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Energetic charged particle absorption by Saturn's icy moons: future studies and new applications

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Energetic charged particle absorption signatures by Saturn's large icy moons, rings and dust are an excellent tool for the study of the planet's magnetospheric dynamics and dust environment. After the first two years of the Cassini mission, relevant observations with the MIMI/LEMMS energetic electron sensors extended and updated the results from previous studies that used data from experiments on the Pioneer 11 and the Voyager missions. The new results include values for the radial diffusion coefficients and their L-dependence, the observation of the non-axisymmetric structure of the electron drift shells, as well as the detection and the physical characterization of ring arcs at Methone's orbit and the G-ring. Furthermore, these results reveal that the information coded in charged particle absorption signatures is even greater than we could initially imagine: the highly variable lifetimes of electron microsignatures suggest a possible link with equally variable dynamic events, such as injections. The shape of the electron drift shells seems consistent with the effect of magnetospheric compression on the dayside, meaning that information about the magnetopause distance might be hidden in the absorption signature locations. The microsignature locations during high-latitude, close moon flybys, can also reveal the shape of the magnetic field lines and be used to ''calibrate" magnetic field models. Such observations could be crucial for the understanding of the magnetospheric and the space environment of Saturn.