X-RAY FLUX FROM DISCRETE SOURCES

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Abstract. Preliminary results of two rocket flights carrying X-ray payloads conducted from Thumba Equatorial Rocket Launching Station (TERLS), Trivandrum, India, on November 3, 1968, and November 7, 1968, respectively, are presented. The results indicate the first evidence for the existence of low energy X-ray flux in the energy range 2–20 keV from Cen-X2 source since the reported extinction in May, 1967. The energy spectrum and the absolute flux of X-rays from Cen-X2, Sco-X1 and Tau-X1 are presented and compared with other observations.

Two identical payloads for the detection of X-rays were launched from Thumba Equatorial Rocket Launching Station (TERLS), Trivandrum, India, one at 0319 UT on November 3, 1968, and another at 0305 UT on November 7, 1968, respectively. Both the spin stabilized rockets were launched towards the zenith (85° elevation) when Sco-X1, Tau-X1 and Cen-X2 were in the field of view of the detector, mounted perpendicular to the spin axis of the rocket. The detector system consisted of a Xenon-Methane filled, 2 mil. Berylium window (60.8 cm^2) proportional counter collimated to 8.7° half transmission in azimuth and 17.2° half transmission in elevation by a slat type mechanical collimator. Inflight calibration of the counters was done using the 6 keV line from Fe^{55} source (15% FWHM), which was explosively ejected at 70 km altitude. Suitably oriented magnetic sensors and Sco-X1 sightings have been utilised to define the rocket attitude to within a $\pm 1°$ accuracy. The preliminary results are presented here and the detailed analysis and results will be published elsewhere (Rao *et al.*, 1969a).

Even though the Centaure rocket launched on November 3, 1968, remained spin

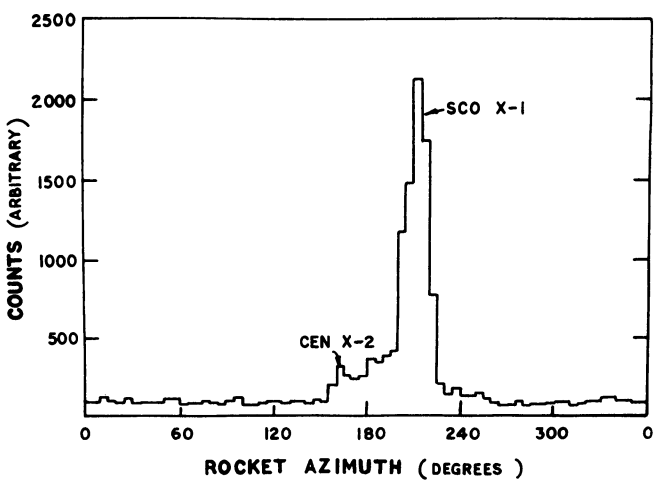

Fig. 1. X-ray count rate from various discrete sources observed on November 3, 1968.

L. Gratton (ed.), Non-Solar X- and Gamma-Ray Astronomy, 88–93.

stabilized at 8 RPS, with the rocket axis pointing at $10^h18'$ R.A. and 15.0°N declination on the celestial sphere, the Nike-Apache rocket launched on November 7, 1968, got into a precession after the split nosecone ejection. The precession axis of the latter rocket was at $10^h8'$ R.A. and 36°N declination with the half cone precession angle of 54°. Figures 1 and 2 show the observed flux of X-rays in the energy range

