

2023 Technology Showcase for Future NASA Planetary Science Missions

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Capabilities

1. ppb or better detection of organic compounds in real time
 - a. **Instrument name:** MERLIN
 - b. **Technique:** Back illuminated Surface Enhanced Raman Spectroscopy (SERS) with high sensitivity for organic and trace biosignature detection. MERLIN can perform high precision mapping across silver nanorod SERS substrates produced with oblique angle thermal vapor deposition. Biosignatures are detectable at ppb or better levels.
 - c. **Mission relevance:** MERLIN was designed for the Abzu mission concept to discover and analyze organics on Mars in situ with a viewing window that connects to ExCALiBR for concentrated organic delivery to the sensor. The hardware and SERS substrate creation techniques are also applicable to the Mars Life Explorer (MLE) to determine organics in ice as well as the Enceladus Orbilander to determine amino acids and lipids in active ice world plumes.
 - d. **TRL 5**
2. Stand-off elemental mapping in real time
 - a. **Instrument name:** L3VIN
 - b. **Technique:** Ultracompact 2.5D elemental mapping with no moving parts using Laser Induced Breakdown Spectroscopy (LIBS). The instrument includes a textual imager co-boresighted with the laser for fine-scale imaging. Auto focusing is performed with liquid lens technology to focus between 0.1 m and 1.4 m. The instrument integrates with a rover or lander and used in the search for organic compounds indicating life or past life. Measurements are performed as individual points, lines, or as a grid with < 1 mm spacing between points.
 - c. **Mission relevance:** L3VIN is designed for geological characterization in a CLPS mission to determine elemental composition and textual/morphological information. The instrument is also relevant to the METRIC concept as well as in situ spectroscopic identification of samples for moon sample return missions including the ASTROLAB and the Endurance A concepts for South Pole-Aitken (SPA) investigations. Textual and elemental information may also be relevant to the Mars Life Explorer mission in the search for biosignatures in Martian ice.
 - d. **TRL 5**
3. Non-invasive detection of trace organics and REE
 - a. **Instrument names:** PERISCOPE and MAUVE
 - b. **Technique:** Identification of organic compounds relevant to astrobiology, including microorganisms, water content, and rare-earth elements in a compact probe with no moving parts using UV fluorescence and multispectral UV imaging. PERISCOPE classifies and maps the distribution of trace organics with 100 μm precision over cm-scale areas. and is designed for borehole mapping, core scanning post acquisition, and/or surface scanning prior to sampling. MAUVE is a UV fluorescence imager that filters light to produce images in multiple bands.
 - c. **Mission relevance:** Valuable for any mission whose priority goal is to search for organic matter and potential biosignatures, water, or rare-earth elements, including lunar and icy

environment surveying. The PERISCOPE optical probe is easily sterilized and may have Planetary Protection applications. These instruments are directly relevant to the Mars Life Explorer (MLE), the CLPS METRIC concept as well as the lunar sample return concepts including ASTROLAB and Endurance A for South Pole-Aitken (SPA) investigations.

- d. **TRL 5**
- 4. Real time mineralogy in ultracompact form factor
 - a. **Instrument name:** MIR3100
 - b. **Technique:** Ultracompact form factor and low power IR spectrometer with two modes: (1) MIR mode (5.5 - 11 μm) collecting thermal radiation from lunar surface material (soil, regolith, rock), and (2) Near-IR mode (2.5 – 5.0 μm) collecting reflected radiation from IR emitters or solar radiation. The instrument is designed to be rover mounted with a 9x2 cm field of view at a 20 cm working distance.
 - c. **Mission relevance:** Designed for a CLPS mission for geological characterization of mineralogy. It is relevant to the METRIC concept as well as in situ spectroscopic identification of samples for moon sample return missions including ASTROLAB and Endurance A.
 - d. **TRL 5**

Hardware

