A STUDY OF THE STRUCTURE AND EVOLUTION OF THE HELIOSPHERIC CURRENT SHEET

Sheela Shodhan, M.S. Computational Physics May 1989
Center for Space Physics, Boston University

We aim to study the structure and the evolution of the heliospheric current sheet by examining current sheet crossings and the associated time variations of the solar wind parameters at various distances from the sun.

Solar wind is a continuous emission of solar coronal plasma into interplanetary space. Pneumann and Kopp(1971) obtained numerical solution to the mhd equations for an isothermal plasma in a simplest model of the solar magnetic field that of a dipole with axis parallel to the solar rotation axis. They showed that beyond a heliocentric distance of two solar radii all the magnetic field lines are open, dragged into interplanetary space by the expanding plasma. Because of the sun's rotation however they are drawn out along an Archimedean spiral. A current sheet separating the magnetic fields from opposite hemispheres of the dipole exists at the dipole equator, aligned with the solar equatorial plane. It extends from the solar corona into interplanetary space.

The solar activity cycle modifies this basic approximate structure at solar minimum. As the solar maximum is approached the pure dipole nature of the magnetic field is destroyed and higher magnetic moments become significant. The current sheet continues to separate magnetic fields of opposite polarities. Because of the complex solar coronal magnetic field, its structure is complicated in the corona and when it is drawn out by the expanding solar wind into a spiral it attains a more convoluted form in the interplanetary space.

Our goal is to study this current sheet as it evolves through various heliocentric distances at different times. We are using the interplanetary magnetic field and solar wind plasma data from Isee3 and Helios spacecrafts; the former at a heliocentric distance of 1 AU and the latter at varying distances from 0.3 to 1 AU. We have begun by examining the current sheet crossing and the accompanied solar wind parameters on April 21,1979 at 1 AU at Isee3 and the same current sheet crossing at 0.5 AU at Helios 2. While the former displays a density peak at the current sheet the latter shows a more complex pattern following the current sheet. Helios white light photometer data show two corresponding features - one that is corotating and the other ejected [Webb and Jackson, 1990]. It seems these features got embedded in the current sheet as they travelled from 0.5 AU to 1 AU. We have made similar comparisons in the density variations between the two spacecrafts at three other times of the current sheet crossings. So far, these results suggest that the current sheet is a very dynamic surface and serves as a conduit for mass ejecta in a hierarchy of sizes.