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# High time resolution studies of flux transfer events at the Earth's dayside magnetopause using Cluster data

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Since launch in 2000, the four ESA Cluster spacecraft have each crossed the dayside magnetopause region thousands of times. Many previous studies presenting analysis of data from the mission, have contributed to a better understanding of the structure and dynamics of that interface and its associated boundary layers. While 2D electron pitch angle distributions (PAD) are routinely produced by the PEACE sensors on Cluster at spacecraft spin resolution (4s), the structures in this region are known to undergo changes on faster timescales than this, in response to both external drivers and internal dynamic processes. However, in certain circumstances, near-complete pitch angle distributions can be obtained at higher time resolution using Cluster burst mode data, facilitating a more detailed analysis of the particle behaviour near the magnetopause. In this paper we present an event during which the four spacecraft made outbound crossings through the low latitude boundary layer while the magnetic field orientation allowed a full pitch angle distribution of electrons to be constructed (every 1/8 s). The four Cluster spacecraft were in the 'multi-scale' formation with separations between individual pairs of spacecraft of either $\sim$8000 or $\sim$800 km. During the event in question, the Cluster spacecraft observed two flux transfer events (FTEs) and made a rapid ($\sim$16s) crossing of the magnetopause. The first FTE was most prominent in the C1 data a few minutes before the spacecraft crossed the magnetopause; and the second FTE was observed by C2 just before its magnetopause crossing. Additionally, C1 detected the signature associated with the second FTE in the magnetosheath, and the data from C3 show a disturbance in the low latitude boundary layer that also appears to be related to this FTE. We have utilized the high time resolution pitch angle distributions of electrons along with the high time resolution electric & magnetic data and ion distributions, to study in detail the structure of these FTEs.