

**BIRCHES: Compact Broadband IR Spectrometer and the Search for Lunar Volatiles** . P. E. Clark<sup>1</sup>, Ben Malphrus<sup>2</sup>, Dennis Reuter<sup>3</sup>, Robert MacDowall<sup>3</sup>, David Folta<sup>3</sup>, Terry Hurford<sup>3</sup>, Cliff Brambora<sup>3</sup>, William Farrell<sup>3</sup>, <sup>1</sup>Jet Propulsion Laboratory, California Institute of Technology (pamela.e.clark@jpl.nasa.gov), <sup>2</sup>Morehead State University, <sup>3</sup>NASA/GSFC.

BIRCHES (Broadband InfraRed Compact, High-resolution Exploration Spectrometer) is the payload instrument on Lunar Ice Cube, a science requirements-driven lunar orbiting 6U cubesat designed to determine volatile distribution as a function of time of day. Led by Morehead State University, the Lunar Ice Cube mission was selected for a NASA HEOMD NextSTEP slot on the EM1 launch. The versatile instrument is being developed for a high priority science application: understanding volatile origin, distribution, and ongoing processes in the inner solar system. BIRCHES, a miniaturized version of OVIRS on OSIRIS-Rex, is a compact (1.5U, 2.5 kg, 10W including cryocooler and electronics) point spectrometer with a compact cryo-cooled HgCdTe focal plane array for broadband (1 to 4 micron) measurements, achieving sufficient SNR (>400) and spectral resolution (10 nm) through the use of a Linear Variable Filter to characterize and distinguish important volatiles (water, H<sub>2</sub>S, NH<sub>3</sub>, CO<sub>2</sub>, CH<sub>4</sub>, OH, organics) and mineral bands. We are also developing compact instrument electronics which can be easily reconfigured to support the instrument in 'imager' mode on future missions, once the communication downlink band-width becomes available, and the HIRG family of focal plane arrays. Thermal design is critical for the instrument. The newly-available compact and efficient AIM cryocooler (with iris controller) is designed to maintain the detector temperature below 115K. In order to maintain the optical system below 230K, a special radiator is dedicated to optics alone, in addition to a smaller radiator to maintain a nominal environment for spacecraft electronics.