Ultra Compact Imanging Spectrometer (UCIS): Technology Maturaion and Applications for Mars, the Moon, and Small bodies.

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Introduction: The Ultra Compact Imaging Spectrometer (UCIS) is the first imaging spectrometer compatible with being put on the mast of a lander or rover that has been built using flight-proven components (Fig. 1) [1,2]. UCIS can generate panoramic image cubes of a scene over the wavelength range of 500–2500 nm with a spatial resolution of 1.4 mrad Individual Field of View (IFOV), corresponding to a spatial sampling of 1.4 cm at 10 m. Microspectroscopy configurations also exist [3]. UCIS can be customized for the thermal environment of Mars, the moon, and asteroids. Thermal considersations limite the wavelength range on Mars, but longer wavelength (3600 nm) cutoffs are available for airless bodies.

MinMap (Martian Application): MinMap is a Martian specific implemnation of UCIS which was proposed to the Mars 2020 mission. Developed jointly by the Jet Propulsion Laboratory (JPL) and Applied Physics Laboratory (APL), MinMap combines the experience of both in VSWIR imaging spectroscopy. The JPL-built M3 (on Chandrayan-1) [4] and APL-built CRISM (on MRO) are the design basis for MinMap [5]. Implementation risk is reduced by JPL and NASA investments in the Ultra Compact Imaging Spectrometer (UCIS, Fig. 1a). The MinMap mast mounted package is show in Figure 2. Total instrument mass is 3.4 kg (3 kg on mast, 1.4 kg in rover body).

A MinMap prototype, UCIS has demonstrated required performance in terrestrial field campaigns (Fig. 1b). Onboard data reduction is achieved by implementing a simplified version of CRISM's data pipeline in an internal processor (Figs. 1c,1d).

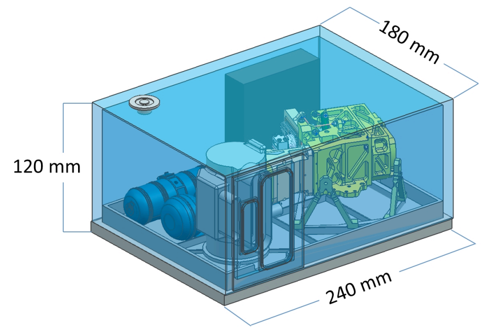

Figure 2: *MinMap mast-mounted Sensor.*

MatISSE TRL Maturation: UCIS is currently undergoing TRL maturation under the NASA MatISSE program for both Lunar and Martian thermal designs. The current TRL maturation and activites to be matured are shown in Figure 3. At the end of the program an integrated sensor head will be qualified for both lunar and Martian applications.

References: 1] Van Gorp, B. et al., (2011) SPIE Optics and Photonics, San Diego, California, August 21–25. [2] Van Gorp, B. et al. (2012) SPIE Optics and Photonics, San Diego, California, August. [3] Ehlmann et al. This Volume. [4] Green, R.O, et al. (2011) J. Geophys. Res., 116, E00G19. [5] Murchie, S., et al. (2007) J. Geophys. Res., 112, E05S03.

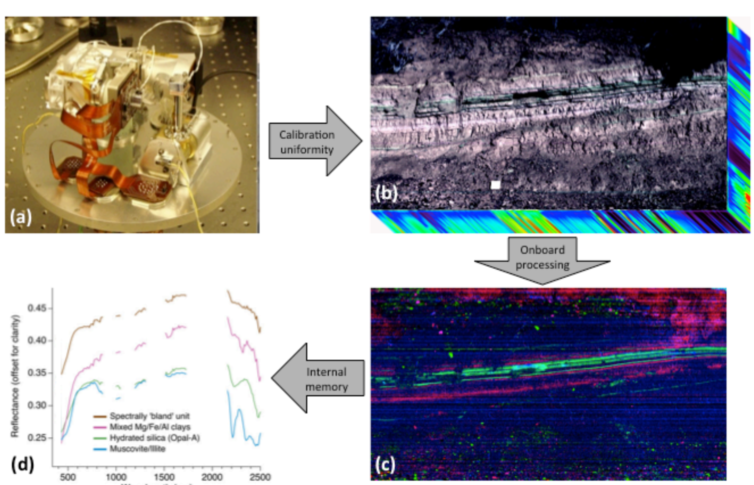

Figure 1: *The M3-based opto-mechanical design and focal plane, which have been prototyped and field-tested (a), provide highly uniform data that can be accurately calibrated using onboard measurements (b). Onboard real-time processing in CRISM-derived electronics process the data into low-volume summary products which are downlinked to Earth (c). Hyperspectral data are stored in MinMap 128-Gb internal memory and high-priority regions are queried for downlink and detailed analysis (d).*

