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STRUCTURE OF THE CONTINUUM BACKGROUND AT HIGH GALACTIC LATITUDES AT 38 MHz

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The purpose of this article is to give the results of an investigation into the origin of the continuum radio emission in directions away from the galactic plane, which has been conducted by the author on the material obtained during her research work at Jodrell Bank.

The observations were done in the first half of 1967. The instrument used was the Mark I radio telescope, working at the frequency of 38 MHz, with the aerial receiving left-handed circularly polarized radiation. The half-power beamwidth was about 8°. The survey itself has been presented at the XIV General Assembly of the the IAU. A more detailed account about the survey and its implications for the spectral indices will be published in the recent future.

The study of the survey has shown that features known as the North Polar Spur (Loop I) and the Cetus Arc (Loop II) show very clearly on the 38 MHz map. Loop III is also seen, as far as surveyed. There are some other arc-like structures which appeared on this relatively large beam survey, paticularly near:

$$l = 150^\circ \quad b = -10^\circ$$
$$l = 190^\circ \quad b = -12^\circ$$
$$l = 205^\circ \quad b = -10^\circ$$
$$l = 200^\circ \quad b = +10^\circ$$
$$l = 220^\circ \quad b = +50^\circ$$
$$l = 25^\circ \quad b = -20^\circ$$
$$l = 75^\circ \quad b = -12^\circ$$

They all have one feature in common: their brightest parts lie near to the Milky Way, and the brightness decreases with increasing latitude.

It has been known for some years that the North Polar Spur (Large et al. 1962, Haslam et al. 1964 and Large et al. 1966), the Cetus Arc (Large et al. 1962 and Quigley and Haslam 1965) and Loop III (Quigley and Haslam 1965) conform closely to small circles for much of their lenghts. Nevertheless, not all of them

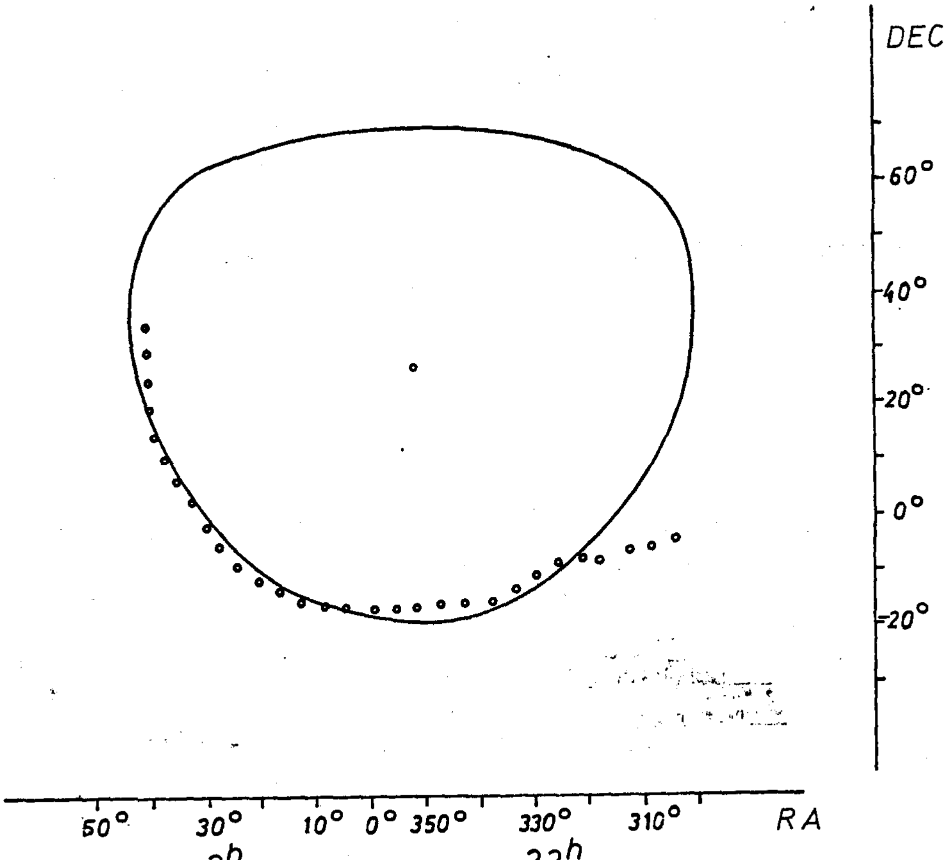

Fig. 1

can be clearly seen at various frequencies all along their paths. This is especially true for weaker features. Therefore, it is still desirable to observe loops an dadd new data to those already known.