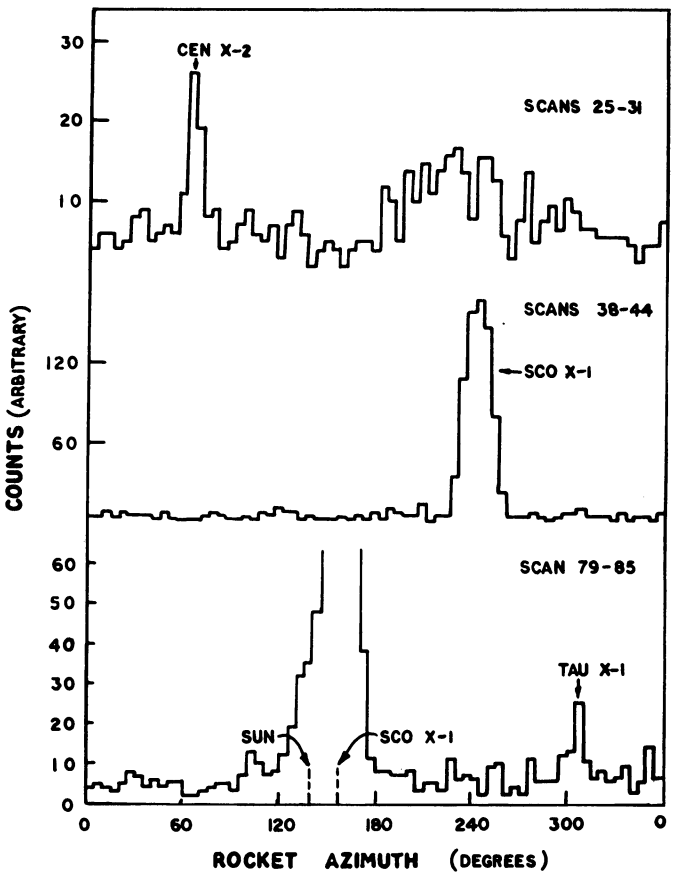

Fig. 2. X-ray count rate from various discrete sources observed on November 7, 1968.

2–6 keV from different sources for the flights of November 3, 1968, and November 7, 1968, respectively. The absolute flux for each source was determined by fitting a triangular response to the observed data after summing up appropriately.

X-ray Flux from Tau-X1:

The results of both the flights for the absolute flux of Tau-X1 are consistent with a power law spectrum of the type

$$f(E) = 8.0\, E^{-0.9\pm0.2}\, dE.$$

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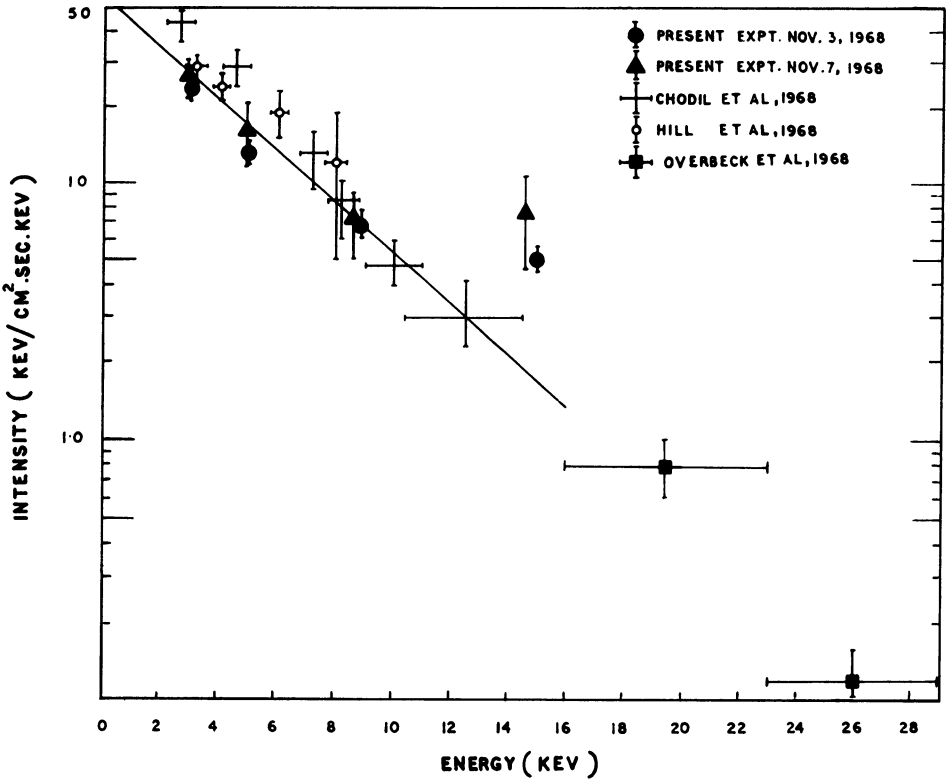

Fig. 3. Energy spectrum of Sco-X1.

