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Search for CSS and GPS Candidates from the Peacock and Wall Catalogue

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Abstract: Samples of CSS/GPS sources suitable for statistical studies have been selected from the 3CR catalogue and from the Peacock & Wall catalogue. The selection criterion used for the Peacock & Wall catalogue CSS/GPS sources selects sources which peak below about 2 GHz and are therefore larger than ∼200 pc. Our main aim is to find among the flat spectrum sources in the Peacock & Wall catalogue smaller size CSS/GPS sources by means of systematic high resolution observations. The discovery of a few more would be important in order to finally have a complete flux limited sample of this class of objects. We discuss the results obtained so far for three of the observed sources.

Keywords: galaxies: active — quasars: individual (0153+744, 0133+476, 0202+149) — radio continuum: general

1 Project Outline

Samples of CSS/GPS sources suitable for statistical studies have been selected from the 3CR catalogue (Laing, Riley, & Longair 1983) and from the Peacock & Wall (1982, hereafter PW) catalogue. The PW catalogue, owing to the higher frequency selection (2.7 GHz and 5 GHz), contains a number of GPS sources whose radio spectra turn over at frequencies higher than those of the 3CR, so that it is particularly suitable for searching for small size objects. However, the selection criterion used for PW CSS/GPS selects sources which peak below about 2 GHz and therefore are larger than ∼200 pc (O'Dea 1998). Smaller size sources with turnover frequency between 2 and 5 GHz would appear as flat spectrum sources and therefore would be confused with the class of core–jet objects. Objects like these can be found only by means of systematic high resolution and/or high frequency observations of all the flat spectrum sources in the PW catalogue. Our main aim is to find among them small size CSS/GPS sources for which structure information was not available.

2 Radio Observations

Our sample consists of eight sources for which the mas structure is unknown or uncertain. The flux density measurements at high frequencies show that the spectrum for the majority of them is not flat. From the optical identification all objects are QSOs. Six sources have been observed with the VLBA at one or more of the following frequencies: 1.6 GHz, 5 GHz, 8.4 GHz, and 15 GHz. Here we discuss the data for three objects (listed in Table 1) examinated so far.

0153+744. The radio emission at mas scales for this quasar at centimetre wavelengths is dominated by two components (Figure 1). Between the two components there is a 'bridge' of emission (components C, D, E as in Hummel et al. 1997). Parameters for each component are listed in Table 2. We find a spectral index $\alpha = 0.2$ ($S \propto \nu^{-\alpha}$) for the North component, as a whole, between 5 and 15 GHz (Table 2). Comparing our results with data from Hummel et al. (1997) we obtain the same value for α between 15 and 22 GHz. Component A is resolved at 22 GHz into a core–jet structure with four distinct components, the second of which, with a flat spectrum, is likely to be the real core. Component B shows complex structure consisting of resolved steep-spectrum emission. The radio spectrum peaks at around 1 GHz so we can classify this object as a GPS source as proposed by O'Dea, Baum, & Stanghellini (1991).

0133+476. This source is only slightly resolved by our observations (Figure 2). From the PW catalogue this

Table 1. General source parameters from Johnston et al. (1995)

Name	Type	z	m_v	$S_{5\,\mathrm{GHz}}$ mJy	$S_{8.4\,\mathrm{GHz}}$ mJy	LS pc
0153+744	QSO	2.338	16.0	1500	910(1)	∼40
0133+476	QSO	0.859	19.0	3300	1699(1)	∼54
0202+149	QSO	0.405(2)	21.9	2400	2270(3)	∼24

(1) Patnaik et al. (1992).
(2) Perlman et al. (1998).
(3) Wright & Otrupcek (1990).

