オンセットアークの構造化と背景電場の変化

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Structuring of onset arcs and background electric field changes

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The nature of the mechanism that initiates the explosive onset of aurora breakup is still one of the outstanding questions under debate. Recently, attention has been drawn to the temporal evolution of the initial brightening arc during a few minutes before the onset. Several ground-based optical observations have shown that, in a few minutes before the onset, the initial brightening arc gets structured and forms an azimuthally arrayed feature. As time progresses, such a structure evolves into larger scale undulation, and eventually leads to the onset of aurora breakup. Ionospheric feedback instability (FBI) occurring in the M-I coupling system is one of the candidates which could explain the structuring of auroral arcs in the pre-onset interval. Recently, a numerical simulation of FBI suggested that the magnitude and direction of the electric field in the ionosphere are key factors controlling the structuring of aurora arcs through FBI. In this sense, it is of great importance to clarify how the background electric field can change during the growth phase of substorm, especially in a few minutes before the initial brightening arc becomes unstable.

In this paper, we employ a Super Dual Auroral Radar Network (SuperDARN) radar in Pykkivibaer, Iceland (63.77 N, 20.54 W) to investigate the temporal variation of the ionospheric electric field in the vicinity of the onset region. Four events of aurora breakup have been extracted from 3 years database of all-sky auroral observations in Tjornes (66.20 N, 17.12 W), Iceland. During all the events, the initial brightening arcs got unstable immediately before the start of the poleward expansion, i.e., auroral breakup. The SuperDARN data show that the magnitude of the background electric field started increasing 30-40 min before the start of the structuring, which implies that the conditions

were favorable for operating the FBI process throughout the growth phase. We will also report how the direction of the electric field changed before the onset in greater detail. The results will be discussed in comparison with recent numerical simulations of the structuring of auroral arcs through FBI. It will also be argued how the estimated relationship between the structuring of initial brightening arcs and the background electric field could be utilized for determining the initial setup of the numerical simulations of FBI.