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Elemental Calibration of SuperCam's LIBS

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The Mars 2020 Mission was designed to address four overarching goals [1]: investigate the mineralogy and geology of the Jezero crater as representative of the ancient Martian environment, assess the habitability of this ancient environment, identify and cache samples with a high potential of preserving biosignatures, and study the current environmental Martian conditions in preparation for human exploration.

One of the primary objective for the SuperCam Instrumental Suite is to remotely investigate elemental composition and mineralogy of rock and soil targets. It will also provide sub-mm context color imaging of outcrop textures, search for organics and volatiles, perform atmospheric characterization, and record sounds [2-3]. To achieve these objectives, SuperCam implements several spectroscopic techniques. Here we focus on the Laser Induced Breakdown Spectroscopy (LIBS) technique that gives access to the chemical composition of martian targets, and the associated methods developed to build quantitative abundance models. LIBS measurements of a suite of more than 300 terrestrial samples covering a wide range of compositions has been acquired at a distance of 3 m with a laboratory replica of the instrument. The database includes a set of the calibration targets (SCCT) similar to those on-board the Perseverance rover. The LIBS Working Group has worked on many steps: Identification and removal of outliers; Definition of representative training and test sets; Comparison of various multivariate regression methods (more than 10 methods). The performances of the methods are evaluated using statistical criteria (Root Mean Squared Error (RMSE) and Maximum Absolute Error (MAE) for both the Cross Validation and Prediction), and from that the best models for each element have been selected [4-5]. First SCCT measurements done on Mars will allow to validate these models, in order to assess the chemical composition of martian targets.

[1] Farley et al. (2020), Space Sci. Rev. 216, 142. [2] Wiens et al. (2020) Space Sci. Rev. 216, in press, [3] Maurice et al. (2020) Space Sci. Rev. 216, in press [4]Anderson et al., LPSC 2021; [5]Forni et al., EGU 2021.