Reply to comment by H. Q. Feng, D. J. Wu, and J. K. Chao on "Comparison of small-scale flux rope magnetic properties to large-scale magnetic clouds: Evidence for reconnection across the HCS"?

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[1] The comment by *Feng et al.* [2010] suggests that the semi-automated algorithm developed by *Cartwright and Moldwin* [2008] is not always a reliable method of identifying flux ropes and that the duration distribution of flux ropes in the solar wind is not bimodal. The semi-automated method was developed in an attempt to remove the subjective nature of visual flux rope identification by using quantitative minimum criteria for flux rope selection. It searches for the classic signatures of a flux rope; that of a core field enhancement coincident with an inflection point in the bipolar field of the flux rope. The automated method identified 68 flux ropes of which *Feng et al.* [2010] find that 10 have magnetic field rotation signatures that are not smooth (low variance) and hence should not be considered flux ropes. It is possible that a small percentage of the events found by the semi-automated program were random IMF fluctuations rather than flux ropes. The smoothness (or low variance) of the flux rope rotation signature can depend on the presence of waves [e.g., *Moldwin and Hughes*, 1992] and has been included as one of the several identifying properties of magnetic clouds [e.g., *Burlaga et al.*, 1981]. How low variance or smooth a flux rope can be is subjective from survey to survey, but was not one of the selection criterions for the automated survey. To examine if the inclusion of the non-smooth events influences the conclusions of the *Cartwright and Moldwin* [2008] study, we removed the 10 flux ropes and analyzed the duration distribution of small to large-scale size flux ropes.

[2] We used the three data sets, the *Cartwright and Moldwin* [2008] small-scale flux ropes identified using an automated method, the *Feng et al.* [2007] flux ropes found visually, and the *Lepping et al.* [2006] database (also available online) found visually. The two visual surveys identified flux ropes by searching for the core field and bipolar field of a flux rope. The *Feng et al.* [2007] survey searched for flux ropes at all scale sizes and found the majority of flux ropes identified by *Lepping et al.* [2006] database. Therefore, we used only 34 of the 96 flux ropes found by the *Lepping et al.* [2006] database since the rest are represented in the *Feng et al.* [2007] survey. We removed the 10 flux ropes from the *Cartwright and Moldwin* [2008] database and the 4 overlapping flux ropes with the *Feng et al.* [2007] database. We combined the small to large-scale flux ropes into one flux rope database and found their durations. We binned the duration in 4 h time bins and plotted them from 0 to 45 h. The duration distribution for solar wind flux ropes of all scale sizes is shown in Figure 1. There is a clear peak in the 4 hour duration bin and a smaller peak in the 14 hour bin. These two peaks show a bimodal duration distribution of flux ropes in the solar wind. From this result we conclude that it is possible the origin of these small-scale flux ropes (duration less than 4 hours) differs from the large-scale flux ropes (duration of 14 or more hours).

[3] The debate on the source region for small-scale flux ropes has been between magnetic reconnection in the solar wind and/or originating at the solar surface. The observations by *Mandrini et al.* [2005] suggested that an erupting minisigmoid on the solar surface created a small-scale flux rope that was observed at 1 AU with the WIND spacecraft. This event was studied by *Cartwright and Moldwin* [2010] who found the small-scale flux rope observed was consistent with Alfvénic activity and was rejected as a flux rope; that is the magnetic field vectors and velocity field vectors were strongly correlated.

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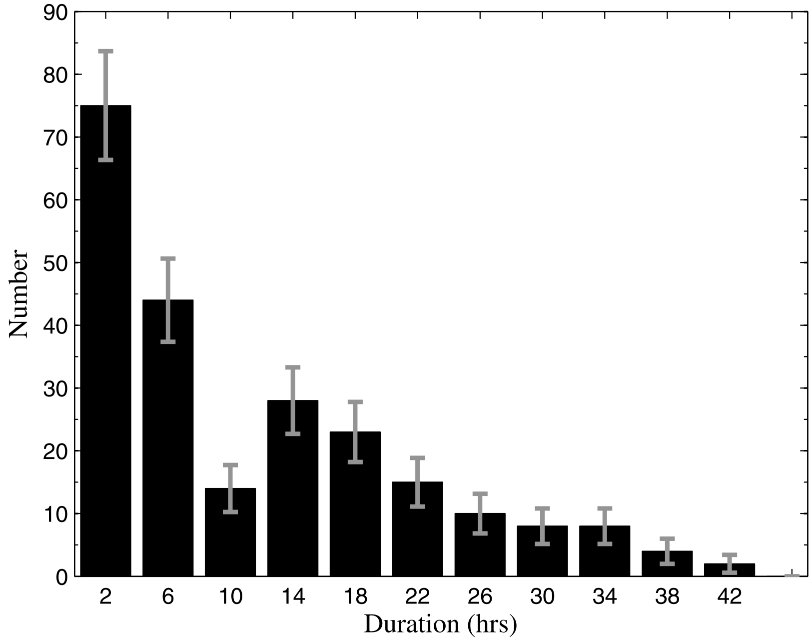

Figure 1. The duration distribution for flux ropes of all scale sizes in the solar wind, binned every 4 hours with error bars being ± the square root of the number of events in each bin.

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