Verification of scenario for substorm ignition in the M-I coupling region

Akira Morioka[1], Yoshizumi Miyoshi[2], Hiroaki Misawa[1], Fuminori Tsuchiya[1] ,
Hiroshi Miyaoka[3], and Natsuo Sato[3]
[1]Tohoku University. [2]Nagoya University. [3]NIPR

The sudden formation of parallel electric fields in the magnetosphere-ionosphere (M-I) coupling system is essential to complete substorm onset. From this standpoint, we have focused substorm ignition on the field-aligned acceleration, by studying the dynamical behavior of auroral kilometric radiation (AKR).

Field-aligned auroral acceleration showed distinct two-step evolution at substorm onset: the activation of low-altitude acceleration (h~4000-5000 km) which corresponds to auroral initial brightening, and subsequent abrupt breakout of high-altitude acceleration (h~8000 -16000 km) which corresponds to auroral breakup. The statistical relationship between the plasma-flow burst in the plasma sheet and its response to the M-I coupling region suggested that plasma flow bursts induce field-aligned current (FAC) which first enhance low-altitude acceleration, and the increasing field-aligned current induces second acceleration above the preexisting low-altitude acceleration as a consequence of current-driven instabilities. Based on these observations, we proposed a scenario: substorm is finally ignited in the auroral M-I coupling region.

The proposed scenario should be, as the next step, verified and compared with the observed evidences of auroral phenomena and established common view of auroral substorm. In our talk, we will try to evaluate the new scenario from some essential points which should be answered consistently with previous observations and theories, such as,

1. What are direct and/or indirect evidences of substorm ignition in the M-I coupling region?
2. Is the "two-step acceleration at substorm" confirmed from in-situ field/particle observations?
3. Is the ion waves resulted from the current driven instability observed in the acceleration region?
4. What is the relation of "ignition" with the current disruption?
5. Can the scenario interpret the observation that auroral breakup locates near the Harang discontinuity?