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IN FLIGHT ACHIEVEMENTS AND FOLLOW-ON FOR COLD GAS MICRO PROPULSION APPLIED TO S/C FINE POINTING AND ATTITUDE CONTROL

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Abstract

Cold Gas Micro-Propulsion technologies and flight equipment have been developed in Europe. The first Cold Gas Micro-Propulsion System has now achieved one year flight operational experience at L2 on board GAIA, as AOCS actuator. Two 6 micro-thrusters branches with control electronics and propellant management provisions downstream the 57 Kg GN2 tank may operate in closed loop control, featuring 0-1000 N thrust range, 0.1N commanding resolution, very low noise spectrum and fast throttling time response. These performances are essential to meet unprecedented sky scanning motion attitude and rate stability, needed to get three-dimensional map of one billion stars in a 5 year high accuracy science observations. The S/C overall performance is in line with scientific goals fulfillment.

Follow-on is currently under implementation at Selex ES by the manufacturing and flight acceptance of thrusters and electronics units for other scientific missions as LISA Pathfinder and Microscope.

These three missions have different scientific objectives but share high degree of requirements commonality. As an exception, Microscope required an electronic unit upgrade, to cope with a different overall system configuration and a faster thrust throttling.

12 micro-thrusters and their electronics unit are under integration on the LISA PF S/C. Thrusters and electronics unit qualification models have been delivered to CNES for the Microscope mission.

The paper reviews technology, GAIA, LISA PF and Microscope systems and equipment , the achieved ground testing performances including ONERA thrust balance testing, and GAIA flight achievements.

High AOCS parameters stability is not the only achievable performance. On board Microscope, aimed to Equivalence Principle flight test, an accelerometer is sensitive to parasitic acceleration down to 10-9 m/s : very “silent” (ideally micro-vibration less) thrusters operation is required together with fast thrust throttling.

The cold gas technology allows thrust range scalability without need of re-development , and may provide a huge max to min thrust ratio, high resolution, very low parasitic micro-vibration, continuous and pulsed operation , down to a ¡ 1 Ns impulse.

In view of these performance capabilities and flexibility, the Selex cold gas technology/equipment is on one side a natural candidate to properly support/enable further scientific missions, as for instance EUCLID (Phase C/D expected in the near term). On the other side, perspectives for application field extension shall be now investigated together with Primes.