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Detection and physical characterization of dust structures at Saturn, through energetic charged particle data: new results from Cassini

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The presence of inert matter that orbits Saturn within its radiation belts can be revealed by a series of absorption signatures in the data of energetic charged particle detectors. The detection of such signatures by the Pioneer 11 detectors has led to the discovery of the moon Epimetheus, as well as of the F and G rings of Saturn. Data from the Pioneer 11 and the Voyager 1 and 2 charged particle experiments has also been analyzed for the characterization of the physical properties of Saturn's E-ring, and for the detection of possible dust structures that share the same orbit with Mimas. So far, data from the Cassini MIMI/LEMMS experiment has revealed the presence of a dust arc at Methone's distance, the existence of large grains within the G-ring arc and possible dust clumps along Enceladus's orbit. In the present work we include an overview of these new discoveries by Cassini and revisit the methods and techniques used to infer the physical properties of the absorbing bodies through the analysis of charged particle data. We also discuss the limitations of these techniques, as well as the importance of multi-instrument observations, which can set constraints to the energetic particle data analysis.