Particle precipitation in the cusp region before and after an abrupt change of the IMF direction: recent results from the CLUSTER mission

C. P. Escoubet[1], J. Berchem[2], J. M. Bosqued[3], F. Pitout[4], M. G. G. T. Taylor[1], K. J. Trattner[5], H. Laakso[1], A. Masson[1], M. Dunlop[6], I. Dandouras[3], H. Reme[3], A. Fazakerley[7], P. Daly[8]

[1]RSSD, ESA/ESTEC, Noordwijk, Netherlands
[2]IGPP/UCLA, Los Angeles, USA
[3]CESR/CNRS, Toulouse, France
[4]LPG, Grenoble, France
[5]Lockheed Martin ATC, Palo Alto, USA
[6]RAL, Didcot, UK
[7]MSSL, Dorking, UK
[8]MPS, Katlenburg-Lindau, Germany

Abstract

The polar cusp is a highly dynamic region responding very quickly to changes in the Interplanetary Magnetic Field (IMF) direction and solar wind dynamic pressure. The immediate effect of the rotation of the Interplanetary Magnetic Field (IMF) from southward to northward on cusp precipitation has been rarely observed by a polar orbiting satellite in the past. The four Cluster spacecraft observed such an event on 23 September 2004 as they were crossing the polar cusp within 2-16 minute from each other. Between the first three and the last spacecraft crossing the cusp, the IMF rotated from southward to northward with a dominant By (GSM) component. For the first time we can examine the changes in the particle precipitation immediately after such IMF change. The first two spacecraft observed a typical IMF-southward ion dispersion, while the last one observed both an IMF-Southward-like dispersion in the boundary layer and an IMF-northward dispersion in the cusp. After the IMF turning, the cusp is shown to have grown in size in both the poleward and equatorward directions. A three-dimensional magnetohydrodynamic (MHD) simulation is used to determine the locations of the sources of the ions and the topology of the magnetic field during the event. After the turning of the IMF northward, the simulation shows first a reconnection on the dawn northern lobes, poleward of the cusp, and then a second reconnection of the same field line on the dusk lobe in the southern hemisphere. We would then have a case of double lobe reconnection when the IMF is northward with a dominant By component (clock angle between 45 and 60 deg.).