THE SCUTUM RING OF H II REGIONS*

TOSHIHIRO HANDA

Department of Astronomy, University of Tokyo, Tokyo, Japan

and

YOSHIAKI SOFUE

*Nobeyama Radio Observatory (NRO**),*
Tokyo Astronomical Observatory, University of Tokyo, Nobeyama, Minamimaki, Nagano, Japan

(Received 2 July, 1985)

Abstract. A ring of compact radio continuum sources was found at $l = 24\overset{\circ}{.}6$ $b = 0\overset{\circ}{.}0$, which we call the Scutum ring. Radio continuum, H I line, and CO line observations are suggested that it is a star-forming region triggered by an expanding diffuse H II region.

1. Introduction

A ring of compact radio continuum sources centered at $l = 24\overset{\circ}{.}6$, $b = 0\overset{\circ}{.}0$, about $30'$ in diameter was found in the Nobeyama Radio Observatory (NRO) 10 GHz survey of the galactic plane region (Sofue *et al.*, 1984). A comparison with the observations at other frequencies indicates these compact sources (a few arc min in size) have flat spectra, indicating a thermal gas origin. Hereafter we call this ring as the Scutum ring.

2. The Distributions of Ionized Gas

The observation was carried out at 10, 5, and 2.7 GHz. The observation at 10 GHz was a part of the galactic plane survey, which has carried out at NRO with the 45 m telescope. The observations at 5 and 2.7 GHz were carried out with the 100 m telescope at the Max-Planck-Institut für Radioastronomie. Other details about the radio continuum observations were written by Handa *et al.* (1985). Figure 1 shows the radio continuum surface brightness distribution of the Scutum ring at 10 GHz.

The features are enveloped by a diffuse radio emission. The spectral-index distribution of this envelope derived from the 10, 5, and 2.7 GHz maps is about -0.1, which suggests its thermal origin. The physical quantities of the diffuse component are shown in Table I.

* Paper presented at the IAU Third Asian-Pacific Regional Meeting, held in Kyoto, Japan, between 30 September–6 October, 1984.

** NRO, a branch of the Tokyo Astronomical Observatory, University of Tokyo, is a cosmic radio observing facility open for outside users.

Astrophysics and Space Science **119** (1986) 127–130.

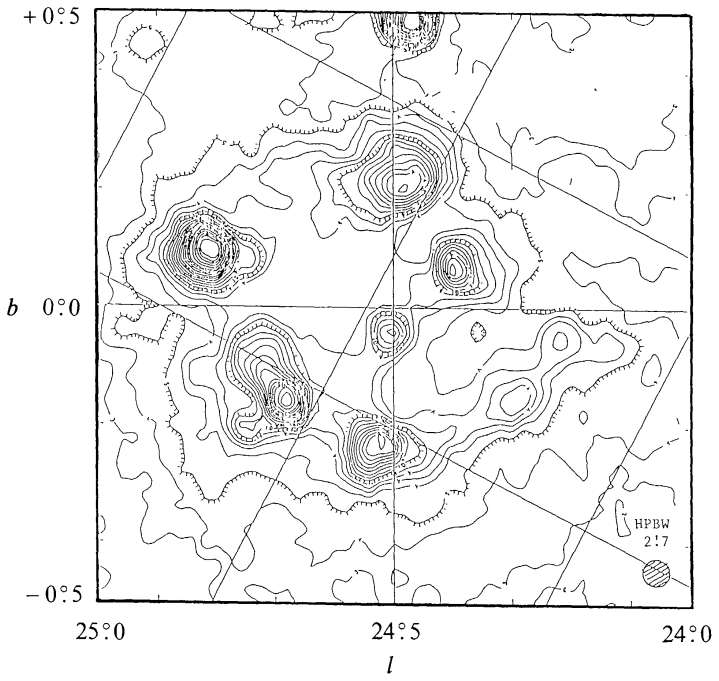

Fig. 1. The distribution of surface brightness of the Scutum ring. The unit of the numbers on the contours is 1.43×10^{-21} W m^{-2} Hz^{-1} ster^{-1}.

TABLE I

Derived quantities for the extended component of the Scutum ring

Frequency (GHz)	10.05	4.75
Total flux density (Jy)	64 ± 8	63 ± 12
Spectral index for total flux density	0.0 ± 0.4	
Brightness temperature at the center (K)	0.14 ± 0.01	0.65 ± 0.06
Emission measure at the center (pc cm^{-2})	6.4×10^3	6.2×10^3
Electron ensity (cm^{-3})	8.0	7.9
Outer radius of the shell (pc)	71	
Inner radius of the shell (pc)	22	
H II mass ($M_\odot$)	2.9×10^5	2.9×10^5
Excitation parameter (pc cm^{-2})	198	195
Rate of Ly photons (photons s^{-1})	4.3×10^{50}	4.1×10^{50}

A distance of 9.1 kpc was assumed. We used an optically thin plasma model with a uniform temperature of 5000 K and uniform density.

