



Gamma ray densitometer for sub-surface density profile measurements

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We report on ESA-funded breadboard development of a gamma ray densitometer (DEN) for planetary sub-surface density profile measurement. DEN comprises a ¹³⁷Cs gamma ray source, a tungsten shielding rod, two semiconductor detectors and associated electronics. These are housed within a 26 mm diameter cylindrical compartment deployed into the planetary sub-surface (by a 'mole' hammering mechanism). The sensor is very much smaller and less massive than terrestrial gamma densitometers and the planetary surface densitometers flown on Soviet lunar, Mars and Venus missions. Density is determined at regular intervals during penetration, by measuring the spectrum of gamma rays. The detected spectrum depends on Compton scattering of photons in the surrounding regolith. The laboratory work performed has included characterisation of the backscatter spectrum and calibration with test materials, with the results being compared with a Monte Carlo model of the instrument. The DEN sensor forms part of the Heat Flow and Physical Properties Package (HP³), conceived initially for the *BepiColombo* Mercury Surface Element but with wider applicability to other worlds such as Mars and the Moon.