Geophysical Research Abstracts
Vol. 14, EGU2012-10554, 2012
EGU General Assembly 2012

Cluster multi-point observations in the auroral region: A critical examination of accelerated particle spectra

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Quasi-static magnetic-field-aligned electric potential drops at altitudes between 1000 and 12000 km are able to accelerate charged particles into and out of the ionosphere above the aurora. Since 2008, Cluster has made regular passes through this so-called auroral acceleration region (AAR), facilitating studies of both the temporal evolution and spatial structure of these regions. Whilst the spacecraft can pass over this region with their foot-points separated by only fractions of a degree, this still translates to 10s km in the ionosphere, and this is comparable to the scale size of some auroral arcs. Consequently, the validity of assumptions made concerning magnetic conjugacy, or that the spacecraft are passing through the same acceleration region at different times, may be severely tested and must be closely examined. In this study, we examine a number of AAR crossings by the 4 Cluster spacecraft and compare the accelerated particle spectra recorded by the different spacecraft in order to determine the likelihood of their being conjugate or passing through the same feature at different times. From this, we attempt to understand the uncertainty in determining the temporal evolution and spatial structure of quasi-static potential drops in the AAR.