Concentrically expanding ring-shaped pulsating aurora: simultaneous observations with Arase

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During the first coordinated campaign observation of pulsating aurora (PsA) with the Arase/ERG satellite in March 2017, we observed a peculiar PsA which expanded radially and eventually formed a concentric ring-shaped structure. Such a Concentrically Expanding ring-shaped PsA (CoE-PsA) was observed during a 5 min from 00:05 to 00:10 UT on March 29, 2017 by an all-sky camera located in Sodankyla;, Finland. The CoE-PsA started from a small patch of diffuse aurora in a limited region. In the first several minutes, the small patch expanded radially in all the directions. Such a variation in the first stage is very similar to that of expansion type PsA reported in the past literature. Subsequently after the initial expansion, a small dark area appeared in the center of the initial patch and this dark region expanded radially too. Expansions of the first bright area and subsequent dark area formed a ring of diffuse aurora in the final stage. By mapping the traced outer/inner boundaries of CoE-PsA, we estimated the speed of the radial expansion of the corresponding structure in the equatorial plane of the magnetosphere. The speed actually varied, but it ranged from 500 to 3000 km/s in the radial direction. The expansion speed in the longitudinal direction was about an order smaller than that in the radial direction.

The magnetic footprint of the Arase satellite was located within the region of CoE-PsA. PWE/OFA onboard the satellite observed collective bursts of chorus whose intensity variation is very similar to that of CoE-PsA. A cross-correlation analysis indicates that the temporal variation of chorus has a delay of a few seconds from that of the optical intensity at the center of the CoE-PsA. In addition, a map of cross-correlation coefficient implies that the satellite footprint was situated in the southeastern part of the CoE-PsA at the time of expansion. In the presentation, we discuss the temporal variation of CoE-PsA by considering oblique propagation of chorus waves in all the azimuthal direction. In particular, we test the feasibility of the model by comparing the speed of the radial expansion of CoE-PsA with the propagation speed of chorus in the direction perpendicular to the ambient magnetic field.

Acknowledgement: The operation of the EMCCD camera at Sodankyla; has been supported by Sodankyla; Geophysical Observatory (SGO).