ROSAT PSPC/HRI observations of the young open cluster NGC2422

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1. Introduction

In order to consolidate the current picture of the activity evolution late type stars , it is of great importance to enlarge the sample of open clusters studied both from the X-ray and from the optical point of view. One very promising open cluster of age similar to that of the Pleiades is NGC 2422, a southern cluster of medium richness with projected diameter of about 30 arcmin, at a distance of about 400 pc. Here we present preliminary results from the study of two pointed X-ray observations of NGC2422, conducted with the ROSAT PSPC (9095 sec total exposure time) and with the ROSAT HRI (38075 sec) detectors. Results are also presented from an on-going campaign of optical spectroscopic observations carried out to identify likely counterparts of X-ray sources.

2. X-Ray measurements

The PSPC observation has been analyzed using the automated pipeline processing described in Mackie et al. (1995), including data screening to cut high background time intervals (Bocchino et al. 1995), source detection and count rate determination based on a wavelet transform detection algorithm (Damiani et al. 1995).For the HRI we have also adopted the above screening and detection algorithms. We have detected 63 sources with significance greater than 99.996% in the PSPC observation (8877 seconds screened exposure time), and 67 sources in the HRI observation (37800 sec). 34 HRI sources are positionally matching with at least one PSPC source, 36 HRI sources do not match with any PSPC counterpart and 31 PSPC sources do not match with any HRI counterpart, for a total of 101 individual X-ray sources. The un-absorbed X-ray flux in the 0.2-2.0 keV energy band has been calculated from the measured count-rates adopting a single temperature (10^7 K) Raymond-Smith emission model with absorption $N_H = 3.3 \times 10^{20}$ cm^{-2} derived from the appropriate $E_{B-V} = 0.05$ (Smyth & Nandy 1962). A cluster distance of 400 ± 10 pc (Shobbrook 1984) has been used to derive the 0.2-2.0 keV X-ray luminosities. Sources with identified optical counterpart (see next section) present X-ray luminosities consistent with those measured for the stars of the Pleiades young open cluster. Most of the PSPC sources with no HRI counterpart are detected outside the central part of the HRI Field of View (FOV) while most of the 36 HRI sources with no PSPC counterpart are found in the central part of the HRI FOV, where the limiting sensitivity of the HRI observation is better than that reached with the PSPC observation.

3. Optical Measurements

We have carried out a detailed program of low dispersion spectroscopic observations at the ESO 1.5m telescope (B&C spectrograph, $\sim 3700 - 7000$ Å spectral coverage) in order to identify the optical counterparts of the X-ray sources. About 150 possible counterparts to the PSPC sources were observed with limiting magnitude $V \sim 16$. Among the various possible counterparts to each X-ray source, those with unplausible X-ray to optical flux ratio for their spectral type were screened out. This alone provides a plausible, single counterpart identification for over 50 sources with more than half of these being late type (F-G) stars. It should be noted that at this spectral resolution (and given the low sensitivity of the ESO 1.5m CCD in the blue) no signs of stellar activity (e.g. Ca II emission cores) are visible in the majority of the counterparts, although some of the later type ones have partially filled in Hα lines. A few of the sources have clearly dMe/dKe foreground stars as counterparts. About one third of the sources have multiple potential optical counterparts based on their PSPC positions. The HRI observation, covering the central part of the PSPC FOV, has helped in most of the abiguous cases to select the actual counterpart.

4. Work in progress

X-ray fluxes and luminosities of PSPC detected sources will be refined using the hardness ratio to better choose the conversion factor from rate to flux. A detailed analysis will be conducted for sources with strongly discrepant fluxes in the two X-ray observations. The optical identification program will be carried on in order to complete the survey of X-ray sources detected both with the PSPC and HRI. An analysis of the membership of NGC2422 is also being conducted through proper motion studies with the aid of new astrometric observations.

Acknowledgments. This work was supported by ASI, MURST (Palermo).

References

Bocchino, F., Barbera, M., & Sciortino, S. 1995, "Röntgenstrahlung from the Universe", in press.

Damiani, F., et al., 1995, "Röntgenstrahlung from the Universe", in press.

Mackie, G., et al., 1995, ADASS 95, in press.

Shobbrook, R.R., 1984, MNRAS, 211, 659.

Smyth, M.J., & Nandy, K., 1962, Pub. of Royal Obs. of Edimburgh