CTB80: COSMIC COLLISION?

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ABSTRACT. High resolution maps of the Galactic radio source CTB80 at three different frequencies are presented. A new interpretation in terms of a cosmic collision between two SNR's of different age is suggested.

CTB80 is one of the most mystifying Galactic Objects yet discovered and has recently attracted considerable attention from X-ray, optical and radio astronomers (see for example: Becker et al. (1981), Angerhofer et al. (1980, 1981), Velusamy et al. (1976), van den Bergh (1980).

The present observations of the radio continuum emission of the extended feature at 408 MHz, 1720 MHz and 4750 MHz and the linearly polarized emission at 1720 MHz and 4750 MHz (Figs 1,2,3) throw new light on the morphological, spectral and polarization properties of the whole source.

SPECTRAL INDEX

At present it is not possible to define the exact form of the continuum spectrum of CTB80. In Fig. 4 are reported the available data from the literature. On the basis of our data the most probable value for the spectral index seems to be $\alpha \simeq 0.45$ between 1 GHz and 5 GHz and $\alpha \simeq 0.0$ at frequencies below 1 GHz. ($S \propto \nu^{-\alpha}$). The overall spectral index distribution between 408 MHz and 1720 MHz appears consistent with the total integrated flux density in the range of frequencies, being predominantly flat. The distribution of spectral index between 1720 MHz and 4750 MHz is also consistent with the total flux densities measured at these two frequencies. The distribution shows that: 1) there is a slope of 0.35 in the central component; 2) there is a steepening of the spectrum away from the central concentration along the eastern ridge (up to $\alpha = 0.7$) and the northern arc (up to $\alpha = 0.5$); 3) the spectrum flattens towards the south-western extremity.

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POLARIZATION

From the figures we can see that considerable linear polarization is found at both frequencies with different distribution and polarization percentage.

At 1720 MHz the source shows linear polarization in the northern and eastern parts. The south western section of the southern arc does not appear to possess significant polarization at this frequency. Also a minimum in the polarization appears to exist on the central source.

In the northern-arc the polarization percentage rises to around 10% in two regions, while on the eastern end of the southern arc, percentage of about 15% are present.

The results at 4750 MHz are quite different. On the south-western arc the linear polarized radiation follows the total intensity distribution, and the peak of polarized radiation corresponds to the peak of the source in the central plateau. Everywhere in this region the polarization percentage is greater than 20%, increasing to about 40% in the southern part of the central plateau. On the northern arc also the polarization intensity closely follows the total intensity contours.

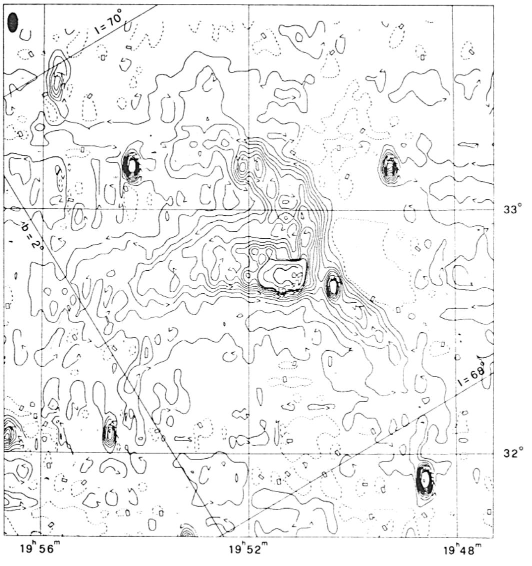

Figure 1. CTB80 at 408 MHz.

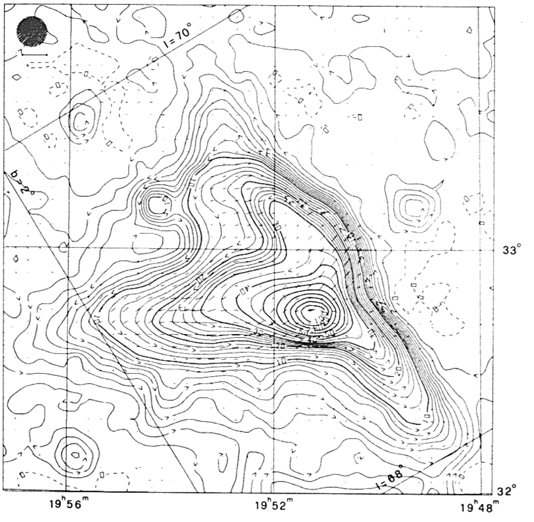

Figure 2. CTB80 at 1720 MHz.

