Galactic and Stellar

Radio Continuum around NGC 7538–IRS 1

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Abstract: We report continuum observations of the NGC 7538–IRS 1, 2 and 3 regions made with the NRO 45-metre dish between 43 and 90 GHz, and present a brief interpretation.

A substantial increase in flux density has been found in continuum observations between 43 and 90 GHz in the NGC 7538–IRS 1, 2 and 3 regions with the NRO 45-metre telescope. Figure 1 shows the 43 GHz intensity map of the NGC 7538 region. Peak brightness temperatures (T_{BP}) are 0.64 K and 0.40 K for the diffuse and the unresolved areas, respectively. Positions of IRS 4–8, and IRS 1–3 from previous workers are given in each area. The unresolved compact area includes IRS 1, 2 and 3. Figure 2 shows the same at 90 GHz, giving peak brightness temperatures of 0.13 K and 0.21 K for the diffuse and the unresolved areas respectively. The T_{BP} decrease between the two frequencies is fairly small for the compact unresolved area compared with that at the diffuse area. This means that there may exist an optically thick free-free emission source or concentrations of dust particles in the compact area. The diffuse main area is optically thin at both frequencies.

Figure 3 shows Nobeyama millimetre-wave interferometer results within the compact area in the NGC 7538 region. The solid contour is the 110 GHz brightness with the 4″ × 8″ beam, and the dashed contour is the 49 GHz brightness with the 8″ × 16″ beam. We see that the 90 GHz excess emission is mostly concentrated in the IRS 1 region, and the 49 GHz peak intensity is nearly at the IRS 2 region.

Figure 4 shows the postulated thermal spectra of each region, IRS 1, 2 and 3 combined with the results of previous workers (cf. Martin 1973). In the figure open triangles are the present 45-metre dish results, and both include radio emission from the sum of the IRS 1, 2 and 3 components within the unresolved compact area (cf. Figures 1 and 2). From these we conclude that the free-free spectrum of the ultra-compact region for IRS 1 in NGC 7538 by Campbell (1984) may have a turnover frequency at around 15 GHz, and may not have a millimetre-wave spectrum increasing as $\nu^{0.6}$, ν, as Scoville *et al.* (1986) postulated for their 2.7-mm interferometric flux density for the mass loss stellar wind model.

A large part of the continuum emission from IRS 1 at around 100 GHz will be free from Campbell's ultra compact H II region. Therefore a new source of 100 GHz emission either from another compact H II region of ultra high density or from a cloud of dust grains around Campbell's H II region is proposed. The points labelled μ and ν in Figure 4 (dotted circles) give a possible spectrum of the new source emission, suggesting a thermal spectrum for a cloud of dust particles around NGC 7538–IRS 1, the source of which will be studied with a higher resolution millimetre-wave interferometer.

A full report on this work appears in the Nobeyama Radio Observatory Report No. 234 in 1990.

Campbell, B., 1984, *Astrophys. J. Lett.*, **282**, L27.
Martin, A. H. M., 1973, *Mon. Not. R. Astr. Soc.*, **163**, 141.
Scoville, N. Z. *et al.*, 1986, *Astrophys. J.*, **303**, 416.

