

A Multifrequency Radio Spectral Study of SNR HB21

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Abstract. Radio observational results at 232 MHz and multifrequency studies of supernova remnant(SNR) HB21 are presented in this paper. Both the integrated spectral index and the spatial variations of spectral index of the remnant were calculated by combining the new map at 232 MHz with previously published maps made at 408, 1420, 2695, and 4750 MHz.

1. Observation

HB21(G89.0+4.7) is an evolved supernova remnant having an angular size of about $1.5^\circ(NS) \times 2.0^\circ(EW)$. New observations with high resolution at 232 MHz were carried out in June, 1992 with the Miyun Synthesis Radio Telescope(MSRT), Beijing Astronomical Observatory which has 192 baselines from 18 m to 1164 m with the interval of 6 m. The missing baselines of 0, 6, 12 m cause a weak large negative background which affects the measurement of total intensity and large scale structure of HB21. A method has been developed (Zhang 1995) to reduce the effects of missing short spacings by using interferometer data only, following Braun and Walterbos (1985). The data were calibrated using Cygnus A and 3C418 and 3C418 was estimated to have a flux density of 13.2 ± 0.6 Jy in the BGPW scale.

2. Results and Discussions

The total intensity map of HB21 at 232 MHz shown in Fig. 1(a) has an integrated flux density of 450Jy at 232MHz. The structure agrees very well with that obtained from other frequencies. By combining our integrated flux with that at 4750 MHz(110 ± 5 Jy) from the maps of Reich(1983), the integrated spectral index is -0.47 between 232-4750 MHz.

Spectral spatial variations of HB21 between 232, 408, 2695 and 4750 MHz have been calculated using T-T plots with all maps convolved to a resolution

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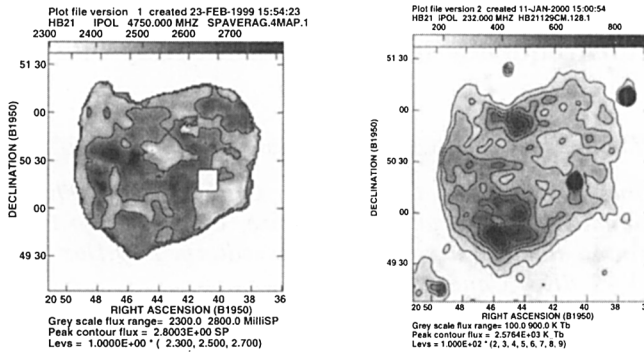


Figure 1. The left (a) is the temperature map of HB21 at 232 MHz and the right (b) is the frequency-average spectral index map of HB21.

of $5.2' \times 4.7'$ and the average spectral index map is shown in Fig. 1(b). The spectral map shows that: (1) the spectral index on scales larger than $10'$ is 0.55 at southeast, falling to 0.35 at northwest; (2) in the central area of the remnant, the median of spectral index is about 0.3, whereas the average spectral index is about 0.47.

Tatematsu et al. (1990) have detected HI and CO along the east and south boundary and HB21 is interacting with this gas. The structure of the central flat spectrum region agrees well with the structure of X-ray seen by ROSAT but not with the optical filaments, which could be caused by post-shock reheating of the interstellar medium.

The Galactic background emission is probably another reason for the large scale spectral variations from the southeast to the northwest of HB21, as the direction along which the spectral index decreases, is nearly in the direction of the increasing Galactic latitude. Milne (1987) showed that HB21 has a magnetic field sweeping across the remnant from north-east to south-west.

The phenomenon of spectra flattening near the edges obtained from our new result is similar to that from SNR HB9 (Leahy, et al. 1999). Both HB9 and HB21 are old and evolved supernova remnants. The electron density integrated along the line-of-sight is highest inside the rim. So absorption by the thermal electrons will be strong there. This causes spectral flattening at low frequency.

References

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