CONCLUDING REMARKS

In view of the non-thermal origin of the radio emission, we may interpret the morphology of CTB80 as produced by a cosmic collision between two SNRs of different age. Their different age is suggested

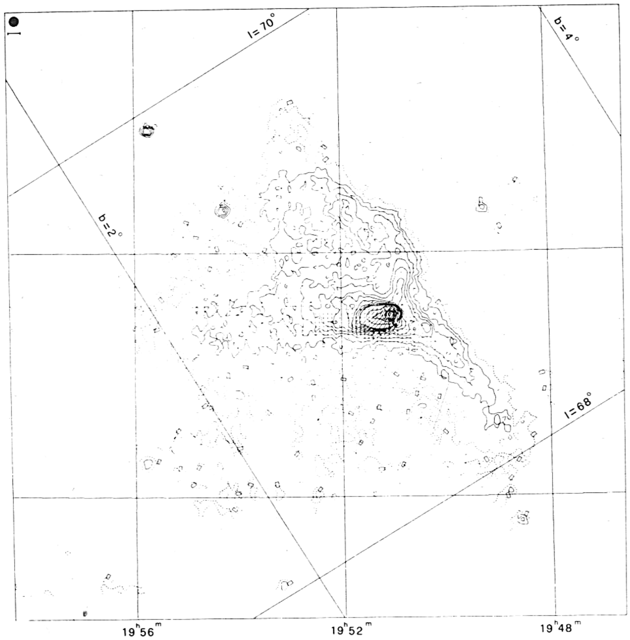

Figure 3. CTB80 at 4750 MHz.

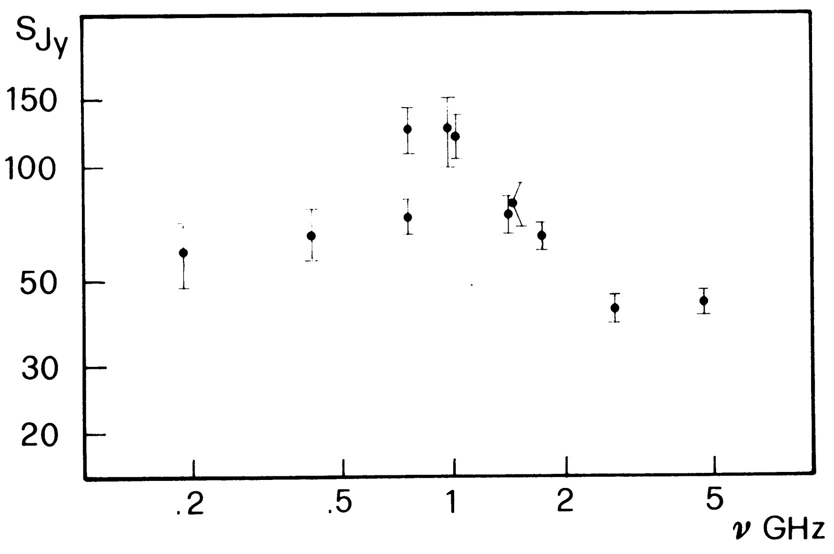

Figure 4. The continuum spectrum of CTB80.

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by the different angular diameters of two expanding shells as clearly visible in our maps. The northern arc might represent the youngest SNR that is shocking the oldest one (southern arc). Only part of the expanding shells are visible, but this is not unusual among SNRs. They are expanding with respect to the two centres roughly at 50 pc of distance from each other (according with the estimated distance of 3 ± 1 kpc, Angerhofer et al.), perpendicularly to the line of sight.

We note on the outer western part, of the object, a steep gradient in the radio brightness distribution, otherwise in the inner part of the object the radio brightness increases slowly. This is not true for the southern part of the central region where the brightness increases very quickly and that might represent the colliding region.

From a general point of view the feature of CTB80 is not dissimilar from the density distribution obtained by Jones et al. (1979) in a collisional simulation between two SNRs of different age expanding through an uniformly dense medium after an explosion with a typical energy emission of 10^{51} erg located in two points separated from each other by 40 pc. The most interesting feature of these calculations is the increase of matter density of a factor 10 in a region, that might correspond, in this framework, with the central part of CTB80. In a three dimensional case, that enhanced density will be distributed in a "Mach Ring" that we are seeing, because of our line of sight, tangentially. As most of the emission from the relativistic particles is displaced in the western part of the object, this means the western part of the "Mach Ring" will be enhanced with respect to the western part. The collision between two shock fronts might produce a reacceleration of the relativistic particles changing the spectral shape of the continuum emission along the source.

REFERENCES

Angerhofer, P.E., Strom, R.G., Velusamy, T., Kundu, M.R.: 1981, Astron. Astrophys. 94, 313.
Angerhofer, P.E., Wilson, A.S., Mould, J.R.: 1980, Astrophys. J. 236,143.
Becker, R.H., Helfand, D.J., Szymkowiak, A.E.: 1981, Columbia Astrophys. Lab. Contr. No. 206.
van den Berg, S.: 1980, Public. of the Astron. Soc. of the Pac. 92, 768.
Jones, E.M., Smith, B.W., Straka, W.C., Kodis, J.W., Guitar, H.: 1979, Astrophys, J. 232, 129.