



The Physics of the Interaction of a Cometary Dust Tail with the Solar Wind

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Abstract

Most MHD simulations of the interaction of the magnetized solar wind with a comet use a one-fluid MHD code. Nevertheless, the heavy ions picked up by the solar wind constitute a separate fluid, and a multi-fluid treatment is appropriate and necessary to treat the interaction correctly. Furthermore, if the comet is dusty, the charged dust can be treated as yet another fluid in the plasma. Because of the large mass ratio between the different fluids, especially with the charged dust fluid, important new effects arise that change the nature of the interaction. The heavy fluid, if it is negatively charged, causes plasma deflection in the direction of the motional electric field and a kink in the magnetic field in the same direction. Positively charged dust causes the opposite plasma deflection and the opposite magnetic field bending. We do not have reports of the magnetic signatures seen as spacecraft crossed dust trails during comet encounters, but we do have a report of a signature inside an ICME that appears to have cut through the dust trail of comet C/2006 P1 (McNaught). In the center of this ICME is a very sharp and strong kink in the magnetic field orthogonal to the flow and the surrounding ICME magnetic field. We interpret this as the signature of charged dust pickup. In this paper we explain the physical processes involved in creating the kink in magnetic field as well as showing the magnetic structure seen by the STEREO A and B spacecraft.