U054-014 **Room: Ocean B** **Time: May 14 15:45-16:10**

Substorm Growth Phase and Onset

Chio-Zong Frank Cheng[1]; Sorin Zaharia[2]; Nikolai Gorelenkov[3]

[1] NSPO; [2] LANL; [3] PPPL

Space and ground-based observations have indicated that the most substorms are initiated in the near-Earth plasma sheet region (~7-12 Re, where Re refers to the Earth radius) and are associated with low frequency (in the Pi 2 range) instabilities. In this paper we present self-consistent 3D global quasi-static magnetospheric configurations, that are in force-balance between plasma and magnetic field in the growth phase, and examine the stability of ballooning modes for the 3D magnetospheric configurations. Due to enhanced earthward plasma convection during the growth phase the plasma pressure increases and magnetic field becomes tail-like in the near-Earth plasma sheet region. An enhanced cross-tail current sheet is formed with thickness of ~1 Re around the local midnight and with a longitudinal extent of ~60-70 deg at X ~-(7-11) Re (where X is zero at the Earth's center and is positive toward the Sun). A magnetic well is formed in the equatorial cross-tail current sheet region with plasma β_{eq} increasing to a large value (can be above 50). The associated ionospheric Birkeland current moves equatorward with an enhanced current density shrinking in latitudinal width, consistent with the observed ionospheric growth phase signatures. To study the onset instability in the late growth phase, we present theoretical analysis and numerical solutions of ballooning modes by solving the kinetic-MHD equations, which include kinetic effects of particle trapping, finite ion gyroradii, and wave-particle resonances. The results indicate that there are two branches of ballooning modes: an MHD-like branch and a kinetic branch. The MHD-like branch of ballooning modes is stabilized by the combined kinetic effect of trapped electron dynamics and finite ion gyroradii. The new kinetic branch of ballooning modes is destabilized through wave-ion magnetic drift resonance and is called kinetic ballooning mode (KBM). The KBM has a real frequency in the Pi2 frequency range. The KBM features are consistent with observations from satellite in-situ measurements and ground-based optical aurora features.