BOSTON UNIVERSITY

Boston University College of Arts & Sciences
Center for Space Physics

2018 - 2019 SPACE PHYSICS SEMINAR SERIES

Optical Phenomena in Earth's Ionosphere

Part I: Above the Clouds: Lightning Sprites

Sprite discharges are large scale natural plasma phenomena occurring due to penetration of quasi-electrostatic lightning field to mesospheric/lower ionospheric altitudes. It has been generally believed that sprites occur when the lightning field exceeds the conventional breakdown threshold field, Ek, in the lower ionosphere. However, recent analysis of high-speed video observations of sprites and electromagnetic measurements of lightning field found that sprite streamers often appear in the lightning field below the breakdown field with a magnitude as low as 0.2Ek. Current sprite theory can't offer a satisfactory explanation to how sprite streamers can form in such low lightning fields. Recently, we have found that sprite streamers can be successfully initiated from ionospheric patches in a lightning field below Ek. The origin of those ionization patches may be attributed to ionospheric disturbances created by meteor trails, electrodynamic effects from thunderstorm and/or lightning, and gravity wave breaking. This is the first study showing that the sprite streamer initiation mechanism that we proposed can explain the main properties of sprite streamer initiation, including time scales, spatial scales, and speeds, observed by high-speed cameras.

Part II - Subauroral ionosphere: S.T.E.V.E.

Strong Thermal Emission Velocity Enhancement (STEVE) is an upper atmospheric phenomenon recently discovered through collaboration between the scientific community and citizen scientists. Optical data from an all-sky imager (REGO at Lucy Lake) showed that STEVE is a narrow, mauve structure that forms south of the auroral oval (in the subauroral region) and Swarm satellite measurements [MacDonald et al., 2018]. The in-situ satellite measurements indicate strong westward flows, high electron temperatures, and a sharp poleward boundary in the density trough, all characteristic signatures of subauroral ion drifts (SAIDs) associated with substorm activity and ion injections. A recent statistical study of STEVE has shown that STEVE forms about one hour after substorm onset and it is associated with a longer than usual expansion phase [Gallardo-Lacourt et al., 2018]. At the moment, little is known about the dynamics that lead to the formation of STEVE. However, because STEVE exhibits SAID-like characteristics and an unusually long substorm expansion phase, it is likely that both ionospheric and magnetospheric processes contribute to its formation. In this study, we investigate the magnetospheric conditions and dynamics associated with STEVE and focus primarily on the occurrence, timing, and penetration depth of energetic particles.

Thursday, April 18th
4:00 - 5:00 p.m.
725 Commonwealth Avenue | Room 502

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