THE STELLAR CONTENT OF THE XMM-NEWTON BRIGHT SERENDIPITOUS SURVEY

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ABSTRACT

We present the initial results of the analysis of the stellar content of the XMM-Newton Bright Serendipitous Survey. The survey includes 56 stellar sources observed in the 0.5 - 4.5 keV energy band. We compare the observations with the predictions obtained with XCOUNT, a model of the stellar X-ray content of the Galaxy. In the same way as in other X-ray shallow surveys, we observe an excess of stars unexpected by our Galaxy model. Here we discuss the properties of the detected stellar population.

Key words: galaxy: stellar content; stars: activity; stars: coronae; X-rays: stars.

1. INTRODUCTION

The XMM-Newton Bright Serendipitous Survey[1] (XBSS) was conceived with the aim of complementing the results obtained by medium and deep X-ray surveys. It contains two flux limited samples of serendipitous XMM-Newton sources at galactic latitudes $|b| > 20°$: the XMM Bright Source Sample (BSS) and the XMM Hard Bright Source Sample (HBSS), with a flux limit of $f_x \approx 7 \times 10^{-14}$ erg cm^{-2} s^{-1} in the 0.5 – 4.5 keV and 4.5 – 7.5 keV energy band, respectively (see della Ceca et al., 2004). The complete sample contains 400 X-ray sources from the 237 selected XMM-Newton fields observed with different filters, 389 sources belonging to the BSS. A total of 56 stellar counterparts have been optically identify (della Ceca et al., 2004), corresponding to 14% to the BSS sample.

The BSS is unique since it is the only survey of this kind where X-ray spectroscopic observations can be taken for all the detected stars. Here we carry out an analysis of the X-ray spectra of the 56 sources in the sample identified with stars (§ 2.1) as well as a study of their light curve (§ 2.2) in order to detect variability. In addition, a cross-identification with SIMBAD and 2MASS catalogues has been made for comparing the results — in terms of number of stars of a given spectral type — with our model predictions. In § 3 we give a summary of the cross-identification results, while the comparison between the number of stars observed and predicted by our model is discussed in § 4.

[1]The XMM-Newton Bright Serendipitous Survey was conceived by the XMM-Newton Survey Science Center (SSC), a consortium of 10 institutions appointed by ESA to help the SOC in distinct technical aspects, including the exploitation of the XMM-Newton serendipitous detections (see http://xmmssc-www.star.le.ac.uk/).

2. X-RAY PROPERTIES OF THE SAMPLE

2.1. Coronal temperatures

A spectral analysis of every X-ray source has been done using an absorbed (WABS) thermal (APEC) model. A 1T or 2T model has been assumed for all the sources but three (HD 32558, GJ 411 and CD-39 7717B), where a third component is necessary to obtain an accurate modelling of the hard tail of the spectrum. The results show a first temperature peaking at $\sim 0,35$ keV and a second one at $\sim 0,95$ keV, with an emission measure ratio (EM_1/EM_2) that peaks at ~ 1.3. The distribution of the two temperatures in the sources where a 1T-model is clearly not enough to reproduce the spectrum, is showed in Fig. 1.

2.2. X-ray variability

The X-ray light curve of the 20 sources with more than 900 counts in EPIC-PN has been studied. The best extraction region has been determined for each star in order to contain the maximum number of photons coming from the source and the minimum from the background. Pile-up effects have been avoided when required by subtracting the central region of the source. Four stars (IM Vir, GJ 411, HD 32558 and CD-39 7717B) present large variations in their light curve. Different processes may be involved in these variations: the binary system

