GALACTIC BACKGROUND RADIATION AT 2 cm AND THERMAL ELECTRONS IN THE GALAXY

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Abstract. The galactic background radiation at 4.2 and 15.5 GHz was observed with a resolution of 11′ at nine points on the galactic equator free of confusion from discrete sources. Relative amounts of thermal and nonthermal radiation were determined, and conditions in the interstellar gas are discussed.

Galactic background radiation was observed at 4.2 and 15.5 GHz with a resolution of 11′ for 9 points on the galactic equator free of confusion from discrete sources. The brightness temperature obtained for the 'ridge' of the background radiation was typically 0.07 K at 15.5 GHz; the observations were made by on-off methods.

The results of these observations were compared with those at lower frequencies and the spectrum of the galactic background radiation between 1.4 and 15.5 GHz was determined. Though the spectrum in the Cygnus-X region was found to be mainly thermal, points in inter-arm and arm regions had positive curvature in the spectra showing a mixture of thermal and nonthermal emission. The turnover occurred near 3 GHz, and the spectral index for the nonthermal emission was found to be about -3.0 for these points.

The amount of thermal emission separated from nonthermal emission was compared with the strength of the recombination lines measured by Gordon and Gottesman (1971) and Jackson and Kerr (1971) to determine the kinetic temperature and emission measures of thermal electrons in the diffuse interstellar gas. They were about 3000 K and 4000 pc cm^{-6}, respectively. A value of about 0.5 cm^{-3} was derived for the rms electron density in the Galaxy, from the emission measure with an assumed pathlength.

A preliminary report has already appeared in *Nature* (Hirabayashi *et al.*, 1972), and full details will appear in *Publ. Astron. Soc. Japan.*

References

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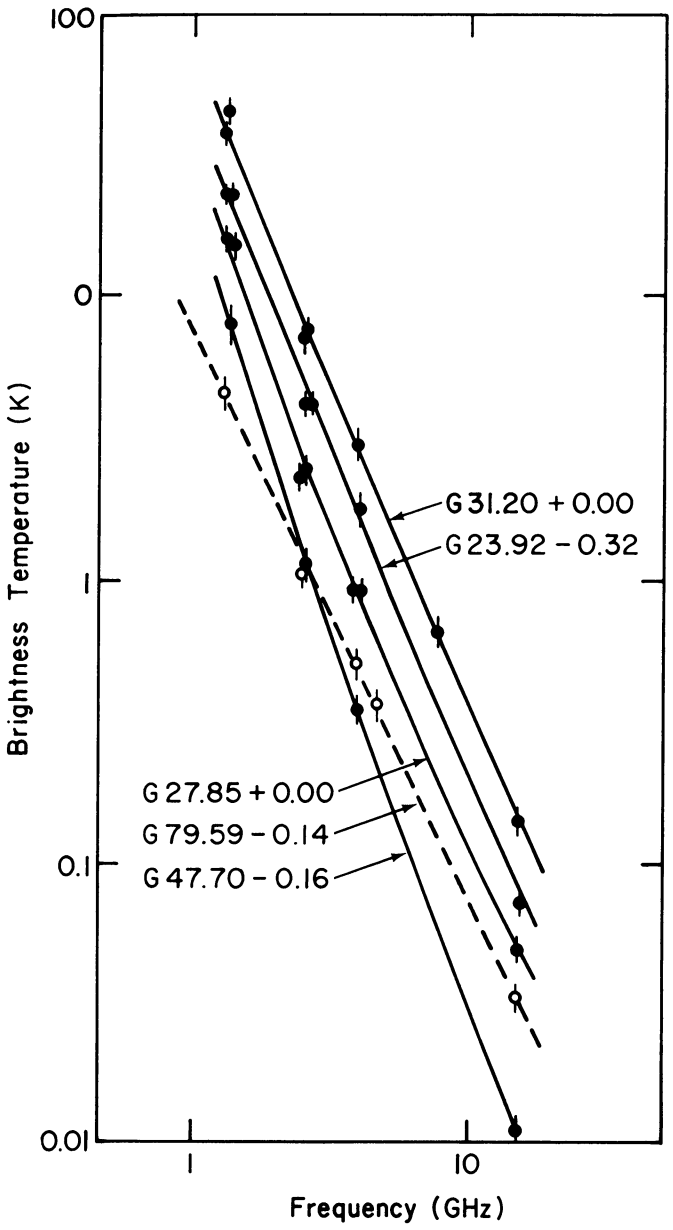

Fig. 1. Spectra of the Galactic background in the frequency range of 1.4 to 15.5 GHz at 5 points on the galactic plane. The ordinate is for the brightness temperature and the abscissa is for the frequency. The points are designated by the new galactic longitude and lattitude. The bars represent the amount of uncertainties estimated by the author. For the points at 1.4, 2.7, 5.0 GHz, the results of NRAO and Parkes galactic plane survey were used. The broken line with open circles shows the spectrum of the point G79.59 – 0.14 and which is just the theoretical spectrum of the optically thin thermal radiation. For other points positive curvatures are seen.

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DISCUSSION

Parijskij: We are preparing a radio map of the Milky Way visible from the Pulkovo Observatory at 4 cm with the large Pulkovo radio telescope. Usually we find the typical nonthermal spectrum of the galactic background. In some places the brightness temperature is extremely low, with an upper limit to the rms electron density of $\ll 0.1$ cm^{-3} (with $T_e \sim 10^4$ K). There is also a very deep minimum not far from the galactic center, symmetrical to that found in the Parkes survey at 6 cm.

Hirabayashi: I have examined the lower frequency results down to 19.7 MHz (Shain *et al.*, 1961) and derived the *f-f* optical depth from the absorption of the galactic background radiation by thermal electrons. The optical depth at 19.7 MHz was larger than that derived from my results by factor of 3. The difference may be due to different spatial resolution for the higher and lower frequency observation. Anyhow, these observational results both at the highest and lowest ends seem to prove the existence of this much thermal electrons in the galactic plane.

Reference

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