The observed energy of X-rays from Tau-X1 in the range 2–5 keV of $(1.6 \pm 0.3) \times 10^{-8}$ ergs/cm^{2}sec agrees well with the energy estimates observed by others, which adds to the credibility of the absolute values of flux that we have derived.

X-ray Flux from Sco-X1:

Figure 3 shows the energy spectrum of Sco-X1 in the energy range 2–20 keV, the data being obtained for different energy windows of nominal value 2–4 keV; 4–6 keV; 6–12 keV and 12–18 keV. The results are consistent with an exponential spectrum with $E_0 = 4.4 \pm 0.2$ keV corresponding to a temperature of $(5.1 \pm 0.2) \times 10^7$ K.

Since the discovery of fluctuations in the optical intensity from Sco-X1 by Hiltner and Mook (1967), the investigation of time variation of X-ray flux from Sco-X1 has assumed a great importance. An examination of all the available results on the absolute flux of Sco-X1, since 1965, as seen from Figure 4 shows that the X-ray luminosity of Sco-X1 has decreased steadily over the period 1965–68. Sporadic short time variations are superimposed upon this general decrease which is consistent with an exponential decay with a time constant of about 4.1 years. If this is true, then the flux of Sco-X1 would decrease by two orders of magnitude in about 20 years (Rao *et al.*,

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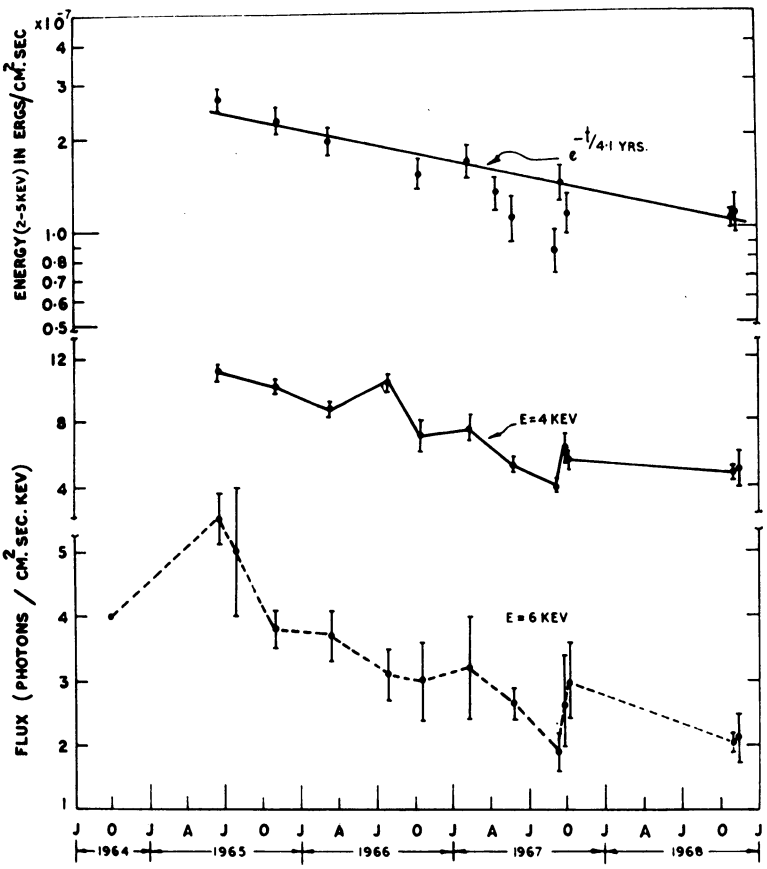

Fig. 4. Time variation of the absolute flux and energy from Sco-X1.

1969b; the references therein), an estimate which is not unreasonable from the theoretical point of view.

