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A study on radiation characteristics and the origin of the Jovian hectometric radiation

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Jupiter has the most active and huge magnetosphere in our solar system due to strong intrinsic magnetic field, fast rotation, and rich plasma source from Io. The Jovian hectometric radiation (HOM) is emitted in the frequency range from 100 kHz to 3MHz. We have investigated radiation characteristics of HOM to reveal the origin, such as radiation conditions and energy sources, based on radio wave data observed with the Galileo/PWS and Ulysses/URAP and a numerical experiment using the ray-tracing method. Radiation characteristics of HOM provide important information on the magnetospheric plasma environment and dynamics.

From the data analysis of the Galileo spacecraft which had been within 300Rj from Jupiter and covered wide range of Local Time (LT), occurrence characteristics of HOM were investigated. Two kinds of asymmetries of HOM intensity were suggested from the Galileo data. One is the north - south asymmetry: more intense HOM events were observed in the southern area. The other one is the LT dependence: HOM intensities observed in the morning and evening regions were smaller than those around 0h LT by about 0.5 From the data analysis of the Ulysses spacecraft which had been in high to low latitude range (-20~80[deg]) to Jupiter, latitudinal occurrence characteristics of HOM were particularly investigated. It is suggested that HOM emissions which were ordinarily observed around the equator (-10~10[deg]) were hardly observed at middle and high latitudes.

To investigate origin of the observed characteristics, we made a 3D ray tracing analysis to derive radiation conditions such as source position and direction. In the ray tracing analysis, the VIP4 model is adopted as Jupiter's magnetic field model and the Divine and Garrett model is adopted as the plasma density model. In the calculation, magnetoionic wave mode of HOM was assumed to be the R-X mode.

Magnetic field of the wave source (L-value), the radiation cone half-angle (b) and the ratio of emission frequency to R-X cutoff frequency (f/f_{R-X}) were adopted as free parameters. And appropriate L, b and f/f_{R-X} values were surveyed as those are suitable for the observed latitudinal and LT dependences. When uniform longitudinal source distribution is assumed, any combinations of L, b and f/f_{R-X} values could not satisfy the observed latitudinal and LT dependences. So, we considered nonuniform longitudinal source distribution. We referred the LT dependence suggested by the wave data of Galileo and the UV aurora data observed by *Grodent et al.* [2003] who showed an MLT dependence of the main oval. As the result, it was suggested that the result of ray tracing analysis satisfied with the Galileo and Ulysses observations when HOM intensity of the sources at 3-9h and 17-23hLT was half of that at the other LT's. However, even in this case, we can't explain intensity ratio between high latitude HOM and equatorial HOM quantitatively. As one of the possibilities, we couldn't evaluate actual HOM intensity in the data analysis of Ulysses, because HOM might be always emitted from low to high latitudes as expected by the ray tracing analysis and we might not be able to separate HOM intensity from back ground noise intensity.