URSI GASS 2021, Rome, Italy, 28 August - 4 September 2021

Isolated Electrostatic Potentials Observed by the Arase Satellite

Tomoe Taki* (1), Satoshi Kurita (1), Hirotsugu Kojima (1), Yoshiya Kasahara (2), Yoshizumi Miyoshi (3), Ayako Matsuoka (1) and Shoya Matsuda(4)
(1) Kyoto University, Uji, japan, e-mail: taki.tomoe.75n@st.kyoto-u.ac.jp; kurita.satoshi.8x@kyoto-u.ac.jp; kojima.hirotsugu.6m@kyoto-u.ac.jp; matsuoka@kugi.kyoto-u.ac.jp
(2) Kanazawa University, Ishikawa, Japan; e-mail: kasahara@is.t.kanazawa-u.ac.jp
(3) Nagoya University, Aichi, Japan; e-mail: miyoshi@isee.nagoya-u.ac.jp
(4) JAXA, Japan; e-mail: matsuda@stp.isas.jaxa.jp

The present paper discuss properties of solitary waves observed by the Arase satellite in the Earth's inner magnetosphere, applying the interferometry technique. Isolated electrostatic potentials in space have been observed as solitary-bipolar electric field waveforms by many satellites such as GEOTAIL[1], Polar[2], FAST[3] and RBSP[4]. The solitary bipolar waveforms observed in the magnetotail by the GEOTAIL satellite is called Electrostatic Solitary Waves (ESW). Observations and computer simulations demonstrated that the potential structure could be represented by a one-dimensional Gaussian-shape parallel to the magnetic field[5]. On the other hand, no specific model has been proposed for the potentials observed in the inner magnetosphere.

Plasma wave observations by the Arase satellite show the existence of solitary waves in the inner magnetosphere. Observed waveforms are spiky and isolated. However, unlike waveforms observed by other satellites, they appear as various shapes of waves such as bipolar and asymmetric waveforms.

The plasma wave receiver onboard the Arase satellite has the capability to identify phase differences of observed waves by making use of two monopole electric field sensors. This is so-called interferometry technique that allows us to determine relative velocities of the potential to the satellite as well as the potential polarity. The size of the potential can also be estimated from the determined relative velocity. By applying the interferometry technique to the symmetric bipolar waves, the spatial scales corresponding to each solitary wave are estimated to be between 380m and 3km. The estimated potential scales are much smaller than the potential scales introduced by the GEOTAIL observations in the magnetotail. The existence of various type of solitary waveforms also suggests the spatial potential structures observed by the Arase are two-dimensional rather than one-dimensional.

By using the interferometry technique of Arase, we succeeded in calculating the spatial scale of the isolated electrostatic potential and determining the polarity of the potential. In the present paper, we discuss the properties of the isolated electrostatic potential structures observed by Arase comparing with other solitary waves observed in other regions.

References

[1] Matsumoto, H., et al. "Electrostatic solitary waves (ESW) in the magnetotail: BEN wave forms observed by GEOTAIL." *Geophysical Research Letters* 21.25 (1994): 2915-2918.

[2] Bounds, Scott R., et al. "Solitary potential structures associated with ion and electron beams near 1RE altitude." *Journal of Geophysical Research: Space Physics* 104.A12 (1999): 28709-28717.

[3] Ergun, R. E., et al. "FAST satellite observations of large-amplitude solitary structures." *Geophysical Research Letters* 25.12 (1998): 2041-2044.

[4] Mozer, F. S., et al. "Time domain structures: What and where they are, what they do, and how they are made." *Geophysical Research Letters* 42.10 (2015): 3627-3638.

[5] Krasovsky, V. L., H. Matsumoto, and Y. Omura. "Bernstein-Greene-Kruskal analysis of electrostatic solitary waves observed with Geotail." *Journal of Geophysical Research: Space Physics* 102.A10 (1997): 22131-22139.