A new sample of GPS sources

A. Marecki[1], J. Niezgoda[1], H. Falcke[2], S. T. Garrington[3], A. R. Patnaik[4]

ABSTRACT

Using four published catalogues we have compiled a new sample of compact sources that *apparently* exhibit a spectral turnover at GHz frequencies. For most of these sources the flux densities at low frequencies (~ 400 MHz) were not available so the convex shape of their spectra was based on a crude extrapolation of L, C, and X-band data. In order to determine the spectral turnovers accurately and to exclude any flat spectrum sources we successfully measured fluxes of 100 objects at 408 MHz with MERLIN. So far we knew that 37 sources in the MERLIN phase calibrator list by Patnaik et al. (1992) were actually GPS sources rather than typical flat spectrum sources. With these observations we increased that number to 117.

1. Sample selection

By definition, GPS sources have a *steep spectrum* at high frequencies but due to the spectral turnover in the GHz range, their spectra in this regime are either flat or inverted ($\alpha > -0.5$, $S\nu \propto \nu^{\alpha}$). The samples of GPS sources published so far appear to be biased, since they mainly consist of steep spectrum sources in the classical sense. Consequently, to get a large, unbiased sample of GPS sources, we have started a programme to identify GPS sources from the MERLIN calibrator list by Patnaik et al. (1992), containing all compact radio sources in the range $35° < \delta < 75°$ with fluxes > 200 mJy at 8.4 GHz and a flat spectrum. The selection criterion of this catalogue is such that, besides typical flat spectrum sources, it should also contain a large number of GPS sources. To determine candidate GPS sources, we took X-band fluxes from Patnaik's list, added L and C-band fluxes from GB catalogues (White & Becker, 1992), fitted second order polynomials to the data and selected the sources with convex spectral shapes. 31 of these sources were strong enough at 365 MHz — the Texas catalogue (Douglas et al. 1980) — and sometimes even at 151 MHz — the 6C catalogue — so that we were able to establish

---

[0]To appear in the Proceedings of The 2nd Workshop on Peaked Spectrum Radio Sources, Leiden 1996, Snellen et al. (eds).

[1]TRAO, N. Copernicus University, Toruń, Poland

[2]Dept. of Astronomy, University of Maryland, College Park, USA

[3]NRAL, Jodrell Bank, UK

[4]MPIfR, Bonn, Germany

Table 1: GPS sources present in Texas catalogue

0059+581	0652+577	1107+485	1324+574	1627+476	1815+614	2323+478
0102+480	0700+470	1239+552	1428+422	1630+358	1946+708	2356+385
0627+532	0750+535	1256+546	1532+680	1745+670	2253+417	
0652+426	0828+493	1311+552	1602+576	1755+578	2310+385	

the turnover frequency satisfactorily. 5 sources out of these 31 (0710+439, 0711+356, 1031+567, 1225+368, 2050+364) are already present in a classic "working sample" of O'Dea et al. (1991). The remaining 26 are listed in Table 1.

For the majority of sources (132 out of 163) we have no low frequency data i.e. they seemed to be weaker than the sensitivity limit of the Texas catalogue (250 mJy). Again, some sources out of these 132 (0108+388, 0153+744, 0636+680, 0646+600, 1333+459, 1843+356) are already listed by O'Dea et al. (1991). A crude extrapolation of the spectra applied to high frequency data (L, C and X bands) of the remaining 126 sources gives us only an unreliable estimate of the frequency turnover and even the convex shape of the spectrum remains uncertain in some cases. Particularly some weaker sources could either be GPS or flat spectrum yet having 365 MHz fluxes below the catalogue limit. Another effect that could have produced a spurious convex shape in our non-simultaneous data is the variability typically observed in flat spectrum sources.

2. Observations and data reduction

In order to investigate the low frequency part of the spectra of our sources we have set up a programme of flux density measurements at low frequency with a high resolution facility (VLA or MERLIN). We decided to use MERLIN at 408 MHz. The observations were carried out from November 1994 until January 1995. The typical length of our snapshots was 15 minutes. Interference at the Cambridge antenna restricted the useful bandwidth from that antenna, so it was not used in the subsequent analysis. Interference and system problems at other sites resulted in the loss of data for more than 20 sources from our sample.

Since we know from the VLA observations in A configuration at 8.4 GHz (Patnaik et al. 1992) that our sources are pointlike we used the *Fringe-frequency-Delay Search* — (FFD) technique (see eg. Walker, 1981). The chief advantage of this technique is that it allows the contribution from confusing sources (which is significant at 408 MHz) to be eliminated by making a form of low-resolution, wide-field map. It can be highly automated and therefore it is also fast and efficient. During the reduction process the scans were divided into subscans consisting of 128 raw 4 second integrations. For each subscan we calculated an FFD array and took a value from its very centre i.e. rejecting all other sources in the beam.

3. Results

Having reduced our data we found that 20 sources have just flat spectra. The remaining 80 sources make a new sample of GPS sources. They are listed in Table 2.

Adding those 26 sources which already had low-frequency data available, (cf. Table 1) we can state that 106 out of the 823 (12.9%) flat spectrum point sources in the MERLIN phase calibrator catalogue by Patnaik et al. (1992) are indeed GPS sources rather than typical flat-spectrum sources. (Together with 11 sources already quoted by O'Dea et al., (1991) we have 117 of them.) Two sources from Table 2. (0513+714 and 1622+665) are also found in WENSS based sample (cf. Snellen, these proceedings). The well defined selection criterion and a large number of "new" sources makes our catalogue ideally suited for statistical surveys of GPS sources.

Table 2: GPS sources found using the MERLIN survey at 408 MHz

0001+478	0148+546	0514+474	0758+594	1125+366	1320+394	1544+398	1941+413
0015+529	0153+389	0537+392	0849+675	1138+644	1321+410	1607+563	2000+472
0046+511	0251+393	0559+422	0851+719	1157+532	1337+637	1614+466	2005+642
0051+679	0307+380	0621+446	0924+732	1206+416	1338+381	1622+665	2013+508
0058+498	0335+599	0651+410	0925+745	1226+638	1357+404	1724+609	2014+463
0102+511	0336+473	0708+742	0939+620	1232+366	1403+411	1753+648	2151+431
0123+731	0338+480	0718+374	1019+429	1239+606	1436+445	1812+560	2248+555
0129+431	0412+447	0732+755	1035+430	1245+676	1454+447	1828+399	2300+638
0129+560	0424+414	0753+373	1055+433	1300+485	1533+487	1839+389	2310+724
0140+490	0513+714	0753+519	1101+609	1308+471	1534+501	1937+630	2341+697

REFERENCES

Douglas J.N. et al. 1980, *The University of Texas Publications, Publications in Astronomy*, **17**

O'Dea C.P. et al., (1991), ApJ, **380**, 66

Patnaik A.R. et al. 1992, MNRAS, **254**, 655

Walker R.C. 1981, AJ, **86**, 1323

White, R. L. & Becker, R. H. 1992, ApJS, **79**, 331

This preprint was prepared with the AAS LaTeX macros v3.0.