Stellar Magnetic Dynamos and Activity Cycles

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Abstract

I present results from a sample of 824 solar- and late-type stars with X-ray luminosities and rotation periods, three times larger than previous compilations. This sample is used to study the relationship between these two parameters, which acts as a probe of the underlying stellar magnetic dynamo. We fit a power-law slope to the unsaturated regime of the rotation-activity relationship using an unbiased subset of our sample and derive a fit of L(X) / L(Bol) = C x Roˆ B with B=-2.70+/-0.13. This is inconsistent with the canonical B=-2 slope to a confidence of 5 sigma and argues for an additional term in the dynamo number equation.

We calculate mass-dependent empirical thresholds for saturation and supersaturation. Late F-type stars are shown to never pass through the saturated regime, passing straight from super-saturated to unsaturated X-ray emission, explaining their previously observed low X-ray saturation levels. We identify a correlation between the empirical saturation threshold determined in this work and the time when stars transition between the convective and interface sequences in rotational spin-down models. We suggest that this may be due to a change in the dynamo configuration. I will also present new results searching for evidence of an activity-rotation relationship in fully convective M-type stars that have previously only been observed to have saturated X-ray emission.

Finally I present results from a blind search for X-ray cycles in XMM-Newton and Chandra observations spanning decade-long timescales and including both X-ray active and inactive stars. We combine the results with a full Monte Carlo analysis to derive meaningful conclusions on the frequency and amplitude of stellar X-ray cycles.

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