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The application of simple mass spectrometers to planetary sub-surface sampling using penetrators

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Ptolemy is an ion trap based gas-chromatograph isotope ratio mass spectrometer which is on-board the Rosetta Lander [Wright et al., 2006; Todd et al., 2007]. The instrument uses the principles of MODULUS (Methods of Determining and Understanding Light Elements From Unequivocal Stable Isotope Compositions [Pillinger and Wright, 1993], to enable results obtained in space to be interpreted directly in the context of terrestrial analyses of meteorites and returned samples. MODULUS typically involves use of a complex sample processing system to purify and separate individual species from a complex starting sample, allowing analysis by a relatively simple, low resolution, but stable and precise mass spectrometer instrumentation.

A number of exciting future mission opportunities are arising where it is unlikely that it will be feasible to incorporate the full MODULUS-style sample processing system. Of particular interest are missions that offer the opportunity to gain access to surface and sub-surface material through the deployment of mass spectrometers from either high-speed penetrator platforms [Smith et al., 2009] or from sub-surface penetrating mole devices deployed by soft landers [Richter et al., 2003].

We will present work aimed at overcoming the resolution restrictions of ion trap mass spectrometers. It is anticipated that this will enable MODULUS style science return from relatively simple instrumentation which is compatible with the future miniaturised sampling platforms currently under consideration for Mars, asteroids, comets and planetary moons.

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