PLASMASPHERIC DENSITY STRUCTURE: APPLICATION OF A FOUR-POINT ANALYSIS TOOL, THE SCALAR GRADIENT

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The Cluster mission allows us to study the geometry and dynamics of the plasmasphere with four-point measurements. Cluster observations of the plasmasphere have shown different kinds of density structures, such as plasmaspheric plumes close to the plasmapause and density irregularities inside the plasmasphere [1,2]. Cluster has revealed a much more complex and dynamic region than considered so far from earlier observations, as well as from early theoretical models and simulations.

The purpose of this paper is to analyse the geometry and orientation of such density structures with respect to the magnetic field. We present two different plasmasphere crossings by the four Cluster spacecraft, one with smooth density variations and one with density irregularities. We use magnetic field data measured by the FGM experiment and electron density data derived from the plasma frequency determined from the resonance sounder and wave analyzer WHISPER. These two plasmasphere cases are examined with a four-point analysis tool, the spatial gradient of any scalar quantity, applied here to the electron density and to the magnetic field strength. This gradient is determined from simultaneous measurements of that scalar quantity, with the hypothesis that all four spacecraft are embedded at the same time in the same structure [3]. This tool needs then small separation distances between the satellites, but also well-calibrated data. This is the case with electron density data from WHISPER, as this instrument provides absolute values.

We compare the direction of the electron density gradient with the local magnetic field direction (Fig. 1). We compare also the gradient of the magnetic field strength with the local field vector (Fig. 1). We note two effects influencing these gradients: (i) the increase of the electron density and (ii) the increase of the magnetic field strength along the magnetic field lines away from the equator. We note also the decrease of these two quantities as one moves radially outward. As a result, the symmetry and/or asymmetry between the electron density distribution and the magnetic field can be assessed in these two plasmasphere crossings.

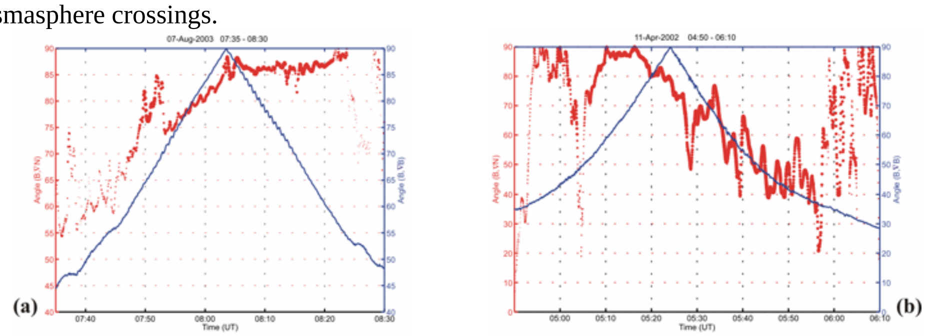

Fig. 1. Angle between **B** and ∇N (in red) and between **B** and ∇|**B**| (in blue) for a plasmasphere crossing with smooth density variations (panel a) and for a plasmasphere crossing with density irregularities (panel b).

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