

Observations of large flow shears around small-scale auroral beads observed at substorm onset

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We present, for the first time, a fine-scale electrodynamic structure behind the auroral beads observed at substorm onset, as inferred from high spatial and temporal resolution measurements of substorm aurora with an all-sky TV camera (ATV) and a coherent HF radar of SuperDARN in Iceland. On the night of September 24, 2006, the ATV observed eastward propagating auroral beads in the initial brightening arc of a substorm just prior to the poleward expansion. During the sequential passage of the beads across the radar beams, the radar detected large velocity flow shears whose magnitude was in excess of 1.5 km/s. The observations suggest that flow shears were located very close to the center of the beads; thus, they corresponded to the horizontal electric fields converging toward the beads, which is consistent with the existence of upward field-aligned currents (FACs) flowing out of the beads. The temporal and spatial resolutions of the current radar measurement were still insufficient for fully resolving the detailed electrodynamic structure behind the fast moving auroral beads. At least, however, we can suggest the existence of localized filamentary FAC structures behind the beads, which played a very important role in connecting the auroral beads in the ionosphere and their source perturbation in the magnetosphere.