SMART-1 Technology Experiments in Preparation to Future ESA Planetary Missions

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SMART-1 is the first ESA Small Mission for Advanced Research in Technology, aimed at the demonstration of enabling technologies for future scientific missions. SMART-1's prime technology objective is the demonstration of the solar primary electric propulsion, a key for future interplanetary missions. SMART-1 will use a Stationary Plasma Thruster engine, cruising 15 months to capture a Moon polar orbit.

SMART-1 payload aims at monitoring the electric propulsion and its spacecraft environment and to test novel spacecraft and instrument technologies.

1. The Diagnostic Instruments include SPEDE, a spacecraft potential plasma and charged particles detector will characterise both spacecraft and planetary environment, together with EPDP, a suite of sensors monitoring secondary thrust-ions, charging and deposition effects. The performance of the Electric Propulsion shall be also monitored by high-accuracy tracking in Ka-Band, making use of the KATE transponder.
2. Innovative Spacecraft technologies will be tested on SMART-1 : Lithium-ion batteries, miniaturised star-trackers and KATE, an experimental X/Ka-band deep-space transponder, to support radio-science (the RSIS Experiment), to monitor the accelerations of the electric propulsion and to test turbo-code technique, enhancing the return of scientific data.
3. A set of miniaturised instruments for imaging and spectrometry which will test novel technologies and support technology investigations, in preparation of future planetary missions:

    - D-CIXS, a compact X-ray spectrometer based on novel SCD detectors and micro-structure optics, to observe astronomy objects and to perform lunar chemistry measurements.
    - SIR, a miniaturised quasi-monolithic point-spectrometer, operating in the Near-IR (0.9 ÷ 2.4 micron), derived from a commercial device, which will be tested in lunar orbit to survey the Moon crust in previously uncovered optical regions.
    - AMIE, a miniature camera based on 3-D integrated electronics , imaging the Moon with 4 different spectral bands realised in a miniaturised thin film filter, and supporting three guest investigations:
        - LASER-LINK, a demonstration of acquisition of a deep-space laser-link from the ESA Optical Ground Station at Tenerife;
        - OBAN, the demonstration of an autonomous navigation tool, based on the processing of images from AMIE and from the star-tracker.

- RSIS, a set of radio-science and technology investigations, aimed at characterising the Ka-band communication channel and at verifying an in-orbit measurement method of libration properties of the planetary target.

The whole payload mass is in the order of 15 kg, against a satellite mass at launch of 350 kg, and allows to perform 9 different experiments with 6 embarked instruments. The key-note of all selected experiments and technology demonstration is the preparation of future Planetary exploration missions and, namely the ESA Mercury Cornerstone.