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Photolysis and radiolysis of ice in Saturn's E ring

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Photolysis, and radiolysis are important processes regarding the decomposition of icy surfaces in the outer solar system as well as astronomical environments. Saturn's magnetosphere is an ideal laboratory for studying these processes. Here we focus on the production of O_2/O_2+ from Saturn's diffuse E ring. Compared to H2 molecules, another major decomposition product from irradiated water ice, heavy O_2 molecules diffuse more slowly from their source(s) and therefore can be used as an ice surface reaction tracer.

Originating from Enceladus, the E ring is composed of water ice grains populated between 3 to about 20 Rs (Saturn radius, 1Rs = 60,268km) under the influences of various forces. The plasma conditions that E ring grains experience vary from the cold plasma at the dense Enceladus torus to the hot, tenuous outer magnetospheric plasma. The sputtering and radiolysis processes determined by the plasma properties are thus coupled with the orbital evolution of E ring grains. Using modeled and measured E ring profile, we will calculate the O_2/O_2+ production rate from the E ring icy grains as well as from the embedded icy moons. We will also calculate the H_2O molecule and water group ion (W+) production rate from these sources and compare with the O_2+/W+ ratio measured by the Cassini Plasma Spectrometer (CAPS).