The H110α recombination line survey with the Bonn discrete 100 m telescope (Downes *et al.*, 1980) indicates that most of the sources are compact H II regions, and are located at a 'tangential point' 9.1 kpc distance from the Sun. The velocity dispersion of the compact H II regions in the association is 7.3 km s^{-1}, which results in $10^6 M_\odot$ for the virial mass of the Scutum ring.

3. The Distribution of H I Gas and CO Clouds Around the Scutum Ring

An H I gas arc associated with the Scutum ring was found by the Maryland–Greenbank H I line survey (Westerhout and Wendlandt, 1982). Figure 2 shows the H I line brightness temperature distribution of the Scutum ring at 107.5 ± 1.0 km s^{-1}.

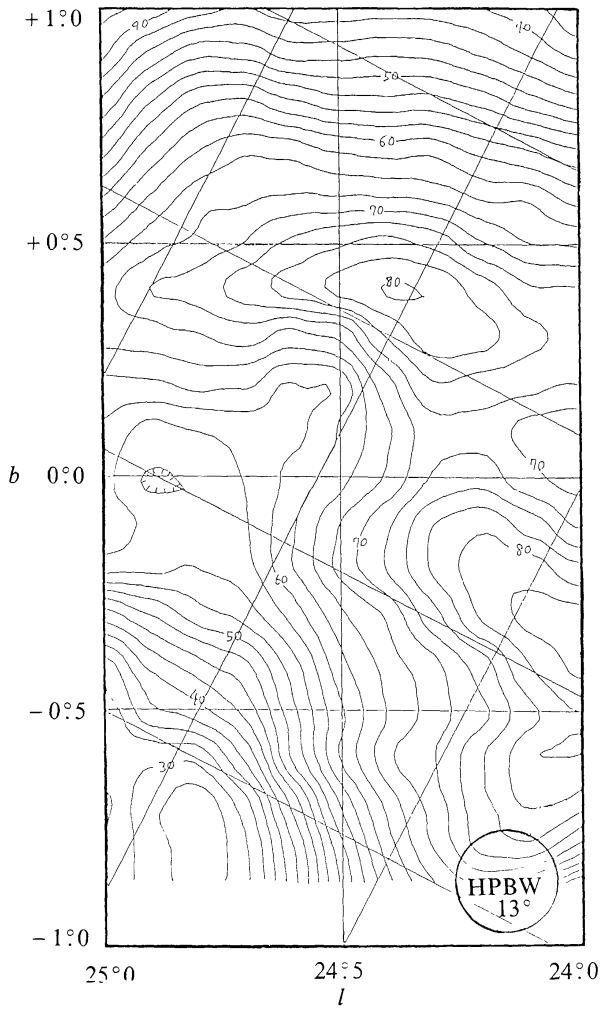

Fig. 2. The distribution of H I line brightness temperature made from the Maryland–Greenbank survey. The velocity range is 107.5 ± 1.0 km s^{-1} (V_{LSR}). The unit of the numbers on the contours is 2.0 K km s^{-1}.

Some CO clouds associated with the ring were found in the Columbia CO line survey (Dame, 1984). In addition, and arc of CO emission associated with the Scutum ring was found by an observation with the Nagoya 4 m telescope (Handa *et al.*, 1985). The shapes of these arcs suggest that there is a shocked region around the Scutum ring.

4. Conclusions

We conclude that the Scutum ring is a star-forming region triggered by an expanding diffuse H II region, which has been suggested as a model for sequential star-formation (Elmegreen and Lada, 1977). The Scutum ring may be in a later phase of a Rosette nebula-type structure.

References

Dame, T. M.: 1984, NASA Technical Paper, No. 2288.
Downes, D., Wilson, T. L., Bieging, J., Wink, J.: 1980, *Astron. Astrophys. Suppl.* **40**, 379.
Elmegreen, B. G. and Lada, C. J.: 1977, *Astrophys. J.* **214**, 725.
Handa, T., Sofue, Y., Reich, W., Fürst, E., Suwa, I., and Fukui, Y.: 1985, *Publ. Astron. Soc. Japan* (submitted).
Sofue, Y., Hirabayashi, H., Akabane, K., Inoue, M., Handa, T., and Nakai, N.: 1984, *Publ. Astron. Soc. Japan* **36**, 287.
Westerhout, G. and Wendlandt, H.-U.: 1982, *Astron. Astrophys. Suppl.* **49**, 143.