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Short and medium term variability study of NGC 2516 solar type stars with EPIC

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Abstract. We present a study aimed to characterize short (hours) and medium (months) term variability of X-ray emission of late-type stars in the young open cluster NGC 2516. X-ray variability studies of solar-type stars in NGC 2516 allow us to explore the dynamo mechanism underlying very active coronae. On short time scales (hours) a more pronounced X-ray variability is observed on the dM stars with respect to dG stars. On time scales of 20 months the distribution of amplitude variations of emission is much lower than on the Sun, thus indicating lack of an analog of solar cycle in young active stars.

Key words. Stars: coronae — Stars: late-type — open clusters and associations: individual: NGC 2516 — X-ray:stars

1. Introduction

Young open clusters offer natural samples of stars with the same physical properties like age, chemical composition and environmental forming conditions. Open cluster studies showed that X-ray activity decreases with stellar age as a result of the rotational slow down and of the relation between stellar rotation and dynamo efficiency. On the Sun, which is a relatively low activity star, X-ray variability is one of main signature of the dynamo mechanism at the heart of the solar corona. NGC 2516 is a rich, young open cluster in the southern emisphere, with age and metallicity very similar to that of the well studied Pleiades. The *XMM-Newton* satellite observed several times NGC 2516 for calibration purposes with typical exposures of ksec. The aim of this work is to evaluate the X-ray variability of a selected sample of dG and dM type stars of NGC 2516 on time scales of hours and months and to compare the observed properties with those of other open clusters, field stars and the Sun.

2. X-ray variability results.

We analyzed 5 EPIC observations encompassing a 19 month period with a typical separation of a few months between subsequent observations. Data sets were processed with the SAS 5.3.3 software; then we filtered the events in the 0.3–5.5 keV energy band and retained only low background rate time intervals. Finally, we focused on a sample of 11 dG and 11 dM type stars (optical catalog from

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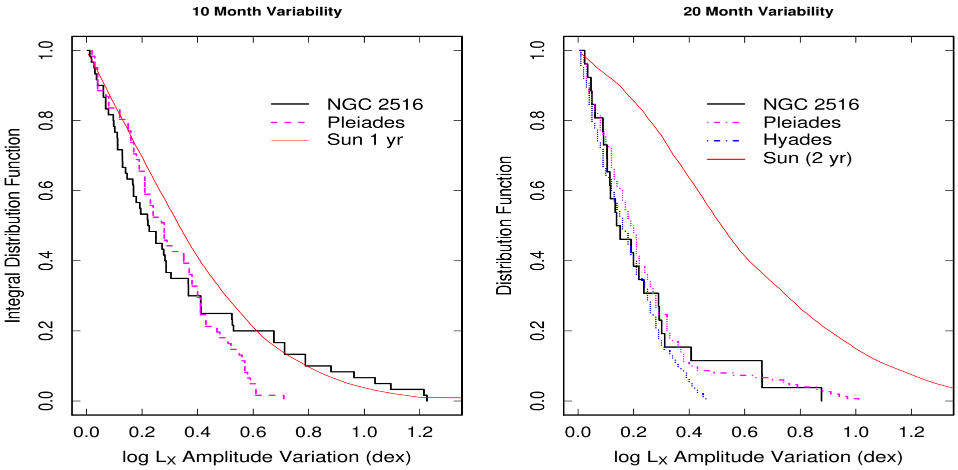

Fig. 1. Cumulative distributions of $\log L_X$ of dG stars in NGC 2516, Pleiades, Hyades and the Sun on time scale of 10 months (left panel) and 20 months (right panel).

Jeffries et al. (2001) with high X-ray counting statistics and detected at least once in our observations. When applying the Kolmogorov Smirnov test, on time scale of hours the fraction of variable dG stars is $\sim$ 13% at a confidence level of 99%. For dM sample the fraction of variables stars is $\sim$ 26%, twice the fraction of variable dG type stars. An analogous result (i.e. more variable sources in dM sample than in dG one) is reported for field stars observed with ROSAT (Marino et al. 2002) while in the coeval Pleiades cluster dG and dM stars show a similar fraction of short-time scale variable stars (Marino et al. 2003).

On time scales of months, we have evaluated for all pairs of observations the ratio between the two values of L_X for each star of the dG sample, observed with a time separation of 10 and 20 months, respectively, and constructed the corresponding integral distribution functions shown in Fig. 1. We have compared them with the analog curves for the Pleiades (Marino et al. 2003) and Hyades clusters (Marino, private comm.) and for the Sun (Micela & Marino 2003). Fig. 1 shows that, on 10 month time scale, NGC 2516 dG stars have amplitude variation distribution intermediate between the Pleiades and the solar ones. On 20 month time scale NGC 2516, Pleiades and Hyades dG stars have very similar distributions of amplitude variations, dominated by much smaller variations than those observed on the Sun. This result suggests that in young stars an analog of the solar cycle, responsible of the observed shape of the Sun distribution, if present, has an amplitude much smaller than in the Sun.

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