The Galactic Center: Feeding and Feedback in a Normal Galactic Nucleus
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Characteristics of millimeter variability of Sgr A*

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Abstract. We present the analysis of flux variations of Sgr A* at millimeter wavelengths based on the long-term monitoring project spanning over a decade using the Nobeyama Millimeter Array. We investigate basic characteristics of the flux variability using some standard parameterizations of the data. Such basic properties of the flux variations in the mm-regime can provide valuable information not only for its underlying mechanisms in general but also for understanding observed radio/mm flux measurements during an accretion event.

Keywords. Galaxy: center — black hole physics — radio continuum: galaxies — techniques: interferometric

1. Data description

The data used in the analysis were collected with Nobeyama Millimeter Array between 1996 and 2007 at 2-and 3-mm bands (with each band consists of the two sideband data: 90 and 102 GHz for the 3-mm band, and 134, and 146GHz for the 2mm band). Each epoch of the observations is separated by roughly 1 to 10 days.

Each sideband data was independently calibrated and peak flux densities were measured on CLEANed images to obtain daily averaged flux densities. Restricted uv distances were used ($< 25k\lambda$) to filter out extended emission. The light curves of these data are shown in Figure 1. A few prominent flares are labeled and some properties were reported elsewhere (e.g., Miyazaki *et al.* 2004). The averaged "quiescent" spectrum is constructed excluding those flux densities during flaring periods. A fit to a spectrum of the averaged fluxes including the publicly available cm-wavelength data (from VLA and GBI) taken within the date ranges of our observations gives the spectral index, $\alpha = 0.38 \pm 0.23$ ($S \propto \nu^{\alpha}$).

2. Millimeter variability characteristics

Variability Index. While data sampling is more sparse for the 2-mm data, the variability index (= sigma/mean) indicates higher variability at 2mm as compared to that of at 3mm (Table 1).

Flux Density Distributions. Figure 2 shows the cumulative probabilities of the 2- and 3-mm fluxes indicating deviations from the log-normal distribution at high flux density end. The component can be fitted by a power law with slopes of −3.9 and −6.6 at 2mm and 3mm, respectively.

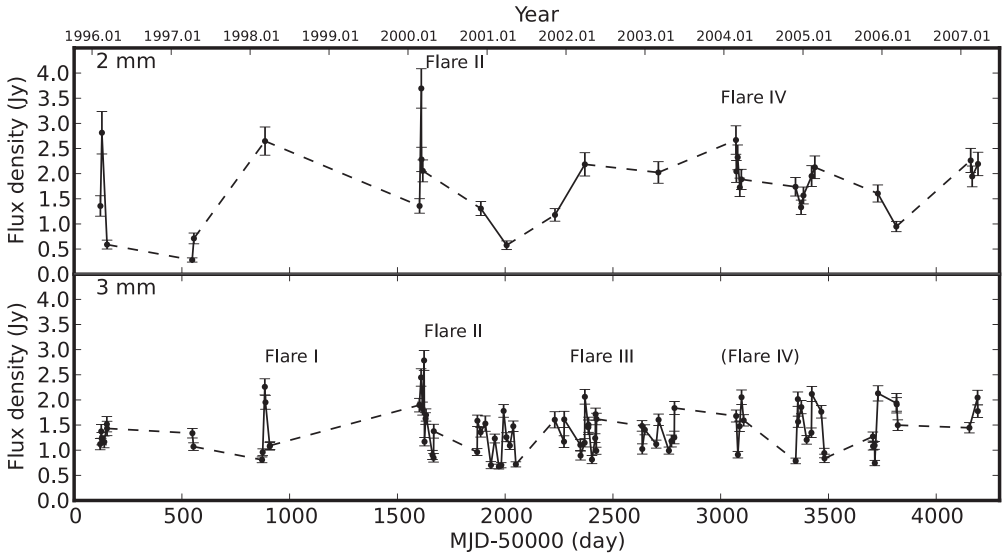

Figure 1. 2- and 3-mm long-term light curves. Some prominent flares are indicated.

Table 1. Variability Metrics

Band	Number of the data	mean	sigma	variability index
2mm	30	1.78	0.76	0.41
3mm	86	1.40	0.45	0.31

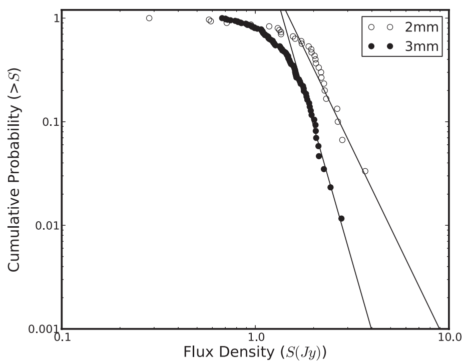

Figure 2. Cumulative probability distributions of the 2- and 3-mm flux densities

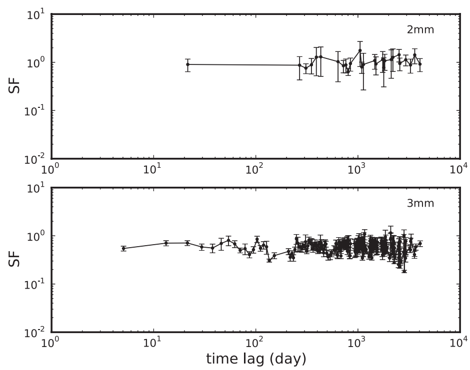

Figure 3. Structure functions at 2- and 3-mm

<u>*Structure Functions*</u>. The structure functions (SF) for the 2- and 3-mm data (Figure 3) appear to be consistent with stochastic variations (slope≈0). For the 3mm data, there are dips at ≈87d and 136d that seem to be related flaring activities (bin width≈8d for the 3mm data). However more careful analysis is necessary including finer time sampling of data to compare with the lower wavelength results such as Macquart & Bower 2006.

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References

Macquart & Bower 2006, *ApJ* 641, 302.
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