SPACE WEATHER IMAGING FROM THE MOON. D. M. Hassler[1] , C. E. DeForest[1] and J. M. Davila[2], [1]Southwest Research Institute (1050 Walnut St., Suite 400, Boulder, CO 80302, hassler@boulder.swri.edu), [2]Goddard Space Flight Center (Code 612.1, Greenbelt, MD 20771).

Introduction: The atmosphere-less surface of the Moon provides a unique, stable platform for deploying visible and UV/EUV imaging instruments to improve our understanding and ability to predict space weather activity, flares, CMEs and Solar Particle Events (SPEs).

Successful space weather forecasting entails reliable characterization of impulsive solar disturbances as well as accurate knowledge of the global corona and solar wind through which they propagate. Observations from the Moon can significantly improve understanding and prediction of CME-related space weather, critical for safeguarding both robotic and human activity on the Moon and beyond.

Background: A Space Weather Imaging Package deployed on the Moon can answer such important questions as: *What are the most relevant observational signatures of flare, CME and Solar Particle Event (SPE) eruption? Are there identifiable precursor signatures which can be used to forecast flare, CME and Solar Particle Event (SPE) eruption? What do we need to improve our ability to nowcast and forecast space weather and Solar Particle Events to ensure safe human exploration?*

Models of CMEs and Flares: Current understanding of coronal stability is not sufficient to predict flares or CMEs. Both systems are thought to be driven by magnetic energy release, but neither the stabilizing mechanism allowing energy to accumulate, nor the release process are understood well enough to predict eruption reliably. Spatial and temporal differences in chromospheric and transition-region line width and Doppler shift are strong discriminators between existing models.

Precursors to Eruption: Existing indicators, such as magnetic field configuration and X-ray sigmoidal structure, do not provide precise prediction of CME onset. Spectral signatures of CME onset are likely to prove more reliable and more robust than existing methods. Signatures that may be detectable up to hours before eruption include an early slow liftoff seen in Doppler shift, increased turbulent motions and/or heating, line asymmetries associated with prominence flows of 100 km/s or higher, sudden downflows in the vicinity of a prominence due to mass draining or reconnection, and sudden broadenings of chromospheric lines associated with energetic particle impacts due to reconnection high over the site of the potential eruption.

Toward a Predictive Capability: Measurements of motions and changes in nonthermal velocity distributions in the lower corona and chromosphere are crucial to understanding the structure of the inner heliosphere, and for separating the various models of CME onset. Depending upon the specific physical process, Dopplergrams and other derived data products are likely to be the most reliable indicators that a specific region is about to erupt. Even without advance warnings, the reliable characterization of near disk-center CME liftoff by means of Doppler imaging represents a significant improvement in space weather modeling capability.

Measurement Approach: Based on our current understanding, spectral imaging observations are the most likely new candidate for direct solar on-disk detection of imminent CME liftoff, and spectral signatures are thought to be required to understand the release process and early propagation of CMEs. Therfore, the measurement strategy for such a Lunar Outpost Space Weather Imaging Package should include a UV/EUV Imaging Spectrograph for flow velocities and energy release signatures, a Filter Magnetograph for solar magnetic field measurements, a Chromospheric/Coronal EUV imager for morphology and dynamics, a coronagraph for detection of Halo CMEs and an Energetic particles (SEP) detector for event characterization.

Human Involvement: Astronauts will be required to deploy the instruments in appropriate locations, and perhaps service them periodically.

Timing: Early human phase, establish complement of instruments with real-time data collection.

Experiment Features and Benefits: The benefits of the proposed instrumentation both enable fundamental improvements in our understanding of the processes leading to solar activity, flares, CMEs, and solar particle events (SPEs) and provide operationally-useful warnings for astronauts during lunar activities to enhance their safety and productivity.