ULTRA COMPACT IMAGING SPECTROMETER.

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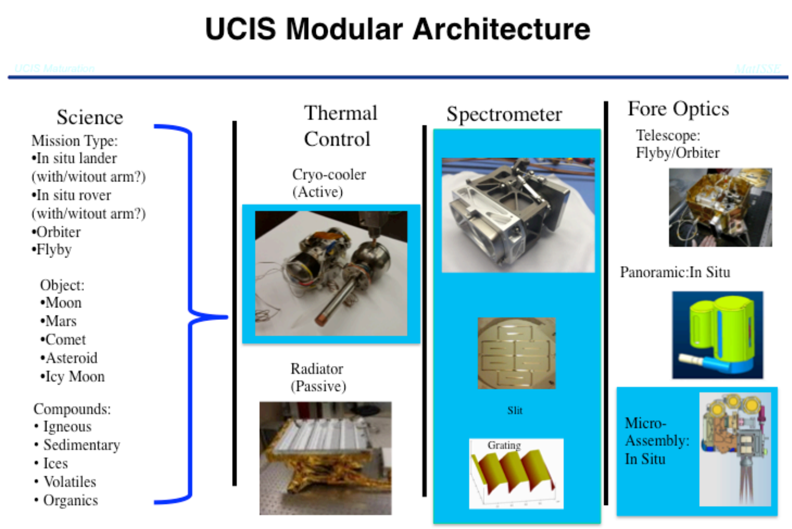
Summary: The Ultra Compact Imaging Spectrometer (UCIS) [e.g. 1,2] is a visible to short wavelength infrared (VSWIR) imaging spectrometer with a modular architecture (Figure1). It is possible to adapt the instrument details to a variety of mission concepts requiring low mass and low power. Imaging spectroscopy is an established technique to address complex questions of geologic processes by mapping diagnostic absorption features due to minerals, organics, and volatiles throughout our solar system. At the core of UCIS is an Offner imaging spectrometer using M^3 heritage spectrometer and a miniature pulse tube cryocooler developed under the NASA Maturation of Instruments for Solar System Exploration (MatISSE) program to cool the focal plane array. The TRL 6 integrated spectrometer and cryo-cooler provide a basic imaging spectrometer capability that is used with a variety of fore optics to address surface mission science goals (e.g. lunar, Mars, small bodies). Potential configurations include: remote sensing from small orbiters and flyby spacecraft; in situ panoramic imaging spectroscopy; and in situ micro-spectroscopy. An integrated spectrometer / micro-cooler / micro-spectroscopy front end is being developed using MatISSE funding.

Reflectance Imaging Spectroscopy: Reflectance imaging spectroscopy is a non-destructive technique for remote mineral identification and mapping of distribution by measuring the reflected light from a surface. Compositional mapping enables the linkage of mineral assemblages to specific locations where geological processes are occurring. Reflectance spectroscopy is an established technique with well-developed spectral libraries and theoretical basis. A wide range of material can be identified and mapped including igneous and sedimentary minerals, ices, volatiles, and organics. It has been successfully used on a wide range of objects ranging from Mercury, the Moon, Mars, asteroids, comets and the outer solar system planets and moons. The technique works at all spatial scales ranging from 100's of kilometers to 10's of microns [5].

UCIS Modular Architecture: The utility of imaging spectroscopy given the range of materials it can measure, the range of spatial scales, and the types of bodies it can be use on makes development of a single instrument challenging. Science requirements, wavelength ranges, platform and the object itself provide distinct instrument requirements. The need for small instruments for in situ and small spacecraft also drive optimization. To develop a technology that works for a such a wide range of applications, for UCIS we adopted modular architecture approach. The desired science, target, and platform then feed into choices for the thermal design, spectrometer design, and optical design. Several variations have been recently proposed for flight. Including:

- Min Map: Panoramic, Mars (Blaney, PI): Mars 2020, CAT 1 (Cryo-cooler, Spectrometer, Panoramic)
- CIMMBA: Micro, Mars (Ehlmann, PI): Mars 2020, CAT 1 (Cryo-cooler, Spectrometer, Microscopic)
- M6 on Merlin Phobos Discovery Proposal (Murchie, PI) (not selected) (Cryo-cooler, Spectrometer, Microscopic)
- Korean Pathfinder Lunar Orbiter (KPLO) mission RFI (Morgan Cable, JPL Lead) (Cryro-cooler, spectrometer, telescope)

References: [1] Van Gorp et al. (2011) Proc. SPIE. 8158, Imaging Spectrometry XVI [2] Van Gorp et al. (2014) J. Appl. Remote Sens. 8(1), 084988 doi:10.1117/1.JRS.8.084988 [3] Ehlmann et al. (2016) This meeting.



Items in blue boxes indicate hardware being integrated into instrument in the MATIESE program.