Research Note

The Structure and Identification of 3C 105

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Summary. We confirm the identification of 3C 105 with an 18.5 mJy galaxy proposed as the identification by Smith et al. (1976). The radio structure of the source is very asymmetrical, with ~ 50% of the 6 cm flux density contained in a compact (< ~ 3” angular size) feature located at the outer edge of the eastern radio lobe. This compact feature is ~ 2.6% polarized at 6 cm; the derived magnetic field direction is approximately perpendicular to the axis joining the compact feature to the nuclear component.

Key words: radio source structure – optical identifications

Introduction

3C 105 is a low declination (+ 3°) radio source whose correct optical identification has remained doubtful (Schilizzi, 1975; Smith et al., 1976) mainly because of its abnormal radio structure. Here we present 6 cm observations (summarized in Table 1) made with the Westerbork Synthesis Radio Telescope (WSRT) which confirm that the galaxy discussed by Smith et al. (1976) is the correct identification.

Observations

Because 3C 105 is at a very low declination, the synthesized beam of the WSRT is 7” (α) × 112” (δ) – i.e. we obtained essentially a fan-beam map giving information about the east-west structure of the source. Further, due to the low declination of the source it was not possible to produce a full 12 h synthesis, but only to track the source for 3 h on either side of the meridian. Thus the map displayed in Fig. 1 has been cleaned and restored with an artificial Gaussian beam free of sidelobes (see Högbom, 1974).

Due to fluctuations in the gains and phases of the interferometer channels on the two separate days comprising the observations there was incomplete cancellation of grating rings. The north-south emission at RA ~ 04° 04′ 36.7 is a residual grating ring artefact and the features located at RA ~ 04° 04′ 44.2 are also almost certainly instrumental features.

Results and Discussion

The WSRT 6 cm map (Fig. 1) shows that in addition to the two extended lobes known from previous observations (Fomalont, 1971; Schilizzi and McAdam, 1975) a compact unresolved source (angular size < 3” east-west) is detected at RA = 04° 04′ 38.95 ± 0.04, DEC + 03° 34′ 27.3 ± 3′ 0 (1950.0). This source, which has a 6 cm flux density of 25.6 ± 1.0 mJy, is closely coincident (ΔRA = − 0′ 4, ΔDEC = 0′ 0, radio – optical position) with the optical galaxy discussed by Smith et al. (1976) to whom we refer the reader for a finding chart. We measured the position of the optical galaxy to an accuracy of ~ 1” on the Palomar Sky Survey prints at the Leiden Observatory – note that a typographical error appeared in this galaxy’s right ascension optical position published by Schilizzi (1975).

On our high resolution map the east and west lobes have east-west angular sizes of 18” and 20” respectively. Their separation is ~ 347” in position angle 137°. The angular sizes are considerably smaller than those found by Fomalont (1971) who determined sizes of 95” and 120” for the east and west lobes respectively. Thus we are probably missing large scale low surface brightness (< ~ 10 mJy per synthesized beam) emission. A comparison of our map with that of Fomalont would probably indicate that these low brightness features lie between the higher brightness peaks that we have detected and the nuclear source.

The optical galaxy associated with the central nuclear source lies close (~ 30” south, in position angle 190°) to the midpoint between the two extended lobes, (the preceding western lobe separation is ~ 176” in position angle 325°; the eastern following lobe separation is ~ 176” in position angle 129°). However the eastern lobe has a much greater integrated flux density than that of the western lobe (4.1 vs. 1.1 Jy respectively at 21 cm (Fomalont, 1971); we have not determined integrated 6 cm flux densities since, as mentioned above, the observations are probably insensitive to large scale diffuse structure). An analysis of a sample of southern double radio sources with large flux density ratios between the components indicated that, for these asymmetric sources, the optical identification almost always lay closer to the centroid of radio emission than the midpoint (Schilizzi, 1975). Thus 3C 105 is a rather unusual asymmetric double source.

At 6 cm the integrated flux density of the entire source is 2.16 Jy (Kellermann et al., 1969). The “hot spot” situated at the outer edge of the eastern lobe is unresolved at our longest spacing (23,991 λ) which implies that its east-west angular size is less than ~ 3”. This is presumably the 2.3 component detected by Bash (1968) at 2695 MHz. The flux density at 6 cm of this unresolved feature is ~ 1.1 Jy so that ~ 50% of the entire flux density of 3C 105 at 6 cm originates in this very compact, high surface brightness feature.

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1 mJy = 10^-29 W Hz^-1 m^-2
Fig. 1. A Westerbork 6 cm map of the radio galaxy 3C 105. The map is compressed in declination so that the synthesized beam appears circular. The ‘L’ shape in the lower right corner of the map shows 1’ in RA and declination. A cross marks the location of an 18.5 m, galaxy (see Smith et al., 1976). The contour values are −10 (dashed) 10, 20, 30, 40, 50, 75, 100, 200, 300, 400, 600, 800, 1000, 1200 mJy per synthesized beam area.

Table 1. Observing log for 3C 105

<table>
<thead>
<tr>
<th>Field centre</th>
<th>RA = 04h04m39.0 s</th>
<th>Dec = 03°34’30’’ (1950.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>4995 MHz</td>
<td></td>
</tr>
<tr>
<td>Shortest spacing,</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>increment,</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>longest spacing</td>
<td>1440 m</td>
<td></td>
</tr>
<tr>
<td>Hour angle coverage</td>
<td>−3 to +3 h</td>
<td></td>
</tr>
<tr>
<td>Dates of observation</td>
<td>January 31, 1977</td>
<td>April 4, 1977</td>
</tr>
<tr>
<td>Synthesized beam half power width</td>
<td>7’’ (RA) x 112’’ (DEC)</td>
<td></td>
</tr>
</tbody>
</table>

The “hot spot” is polarized ~2.6% in position angle 116°. Thus, if we make the assumption that this position angle is not very different from the intrinsic position angle at λ = 0, the magnetic field direction in the “hot spot” is approximately perpendicular to the axis linking the “hot spot” to the nuclear component (position angle ~129°). Similar orientations of the magnetic field are found in other “hot spots” (e.g. Strom et al., 1978). No significant polarized flux was detected in any other parts of 3C 105 at 6 cm.

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References