SPECTROSCOPIC OBSERVATIONS OF MERCURY'S SURFACE BY THE MERCURY ATMOSPHERIC AND SURFACE COMPOSITION SPECTROMETER DURING THE FIRST MESSENGER FLYBY: William E. McClintock[1] (william.mcclintock@colorado.edu), Gregory M. Holsclaw[1], Mark S. Robinson[2], David T. Blewett[3], Deborah L. Domingue[3], James W. Head[4], Noam R. Izenberg[3], Elizabeth A. Jensen[5], Mark C. Kochte[3], Mark R. Lankton[1], Scott L. Murchie[3], Ann L. Sprague[6], and Faith Vilas[7]. [1]LASP, U. Colo., Boulder, CO 80303; [2]School of Earth and Space Exploration, Arizona State U., Tempe, AZ 85251; [3]JHU/APL, Laurel, MD 20723; [4]Brown University, Providence, RI 02912; [5]ACS Consulting, Houston, TX 77001; [6]LPL/ U. Arizona, Tucson, AZ 85721; [7]MMT Observatory, Tucson, AZ 85721.

Introduction: During the first MESSENGER [1] flyby of Mercury, the Mercury Atmospheric and Surface Composition Spectrometer (MASCS) [2] will measure reflectance spectra from Mercury's surface, covering the wavelength range 115–1450 nm. These are the first high-spatial-resolution (< 10 km) spectra at any wavelength and the first reported ultraviolet (UV, $\lambda < 360$ nm) observations of the surface.

Observations: The four MASCS observing sequences executed during the near-planet portion of the flyby are shown in Figure 1. The instrument line of sight crosses the terminator at the beginning of MSCM3 and remains on the sunlit side of the surface for approximately 14 minutes.

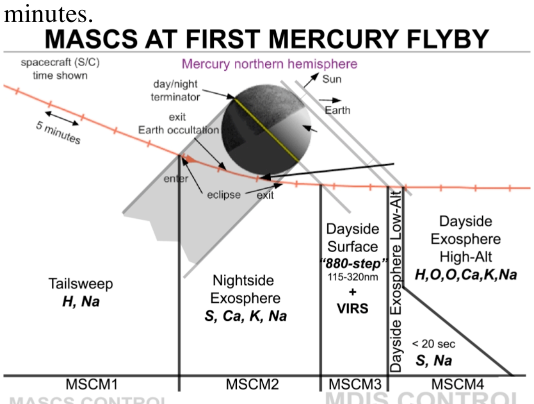

Fig 1. *The orange line shows MESSENGER's trajectory near closest approach during the first Mercury flyby. Ticks mark 5-minute intervals. Vertical lines delineate boundaries of the four MASCS observing sequences. Sunlit surface observations are performed during MSCM3.*

MASCS consists of a small Cassegrain-style telescope feeding a pair of separate spectroscopic channels. The UltraViolet and Visible Spectrometer (UVVS) is a point scanning monochromator covering the wavelength range 115-600 nm with ~ 0.75 nm resolution, and the Visible and Near Infrared Spectrograph (VIRS) is a point spectrograph covering the wavelength range 320-1450 nm with 5 nm resolution.

The blue curve in Figure 2 shows the VIRS field of view (FOV) track during the flyby.

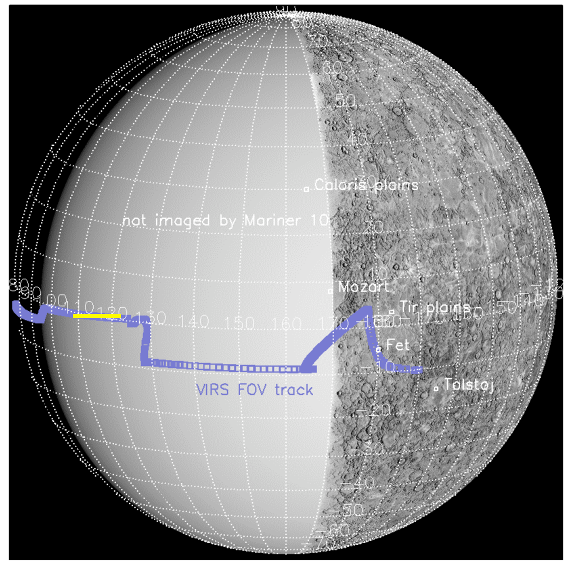

Fig 2. *The blue curve is the FOV track for VIRS on a simulated orthographic view of Mercury upon which a shaded relief map derived from Mariner 10 images [3] has been projected. A yellow rectangle marks the location of the UVVS observations.*

The VIRS profile generally follows the equator from approximately 95˚ to 180˚ E, a range largely not imaged by Mariner 10. VIRS will operate on a ~1 second cadence, collecting approximately 675 spectra with typical spatial resolutions of 3-4 km. Instrument operational constraints for the first flyby limit UVVS observations to four scans covering the range 115-320 nm (UVVS is too sensitive to view Mercury's visible reflected light without damage) over a 5 km x 100 km (latitude x longitude) swath, marked on Figure 2 with a yellow rectangle.

