OBSERVATION OF SOFT X-RAY EMISSION FROM A REGION NEAR PER X-1

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(Received 12 November, 1973)

Abstract. Soft X-ray emission from the X-ray source Per X-1 was observed in the 0.4–2 keV energy interval from a rocket borne X-ray detector. Spectral analysis of the data indicates that in the 0.4–2 keV band the X-ray emission from Per X-1 can be fitted either with a power law of slope $-(4.8 \pm 1.2)\pm 0.12$ or a thermal bremsstrahlung spectrum with a $kT$ value of $(0.26 \pm 0.08)$ keV. Such a steep spectrum is inconsistent with the spectrum measured above 2 keV. The measured flux in 0.4–2 keV band corresponds to X-ray luminosity of $3 \times 10^{45}$ ergs s$^{-1}$ for Per X-1.

1. Introduction

X-ray emission from Per X-1 was first detected by Fritz et al. (1971). Subsequently more detailed observations from UHURU in the (2–10) keV band (Forman et al., 1972) confirmed this result and associated this source with the Perseus cluster. Below 2 keV the only observations are by Fritz et al. and Hayakawa et al. (1972) and they indicate a significant flux of soft X-rays from this source.

In this paper we report the observations of soft X-ray emission in the 0.4–2.0 keV range from a region near the X-ray source Per X-1. The observations were made using a soft X-ray instrument aboard an Aerobee 170 rocket launched from White Sands Missile Range on 1971 October 23 at 0345 UT. The spatial and spectral distribution of soft X-rays from the Cygnus Loop were observed in this flight and have been described by Stevens and Garmire (1973) and Stevens et al. (1973). After observations of the Cygnus Loop, a series of maneuvers brought Per X-1 into the field of view, where the detectors were kept pointed until the end of the experiment.

2. Instrument and Observations

The detectors consisted of a bank of four multi-layer, multi-anode proportional counters filled with methane gas at a pressure of 15 torr. Two detectors were equipped with $0.4^\circ \times 9.8^\circ$ collimators (detectors A and B) and the others were collimated to $12^\circ \times 12.3^\circ$ (detector C) and $9.3^\circ \times 10.0^\circ$ (detector D). The pointing direction in the sky was $\delta \approx 42^\circ$ and $\alpha \approx 42^h 5$. Since this was about $4.5^\circ$ away from Per X-1, the source was observed only in detectors C and D. Our observations show an increase in the counting rate in detectors C and D, but no detectable increase was recorded in detectors A and B as expected. Detector C was covered by a $140 \mu g \text{cm}^{-2}$ thick poly-

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propylene window and detector D was covered by a similar film 271 \( \mu g \text{ cm}^{-2} \) thick. The detector with the thicker window did not have a very good signal to noise ratio and therefore we present here the results from only the detector with 140 \( \mu g \text{ cm}^{-2} \) thick window, which performed well throughout the experiment. This detector had an effective area of 395 cm\(^2\). Details of the detectors and associated instrumentation have been described by Stevens (1972).

3. Data Analysis and Results

The observations were made during 334–340 s after launch in the descent phase of the rocket flight. During this period the altitude dropped from 122 to 115 km. The variation in altitude results in a varying background in the detector due to the attenuation of the soft X-rays. The data were corrected for this varying attenuation by applying a correction to each appropriate one-second intervals after the non-X-ray background was subtracted. The X-ray background was estimated from data obtained during a 309–318 s period, when there was no known source in the field of view of the detector and the average altitude was \( \sim 140 \) km so that atmospheric absorption was negligible. The non-cosmic X-ray instrumental background was determined during the time the rocket was deep in the atmosphere and was subtracted from all the data. In the energy intervals of 0.4–1.0 keV and 1.0–2.0 keV a total of about 153 \( \pm 27 \) counts and 43 \( \pm 21 \) excess counts respectively were recorded in the layer of the counter adjacent to the window. In Figure 1 we have plotted the window layer counting rate in \( (0.5–1.5) \) keV

![Figure 1](image_url)

Fig. 1. Plot of the number of counts in \( (0.5–1.5) \) keV band/2 s vs time after launch.