

CASSINI COSMIC DUST ANALYSER: COMPOSITION OF DUST AT SATURN. N. McBride¹, J. K. Hillier¹, S. F. Green¹, J. P. Schwanethal¹, J. A. M. McDonnell¹, R. Srama², S. Kempf², F. Postberg² and E. Grün^{2,3}, ¹Planetary and Space Sciences Research Institute, The Open University, Milton Keynes, MK7 6AA, UK, n.m.mcbride@open.ac.uk, ²MPI für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany. ³Hawaii Institute of Geophysics and Planetology, University of Hawaii, 1680 East West Road, POST 512c, Honolulu, Hawaii, HI 96822, USA.

The Cosmic Dust Analyser (CDA) aboard the Cassini spacecraft has been sampling dust within the Saturnian system since orbit insertion in July 2004. CDA consists of two primary subsystems: the Dust Analyser subsystem, with instruments capable of measuring charge, velocity, mass, low-rate flux and composition of dust particles, and the High-Rate Detector (HRD) which measures high-rate fluxes of impacting particles using a PVDF impact sensing system. The Dust Analyser uses the characteristics of the plasma generated by an impact of a dust particle on a metal target to determine (approximately) particle mass and speed. A crucial subsystem of CDA is the Chemical Analyser, which uses a discrete central rhodium target section within the Dust Analyser. This target is held at 1 kV with respect to a mesh grid 3 mm in front of it, producing a strong electric field that accelerates impact-generated ions towards an electron multiplier, so delivering positive ion time-of-flight mass spectra (TOFMS) of impacting particles.

The Chemical Analyser is now returning thousands of spectra from the Saturnian system. For example, during a single ring plane crossing (the descending ring plane crossing in October 2004), it produced nearly 300 TOFMS of E-ring dust particles at a distance of $\sim 8 R_S$ from Saturn. Interpreting these TOFMS can be complicated. In principle the arrival time at the multiplier, of an initially stationary ion, is governed by the relation $t = b + a\sqrt{m}$, where m is the ion mass, b is a zero point time offset, and a is a 'stretch' parameter related to the instrument geometry and field strength. However, this behaviour is complicated by the initial velocity distribution of the ions, plasma shielding effects, differing geometries within the instrument, and unknown zero-point offsets attributable to triggering time differences. In cases where the ion species corresponding to at least two peaks can be identified unambiguously, the a and b parameters can be determined with reasonable accuracy (enabling spectra to be converted from time to mass space). However the aforementioned effects mean that a given ion species (a single m value) will give rise to spectral peaks which can vary from very narrow to extremely broad. Furthermore, the peak width and overall peak shape is likely to depend also on the impact velocity, mass and composition of the dust particle.

Identification of mass species within the TOFMS can be made easier by understanding the ion dynamics within the instrument as a whole. This paper presents an overview of the Chemical Analyser and discusses the effects of the ion dynamics within the instrument and how it affects the peak shapes and position. This is demonstrated by use of an in-house ion dynamics code developed specifically for the CDA instrument (see also Hillier et al., this abstract volume). We then present TOFMS obtained within the Saturnian system, with interpretation of the impacting particles' composition. For example, during the E-ring plane crossing during October 2004, we found that the particles predominantly consisted of water ice (manifesting itself in the TOFMS as hydronium ions, with varying numbers of water molecules attached) and minor silicate impurities. Results obtained up to September 2005 will be discussed.