Absorption Spectroscopy of Mercury's Exosphere During the 2016 Solar Transit. C. A. Schmidt[1,2], F. Leblanc[2], K. Reardon[3], R. M. Killen[4], D. E. Gary[5], K. Ahn[6], [1]Boston University, [2]LATMOS Laboratoire Atmosphères, Milieux, Observations Spatiales / CNRS, [3]National Solar Observatory, [4]NASA Goddard Space Flight Center, [5]New Jersey Institute of Technology, [6]Big Bear Solar Observatory

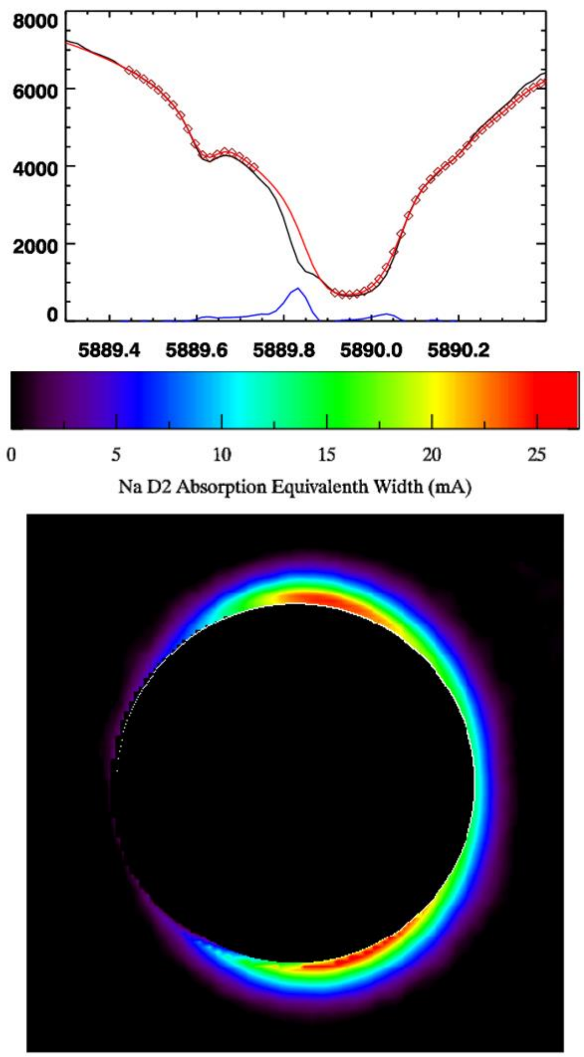
Introduction: Sodium is the most studied species in Mercury's exosphere and its bright resonant transitions offer a wealth of information. A consistent portrait of the sodium exosphere has been nearly 30 years in development. Due to the planet's proximity to the Sun, much of the ground-based work has been done in daylight using solar telescopes, and despite the higher background noise levels compared to traditional astronomical observations, exospheric sodium emissions are sufficiently bright to be measured by specialized instrumentation. On rare occasions, the exosphere can also be measured in *absorption* as Mercury transits between Earth and the Sun. Such observations can provide excellent spectral, spatial and temporal coverage of an otherwise elusive target, since more than ample photons are available with a modern telescope pointed at the Sun.

2016 Solar Transit: Transit observations have the unique property that line absorption can effectively provide an image of the exosphere's column density at all points above the terminator. We observed Mercury during the 9 May 2016 transit with the 1.6m Goode Solar Telescope at Big Bear Solar Observatory using the Fast Imaging Solar Spectrograph. Its adaptive optics system locked onto the solar granulation structure, permitting sub-arcsecond spatial resolutions. The spectrograph slit scanned over the planet's disk in 130 steps every 16 seconds. This technique produced nearly 500 "data cubes," each with a high resolution spectra as its 3rd dimension.

Shown in the upper panel of the figure, line profiles at every spatial bin (black) are divided by a shifted-and-scaled reference spectrum (red) in order to isolate the exosphere's absorption (blue) from line absorption in the solar atmosphere and structures inherent to granulation. Equivalent widths shown in the lower panel are directly proportional to the exosphere's column density, ~10^{11} cm^{-2}. The densest column of sodium appears near the poles and at dawn, whereas the dusk-side column is very tenuous.

This sodium distribution is strikingly similar to 2003 transit results taken at the same 150° true anomaly angle [1], confirming MASCS-UVVS evidence that the atmosphere is seasonally predictable [2]. However, the data quality and volumes herein permit a more in-depth study than previous transit measurements. This presentation will describe the atmospheric scale heights, the Doppler shifts due to the bulk motion of the atmosphere and an investigation of potential temporal variability within the 2.5 hours of observation.

2019 Solar Transit: The entire 5.5 hour transit on 11 November, 2019 will be optimally visible from European solar telescopes like THEMIS and GREGOR. This event will provide an excellent opportunity to characterize the sodium exosphere in the opposite Mercury season and better study its time-dependence.



References: [1] Schleicher, H et al., 2004, Detection of neutral sodium above Mercury during the transit on 2003 May 7, Astronomy & Astrophysics, v.425 [2], Cassidy et al., 2015, Mercury's seasonal sodium exosphere: MESSENGER orbital observations, Icarus, v.248.