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Detection of Group of Black hole Binaries at the Center Part of Our Galaxy Based on

OYA, Hiroshi[1*]

[1]Tohoku University

1. Introduction Through the current studies on the detection of Ker

Black holes located at the center part of our Galaxy, being based on the observations of decameter radio wave pulses, the investigation of the accurate source direction has been made for the largest case of Gaa and Gab. In this study, the works has been expanded to other 3 cases such as , Gac-Gad, Gae-Gaf and Gag-Gah systems. The directions of sources of decameter wave pulses are analyzed using newly observed data in 2014 considering the deviation effects, of the ionosphere, on the propagating direction of radio wave.

2. Observation System The observations to determine the source direction of

the decameter radio wave pulses have been carried out using the long baseline decameter radio wave interferometer of Tohoku university which consist of three observation stations located at Yoneyama, Kawatabi and Zao in Miyagi Prefecture, Japan; the longest baseline is 84km and shortest baseline is 44km. The signals observed at 22.186MHz with band width of 1kHz are sent from each station through the telemetry system directly to the central station at Sendai where the detected signals are converted into digital signals by AD converters with conversion rate of 6000 data per second being divided into 3 channels with 100Hz band width.

3. Data Analyses Observations in 2014 have been made from early

February to 10th of April. In this work the data observed March 18, 19, and 20 are selected for analyses. The pulse form is detected by applying period correlated accumulation method (so called box car method modified for varying periods) together with analyses of correlation between interferometer fringe and template fringes to decide the source direction. To form the template fringe the ionosphere effect for propagation of radio waves at 22.816MHz are considered by applying 3-layer-ionosphere model where foF2 values observed at Kokubunji station are applied. A fine adjustment to compensate the systematic bias of the detected source direction due to the characteristic of the selected ionosphere model, is made by searching the direction of the template fringe.

4. Results and Discussions

4.1Source Direction Source directions are obtained in forms of correction

angles deviating from the predicted Sgr A∗direction that are calculated with consideration of ionosphere effects. The case of Gaa-Gab binary, results are given as Gaa(RA(0.01,0.53);Dec(-0.45,0.63))–Gab(RA(0,109);Dec(-1.53,1.33)). This format indicates that for Gaa average deviation angle for RA (right ascension) of Gaa is 0.01 arc minutes with standard deviation of 0.53 arc minutes and average correction angle for Dec(declination) of Gaa is -0.45 arc minutes with standard deviation of 1.33 arc minutes. Though detail values for other BH binary system will be given in the presentation, the results show that with only one exception of the case of declination of Gab, all average correction angle are within the deviation angle, suggesting that the source directions coincide with SgrA∗within an error of 1.89 arc minutes.

4.1 Parameters of BH binary Systems The sources of pulses are assumed

to be Ker black holes with masses which are approximately proportional to the pulse periods. Applying Kepler law using orbital parameters resulted from observed periods , then masses of BH of binary system have been derived.

5. Conclusion Within determination error of 1.89 arc minutes, there exist

at least 4 binary systems in Sgr A∗such as Gaa-Gab, Gac-Gad, Gae-Gaf, and Gag-Gah system which show orbital periods, respectively 2050 sec, 1024 sec, 1200sec and 325 sec. Each black hole has mass as given with unit of million solar mass from 1.30 to 1.32, for Gaa; from 1.04 to 1.07, for Gab; from 0.82 to 0.84 for Gac; from 0.57 to 0.60, for Gad; from 0. 15 to 0.17,for Gae ; from 0.11 to 0.14, for Gaf ; from 0.17 to 0.18, for Gag and from0.14 to 0.15 for Gah.

Keywords: Black Hole, Binary, Decameter Radiowave, Interferometer, Galaxy Center