

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Moon Exploration – Part 3 (2C)

Author: Dr. Andoni G. Moral  
National Institute for Aerospace Technology (INTA), Spain, moralia@inta.es

Dr. Carlos Pérez  
Instituto Nacional de Técnica Aeroespacial (INTA), Spain, carlos.perez@cab.inta-csic.es

Ms. Laura Seoane Purrinos

Instituto Nacional de Técnica Aeroespacial (INTA), Spain, seoanepl@inta.es

Dr. Pablo Rodríguez Pérez

Instituto Nacional de Técnica Aeroespacial (INTA), Spain, rodriguezpp@inta.es

PHOENIX: NOVEL PORTABLE HANDHELD COMBINED SPECTROMETERS FOR LUNAR  
SURFACE EXPLORATION

**Abstract**

ExPeRT (Exploration, Preparation, Research and Technology) activity area as a part of the ESA's Terrae Novae Exploration programme (formerly E3P) is tasked with preparing and de-risking technologies for future space exploration missions. Future human and robotics missions to the surface of the Moon, Mars and asteroids will involve scientific exploration and resource prospecting requiring new analytical instruments to enable rapid and high-quality in-field decision-making.

In response to ESA's ITT (Invitation To Tender) for the development of two prototypes of combined and portable spectrometers via ExPeRT, INTA proposed developing a Raman+LIBS (BB1) and a Raman+XRF (BB2). These PHOENIX (Portable Handheld cOmbinEd Raman-LIBS-XRF) spectrometers are intended for the real-time in-situ characterization of geological materials on terrestrial planetary analog sites, as Technology Readiness Level (TRL) 4 prototypes prior to future human exploration of the Moon and other planetary bodies. INTA leads an international consortium, together with University of Leicester (UK), University of Valladolid (ES) and Mission Control Inc. (CA), for the development of these two most promising complementary methods that provide key support for informed decision-making during planetary sampling activities. These combined spectrometers, in addition to combined spectroscopic techniques, also have a context camera that allows imaging and aligning the instrument. Raman is sensitive to molecular structure, along with laser-induced breakdown spectroscopy (LIBS) and X-Ray Fluorescence (XRF) that allow the identification and measurement of chemical elements and their relative abundances in rocks and associated minerals.

Under ESA Contract No. [4000138579/22/NL/AT], INTA coordinates all management tasks of PHOENIX instruments, so as the BB1 technical development, participating also with the Raman channel of BB2, which is led by University of Leicester. CAB (Centro de Astrobiología) from INTA, coordinates all related scientific activities, supporting ESA for the relevant analogues and samples selection for the two breadboards verification campaign. Following the completion of the prototypes, field tests will be conducted in collaboration with ESA's PANGAEA team, who run astronaut field geology training, to further assess the performance, usability and ergonomics of the spectrometers for informing their future development.

Since these are demonstrator prototypes of the technology, most of the elements that make up the future instrument are commercial, but have been carefully selected in order to easily increase its TRL, up to a Moon qualified design in the coming years.