LOOP I (THE NORTH POLAR SPUR) REGION - A QUASI RADIO HALO

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The distribution of total spectral indices between 38 and 408 MHz with a resolution of 7°.7 for $\delta > -25°$ has the following main properties:

1. Relatively small variations of spectral indices over the sky.
2. High indices in the central region at high galactic latitudes.
3. Moderately low spectral indices in the anticentre region.
4. Lower indices in the low-brightness regions (cold holes).
5. The lowest indices in regions containing large amounts of HII.

These properties may be explained by distribution of the moderate-spectral-index emission from the galactic disk, high-spectral-index extragalactic emission, moderate-spectral-index emission from the galactic spurs, high-spectral-index emission from regions on the outer side of the galactic spurs, and absorption in HII regions. The disk and the spurs could be related, at least partly. The absence of a high-spectral-index radio halo is indicated by the low-spectral-index cold hole inside Loop I, centered at $\ell \sim 0°$, $b \sim 0°$. This hole in the Ser-Vir region, where the halo is expected to be bright, has almost as low an index as other cold holes (e.g. the hole centered at $\ell \sim 195°$, $b \sim 45°$).

The spectral-index distribution is similar to the distribution of the quantity T'_g. T'_g was defined generalizing the idea published by Webster (1978). T'_g is constructed formally in the same way as Webster's T'_h, eliminating the radiation of a chosen spectral index β_c and the extragalactic radiation. T'_g is proportional to the brightness of the residual radiation dominant in the region concerned.

The computation of T'_g based on temperatures at 38 and 408 MHz shows that after eliminating the emission of any spectral index between 2.4 and 2.5, the T'_g distribution looks similar to the spectral-index distribution. If there were a radio halo, T'_g in the Ser-Lib region would be greater than T'_g at higher galactic longitudes. The values of T'_g calculated from the observations are much lower than those expected for the spheroidal radio halo in the Ser-Lib region (e.g. Figure 1). The similarity in shape between the contours of the spheroidal halo and the North Polar Spur (NPS) produces a good fit of the observed and theoretical distribution in the

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region lying more than 10^{o} outside the main ridge of the NPS. This similarity arises from the coincidence that the centre of Loop I lies in the Sco-Cen association, near the direction to the galactic centre which is expected to be the centre of the halo.

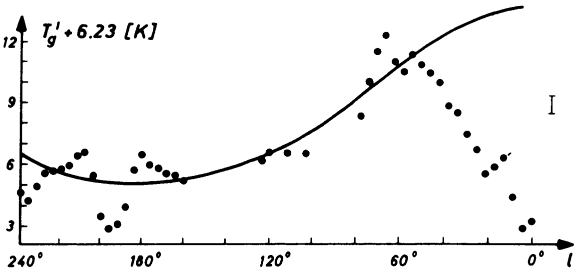

Figure 1. The T_g' distribution for b=38°. The dots are values of T_g'+6.23 computed from data at 38 and 408 MHz for β_c=2.5. The curve corresponds to the best-fit spheriod (19, 18.75 kpc) matched to the dots for ℓ>40°.

The high-spectral-index region outside of the NPS comes from a weak component having steep spectrum and related to the NPS. The existence of such a component explains naturally the splitting of T-T diagrams of the NPS. Furthermore, similar components should exist in other spurs as well. It was found that all spurs exhibit a splitting of their T-T diagrams which follows a "curvature rule": the points on the convex side of the spur lie on the upper part of a standard T-T diagram. The model, consisting of the four emission components described in connection with the total spectral indices, can interpret all observed characteristics of T-T diagrams. This "4v" (four vectors) model demands only an adequate distribution of the galactic components. The high-spectral-index feature south of the galactic plane in the region of Loop I is likely to be related to this loop also.

The spectrum of the NPS based on data in the range between 10 and 820 MHz is found to be flatter at lower frequencies and steeper at higher frequencies than the spectrum of the general galactic background. The flux-density spectrum of the NPS was derived to be:

$$\log S = a + 0.13 \log f \,[\mathrm{MHz}] - 0.145 \log^2 f \,[\mathrm{MHz}].$$

The difference in indices between the low and high-frequency ends is 0.5. There is no maximum in the spectrum in this frequency range.

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REFERENCE

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