000	71459.21	4– 29469.40	4	I5p3–Id	3.813 (8)
2380.628	46	41992.92	−0.007	71459.21	4– 29466.42	3	I5p3–Id	3.374 (8)
2379.179	59	42018.49	−0.003	73920.66	5– 31902.23	4	I4p3–I4s1	1.637 (9)
2378.872	59	42023.91	−0.002	77318.02	3– 35294.14	4	F4p3–F4s1	2.589 (9)
2377.186	59	42053.72	−0.006	76978.95	4– 34925.33	5	F4p3–F4s1	1.349 (9)
2377.077	59	42055.64	−0.001	61032.44	9– 18976.82	9	I7p3–I7d3	6.033 (8)
2375.511	59	42083.36	−0.002	68186.11	6– 26102.79	7	I6p3–I6s1	1.373 (9)
2370.336	59	42175.23	−0.028	71785.72	6– 29610.99	7	I5p3–I6d5	2.192 (8)
2367.988	54	42217.05	−0.005	67699.20	8– 25482.23	8	I6p3–I6d3	
2367.641	59	42223.24	−0.001	61539.18	8– 19315.96	8	I7p3–I7s1	5.926 (9)
2367.433	59	42226.95	0.001	74129.19	4– 31902.23	4	I4p3–I4s1	2.941 (9)
2359.332	59	42371.93	0.000	62598.14	6– 20226.22	7	I6p1–I7s1	1.497 (9)
2358.793	59	42381.60	0.002	62607.86	7– 20226.22	7	I6p1–I7s1	6.505 (8)
2358.699	59	42383.30	0.001	61699.28	7– 19315.96	8	I7p3–I7s1	1.529 (9)
2348.778	45	42562.31	0.003	61539.18	8– 18976.82	9	I7p3–I7d3	1.675 (8)
2348.256	45	42571.75	−0.001	81837.54	4– 39265.81	5	F3p3–	
2344.217	41	42645.10	0.001	73395.34	3– 30750.22	4	I4p3–d	2.199 (8)
2340.495	46	42712.92	−0.005	71531.27	7– 28818.44	7	I5p3–I5d3	
2338.394	59	42751.28	0.000	74944.47	5– 32193.19	5	H5p1–I4s1	3.279 (8)
2338.270	41	42753.57	−0.002	71531.27	7– 28777.74	6	I5p3–I6d5	
2334.417	47	42824.12	0.003	73919.99	6– 31095.82	6	I4p3–I4d3	1.734 (8)
2334.376	48	42824.86	−0.001	73920.66	5– 31095.82	6	I4p3–I4d3	2.485 (8)
2329.566	48	42913.29	−0.003	81837.54	4– 38924.30	3	F3p3–	
2329.483	59	42914.81	−0.007	74129.19	4– 31214.52	5	I4p3–d	3.086 (8)
2326.635	48	42967.33	−0.003	71785.72	6– 28818.44	7	I5p3–I5d3	2.355 (8)
2325.480	38	42988.68	0.001	76174.34	3– 33185.64	3	F3p1–F4d3	
2324.775	46	43001.71	−0.003	71779.39	5– 28777.74	6	I5p3–I6d5	1.572 (8)
2324.435	41	43008.01	−0.002	71785.72	6– 28777.74	6	I5p3–I6d5	
2323.359	43	43027.91	0.001	75221.11	6– 32193.19	5	H5p1–I4s1	
2322.589	59	43042.19	0.003	74944.47	5– 31902.23	4	H5p1–I4s1	2.391 (8)
2309.194	59	43291.84	0.003	62607.86	7– 19315.96	8	I6p1–I7s1	2.306 (8)
2296.380	70	43533.39	0.001	76724.94	6– 33191.53	6	F4p3–d	4.423 (8)
2290.894	40	43637.62	−0.003	73920.66	5– 30283.09	6	I4p3–I5d3	
2289.438	45	43665.37	0.000	5081.77	4– 48747.15	5	3F–?d	
2277.654	65	43891.26	0.001	61539.18	8– 17647.90	7	I7p3–I7d3	7.468 (8)
2276.433	59	43914.80	0.005	71785.72	6– 27870.83	5	I5p3–I6d5	1.858 (8)
2275.904	48	43925.02	0.001	73920.66	5– 29995.62	5	I4p3–I5d3	1.782 (8)
2275.704	46	43928.88	0.002	73395.34	3– 29466.42	3	I4p3–Id	1.587 (8)
2269.376	59	44051.35	0.001	61699.28	7– 17647.90	7	I7p3–I7d3	2.149 (8)
2268.994	43	44058.78	0.001	71531.27	7– 27472.46	6	I5p3–I6d3	
2265.210	45	44132.37	0.000	77318.02	3– 33185.64	3	F4p3–F4d3	1.763 (8)
2262.040	47	44194.20	0.003	74944.47	5– 30750.22	4	H5p1–d	
2255.967	46	44313.17	0.005	71785.72	6– 27472.46	6	I5p3–I6d3	
2252.463	43	44382.09	0.004	80712.97	6– 36330.81	5	H5p3–d	
2248.962	45	44451.19	0.004	73920.66	5– 29469.40	4	I4p3–Id	
2245.615	46	44517.43	0.003	61493.77	6– 16976.28	6	I7p3–I7d3	
2244.898	45	44531.65	0.005	76724.94	6– 32193.19	5	F4p3–I4s1	
2235.292	59	44722.99	0.000	61699.28	7– 16976.28	6	I7p3–I7d3	3.178 (8)
2232.360	48	44781.73	0.003	68084.68	7– 23302.89	7	I6p3–I7d5	
2198.158	41	45478.43	0.006	68084.68	7– 22606.12	6	I6p3–I7d5	3.117 (8)
2193.262	39	45579.95	0.002	68186.11	6– 22606.12	6	I6p3–I7d5	
2190.780	39	45631.58	0.000	62607.86	7– 16976.28	6	I6p1–I7d3	
2165.267	41	46169.18	0.006	68186.11	6– 22016.80	5	I6p3–I7d5	
2132.044	42	46888.54	−0.001	56025.40	8–102913.92	7	I7p1–I77s	3.933 (9)
2124.614	45	47052.50	0.002	55547.30	7–102599.84	8	I7p1–I77s	4.566 (9)

