X-RAY VARIABILITY AND ROTATION IN THE PLEIADES CLUSTER

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1. Introduction

The issue of coronal emission variability is one of the current problems of stellar physics. The Sun exhibits large variability in X-rays with amplitude of more than one order of magnitude due to a combination of flares, rotational modulation and 11-year cycle. It is unclear which is the temporal behavior of coronal emission of other stars and how the way in which available observations sample the intrinsic variability affects our view.

Here, we present a preliminary report of a comprehensive variability analysis of X-ray observations of the Pleiades cluster. Taking advantage of IPC observations (obtained in 1979/1981), of pointed PSPC observations (obtained in 1991) and of the more recent HRI observations (1994/1996) we have explored time scales up to the solar cycle length in a substantial fraction of the members. For the IPC observations we have adopted the X-ray luminosities reported by Micela et al. (1990), while, with the aim to minimize systematic effects due to different analysis techniques, we have reanalyzed all the PSPC (originally analyzed by Stauffer et al. 1994, and Micela et al. 1996) and HRI observations in a homogeneous way with a Wavelet based algorithm (Damiani et al. 1997a, 1997b). Furthermore we have analyzed separately the single temporal segments of the PSPC and HRI observations, taken at well separated times.

We find that the maximum likelihood cumulative distribution functions of amplitude variations for all cluster members taken together, and in particular for G stars, are very similar to that obtained for solar flares (Drake 1971). Furthermore, the distribution obtained combining all the *Einstein* and ROSAT data (that probes time scales up to 15 years) does not significantly differ from the distribution obtained from the PSPC data only, that instead probes time scales from days to 18 months (see also Gagné et al. 1995).

Furthermore, taking advantage of recent $v\ sin(i)$ and rotational period determination (mainly for the slowest rotators) we revisit the relation between L_x and rotational velocity for G and K Pleiades compared with the relation for Hyades stars of similar spectral types. We find that in the G star sample is present a relationship between L_x and $v\ sin(i)$ (although with a slope less steep than the canonical Pallavicini et al., 1981, v^2 law), but with a dispersion around this relation of a factor 3 - 10, due exclusively to variability. We note that the Hyades tend to stay in the lower part of the distribution of Pleiades data points. In the Pleiades K star sample the relation between X-ray luminosity and rotation is absent down to $v\ sin(i) \sim 3$ km/sec, with an amplitude variation independent of rotation, well evident also in the "saturated" stars, casting doubt on the interpretation of saturation in terms of complete coverage of stellar surface (filling factor equal to the unity). Next step in the process of understanding the nature of the emission of active young stars will be the removal of the extreme X-ray luminosity values due to the occurrence of flares, with the aim of disentangling the variations due to flares from those due to rotational modulation and cycles.

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