A Portable Tool for In Situ Sample Screening and Site Characterization on the Moon. P.E. Clark[1], K. Gendreau[2], Z. Arzoumanian[2], A. MacAdam[2], J. Bleacher[2]. [1]Catholic University of America (Physics Department), [2]NASA/GSFC, Greenbelt, MD 20771, Pamela.E.Clark@NASA.gov.

Addressing the Need for In Situ Sample Screening Site and Characterization: In situ analysis of lunar rock, regolith, and dust samples is an essential need for planetary surface exploration by human, robotic rover, or sample return missions to the Moon [1]. Optimally, such a capability should allow rapid, comprehensive, quantitative compositional (elemental and mineralogical) and textural analysis of a wide range of samples and surfaces, with minimal mass, volume, use of consumables and expenditure of power. To meet these needs, we are developing and testing the CMIST (Chromatic Mineral Identification and Sample Texture) instrument, a breakthrough combined X-ray diffraction/fluorescence spectrometer (CXRDF) with sample imaging capability currently at the laboratory prototype stage. CMIST is designed to perform sample classification (e.g., petrology) and texture analysis (e.g., petrography) without sample preparation [2].

In-Situ Tool Description: The goal is to design CMIST (**Figure 1**) to be low power (<5 W), low mass (<5 kg), extremely compact (eventually, large coffee cup size) instrument, useful in either handheld or rover–mounted modes, to provide sample measurements adequate for rock type discrimination within minutes. The combined X-ray diffractometer and fluorescence spectrometer has already demonstrated the ability to measure element abundances, distinguish mineral phases, and identify ice polymorphs.

Current Development: Our objectives are to determine phases of, sizes of, orientations of, and relationships among mineral grains to determine a rock's type, origin, and formation history. The novel analytical methodology is being built around the XSPEC software package, long a standard spectroscopy tool in X-ray astrophysics, modified to include elements of Rietveld phase refinement informed by crystalline texture analysis. In order to calibrate the instrument, we are currently developing a 3D configurable sample interface and lunar mineral standards set to analyze spectra from a standard suite of terrestrial rock and mineral analogs for lunar samples to determine geometric distribution functions. The known-orientation analog rock sample suite will include impact ejecta, volcanic rocks, and with this input, we will construct a portable unit and demonstrate its utility in field studies. The CMIST prototype has already demonstrated the capability to characterize mineral phases in an unprepared rock sample of known composition analogous to the common lunar rock anorthositic gabbro as a proof of concept **(Figure 2**). Our next step is determining how rapidly to identify d-spacing and fluorescent line signatures characteristic of major lunar rock types.

References: [1] Committee on Scientific Exploration of the Moon, 2007, NRC, Final Report, http://www.nap.edu/catalog/11954.html; [2] K. Gendreau, Z. Arzoumanian, V. Martins, R. Millham, G. Ricker, P. Fort, R. Starr, J. Trombka, 2006, http://esto.nasa.gov/conferences/ESTC2006/presentations/c1p1.pdf; [3] Hirose and Sasaki, 1999, Chung and Smith, Ed., CRC Press, 317-372.

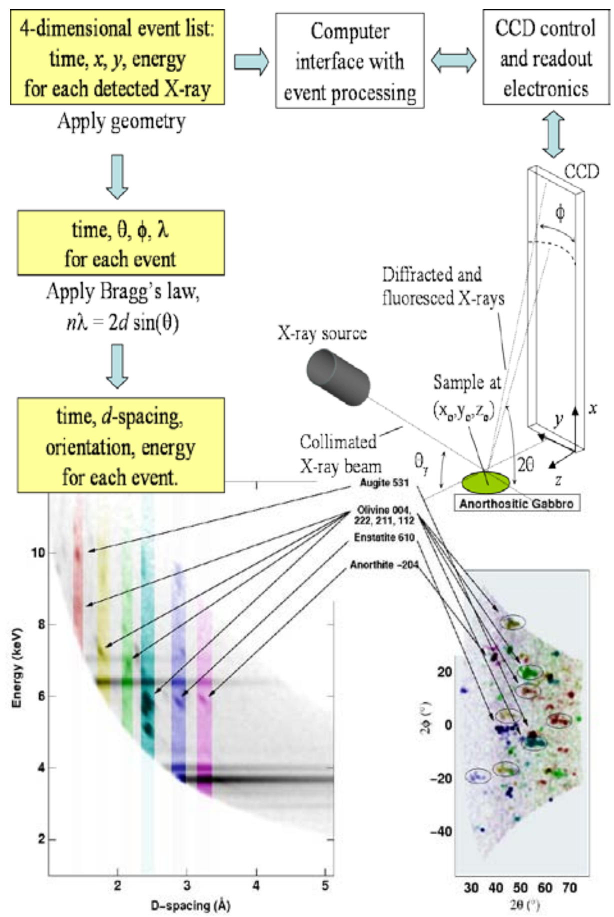

Figure 1. Above, CMIST advanced XRF/XRD performs mineral and texture analysis without sample preparation. Figure 2. Below, Proof of concept data from unprepared known sample of lunar analogue anorthositic gabbro showing CMIST capability to distinguish and characterize phases for anticipated minerals. Color coded d-spacings (left) distinguish major mineral by Miller indices. Map of 1x2 mm target area (right) shows orientations and Laue distribution patterns for mineral grains.