Notes: Lines noted NS in the second column (Intensity) are taken from Ref. [2].
[2] Possibly blend with an Er II line.
[a] Wavelength from Ref. [2], the deviation with Ref. [9] is too large.
[b] Revised wavelength from H. Crosswhite.
[c] Theoretical wavelength, masked by a strong Er II line.
[d] Given as Er II in Ref. [9] and absent in Ref. [2].
[e] Theoretical wavelength, absent in Ref. [2] and [9], but strong in HR 465 (Ref. [8]).
[f] Theoretical wavelength, far from 3473.870 (Ref. [9]).
[g] Theoretical wavelength, far from 3469.127 (Ref. [9]).

Table II. *Energy levels of Er III with main components of their eigenfunctions and* gth *Landé factors. Leading components smaller than* 33% *are omitted.*

Configuration $4f^{12}$

LS-Term	J	Energy (cm^{-1})	1st Comp. %	2nd Comp.	%	gth	Note	Label in Table I
^3H	6	0.00	99.2	^1I	0.8	1.165	a	3H
^3H	5	6969.80	100.0		0.0	1.033	a	3H
^3H	4	10785.51	61.5	^3G	27.0	1.139	b	3H
^3F	4	5081.77	62.7	^1G	28.7	0.945	a	3F
^3F	3	12472.55	100.0		0.0	1.083	N	3F
^3F	2	13219.80	79.9	^1D	18.6	0.732	N	3F
^1G	4	18383.59	59.8	^3H	29.9	0.966	N	1G

