Verification of Super Massive Black Hole Binaries Discovered at the Center of Our Galaxy by Observations of Decameter Radio Wave Pulses

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1. Introduction Based on the observations of decameter radio wave pulses from the center part of our Galaxy by using ,mainly, decameter radio wave interferometer at Tohoku University, search for super massive black holes has currently been carried out starting from 1984. In 1999, it had tentatively reported that there were at least 23 black holes which could be origins of the decameter radio wave pulses. From 2016, new observations to verify the proposed black hole hypothesis were started and further development of the observations had been realized by introducing digital system to obtain the interferometer data. New analyses provide evolutional progress correcting the previous results of the present study.

2. Observations In 2016, observations of the decameter radio wave pulses had been made from February 2 to February 28, for non Galaxy center condition, and from March 15 to June 30 aiming at the Galaxy center. The utilized decameter long baseline interferometer at Tohoku University consist of three observation stations at Kawatabi, Zao and Yoneyama which provide three interferometer base lines with the length ranges from 44km to 83km. At each station, signals at 21.860MHz were observed and converted down to 1kHz with bandwidth of 500Hz which were sent to the Sendai station ,through the telemeter system. The signals at the backend of the telemetry system were converted into digital signals by AD converter with sampling rate of 3000 data points per sec.

3. FFT analyses and Confirmation by Simulation For the obtained digital data from each observation point of the interferometer system, interferometry correlation functions were calculated by digital computer to find interferometry fringe function to which the template fringe to detect the arrival directions of the signal were applied culculating the correlation. To these direction correlated data, FFT analyses are carried out so as to pick up the source signals of a few percent level compared with large background noises by averaging 6000 times trial of independent FFT operations. The results had definitely indicated that the purposing spectra are arriving from the center part of our Galaxy with allowance angle range of +- 0.5 degree. The resulted spectra are characterized by two fundamental periods at 156.6sec corresponding to the source Gaa and 130.8 sec corresponding to Gab. These two fundamental spectra are associated with 2nd and 3ird harmonics; furthermore all spectra are associated with 3 to 5 sideband spectra both in the upper side and lower side of the principal spectra. All sidebands have a frequency gap of 1/2200 Hz :that is, all spectra are manifestation of the frequency modulation caused by orbital motions of Gaa and Gab with orbiting period of 2200sec.

4. Confirmation by FFT simulation Based on the characteristic parameters deduced by the FFT analyses, possible signals from spinning Gaa and Gab which are moving along two orbits with a common period of 2200sec with speeds respectively of 0.16c and 0.19c are constructed as simulation function to understand the observed FFT results: it is concluded that FFT results for this constructed function revealed coincidence with observation case. That is, current results in which 5 set of black hole binary have been proposed should be corrected so as to be one set of principal black hole binary consisting of

Gaa and Gab .

5. Box Car Analyses Accurate feature of the Gaa and Gab black hole binary system has been investigated applying period correlation analyses (Box Car analyses) to find pulse forms with search of the orbit period and orbiting speeds together. The results has indicated that orbiting period of Gaa and Gab is 2205 sec ; two black holes have two separated visible sources of radio wave as manifestation of curving effect of the ray paths due to the space rotation of the ergo-sphere.

Keywords: Black Hole Binary, Galaxy Center, Decameter Radio Wave

