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Plasma Composition in Solar System Magnetospheres

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The composition of magnetospheric plasmas (<50 keV) can affect processes on all scales. For example, collision cross-sections, reaction rates, and cyclotron frequencies are properties specific to particular ion species. They cause ions to respond differently to magnetospheric boundary conditions such as planetary atmospheric composition, magnetic field intensity, gravitational field and rotation rate, to name a few. The interactions between ion properties and magnetospheric conditions are obviously different at comets, planets, moons, etc., giving rise to a complex set of dynamics driven in part by ion composition. At Earth, for example, composition dependent processes affect particle entry into the magnetosphere, auroral ion outflows and ring current decay. To cite a second case, the properties of cometary comas depend to a large extent on the lack of a tangible gravitational field, on chemical reaction rates and on wave-particle interactions. With the arrival of Cassini at Saturn we have yet another intriguing example of the effects of plasma composition in a very different kind of magnetosphere, namely a rapid rotator with large and varied internal sources of plasma. In this paper I will discuss a few examples of ion/magnetosphere interactions and compare them with new results from the Cassini mission.

Keywords: Saturn; magnetosphere; ion composition; plasma dynamics