Configuration $4f^{11}6p$

Multiplet	J	Energy (cm^{-1})	1st Comp. %	gth	Note	
$^4I_{15/2}p_{1/2}$	7	55547.30	96	1.243	a	I7p1
	8	56025.40	98	1.164	a	I7p1
$^4I_{15/2}p_{3/2}$	9	61032.44	98	1.219	a	I7p3
	6	61493.77	72	1.170	a	I7p3
	8	61539.18	98	1.207	a	I7p3
	7	61699.28	84	1.167	a	I7p3
$^4I_{13/2}p_{1/2}$	6	62598.14	74	1.146	a	I6p1
	7	62607.86	86	1.086	a	I6p1
$^4I_{11/2}p_{1/2}$	5	65934.64	79	1.026	a	I5p1
	6	66077.65	82	0.964	a	I5p1
$^4I_{13/2}p_{3/2}$	8	67699.20	99	1.148	c	I6p3
	5	67986.38	90	1.047	a	I6p3
	7	68084.68	99	1.130	a	I6p3
	6	68186.11	95	1.088	a	I6p3
$^4I_{9/2}p_{1/2}$	4	68234.37	50	0.937	N	I4p1
	5	68332.21	54	0.876	N	I4p1
$^4F_{9/2}p_{1/2}$	5	71050.12	54	1.100	N	F4p1
	4	71055.16	50	1.128	N	F4p1
$^4I_{11/2}p_{3/2}$	4	71459.21	61	0.932	N	I5p3
	7	71531.27	83	1.061	N	I5p3
	5	71779.39	72	0.983	a	I5p3
	6	71785.72	81	1.036	a	I5p3
$^4I_{9/2}p_{3/2}$	3	73395.34	66	0.651	N	I4p3
	6	73919.99	52	1.011	N	I4p3
	5	73920.66	38	1.032	N	I4p3
	4	74129.19	56	0.867	N	I4p3
$^2H_{11/2}p_{1/2}$	5	74944.47	40	1.122	N	H5p1
	6	75221.11	52	1.091	N	H5p1
$^4F_{7/2}p_{1/2}$	3	76174.34	82	1.239	N	F3p1
	4	76480.35	85	1.161	N	F3p1
$^4F_{9/2}p_{3/2}$	6	76724.94	61	1.183	N	F4p3
	5	76751.75	53	1.143	N	F4p3
	4	76978.95	60	1.153	N	F4p3
	3	77318.02	56	1.178	N	F4p3
$^2H_{11/2}p_{3/2}$	6	80712.97	53	1.153	N	H5p3
$^4F_{7/2}p_{3/2}$	4	81837.54	54	1.178	N	F3p3

Configuration $4f^{11}5d + 4f^{11}6s$

Multiplet	J	Energy (cm^{-1})	First Comp. %	$4f^{11}6s$ %	gth	Note	Label in Table I
$^4I_{15/2}d_{3/2}$	6	16976.28	91	0.0	1.301	a	I7d3
	7	17647.90	78	0.2	1.262	a	I7d3
	9	18976.82	95	0.0	1.137	a	I7d3
	8	19918.26	92	0.1	1.179	a	I7d3
$^4I_{15/2}s_{1/2}$	8	19315.96	97	99.9	1.246	a	I7s1
	7	20226.22	96	99.3	1.148	a	I7s1
$^4I_{15/2}d_{5/2}$	10	20470.33	96	0.0	1.197	a	I7d5
	9	21688.27	96	0.0	1.191	a	I7d5
	5	22016.80	51	0.0	1.211	a	I7d5
	6	22606.24	52	0.1	1.205	a	I7d5
	8	22951.53	90	0.1	1.178	a	I7d5
	7	23302.89	65	0.3	1.145	a	I7d5
$^4I_{13/2}d_{3/2}$	8	25482.23	91	0.0	1.053	c	I6d3

