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Reproducing impact ionization mass spectra of E and F ring ice grains at different impact speeds

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Abstract

In situ mass spectrometers analyzing the composition of icy grains in space, like the Cosmic Dust Analyzer (CDA) on Cassini or the Surface Dust Analyser (SUDA) onboard the future Europa Clipper Mission, employ the impact ionization mechanism to ionize substantial parts of impinging ice grains by the kinetic energy of the impact. As the impact speed of the grains can vary greatly, the resulting cationic or anionic mass spectra can have very different appearances, even if similarly composed.

A good analog to the impact ionization of ice grains is a laser based analog experiment where a μm sized liquid water beam is intersected by a pulsed infrared laser at suitable energies and wavelengths. The cationic and anionic products are monitored by a high performance time of flight mass spectrometer. In this way, CDA's cationic mass spectra from ice grains of the E ring as well as the F ring could be accurately reproduced.

In this work, we demonstrate the capability of our improved laser experiment in Heidelberg to quantitatively reproduce CDA spectra recorded at a wide variety of impact speeds. CDA spectra of E and F ring ice grains recorded at different impact speeds varying from 4 – 20 km/s are grouped into different speed regimes. We accurately reproduce the drastically varying spectral appearances by tuning the laser parameters and the delaytime of the gating system in front of the mass spectrometer. We compare CDA spectra of different composition (Type 1, 2, and 3 from Postberg et al., 2008, 2009) recorded at the different speed regimes with our analog spectra and prove the capability of the Heidelberg analog experiment to reproduce them.

References

[1] Postberg, F., Kempf, S., Hillier, J., Srama, R., Green, S., McBride, N and Grün, E.: The E-ring in the vicinity of Enceladus II. Probing the moon's interior-The composition of E-ring particles, Icarus, Vol. 193, pp. 438-454, 2008.

[2] Postberg, F., Kempf, S., Schmidt, J., Brilliantov, N., Beinsen, A., Abel, B. Buck, U. and Srama, R..: Sodium salts in E-ring ice grains from an ocean below the surface of Enceladus, Nature, Vol. 459, pp. 1098-1101, 2009.