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RAMAN LASER SPECTROMETER FOR MARS EXPLORATION

Abstract

The Raman Laser Spectrometer (RLS) is one of the Pasteur Payload instruments, within the ESA's Aurora Exploration Programme, ExoMars mission.

Purpose: Two missions are currently under evaluation within the ExoMars programme: one consisting of an Orbiter plus probably an Entry, Descent and Landing Demonstrator(to be launched in 2016) and the other, with a launch date of 2018, which will include a joint Rover as part of ESA-NASA collaboration. ExoMars Rover would carry a drill and a suite of instruments dedicated to exobiology and geochemistry research. ExoMars 2018 main European Scientific objective is "Searching for evidence of past and present life on Mars", which would be assessed by Pasteur Payload. Particularly, the RLS scientific objectives are as follows:

-identify organic compound and search for life -identify the mineral products and indicators of biologic activities -characterize mineral phases produced by water-related processes -characterize igneous minerals and their alteration products -characterise water/geochemical environment as a function of depth in the shallow subsurface

Methodology: Raman Spectroscopy is used to analyse the vibrational modes of a substance either in the solid, liquid or gas state. It relies on the inelastic scattering (Raman Scattering) of monochromatic light produced by atoms and molecules. The radiation-matter interaction results in the energy of the exciting photons to be shifted up or down. The shift in energy appears as a spectral distribution and therefore provides an unique fingerprint by which the substances can be identified and structurally analyzed.

The RLS is being developed by an European Consortium composed by Spanish, French, German and UK partners. It will perform Raman spectroscopy on crushed powdered samples inside the Rover's Analytical Laboratory Drawer.

Results: RLS expected main characteristics:

-Laser wavelength: 532 nm -Irradiance on sample: 0.6 – 1.2 kW/cm2 -Spectral range: 150-3800cm-1 -Spectral resolution: 6 cm-1 lower wavenumbers; 8 cm-1 long wavenumbers -Spot size: 50 microns

Currently, development of extended Phase B is on going and it is expected to hold a delta-PDR by the end of 2012. During this phase, instrument performances are being evaluated by means of simulation tools and development of an instrument prototype.

Conclusions: The RLS is a key tool to achieve ExoMars objectives and its current technological development provides a promising future for being used on other planetary missions as a non destructive analysis technique. It is as well under study its implementation as part of Marco Polo mission and as part of a Lunar mission from JAXA.