EPSC Abstracts
Vol. 6, EPSC-DPS2011-93, 2011
EPSC-DPS Joint Meeting 2011

Collisions in Space: Observations of Disturbances in the Interplanetary Magnetic Field Caused by Destructive Collisions of Small Bodies

H.R. Lai (1), Y.D. Jia (1), C.T. Russell (1), G.L. Delzanno (2)
(1)UCLA, Los Angeles, CA (2) LANL, Los Alamos, NM (hlai@igpp.ucla.edu / Fax: 310-206-8042)

Abstract

Collisions between small interplanetary bodies can produce clouds of dust particles, which rapidly become charged in the solar wind plasma. A wide range of particle sizes will be produced and the smallest nanoscale particles can be accelerated to solar wind speed in minutes. Our multi-fluid MHD simulation with charged dust as one fluid shows a three-dimensional disturbance in the magnetic field with compression and draping in the flow direction and bending in the direction perpendicular to both the flow and unperturbed magnetic field, producing a current sheet orthogonal to the flow. The Lorentz force of this current balances the transverse momentum of the gyrating dust particles and the solar gravity force balances the magnetic pressure gradient force. Thus the magnetic gradient force is proportional to the mass of the picked up dust and allows us to weigh the dust cloud. The magnetic field behavior in the simulation results qualitatively resembles the phenomenon called an interplanetary field enhancement (IFE), which is featured by a cusp-shaped magnetic field enhancement lasting from several minutes to hours, with a sharp discontinuity in at least one component of the magnetic field. The association between IFE appearance and dust production was first inferred from PVO data in the 1980s, but the IFE formation process has been unclear until now. In this paper, we will gather the statistics of IFEs and use the magnetic compression to weigh the mass of the dust cloud. We will also estimate the volume over which individual events may be sensed. Using this volume together with the IFE occurrence rate we can calculate the inferred collision rate. We find for the IFE with mass about 10^7 kg, this rate approximately agrees with the estimated rate of collision of interplanetary bodies which can produce dust within the same mass range.