Geomagnetic field and energetic particle oscillations observed at geosynchronous orbit during the growth and expansion phases of a substorm

*Khan-Hyuk Kim[1], Hyuck-Jin Kwon[1], Jongho Seon[1], Uli Auster[2], Werner Magnes[3], Stefan Kraft[4]

1. School of Space Research, Kyung Hee University, Korea, 2. IGeP, TUBS, Mendelssohnstrasse, Braunschweig, Germany, 3. Space Research Institute, OeAW, Graz, Austria, 4. ESOC-ESA, Robert-Bosch-Strasse, Darmstadt, Germany

Magnetic field and energetic electron data (E > 175 keV) acquired by GEO-KOMPSAT-2A (GK-2A) geosynchronous spacecraft in the pre-midnight sector have been used to study quasi-periodic magnetic field and particle oscillations during the substorm growth and expansion phases on 6 March 2019. Three types of oscillations are found in the magnetic field and electron flux: (1) ~300-s and (2) ~120-s oscillations during the decrease of the energetic particle flux prior to the expansion phase (i.e., during the substorm growth) and (3) ~60-s oscillations during the substorm expansion. The ~300-s electron flux oscillations have a quadrature relationship with the magnetic field oscillations in the azimuthal component at geosynchronous orbit, indicating the properties of a standing Alfven wave, and are nearly identical to the waveform of the geomagnetic field measured at low latitude (L = ~1.3) ground station. The ~120-s electron flux oscillations were observed just before the substorm onset. They are out of phase with the magnetic field perturbation in the radial component, which is dominant in the pre-midnight sector. There are no ground perturbations corresponding to the ~120-s electron flux oscillations. At the substorm onset, the ~60-s electron flux oscillations were excited, and the first four cycle of the flux oscillations show an in-phase signature of Pi2 oscillations identified at low-latitude ground station. In this study, we discuss how and where the electron flux oscillations are generated during the substorm growth and expansion phases.

Keywords: Substorm, Geosynchronous orbit, Alfven wave

