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Ptolemy operations as part of the Rosetta mission during the targeted flyby of asteroid 21 Lutetia.

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Rosetta is a European Space Agency 'Planetary Cornerstone' mission intended to solve many of the unanswered questions surrounding the formation of the Solar System. The Rosetta cruise has included: three gravitational assist manoeuvres using Earth, one such manoeuvre past Mars, an 800 km flyby of the 5 km diameter E-type asteroid 2867 Šteins, and a 3,100 km flyby of the 100 km diameter asteroid 21 Lutetia which took place on July 10^{th} 2010. In 2014, Rosetta will rendezvous with, map, and then deposit a lander upon the surface of comet 67P/Churyumov-Gerasimenko.

Ptolemy is a miniature chemical analysis laboratory aboard the Philae lander intended to determine the chemical and isotopic composition of material sourced from beneath, on and above the surface of the target comet. The primary science will be returned from solid cometary samples processed in the ovens of the Sampler, Drill and Distribution system (SD2). The resulting sample gas mixture is processed in a chemical preparation suite before delivery to a three channel gas chromatograph (GC) for separation. Elution products are passed to a quadrupole ion trap mass spectrometer for identification and quantification.

Ptolemy can also passively adsorb coma material onto Carbosphere^{TM} molecular sieve within one of the SD2 sample ovens for later release and analysis. Also possible are simple 'sniff' detections of the current spacecraft environment bypassing the sample inlet and GC system and instead directly analysing the inside of the mass spectrometer, itself connected to space via a vent pipe. During post launch testing the detection limit was measured to be in the region of 10^{-11} mbar, using an on-board supply of argon doped at 100 ppm in the helium carrier gas.

The once clear-cut differentiation between volatile rich comets and volatile depleted asteroids has been somewhat eroded by recent ground based observations of the main belt asteroids 24 Themis and 65 Cybele, showing that these bodies harbour organic-rich surfaces with exposed water ice. In addition, at least four comets reside within the main asteroid belt, the prototype being 133P/Elst-Pizarro and there are likely to be many more such bodies as yet undiscovered.

It was known prior to the encounter that 21 Lutetia had carbonaceous material and hydrated minerals on its surface, both were potential sources of outgassing. However, the volatile composition and outgassing nature of main belt asteroids are only loosely constrained; it was therefore decided to attempt to detect the plausible exosphere surrounding Lutetia during the 2010 Rosetta flyby.

Not being among the primary mission objectives of the Ptolemy instrument, the asteroid observations were constrained by spacecraft considerations and instrument resource limitations. Only a small number of observations were possible and not at the closest approach distance. As such it was decided to target Ptolemy's exosphere search by taking six mass spectra around the period of zero phase angle – 15 minutes prior to closest approach above the area on the surface of Lutetia receiving the greatest level of insolation. Ptolemy also made four further sets of six measurements several hours either side of 'close approach' to provide background data.

These spectra covered the mass range 10-140 Da, detecting water and a variety of other species with some enhancement around the sub-Solar point, indicating the possibility of an extant exosphere. The question remains open as to whether this was indeed an extant exosphere or if the increased signal recorded was the result of spacecraft outgassing.

The following presents Ptolemy's operations to date, science results from the flyby of 21 Lutetia including possible implications for outgassing of main belt asteroids, and shows the road ahead for the Ptolemy instrument with plans for pre- and on-comet operations.