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A micro-radiation belt of electrons generated by Saturn's F-ring

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Abstract

Energetic electron data collected during Cassini's Proximal orbits from regions just outward Saturn's dense A-ring (2.27 Rs), contain signatures of highly confined MeV electron intensity enhancements which we call microbelts. These microbelts map persistently near the planets narrow F-ring at 2.32 Rs and they have an average L-shell extent of 0.02 Rs. Their occurrence probability in local time is not uniform, as for every orbit they were either occurring inbound (pre-noon) or outbound (post-noon). 80% of the detections took place few hours post-noon and only 20% pre-noon. We demonstrate that these microbelts contain local time stationary MeV electrons, trapped in local-time and L-shell confined trajectories which result from the presence of a local electron source in a region where corotation is superposed with weak, dawnward plasma flows. These flows are likely associated to the well-established noon-midnight convective electric field at Saturn. The source process for the microbelts' electrons is likely secondary electron production due to Galactic Cosmic Ray collisions with heavy material in the F-ring (dust clumps, moonlets), as implied by the microbelts' colocation with the F-ring. The formation and stability of the microbelts against the variability of the convective flows is demonstrated through test particle simulations. An attempt to reconstruct the electron spectrum within the microbelts, using the latest results for the simulation of LEMMS's responses to MeV electrons, will also be shown.