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22 GHz MONITORING OF SGR A* DURING THE G2 PERI-CENTER PASSING WITH THE JAPANESE VLBI NETWORK

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ABSTRACT

We have been performing daily VLBI monitoring of the flux density of Sagittarius (Sgr) A* at 22 GHz from February 2013 to August 2014 using a sub-array of the Japanese VLBI Network (JVN). The purpose of this monitoring is to explore the flux density variability at daily time resolution for a period longer than one year with the G2 cloud approaching. The flux density of Sgr A* is basically stable during the observational period, though there are some small variations. The average and scattering range are consistent with the previously observed values. We have observed no strong flare of Sgr A* although it is near the expected peri-center passing.

Key words: journals: individual: Sagittarius A*, VLBI

1. INTRODUCTION

Sgr A* is a compact radio source at the center of the Milky Way Galaxy, which contains a super massive black hole of 4 million solar masses (Ghez et al. (2008), Gillessen et al. (2009)). Gillessen et al. (2012) found a small cloud, G2, near the black hole. The G2 cloud was predicted to come closer to the peri-center distance of 200 AU in the spring of 2014 (Gillessen et al. (2013)). There were some simulations which predicted that the emission of SgrA* might increase due to this event (e.g. Narayan et al. (2012), Saitoh et al. (2014)). Monitoring observations of this event are very important to determine what happens at the Galactic center. We have conducted daily monitoring of the flux density of Sgr A* at 22 GHz. The purpose of this monitoring is to explore the flux density variability on the time resolution of a day for the period long than one year with the G2 cloud approaches.

2. OBSERVATIONS

We used a sub-array of the Japanese VLBI Network (JVN) for daily monitoring of the flux density of Sgr A* at 22 GHz from February 25, 2013 to August 12, 2014. The sub-array consists of the Mizusawa 10-m radio telescope, Takahagi /Hitachi 32-m radio telescopes, and Gifu 11-m radio telescope. The Tsukuba 32-m radio telescope and Kashima 34-m radio telescope have joined it on occasion. Because the sub-array has projected baselines of 90-140 km on the line of site from Sgr A*, we can measure the flux density of Sgr A* avoiding contamination from the extended structure surrounding Sgr A* and the flux density decrease from partially resolved-out flux arising from using the longer projected baselines. We used the K5/VSSP32 VLBI data acquisition (DAQ) system (Kondo et al. (2006)), which stored the VLBI data with 2 bit sampled 32 MHz bandwidth (128 M bps data rate). The observed data was transported to JAXA over the internet, and was correlated by a software correlator in JAXA, Sagamihara after each daily observation. Three quasars, NRAO530, J1626-2951, and J1924-2914, were observed each day as flux calibrators, and Sgr A* was observed twice each day. The on-source observational time of each source was 10 minutes per day. The system temperature of each radio telescope was between 100-200K except during the summer season. The uncertainty of the correlated flux density over the whole period was about 0.3 Jy.

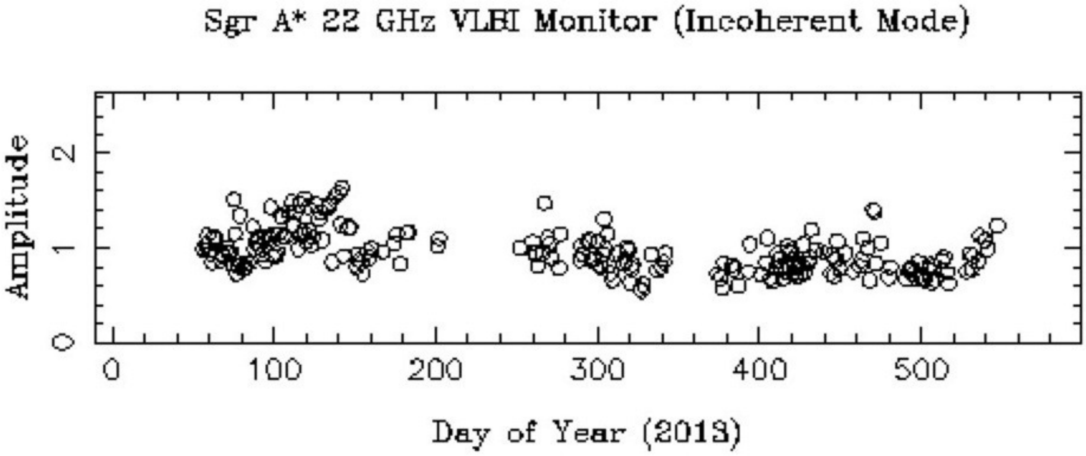

Figure 1. Relative flux density variation of SgrA* at 22GHz.

3. RESULTS AND DISCUSSION

Figure 1 shows the relative time variation of the flux density of Sgr A* from 2013 February to 2014 August. The unit of the vertical axis is not Jy but an arbitrary unit, as only the relative variation has meaning in this figure. Basically the variation of the flux density was less than a factor of two even though there are some small variations (Tsuboi et al. (2013a), Tsuboi et al. (2013b), Tsuboi et al. (2013c), Tsuboi et al. (2014)). From the detailed calibration of the flux density, the averaged flux density of whole observed period was 1.23 plus minus 0.33 Jy and was consistent with previously observed values. We have observed no strong flare of Sgr A* although it is around the expected peri-center passing.

One plausible explanation lack of strong flare of SgrA* is that G2 is not a molecular cloud but rather a star without a dust and molecular gas envelop. However, we cannot exclude the possibility that G2 is a molecular cloud but the magnetic field in the accretion flow is too strong to create a bow shock.

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