The fact that the Cetus Arc was so distinct over the lenght of almost 135° on the 38 MHz map provided the stimulus to do a new computation of the best fit small circle, using the least square procedure. The computing program was originally written by Dr C. G. Salter in Atlas Autocode, and rewritten by the autor, who was kindly given the program, into Fortran IV. The method used computes the circle's centre and radius which minimize the sum of the squares of the differences between the distance from the circle's centre to the Arc points, and the circle's radius. The track of the spur was determined by finding the midline of the spur-like feature. The points were sampled every 4° approximately, all along the path.

The computation has shown that the Cetus Arc, as obtained at 38 MHz, follows the circle having the parameters:

Centre at $l = 101° \pm 5°$, $b = -32.9° \pm 5°$

Diameter, $90° \pm 5°$

Fig. 1 shows the Cetus Arc and the best fit circle plotted on a rectangular grid in equatorial coordinates.

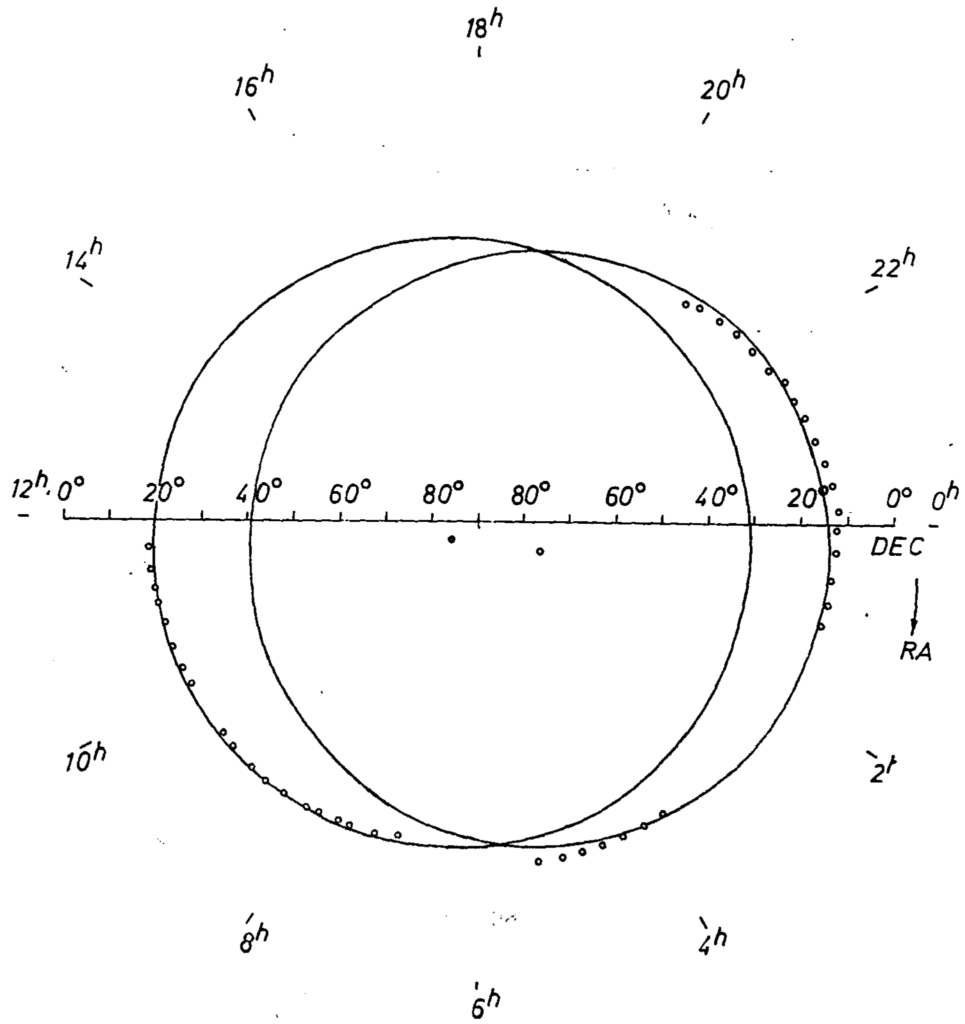

Fig. 2

The results obtained agree very well with those of Quigley and Haslam (1965) and Salter (1970), within a position accuracy of the survey.

The arc-like feature starting at about $l = 150°$, $b = -7°$ can be traced, through the constellations Perseus and Andromeda, up to $l = 135°$, $b = -15°$. It can be found on the high resolution 38 MHz survey (Williams, Kenderline and Baldwin 1966), as well. As noted by Salter (1970), the corresponding feature seen at the 408 MHz survey lies along the predicted path along which Loop III would appear at southern latitudes. This result is what is expected by the supernova remnant hypothesis. The 38 MHz observations of the region around $l = 140°$ support this point of view. No feature corresponding to the link between the Cetus

Arc and Loop III is apparent on the 38 MHz survey. Therefore it seems more probable that Loop III represents a supernova remnant than part of a single feature, as proposed by Rougoor (1966).

