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Evidence for lobe reconnection as a source mechanism for the cold dense plasma sheet

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Initial observations of cold, dense plasma sheet (CDPS) regions by equatorial spacecraft indicated that they occur during extended intervals of northward IMF near the low latitude boundary layer (LLBL). Since CDPS domains have plasma characteristics intermediate between the plasma sheet and the magnetosheath, the latter has long been considered a candidate source. During northward IMF the flanks of the LLBL can be Kelvin-Helmholtz unstable, so this mechanism was initially deemed a likely candidate for transporting cold, dense sheath plasma across the magnetopause. More recently, a process involving lobe reconnection was proposed, which directly injects magnetosheath plasma and accelerates it. An important signature of quasi-steady lobe injection is energy-dispersed ion signatures (EDIS) with faster particles expected at higher latitudes. We present low-altitude FAST spacecraft observations of EDIS and show that they support the lobe injection hypothesis. This is evident in a large statistical sample of long-duration northward IMF events, as well as in individual case studies. We present additional support from the Cluster and THEMIS spacecraft. Finally, case examples are compared with the results from a simulation study, in which ions are tracked within the electric and magnetic fields obtained from a run of the OpenGGCM global MHD code. Particles are pushed according to the Lorentz force using a leap-frog scheme, and accumulated at low-altitudes within the simulation. Synthetic spectra for spacecraft trajectories are generated for direct comparison with observations.