A study of a sample of cool stars X-ray selected with EXOSAT using ROSAT data

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1. Introduction

The observations carried out by the Einstein and EXOSAT Observatories, as well as the all-sky X-ray and EUV surveys recently completed by ROSAT and EUVE, have provided large samples of serendipitous stellar sources. In order to determine the physical nature of the stellar serendipitous X-ray sources detected by EXOSAT, we embarked on an extensive optical program. We found that at least one third of the EXOSAT serendipitous sources is in fact constituted by young stars, with ages comparable to or younger than the Pleiades (Tagliaferri et al. 1992, 1994). Similar results have been found for stars X-ray selected with Einstein (Favata et al. 1993) and ROSAT-WFC (Jeffries 1995). We showed that fourteen objects, out of the 47 studied EXOSAT optical counterparts, turned out to be clearly variable, with periods in the range 1-8 days, including a newly discovered eclipsing binary. There is also strong evidence that some of the observed stars are previously unknown nearby (d \leq 25 pc) M dwarfs (Cutispoto et al. 1995).

Here we present the results of an analysis performed on data obtained with the PSPC detector on board the ROSAT satellite. The aim of this project is to investigate in more details the properties of the X-ray emission of these X-ray selected cool stars.

2. The Results

We searched the ROSAT public archives available on the computers of HEASARC at GODDARD. We selected all observations that had one of our star in the field of view (FOV) and retrieved the data for the analysis. In total we selected 63 ROSAT-PSPC observations related to 43 distinct sources. A two temperature model was required to represent the spectra of our stars. The softer temperature is centered at \sim 0.15 keV with little scatter, while the harder temperature has a value around \sim 1 keV, but with a higher scatter. These results are very similar to those obtained for the PSPC data of a sample of active RS CVn binary stars (Dempsey et al. 1993). In 25% of the light curve analysed we detected flare like events; most of them are detected in M stars (50% of the M sample shows flare).

Interestingly, we find that the correlation with the vsini is weak, while that one with the bolometric luminosity is very good (see Fig. 1). This confirm
the results already found by other authors, for instance for the sample of stars contained in the Einstein EMSS (Fleming et al. 1989), or for a sample of active flare stars (Agrawal et al. 1986; Pallavicini et al. 1990). This can be explained with the presence of a saturation level above which the X-ray luminosity does not increase any more with the star rotation rate but with the radius. An X-ray flux limited selected sample will preferentially select star above or near this saturation level. Evidence of a saturation level in star activity has recently also been found in young open cluster studied with ROSAT (Stauffer et al. 1994, Randich et al. 1995) and in a complete ROSAT sample of nearby stars (Fleming et al. 1995).

Fig. 1. Note the weak correlation of $L_X$ with vsini and the good correlation with the bolometric luminosity.

If we compare the hardness ratio of our stars with those of the EMSS sample and of all K-M stars within 7 pc of the Sun (Fleming et al. 1995), it is clear that the two X-ray selected sample have harder X-ray spectra than the optically-selected sample. Another indication that our stars are between the most active coronal sources.

References

Tagliaferri, G. et al. 1992 High-resolution Spectroscopy with the VLT (ESO)