The negative latitude spur arising at l = 190°, b = —12° from the galactic plane is another large scale feature without an obvious bridge connecting it to the similar feature on the other side of the galactic plane. The nearest spur is a weak extended emission arc starting at about l = 200°, b = 10°. Nevertheless, it is interesting to note the proximity of their joints to the Milky Way.

The position and the shape of the spur at l = 190° and the spur at l = 75° suggest that they could be related one to the other. They lie close to the circle which has the centre at l = 127° ± 5°, b = 12.5° ± 5°, and the radius 63°±5

The weak spur at l=200°, b=10° and the spur-like feature in Leo, betwee l=220°, b = 50° and l=250°, b=75°, lie almost parallel to the celestial equat They could be both parts of a circle which has the centre at l = 130° ± 4. b = 32° ± 4.5°, and the radius 65° ± 4.5°.

Fig. 2 represents the best fit circles and the spur-like features in Cancer and Leo and the spurs in Pegasus and Taurus, which are described above.

The spur at about l = 25°, b = —20° lies on the edge of the region observed. This small spur in Sagittarius rises from the galactic plane very near to the place where the North Polar Spur joins it. No bridge connecting the North Polar Spur either to the Sagittarius spur or to the Cetus Arc could be detected on the 38 MHz survey. On the 30 MHz southern sky map of a similar resolution (Mathewson et al. 1965) no obvious continuation of the small Sagittarius spur could be found. Therefore no best fit circle was calculated.

The North Polar Spur as observed at 38 MHz confirms to the circles computed by Quigley and Haslam (1965) and Salter (1970).

The feature near l = 205°, b = —10° most probably is not a spur but the Orion complex of radio sources.

Some of the spurs discussed above were not noticed on the similar resolution 404 MHz survey (Pauliny-Toth and Shakeshaft 1962) because it was considerably undersampled. Many of them can be detected on the 408 MHz map (Haslam et al. 1970) convolved down to the resolution of the 404 MHz survey.

Fig. 3 shows the galactic spurs and the spur-like features plotted in new galactic coordinates on an Aitoff projection as based on the 38 MHz data and data of Salter (1970) and other observers. The dotted line surrounds the area unaccessible to majority of observers in the northern hemisphere.

As it can be seen, the curious feature about spurs is that they are related to the galactic plane in such a way that at least one spur from the northern and one from the southern hemisphere join the galactic plane in the same region. At the same time no bridge across the galactic plane was seen in any of these cases.

In one case (Loop III), the 38 MHz observations confirm that the spur has a continuation on the other side of the plane along a small circle.

All this is very difficult to explain by a single feature model. On the other side, the supernova remnant hypothesis does not seem to give a right explanation about the neighbourhood of joints. The problem of origin of the spurs has still to be more investigated.

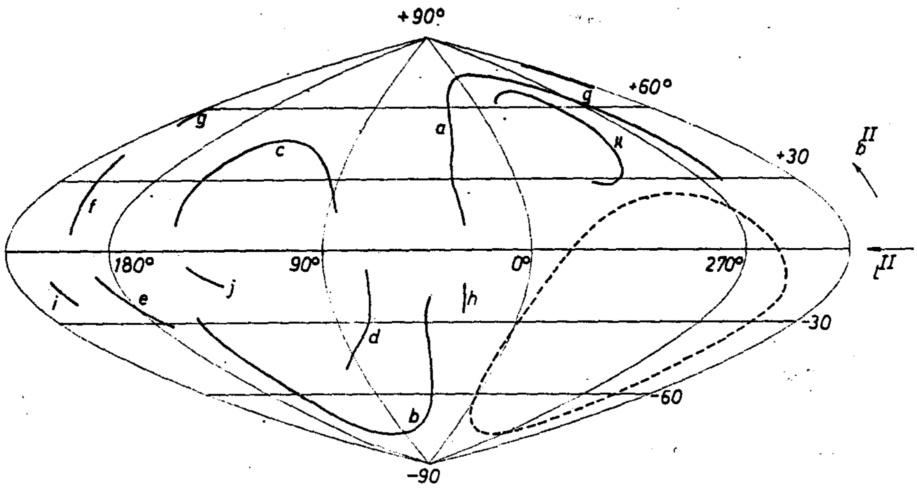

Fig. 3.-The galactic spurs: a:-theNorth polar spur; b:-the Cetus arc; c:- the Loop III; d:- the spur south of the Cygnus region; e:- the spur in Taurus; f:- the spur in Cancer; g:-the arc in Leo; h:- the spur in Sagitarius; i:-possible spur in Orion; j.-the spur in Perseus; κ:-Loop IV.

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