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GIADA:
State of Health during the Seven Years of Rosetta Cruise

A. Rotundi(1), V. Della Corte(1), E. Bussoletti(1), L. Colangeli(2), P. Palumbo(1), J. J. Lopez–Moreno(3), J. Rodriguez(3), M. Accolla(1), A. Aronica(4), F. Esposito(5), M. Ferrari(1), M. Fulle(6), S. Ivanovski(5), J.M. Jeronimo(3), A. Lopez-Jimenez(3), F. Lucarelli(5), E. Mazzotta Epifani(5), V. Mennella(5), R. Morales(3), F. Moreno(3), E. Palomba(4), R. Sordini(1) and the International GIADA team

(1) Università degli Studi di Napoli "Parthenope" - Dipartimento Scienze Applicate, Centro Direzionale Isola C4, 80143, Napoli (Italy), (2) ESA ESTEC, The Netherlands, (3) Instituto de Astrofisica de Andalucia, Granada, Spain, (4) IAPS-INAF , Roma , Italy, (5) INAF-OAC, Napoli, Italy, (6) INAF-OAT, Trieste, Italy

Abstract

GIADA (Grain Impact Analyzer and Dust Accumulator) is one of the instruments flying on-board the Rosetta orbiter devoted to study the cometary dust environment of 64P/Churiumov-Gerasimenko. We present the results of the data analysis of Payload Checkouts (PCs) performed during the seven-years Cruise Phase when GIADA was not supposed to perform scientific measurements. The instrument sub-systems were monitored periodically during 13 PCs to check their state and any possible performance variation. Only slight variations in terms of sensitivity and in dynamical range where identified, confirming the instrument nominal performances.

2. The Cruise Phase Mission

During the cruise phase of the Rosetta mission, 13 Payload Checkouts (PCs) where planned for instruments verification and maintenance. PCs, performed at different heliocentric distances, were either Passive or Active (Figure 1). The Passive PCs being dedicated to check the global instrument status following standard procedures. The Active PCs, performed before crucial Rosetta operations (e.g. Earth and Mars swing-by, asteroids fly-by), were devoted to test the instrument behavior in different configurations and the possible interference among instruments onboard.

From June 2011 to January 2014, due to the Rosetta Hibernation state, the PCs will be not performed till just prior to the rendezvous maneuver.

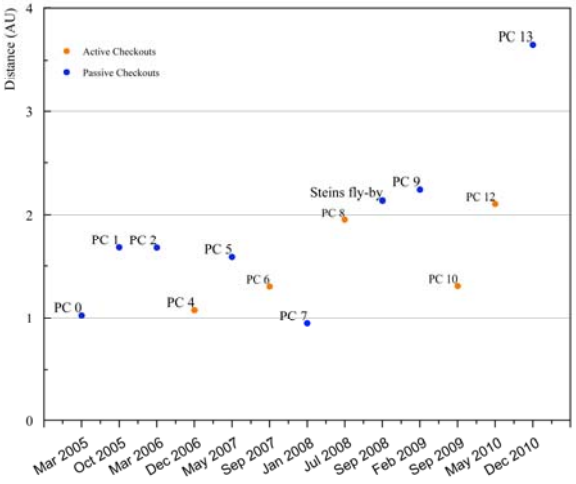

Figure 1 Active and Passive Payload Checkouts dates versus heliocentric distance.

3. PC's Analysis

In order to verify GIADA health status, we analyzed the calibration data produced during the different PCs by the GDS (Grain Detection System, based on grain detection through light scattering) and IS (Impact Sensor, giving momentum measurement through impact on a sensed plate) and the measured frequency for the 5 QCMs (Quartz Crystal Microbalance) forming the MBS subsystem, giving deposited dust mass measurement. The QCMs have a starting specific frequency (unloaded sensor surfaces) due to the coupling of the 2 Quartz Crystals constituting the device. The IS (Impact Sensor) subsystem has an internal calibrator that produces a known pulse on the impacting plate. The calibration data for the GDS is the noise level of the two optical receivers detecting the scattered light.

