High-Energy X-Ray Sources Near the Galactic Equator Between $\ell^{II} \sim 335°$ and $\sim 350°$

Jeffrey E. McClintock, George R. Ricker,
Stanley G. Ryckman and Walter H.G. Lewin

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Jeffrey E. McClintock, George R. Ricker,
Stanley G. Ryckman and Walter H.G. Lewin
Center for Space Research and Department of Physics
Massachusetts Institute of Technology

ABSTRACT

On October 15-16, 1970, we carried out balloon X-ray observations from Australia. We detected at least two hard X-ray sources (energies > 18 keV) near the Galactic Equator in the region $\sim 335° < \ell^{II} < \sim 350°$.

During a balloon flight from Mildura, Australia on 1970 October 15-16, we carried out X-ray observations in the vicinity of the Galactic Equator. As a result of this flight we recently reported several new highly variable sources in the constellations Crux and Centaurus (McClintock, Ricker and Lewin, 1971) and in Sagittarius (Lewin, Ricker and McClintock, 1971). The existence of each of these sources has since then been confirmed by observations from Uhuru and consequently their positions have been improved considerably (2ASE Catalog, Giacconi et

al, 1972).

We report here hard X-ray sources in the region $335° < \ell^{II} < 350°$ from which we earlier (October 1967) observed a hard X-ray flux (Lewin et al, 1969).

We used a 45 cm^2 NaI(Tl) scintillation detector, surrounded by a NaI(Tl) anti-coincidence jacket, mounted in an altazimuth configuration. The slit field of view had an angular width of 1°.5 x 13° full width at half maximum.

A balloon with a volume of 34 million cubic feet, manufactured by Winzen Research, Incorporated, carried the instruments to an altitude of ∿147,000 feet (∿1.5 g/cm^2). The data were both recorded on board and transmitted to a ground-base station. X-rays were recorded in eight energy channels covering the range from ∿15 to ∿150 keV. We present here data obtained in the range from ∿18 to 50 keV. Spectra of these and previously reported hard X-ray sources will be presented in a later paper.

During scan no. 6 (between 1970 October $16^d\ 6^h\ 25^m$ and $16^d\ 7^h\ 41^m$), we detected at least two sources. During this scan a point source would move through the center line of our slit field of view in about 20 minutes as a result of the diurnal motion of the Earth. Figure 1 shows the counting rate versus Universal Time as measured during this scan. Each data point represents the average raw counting rate in 72 seconds. The downward pointing arrows

indicate the times that previously reported X-ray sources crossed the center line of our field of view. Scan no. 6 terminated about 3 minutes before 2ASE 1702-36 (GX 349+2) would appear on the center line of the telescope's field of view (see dashed arrow). The limited float time of the balloon (~10 hours) did not permit us to make another scan over this region of the sky to substantially reduce the positional uncertainty of the sources.

As one can see from Figure 1, there is some evidence (3σ) that an X-ray source crossed the center line of our field of view between $6^h\ 44^m$ and $6^h\ 54^m$. A relatively strong source passed our center line between $7^h\ 16^m$ and $7^h\ 24^m$ and another source between $7^h\ 31^m$ and $7^h\ 38^m$. Figure 2 shows three regions in the sky where these sources are located. It also shows the positions of sources observed by Uhuru (2ASE Catalog, Giacconi et al, 1972) and the positions of GX 340+6 and GX 342-8 (not confirmed by Uhuru) reported by Mayer, Bradt and Rappaport, 1970.

Region 1

The excess counts (see Figure 1) have a statistical significance of only $\sim 3\sigma$. They may have come from either one (or both) GX 340+6 and 2ASE 1641-45 (GX 340+0). The X-ray source GX 340+6 (Mayer et al, 1970) is not reported in the latest 2ASE Catalog (Giacconi et al, 1972).

Region 2

Our data are consistent with the assumption that the variable X-ray source 2ASE 1705-44 is the sole source of the hard X-rays as measured by us in region 2 (see Figure 2). We cannot exclude the possibility of some or a substantial contribution from the variable source 2ASE 1704-42. Clearly it is also possible that we have measured hard X-rays from a source (likely variable), so far undetected by Uhuru.

Region 3

No source reported by Uhuru could be responsible for the excess counting rate as measured by us between $7^h\ 30^m$ and $7^h\ 40^m$. Part or all of the excess counting rate may be due to the GX 342-8 source (not reported by Uhuru) and part of it could be due to the variable source 2ASE 1702-36 (GX 349+2). The latter source never appeared on the center line of our slit field of view (see dashed arrow pointing down in Figure 1).

These observations do not allow an unambiguous identification with any X-ray source reported earlier, yet neither do they give substantial evidence that the hard X-rays as detected by us are due to new sources not yet reported from rocket and satellite observations.

