THE SUPERCAM MAST UNIT ON THE NASA MARS2020 MISSION

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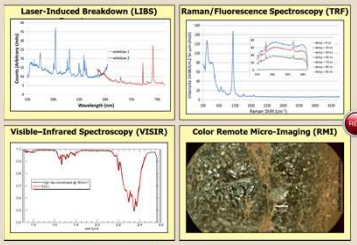
SUPERFCAM INSTRUMENT



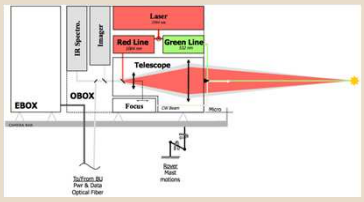
SuperCam Instrument is an evolution from the successful **ChemCam on MSL** Curiosity. SuperCam is an instrument package capable of five different remote-sensing techniques:

- Laser-Induced Breakdown Spectroscopy (LIBS),
- Raman and time-resolved fluorescence (TRF),
- passive visible and infrared (VISIR) reflectance spectroscopy,
- remote micro-imagery (RMI)
- a sound recording device (MIC).

The SuperCam package consists of three separate major components:

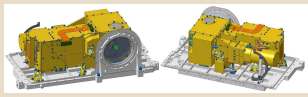
- the SuperCam Body Unit (SCBU) developed by LANL (Los Alamos, NM),
- the SuperCam Mast Unit (SCMU) developed by IRAP (Toulouise, France) with CNES funding
- the SuperCam Calibration Target (SCCT) provided by the University of Valladolid (UVa, Spain)

SUPERCAM MAST UNIT



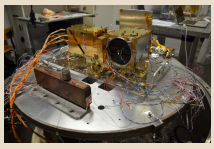
The SuperCam Mast Unit consists of two separated units :

- the Optical Box (OBOX)
- the Electronic Box (EBOX)

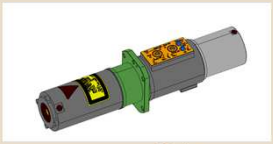


The SuperCam Mast Unit combines several functions :

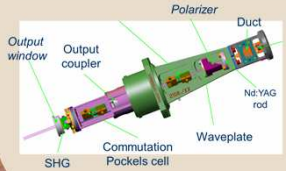
- it focuses the telescope, generates the laser beam to trigger the LIBS plasma and Raman scattering,
- it collects LIBS/Raman/VISIR light which is redirected to the spectrometers,
- It reads RMI images
- It records sound.

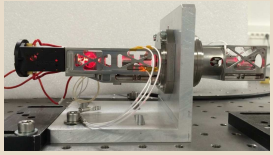


SUPERCAM LASER



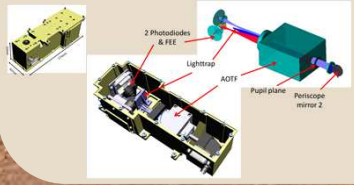
As for ChemCam, the SuperCam laser is developed by TOSA (THALES Optronique). SuperCam laser has high heritage from ChemCam but differs in several ways : a new Nd:YAG crystal to support higher firing rates has been accomodated and a doubling crystal (KTP) has been added to convert the 1064 nm red line in 532 nm green line on demand





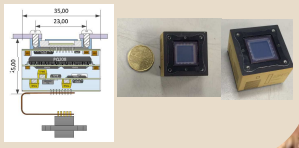
INFRARED SPECTROMETER (IRS)

The IRS bandpass lies between 1.3µm and 2.6 µm with a spectral resolution of 30 wavenumbers. The IRS concept is based on the scan of an Acousto-Optical Tunable Filter (AOTF). Applying a Radio Frequency (RF) signal on a transducer mounted on the AOTF, the crystal diffracts two useful orders, output wavelength depending on the excitation RF frequency. Photons are focused on the two different HgCdTe photodiodes embedded in a triple-stage Thermo-Electric Cooler (TEC).



REMOTE MICRO IMAGER (RMI)

The RMI is a context color imager of 15 mrad of FOV. The panchromatic 1Mpx CCD of ChemCam has been replaced by a 2048*2048 CMOS with a Bayer filter from CMOSIS.
A CASPEX (Color CMOS Camera for Space Exploration) product has been selected : it is a high level integration device (35*35*27 mm^3), space radiations tolerant which takes the benefits of 3Dplus technology.
A High Dynamic Range (HDR) method is applied to maintain the ChemCam signal to noise ratio.



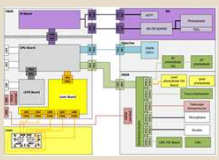
MICROPHONE (MIC)

The MIC primary science objective is to support the LIBS investigations to obtain unique properties of Mars rocks and soils. In addition, the MIC can monitor various artificial sounds of the rover and contribute to basic atmospheric science.
The MIC assembly is composed of two parts: the microphone finger mounted on the RWEB window bracket and the front-end electronics fixed on the OBOX.

ELECTRICAL ARCHITECTURE

Four electronic boards are located in the Ebox :

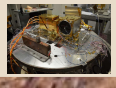
- The Low Voltage Power Supply (LVPS) board distributes digital and analogic secondary power lines.
- The Digital Processor Unit (DPU) board communicates with the SCBU, controls and monitors all the SCMU subsystems.
- The laser board board drives the Laser with high current and high voltage signal for firing.
- The IR board functions are to power the AOTF , to control the TEC cooler and to sample the IR photodiodes signal.

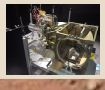


DEVELOPMENT AND TEST APPROACH

The overall philosophy maximizes heritage and focuses strong attention on the few lower-heritage areas to ensure success. The plan is rich in development models :

- *EDU Model*: The SCMU Engineering and Development Unit (EDU) Model was built to be fully functional, but not fully form and fit. All the functions are present and characterized at ambient. EDU SCMU is being tested with EDU SCBU at LANL.
- *TU Model* : The SCMU EDU will be refurbished to be the SCMU Testbed Unit (TU) and delivered to JPL after being integrated with the SCBU for Mars 2020 Vehicle System TestBed purposes.
- *STM Model*: The SCMU STM (Structural and Thermal Model) was built last spring and passed successfully the environmental tests (vibration, shock, thermal vacuum).
- *EQM Model*: A fully representative SCMU Engineering and Qualification Model (EQM) model is being built and will be tested at Qualification level in spring 2017. Performance will be verified and characterized. The EQM model will be delivered to LANL, for tests at Instrument level, then, for Calibration. This model will stay at LANL, as a ground model, during the mission.
- *Flight Model*: This model, for flight, will be very similar to the EQM, but with screened EEE parts. The FM model will go through acceptance tests campaign and will be delivered to LANL and then to JPL in 2018.





References: [1] Wiens et al. (2012) *Space Sci. Rev. 170*. [2] Maurice et al. (2012) *Space Sci. Rev. 170*. [3] Maurice et al. (2015) *LPSC 46*. [4] Clegg et al. (2015) *LPSC 46*. [5] Wiens et al. (2016) *LPSC 47*. [6] Maurice et al. (2016) *LPSC 47*. [7] Fouchet et al. (2015) *LPSC 46*. [8] Gasnault et al. (2016) *LPSC 47*. [9] Virmontois et al. (2016) *LPSC 47*.