J. Astrophys. Astr. (2011) **32,** 55–56

Radio Observations of the S5 Sample

Jun Liu* & Xiang Liu
Xinjiang Astronomical Observatory, Chinese Academy of Sciences, Urumqi, Xinjiang 830011, People's Republic of China.
**e-mail: liuj@uao.ac.cn*

Abstract. The S5 sample was monitored on a monthly basis since December 2008 at Urumqi Observatory. Most of the sources are variables and a considerable proportion (about 20%) exhibited a significant inter-month flux variability (modulation index $> 4\%$) during the 1-year observation.

Key words. Galaxies: active—quasars: general—radio continuum: galaxies.

Active galactic nuclei (AGN) produce enormously high luminosities in extremely compact and small regions. The observation of the flux density variability in an AGN provides a powerful technique for investigating the emission mechanisms as well as the internal structure and size of the compact region. Hence, variability studies are essential for understanding the physics of AGN.

The S5 sample (Kühr *et al.* 1981) contains a complete sample of 185 radio emitting objects brighter than 250 mJy at 5 GHz with $\delta(1950) \geq 70^\circ$ and $|b^{\rm II}| > 10^\circ$. We monitored the entire sample at 5 GHz with the Urumqi 25-m radio telescope monthly (10 observing campaigns carried out between December 2008 and December 2009) to study the source variability statistically. All the observations were made in 'cross-scan' mode, each scan consisting of 8 sub-scans, 4 azimuth drifts and 4 elevation drifts across the target. This enables us to check the pointing offsets in both the coordinates. Such an observation method was also performed at Effelsberg in monitoring some classic IDV sources (e.g., S5 0716+714), and a detailed description of data calibration procedure can be found in Kraus *et al.* (2003).

Here, we list the basic information and the monthly observation results of 15 variables which show the most violent variability in Table 1 that consists of source B1950, optical identification (G: galaxies, Q: quasars, BL: BL Lac objects, EF: empty field), the number of flux measurements in flux monitoring, the mean flux density in flux monitoring, standard deviation, the modulation index, the variability amplitude and the reduced χ^2. The last three columns (m, Y, $\chi^2_{\rm red}$) are used to judge the degree of variability, and the definition of these parameters are described in Kraus *et al.* (2003).

We studied the statistics of the variability and performed cross-correlation analysis for different AGN types in order to investigate whether there is any dependence on the degree of variability and other source parameters such as galactic latitude, spectral indices, etc. However, there is no obvious dependence of the degree of variability

Table 1. A brief result for 15 variables.

Source	ID	Scans	S (Jy)	ΔS	m (%)	Y (%)	$\chi^2_{\rm red}$
0016+731	Q	14	1.287	0.096	7.46	21.65	6.825
0205+722	Q	14	0.456	0.030	6.52	18.72	3.783
0615+820	Q	10	0.878	0.065	7.36	21.34	8.024
0633+734	Q	9	0.652	0.050	7.73	22.48	7.024
1039+811	Q	11	0.931	0.084	8.97	26.30	8.688
1044+719	Q	11	1.332	0.112	8.42	24.61	9.739
1053+704	Q	10	0.309	0.026	8.29	24.22	7.941
1053+815	Q	11	0.739	0.053	7.13	20.62	6.622
1357+769	Q	11	0.560	0.065	11.67	34.55	13.487
1531+722	Q	10	0.333	0.027	7.98	23.27	5.390
1726+769	Q	9	0.329	0.055	16.57	49.40	29.133
0716+714	BL	13	1.261	0.236	18.74	55.93	63.999
2007+777	BL	12	1.070	0.149	13.95	41.48	22.638
2023+760	BL	11	0.529	0.039	7.37	21.36	5.640
1322+835	EF	10	0.323	0.020	6.07	17.31	3.238

on the above-mentioned quantities. Our result implies that mid-term variability seems more likely to be of intrinsic origin.

We performed IDV (intra-day variability) observations for 7 S5 sources (source name in bold in Table 1) in order to check whether a short-term variability exists when a mid-term variability had already been found. The result of our observations shows that 0716+714, 1044+719 and 1053+815 exhibit rapid variability on a time scale of 2∼4 days, however, 0633+734, which reveals large amplitude of inter-month variability, is quite stable on short time scales. This result indicates different origins of mid-term and short-term variability.

Acknowledgements

This work is supported by the National Natural Science Foundation of China (Grant Nos 10773019 and 11073036) and the 973 Programme of China (2009CB824800).

References

Kraus, A., Krichbaum, T. P., Wegner, R., Witzel, A. *et al.* 2003, *Astron. Astrophys.*, **401**, 161.
Kühr, H., Pauliny-Toth, I. I. K., Witzel, A., Schmidt, J. 1981, *Astron. J*, **86**, 854.