Title: Solar Tomography with Minimal Solar Rotation

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Instrument Points of Contact
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Scientific Objectives and Justification

The goal of this joint observing program is to study the distribution of electron density in the corona. Three-dimensional reconstructions of coronal electron density are created using a tomographic inversion, which requires polarized brightness (pB) observations of the corona from multiple perspectives, with total angular coverage of 180 degrees. The sparsity of the distribution of Sun observing spacecraft necessitates the use of the Sun's rotation to achieve the required angular coverage. Classically, coronal tomography has been done using observations from a single spacecraft, which requires half a rotation of observations (approximately 14 days). However, this only allows reconstruction of features that vary on time scales longer than 14 days.

Using more than one view point, such as those provided by STEREO, can reduce the required rotation time. When STEREO is combined with the LASCO instruments on SOHO and the ground based MLSO Mk4 Coronameter, three points of view are available. For three points of view, the optimal configuration is a 60 degree separation between the viewpoints [1]. This reduces the required solar rotation time to less than 4.5 days and allows reconstruction of features varying on that same time scale. This configuration is achieved with the STEREO spacecraft have a separation of approximately 120 degrees, which occurs on 2009-10-11. As this configuration will only appear once, and because a higher cadence has shown a significant increase in reconstruction quality [2], it is essential to gather pB images at the highest feasible cadence from all observatories. pB images from the SECCHI/COR1, SECCHI/COR2, LASCO/C2, LASCO/C3, and MLSO/Mk4 coronagraphs will allow reconstructions from three points of view from 1.4-15 solar radii.

Proposed Date

The optimal configuration of the observatories will be on 2009-10-11 when the STEREO separation is approximately 120 degrees. As the data from this joint observing program will be used to create dynamic (time varying) three dimensional tomographic reconstructions, it is necessary to have data from a longer period of time than the minimal 4.5 days. In this configuration, a full rotation will provide the richest data set on which to investigate the density distribution.

Thus, this JOP is proposed to run for a full rotation centered on the date of optimal configuration, that is 2009-09-27 through 2009-10-27, where the angular separation of the STEREO spacecraft will vary between 117.5 degrees and 122.5 degrees.

Observations

STEREO/SECCHI: pB series from COR1 and COR2 at the highest feasible cadence. Minimum for COR1 would be a 30 minute cadence. A similar cadence is ideal for COR2. If possible, images should be taken within a few minutes of COR1 images.

SOHO/LASCO: Synoptic pB images from C2 and C3 with highest cadence possible is ideal. C2 should take precedence over C3. At minimum, 4 pB images per day from C2, 6 per day if possible. If possible, images should be taken within a few minutes of COR1 images.

MLSO/Mk4: pB images at the standard cadence, weather permitting. If possible, images should be taken within a few minutes of COR1 images.

References

[1] J.M. Davila. Solar tomography. *The Astrophysical Journal*, 423:871, 1994.

[2] R.A. Frazin, A.M. Vasquez, F. Kamalabadi, and H. Park. Three-dimensional Tomographic Analysis of a High-Cadence LASCO-C2 Polarized Brightness Sequence. *The Astrophysical Journal Letters*, 671(2):201–204, 2007.