**High Spectral Resolution Observations of Lunar Exospheric Sodium and Potassium Emissions.** R. J. Oliversen[1], E. J. Mierkiewicz[2], D. C. P. Kuruppuaratchi[2], S. A. Rosborough[3], S. D. Robertson[2], M. Sarantos[1], and N. J. Derr[4], [1]NASA Goddard Space Flight Center, [2]Embry-Riddle Aeronautical University, [3]Southeastern Universities Research Association/GSFC, [4]Harvard University.

We utilized high resolution spectroscopy to investigate the lunar exosphere by measuring sodium and potassium spectral line profiles to determine variations in exospheric effective temperatures and velocities. Observations were made at the National Solar Observatory McMath-Pierce Telescope. We used a dual-etalon Fabry-Perot spectrometer with a resolving power of 180,000 (1.7 km/s) to measure the line widths and radial velocities of Doppler shifted sodium D2 (5889.9509 Å) and potassium D1 (7698.9646 Å) emission lines. The instrument's two or three arcmin Field of View (FOV), 224 km or 336 km at a mean lunar distance of 384,400 km, respectively, was positioned off the limb over a wide range of latitudes. As these are ground-based measurements, observations taken at 1st and 3rd quarter are at local noon while observations taken at full moon are at 6 am (dawn) and 6 pm (dusk) locally. The FOV was positioned from the limb (centered at ~112 km or ~168 km) to one lunar radii (~1740 km) away from the limb. The data collection of sodium and potassium emissions began in 2011 and 2014, respectively, and ended in 2017. The deconvolved line widths indicate sodium temperatures at large phase angles ( > 40°) are on the order of 1500 K while temperatures near full Moon ranged from 2500 K to 8000 K. The larger line widths and temperatures near full Moon are unlikely to be solely due to the geometrical effect of looking `down' the lunar tail. There are asymmetries between waxing phase data and waning phase data seen in all years. The relative intensity for the FOV at the limb for sodium, corrected for the Sun-Moon motion, show intensities that are higher after full Moon; a result that is consistent with enhanced photo-simulated desorption efficiency after the Moon resides in the plasma sheet. The potassium effective temperatures typically ranged between 500 K – 2000 K. However, the potassium relative intensity decreases significantly between a phase angle of 90° and 30°, typically by more than a factor of three, such that the potassium emissions at the smaller phase angles were often beneath our sensitivity. Although, like sodium, potassium's intensity increases after exiting the magnetotail. This work was partially supported by the NASA Planetary Astronomy programs, NNX11AE38G and NNX13AL30G.