Two Classes of Earthward Fast Flows in the Plasma Sheet

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Abstract

In this study we first identify earthward plasma sheet fast flows from Geotail plasma and magnetic data and then estimate rates of change of nightside auroral power over the courses of the fast flows using Polar Ultraviolet Imager auroral images. It is found that 62 fast flows observed at $|Y| < 5$ Re can be classified into two classes. One class of the fast flows was often observed near $X = -10$ Re and the other class of all fast flows was found at $X < -15$ Re. The auroral power rates for the first class of the fast flows are found to be high, indicating the auroral brightness on the nightside was significantly increasing over the courses of these fast flows. The auroral images show an apparent substorm bulge developed at premidnight during these fast flows. The auroral power rates for most of the fast flows in the second class are low. The auroral features, such as poleward boundary intensifications and pseudobreakups, are found to be associated with these fast flows. The first class of the fast flows can be interpreted by the current disruption theory while the second class of the fast flows can be interpreted by the bubble theory. A fast flow in the second class can propagate earthward and trigger a substorm due to the braking of the fast flow, leading to a developing auroral bulge at premidnight and mixing with localized auroral activations directly related to later earthward fast flows.