Dust Impact Monitor DIM onboard Rosetta/Philae: Calibration experiments with ice particles as cometary analogue materials

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The Rosetta lander spacecraft Philae will land on the nucleus surface of comet 67P/Churyumov-Gerasimenko in November 2014. Philae is equipped with the Dust Impact Monitor (DIM). DIM is part of the SESAME instrument package onboard Philae and employs piezoelectric PZT sensors to detect impacts by sub-millimetre and millimetre-sized ice and dust particles that are emitted from the nucleus and transported into the cometary coma by the escaping gas flow. DIM will measure fluxes, impact directions, as well as the speed and size of the impacting particles.

We studied the performance of DIM based on impact experiments and compared the measurements with the sensor's expected theoretical behaviour as derived from the Hertz theory of elastic impacts. We simulated impacts onto the DIM sensor with spherical ice particles with radii of approximately 0.7 mm and porous particles of other materials with radii up to 4 mm. Impact speeds range up to $2\,\mathrm{m\,s^{-1}}$. Cometary grains on ballistic trajectories will have impact speeds below the escape speed from the nucleus surface (approximately $1.5\,\mathrm{m\,s^{-1}}$), thus the impact speeds achievable by our experiments cover the range expected at the comet. Our results show that the signal strength and the contact durations measured with the DIM PZT sensors can be well approximated by the Hertz contact mechanics.

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