# POSSIBLE CONTRIBUTIONS OF SUPERNOVA REMNANTS TO THE SOFT X-RAY DIFFUSE BACKGROUND (0.1 - 1 keV)

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## ABSTRACT

Almost all of the B band (0.10-0.19 keV) and C band (0.15-0.28 keV) X-rays probably originate in a hot region surrounding the Sun, which Cox and Anderson have modeled as a supernova remnant. This same region may account for a significant fraction of the M band (0.5-1 keV) X-rays if the nonequilibrium models of Cox and Anderson are applicable. A population of distant SNR similar to the local region, with center-to-center spacing of about 300 pc, could provide enough galactic M band emission to fill in the dip in the count rate in the galactic plane that would otherwise be present due to absorption of both the extra-galactic power law flux and any large-scale-height stellar (or galactic halo) emission.

## INTRODUCTION

The data were obtained in a series of ten sounding rocket flights. The payloads had two proportional counters collimated to $\sim 6\overset{\circ}{.}5$, one with a boron-coated window and one with a carbon-coated window. Our low energy data (0.1-1 keV) were binned into the three broad energy bands defined above. Figure 1 shows the response curves for these bands.

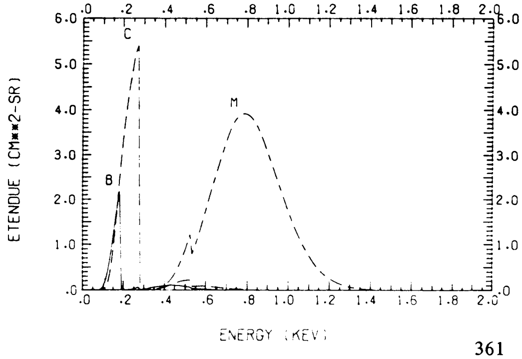


Figure 1. Effective area-solid angle product for the B, C, and M bands.



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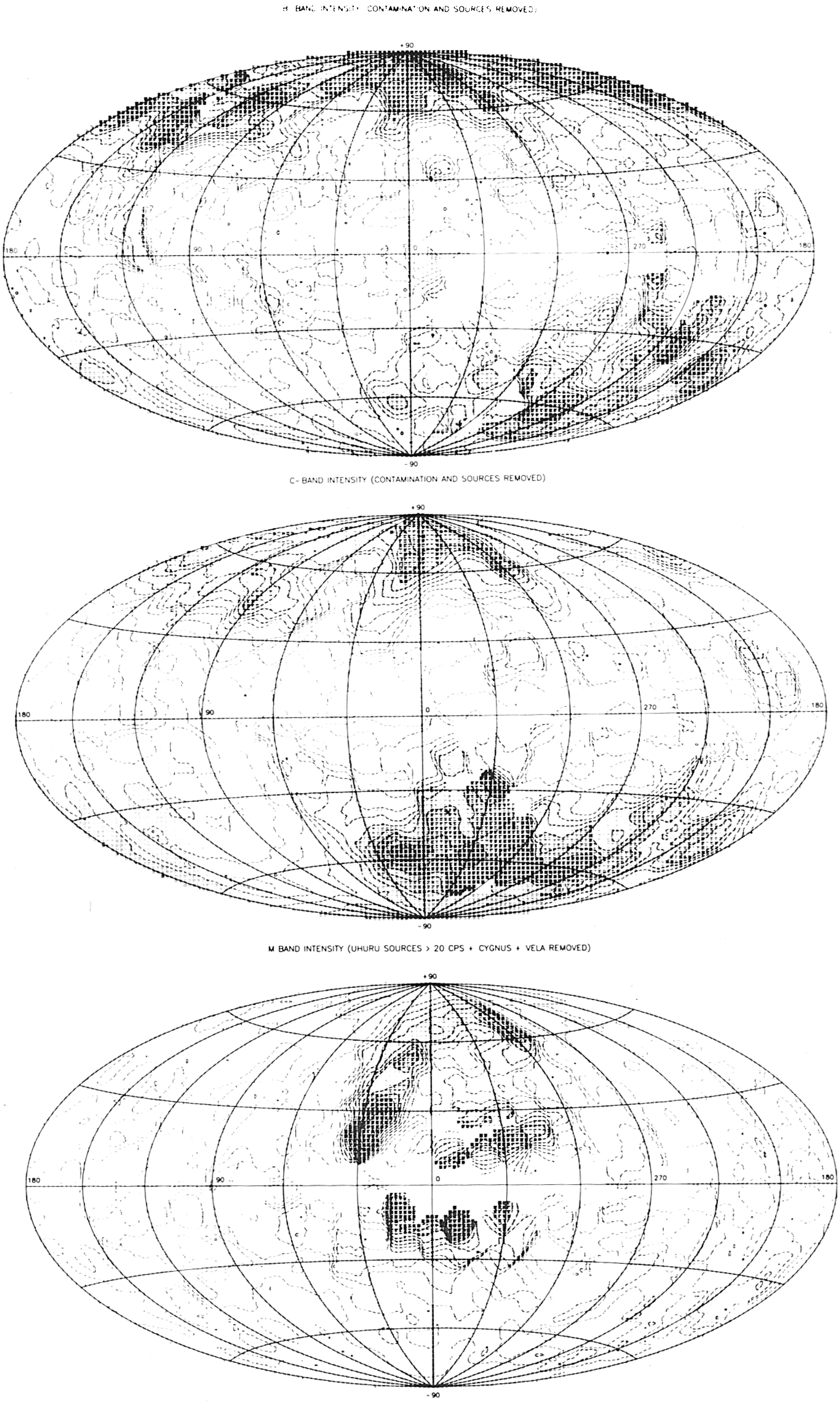