We plan to considerably improve the accuracy in the

source positions in this region of the sky during new balloon observations from Australia in March-April 1972.

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FIGURE CAPTIONS

Figure 1

Counting rate versus time for scan 6 on October 16, 1970. Each data point ($\pm 1\sigma$ error loss) represents the counting rate observed in a 72-second period. The arrows indicate approximate times when known X-ray sources cross the center line of the field of view of our telescope ($\sim$1.5 x 13° FWHM).

Figure 2

Pairs of lines indicate areas in the sky (1), (2) and (3) where hard X-ray sources are located. The lines are determined by the uncertainty in the location of the peaks in the counting rate plot (Figure 1). The arrows indicate the motion of the field of view relative to the stars as a result of the diurnal motion of the Earth.

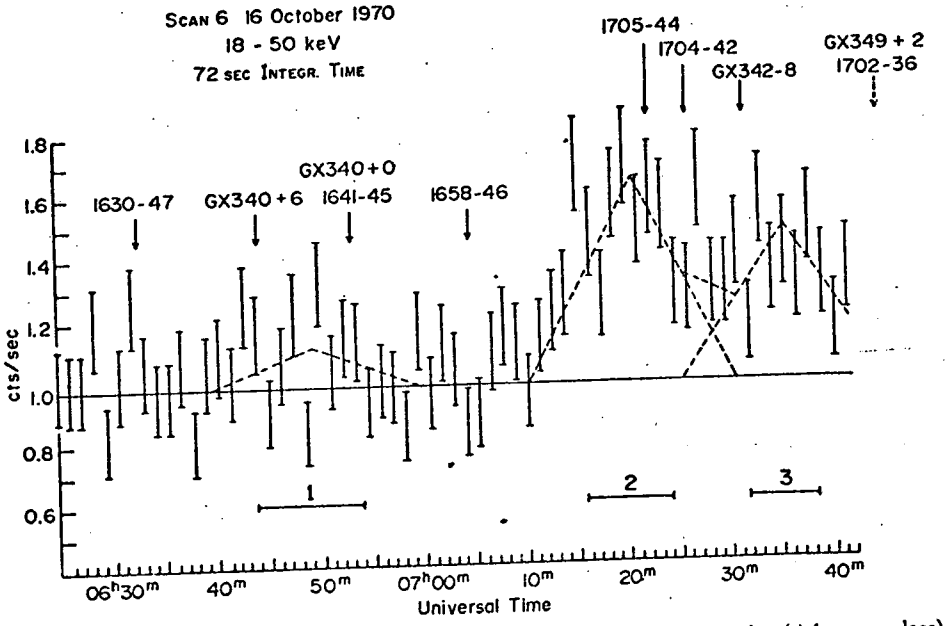

Fig. 1.—Counting rate versus time for scan 6 on 1970 October 16. Each data point (±1 σ error loss) represents the counting rate observed in a 72-s period. Arrows indicate approximate times when known X-ray sources cross the centerline of the field of view of our telescope (~1°.5 × 13° FWHM).

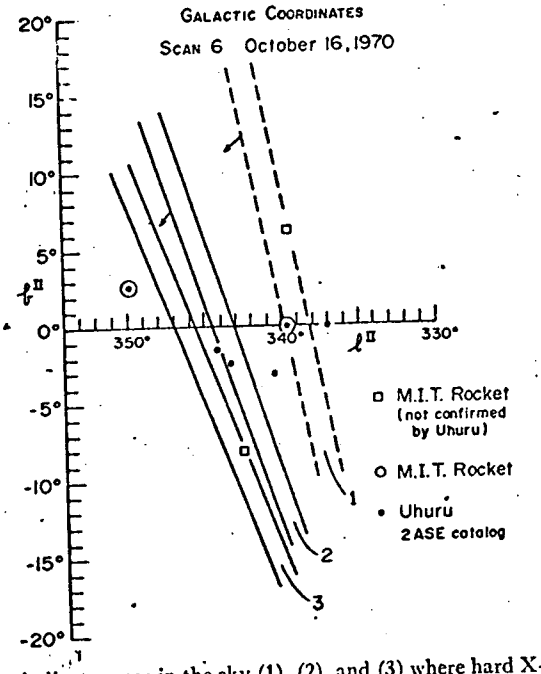

Fig. 2.—Pairs of lines indicate areas in the sky (1), (2), and (3) where hard X-ray sources are located. The lines are determined by the uncertainty in the location of the peaks in the counting-rate plot (fig. 1). Arrows indicate the motion of the field of view relative to the stars as a result of the diurnal motion of the Earth. (The source plotted at $l^{II} \sim 350°$, $b^{II} \sim 2°.7$ actually belongs at $l^{II} \sim 349°.1$, $b^{II} \sim 2°.7$.)