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First analysis of hydrogen in ChemCam spectra at Curiosity landing site.

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The NASA Mars Science Laboratory (MSL) rover Curiosity includes the first Laser-Induced Breakdown Spectroscopy (LIBS) instrument ever used on a planetary mission. With LIBS, light elements can be analyzed as indicators of the presence of water and other key element for habitability and life. A hydrogen signal is observed in essentially all soils and at lower levels in a few rocks in ChemCam data collected in the first 100 sols. LIBS data are processed by first subtracting a dark spectrum measured for the same integration time as the active spectra to account for reflected sunlight, pattern noise and counts due to thermal dark current. A strong H absorption line (Hα at 656.5 nm) detected in the dark spectra results from Fraunhofer lines in the solar spectrum. The dark spectrum depends highly on target type and solar irradiation properties and is measured either prior to or after the LIBS analysis. Here, data processing and the correction with the dark spectra for the H emission signal in LIBS spectra of martian targets are discussed.
On Sol 13, with ChemCam the first LIBS spectrum of an extraterrestrial target, a martian rock named Coronation, was obtained. A dark spectrum was collected prior to the LIBS analysis and was subtracted from the data. The hydrogen emission line is partly superimposed by a carbon line at 658.0 nm that is present with almost constant intensity in all the LIBS data due to the CO_2 dominated atmosphere on Mars. In order to investigate variations of the hydrogen signal, univariate analysis using areas of peaks fitted with Lorentzian lineshapes was undertaken to compare peak area with H and C concentration; both lines were fitted simultaneously to determine the contributions of each element. Hydrogen is observed within the first shots on Coronation and can be attributed to the dust layer on top of the rock. As soon as the dust layer is removed (usually between 1 - 5 shots for rocks) the intensity of the H line remains constant with low intensity. For 30 shots, C was found to be subject to only minor variations typical for shot-to-shot fluctuations of LIBS emission lines. Dark spectra obtained on different sols and of various targets were compared with regard to the solar hydrogen absorption line. The ratio of the dark spectra intensity to the hydrogen absorption line depths is characteristic for the solar spectrum and was found to be very stable in the ChemCam data. To investigate the differences and effects of the dark spectra measured prior to and after the LIBS analysis, a special sequence of ten alternating single dark and single active LIBS spectra was obtained on Sol 84 from the soil Crestaurum-2. Results will be presented in this work.