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Rhea's magnetospheric interaction: energetic electron observations by Cassini MIMI/LEMMS

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Although Rhea is a plasma absorbing moon, energetic particle observations in its vicinity show a variety of unexpected interaction features, besides the expected wake signature. Energetic electron data contain a series of flux depletions, some of which extend up to 8 moon radii on each side of the wake. The association of these depletions with absorption by dust and boulders orbiting within Rhea's Hill sphere was not confirmed, so in this study we review data from all four Cassini flybys of Rhea to date seeking for alternative interpretations. We focus on energetic electron observations, which are placed in context with magnetometer and cold plasma electron density data. The most interesting common structure in all flybys is that of narrow dropouts in energetic electron fluxes, visible near the wake flanks. These are typically seen together with narrow flux enhancements inside the wake. A phase-space-density analysis indicates that these structures form due to rapid transport of energetic electrons from the magnetosphere to the wake, through narrow channels. The possibility that this transport is a signature of a flute (interchange) instability that acts on the electrons is discussed. Besides the small structures, there are many more puzzling observations. For instance the electron number density appears unaffected during Rhea's wake crossings, although the magnetometer shows signatures consistent with plasma pressure loss due to ion absorption at Rhea. The impact of such observations in understanding Rhea's system is also discussed.