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THE ROTATION-ACTIVITY RELATION IN 500-MYR-OLD STARS

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We characterize the magnetic activity-rotation relation for low-mass members of the 500-Myr-old open cluster M37. We identify saturated and unsaturated regimes in the dependence of activity to rotation. We find that coronal activity depends more strongly on rotation than chromospheric activity. We also find possible evidence for coronal stripping.

In late-type, main-sequence stars, rotation rate and magnetic field strength decrease over time as a result of angular momentum loss through stellar winds (Parker 1960). We study the rotation-activity relation on a co-eval sample of stars to better understand the relationship between these two quantities.

The ≈500 Myr-old open cluster M37 has been extensively surveyed for rotation periods (P_{rot}) (Messina et al. 2008, Hartman et al. 2009), as well as X-ray detections with *Chandra* (Núñez et al. 2015) and Hα detections with the hectospec instrument at MMT (Núñez et al. 2017), the latter two as magnetic activity tracers in the stellar coronae and chromospheres, respectively.

We calculate Rossby numbers as $R_o = P_{\rm rot}/\tau$, where τ is the convective turnover time, and ratios of X-ray and Hα luminosity to bolometric luminosity, to minimize mass dependencies in our characterization of the rotation-activity relation. Beyond a threshold R_o value, both Hα and X-ray activity are unsaturated and follow a power law of the form R_o^{β}. We find that β is steeper in the X-ray regime (-2.03) than in the Hα regime (-0.51). Furthermore, we find that the R_o threshold value is lower in the Hα regime (0.03) than in the X-ray regime (0.09, see Fig. 1). We interpret this as a possible indicator of coronal stripping (Jardine & Unruh 1999).

The fact that the characteristics of the rotation-activity relation depend on the activity tracer used highlights the need to properly characterize the different heating mechanisms present at the different atmospheric layers in low-mass, main-sequence stars.

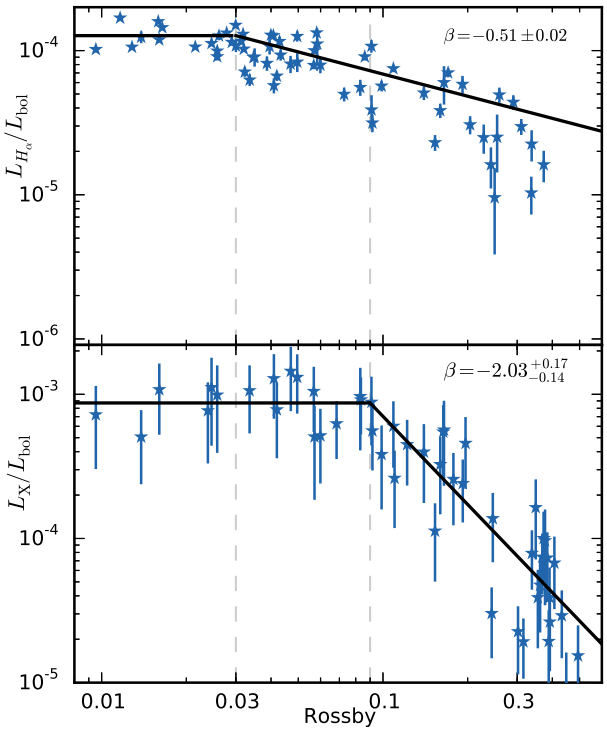

Fig. 1. $L_{\rm H\alpha}/L_{\rm bol}$ v. R_o (top) and $L_{\rm X}/L_{\rm bol}$ v. R_o (bottom) for M37 stars. Solid lines are the MCMC best-fit parameters. Vertical lines mark the threshold R_o values. The best-fit power slopes β are noted in each panel.

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