Table II. *Continued*

Configuration $4f^{11}5d + 4f^{11}6s$							
Multiplet	J	Energy (cm^{-1})	First Comp. %	$4f^{11}6s$ %	gth	Note	Label in Table I
${}^4I_{13/2}s_{1/2}$	7	26102.79	97	97.6	1.167	a	I6d3
${}^4I_{13/2}d_{3/2}$	5	26192.70	44	0.3	1.140	a	I6d3
${}^4I_{13/2}s_{1/2}$	6	26411.84	97	99.3	1.049	a	I6s1
${}^4I_{13/2}d_{3/2}$	7	26579.97	74	2.2	1.055	a	I6d3
${}^4I_{11/2}d_{3/2}$	4	26648.59	45	0.0	1.071	N	I5d3
${}^4I_{13/2}d_{5/2}$	9	27471.61	98	0.0	1.131	N	I6d5
${}^4I_{13/2}d_{3/2}$	6	27472.46	56	0.5	1.077	a	I6d3
${}^4I_{13/2}d_{5/2}$	5	27870.83	50	0.3	1.165	a	I6d5
${}^4I_{13/2}d_{5/2}$	8	28555.40	97	0.0	1.130	c	I6d5
${}^4I_{13/2}d_{5/2}$	6	28777.74	60	3.2	1.080	a	I6d5
${}^4I_{11/2}d_{3/2}$	7	28818.44	51	0.1	1.020	a	I5d3
${}^4I_{11/2}d_{3/2}$	3	29466.42	34	0.0	0.829	N	Id
$4f^{11}5d$	4	29469.40		0.1	1.051	N	Id
${}^4I_{13/2}d_{5/2}$	7	29610.99	66	0.1	1.068	d	I6d5
${}^4I_{11/2}s_{1/2}$	5	29806.48	71	82.9	0.920	a	I5s1
${}^4I_{11/2}d_{3/2}$	5	29995.62	36	16.8	0.977	N	I5d3
${}^4I_{11/2}s_{1/2}$	6	30014.18	75	94.7	1.068	e	I5s1
${}^4I_{11/2}d_{3/2}$	6	30283.09	39	1.1	0.949	e	I5d3
${}^4F_{9/2}d_{3/2}$	4	30750.22	37	0.2	1.144	N	d
${}^4I_{9/2}d_{3/2}$	6	31095.82	50	0.9	0.870	e	I4d3
$4f^{11}5d$	5	31214.52		1.3	1.047	N	d
${}^4I_{11/2}d_{5/2}$	8	31701.46	81	0.0	1.052	N	I5d5
${}^4I_{9/2}d_{5/2}$	3	31846.16	45	0.0	0.808	N	I4d5
${}^4I_{9/2}s_{1/2}$	4	31902.23	44	82.2	0.824	N	I4s1
${}^4I_{9/2}s_{1/2}$	5	32193.19		55.3	1.037	N	I4s1
$4f^{11}5d$	4	32196.96		16.5	0.940	N	d
${}^4I_{11/2}d_{5/2}$	7	32559.55	67	0.1	1.067	N	I5d5
$4f^{11}5d$	5	32614.37		41.9	1.010	N	d
$4f^{11}5d$	4	33033.10		1.2	0.947	N	d
${}^4F_{9/2}d_{3/2}$	3	33185.64	48	0.1	1.209	N	F4d3
$4f^{11}5d$	6	33191.53		0.0	1.150	N	d
$4f^{11}5d$	5	33704.29		1.5	0.976	N	d
${}^4I_{11/2}d_{5/2}$	6	33875.19	57	0.3	1.055	e	I5d5
${}^4F_{9/2}s_{1/2}$	5	34925.33	56	99.0	1.196	N	F4s1
${}^4F_{9/2}s_{1/2}$	4	35294.14	60	91.6	1.103	N	F4s1
$4f^{11}5d$	6	35856.62		0.2	1.080	N	d
${}^4F_{9/2}d$	4	35903.96		6.7	1.161	N	F4d
$4f^{11}5d$	3	36167.30		0.4	0.928	N	d
$4f^{11}5d$	5	36330.81		0.8	1.103	N	d
${}^4I_{9/2}d_{5/2}$	6	36570.10	50	0.1	1.039	N	I4d5
${}^4F_{9/2}d_{5/2}$	7	36636.87	45	0.0	1.133	N	F4d5
$4f^{11}5d$	5	36655.60		1.5	1.006	N	d5
${}^4I_{9/2}d_{5/2}$	4	37608.12	40	0.8	0.891	N	d
$4f^{11}5d$	3	37812.87		0.2	1.188	N	d
$4f^{11}5d$	2	38563.97				N	?d
?$4f^{11}5d$	6	38781.51		32.1	1.191	N	
?$4f^{11}6s$	6	38853.02		67.0	1.179	N	
$4f^{11}5d$	3	38924.30		0.1	1.187	N	d
$4f^{11}5d$	5	39265.81		35.1	1.082	N	
${}^4F_{7/2}d_{3/2}$	4	39667.36	39	9.9	1.134	N	F3d3
${}^4F_{7/2}s_{1/2}$	4	40166.45	73	79.8	1.257	N	F3s1
$4f^{11}5d$	3	40407.72		28.7	1.022	N	d
$4f^{11}5d$	4	40580.40				N	
$4f^{11}5d$	5	40857.10			1.198	N	d?
$4f^{11}5d$	5	46552.18				N	d?
$4f^{11}5d$	4	46937.23				N	
$4f^{11}5d$	5	48747.15				N	d?
$4f^{11}7s$							
${}^4I_{15/2}7s_{1/2}$	8	102599.84				N	I77s
${}^4I_{15/2}7s_{1/2}$	7	102913.92				N	I77s

Notes:
a Level first reported in [2].
b Level first reported in [1].
c Level first reported in [3].
d Level first reported in [2], the J-value is revised.
e Level present in the list of classified lines of [2].
N New energy level.

