Latitudinal Distribution of Auroral Kilometric Radiation Ordinary and Extraordinary Wave Modes Observed by KAGUYA

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1. Introduction

The auroral kilometric radiations (AKR) are intense radio emissions originating from the Earth's auroral region. An important property of the AKR is its polarization. The AKR is believed to be generated by the cyclotron maser mechanism because the polarization is dominated by right-handed extraordinary (R-X) mode with small contribution of left-handed ordinary (L-O) one. However, intense L-O mode was also observed from low latitude spacecraft, Jikiken and Akebono. *Hashimoto* [1] interpreted such L-O mode as a result of propagation effects through density gradients near the source and through the plasmapause.

The KAGUYA mission gave a good opportunity to make a stochastic analysis of the AKR polarization from lunar orbits. The waveform capture instrument (WFC) [2] was a plasma wave receiver on-board the KAGUYA spacecraft. The frequency sweep receiver WFC-H, which was a subsystem of the WFC, continuously observed power spectrum and polarizations of waves in a frequency range from 1 kHz to 1 MHz for about one year mission period.

2. Methodology

A problem in the AKR polarization measurement is that the relation between the source polarization and the observed polarization depends on the source hemisphere. Using lunar occultation is convenient to determine the AKR source locations [3]. As the KAGUYA rotated around the Moon, we can identify the source hemisphere depending on whether the AKR is observed when the polar region of one hemisphere is seen and that of the other is shadowed by the Moon. The AKR source locations can be also determined by a simple fitting of orbital variations of the observed elliptical polarization ratio under some situations.

The AKR observed by the KAGUYA/WFC can be classified into four types; the L-O mode and R-X mode from Earth's northern and southern hemispheres, respectively. Since the moon goes at latitudes up and down to about 30 degrees from the geomagnetic equator, latitudinal distribution of the AKR types can be examined. We also examined Kp-dependences of the distribution.

3. Results

Our statistical analysis of the AKR types shows a clear equatorial symmetry. The total observation probability of the R-X mode from both hemispheres is 50-60% at the latitudes within 30 degrees from the equator.

The R-X and L-O modes from both hemispheres can be observed at the latitudes. This result means that not only the L-O mode waves but also the R-X mode waves can propagate across the equatorial plane. However, the observation probability of the R-X mode from the opposite hemisphere becomes small when the observation point goes higher latitudes. It is noted that this tendency is remarkable when the Kp index becomes larger. On the other hand, the observation probability of the L-O mode waves does not have large dependences on the latitude. The R-X mode waves are influenced by the extent of the plasmasphere through their propagation to the moon more strongly than the L-O mode waves.

References

1. K. Hashimoto, "A Reconciliation of Propagation Modes of Auroral Kilometric Radiation," *J. Geophys. Res.*, **89(A9)**, 1984, pp.7459-7466.
2. Y. Kasahara, Y. Goto, K. Hashimoto, T. Imachi, A. Kumamoto, T. Ono, and H. Matsumoto, "Plasma Wave Observation Using Waveform Capture in the Lunar Radar Sounder on board the SELENE Spacecraft," *Earth, Planets and Space*, **60**, 2008, pp.341-351.
3. J. K. Alexander and M. L. Kaiser, "Terrestrial Kilometric Radiation 1. Spatial Structure Studies," *J. Geophys. Res.*, **81**, 1976, pp.5948-5956.

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