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

EXOMARS RAMAN LASER SPECTROMETER SCIENTIFIC PERFORMANCES CHECK WITH A BREADBOARD

Abstract

The Raman Laser Spectrometer (RLS) is one of the Pasteur Payload instruments, within the ESA's Aurora Exploration Programme, ExoMars mission. It will perform Raman spectroscopy on crushed powered samples deposited on a small container after crushing the cores obtained by the Rover's drill system.

For being able to check that the Instrument fulfils main scientific requirements, a breadboard which verifies the TRL5 (Technology Readiness Level 5) achievement by the Instrument, has been developed. With results obtained from that model campaign, it has been demonstrated that the Instrument satisfies scientific functionality in a relevant environment.

The Instrument breadboard has kept all optical critical parameters, interfaces between units, and relevant functionalities.

The RLS is composed by the following units:

SPU (Spectrometer Unit): a spectrometer concept based on a single transmission holographic grating, used as dispersion element; and with a thermally controlled CCD detection.

iOH: (Internal Optical Head): an optical unit which focus (autofocus mechanism capability) the laser excitation light over the sample through the excitation path, and filters the scattered Raman signal for its processing at the SPU through the reception path.

ICEU (Instrument Control and Excitation Unit): within this unit it is housed the high stability laser source, the Front End Electronics; and the power and processor modules.

A breadboard unit was developed and tested for each of the previous subsystems; and finally integrated and tested at Instrument level (designed as modular as possible in order to be able to upgrade the breadboard in a step by step process), for checking main scientific requirements for significant samples identification. The Instrument breadboard programme has been developed for two years, and has been able to achieve the following objectives:

verify RLS critical scientific performances: spectral resolution, spectral accuracy, SNR...

validate the System Radiometric Model

validate RLS critical functionalities, such as: CCD control and commanding, iOH autofocus...

confirm the overall concept of the Instrument operation: spectra extraction, operation timing, operation algorithms...

After RLS breadboard campaign, Instrument scientific critical performances have been verified, allowing go on with future Instrument models. And also, with the radiometric model validation it will be easy to predict how future possible Instrument design modifications could affect to Instrument final performances.