ACTIVITY AND ROTATION IN THE YOUNG CLUSTER H PER

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THE PROJECT

Aims

We study the relation between X-ray luminosity and rotational period in young stars, and in particular in stars that, at an age of 10-20 Myr, are in the transition phase between pre-main sequence (PMS) and zero-age main sequence (ZAMS).

Rationale

The activity-rotation relation (see Pizzolato et al. 2003, Wright et al. 2011) at this young evolutionary phases is crucial since at this age both fast and slow rotators co-exist. Moreover this study allows to constrain how stellar activity evolves during PMS phases when stellar internal structure is rapidly changing.

The target: H Persei

We focus on the young open cluster H Per, ~13 Myr old, very rich, located at 2300 pc, and characterized by low extinction.

H Per has been observed with Chandra to measure X-ray luminosity of its members.

H Per rotational periods have been obtained within the framework of the MONITOR project (Aigrain et al. 2007).

X-RAY AND OPTICAL DATA

X-ray observation

We have combined three Chandra observations of H Per, for a total exposure time of 200 ks. We have detected 1010 X-ray sources (red diamonds in fig. 1).

Optical monitoring

Rotational periods have been derived for 586 H Per members (Moraux et al. 2013; blue circles in fig. 1) .

X-ray source identification

We have cross correlated the two catalogs obtaining a final catalog of 202 H Per members with detected X-ray emission and known rotational period.

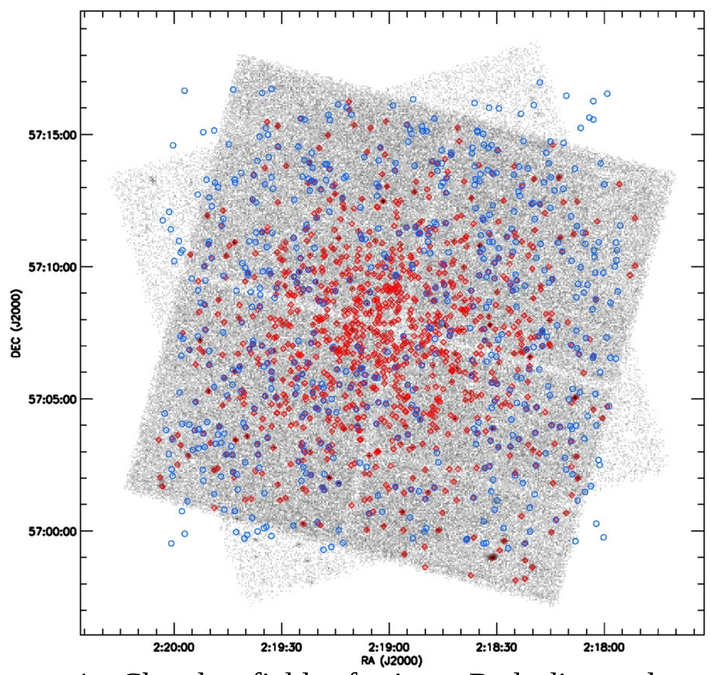

Figure 1: Chandra field of view. Red diamonds mark detected X-ray sources. Blue circles indicate H Per members with measured rotational period.

Stellar parameters

X-ray luminosities have been derived from the observed X-ray flux, corrected for the interstellar absorption. Stellar masses are from Moraux et al. (2013). Empirical turnover times have obtained from the comparison of published photometry (Currie et al. 2010) with the relation provided by Pizzolato et al. (2003).

The final H Per sample is made of stars with:

- L_X ranging from 29.4 to 30.7,
- P_{rot} ranging from 0.13 to 15.9 d,
- masses ranging from 0.3 to 1.6 M_{sun}.

ACTIVITY vs ROTATION: RESULTS

Analysis

We report $\log L_X$ vs rotational period P_{rot} in fig. 2, and $\log L_X/L_{bol}$ vs Rossby number R (the ratio between the rotational period and convective turnover time) in fig. 3.

Stars with 1.3 M_{sun} <M< 1.6 M_{sun} and with short P_{rot} display significant correlation between L_X and P_{rot}. Stars in the same mass range display significant correlation between L_X/L_{bol} and R, for small R value.

Results

- In the saturation region the $\log L_X/L_{bol}$ level depends on stellar mass, and, in particular, it decreases for increasing mass.
- Supersaturation is clearly observed for stars with mass ranging between 1.3 and 1.6 M_{sun}. Lower mass stars do not show supersaturation.

