# Case Study of Asymmetries in Polar Rain Aurora

Dennis M Herschbach; Yongliang Zhang, dennis.m.herschbach@gmail.com

***Abstract***

Electrons and ions from the solar wind can directly enter Earth's polar upper atmosphere on both closed and open magnetic field lines. This occurs via the magnetosphere, where these particles are energized. When they then hit the neutral atmosphere, they ionize/excite molecules and atoms. Excited neutrals subsequently emit photons when they return to their previous ground state, which can have different wavelengths and are often visible to the naked eye such as in aurora Australis or aurora Borealis. Because they originate from the solar wind, auroral observations can reveal some of the physical processes that occur in the space that surrounds the Earth. A special kind of aurora, polar rain aurora (PRA), is a phenomenon caused by solar wind electrons that enter the polar atmosphere directly on open field lines. Precipitating electrons, which are not energized/accelerated by the magnetosphere, often have low energy flux and don't create visible aurora. However, satellite-based ultraviolet imagers have higher sensitivities and are able to detect lower energies. PRA events were obtained through a manual search of auroral images from the Global UltraViolet Imager (GUVI) on the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) satellite and the Special Sensor Ultraviolet Spectrographic Imager (SSUSI) on the Defense Meteorological Satellite Program (DMSP) satellites. While PRA often appears in symmetrical and homogenous shapes, we present multiple events that exhibit unique spatial variations and structures such as shifts, tilts, or gaps. These features are likely due to structures in the solar wind energetic electrons, the magnitude and orientation of the interplanetary magnetic field (IMF), magnetic field reconnection, magnetic variations on the high latitude magnetopause, and/or a combination of the four processes above. In order to fully understand PRA variations and structures, a comprehensive statistical study as well as global magnetosphere simulation is required.

978-1-7281-7520-1/20/$31.00 ©2020 IEEE