SUPERCAM CALIBRATION TARGET GENERAL DESIGN.

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Introduction: SuperCam is high heritage instrument successor of the very successful ChemCam [1]. It is part of Mars2020 payload, and will be working on the surface of Mars on early 202.

ChemCam is an stand-off instrument that performs LIBS analyses and imaging of samples on the surface of the red planet on board Curiosity. For Mars2020, SuperCam incorporates more analytical techniques to analyze samples without contact. To LIBS, Laser Induced Breakdown Spectroscopy, SuperCam adds: plasma spark sound analysis, Time Resolved Raman Spectroscopy, Fluorescence spectroscopy, VISIR spectroscopy and color microimaging. With this complete suite of techniques SuperCam will be able to analyze morphology, elemental composition, molecular composition and textures of samples. This combination of information coming from different techniques will provide a full picture of the surface of Mars, but also represents a challenge from the point of view of calibration, as each technique has different needs from a calibration point of view, and there is also the need of cross calibration among techniques. All this needs have been taken into account during the design of the SuperCam Calibration Target, SCCT.

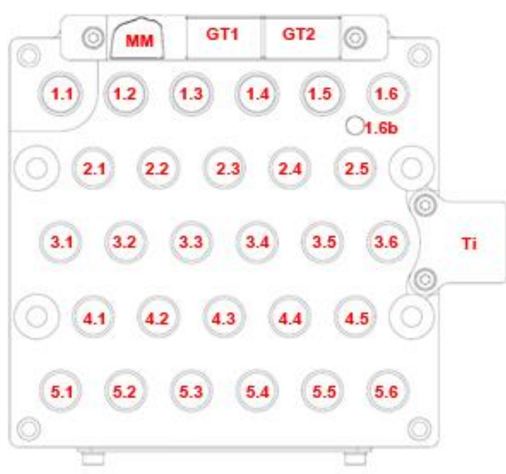

Fig. 1. Schematics of the different elements of the SCCT

Design of the SCCT: The SCCT includes a total of 30 samples divided as follows: twenty-two different sintered mineral samples intended to calibrate the chemometric analyses performed by LIBS and Raman(2.x, 3.x, 4.x, 5.x); one organic sample to monitor the impact of the Martian conditions or organic molecular groups with Raman spectroscopy (1.6); five reflectance standards provided by NBI in Denmark consisting on RGB (1.3 to 1.5) plus white (1.1) and dark (1.2) samples (all of these include a magnetic dust removal system), for RMI and VISIR calibration; a diamond sample (1.6b) to calibrate Raman spectrometer response and Rayleigh position; a titanium plate (Ti) for wavelength calibration and a geometric target (GT1 and GT2) including elements for RMI calibration. An additional element (MM), consists on a martian meteorite that serves as practice target, and in fact as an "inverse sample return".

The reflectance standards follow a design based on the magnetic experiment on pathfinder, using the ferromagnetic properties of the martian dust to keep clear these samples and providing more time of use. These samples will provide information about the dark current of the VISIR spectrometer, the solar spectrum, or correct white balance for the Remote Micro Imager (RMI), as well as calibration for the VISIR spectrometer.

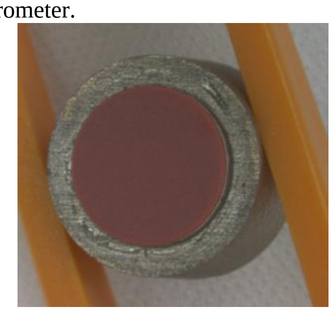

Fig. 2. Red reflectance standard with the magnet for dust protection

The organic sample consists on a piece of highly crystalline PET polymer, similar to the one used in Exomars RLS Calibration Target [2].

