Auroral intensification in relation to the magnetotail Pi2 and EMIC wave enhancements

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This paper presents an important observation for an auroral intensification event in strong relation to the magnetotail Pi 2 and EMIC wave enhancements observed during a substorm event on 04 April 2009. Substorm onset was identified at 08:32 UT with an auroral initial brightening and then an initiation of Pi 2 oscillations at 08:26 UT. About 6 minutes after the auroral intensification occurred at 08:32 UT. The Pi 2 and EMIC wave enhancements were observed at the same time, when THEMIS B satellite encountered the dense plasmaspheric plume at X=~7~8 Re, where was far from the usual location of the plasmapause boundary in the mid-night magneotail. The generation of the EMIC waves was found to be in association with the newly injected westward-drifting ions, oscillating with Pi 2 period. Wave modes appeared with electro-acoustic modes signifying ordinary sound wave, slow mode wave and electromagnetic ion-cyclotron (EMIC) waves at the same time. The frequency of these waves was found to be near He+ gyro-frequency, implying that the presence of heavy ion (He+) might provide new couplings (instabilities) for these EMIC waves. The generation of the EMIC waves might drive the electron heating, suggesting an important candidate for auroral intensification electrons, within the overlap of the ring current and the plasmasplume through some mechanisms such as Coulomb collisions of plasmaspheric electrons with the ring current ions, Landau damping of electromagnetic ion cyclotron waves generated by ring current ions, and/or kinetic Alfven waves in association with the waves. Another important result obtained in this study is a finding of good conjunction between the ground station and the magnetotail from the observation of Pi 2 oscillation period and phase relations between them. The velocity field oscillations observed at the THEMIS-B in the magnetotail showed a same oscillation period of Pi 2 observed on the ground. The velocity field Pi 2 oscillation at the magnetotail leads a quarter cycle for the Pi 2 oscillations observed on the ground. These observations imply that the generation of field-aligned currents (FAC’ s) in association with the velocity field oscillations in the equatorial plane might establish the field-line resonance for these Pi 2 oscillations. Therefore, the present study provides the important role of Pi 2 and EMIC waves for auroral intensification and certifies a good conjugacy between the ground station and the satellite location in the magnetotail.

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