# A DEEP X-RAY SURVEY OF THE PMS POPULATION OF THE UPPER SCO-CEN ASSOCIATION

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We have searched for low-mass pre-main-sequence stars in the Upper Sco-Cen star-forming region using ROSAT pointed observations analyzed with an innovative source detection method based on wavelet transforms (cf. Damiani et al. 1997a,b). In a ROSAT PSPC image we find 32 sources down to a limiting flux of 3.9 $10^{-14}$ erg $cm^{-2}$ $s^{-1}$. In two HRI observations that cover with greater sensitivity approximately one-third of the same region we find 17 sources, down to a limiting flux of 1.4 $10^{-14}$ erg $cm^{-2}$ $s^{-1}$. Half of the HRI sources where not detected either in the PSPC pointed observation nor are reported in the ROSAT Bright Source Catalog, nor in the final analysis of Einstein IPC data of the same region, yielding 18 sources down to a limiting flux of 9.1 $10^{-14}$ erg $cm^{-2}$ $s^{-1}$. In our survey, we have a total of 50 distinct X-ray sources, of which only 13 were known as Einstein IPC sources in a sky region of nearly the same area as that we have surveyed. Our new analysis allows us to largely increase the census of likely PMS stars in the Upper Sco-Cen region and shows that the IPC survey of PMS stars in this region by Walter et al. (1994, hereafter WVMBM) is more incomplete than previously reported. A recent X-ray surveys, based on the ROSAT All-Sky Survey (RASS) data, studied a much larger areas of the sky, but with the same limiting sensitivity as the older *Einstein* observations and have identified several ($\simeq$ 100) new low-mass WTTS in the region (Preibisch et al. 1997). To put on a more quantitative base the bias due to the shallow limiting sensitivity we compared the Log N - Log S (cf. Fig. 1) derived from the *Einstein* IPC results and that built from our ROSAT survey. For fluxes greater than $10^{-13}$ erg $cm^{-2}$ $s^{-1}$ the

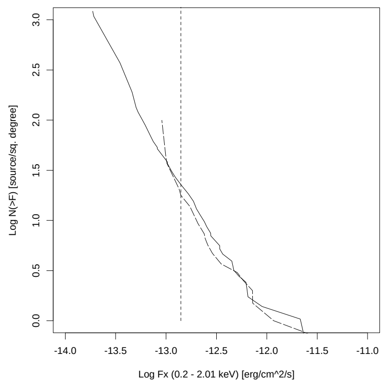


*Figure 1.* The Log N - Log S deduced from the sample of sources detected with the pointed ROSAT observations (solid line) and with the Einstein IPC (long-dashed line). The vertical line marks the flux of the weakest IPC source reported by WVMBM. Note that the larger size of the ROSAT source sample allows us to better define the shape of the Log N – Log S, in particular below the limit of the WVMBM survey. Since the Log N – Log S does not seem to flatten at weaker flux, the total number of X-ray emitters, most of which are likely associated with stars of the Upper Sco association, is significantly greater than that obtained with the IPC and reported by WVMBM.

*"Einstein"* and the "ROSAT" Log N – Log S are in very good agreement. The ROSAT Log N - Log S shows that the number of sources continues to increase (with a slope of approximately 1.5) toward weak fluxes and indicates the incompleteness of the sample of the sources detected with the *Einstein* IPC. The likely PMS nature of the stellar counterparts of the faint X-ray sources is supported by follow-up optical spectroscopy of some of these sources, as well as by the presence of variability of X-ray emission in a substantial fraction of them, and by the characteristics of available X-ray spectral information. A complete account of this work can be found in the paper by Sciortino et al. (1998). We are currently in the process of identifying the optical counterparts of a larger fraction of the X-ray sources detected in our survey. Photometric observations have been obtained and spectroscopic observations have been scheduled at ESO in June 1998.

## References

Damiani F., Maggio A., Micela G., Sciortino S., 1997a, Astroph. J. 483, 350
Damiani F., Maggio A., Micela G., Sciortino S., 1997b, Astroph. J. 483, 370
Preibisch T., Zinnecker H., Guenther E. et al. 1997, Cool Stars, Stellar Systems and the Sun 10, R. Donahue and J. Bookbinder eds., in press
Walter F. M., Vrba F. J., Mathieu R. D., Brown A., Myers P. C., 1994, Astron. J. 107, 692 (WVMBM)
Sciortino S., Damiani F., Favata F., Micela G. 1998, A&A, in press.