Mercury's Na exosphere as seen with very high spectral resolution from the ground, and from space with MESSENGER

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The MErcury Surface, Space ENvironment, GEochemistry, and Ranging NASA's spacecraft, known as MESSENGER, flew by Mercury on September 29, 2009. It was the spacecraft's third and final flyby, before it went into orbit around the planet. The flyby presented a unique trajectory approach and perspective on the planet's exosphere, not available when in orbit. We present very high spectral resolution ground-based data obtained at the University of Texas McDonald 2.7-m telescope. These data were acquired within hours of the data taken with the Ultraviolet and Visible Spectrometer (UVVS) onboard MESSENGER. Both datasets targeted similar spatial regions, in the polar altitudes of Mercury. We compare the sodium emissions from both measurements in the exosphere. We find that close to the surface, both intensity measurements match, but the intensities fall off differently with altitude, with the MESSENGER data showing an exponential drop off, sharper than that of the ground-based data; an effect that we attribute to atmospheric seeing. In addition, our ground-based data provided Full Width Half Maximum (fwhm) speeds and Doppler shift speeds; our results suggest energetic processes took place in the polar regions on the dusk side of the planet, but arguably on the dawn side as well. We confirm previous conclusions of Leblanc et al. (2008, 2009) where signatures of energetic processes seem to be coupled with high fwhm speeds and intensity peaks. We compare our Doppler shift velocities with previous works, and find agreement within the uncertainties with Potter et al., (2013) on their transit velocity measurements. Although our peak emissions along the terminator vary in structure and in brightness, they do not exhibit distinctive signatures in the intensity profiles at altitudes above the poles, when compared with convolved MESSENGER space data.