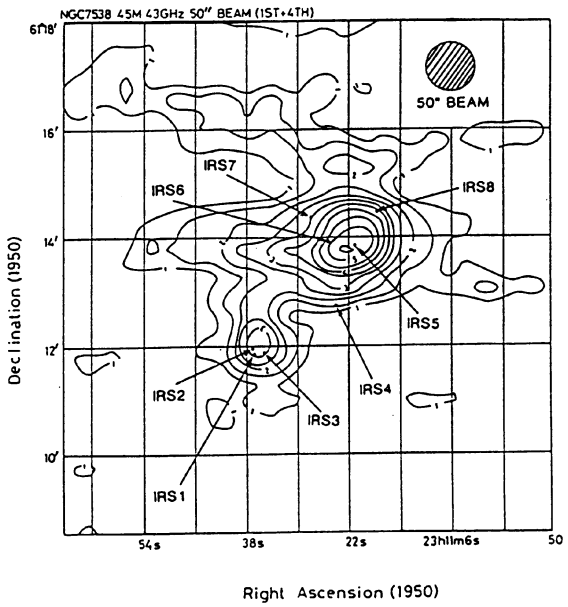

Figure 1 – 43 GHz intensity map of the NGC 7538 region

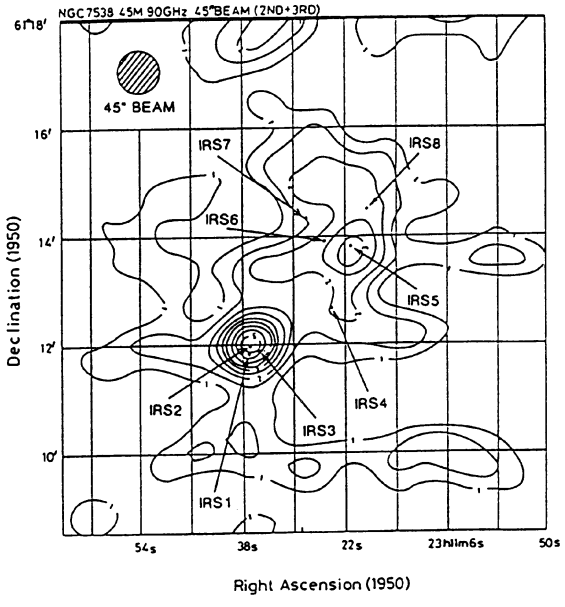

Figure 2 – As for Figure 1 at 90 GHz

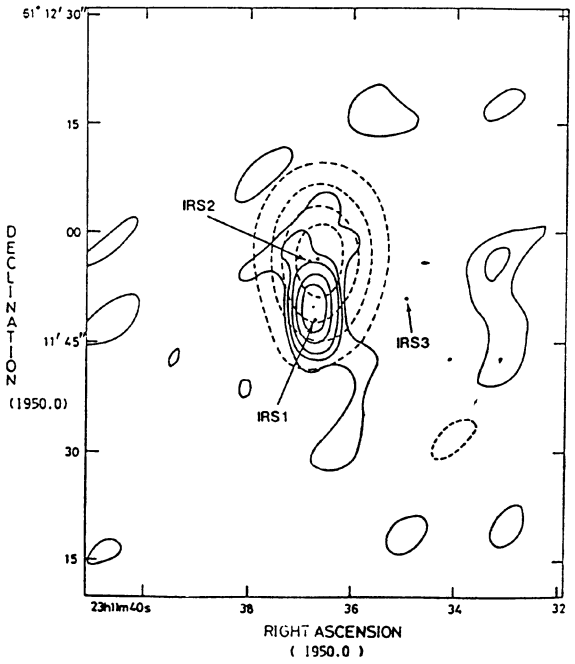

Figure 3 – Nobeyama millimetre-wave interferometer results for the compact region in NGC 7538

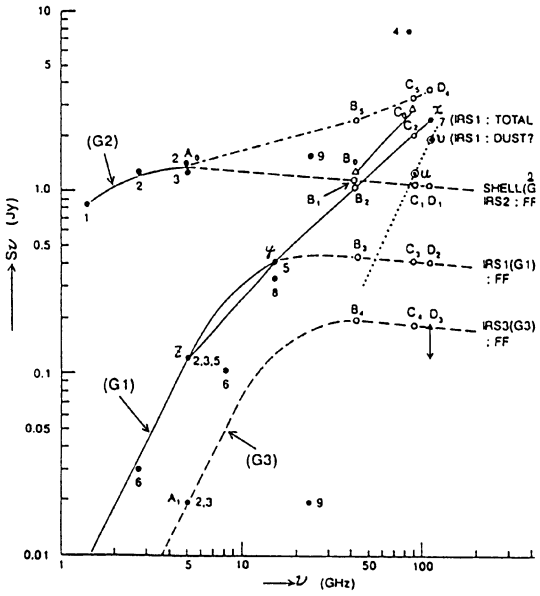

Figure 4 – Postulated thermal spectra for the different NGC 7538 IRS regions