

HELIUM ABUNDANCES IN FOUR GALACTIC HII REGIONS FROM RADIO RECOMBINATION LINE OBSERVATIONS

By W. K. HUCHTMEIER* and R. A. BATCHELOR*

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Abstract

Helium abundances in four galactic HII regions have been derived from radio recombination line observations.

In this note we report measurements of the hydrogen and helium 109α radio recombination lines made with the 64 m Parkes radio telescope equipped with a cryogenically-cooled parametric amplifier followed by a 64-channel filter backend (Batchelor *et al.* 1969) with 100 kHz filters. Observations were made by taking the difference between a 15 min integration on source and a 15 min integration off source, with the telescope in the same hour-angle range in order to reduce instrumental baseline effects. The final profiles were further corrected for residual linear baseline slopes.

Observed parameters of the final profiles are given in Table 1. The abundances of singly-ionized helium listed in the final column were derived using the usual assumptions that (1) the helium and hydrogen have the same distribution throughout the nebula and (2) the line enhancement factors and the deviations from populations at local thermodynamic equilibrium are the same for both gases. These (number) abundances are typical of those found for the majority of galactic HII regions, namely $N(\text{He}^+)/N(\text{H}^+) \sim 0.1$ (see e.g. Mezger *et al.* 1970).

For the sources G291.3–0.7 and G291.6–0.5 the He^+ abundances derived by Mezger *et al.* (1970) are given for comparison. The two sets of values agree within the indicated r.m.s. errors. Electron temperature, electron density, mass of ionized hydrogen, excitation measure, and internal turbulent velocity calculated on the basis of a spherical model HII region do not differ significantly from the values derived by Wilson *et al.* (1970).

References

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* Division of Radiophysics, CSIRO, P.O. Box 76, Epping, N.S.W. 2121.

TABLE 1
MEASURED PARAMETERS FOR FOUR HII REGIONS
 S = flux density, T_b = full beam brightness temperature, line integral $\varepsilon = \int T_b dv$

Galactic source number	Position (1950) R.A. h m s	Dec. ° ' "	Size* (min arc) θ_α θ_δ	Total S (f.u.)†	Integ. time (min)	Peak T_b (K) Continuum $\left\{ \begin{array}{l} \text{H line} \\ \text{He line} \end{array} \right.$	Line width corrected (kHz)	Radial velocity‡ (km s ⁻¹)	Line integral ε (K kHz)	Ionized helium abundance§ $\varepsilon(\text{He}^+)/\varepsilon(\text{H}^+)$
282.0-1.2	10 04 53	-56 57.5	1.3 2.1	25.9	70	21.9 $\left\{ \begin{array}{l} 0.843 \pm 0.049 \\ 0.113 \end{array} \right.$	500 $\pm$ 20 346 $\pm$ 100	+19.2 $\pm$ 1.2 +25.2 $\pm$ 6.0	452 $\pm$ 43 43 $\pm$ 14	0.095 $\pm$ 0.019
291.3-0.7	11 09 45	-61 02.6	0.9 0.9	97.4	40	98.1 $\left\{ \begin{array}{l} 3.607 \pm 0.081 \\ 0.40 \end{array} \right.$	530 $\pm$ 20 630 $\pm$ 100	-25.0 $\pm$ 1.2 -25.7 $\pm$ 6.0	2079 $\pm$ 144 268 $\pm$ 30	0.129 $\pm$ 0.023 (0.088 $\pm$ 0.032)
291.6-0.5	11 12 53	-60 59.4	3.8 6.5	172.1	50	62.5 $\left\{ \begin{array}{l} 2.02 \pm 0.031 \\ 0.199 \end{array} \right.$	824 $\pm$ 20 827 $\pm$ 100	+10.3 $\pm$ 1.2 +11.3 $\pm$ 6.0	1784 $\pm$ 176 177 $\pm$ 30	0.099 $\pm$ 0.021 (0.13 $\pm$ 0.024)
10.2-0.3	18 06 23	-20 20.2	2.3 1.8	49.4	45	34.1 $\left\{ \begin{array}{l} 2.323 \pm 0.031 \\ 0.135 \end{array} \right.$	594 $\pm$ 20 630 $\pm$ 100	+14.0 $\pm$ 1.2 +16.2 $\pm$ 6.0	1488 $\pm$ 140 91 $\pm$ 20	0.061 $\pm$ 0.016

* Corrected for instrumental broadening.

† 1 flux unit (f.u.) = $10^{-26} \text{ W m}^{-2} \text{ Hz}^{-1}$.

‡ Relative to the local standard of rest.

§ Values in parentheses derived by Mezger *et al.* (1970).