

SPACE EXPLORATION SYMPOSIUM (A3)  
Moon Exploration – Part 1 (2A)

Author: Prof. Bernard Foing  
European Space Agency (ESA/ESTEC), The Netherlands

## ESA SMART-1 MISSION: LEGACY AND LESSONS FOR FUTURE LUNAR EXPLORATION

**Abstract**

We review ESA's SMART-1 highlights and legacy 10 years after lunar insertion on 15 November 2004. We discuss lessons for future lunar exploration and upcoming missions. These results and legacy are relevant to the preparation for future missions, in particular in the frame of collaboration between Russia and ESA on upcoming landers and on a polar sample return. Also the results contribute to the preparation for a global robotic village and international lunar bases (consistent with ILEWG and Global Space Exploration roadmaps). The SMART-1 mission to the Moon achieved record firsts such as: 1) first Small Mission for Advanced Research and Technology; with spacecraft built and integrated in 2.5 years and launched 3.5 years after mission approval; 2) first mission leaving the Earth orbit using solar power alone with demonstration for future deep space missions such as BepiColombo; 3) most fuel effective mission (60 litres of Xenon) and longest travel (13 month) to the Moon!; 4) first ESA mission reaching the Moon and first European views of lunar poles; 5) first European demonstration of a wide range of new technologies: Li-Ion modular battery, deep-space communications in X- and Ka-bands, and autonomous positioning for navigation; 6) first lunar demonstration of an infrared spectrometer and of a Swept Charge Detector Lunar X-ray fluorescence spectrometer ; 7) first ESA mission with opportunity for lunar science, elemental geochemistry, surface mineralogy mapping, surface geology and precursor studies for exploration; 8) first controlled impact landing on the Moon with real time observations campaign; 9) first mission supporting goals of the ILEWG/COSPAR in technical and scientific exchange, international collaboration, public and youth engagement; 10) first mission preparing the ground for ESA collaboration in Chandrayaan-1, Chang' E1-2-3 and near-future landers, sample return and human lunar missions. The SMART-1 technology legacy is applicable to application geostationary missions and deep space missions using solar electric propulsion. The SMART-1 archive observations have been used to support scientific research and prepare subsequent lunar missions. Most recent SMART-1 results are relevant to topics on: 1) the study of properties of the lunar dust, 2) impact craters and ejecta, 3) the study of illumination, 4) observations and science from the Moon, 5) support to future missions, 6) identifying and characterising sites for exploration and exploitation.