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On the role of discrete auroral arcs for the transport of plasma in the magnetosphere

A. Kullen (1), S. Figueiredo (2), **S. Buchert** (1), A. Vaivads (1), M. Andre (1), T. Johansson (2), G. Marklund (2)

(1) Swedish Institute of Space Physics, Uppsala, Sweden, (2) Alfvén Laboratory, Royal Institute of Technology, Stockholm, Sweden (Stephan.Buchert@irfu.se)

It is relatively widely accepted that discrete auroral arcs are associated with fieldaligned potential drops in an acceleration region and with strong perpendicular electric fields above this region. The plasma convection conforming to this electrodynamic structure is expected to form a very elongated vortex, if the electric field seen by a spacecraft crossing above this potential drop is bipolar which is often observed. For a homogeneous plasma density perpendicular to B the plasma in such a vortex is expected to be transported only locally, i. e. there is no significant net mass flow when integrating across the arc structure.

We present observations by the Cluster spacecraft showing that, contrary to the above conjecture, a considerable net transport of plasma is taking place along discrete arcs, as these occur often near steep density gradients. We found several cases of quiet time arcs near the poleward oval boundary, where up to 80 percent of the net plasma transport through a cross section of the oval occurs in "convection channels" adjacent to a discrete arc. We also investigate whether arcs move in the normal direction pushing the density gradient with them by removing plasma tangentially similar to how a snowplough moves through snow.