SEMINAR

專題演講

國立中央大學 太空科學與工程學系

Department of Space Science and Engineering, National Central University

Time

Monday, September 23, 2024

14:00 – 15:00

Place

健雄館 (科四館)

S4-817-1 教室

Room S4-817-1, Chien-Shiung Building

赤道區電漿不規則體與瑞利-泰勒不穩定—衛星觀測以及模式模擬

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Longitudinal and seasonal variation observed by low-inclination satellites ROCSAT-1 during 1999–2004 and FORMOSAT-7/COSMIC-2 (F7/C2) in 2020, as well as a high-inclination satellite, DEMETER, during 2006–2010 are investigated in detail. The nonphysical anomalous feature in south American sector is caused by the limitations of traditional plasma irregularity auto-detections. Calculating perturbations using a logarithmic scale for density would lead to the misidentification of plasma irregularities, particularly when the ambient density is very low. Therefore, the Hilbert-Huang transform (HHT) is further applied to study the morphology of plasma irregularity. In general, the HHT instantaneous total amplitude of irregularity agrees well with previous studies and S4 scintillation observed by F7/C2, indicating that the instantaneous total amplitude can be a good reference for studying ionospheric plasma irregularities.

On the other hand, a new expression for the R-T instability growth rate, based on field-line integrated theory, is established. This expression is designed to be directly applicable in ionospheric models that utilize the magnetic flux tube structure with Modified Apex Coordinates. The growth rates of R-T instability are calculated using a self-consistent model: the coupled Whole Atmosphere Model and Ionosphere Plasmasphere Electrodynamics Model (WAM-IPE). A comprehensive analysis of the diurnal, longitudinal, and seasonal variations of the R-T instability growth rate is carried out. It also examines the dependencies of growth rates on pre-reversal enhancement (PRE) vertical drifts and solar activity. The results indicate that significant R-T growth rates occur between 18:00 and 22:00 local time when strong PRE is present in the equatorial ionosphere. Additionally, the simulated R-T growth rate increases with higher levels of solar activity and shows strong correlations with the angle between the sunset terminator and the geomagnetic field line. These results are consistent with plasma irregularity occurrence rates observed by various satellites, suggesting that the newly developed R-T growth rate calculation has great potential for predicting the occurrence of EPBs.

Further investigation of the relationship between the EPB occurrence rate and the R-T growth rate using ROCSAT-1 observations and WAM-IPE simulations within the time range of 1900~2200 LT during the high solar activity period of 2000~2002 is further investigated. The HHT instantaneous total amplitude and σ index are used as thresholds to identify large plasma irregularities. The result shows that when the growth rate reaches 10^{-4} the probability of a deep EPB event occurring is approximately 55%. However, since the current free-run WAM-IPE cannot perfectly simulate the actual ionospheric structure, there are discrepancies in the comparison of the growth rate and S4 scintillation. This indicates that predicting EPB occurrence remains challenging and should be further considered.