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# How Enceladus Powers the Saturnian Magnetosphere

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The Enceladus plume is pumping about $10^{28}$ water group molecules into the saturnian magnetosphere per second, or about one-quarter of the rate of atmospheric loss of Io in the much larger jovian magnetosphere. In turn, about one-quarter of that material appears to be ionized in the inner magnetosphere. The seven Enceladus encounters to date (E0 - E6) show that the outgassing rate has been steady within a factor of two over the last three years. While it is clear that the addition of Enceladus-derived plasma to the magnetosphere must be the ultimate source of energy to drive magnetospheric processes, it is not clear how the magnetospheric phenomena are driven. A key concept that is not included in current numerical and phenomenological models is the balance between centripetal and centrifugal forces during the interaction of the plume with the corotating plasma. When the magnetospheric plasma approaches Enceladus, centrifugal force stretches the magnetic field line outward. This force is balanced by the inward centripetal force of the curvature in the stretched field. When the plasma reaches the plume, it exchanges charge with the plume and a stream of fast neutrals sprays the region around Enceladus with a disk of neutral atoms and molecules. The magnetic field line, released of its centrifugal force (but not its mass), is pulled inward and then slowly accelerated again. When it is accelerated to corotational speed, the flux tube returns to near its original location. This circulation pattern is powered by the rotation of the planet but is in quasi-harmonic resonance with the 1.37 day period of Enceladus. Thus, the wave so forced can build up to a significant amplitude and this may explain the circulation pattern proposed by Gurnett et al. to explain the observed density modulation. We note that the region of exact resonance with the SKR period lies just inside the orbit of Enceladus in the region expected to be the post-Enceladus-interaction reacceleration region. We note that the same process occurs at Io in the jovian magnetosphere possibly accounting for the Io ribbon and the system IV rotation period.