VISIBLE AURORAL ARCS AND ION BEAMS

The auroral arcs are produced by ∼1–10 keV electrons, energized by a parallel electric field in the Auroral Acceleration Region (AAR), at several 1000 km above the Earth; at the same time ionospheric ions are accelerated upwards, forming beams. Although there is no direct connection between auroral light and ion beams, observational evidence supports the association of ion beams at lower altitudes with the development of visible arcs (*Marghitu et al., 2001*).

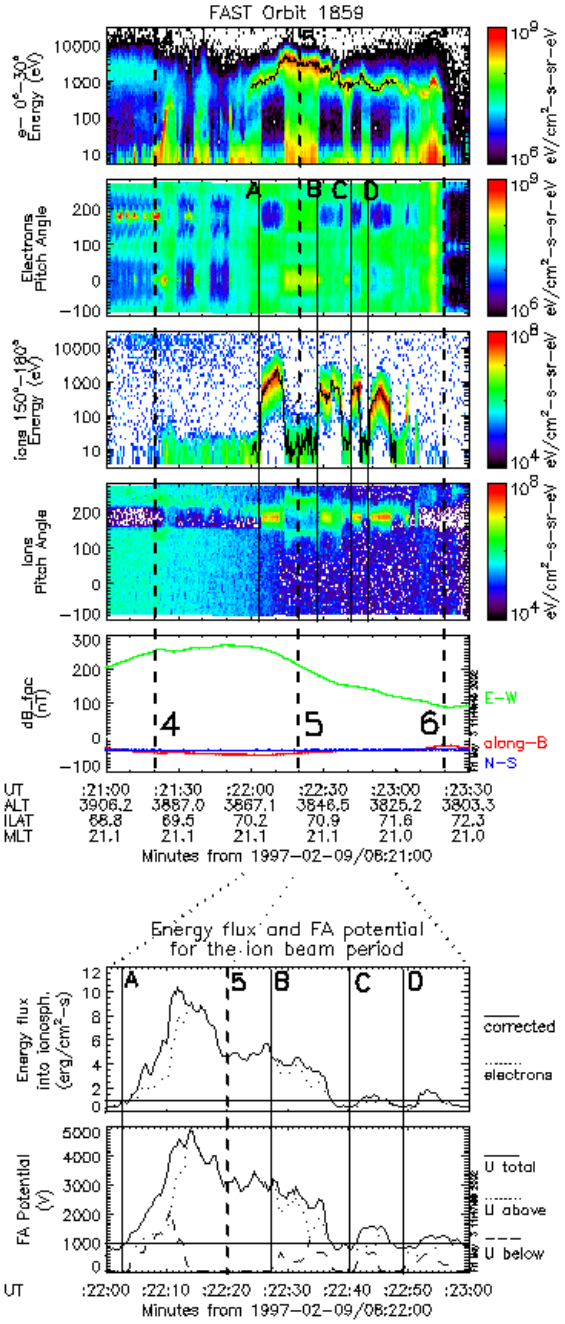

Fig.1 ***Top*** *Energy and pitch-angle spectrograms for downgoing electrons (panels 1,2) and upgoing ions (panels 3,4). The perturbation magnetic field is shown in panel 5. The dotted cuts 4, 5, 6 relate to the frames in Fig.2. The full-line cuts correspond to the right marks of the pairs 'A–A' . . . 'D–D' in Fig.2.* ***Bottom*** *Electron energy flux at 110 km (panel 1) and field-aligned potential (panel 2).*

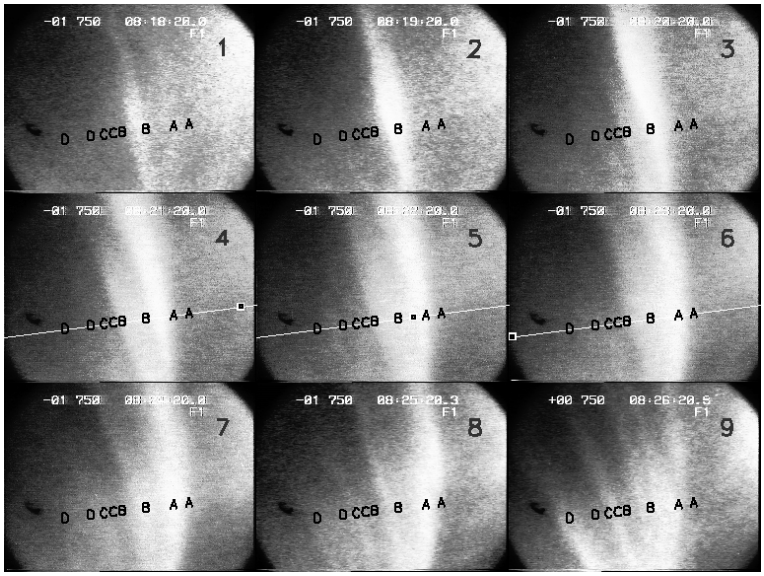

Fig.2 Selection of auroral images, 1 minute apart, taken on February 9, 1997, UT 8:18–8:26. North and East are at the left and bottom side. FAST (indicated as a square) crosses the camera's field of view in frames 4, 5, 6. The pairs 'A–A' . . . 'D–D' show the respective ion beams. Marking all the frames does not imply that ion beams are necessarily there and is only meant to provide a reference for the evolution of luminosity.

A typical FAST overpass (Fig.1) shows a large inverted-V with embedded ion beams, the pattern most probably resulted from altitude variations of the bottom side of the AAR (*McFadden et al., 1999*). Ground optical data in conjunction with FAST (Fig.2) enable relating features measured by the satellite with the evolution of the auroral structure. On the longer time scale of the optical observation one can see that the more energetic part of the inverted-V (A to B) is relatively stable, denoting an equillibrium state along the respective flux tubes. On the other hand small enhancements in the energy flux (C and D) develop into visible arcs, consistent with a positive feedback mechanism (*Sato, 1978*). A peculiar feature is the association of ion beams with the energy flux enhancements C and D, and further with the visible arcs. This association supports recent simulation work by *Ergun et al., 2000*, who found that the altitude of the bottom side of the AAR is determined by the balance between backscattered and secondary electrons, and ionospheric ions. An increase in the energy flux results in a larger backscattered and secondary flux, which leads to the lowering of the bottom side of the AAR.

References

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