RADIO CONTINUUM OBSERVATIONS OF THE NUCLEI OF NEARBY GALAXIES

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A survey has been carried out at Jodrell Bank of the continuum radio emission from nearby galaxies. The objects include normal galaxies, Seyfert galaxies and others with nuclei active at optical and radio wavelengths.

In particular, a systematic study has been made of 100 Sbc (T=4) galaxies taken from the Second Reference Catalogue of Bright Galaxies. Each has also been measured in the HI λ21 cm line, so that good estimates of systemic velocity, hydrogen mass and total mass are available for correlation with continuum and optical data. 30 of the Sbc galaxies show emission with flux densities >50 mJy at λ18 cm on the MK IA-MK II interferometer (baseline 2500λ). These were subsequently observed at λ18 cm on short tracks with the Multi-Telescope Radio-Linked Interferometer (MTRLI) and a number were found to have flux densities >20 mJy; the resolution covered by the various baselines of the MTRLI was 0.25 to 2 arcsec. Several of these objects are intense enough to be mapped with the MTRLI at λ75 cm with a resolution of 1 arcsec.

Another group of galaxies mapped with the MTRLI at λ18 cm and λ75 cm are those with active nuclei. These have been selected from the surveys of Hummel (1980) and others. Objects already observed with the MTRLI at λ18 cm and/or λ75 cm include NGC 1068, 1275, 3690 and Mkn 3.

In this short report we will discuss our observations of NGC4151 in some detail. NGC4151 is a type 1.5 Seyfert galaxy at heliocentric velocity of 990 km s^{-1} (i.e. a distance of 10 Mpc) where 1 arcsec is 50 pc. The integrated flux density of NGC4151 seen with the MTRLI at λ18 cm is 280 mJy and accounts for most of the known flux density in the nucleus. It consists of central double source and extended features either side extending 2 arcsec from the nucleus. The central double source has a separation of 0.45 $\pm$ 0.02 arcsec at a position angle (pa) of $83^{\circ}.5 \pm 1^{\circ}.0$; it is coincident, within the combined measurement errors, with the optical nucleus. It is likely that the brighter and

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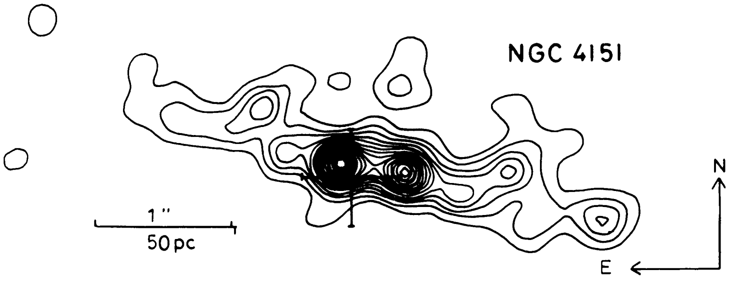

Fig.1 1665 MHz MTRLI map of the nucleus of NGC4151; the angular resolution is 0.25 arcsec

more compact (<0.15 arcsec) eastern component is associated with the optical nucleus which has a diameter <0.08 arcsec (Schwartzschild 1973). Low brightness elongated structure extends either side of the nucleus along pa = $77^o \pm 2^o$, a value significantly different from that of the central double source.

We consider that the extended structure in the nuclear regions of NGC4151 is indicative of a jet-like phenomenon. Its linear scale is 200 pc, an order of magnitude smaller than the jet in Virgo A or in radio galaxies and quasars. Further evidence for the similarity with the processes in quasars is the observation (Schmidt & Miller 1980) of optical polarization at pa = 88^o which is close to that of the radio continuum. Furthermore, there is ample evidence from optical spectral line studies that expansion motions of up to 550 km s^{-1} exist within the forbidden-line region (5 x 2 arcsec) and possibly extends out to ∿20 arcsec from the nucleus.

It is of interest to describe the radio and optical activity in the nucleus of NGC4151 in terms of a single model. Despite the observed rotation in the inner part of the galaxy, the inner and outer forbidden-line regions are at the same pa, thus implying a stationary source. Furthermore, the relativistic electrons producing the radio continuum and the expansion motions in the forbidden-line region both have lifetimes of 2 x 10^5 to 10^6 yrs. The radio jets are conceived of as arising from relativistic particle beams fixed in space. Forbidden-line clouds which rotate with the general interstellar medium in the centre of NGC4151 are envisaged as entering the jet region and then being accelerated outwards as described by Blandford & Königl (1979). An outwards motion for the clouds of 550 km s^{-1} can be achieved in 10^5 years with realistic cloud parameters. More details of the observations and the model are given in Booler, Pedlar & Davies (1981).

Blandford, R.D., and Königl, A.: 1979, Astrophys.Lett. 20, 15.
Hummel, E.: 1980, Astron.Astrophys.Suppl.Ser. 41, 151.
Schmidt, G.D., and Miller, J.S.: 1980, Astrophys.J. 240, 357.