Resolving the evolution of pulsating aurora: High-speed Tjörnes-Arase-Syowa conjugate observation

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Pulsating auroras were observed by ground-based high-speed imagers after an auroral breakup at Tjörnes in Iceland and at its magnetic conjugate station, Syowa station in Antarctica simultaneously on 22 September 2018. Two identical all-sky imagers at both stations and a narrow field-of-view imager at Syowa station were used to elucidate the hierarchical structure of the modulation in the auroral luminosity and the evolution of pulsating patches at different time scales. A few minutes before the main pulsation start, a fast intensity modulation of ~20 Hz was identified by the narrow field-of-view imager with ~3 Hz modulation in a small aurora patch. The Arase satellite was located on the magnetic field line connecting these two stations at that time. Although the foot-print of Arase satellite was out of the narrow field-of-view, the Plasma Wave Experiment onboard Arase satellite observed chorus emissions whose intensity was modulated at the same period of the auroral fast intensity modulation. The patch size and the pulsation period evolved in time at both hemispheres and the period settled in the period of main pulsation. The variation of chorus emission intensity of main-pulsation time scale shows a good correlation with the intensity variation of pulsating aurora. The pulsating patches differ in its shape and period between both hemispheres although several synchronized patches were also observed when the pulsating aurora drifted away from the all-sky field-of-view. We show the evidence of the fast modulation of the auroral luminosity and the chorus wave intensity, and the evolution of pulsating aurora in terms of the transition of on and off of the pulsating patch, patch size, and pulsating period in both hemispheres in different timescales.