The mineral samples were provided from different laboratories on France, providing a sample of the relevant mineral groups and compositions. More candidates than the final selected samples were prepared, this final set that was included in the Flying Model was selected in science meetings within the Calibration Target Science Group. The samples were crushed and then sintered to provide a hard disk able to survive the harsh mechanical environment of the travel to Mars, and at the same time this processing ensured the spatial homogeneity of the samples. This homogeneity, as long as the composition and microstructure of the samples was characterized in Spain and France, using Raman imaging, imaging XRF [3], LIBS, Microprobe and ICPM [4]. Some changes in the micro structure of the samples was observed, but was expected, but the results allowed to have a set of samples that will ensure a good chemometric calibration in the surface of Mars, and also good correlation of the Raman and LIBS techniques, as these two techniques will provide complementary information of the same point of the sample, making possible data fusion techniques between both data origins.

While the wavelength calibration of the three spectrometers in SuperCam will be done using LIBS lines from the titanium plate, which are fixed in wavelength, the Raman effect, and the therefore the Raman bands, are relative to the laser source. To characterize the status of this laser source and the center of its emission it is necessary to have a well known and fixed Raman band. This is provided byt the diamond sample, that has a strong Raman band that is not sensitive to pressure or temperature, the position in nanometers of this band will allow to monitor the real wavelength of the laser.

The holder mechanical assembly of the SCCT is the structure on charge of keeping safe the samples from environmental and mechanical environments, what is a challenge taking into account the different materials with very different thermal and mechanical properties. From the mechanical point of view one the greatest concerns of the design was the survival of the samples to the high level shocks environment during Mars landing (3500 g). For this means, each sample is mounted in an individual hole with a 8 mm window to be seen by the instrument, and fixed using a shock attenuation spring, that can deal with the different tolerances and thermal expansions of the samples while providing a good performance in shocks mitigation through a huge range of compression values. The passive reflectance standards include the same system, adequate to the higher mass of the magnetic dust removal system.

Status of the SCCT: The SCCT is the first subsystem of SuperCam delivered to JPL. Previous to this delivery several tests were done on the samples (additional to the characterization), as UV aging tests. And more tests were done on the assembled unit as part of the qualification process [5], and later the acceptance campaign. During these tests the SCCT faced random vibrations, quasistatic loads, 4.000 g pyroshocks and thermal cycling going from -135 ºC to 115 ºC. All of what ensured its ability to survive not only to the travel to Mars, but the mission time in its surface.

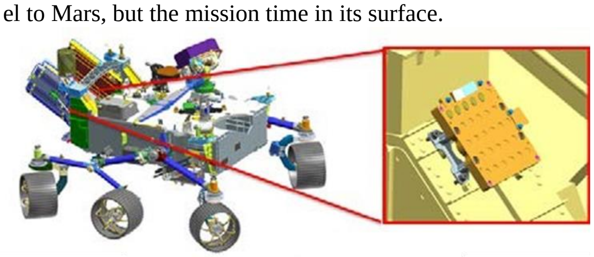

Fig. 3. SCCT accommodation on the Rover

The SCCT EQM (UVA) remains at this moment in Madrid, stored at INTA, and its used during joint tests with the main subassemblies of SuperCam, the Mast Unit (IRAP) and the Body Unit (LANL). A full set of samples was provided at earlier stages of the project to LANL so they could be used for development and tests of the spectrometers. An Engineering Model is delivered to JPL to be included in the test bed rover that will roll over the Mars yard. The final two models delivered are the Flying model, delivered already to JPL and ready for assembly, and its twin Spare Unit, built at the same time, that is safely stored in clean conditions in Spain, in case it is requested.

Fig. 4. SCCT FM fully assembled, prior to delivery

References: **References:** [1] S. Maurice et al. (2015) *LPSC XLVI* Abstract #2818. [2] G. López et al. (2018) Georaman Conference [3] J.M. Madariaga et al. (2018) *LPSC XLVIII.* [4] A. Cousin et al. (2018) *LPSC XLVIII.* [4] J.A. Manrique et al. (2018) Georaman Conference.