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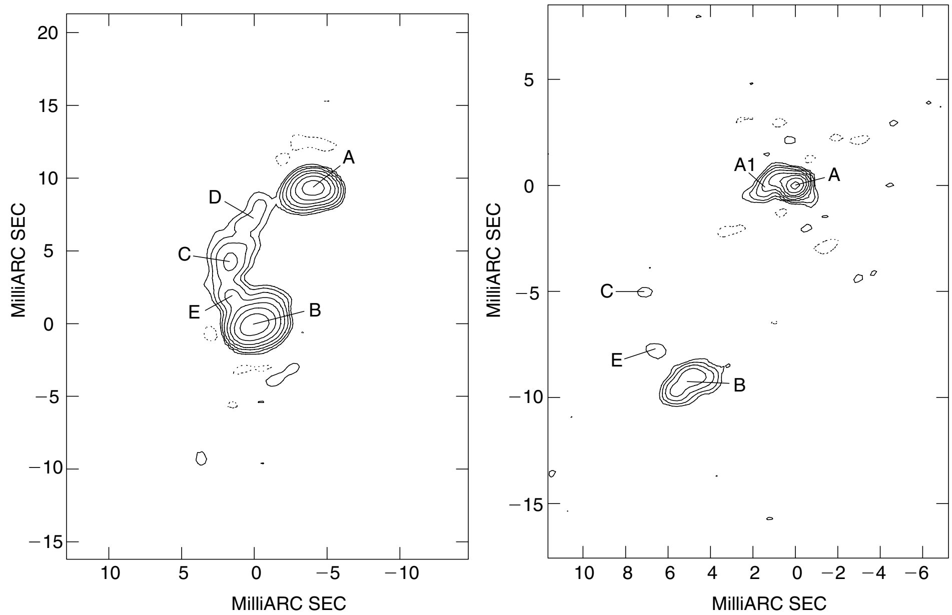

Figure 1 Left: 0153+744 at 5 GHz. Peak flux = 237 mJy/beam, contour levels = −2, 2, 4, 8, 16, 32, 64, 128, 256 mJy/beam. Right: 0153+744 at 15 GHz. Peak flux = 168 mJy/beam, contour levels = −1, 1, 2, 4, 8, 16, 32, 64, 128, 256 mJy/beam.

Table 2. Observed source parameters derived from the images in Figures 1–3

Name	ν GHz	Comp	beam			rms mJy/b	Maj mas	Min mas	PA °	S_p mJy/b	S_{tot} mJy	α
			mas	mas	°							
0153+744	4.8	A	1.26	1.14	77.5	0.4	1.40	0.52	96.9	203.0	301.0	0.2
		B					1.83	1.02	113.1	237.0	503.0	2.0
		C					1.83	1.01	167.9	20.2	7.1	2.2
		D					4.32	0.78	143.6	6.3	5.7	
		E					1.89	0.68	37.0	22.7	14.6	2.1
0153+744	15	A	0.68	0.50	−60.53	0.3	0.39	0.11	51.7	168.6	193.7	
		A1					1.82	0.43	102.5	25.4	24.0	
		B					1.76	0.79	121.1	13.6	54.7	
		C					–	–	–	1.6	1.0	
		E					0.85	0.37	58.3	1.9	2.1	
0133+476	1.6		6.54	3.90	−0.77	1.4	3.52	2.12	158.9	944.5	1184.7	
												−0.3
0133+476	4.8		1.97	1.43	−13.99	0.9	0.80	0.20	158.8	1504.2	1627.1	
												−0.7
0133+476	8.4		1.45	1.08	20.74	1.9	0.50	0.17	145.6	2332.4	2521.2	
0202+149	8.4	A	1.98	1.12	26.3	1.8	0.50	0.18	145.5	1589.4	1825.9	0.8
		B					–	–	–	96.9	168.2	2.5
0202+149	15	A	1.33	0.51	−26.09	2.4	0.76	0.19	135.1	1079.6	1376.5	
		B					0.83	0.70	21.0	28.0	76.4	

object was already known to have an inverted spectral index. We find that the radio spectrum peaks at a frequency ≥8.4 GHz, which makes it a new High Frequency Peaker source (Dallacasa et al. 2000; this workshop).

0202+149. This object has a ‘core’-dominated structure (A) with a faint component (B) ~7 mas apart (Figure 3). The ‘core’ has spectral index $\alpha = 0.8$, while component B has a steep spectral index $\alpha = 2.5$ (Table 2). The radio spectrum peaks at around 400 MHz, which makes this a CSS source.