Figure 2. B, C, and M band all-sky maps.

Maps of the B, C, and M band data are presented in Figure 2. Two very bright supernova remnants, Vela and the Cygnus Loop, have been removed from these maps. Fainter SNR (SN1006, Lupis Loop) or probable SNR (North Polar Spur, Eridanus, and Gemini-Monocerous enhancements) are still visible, but are excluded from any further analysis here. The experiments and data reduction are described in detail by McCammon et al. (1983).

## THE LOCAL CAVITY

The intensity of the low energy diffuse background is everywhere greater than that predicted by an extrapolation to lower energies of the power law spectrum observed at energies > 2 keV. At least two additional sources of X-rays seem to be required: one primarily for the quite anisotropic B and C bands and a different one primarily for the rather isotropic M band. Sanders et al. (1977) proposed that the source of most of the B and C band X-rays is a hot ($\sim$ million degree) region surrounding the Sun that has uniform temperature but varying emission measure in different directions due to the varying extent of this region. We interpret this region as a local supernova cavity surrounding the Sun.

Theoretical support for such a picture comes from the work of Cox and Anderson (1982). They have calculated the dynamical, thermal, ionization, and spectral structures for blast waves of energy $5 \times 10^{50}$ ergs in a hot low-density interstellar environment. Their nonequilibrium model shows that the B and C band intensities are reproduced by such an explosion if the ambient density is about 0.004 $cm^{-3}$, the blast radius is roughly 100 pc, and the solar system is located inside the shocked region. However, the M band count rate produced by this model is only 20-30% of the observed rate, consistent with the suggestions that most of the M band counts have a different origin.

