

## **A cross-correlation analysis of Pi oscillations in auroral luminosity and magnetic field variations**

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Pi 1 and Pi 2 period range oscillations are examined in auroral luminosity and magnetic field variations during a substorm activity observed on 30 September, 2011 at a conjugate – pair station, SYOWA in Antarctica and TJORNES in Iceland. Similarity and simultaneity in appearance of these Pi oscillations between the phenomena and between the conjugate stations are examined with a cross-correlation analysis. The examination revealed that Pi 1 and Pi 2 oscillations can be clearly identified in auroral luminosity variations and they have a close relationship to magnetic field Pi 1 and Pi 2 oscillations throughout the substorm activity, particularly with a high coherency during the pre- substorm expansion phase. However, clear time lags for the appearance of the auroral luminosity Pi 2 and Pi 1 oscillations are observed between the conjugate stations, and further clear time lags for the appearance of the magnetic field Pi 1 and Pi 2 oscillations with respect to the auroral luminosity Pi 1 and Pi 2 oscillations are recognized at each station. The former time lags can be interpreted by taking into account of conductivity difference in the ionosphere and magnetic field intensity difference between the conjugate stations, while for the latter time lags can be interpreted by taking into account of polarization variations of the magnetic field oscillations between the conjugate stations, respectively. The drastic changes of the time lags and polarizations of the Pi 1 and Pi 2 oscillations were observed in association with the strong auroral luminosity enhancements during the expansion phase, suggesting that the strong auroral particle precipitations in association with the poleward development of the aurora may strongly affect these time lags and polarization variations of the Pi 1 and Pi 2 oscillations during the expansion phase.