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MERLIN Images of Five Compact Symmetric Object Candidates at 1.6 GHz

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Abstract We present results of MERLIN observations of five compact radio sources at 1.6 GHz, part of a large survey to identify compact symmetric objects (CSOs). We give for the first time MERLIN maps of two sources, 1604+315 and 1751+278. The five observed sources show very compact, unresolved point-like structure, which may imply that they are good CSO candidates.

Key words: radio interferometry — radio continnum: galaxies — compact symmetric object

1 INTRODUCTION

Compact Symmetric Objects (CSOs) are powerful and compact sources (overall size < 1 kpc) with lobe emission on both sides of the central engine. The small size of these sources is almost certainly to be attributed to the youth of the sources themselves (ages < 10^4 yr) and not due to a dense confining medium (Readhead 1996). The unification scenario assumes that CSOs evolve into compact steep spectrum (CSS) sources and then into Fanaroff-Riley type II objects (Fanti 1995). Unfortunately, the small number of CSOs known to date is statistically insufficient for studying this evolutionary scenario.

In recent years, VLBI observations for identifying CSOs have been made (Taylor et al. 1996; Peck & Taylor 2000). The results show that the confirmed CSOs and most CSO candidates are commonly found in samples of GHz peaked spectrum (GPS) sources, and occasionally included in flat spectrum source samples. With the similarities of their sizes and radio spectra, CSOs and GPS sources may lie in an almost same early evolutionary stage of powerful radio source.

From the GPS sample (de Vries et al. 1997; Stanghellini et al. 1998), we first selected five sources 1345+125, 1518+046, 1604+315, 1751+278 and 1404+286 (OQ208). The GPS sources 1604+315 and 1751+278 have not any milliarcsecond morphology information before this observation. The other three sources have symmetric, milliarcsecond VLBI features, and could be CSO candidates. But we expect to know if they have any extended larger scale emission. Using

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MERLIN with the relatively low frequency and sufficient sensitivity, the snapshot observations permit us to obtain information on the low brightness, extended emission of these sources.

2 OBSERVATION AND DATA REDUCTION

The observation was made with MERLIN (Multi Element Radio Linked Interferometer Network) at 1.657 GHz of left-circular polarization on November 13, 1999. 7 antennas (Detford, Cambridge, Knockin, Darnhall, MK2, Lovell, Tabley) were used in the snapshot observation. The total observation time was 3079 seconds with not bad uv-coverage. After the initial calibration (the amplitude was calibrated with calibrator 3C 286), the total intensity images were derived by using the Caltech software DIFMAP.

3 RESULTS AND DISCUSSION

Table 1 lists, for each source, some of the parameters. The flux densities were estimated by using AIPS task IMSTAT. The total intensity MERLIN images at 1.6 GHz are displayed in Figures 1–5.

Table 1 Source Parameters

Source (1)	GPS (2)	ID (3)	z (4)	S (Jy) (5)
1345+125	Y	G	0.122	4.88
1404+286	Y	G	0.077	1.14
1518+046	Y	Q	1.29	3.55
1604+315	Y	G	1.5	0.83
1751+278	Y	G	0.86	0.61

Note: Col.(1): Source name. Col.(2): GPS identification, Y-yes.
Col.(3): Optical identification, G-galaxy, Q-quasar. Col.(4): Redshift. Col.(5): Flux density.

1345+125: The VLBI maps of this source at 6 cm have been made by Shaw et al. (1992) and Stanghellini et al. (1997). The radio structure of this source is clearly resolved into core and jets. However, in our Figure 1, this source is not resolved, except a possible slightly-extended emission in the north-south direction, which is consistent with the VLBI structure.

1404+286: The radio source was observed with global VLBI arrays at 1.67 GHz, 5 GHz and 8.4 GHz (Zhang et al. 1994; Stanghellini et al. 1997; Liu et al. 2000). Their results indicate that the radio structures on milliarcsecond scales are resolved into an asymmetric compact double components. Figure 2 shows that this source to be a point source.

1518+046: This source has been observed at 1.6 GHz and 5 GHz before with VLBI (Phillips & Mutel 1981; Mutel et al. 1985). The previous works reveal 1518+046 to consist of two main components separated in the NE-SW direction by about 120 mas. Our observation can not distinguish them due to the relative low resolution along this direction. No diffuse structure has been detected.

1604+315: No mas morphology information of this source has been obtained before. Our observation displays for the first time that it is a compact source; no low brightness, extended structure is found with our resolution.

1751+278: This source is in the same situation as 1604+315, no previous VLBI or MERLIN image was available. We present the MERLIN image at 1.6 GHz. It is also unresolved by the resolution of MERLIN.

