EGU21-1986
https://doi.org/10.5194/egusphere-egu21-1986
EGU General Assembly 2021

Atmospheric Science with Visible/Near-Infrared Spectra from the Mars 2020 Perseverance Rover

Timothy McConnochie[1,2], Thierry Fouchet[3], Franck Montmessin[4], Pierre Beck[5], Baptiste Chide[6,7], Raymond Francis[8], Olivier Gasnault[7], Jeremie Lasue[7], Carey Legett[9], Mark Lemmon[1], Sylvestre Maurice[7], Raymond Newell[9], Claire Newmann[10], Dawn Venhaus[9], Roger Wiens[9], and Michael Wolff[1]

[1]Space Science Institute, Boulder, CA, USA (tmcconnochie@spacescience.org)
[2]University of Maryland, College Park, MD, USA
[3]LESIA, Meudon, France
[4]LATMOS, Guyancourt, France
[5]IPAG, Grenoble, France
[6]ISAE-SUPAERO, Toulouse, France
[7]IRAP-CNRS, Toulouse, France
[8]JPL, California Institute of Technology, Pasadena, CA, USA
[9]Los Alamos National Laboratory, Los Alamos, NM, USA
[10]Aeolis Research, Pasadena, CA, USA

The Mars 2020 "Perseverance" rover's SuperCam instrument suite [1,2,3] provides a wide variety of active and passive remote sensing techniques [4, 5, 6, 7] including passive visible & near-infrared ("VISIR") spectroscopy [8]. Here we present our plans to use the VISIR technique for atmospheric science by observing solar radiation scattered by the Martian sky, similar to the "passive sky" technique demonstrated with ChemCam on the Mars Science Laboratory (MSL) rover [9]. Our presentation will focus on the objectives and techniques of SuperCam VISIR atmospheric science, but we will also present initial atmospheric science results or relevant instrument performance validation results to the extent that such are available at the time of the conference.

The objectives of VISIR atmospheric science are O_2, CO, and H_2O vapor column abundances, and aerosol particle sizes and composition. These objectives are motivated by unexpected seasonal and interannual variability in the O_2mixing ratio that is argued to be so large as to require O_2 sources and sinks in surface soils [10], by evidence of surface-atmosphere exchange of H_2O [11], by the potential significance of O_2 and H_2O volatiles as field context for returned samples due to their active exchanges with surface materials, and by the Mars 2020 mission [12] objectives of characterizing dust and validating global atmospheric models to prepare for human exploration

The SuperCam spectrometers used for VISIR mode are a ChemCam-heritage reflection spectrometer covering 385–465 nm with < 0.2 nm res. [2], an intensified transmission spectrometer covering 536–853 nm with 0.3–0.7 nm res. [2], and an acousto-optic-tunable-filter (AOTF) -based IR spectrometer covering 1300–2600 nm with 20–30 cm^{-1} res. [1, 8]. Our primary observing strategy is the same approach used for MSL ChemCam "passive sky" observations [9]:

ratioing instrument signals from the two pointing positions with different elevation angles eliminates solar spectrum and instrument response uncertainties that are ~100x and ~10x larger than signals of interest for the transmission and AOTF IR spectrometers, respectively. We will also make use of single pointings directed at the white SuperCam calibration target for less-resource-intensive water vapor and aerosol monitoring, and of multiple-pointing lower-signal-to-noise sky scans to better constrain aerosol size and shape. **Sky radiance is fit with a discrete ordinates multiple scattering radiative transfer model identical to that of [9]. As in [9] gas abundances are made robust to aerosol scattering uncertainties by fitting** CO_2 absorption bands with an aerosol vertical profile parameter.

References: [1] Maurice S. et al. (2020) SSR, in press. [2] Wiens R.C. et al. (2021) SSR 217, 4. [3] Manrique J.-A. et al. (2020) SSR 216, 138. [4] Ollila A.M. et al. (2021), this meeting. [5] Ollila A.M. et al. (2018) LPSC 49, 2786. [6] Forni O. et al. (2021), this meeting. [7] Lanza N. L. et al. (2021), this meeting. [8] Johnson J.R et al. (2021), this meeting. [9] McConnochie T.H et al. (2018), Icarus 307, 294. [10] Trainer M.G. et al. (2019), JGR 124, 3000. [11] Savijärvi H. et al. (2016), Icarus 265, 63. [12] Farley K.A. et al. (2020), SSR 216, 142.