Future Work

The data for the following sources are still under analysis:

- 0859+470 at 15 GHz;
- 0945+664 at 1.6 GHz, 5 GHz, 15 GHz;
- 0954+556 at 1.6 GHz, 5 GHz, 15 GHz.

The discovery of a few CSS/GPS sources of small size is important in order to finally have a complete flux limited sample of this class of objects (PW). These data will

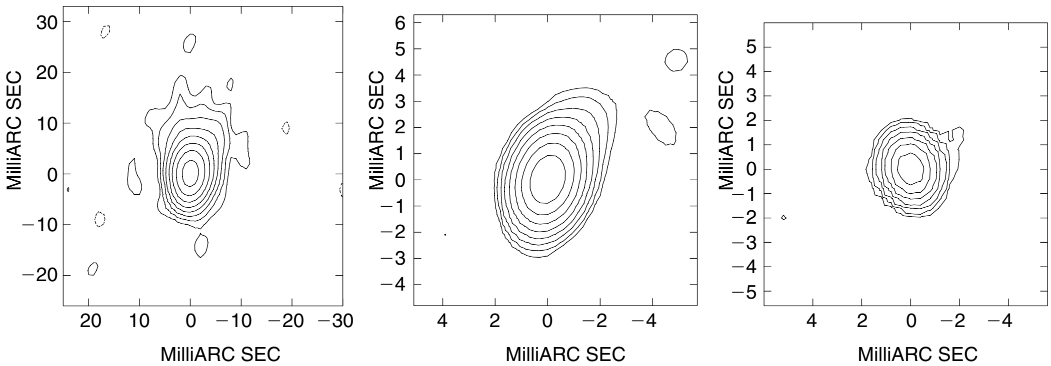

Figure 2 Left: 0133+476 at 1.6 GHz. Peak flux = 944 mJy/beam, contour levels = −5, 5, 10, 20, 40, 80, 160, 320, 640, 1200 mJy/beam. Centre: 0133+476 at 5 GHz. Peak flux = 1504 mJy/beam, contour levels = −7, 7, 14, 28, 56, 112, 224, 448, 856, 1712 mJy/beam. Right: 0133+476 at 8.4 GHz. Peak flux = 2332 mJy/beam, contour levels = −20, 20, 40, 80, 160, 320, 640, 1280, 2560 mJy/beam.

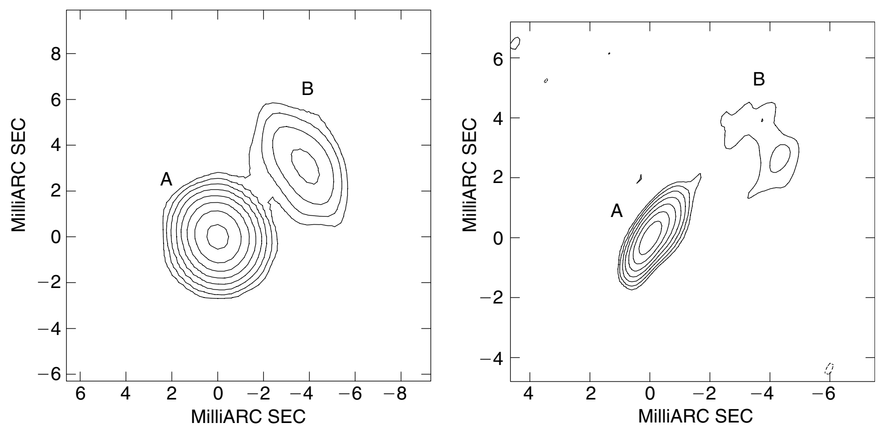

Figure 3 Left: 0202+149 at 8.4 GHz. Peak flux = 1589 mJy/beam. Right: 0202+149 at 15 GHz. Peak flux = 1079.6 mJy/beam. Contour levels = −10, 10, 20, 40, 80, 160, 320, 640, 1280, 3560 mJy/beam.

complete the structure knowledge of the flat spectrum population of the PW sources. Combining the observations of bright CSS/GPS sources with our results will result in a complete flux limited sample spanning a range in source size of $\sim 10^4$, which is important to study source evolution.

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