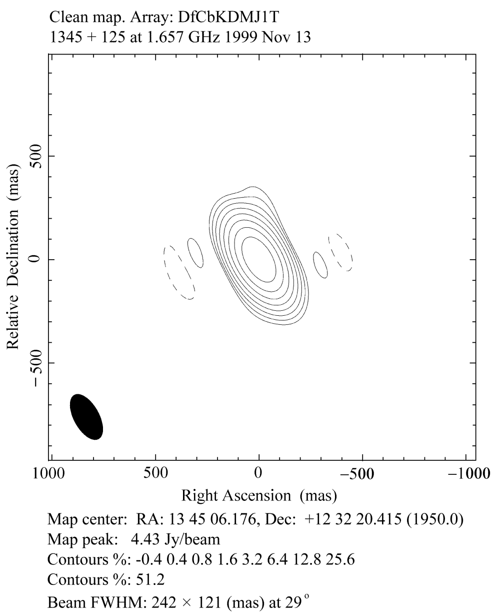

Fig. 1 The total intensity MERLIN image of 1345+125 at 1.6 GHz

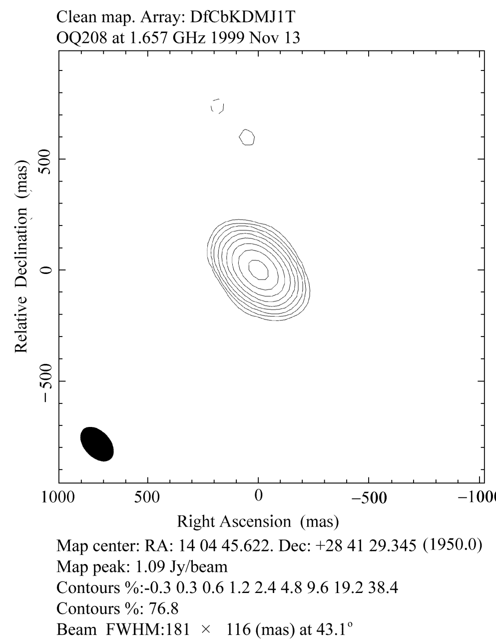

Fig. 2 The total intensity MERLIN image of 1404+286 at 1.6 GHz

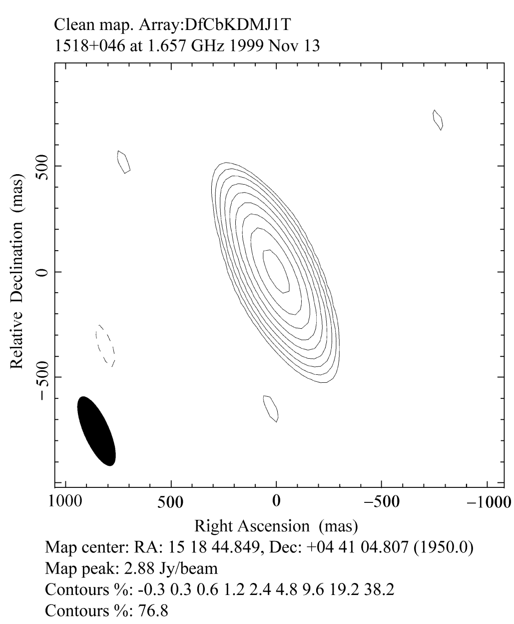

Fig. 3 The total intensity MERLIN image of 1518+046 at 1.6 GHz

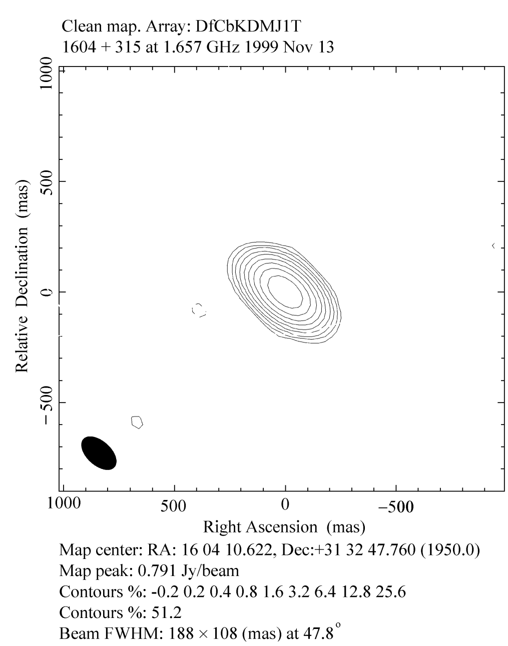

Fig. 4 The total intensity MERLIN image of 1604+315 at 1.6 GHz

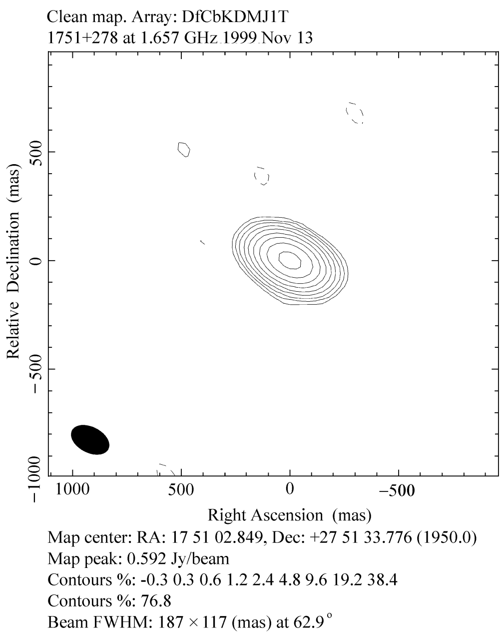

Fig. 5 The total intensity MERLIN image of 1751+278 at 1.6 GHz

We have also attempted model fitting with the DIFMAP for the five sources, and found that they could not be convincingly fitted with two or more components. From Figure 1, the source 1345+125 is possibly slightly resolved in the north-south direction, but we cannot confirm this in this paper. In summary, our observation provides the first MERLIN images for two sources, 1604+315 and 1751+278, where they are still point sources. No extended structure were detected in any of the five sources; this may suggest that they are good CSO candidates. Sensitive, multi-frequency and multi-epoch observations are needed to identify CSOs with a core and two-side jets on scales smaller than 1 kpc. At the same time as the MERLIN observation, we made EVN observation at 1.6 GHz for these sources; this will give for the first time the VLBI structures in 1604+315 and 1751+278, and images of the other three sources for use in multi-frequency and multi-epoch studies.

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