The source location of Jovian decametric radiation obtained by dual frequency long baseline interferometer observation

Tomoyuki Nakajo[1], Takayuki Ono[2], Masahide Iizima[3], Hiroshi Oya[4]

[1] Astronomy and Geophysics Sci.,Tohoku Univ., [2] Department of Astronomy and Geophysics, Tohoku Univ., [3] Geophysical Inst., Tohoku Univ., [4] Space Commu. Fukui Univ.

The identification of the source location of Jovian decametric radiation (DAM) is one of the essential observation to understand the generation mechanism of this intense radio emission. Although long baseline interferometry is the unique means to identify the source position directly, it has been well known that the irregularities of the plasma density in the earth's ionosphere significantly affect the accurate phase observation of DAM in the ground. To overcome this difficulty, we have developed the dual frequency interferometer system for long baseline observation of DAM. The principles of the dual frequency interferometry have been established in the field of VLBI. However, in the case of the DAM observation, the frequency spectrum of the signal is restricted to be extremely narrow bandwidth (a few hundred kHz) compared to the frequency in an itself (nearly 20 MHz); consequently, the high-precision measurement of the fringe phase is required. In order to achieve the necessary accuracy in the phase measurement, the receivers employed in the new observation system have a wider frequency bandwidth than the traditional DAM receivers.

After the initial observation by employing the in Iitate-Yoneyama baseline in 2002, 2D observation has become possible in 2003 installing the same interferometer receiver system at Zao station. The receiving system consists of three parts, i.e., the front-end, the main receiver and the data recording system. The front-end consists of a log-periodic antenna, a band pass filter whose passband is 20-30MHz, and a low noise wide-band pre-amplifier. The main receiver is a double stage super-heterodyne receiver and the received RF signal is converted into a frequency range from 5 to 15kHz. In each station, two independent main receivers are set to carry out the simultaneous observation of the DAM signal at two different frequencies with spacing of about 500 kHz. The output waveforms from the main receivers are, then, digitized directly by the data recording system. The time synchronization in the observation at the different stations is achieved by the 1PPS signal supplied by GPS. The phase stability of the observation system is almost decided by the stability of main receiver. The stability is achieved to be as 1.0 (degree) by using Direct Digital Synthesizer (DDS) as the local oscillator, whose reference signal is fed from the cesium frequency standard. In order to evaluate the quality of data, the temperature of each part of the receiver is monitored. The phase calibration of main receiver can be carried out at any time by using the calibration signal generator installed in each station. The observation system in each station is controlled and monitored from the Sendai station through the computer network by using the communication line.

The results of the interferometer observations carried out in 2002 have shown that the sources of DAM are possibly located at both northern and southern polar region of the Jupiter, suggesting a switching phenomenon of source position between two hemispheres. The observation results obtained in 2003 will also be presented and discussed in detail at the meeting.