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GIADA: extended calibration activities before the comet encounter

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The Grain Impact Analyzer and Dust Accumulator – GIADA – is one of the payloads on-board Rosetta Orbiter. Its three detection sub-systems are able to measure the speed, the momentum, the mass, the optical cross section of single cometary grains and the dust flux ejected by the periodic comet 67P Churyumov-Gerasimenko.

During the Hibernation phase of the Rosetta mission, we have performed a dedicated extended calibration activity on the GIADA Proto Flight Model (accommodated in a clean room in our laboratory) involving two of three sub-systems constituting GIADA, i.e. the Grain Detection System (GDS) and the Impact Sensor (IS). Our aim is to carry out a new set of response curves for these two subsystems and to correlate them with the calibration curves obtained in 2002 for the GIADA payload onboard the Rosetta spacecraft, in order to improve the interpretation of the forthcoming scientific data.

For the extended calibration we have dropped or shot into GIADA PFM a statistically relevant number of grains (i.e. about 1 hundred), acting as cometary dust analogues. We have studied the response of the GDS and IS as a function of grain composition, size and velocity. Different terrestrial materials were selected as cometary analogues according to the more recent knowledge gained through the analyses of Interplanetary Dust Particles and cometary samples returned from comet 81P/Wild 2 (Stardust mission). Therefore, for each material, we have produced grains with sizes ranging from 20–500 μm in diameter, that were characterized by FESEM and micro IR spectroscopy.

Therefore, the grains were shot into GIADA PFM with speed ranging between 1 and 100 ms^{-1}. Indeed, according to the estimation reported in Fink & Rubin (2012), this range is representative of the dust particle velocity expected at the comet scenario and lies within the GIADA velocity sensitivity (i.e. 1-100 ms^{-1} for GDSand 1-300 $ms^{-1}$for GDS+IS 1-300 ms^{-1}).

The response curves obtained using the data collected during the GIADA PFM extended calibration will be linked to the on-ground calibration data collected during the instrument qualification campaign (performed both on Flight and Spare Models, in 2002). The final aim is to rescale the Extended Calibration data obtained with the GIADA PFM to GIADA presently onboard the Rosetta spacecraft.

In this work we present the experimental procedures and the setup used for the calibration activities, particularly focusing on the new response curves of GDS and IS sub-systems obtained for the different cometary dust analogues. These curves will be critical for the future interpretation of scientific data.

Fink, U. & Rubin, M. (2012), The calculation of Afρ and mass loss rate for comets, Icarus, Volume 221, issue 2, p. 721-734