Table III. *Fitted energy parameters, and their standard errors (cm^{-1}) in Er III. The constrained parameters are indicated by an "f", for "fixed value" and an "r" for "held in a constant ratio with the parameter above".*

Parameter	Value	Standard error
Configuration $4f^{12}$		
E_0	9458.7	10
E_1	6147.1	r
E_2	30.87	0.17
E_3	617.4	1.7
ζ_{4f}	2245.0	4.6
α	20	f
β	200f	
γ	−55	f
Number of levels		7
Number of free parameters		4
r.m.s. deviation		22
Configuration $4f^{11}6p$		
E_0	80408.3	39.3
E_1	6512.1	12.3
E_2	30.18	
E_3	667.2	1.2
F^2(f,p)	5872	141
G^2(f,p)	1811	35
G^4(f, p)	1542	91
ζ_{4f}	2394.5	3.7
ζ_{6p}	3672.8	6.5
$\alpha\ f^{11}p$	7.5	0.7
$\alpha\ f^{11}$	20	
$\beta\ f^{11}$	185	
$\gamma\ f^{11}$	−55	
Number of levels		35
Number of free parameters		9
r.m.s. deviation		22
Configuration $4f^{11}5d + 4f^{11}6s$		
E_0	38122.0	106
T(6s–5d)	2836.1	125
E_1	6493.8	32
E_2	29.56	0.60
E_3	659.0	1.1
F^2(f,d)	20070	243
F^4(f,d)	14602	344
G^1(f,d)	7707	194
G^3(f,d)	8134	361
G^5(f,d)	5633	286
G^3(f,s)	2123	95
ζ_{4f}	2386.0	4.4
ζ_{5d}	1087.3	7.9
α_{TOT}	6.3	0.7
D^3(f,d)	1626	f
X^2(f,d)	2660	233
X^4(f,d)	2360	465
$\alpha\ f^{11}$	20	f
$\beta\ f^{11}$	185	f
$\gamma\ f^{11}$	−55	f
R^2(rd,fs)	0	f
R^3(fd,sf)	2878	297
Number of levels in the fit		64
Number of free parameters		17
r.m.s deviation		35

Table IV. *Lines of Er III newly identified in the spectrum of the star HR 465*

λ_{star} (Å)	Intensity in star	λ_{lab} (Å)	Spectrum	Other spectrum
3262.97	0–1	0.95	Er III	Tb II
3376.15	2	0.16	Er III	Nd
3377.43	2	0.37	Er III	Zr II
3404.85	3d?	0.90	Er III	Zr II
3455.06	2	0.12	Er III+	
3460.78	1d?	0.80	Er III	Pd I
3473.91	4	[0.91]	Er III	Ho II, Mn II
3492.75	1–2	0.75	Er III	
3501.14	1–	0.16	Er III	
3639.01	5d?	[0.98]	Er III	See note in Table I
3687.46	3	0.43	Er III	Fe I
3698.98	1–2?	0.90	Er III+	
3739.41	3–4	0.42	Er III	
3812.54	3	0.55	Er III	
3825.54	1–	0.53	Er III	
3898.40	1	0.35	Er III+	
3913.48	5	0.50	Er III	Ti II
3945.17	4–5	0.17	Er III	
3963.42	2?	0.46	Er III+	
3977.34	3d?	0.31	Er III	
4065.03	3–4 d to r	0.04	Er III	Ho II
4123.47	3	0.45	Er III	
4204.01	2d	3.96	Er III	Fe I, Nd
4356.58	3d?	0.54	Er III+	
4361.99	4	2.01	Er III	Sm II
4443.35	4d?	0.28	Er III	Dy III
4463.00	5	0.01	Er III	NdII
4493.57	3–4	0.61	Er III+	
4579.81	1	0.81	Er III	
4669.11	m	0.09	Er III	