**GIADA (Grain Impact Analyser and Dust Accumulator): activity performed in support to the comet 67P/Churyumov-Gerasimenko encounter.**

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**Introduction:** Rosetta is an ESA space mission that, after a trek of 10 years across the Solar System, in 2014 will reach the short period comet 67P/Churyumov-Gerasimenko and follow it during its approach to the Sun to study how the activity of the comet evolve. GIADA is an in-situ instrument devoted to measure the dynamical properties of the dust grains emitted by the comet. In preparation to the operative phase of the mission several activities have been performed in order to be prepared to the challenging environment of the comet with respect to the data interpretation. GIADA consists of three measurement subsystems: 1) the GDS (Grain Detection System) an optical device detecting each single dust grain and measuring its optical cross-section and speed; 2) the IS (Impact Sensor) an aluminum plate equipped with 5 piezo-sensors measuring the momentum of each dust grain impacting the plate; 3) MBS (Micro Balance System) constituted by 5 Quartz Micro Balances. The first two subsystems, by means of a combined detection, provide the speed, mass and momentum of individual dust grains with size ranges between 60 and 1000 microns; the third subsystem allows a measure of the mass flow for the dust grains with sizes lower than 10 microns. The performances of the instrument are summarized in Table 1 [1].

**Table 1** GIADA performances

| Subsystems | Physical quantity measured | Ranges |
|---|---|---|
| GDS | Optical Cross Section<br>Speed | 30-500 [µm] (radius)<br>1-300 [m/s] |
| IS | Momentum | 6.5e-10 to 4e-4 [kg*m/s] |
| MBS | Accumulated mass | 1e-10 to 1e-4 [g] |

During the mission cruise and hibernation phases the GIADA science team carried out three major activities to prepare the science operations during the comet phase of the mission and data interpretation:

- Extended Calibration using the GIADA Flight Spare Model.
- Develpoment of a simulation tool to evaluate GIADA performances vs simulated dust coma environment.
- Analysis of the Cruise Phase instrument collected data, in order to characterize and link the on ground calibration data to the in flight instrument behaviour.

**Extended Calibration and Cruise Phase data analyses:** Taking into account the knowledge gained through the analyses of Interplanetary Dust Particles and cometary samples returned from comet 81P/Wild 2 (Stardust mission) [2][3][4], we selected terrestrial materials as cometary dust analogues and we produced grains with selected sizes ranging from 20 – 500 µm in diameter (see Table 2). These grains were characterized by FE-SEM/EDS and micro IR spectroscopy. Single grains are then manipulated and shot into the GIADA Flight Spare Model, housed in our laboratory, with velocities in the range of 1 – 100 m/s [5] to obtain calibration curves as a function of chemico-physical grain properties. This activity allowed also to characterize the subsystem sensitivity to the dust grain chemico-physical properties. By means of the on-ground calibration data collected during the instrument qualification campaign (performed on Flight and Spare Models) we rescale the Extended Calibration data to GIADA mounted on board the Rosetta S/C. The calibration curves coupled with the GIADA telemetries collected during the Rosetta cruise phase [6] constitute a large database of sensors responses that will support the scientific data interpretation.

**GIPSI - the simulation tool to evaluate GIADA performances:** In order to evaluate GIADA behavior in an operative scenario a SW capable of predicting the instrument scientific and technical performances vs. a simulated cometary dust environment was developed. GIPSI (GIADA Performance Simulator) describes the instrument performances, in terms of scientific (grains detected) and technical (power, data volume, etc.) response having as inputs the orbit proposed by the Rosetta Scientific Ground Segment and the output of an evolutionary coma dust model [7].

GIPSI is a Java client software able to simulate the behavior of each GIADA sensor.

**Table 2:** List of terrestrial materials used during the Extended Calibration performed on the GIADA Flight-Spare Model.

| CLASS | SAMPLE | FORMULA |
|---|---|---|
| Nesosilicate | Forsterite | $Mg_2SiO_4$ |
| Nesosilicate | Fayalite | $Fe^{2+}{}_2SiO_4$ |
| Sorosilicate | Melilite | $(Ca,Na)_2(Al,Mg,Fe^{2+})(Si,Al)_2O_7$ |
| Inosilicate | Enstatite | $Mg_2Si_2O_6$ |
| Phyllosilicate | Talc | $Mg_3Si_4O_{10}(OH)_2$ |
| Phyllosilicate | Serpentine | $Mg_3Si_2O_5(OH)_4$ |
| Phyllosilicate | Kaolinite | $Al_2Si_2O_5(OH)_4$ |
| Tectosilicate | Albite | $NaAlSi_3O_8$ |
| Tectosilicate | Anortite | $CaAl_2Si_2O_8$ |
| Oxide | Corundum | $Al_2O_3$ |
| Sulphide | Pyrrhotite | FeS |

With the simulator we can obtain the performances that GIADA can reach, in term of the number of dust particles detected by each sensor along a specific S/C trajectory within a specific simulated dust coma environment. GIPSI can evaluate GIADA performances starting from different coma dust model: ab-initio physical models [8] and models obtained from cometary astronomical observations [9].

**Conclusion:** The Rosetta mission currently is approaching the end of the hibernation phase. The challenging cometary dust environment that GIADA will characterize required a great deal for the preparation of appropriate tools to be used in support of data interpretation. Actions taken, as the extended calibration performed on the GIADA Flight Spare model, will allow to obtain the maximum scientific return from the real measurements that GIADA will perform.

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