THE SWRI ULTRAVIOLET REFLECTANCE CHAMBER (SWURC): PROGRESS TOWARD A FAR ULTRAVIOLET SURFACE REFLECTANCE LIBRARY. Y. Liu, K. D. Retherford, M. W. Davis, P. S. Mokashi, E. L. Patrick, P. L. Karnes, and G. R. Gladstone, Southwest Research Institute, San Antonio, TX 78238 (yang.liu@swri.edu).

Introduction: UV reflectance spectroscopy is a historically untapped resource for studying airless planetary surfaces (Moon, Mercury, Europa, etc.). While visible and near infrared (VNIR) spectra have more commonly been used than UV light as there are many diagnostic spectral features, the study of surface reflected light at UV wavelengths has provided much valuable knowledge that is otherwise unattainable at other wavelengths [1]. However, few laboratory measurements of the FUV spectral signatures of common minerals and ices exist. Early Apollo-era measurements were only conducted at one reflection angle with poor wavelength sampling [2]. This lack of laboratory measurements of materials has limited the precise interpretation of remote sensed FUV data from the Moon, asteroids, comets, etc. A handful of groups, including our own, are now undertaking the difficult task of performing these measurements with modern vacuum-UV systems.

To better interpret the FUV reflectance data from current FUV space instruments, including Lunar Reconnaissance Orbiter (LRO) Lyman Alpha Mapping Project (LAMP), and New Horizons and Rosetta Alice imaging spectrographs, we have developed a state of the art FUV reflectometer chamber and data acquisition system that can measure the bidirectional reflectance from 115 to 180 nm over various reflectance angles in the principal plane. The spectral resolution is 0.5 nm. Named the SwRI Ultraviolet Reflectance Chamber (SwURC), our instrument provides laboratory-based FUV bidirectional reflectance distribution function (BRDF) measurements of water frost/ice, lunar soils, simulants, and analogs.

Experiment Setup: SwURC is a state of the art UV facility designed to conduct FUV reflectance measurements of broad relevance to planetary sciences (Figure 1). The main body of the chamber consists of a six-way cross of 34 cm diameter ports including connections to a monochrometer, a vacuum pump station, a linear actuator that moves the sample out of the beam path, a LN_2 feedthrough, rotary and electrical feedthroughs, a load-lock door for easy sample exchanges without chamber disassembly, and a blank plate for additional instrument installation.

A 30 W Deuterium lamp feeds the entry slit of a VUV f/4.5, 200 mm focal length monochromator using a reflective concave mirror. The monochromator is mounted on the chamber such that it illuminates the horizontally mounted sample tray at a fixed 45° angle.

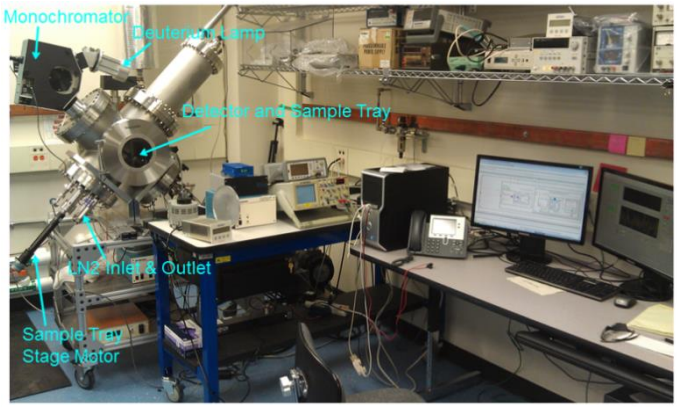

Figure 1. The SwURC facility.

A collimator accepts the expanding monochromator beam and focuses it into a well collimated beam of ~1 cm high and <0.5 cm wide. The detector can rotate freely over a 270° range, so both forward and backscatter measurements are possible. However, the -30° to -60° range (0° is defined as the detector directly above the sample tray) is not a useable region since here the detector assembly moves between the exit slit and the sample tray, blocking the UV light. For calibration purposes, the sample tray can be retracted and the detector moved to the direct beam position (i.e. 135°), where it directly views the exit slit. The control and operation of the SwURC is performed from a PC located at a nearby workbench. The SwURC user interface (UI) is a highly automated LabView virtual instrument that controls all chamber functions except LN2 flow and vacuum pump operation (Figure 1).

An additional feedthrough device enables heating the sample in situ with a 500 W heat lamp. Measurements of the sample with and without adsorbed water are therefore possible.

Heat straps and additional vacuum pumps near the lamp and monochrometer have cleaned up the chamber. A new grating and new channeltron detector are now in place and operating. Additional alignment work and calibrations are underway.

Status: Initial measurements of of JSC-1A lunar simulants at coarse and fine grain sizes and crystalline water ice have been reported previously [3]. We are now improving the counting statistics and calibration factors and will report the recent radiometric calibration results from measuring the specular reflection of Al/MgF2 coated mirrors and the diffuse reflectance of Fluorilon. We'll repeat and refine the FUV spectral reflectance measurements of water ice and lunar simu-

lants. Also we plan to repeat the Apollo returned sample measurements performed by *Wagner*, *Hapke*, and *Wells* [2] with better wavelength and angular resolution.

Acknowledgements: The SwURC facility was developed by SwRI capital equipment and IR&D funds. Measurements conducted in support of the LRO/LAMP investigation are funded by NASA.

References:

[1] Cloutis, E. A., et al., Ultraviolet spectral reflectance properties of common planetary minerals, *Icarus*, 197, 321-347, 2008.

[2] Wagner, J.K., et al., Atlas of Reflectance Spectra of Terrestrial, Lunar, and Meteoritic Powders and Frosts from 92 to 1800 nm, *Icarus*, 69, 14-28, 1987.

[3] Retherford, K. D., et al., Lunar Ultraviolet Reflectance Experiment (LURE): Far-UV Signatures of Water Ice, *LPSC meeting*, Woodlands, TX, 2012.