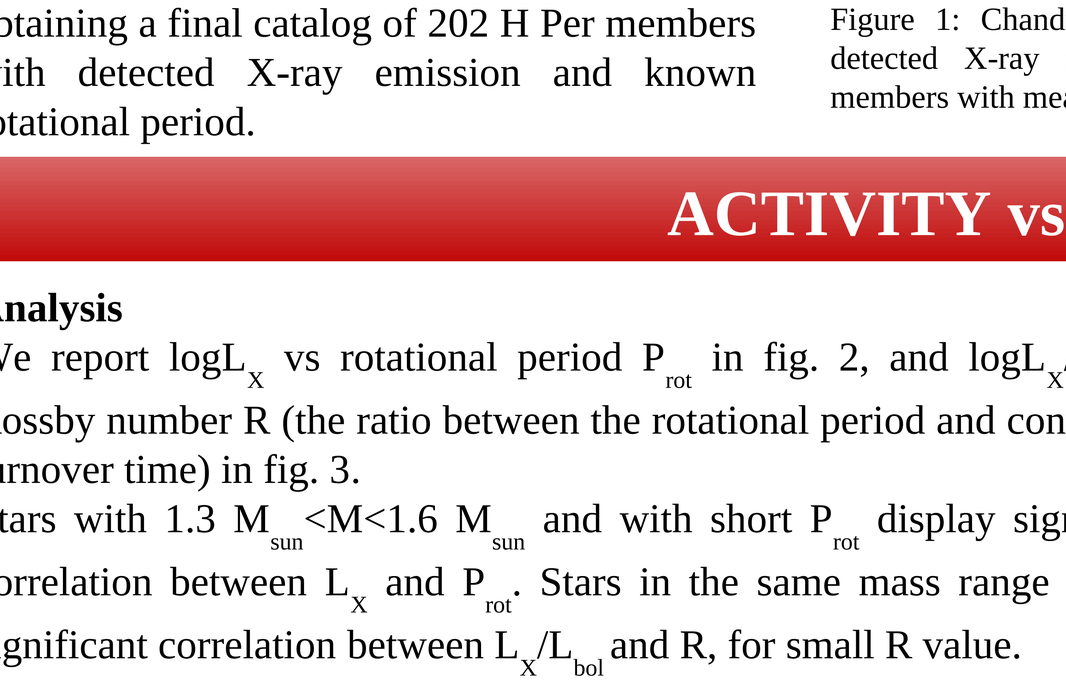

Figure 2: $\log L_X$ vs rotational period P_{rot}.

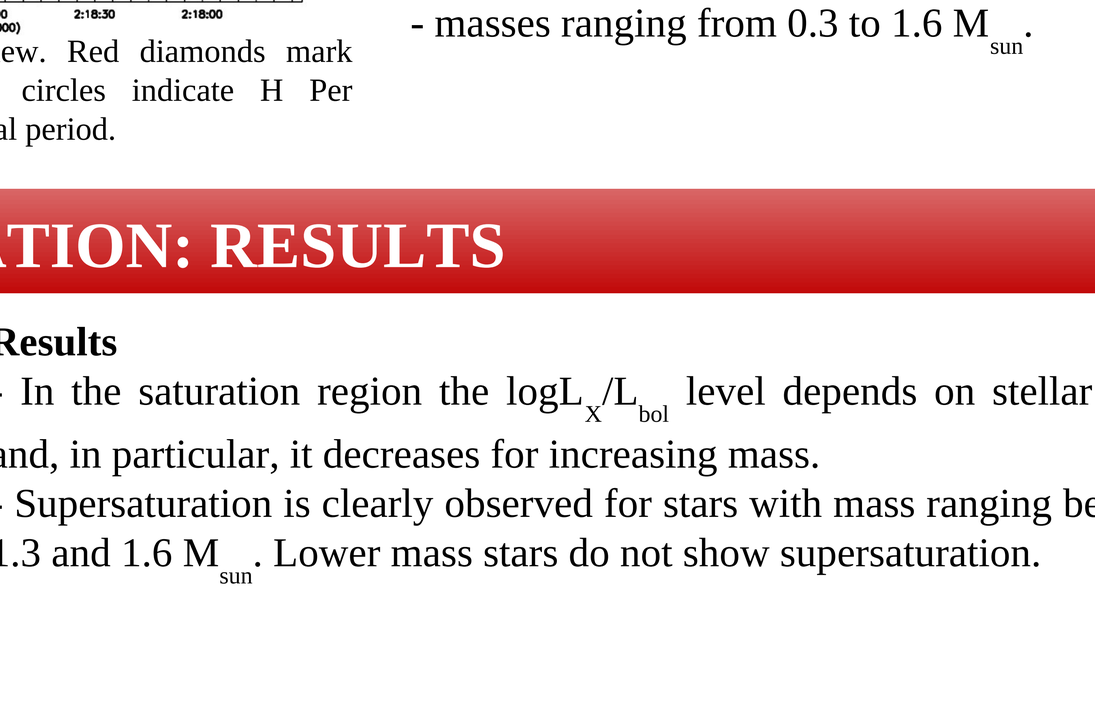

Figure 3: $\log L_X/L_{bol}$ vs Rossby number R. Solid gray line marks the relation derived by Wright et al (2011) for saturated and non-saturated region. Dotted gray line indicated the supersaturation region obtained for $1.3\ M_{sun} < M < 1.6\ M_{sun}$.

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