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Moon-magnetosphere interaction signatures as tools for studying the magnetospheres of outer planets

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Moons within the magnetospheres of the outer planets cause a variety of disturbances in their local particles and fields environment. Signatures of such disturbances are not only observed during close moon flybys, but may also propagate at intermediate and/or large distances from their point of origin. The date, the location and the physical properties of the initial perturbation can be well constrained in several cases, meaning that observations of such distant interaction signatures can be used to study how these disturbances evolve in space and time. As this evolution can be connected to the physical properties of the surrounding space environment, it becomes apparent that moon-magnetosphere interactions at the outer planets provide an excellent means to extract fundamental information about the configuration and the dynamics of each respective magnetosphere. This is in a way comparable to what can be achieved through coordinated observations by multiple spacecraft. For instance, Saturn's inner moons orbit the planet within the highly dipolar, stable magnetic field region and therefore signatures of energetic electron absorption can persist for long periods of time. Any deviations from slow fill-in of these wakes can provide important clues to magnetospheric dynamics that occurred during this process. In this presentation we review the various applications of using the outer planetary moons as "tools" for magnetospheric science, we present sample results derived from this approach, and we also discuss what additional applications may exist for ongoing or future missions (Cassini, Juno, EJSM).