IMAGING GEOSPACE FROM CIS-LUNAR ORBIT. L.J. Paxton[1], [1]Johns Hopkins University Applied Physics Laborator, Laurel, MD 20723

Introduction: Photon imaging of Geospace, the global ionosphere and magnetosphere, can be accomplished from the lunar surface, in lunar orbit, or in other orbital locations via trans-lunar assets. The ability to image the entire Earth at FUV wavelengths would transform our understanding of the coupled magnetosphere/ionosphere/thermosphere system.

*Value.*Global observations of ionospheric and magnetospheric phenomena provide measurements that are key to understanding space weather in the regions of space where most scientific, commercial and military space operations occur. These measurements also provide constraints to global ionospheric models and provide keys to solving compelling questions associated with the coupling between the magnetosphere and ionosphere and coupling of the high and mid-equatorial regions of the ionosphere.

Figure 1, an annotated image from the Apollo 16 FUV camera built by George Carruthers of NRL[1], illustrates in coarse resolution the fetures to be observed from the moon.

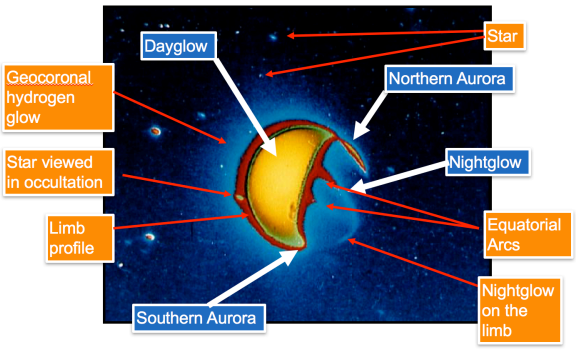

Figure 1. Many of these questions identified above have applications to space weather and therefore have significant value beyond providing an understanding to the dynamics of the coupled Geospace region. Typical products are: O, O2, and N2 limb profiles; O/N2 maps; auroral characteristic energy and flux; auroral boundaries; ionospheric characterization including TEC.

The value of FUV remote sensing has recently been reviewed [2]. The signatures, illustrated schematically in Figure 2, cover the inputs and the response of the system. A cis-lunar FUV imaging system would be well suited to providing imagery of the system at either selected FUV wavebands or full spectral information with a low data rate and low power consumption using proven, validated algorithms. The sensor design is not entirely specifiable based on the lack of specificity in

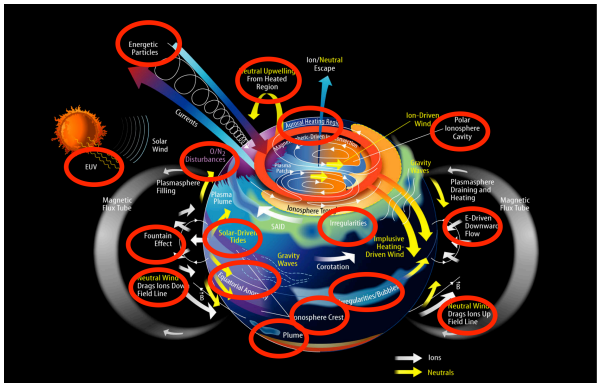

Figure 2. Annotated version of the well-known "Grebowsky" figure. The cirlces indicate the phenomena that have FUV signatures.

the mission concept. However, a sprectographic system using a scan system (ether a mirror or platform) can accommodate a large range of viewing geometries. The cis-lunar platform concept actually provides an incredible opportunity; with the same system wwe can specify the spatial variability of the coupled ionosphere/thermosphere system over three orders of magnitude in spatial resolution. This can be accomplished by not attempting to vary the spatial resolution of the imager – by choosing a spatial resolution suitable for mesoscale imaging and using that to fix the resolution of the system at the effective apogee, we can produce a cost-effective design.

References:

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[2] LJ. Paxton and Y. Zhang, Far Ultraviolet Imaging of the Aurora in Space Weather Fundamentals, ed. G. Khazanov, CRC Press, 2016. Far ultraviolet instrument technology, LJ Paxton, RK Schaefer, Y Zhang, H Kil, Journal of Geophysical Research: Space Physics 122 (2), 2706-2733