

Statistical study of drifting electron holes associated with substorms observed by the Arase satellite

*Taku Namekawa^{1,2}, Iku Shinohara¹, Takefumi Mitani¹, Kazushi Asamura¹, Nagai Tsugunobu¹, Satoshi Kasahara², Shoichiro Yokota³, Tomoaki Hori⁴, Ayako Matsuoka⁵, Yoshizumi Miyoshi⁴

1. ISAS / JAXA, 2. The University of Tokyo, 3. Osaka University, 4. Nagoya University, 5. Kyoto University

Drifting electron hole (DEH) is a dropout in the electron flux frequently observed in an energy range similar to that of electron injections in the Earth's magnetosphere [Sergeev et al., 1992]. The flux dropout is thought to be caused by the deformation of the electron drift shell due to a large-scale reconfiguration of the magnetic field associated with substorm onset.

Most of these substorm-related DEHs were observed near and outside the geosynchronous orbit [Cohen et al., 2019, Liu et al., 2019, Shukhtina et al., 1996]. DEHs were also observed in the region of $L > 5$ inside the geosynchronous orbit by the Arase satellite [Miyoshi et al., 2018]. However, there has been very limited discussion of these DEHs since the statistics cover only quiet conditions and a small number of events, and this electron dropout is not yet fully understood.

To investigate the characteristics of DEH, we conducted a statistical study by analyzing data obtained by the HEP and MEP-e instruments onboard the Arase satellite. We selected the DEH events that were observed simultaneously with the injection by inspecting the data during the periods when Arase observed the night side to the dawn side of the magnetosphere from 2017 to 2019. The resultant DEH events were mainly observed in the pre-midnight sector to the dawn side. We estimated the drift trajectories of electrons corresponding to energy-dispersed DEHs to identify their source region. The source region of DEHs extends over 3-4 hours around local magnetic midnight, which distribution is similar to that of the injections simultaneously observed. This result is consistent with the model presented by Sergeev et al. [1992].

On the other hand, there are some events in which the source sectors of DEH and injection are different, even though they were observed simultaneously. The existence of such events suggests that DEHs may not be explained by a simple model assuming a single source region.

Keywords: Drifting electron hole, Particle injection, Substorm, Arase satellite