MHD Test Particle Simulations of > 10 MeV Radiation Belt Formation During Storm Sudden Commencement

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In comparison with the Earth's outer zone radiation belts, sudden large variations of inner zone energetic particle fluxes are rare, occurring only during very large geomagnetic storms, usually initiated by coronal mass ejection (CME) driven interplanetary shocks. The violent geomagnetic storms of October-November 2003 mark the beginning of strong activity characterizing the declining phase of Solar Cycle 23. During the 29 October 2003 storm, ultra-relativistic ($\gtrsim 10$ MeV) electrons were injected well inside of $L = 3$ producing a stably trapped radiation belt population that persisted for months following this event (Looper et al., GRL, Vol. 32, No. 3, 2005). Results will be presented from a numerical study of shock-induced transport and acceleration of electrons resulting in a newly formed 10-20 MeV belt. Test-particle trajectories were followed in time-dependent fields from an MHD magnetospheric model simulation of the 29 October 2003 storm sudden commencement (SSC) driven by measured solar wind parameters. Both outer zone and solar energetic electrons (SEEs) are found to provide a source population for the new belt. Energy and pitch angle distributions of the new belt resulting from an outer zone source are compared with those obtained using an SEE source. The newly formed belt is predominantly equatorially mirroring. This result is in part due to an SSC electric field pulse that is strongly peaked in the equatorial plane, preferentially accelerating equatorially mirroring particles. The time scale for subsequent pitch angle diffusion of the new belt, calculated using quasi-linear bounce-averaged diffusion coefficients, is in agreement with the observed delay in the appearance of peak fluxes at SAMPEX in low Earth orbit.