LETTERS TO THE EDITOR

ASTRONOMY

A Supernova Remnant in the Large Magellanic Cloud

THE proximity of the Large Magellanic Cloud offers an unparalleled opportunity for the detailed comparison of an external galaxy at optical and radio wave-lengths. Recently the 210-ft. steerable reflector at the Australian National Radio Astronomy Observatory has been used to survey the Large Cloud at a number of wave-lengths between 11 cm and 220 cm. The results of this work have been presented at the recent International Astronomical Union/International Scientific Radio Union Symposium No. 20 (ref. 1).

Fig. 1. *Hα* photograph of *N49* taken with the Uppsala Schmidt telescope

The high resolving power and sensitivity of the 210-ft. reflector at short wave-lengths enabled the radio emissivities of about 40 emission nebulæ in the main body of the Large Cloud to be determined. Observations of these *H*II regions were carried out at 21 cm and 11 cm where the aerial beam-widths at half-intensity points are 14′ of arc and 7·5′ of arc respectively and the receiving systems allow temperature differences of 0·1° K to be measured. For each *H*II region, the expected flux density at 11 cm was calculated from the *Hβ* flux densities of Dickel, Aller and Faulkner[2] and the *Hα* flux densities of Doherty, Henize and Aller[3] and compared with the observed flux density. In most cases reasonable agreement was obtained between the radio and optical observations which was consistent with a thermal origin of the radio emission.

However, in the case of one small emission nebula listed as *N*49 in the catalogue of Henize[4], the flux density at 11 cm ($1{\cdot}3 \times 10^{-26}$ W m^{-2}(c/s)$^{-1}$) is some 15 times greater than that calculated from the *Hα* intensity. This suggests that a considerable proportion of the radio emission could be of non-thermal origin. Our measured position at 11 cm of (1950·0) R.A. $05^{h}\ 26^{m}{\cdot}0$, Dec. $-66°\ 08'$, is within 0·5′ of arc (our experimental accuracy) of the optical position. Combining our intensity measurements of *N49* at 11·21 and 75 cm and that of the Mills, Slee and Hill[5] source (05–64) at 85·5 Mc/s, the spectrum has an index of -1 which clearly indicates a non-thermal origin of the radiation. Mills, Slee and Hill give an estimate of the east–west diameter of 0·5′ of arc which is in fair agreement with the overall optical size of 1′ of arc.

Fig. 1 shows the region of *N49*. The photograph is from a 7-min exposure in *Hα* light with the 20/26-in. Schmidt telescope of the Uppsala Southern Station. It may be noted that no exciting star can be seen in the nebula either in Fig. 1 or on longer exposures. On a 1-h exposure in ultra-violet light with the Uppsala Schmidt telescope the central part of *N49* is filled by weak emission but no stellar object appears. The nebula shows a looped filamentary structure characteristic of remnants of galactic supernovæ. Henize[4] also reported strong OI emission from *N49* which is another characteristic feature of these objects[6].

It therefore appears reasonable to assume on the basis of these radio and optical observations that *N49* is a supernova remnant in the Large Magellanic Cloud and is the first such remnant to be discovered in an external galaxy. The outer diameter of the looped structure of *N49* is 16 parsecs and the inner diameter is 6 parsecs, using 55 kiloparsecs as the distance to the Large Cloud. If we assume an expansion rate of 5,000 km/sec for the supernova shell with no deceleration due to collision with interstellar matter then the minimum age is 1,500 years. The intrinsic radio luminosity of *N49* is only 5 times less than Cassiopeia *A*, the most intense of the known galactic supernovæ. It is of interest to note that the spectral indices of the radio emission from Cassiopeia *A* and *N49* are very similar and much 'steeper' than that of other galactic supernovæ.

If Shklovsky's[7] formula for the variation of flux density with radius of supernova remnants is applied, it is found that *N49* would be intrinsically 1,000 times more intense than Cassiopeia *A* at comparable ages. Such supernovæ in the first few years of their existence would be readily observable with existing radio telescopes in galaxies many megaparsecs distant.

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