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Substorm Injected Energetic Electrons and Ions Deeply into the Inner Magnetosphere Observed by BD-IES and Van Allan Probes

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When substorm injections are observed simultaneously with multiple spacecraft, they help elucidate potential mechanisms for particle transport and energization, a topic of great importance for understanding and modeling the magnetosphere. In the present paper, by using the data return from the BeiDa- IES (BD-IES) instrument onboard an inclined (55[U+25E6]) geosynchronous orbit (IGSO) satellite together with geo-transfer orbit (GTO) Van Allen Probe A&B satellite, we analysis a substorm injection event occurred on Oct 16, 2015. During the substorm injection, the IES onboard IGSO is outbound while both Van Allen Probe A&B satellites are inbound. This configuration of multiple satellite trajectories provides a unique opportunity to investigate the inward and outward radial propagation of the substorm injection simultaneously. This substorm as indicated by AE/AL indices is closely related an IMF/solar wind discontinuity with a sharp change in the IMF Bz direction (northward turning). The innermost signature of this substorm injection has been detected by the Van Allen Probes A & B at L$\sim$ 3.7. The outermost signature, observed by the BD-IES, is found to be at L$\sim$ 10. This indicated that this substorm have a rather global effect rather than just a local effect. Further, we suggest that the electric fields carried by fast-mode compressional waves around the substorm injection are the most likely mechanism candidate for the injection signatures of electrons observed in the innermost and outermost inner magnetosphere.