Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PCG31-25 Room:301A Time:May 23 17:15-17:30

Objective detection of weak Jovian decametric radiation by using a short baseline interferometer system

Tomoyuki Nakajo[1*], Takashi Aoyama[1], Hiroshi Oya[2]

[1]Fukui University of Technology, [2]Tohoku University

1.Introduction

Jovian decametric radiation (DAM) is a well-known radio wave radiated from auroral region at Jupiter. Observation of DAM is very important for study of planetary magnetosphere different from Earth. Especially, occurrence probability of DAM is important for monitoring the activity of Jovian magnetosphere.

However, standard detection techniques of DAM can be affected by subjective view of observer because the judgment is based on the morphology observed in the received signals. In this study, we performed data analysis for a short baseline interferometer system in order to establish a more objective detection technique for DAM.

2.A short baseline interferometer system in Fukui University of Technology (FUT)

The interferometer system consists of 3 baselines with 100 m class baseline length. The observation is usually carried out with the observing frequency of 23.31 MHz. In the system, fringe waveforms are digitized by 5 Hz sampling frequency and stored in HDD.

3.Fringe correlation technique

In order to detect the fringe wave of Jupiter origin, we calculated normalized correlation coefficient between observed and theoretical fringe waveforms. The theoretical fringe waveform is calculated under assumption that DAM is radiated continuously with a constant intensity. We judge the detected signal to be DAM in the case the correlation coefficient exceeds a given threshold value. In the analysis, we set the threshold value as 4 sigma in probability distribution of obtained correlation coefficients. We were forced to select the integration time as about 2 hours which is too long compared to typical duration of DAM because of the short baseline length in our interferometer system. Therefore, it should be noted that a short duration DAM may not be detected in the present study.

4.Validity of fringe correlation technique

We evaluated the validity of fringe correlation technique based on the following 3 viewpoints.

(1)Comparison with standard CML-Io phase diagram

We calculated a CML-Io phase diagram by using only the observation result in the present study and compared with the standard diagram. The result shows the diagram obtained in the present study is similar to the standard one, which indicates the validity of fringe correlation technique.

(2)Comparison with the dates expected a shock structure of solar wind reaches Jupiter

Next, we compared the detection dates of DAM with the dates expected a shock structure of solar wind reaches Jupiter. The dates expected a shock structure of solar wind reaches Jupiter were calculated by using the solar wind data of WIND spacecraft. The analyses were performed by using the data obtained within one month before and after the opposition. As the results, it was confirmed that the almost signals detected in non-Io phase were received within one day before and after the date a shock structure of solar wind reaches Jupiter.

(3)Comparison with the observation in Nancay observatory

Finally, we compared with the wideband spectrum data in Nancay observatory. The result in 2009 and 2010 shows the dates DAM were detected in FUT and Nancay are mostly agreement, which indicates the validity of detection technique in the present study. On the other hand, we could not detect distinct DAM signals in Nancay data of 2007 and 2008 although signals were detected in FUT. This result probably shows fringe correlation technique can be more highly sensitive than the spectrum observation in Nancay.

5.Discussion and future study

We confirmed that the fringe correlation technique is very effective for objective detection of weak DAM emission. The results indicate a majority of non-Io DAM is radiated within one day before and after a shock structure of solar wind reaches Jupiter. In addition, we might detect a new Io-related component in CML-Io phase diagram. We need to continue the observation and develop a new interferometer network with a few km baseline lengths which can detect a short duration DAM signals.

Keywords: Jupiter, decametric, radio, interferometer, solar wind