## THE M BAND DATA

Nousek et al. (1982) found that the M band data from latitudes <-15° were consistent with an absorbed power law plus an absorbed large-scale-height disk-shaped distribution of galactic emission. We compare the latitude dependence of the data to a model consisting of these two M band sources plus the local cavity contribution. The M band data, averaged over ten degree latitude intervals, are shown in Figure 3. The modeled contribution of the absorbed extragalactic power law is indicated by the line with alternating long and short dashes. We assume that the large-scale-height disk-shaped emission component of Nousek et al. is the integrated contribution of a population of dM stars (Rosner et al. 1981). Thus, the short-dash line shows the predicted contribution from an exponential distribution of stars (scale height = 350 pc, $n_S(0)$ = 0.065 $pc^{-3}$, $L_X = 2 \times 10^{28}$ ergs $s^{-1}$) absorbed by an exponential distribution of gas (scale height = 110 pc, $n_H(0) = 1$ $cm^{-3}$). The long-dash line gives the contribution from the local SN cavity, assuming that the M band

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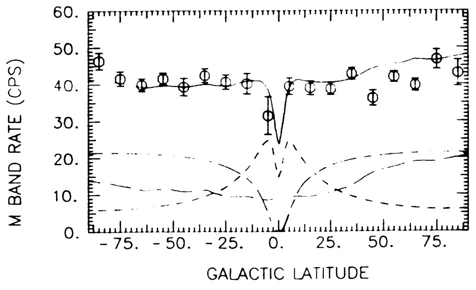


Figure 3. M band count rate as a function of galactic latitude. The modeled contribution of the extragalactic power law (— - —), stars (---), and local cavity (— — —) are shown, along with their total (solid line).

count rate from the cavity is 10% of the C band rate from the cavity (Cox and Anderson).

Figure 3 shows reasonable agreement between the data and the model, except perhaps within 10° of the galactic plane where the model shows a dip. A more detailed examination of the data near the plane reveals that in the longitude interval 90°<ℓ<180°, there is a broad dip at low latitudes. In this interval, the above model, with slightly different parameter values, is a reasonable fit to the data. But in the longitude interval 180°<ℓ<250°, the data show no dip in the plane. Since the dip in the model is an unavoidable feature of both the large-scale-height and extragalactic components, some additional X-ray emission component is needed which can fill in at low latitudes.

## MORE DISTANT CAVITIES

The data from several scans in the interval 200°<ℓ<250° were averaged in longitude and plotted in Figure 4a along with the model lines of Figure 3 (convolved with our collimator response). We have calculated the flux from a population of old SN cavities like our own to see if

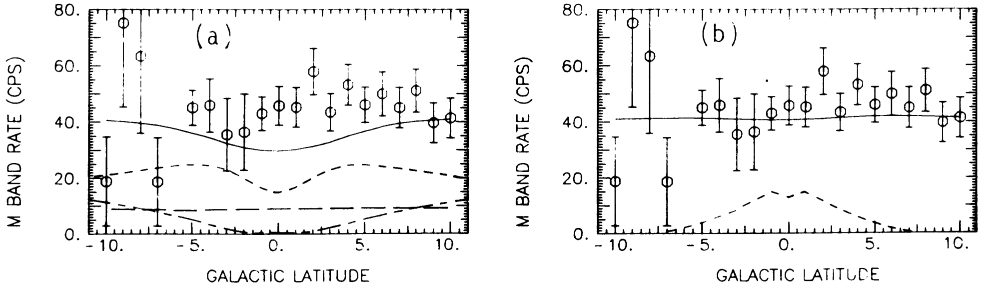


Figure 4. The data are from scans across the plane in the interval 200°<ℓ<250°. (a) The model lines are as in Figure 3, except they have been convolved with our collimator response function. (b) The dashed line shows the calculated contribution from a population of old SN cavities, and the solid line gives the total model with this component added in.

this is a reasonable candidate for the X-ray emission required to fill in the dip in the plane. These cavities are all assumed to be spherical with the same radius and surface brightness as our cavity and were randomly placed with their centers in the galactic plane with a mean distance between centers of 300 pc. The dashed line of Figure 4b shows the contribution from such cavities. The solid line shows that the addition of this component (again smoothed with our collimator response) provides a nearly latitude-independent M band flux. A question that must be answered, however, is why two adjacent longitude intervals along the galactic plane show such a different M band latitude dependence.

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