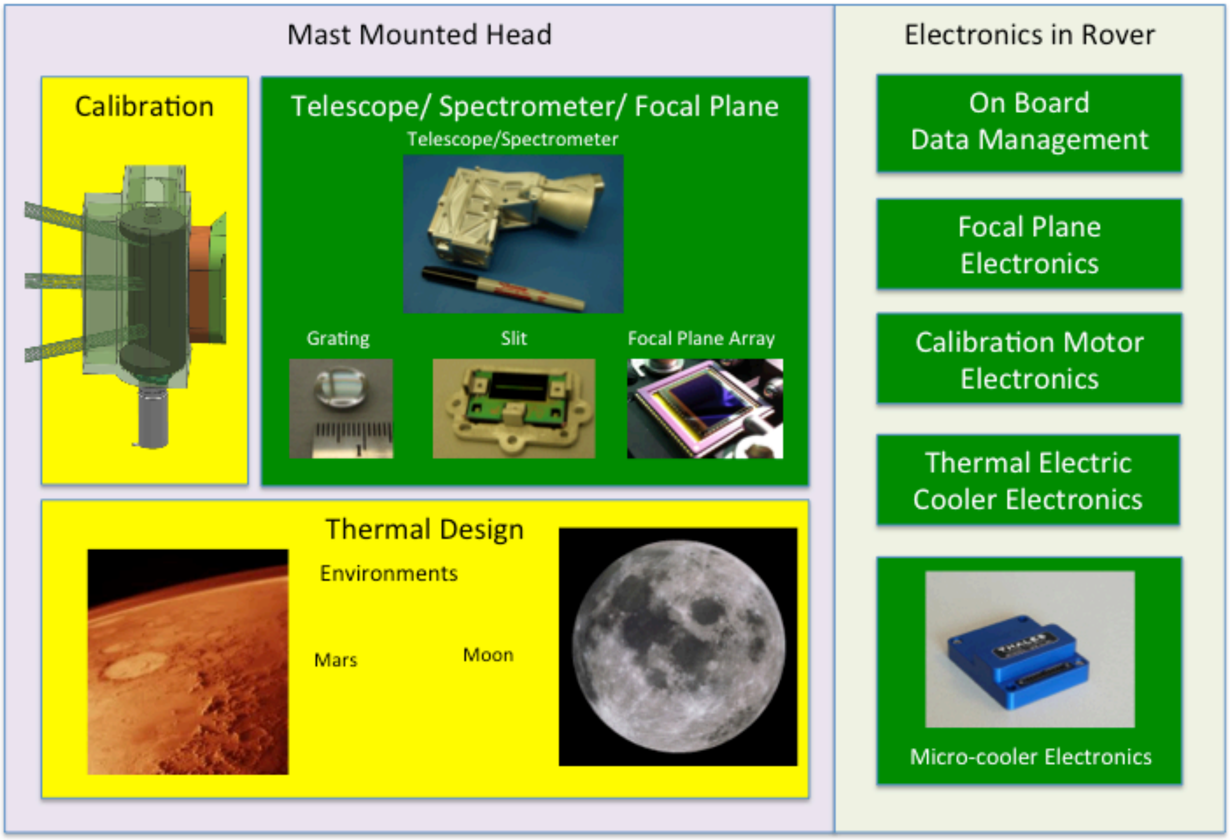

Figure 3. UCIS instrument readiness overview. Green indicates elements with sufficient TRL>6 Yellow identifies elements being matured under MatISSE. Optical hardware is on the mast while the electronics are located in the rover body.