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Introduction: SHERLOC is an arm mounted instrument that is part of the Mars 2020 payload. It combines imaging with UV resonance Raman and native deep UV fluorescence spectroscopy in order to identify potential biosignatures and understand the aqueous history of a site on Mars [1]. It will enable both spectroscopy and color microscopic imaging. It utilizes a Deep UV laser (248.6 nm) to generate characteristic Raman and fluorescence photons from a target/area of interest. The DUV laser is co-boresighted to a context imager and integrated into an autofocusing/scanning optical system that allows us to correlate spectral signatures to surface textures, morphology and visible features. These spectral maps reveal more information than spectra alone by relating minerals and chemicals to textures in a way simple bulk analysis does not.

The goals of the SHERLOC investigation are to:

- *Assess the habitability potential of a sample and its aqueous history.*
- *Assess the availability of key elements and energy source for life (C, H, N, O, P, S etc.)*
- *Determine if there are potential biosignatures preserved in Martian rocks and outcrops.*
- *Provide organic and mineral analysis for selective sample caching.*

To do this SHERLOC does the following:

- *Detects* and *classifies* organics and astrobiologically relevant minerals on the surface and near subsurface of Mars
- Bulk organic sensitivity of 10^{-5} to 10^{-6} w/w over an 7 x 7 mm spot.
- Fine scale organic sensitivity of 10^{-2} to 10^{-4} w/w spatially resolved at <100µm
- Astrobiologically Relevant Mineral (ARM) detection and classification to <100µm resolution

Scientific Operations: The Wide Angle Topographic Sensor for Operations and eNgineering (WATSON) imager, a built to print version of MAHLI that was flown on MSL, provides color wide field and microscopic images of sample at distances of 2 to 25 cm.

For spectroscopy, operations are planed around a single arm placement, 48 mm above the target. Through the use of an internal scanning mirror, autofocusing lens, and a depth of focus of ±500 µm, the 100 µm laser spot can be systematically scanned with a fine-scale spatial resolution on natural or abraded surfaces, with the additional capability of investigating boreholes to a depth of at least 13 mm without further arm movement. While the instrument is being designed to be flexible with respect to operations, the nominal activity includes two opsmodes which are:

Survey mode. Initial observations will be performed on an abraded patch in survey mode. The laser will raster over a 7x7 mm area with 200µm spacing to generate 1225 spectra arranged in a 35x35 point grid. A Raman/fluorescence spectrum is acquired within 1 sec at each point. These spectra can be averaged together to get bulk organic/mineral abundances.

Detailed mode. In a typical operational scenario, survey mode would be used to identify an area of interest to be analyzed using detail mode. The internal computer will analyze the acquired spectra from survey mode for Raman and/or fluorescence signatures and determine a region of high interest to perform a detailed analysis. During detailed mode, a denser map is generated over a 1x1mm areas. This consists of rastering the 100µm laser beam at 100 µm steps to generate 100 Raman/fluorescence spectra in a 10x10 grid.

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References: [1] Beegle, L. W. et al. (2015) *IEEE, 90,* 1-11.

Ops mode	Survey	Detailed
# of Spectra	1225	100
Area Scanned	49 mm^2	Up to 1 mm^2
Duration	8.8 min	23 min
Avg Power	~41 W	~54 W
Data Volume	~50 Mbits (3:1)	~7 Mbits (3:1)
Laser Pulses	9600	40,000
Aromatics	✓ Spatially resolved	✓ Spatially resolved
Aliphatics	✓ Bulk	
Mineral (ARM)	100 µm grains	<50 µm grains