X-ray flux from Cen-X2:

The most important result of these two flights is the rediscovery of the low energy X-ray flux from Cen-X2 source. The observed spectrum during both the flights, plotted in Figure 5, is consistent with a power law having an exponent of $-(1.2\pm0.2)$. In the same figure are plotted the data for Cen-X2 in 20–100 keV range observed on October 15, 1967, by Lewin *et al.* (1968). It is evident that a single power law spectrum can satisfactorily explain both the low energy flux observed by us and the high energy flux observed by Lewin *et al.* almost a year earlier.

Cen-X2 was not detectable in October, 1965 (Grader *et al.*, 1966), was observed as a time varying object during April–May, 1967 (Francey *et al.*, 1967; Cooke *et al.*, 1967) and again apparently ceased to exist in September, 1967 (Chodil *et al.*, 1968). The decrease in flux during April–May, 1967 can be represented by an exponential

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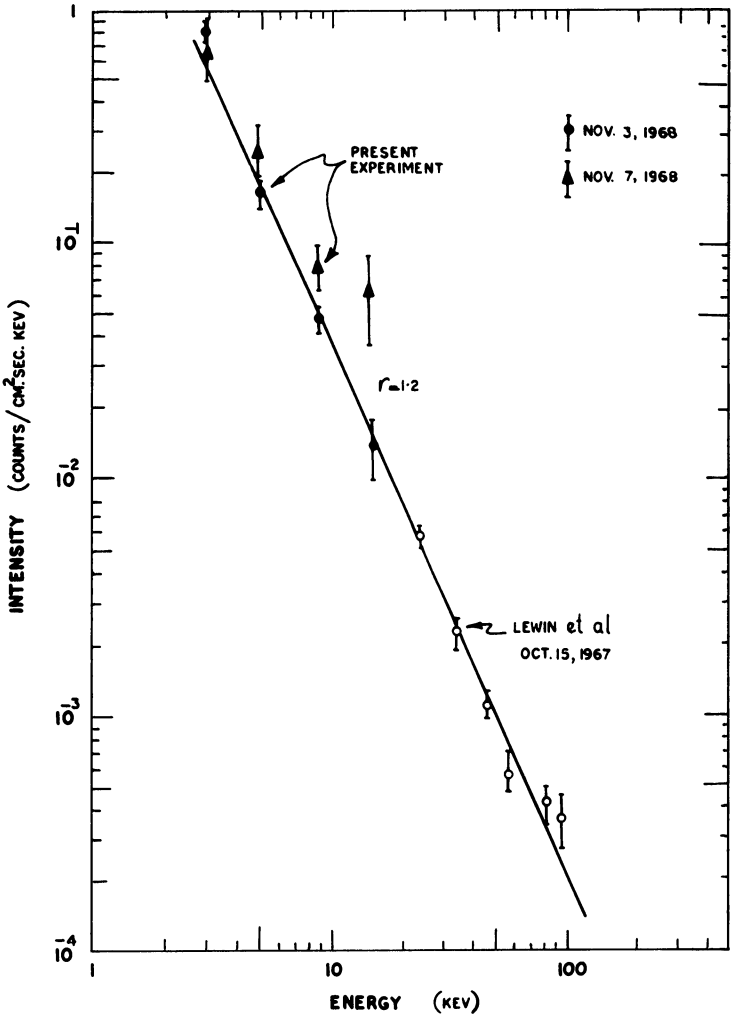

Fig. 5. Absolute flux of Cen-X2 as a function of energy.

decay with a time constant of 23.4 days. The extrapolated X-ray flux in the energy 2–5 keV using Lewin *et al.*'s spectrum observed on October 15, 1967, is also shown in the same figure. However, no low energy flux was observed on June 12, 1968, by Pounds (1970). They have provided an upper limit of 0.15 photons/cm^{2}sec for the flux in the energy range 2–5 keV. The first evidence for the presence of low energy flux, since May 1967, is reported here from our flights on November 3, 1968 and November 7, 1968.

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