Geophysical Research Abstracts
Vol. 13, EGU2011-7360, 2011
EGU General Assembly 2011

Determining the axial direction of high-shear flux transfer events

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Flux transfer events are bursts of dayside reconnection, which give rise to local perturbations of the magnetic field which can be observed by spacecraft near the magnetopause. A key difference between the original model proposed by Russell & Elphic (1978) to explain the observed signatures, and subsequent models (Lee & Fu, 1985; Southwood et al., 1988; Scholer, 1988) is that when the magnetic shear across the magnetopause is close to 180°, the Russell & Elphic model will give rise to a structure whose axis is oriented north-south, whereas the subsequent models will result in a dawn-dusk oriented structure. Several techniques for determining the axial direction of such structures have been suggested: minimum variance analysis on the magnetic field (e.g. Kharbrov & Sonnerup, 1998; Xiao et al., 2004), minimisation of the axial electric field (Sonnerup & Hasegawa, 2005), and Grad Shafnarov reconstruction (Hau & Sonnerup, 1999; Sonnerup et al., 2004). We apply these techniques to a series of flux transfer events observed by Cluster at a high-shear magnetopause crossing on 27th March 2007 (an interval previously studied by Fear et al., 2010). Minimum variance analysis on the signatures caused by the draping of unreconnected magnetic flux around the flux transfer events consistently results in an axial direction which is directed dawn-dusk. However, the electric field technique, applied to flux transfer events which are penetrated by the spacecraft, results in a mixture of north-south and dawn-dusk axes. Testing these axial directions with Grad Shafnarov reconstruction suggests that the axes of events which appear to be oriented dawn-dusk might be more reliably determined than the axes of events which appear to be north-south.