In Figure 2 are reported the signal readings for the QCM 1 with sensitive surface in +X satellite direction. The QCM 1 shows a small increase in the frequency probably due to a contamination coming from the spacecraft outgassing or due to the residual of spacecraft thrusters activity.
Figure 3 displays the evolution of the detection level for the two channels of the GDS receiver. The data analysis shows a good stability for the GDS detection level and an unvaried optical cross section detecting capability with respect to that calibrated on-ground. Figure 4 shows the signal level of PZT1, one of the 5 IS piezoelectric sensors, obtained exciting the sensor by the internal calibrator. The analysis of the data acquired during the whole cruise phase shows an excellent sensor response stability.

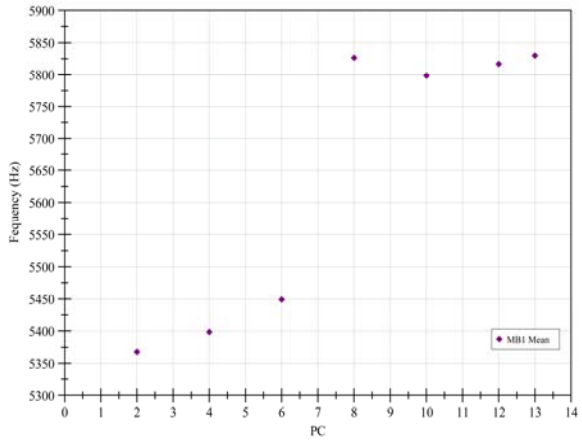

Figure 2: Mean values of QCM1 frequency measured during active PCs plus the last passive PC performed before the hibernation.

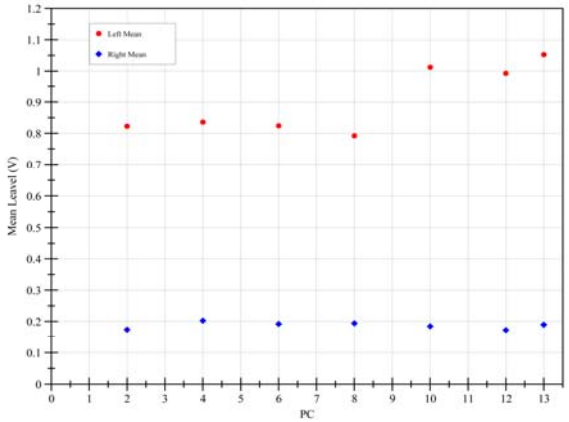

Figure 3: Mean values of the GDS channels detection levels during active PCs plus the last passive PC performed before the hibernation.

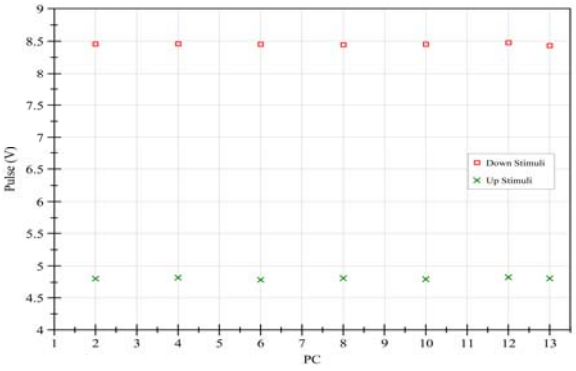

Figure 4: Mean values of the signal from PZT1 due to the internal calibrator excitation during active PCs plus the last passive PC performed before the hibernation.

6. Conclusions

The GIADA instrument maintained a nominal behaviour during the whole Rosetta Cruise Phase. The sensors devoted to characterize the dust cometary environment show only slight variations in terms of sensitivity (GDS) and in dynamical range (MBS). The data collected during the long cruise phase allowed a full characterization of the instrument behaviour, which will be critical for a correct future scientific data interpretation.

Acknowledgements

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