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Cassini UVIS observations of Saturn and Titan

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The Cassini Ultraviolet Imaging Spectrograph (UVIS) is part of the remote sensing payload of the NASA/ESA Cassini spacecraft. This spectrograph includes channels for extreme UV and far UV spectroscopic imaging, high speed photometry of stellar occultations, solar EUV occultation, and a hydrogen/deuterium absorption cell. We report our initial results from UVIS observations of Saturn's rings. Dynamic interactions between neutrals, ions, rings, moons and meteoroids produce a highly structured and time variable Saturn system

Oxygen in the Saturn system dominates the magnetosphere. Observed fluctuations indicate close interactions with plasma sources. Stochastic events in the E ring may be the ultimate source. The spectral signature of water ice is seen on Phoebe and in Saturn's rings. Water ice is mixed non-uniformly with darker constituents. The high structure of the UV ring reflectance argues that collisional transport dominates ballistic transport in darkening the rings. Our preliminary results support the idea that rings are recycled fragments of moons: the current processes are more important than history and initial conditions. The spectra along the UVIS SOI radial scan indicate varying amounts of water ice. In the A ring, the ice fraction increases outward to a maximum at the outer edge. This large-scale variation is consistent with initially pure ice that has suffered meteoritic bombardment over the age of the Solar system (Cuzzi and Estrada 1998). We also see variations over scales of 1000 – 3000 km, which cannot be explained by this mechanism. Ballistic transport of spectrally neutral extrinsic pollutants from meteoroids striking the rings has a typical throw distance of 6000 km (Durisen et al 1989), too long to explain this finer structure. We propose a class of smaller renewal events, in which a small moon residing within the rings is shattered by an external impactor (Colwell and Esposito 1993, Barbara and Esposito 2002, Esposito and Colwell 2003). The interior of such a body has been shielded from external meteoritic bombardment, and thus contains purer ice. Since the amount of meteoroid

pollution provides a rough clock to estimate the age of the rings (Cuzzi and Estrada), these random events reset that clock locally, making the material at that radial location younger and purer. As these purer ring particles collide with others, they exchange regolith, and the range of purer water ice spectrum spreads radially.

The radial variation we interpret as due to differential pollution in our data set is consistent with the disruption of several small bodies in the A ring in the last 10^7 to 10^8 years. When the small moon Pan (Showalter 1991, R $\sim$ 10 km, now residing in the nearby Encke Gap) is eventually shattered by an external impact (Colwell et al 2000), the gap will close up, and for some 10 to 100 million years thereafter a brighter radial swath of purer water ice at its former location will gradually spread and darken.

Titan observations include emission spectra, discontinuous aurora, measurement of the methane, ethane, acetylene and diacetylene profiles. We infer vertical mixing, diffusive separation, scale heights and temperature profiles from 400 to 1600 km altitude.