BOSTON UNIVERSITY

Space Physics Seminar
Thursday, February 25, 2016

Time-dependent Global Modeling of the Inner Heliosphere

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Abstract:

The field of global modeling of the inner heliosphere dates back to the 1980's when magnetohydrodynamic (MHD) simulations of various heliospheric plasma environments were actively pursued. The solar wind, with the embedded interplanetary magnetic field, presented a fascinating object of study in its own right, but it was also already clear at the time that solar wind disturbances cause major activity in planetary magnetospheres on their way. There are two primary types of such disturbances on a large scale: stream interactions, which shape the background solar wind and dominate the interplanetary environment during solar minima, and coronal mass ejections (CMEs), prevalent during solar maxima. Both represent intrinsically time-dependent phenomena, but only recently have simulation efforts emerged modeling temporal evolution of the background solar wind. Since the solar wind is a super-fast flow of plasma — with all MHD characteristics propagating away from the Sun — its global properties are to a large extent determined by what is known about the state of the underlying corona. However, that knowledge has historically been derived from monthly synoptic photospheric magnetograms, which severely handicapped global models rendering them independent of time on scales of a month or shorter. Recent advances in assimilative modeling of the photospheric magnetic fields have fundamentally changed this picture yielding magnetograms that capture temporal evolution on the Sun at a daily or even shorter time cadence.

In this presentation, I will describe recent efforts devoted to simulations of the inner heliosphere, including both time-dependent background solar wind and CMEs. Some features of the time-dependent heliosphere will be highlighted in comparison with NASA observatories, such as MESSENGER, ACE, STEREO A and B. I will comment on the formation of magnetic field reversals in pseudo-streamer regions, which is in accord with recent statistical observations. I will also demonstrate the corrugation of the heliospheric current sheet caused by solar wind velocity shears. For CME simulations, I will describe some details of this modeling effort demonstrating in particular how the geo-effective properties of the heliospheric transients can be dependent on the numerics and the resolution of the model. This suggests that — just like in terrestrial climate and weather simulations — efforts concentrating on ensemble modeling of heliospheric transients should be pursued.

I will conclude my talk by briefly describing some of the recently funded projects I am involved in, concentrating on a few compelling problems of magnetospheric physics. These will include magnetospheric boundary instabilities, incorporation of kinetic reconnection and ionospheric turbulence physics, and ingestion of empirical hot plasma pressures into global models.

3:15 pm
Refreshments
CAS Room 500

3:45 pm
Seminar
CAS Room 502

Next Week

- Wen Li
  UCLA
- Recent Advances in Understanding Earth's Radiation Belt Dynamics and Its Response to Solar

http://www.bu.edu/csp/edoutreach/seminar/

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