A&A 591, A93 (2016)

Dust Impact Monitor (SESAME-DIM) on board Rosetta/Philae: Millimetric particle flux at comet 67P/Churyumov-Gerasimenko

Attila Hirn[1,2], Thomas Albin[3,4,2], István Apáthy[1], Vincenzo Della Corte[5], Hans-Herbert Fischer[6], Alberto Flandes[7,2], Alexander Loose[2], Attila Péter[1], Klaus J. Seidensticker[8] and Harald Krüger[2]

[1] Centre for Energy Research, Hungarian Academy of Sciences, Konkoly Thege Miklós út 29-33, 1121 Budapest, Hungary
e-mail: attila.hirn@energia.mta.hu
[2] Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany
[3] Institut für Raumfahrtsysteme, University Stuttgart, Pfaffenwaldring 29, 70569 Stuttgart, Germany
[4] Medical Radiation Physics, Faculty VI, Carl von Ossietzky University, Georgstrasse 12, 26121 Oldenburg, Germany
[5] Institute for Space Astrophysics and Planetology (IAPS), National Institute for AstroPhysics (INAF), via Fosso del Cavaliere 100, 00133 Roma, Italy
[6] Deutsches Zentrum für Luft- und Raumfahrt, Raumflugbetrieb und Astronautentraining, MUSC, Linder Höhe, 51147 Köln, Germany
[7] Ciencias Espaciales, Instituto de Geofísica, Universidad Nacional Autónoma de México, 04510 Coyoacán, México, D.F., Mexico
[8] Deutsches Zentrum für Luft- und Raumfahrt, Institut für Planetenforschung, Rutherfordstraße 2, 12489 Berlin, Germany

Received: 23 February 2016
Accepted: 27 April 2016

Abstract

Context. The Philae lander of the Rosetta mission, aimed at the in situ investigation of comet 67P/Churyumov-Gerasimenko, was deployed to the surface of the comet nucleus on 12 November 2014 at 2.99 AU heliocentric distance. The Dust Impact Monitor (DIM) as part of the Surface Electric Sounding and Acoustic Monitoring Experiment (SESAME) on the lander employed piezoelectric detectors to detect the submillimetre- and millimetre-sized dust and ice particles emitted from the nucleus.

Aims. We determine the upper limit of the ambient flux of particles in the measurement range of DIM based on the measurements performed with the instrument during Philae’s descent to its nominal landing site Agilkia at distances of about 22 km, 18 km, and 5 km from the nucleus barycentre and at the final landing site Abydos.

Methods. The geometric factor of the DIM sensor was calculated assuming an isotropic ambient flux of the submillimetre- and millimetre-sized particles. For the measurement intervals when no particles were detected the maximum true impact rate was calculated by assuming Poisson distribution of the impacts, and it was given as the detection limit at a 95% confidence level. The shading by the comet environment at Abydos was estimated by simulating the pattern of illumination on Philae and consequently the topography around the lander.

Results. Based on measurements performed with DIM, the upper limit of the flux of particles in the measurement range of the instrument was of the order of 10^{-8}–10^{-7} m^{-2} s^{-1} sr^{-1} during descent. The upper limit of the ambient flux of the submillimetre- and millimetre-sized dust and ice particles at Abydos was estimated to be 1.6×10^{-9} m^{-2} s^{-1} sr^{-1} on 13 and 14 November 2014. A correction factor of roughly 1/3 for the field of view of the sensors was calculated based on an analysis of the pattern of illumination on Philae.

Conclusions. Considering particle speeds below escape velocity, the upper limit for the volume density of particles in the measurement range of DIM was constrained to 10^{-11} m^{-3}–10^{-12} m^{-3}. Results of the calculations performed with the GIPSI tool on the expected particle fluxes during the descent of Philae were compatible with the non-detection of compact particles by the DIM instrument.

Key words: comets: individual: 67P/Churyumov-Gerasimenko / instrumentation: detectors / methods: data analysis / methods: numerical