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Short-Term Variability of Sagittarius A* at Millimeter Wavelengths

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Abstract. We present preliminary results from the observations of the Galactic Center compact source, Sgr A* at 3 and 2 millimeter wavelengths using the Nobeyama Millimeter Array to monitor flux density variations on timescales shorter than a month. Such high spatial resolution observations at millimeter wavelengths are important to shed more light on the origin of the variability and the nature of this compact source. Our observations indicate the flux density varies at least by ∼30% in one to two weeks at 3 mm.

1. Introduction

At cm wavelengths time variability studies of Sgr A* have been done quite thoroughly. The variability below ∼10GHz is dominated by refractive scintillation while at higher frequencies the intrinsic variability dominates with occasional outbursts (e. g., Zhao et al. 1992). On the other hand, variability at millimeter wavelengths is not well established. Wright & Backer (1993) reported significant flux variations at $\lambda = 3.4$mm in a month during the decay of a flare observed by VLA in 1990 using the BIMA while others found no mm/submm variations (Zylka et al. 1995; Gwinn et al. 1991). Sgr A* is embedded in an extended H II region, Sgr A West, whose emission is dominant component even at millimeter wavelengths when it is observed with larger beam sizes (e. g., Tsuboi et al. 1988). Therefore the high resolution observations are important to isolate the compact component from the extended component to monitor any variability Sgr A* has.

Here we present multi-epoch observations of Sgr A* at mm wavelengths using the Nobeyama Millimeter Array (NMA).

2. Observations

Observations were made at 101.7 GHz (2.9mm) and 146.5 GHz (2.0mm) using the NMA, a six-element interferometer at the Nobeyama Radio Observatory. At each epoch, we observed at the two frequencies in consecutive days as much as possible. The array configuration we used gives projected baselines of $\sim 7k\lambda$ - $55k\lambda$ at 102 GHz. Uranus was used for flux density scaling. Most of the data presented here were taken during Spring of 1996 with 320-MHz bandwidth while some were taken with 1-GHz bandwidth using our new correlator (Hashimoto et al., these proceedings, p. 401) during Spring of 1997.

3. Results & Discussions

Figure 1 shows a plot of 102-GHz peak flux densities determined from the maps with a nearly identical beam of $3.7''$x $1.8''$. Uncertainties in flux calibration are estimated to be ~15% on average for 102 GHz. For 147 GHz, the accuracy of flux calibration more severely depends on phase stability, and the uncertainties are estimated to be ~20% or more. Time variations at 102 GHz appear to be present. Although it is not shown on the figure, the flux density at 147 GHz appears to be also variable. It declined from 1.3 Jy (JD = 2450129) to 0.7 Jy (JD = 2450153) while at 102 GHz, the flux density at the period actually increased from 1.1 to 1.3 Jy. We also observed a similar trend in April 10-11, 1997.

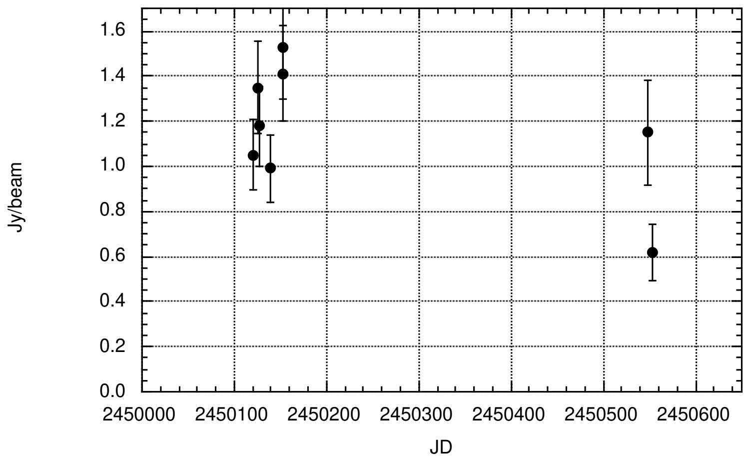

Figure 1. Flux density variations of Sgr A* during 1996 - 97 at 102 GHz. Error bars indicate the absolute flux scaling errors. Relative errors between epochs are expected to be much smaller.

Our 1996 data indicate as much as 30% flux variations in one to two weeks which is comparable to that reported by Wright & Backer (1993). Even larger variability seen in our 1997 data (varying by a factor of two in 6 days). Variability at 147 GHz and millimeter spectral index variations are suggested but need further investigation.

References

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