Initial Analysis Approach: Ground-based observations of Mercury reveal a surface with a red, nearly featureless spectrum in the visible and near infrared (wavelengths greater than ~ 500 nm [4]) that has been interpreted as evidence for a largely iron-poor feldspathic composition [*e.g.*, 5,6,7]. Interpretation of Mercury's spectral reflectance is complicated by our lack of knowledge about the effects of space weathering on its surface materials, which both suppresses the strength of spectral absorption features and reddens the spectrum [8]. The relative high spatial resolution afforded by the MASCS observations will allow us to measure the spectral reflectance of freshly exposed material that is relatively unaffected by space weathering. Spectra of these immature materials provide the strongest absorption features and thus the most confident mineralogic identifications. Comparison of contiguous spectra of mature and immature material will allow a better understanding of the effects of space weathering and will enable more confident interpretations of the broad-scale mature regions that constitute most of Mercury's regolith.

Observations of 4 Vesta suggest that the UV region might be a more sensitive indicator of space weathering in the visible and near infrared [9]. Both laboratory spectra of lunar soils [10] and measurements from space [11] show an upturn in the UV where surface scattering controls the spectral reflectance. Thus, UVVS observations at UV wavelengths (<350 nm) could be an important new tool for understanding space weathering at Mercury.

As a point of departure, the Mercury flyby observations discussed here will be compared with lunar reflectance measurements obtained by MASCS during MESSENGER's Earth flyby, which occurred on August 2, 2005 (Figure 3). This approach allows direct comparison of spectra from the two objects because the data will have been obtained with a single instrument. Although the spatial resolution of the lunar spectral reflectance was only ~400 km and ~ 800 km for VIRS and UVVS, respectively, because the lunar flyby occurred at a distance of ~ 950,000 km, MASCS did separate highlands from maria [12]. It will be particularly useful to compare the relative shapes of the UV observations from Mercury and the Moon in order to investigate the effects of differential space weathering on these two bodies.

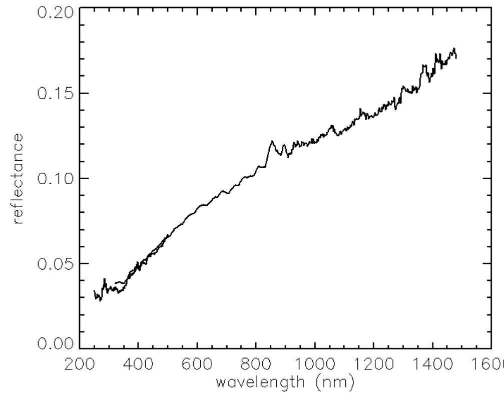

Fig 3. *MASCS observation of lunar reflectance obtained during Earth flyby. The field of view of the instrument was centered at latitude = -10°, longitude = -110°, which is located on the far side as viewed from Earth, and the phase angle was 65°.*

References: [1] S. C. Solomon *et al.* (2007) *Space Sci. Rev.*, 131, 3-39. [2] W. E. McClintock and M. R. Lankton (2007) *Space Sci. Rev.*, 131, 481-521. [3] USGS Map I-1149, 1979. [4] T. B. McCord and J. B. Adams (1972) *Icarus*, 17, 585-588. [5] F. Vilas (1988) in *Mercury* (ed. F. Vilas *et al.*), 59-76. [6] D. T. Blewett *et al.* (1997) *Icarus*, 129, 217-231. [7] J. Warell et al (2006) *Icarus* 180, 2, 281-291. [8] M. J. Cintala (1992) *JGR*, 97, 947-973. [9] A. R. Hendrix *et al.* (2003) *Icarus* 162, 1-9. [10] J. K. Wagner *et al.* (1987) *Icarus* 69, 14-28. [11] M. Snow *et al.* (2007) *Proc. SPIE*, 6677. [12] G. M. Holsclaw *et al.* (2005) *Eos Trans. AGU, 86, Fall Meeting suppl.*, abstract #P51A-0896.