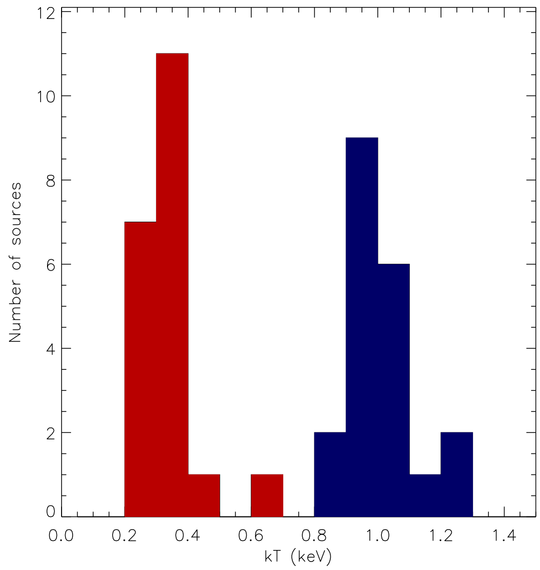

Figure 1. Distribution of T_1 and T_2 for those stars with two temperature components fitted.

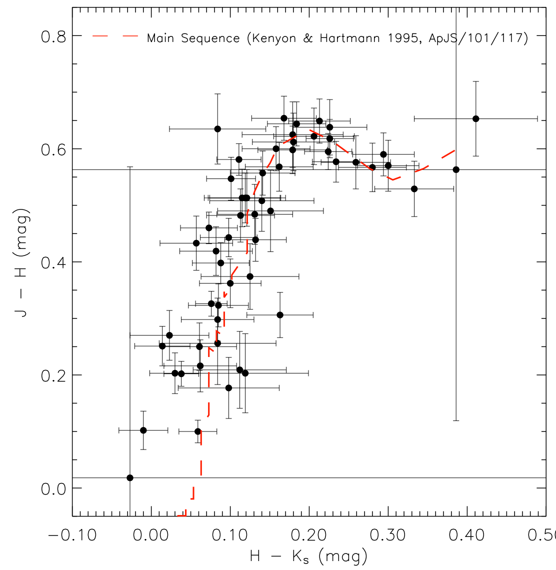

Figure 2. Color-color diagram of the 2MASS – infrared – counterparts of the stars in BSS. Dashed line is the main sequence track.

IM Vir shows rotational modulation of the emission coming from active regions; energetic flare events typical of late-K dwarfs and UV Cet type stars have been detected in the M2 dwarf GJ 411 and the F8 star HD 32558; finally, the young star CD-39 7717B shows a continuous rising light curve which could be induced by accretion.

3. CROSS-IDENTIFICATION

A cross-correlation of our sample with SIMBAD and 2MASS databases has been made in order to find optical and infrared counterparts, respectively. We have used a search radius of 18 arcsec. Nevertheless, all the 2MASS counterparts are situated within 8 arcsec from their corresponding source (95% with an offset $<$ 5 arcsec). In spite of the large radius used, only 28 sources show an optical counterpart in SIMBAD, while the whole sample has been cross-identified with 2MASS. The color-color diagram of the infrared counterparts (Fig. 2) suggests that all the observed sources are indeed main sequence stars.

4. MODEL PREDICTIONS

The X-ray Galactic model XCOUNT (Favata et al., 1992; Micela et al., 1993) has been used for predicting the number and properties of the coronal sources detected in the BSS. A total of 25 stars are predicted by the model for the observational conditions of the survey: 1 dA, 2 dF, 4 dG, 8 dK and 10 dM, where intermediate-age and old stars dominate contributing an 83% (43% and 40% respectively). The reason of the large discrepancy may be related to several causes: uncertainties in the Galactic structure model, adopted X-ray luminosity functions, and statistical uncertainties in the simulation (see Feigelson et al., 2004). In addition, exotic sources such as cataclysmic variables and white dwarfs are not predicted by the model. Spectral types have been derived from the $J - K_s$ color for the 2MASS counterparts. The results, in terms of number of stars of an specific spectral type, have been compared with the predictions, obtaining that there is an excess of yellow stars similar to the observed in other X-ray shallow surveys. Optical spectroscopic observations of our sample are ongoing.

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