

Dust Impact Monitor (SESAME-DIM) Measurements at Comet 67P/Churyumov-Gerasimenko

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The Rosetta lander Philae successfully landed on the nucleus of comet 67P/Churyumov-Gerasimenko on 12 November 2014. Philae carries the Dust Impact Monitor (DIM) on board, which is part of the Surface Electric Sounding and Acoustic Monitoring Experiment (SESAME). DIM employs piezoelectric PZT sensors to detect impacts by sub-millimeter and millimeter-sized ice and dust particles that are emitted from the nucleus and transported into the cometary coma. The sensor measures dynamical data like flux and the directionality of the impacting particles. Mass and speed of the grains can be constrained for pre-defined density and elastic grain properties.

DIM was operated during three mission phases of Philae at the comet: (1) Before Philae's separation from Rosetta at distances of about 9.6 km, 11.8 km, and 25.3 km from the nucleus barycenter. In this mission phase particles released from the nucleus on radial trajectories remained undetectable because of significant obscuration by the structures of Rosetta, and no dust particles were indeed detected. (2) During Philae's descent to its nominal landing site Agilkia, DIM detected one approximately millimeter-sized particle at a distance of 4.97 km from the nucleus' barycenter, corresponding to an altitude of 2.4 km from the surface. This is the closest ever dust detection at a cometary nucleus by a dedicated in-situ dust detector. Laboratory calibration experiments showed that the material properties of the detected particle are compatible with a porous grain having a bulk density of approximately 250 kg m^{-3} . Particles leaving the comet on radial trajectories were detectable with only a very small sensitive area of the DIM sensor while backfaling particles or particles in orbit about the nucleus had a more favorable detection geometry. (3) At Philae's final landing site, Abydos, DIM detected no dust impact which may be due to low cometary activity in the vicinity of Philae, or due to shading by obstacles close to Philae, or both.