地上-衛星同時観測による脈動オーロラ起源の推定

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Coordinated ground-satellite observations to study on generation mechanism of pulsating aurora

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Pulsating auroras are common phenomena, which are observed universally during the recovery phase of substorms in the auroral and sub-auroral zones. The most widely held theoretical view (hereinafter called the classical/standard model) of pulsating aurora generation envisages a type of relaxation oscillator involving trapped electrons and ELF/VLF wave-producing instabilities in the equatorial plane of the magnetosphere. The shape of each luminous patch in the ionosphere represents the magnetic mapping of a region of enhanced plasma density near the equatorial plane. However, even today, there is no direct evidence to support the classical/standard model, as regards the generation region, periodicity, and shapes. This is because of a lack of direct satellite observations of pulsating auroral patches in the source/modulation regions. In general, spacecraft observations of these phenomena have not been able to distinguish between their spatial and temporal characteristics, because of the complex shapes, rapid movements, and periodicities exhibited by pulsating auroras. For an investigation of the generation region and modulation mechanism for pulsating aurora, simultaneous observations of optical aurora from conjugate observatories on the ground and from satellites are very important. Recently Sato et al (GRL, 2002; JGR, 2004) reported a direct comparison of pulsating auroras observed from the ground at Syowa and onboard the FAST satellite together with the Syowa-Iceland conjugate-pair observation. The major findings were: 1) The source region was located not at the equatorial plane but more earthward (2-6 Re from the ground), 2) the down-going, high-energy ion flux modulation was almost out of phase (anti-correlated) with the down-going high-energy electron flux, 3) the magnetic field variation was almost correlated (in-phase) with the down-going high electron flux modulations, 4) the form of the pulsating aurora appeared to be closely related to the inverted-V potential structure, 5) ELF/VLF wave activities were not observed by FAST in the region of pulsating aurora, and 6) the pulsating aurora was not conjugate in shape. These findings did not support the classical/standard model but they suggest that parallel ULF electric fields may modulate high-energy electrons to precipitate via ionosphere-magnetosphere coupling processes, which produce pulsating aurora.

The ERG (Energization and Radiation in Geospace) project is the satellite observation of equatorial inner magnetosphere with the particle and wave instruments that cover important energy and frequency ranges. So we expect the coordinated ground-ERG satellite observation could find new evidences for generation mechanism of pulsating aurora.