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Multifrequency GMRT Observations of HII Regions

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Abstract. The electron temperatures of the compact cores of the galactic HII regions S206 and S209 have been determined by radio continuum observations near 235, 327 and 610 MHz using the Giant Meterwave Radio Telescope (GMRT). The resolution of our maps are 11" and 6" at 327 and 610 MHz respectively. These are the highest resolution low frequency maps of these HII regions.

1. Introduction

The optical depth for free-free emission from HII regions varies as $\tau \sim \nu^{-2.1}$. At sufficiently low frequencies therefore these regions become optically thick and the observed brightness temperature T_B is equal to the electron temperature T_e.

Accurate measurement of T_e however requires high resolution images, particularly so for HII regions with low emission measure (EM) where often only a very compact core is optically thick even at frequencies as low as a few hundred MHz. We present here preliminary analysis of GMRT low frequency (232, 327 and 610 MHz) maps of the HII regions S206 and S209.

2. Observations & Discussion

At 610 MHz correction for the differing sky background at the flux calibrator and the source was made by actually measuring the system temperature at these two locations. The 327 MHz maps were scaled to give the same flux for point sources as the WENSS survey, and at 232 MHz the flux scale was set to that of the Miyun survey. Both HII regions show structures on scales of a few arcseconds including shells, rings and cometary type structures, enveloped by a diffuse emission. Here we restrict ourselves to a discussion of the electron temperature in the bright 'core' regions. A more detailed ananlysis will be presented in Omar et al. 2000.

For a homogeneous, spherically symmetric HII region (which we approximate the *core region* to) we have the flux S given by (Hjellming et al. 1969, Mezger et al. 1967)

$$S = 3.07 \times 10^{-2} T_e \nu^2 \Omega (1 - e^{-\tau(\nu)}); \;\; \tau(\nu) = 1.643 \times 10^5 \nu^{-2.1} EM \; T_e^{-1.35} \quad (1)$$

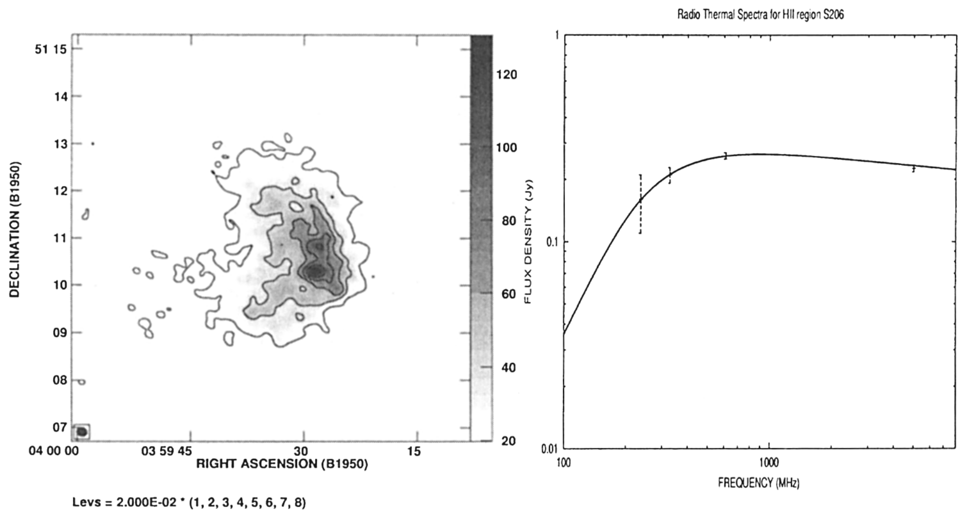

Figure 1. [A]610 MHz GMRT image of S206. [B]Measured flux for S206 plotted on an isothermal nebula model.

We can model the HII region by solving these equations iteratively for different EM and T_e using observations at a minimum of two frequencies (eg. Terzian et al. 1968). For the core region in S206, the temperaturé we determine from our 235, 327 and 610 MHz fluxes is 10500 ± 1000^o K and the emission measure is 2.5×10^5 cm^{-6} pc. The predicted flux at 4.9 GHz using these numbers is in good agreement with the WSRT measurement by Deharveng et al.(1976). This temperature is also in reasonable agreement with the value of 8400 ± 800^oK obtained using the H94α recombination line by Carral et al.(1981). The temperature we obtain for core region of S209 is 7200 ± 700^oK again in reasonable agreement with the value of 8280 ± 800^oK obtained using the H137β recombination line by Churchwell et al. (1978).

References

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