LETTERS TO NATURE

PHYSICAL SCIENCES

Radio Spectrum of Maffei 2

THE conclusion that Maffei 1 and 2 are previously unrecognized nearby galaxies[1] has aroused considerable interest; a positive detection of high frequency radio emission from Maffei 2 has been reported[2,3] as also has a null result in the direction of Maffei 1 (ref. 4). Here we report observations at a much lower frequency; they are results obtained during a radio survey[5] using the Cambridge 178 MHz pencil-beam synthesis instrument, with beam size $18'.5 \times 23'.4$.

A source with flux density 4.2 ± 1.0 f.u. (1 f.u. $= 10^{-26}$ W m^{-2} Hz^{-1}) was detected at right ascension 02 h 38 m 10 s, declension $+59°\ 20'.5$ (1950), which is 3′ south of the centre of Maffei 2. This difference is larger than our usual standard error in declination (1′.2) because the measurement is affected by the proximity of 3C 69; the source is definitely the same as that detected at higher frequencies and identified with Maffei 2. The recent measurement[3] at 1,415 MHz gave a flux density of 1.08 ± 0.10 f.u. for Maffei 2 which, combined with our value of 4.2 f.u. at 178 MHz, yields a spectral index, α, of 0.65 ± 0.1 (where α is defined by flux density $\propto$ (frequency)$^{-\alpha}$). Bell *et al.*[2] derived a spectral index of 1.30 ± 0.05 between 10,700 and 3,200 MHz but such a steep spectrum certainly does not continue to low frequencies as a flux density of 20 f.u. at 178 MHz would then be expected. Thus, the spectrum seems to steepen at high frequency, and De Jong[6] finds evidence of a similar change of slope in the spectra of some other normal galaxies at more than 1,400 MHz. But the available angular size data suggest that the steepness of the high frequency spectrum of Maffei 2 may have been overestimated. The 1,415 MHz measurements[3] indicate a source width (in right ascension) of $3'.4 \pm 0'.5$, whereas Bell *et al.*[2] detected no broadening and consequently their flux densities are peak values, not corrected for the finite size of the source. Any flux density correction factors, allowing for finite source size, would be larger at higher frequencies and produce a spectrum flatter than before correction. For example, if the intrinsic source size between 3,200 and 10,700 MHz were 2′ (the upper limit derived by Bell *et al.*[2]), the spectral index in this frequency range would be 1.05; if the source size were 3′.4 (using the 1,415 MHz measurement in preference to the higher frequency 2′ upper limit), the spectral index would be 0.75 and would show scarcely any change over the entire range 178–10,700 MHz.

The search[4] at 1,415 MHz for a source associated with Maffei 1 revealed a previously uncatalogued radio source $\approx 15'$ north of Maffei 1, with flux density 0.427 ± 0.001 f.u. This source is also present on the 178 MHz records in which it has a flux density of 2.5 ± 1 f.u. It therefore seems to be non-thermal, with spectral index ≈ 0.9, but its separation from the centre of Maffei 1 suggests it is an unrelated background source.

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Are the Maffei Galaxies Members of the Local Group?

I SUGGEST in this report that the highly obscured galaxy IC342 might be associated with Maffei 1 and Maffei 2 (refs. 1 and 2). IC342 is the fourth largest (after M31, M33 and M101) spiral galaxy known. It is separated from Maffei 1 by less than 12° which, at a distance of 2 M parsec (Mpc), would correspond to a projected separation of only 0.4 Mpc. Available data on Maffei 1 and on IC342 are compared in Table 1.

Table 1 Data on Maffei 1 and IC342

Object	l^{II}	b^{II}	V^* (km s^{-1})	Distance (Mpc)
Maffei 1	135.8°	−0.6°	+188†	$0.5 \leq D \leq 2$
IC342	138.2°	+10.6°	+195‡	$D \approx 2$

* Radial velocity relative to the Local Group (see de Vaucouleurs and de Vaucouleurs[8]). † From Spinrad *et al.*[2]. ‡ From Ford *et al.*[7].

IC342 has been suggested[3,4] to be a possible Local Group member. Recent investigations indicate that IC342 is probably too distant to be considered a *bona fide* member of the Local Group. From 21 cm observations Dieter[5] obtained a distance

$$D\ (\text{Mpc}) = 18\ \mathcal{M}\ (\text{HI})/\mathcal{M}\ (\text{total}) \qquad (1)$$

Substituting the value ($\mathcal{M}$ (HI)/$\mathcal{M}$ (total)) = 0.10, that Roberts[6] obtained for galaxies of type Sc, into equation (1) yields a distance of 1.8 Mpc. This value is probably uncertain by about a factor of two. Summarizing available optical data, de Vaucouleurs (quoted by Dieter[5]) concluded that IC342 is