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3D Magnetospheric Structure Prior to Substorm Onset and Onset Mechanism C.Z. CHENG, Plasma and Space Science Center, National Cheng-Kung University, Taiwan, SORIN ZAHARIA, Los Alamos National Laboratory, NIKOLAI GORELENKOV, Princeton Plasma Physics Laboratory — Space and ground-based observations have indicated that the substorm onset occurs in the near-Earth plasma sheet region ($\sim 8-10R_E$)and is associated with a low frequency (in the Pi 2 range) instability. To understand substorm onset process we model the global magnetospheric structure prior to substorm onset realistically by 3D quasi-static equilibrium solutions which consist of a current sheet with an enhanced cross-tail current density with thickness of $\sim 1R_E$ around the local midnight and with a longitudinal extent of $\sim 60-70^\circ$ at $X \sim (7-11)R_E$. The associated ionospheric Birkeland current moves equatorward with an enhanced current density shrinking in latitudinal width, consistent with the observed ionospheric growth phase signatures. The observed low frequency instability has been explained as kinetic ballooning modes (KBMs) which are excited when β_{eq} increases from ~ 20 to above 50. To study the onset instability, we present theoretical analysis and numerical solutions of KBMs, which include kinetic effects of particle trapping, finite ion gyroradii, and wave-particle resonances. The results indicate that a new branch of unstable KBM is destabilized through wave- ion magnetic drift resonance. The KBM has a real frequency in the Pi2 frequency range. The kinetic calculations will be compared with the MHD theory.

C. Z. Cheng
Plasma and Space Science Center, National Cheng-Kung University, Taiwan

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