THE HIGH-LATITUDE DISTRIBUTION OF GALACTIC GAMMA RAYS AND POSSIBLE EVIDENCE FOR A GAMMA-RAY HALO

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During its 6.7-year lifetime the COS-B experiment included about 15 months of observations towards latitudes $|b| > 20^\circ$ and covered almost all latitudes from the South to North galactic poles. Studies comparing the local gamma-ray emission with the distribution of gas (Lebrun et al. 1982, Strong et al. 1982) have so far been limited to $10^\circ < |b| < 20^\circ$, where the correlation is found to be fairly good and the structured emission can therefore be attributed mainly to cosmic-ray interactions with gas. The extension of this type of analysis to higher latitudes is now possible using the COS-B database.

The latitude distribution of gamma rays was compared with that expected from gas using galaxy counts as the total gas tracer. It was found that this component is inadequate to account for the whole of the observed latitude variation and that an additional component having a wide latitude distribution is required. Figure 1 shows the latitude variation of the residual 70-5000 MeV intensity after subtraction of the estimated gas contribution, averaged over all available longitudes. One interpretation of the latitude dependence of the residual attributes it to a thick disk or 'halo' surrounding the Galaxy, with for example a radius of 15 kpc and scale height of a few kpc, although the parameters and form are not strongly constrained by the data. In a typical model the intensity from the 'halo' towards the galactic poles is $\sim 10^{-5}$ cm^{-2} sr^{-1} s^{-1}, and at latitudes $|b| < 30^\circ$ it has a substantial longitude variation while its intensity is comparable to that of the gas emission.

An identical analysis has been performed on the SAS-2 data (taken from Fichtel et al., 1978) and this leads to essentially the same conclusions.

The origin of the 'halo' emission is unknown, but a plausible mechanism is inverse Compton scattering (ICS) by cosmic-ray electrons on starlight (Worrall and Strong 1977). In this case it may be related to the large scale-height diffuse X-ray emission seen in the UHURU (Protheroe et al. 1980), Ariel V (Warwick et al. 1980) and HEAO-1 (Iwan et al. 1982) data. If these X-rays are at least in part due to ICS on the 2.7K back-

H. van Woerden et al. (eds.), The Milky Way Galaxy, 235–236.

ground then gamma rays of $\sim$ 100 MeV will be produced by ICS on starlight. Taking an X-ray intensity at $|b| = 90°$ of 2×10^{-9} erg cm^{-2} sr^{-1} (2-20 keV) (Iwan et al. 1982) and a starlight energy density of 1 eV cm^{-3}, then the expected gamma-ray intensity is roughly equal to that required for the halo component.

Independent of the physical process involved the present geometrical interpretation attributes a part of the 'isotropic' background deduced from the SAS-2 data (Thompson and Fichtel 1982) to the 'halo'; however, in view of the inadequacy of the simple model, it is possible that all of the high-latitude component is in fact galactic.

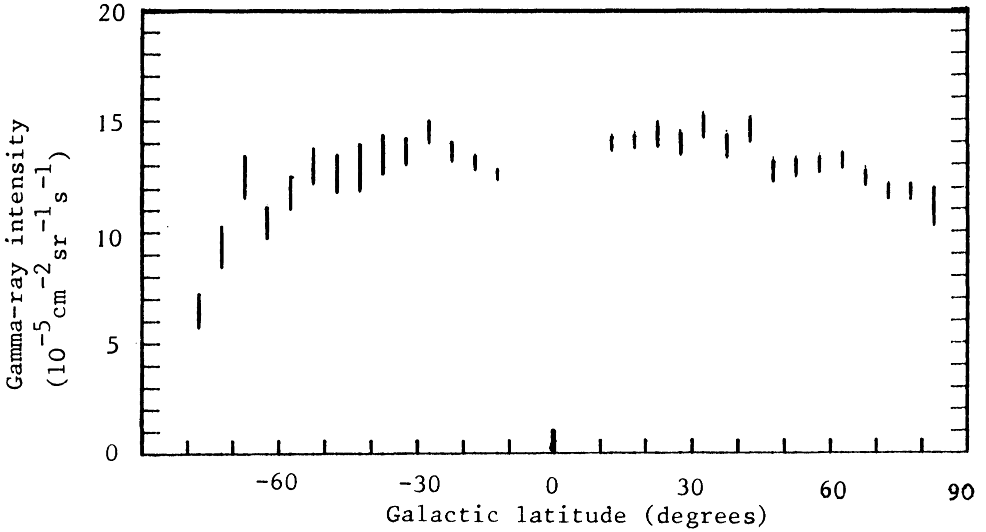

Figure 1. Latitude distribution of gamma-ray intensity (70-5000 MeV) after subtraction of the estimated contribution from cosmic-ray/gas interactions and averaged over all longitudes for which COS-B data are available. Instrumental background has not been subtracted.

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