A *ROSAT* DEEP SURVEY OF THE GALACTIC PLANE $180° < l < 280°$

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ABSTRACT. We have performed a moderately deep soft X-ray survey of the Galactic Plane using pointed observations with the *ROSAT* Position Sensitive Proportional Counter. The survey is more than an order of magnitude more sensitive than previous X-ray surveys near the galactic plane.

1. The survey

We have performed a moderately deep soft X-ray (0.1–2 keV) survey of the Galactic Plane using pointed observations with the *ROSAT* Position Sensitive Proportional Counter (PSPC) (Morley et al 1996). The survey is more than an order of magnitude more sensitive than previous X-ray surveys near the galactic plane (e.g. Hertz & Grindlay 1984; Motch et al 1997). The data consist of 9 fields each of $\approx$ 10 ks exposure, pointed at positions on or very close to the galactic plane ($|b| < 0.3°$) in the longitude range $180° \lesssim l \lesssim 280°$. This region has relatively low X-ray absorbing material out to distances of several hundred parsecs and presents less source-confusion problems than at other longitudes. The survey utilised the inner 18 arcmin of each PSPC field.

2. Results

The total sky area surveyed was 2.5 deg^2; this yielded 93 sources, 89 of which were detected only in the 'hard' (0.4–2.0 keV) band. Eight sources were detected in both 'soft' (0.1–0.4 keV) and hard bands. In the hard band, the survey coverage is $\gtrsim$ 90 per cent for sources brighter than 0.002 count s^{-1} ($\sim 2 \times 10^{-14}$ erg cm^{-2} s^{-1}), but falls steeply below this value, with the weakest sources being $\sim$ 0.001 count s^{-1}. The median limiting flux is $\approx$ 0.0013 count s^{-1} ($\sim 1.3 \times 10^{-14}$ erg cm^{-2} s^{-1}). There are 65 sources with hard-band count rates $>$ 0.002 count s^{-1}.

3. The number–flux relation

Fig. 1 shows the measured (coverage-corrected) number–flux relation ($\log N - \log S$), together with predictions of galactic cool-star and extragalactic populations. The extragalactic $\log N - \log S$ was computed from the high-latitude measurements of Hasinger et al (1993), suitably attenuated by galactic absorption. The cool-star predictions were taken from Guillout et al (1996) and from computations by the present authors using the XCOUNT model (Favata et al 1992).

The coverage-corrected, number-flux relation, for source count rate $S > 0.002$ count s^{-1}, was fitted with a power-law $N(> S) = N_0 S^{-\alpha}$, after first subtracting the estimated extragalactic component. The best-fit parameter values and 1-parameter 90 per cent confidence intervals were $\alpha = 1.3$ (0.9–1.9), and $\mathrm{N}_0 = 20.6$ (15.1–26.2) sources per square degree above $S > 0.002$ count s^{-1}. The estimated extragalactic contribution to the total galactic-plane source counts is a relatively minor one; assuming zero contribution increases the normalisation to $N_0 = 25.7$ (20.0–31.1) and has little effect on the (already rather poorly constrained) power-law index.

4. Identifications

Only a few sources have possible identifications from the SIMBAD database. Work is in progress to identify the optical counterparts; multi-band (UBVRI) CCD photometry has been obtained for all of the fields, to a limiting magnitude of $V \approx 19$. Since coronal emission from cool stars (spectral types F–M) is well-established empirically to'saturate' at $L_\mathrm{X}/L_\mathrm{bol} \sim 10^{-3}$, we can estimate that for limiting PSPC count rates of > 0.002 (> 0.001) count s^{-1} the corresponding apparent magnitudes will be $V \lesssim 18$ ($\lesssim 19$).

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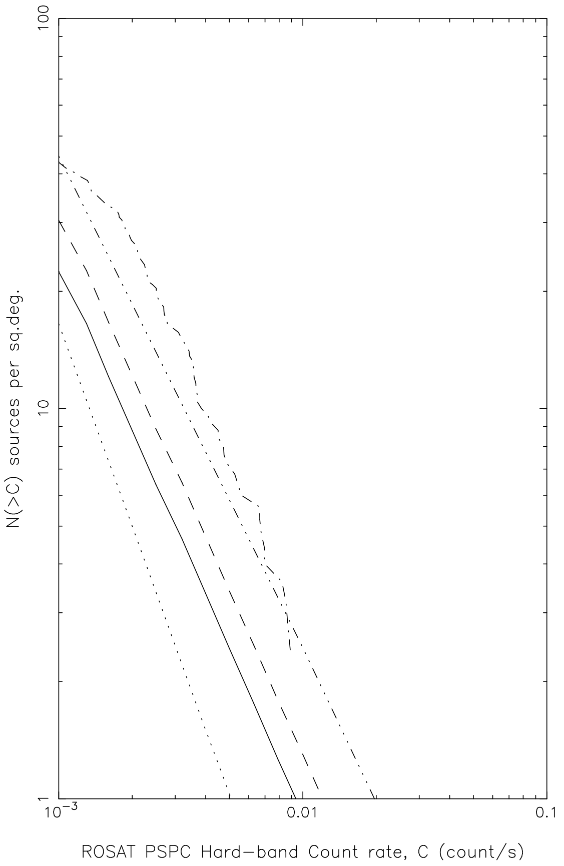

Fig. 1. Measured and predicted galactic-plane number-flux relations. From the top downwards, the curves are: (a) measured, coverage-corrected $\log N - \log S$; (b) prediction from Guillout et al (1996); (c) and (d) predictions by the present authors using the Palermo XCOUNT model, with two different assumptions for the space density of RS CVn-type binary systems; (e) estimated contribution from extragalactic sources.