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Plasma transport into the cusp and LLBL

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During the prolonged periods of northward IMF and large solar wind dynamic pressure on 17 and 18 September 2000, the IMAGE spacecraft detected two concurrent proton auroras induced by energetic proton precipitation from the cusp and LLBL. Plasma observations from DMSP satellites flying above the auroras confirm their source regions. The cusp ion spectrum is featured by a sharp spectral peak and the typical low-energy ion cutoff. Ion energy and flux are characteristics of magnetosheath ions. In contrast, LLBL ions are of both solar wind and magnetospheric origins. Their energy spectrum is spectrally complete and has a very broad spectral width. When IMF was strongly northward during these events, the high-latitude ionospheric plasma convection derived from the SuperDARN radar observations showed the typical four-cell pattern. The cusp aurora is on open field lines convecting sunward and the LLBL aurora is on closed field lines convecting antisunward. These simultaneous observations from IMAGE, DMSP and SuperDARN are consistent with magnetic merging occurring at the high-latitude magnetopause poleward from the cusp. However, there is no indication from these observations of recent merging at LLBL or merging taking place on both hemispheres to form a closed LLBL. It is likely that diffusion due to wave-particle interaction at the magnetopause current layer is responsible for the formation of the LLBL. Both merging and diffusion processes are important for the transport of magnetosheath energetic ions across the magnetopause into the magnetosphere. They occur at the same time but at different locations.