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TEMPERATURE, BRIGHTNESS AND SPECTRAL INDEX OF THE CYGNUS RADIO LOOP

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RESUMEN

Se presenta el brillo estimado del remanente de supernova del Velo del Cisne en 2720, 1420, 820, 408 y 34.5 MHz. Mediante el método que hemos desarrollado anteriormente para anillos grandes, utilizamos las observaciones de radioemisión en el continuo para calcular las temperaturas de brillo medias y los brillos superficiales del Velo del Cisne en las frecuencias mencionadas. Estimamos el espectro de las temperaturas medias versus frecuencia entre las cinco frecuencias y obtenemos el índice espectral del Velo del Cisne. Nuestros resultados muestran que el Velo evoluciona en un medio de baja densidad, y que la energía inicial de la explosión de supernova fue relativamente baja. Confirmamos el origen no-térmico de la radiación del anillo del Cisne y mostramos que nuestro método es aplicable a la mayoría de los remanentes de supernova.

ABSTRACT

The estimated brightness of the Cygnus loop supernova remnant (SNR) at 2720, 1420, 820, 408 and 34.5 MHz is presented. The observations of the continuum radio emission are used to calculate the mean brightness temperatures and surface brightnesses of this loop at the five frequencies in a wide spectral range, using the method we have previously developed for large radio loops. The spectrum for mean temperatures versus frequency between the five frequencies is estimated and the spectral index of the Cygnus loop is obtained. Also, from our results it can be concluded that the Cygnus loop evolves in a low density environment and that the initial energy of the supernova explosion was relatively low. The results obtained confirm the non-thermal origin of the Cygnus radio loop and show that our method is applicable to almost all remnants.

Key Words: ISM: supernova remnants — radiation mechanisms: non-thermal — radio continuum: general — surveys

1. INTRODUCTION

In our investigation, we are supposing the radio loops to be evolved supernova remnants (SNRs). Supernova remnants represent shells of approximately spherical shape which are spreading, and depending of the interstellar matter density, they change their shape. We can see only parts of these spherical contours which represent radio spurs, i.e., areas of more intense emission in the sky, spur-like and of huge dimensions. Radio loops consist of several spurs lying approximately on the same small circle of the celestial sphere. Their material probably expands inside of bubbles of low density. Bubbles are made by former SNR explosions or by strong stellar winds (Salter 1983; McKee & Ostriker 1977, and references therein). The radio emission from SNRs is generally understood to be synchrotron emission from relativistic electrons moving in the magnetic field.

A star in the constellation of Cygnus exploded and its remnant is the Cygnus loop. It is classified as a mid-aged SNR of type S, is located below (but near the plane of) the Galactic equator, and is less than 1 kpc away from us. It is listed in Green's catalogue of SNRs as G74.0-8.5 (Green 2004, 2006, 2009). As shown in Green (1984), this remnant has decelerated considerably by its interaction with the surrounding interstellar medium.

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