Title:

Li-rotation connection in pre-Main Sequence, solar and low-mass stars.

PRESENTER:

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Abstract: A connection between lithium depletion and rotation has been reported for a handful of stellar clusters/associations spanning ages from ~5 to ~150 Myrs. **The Lithium-Rotation (Li-Rot) relation consist in fast rotators tend to be Li richer compared to their slower rotator siblings for a specific mass/temperature range**. **This relation can give us insights about transport processes in stellar interiors,** hidden from observations otherwise. For this reason, it is imperative to expand the knowledge of the Li-Rot connection to more clusters (checking its universality), and to better understand its evolution and the different factors at play, like environment and formation scenario.

To test the environmental effects we checked the case of the stellar stream Pisces-Eridanus (Psc-Eri), which is similar in age to the Pleiades. Combining rotational periods (Prot) from the literature with our own high resolution, optical spectroscopic observation with FEROS, **we found that the Li-Rot relation was comparable with the one in the Pleiades, which tells us that this relation might be independent of the formation environment.**

To test the evolution of the Li-Rot relation, we analyzed two cases, the **Upper Scorpius association (USco)** and the **TW Hydrae moving group (TWA)**. Both stellar groups have ages close to ~10 Myr, which is an ideal young age to trace the origins of the Li-Rot relation, but old enough to study "clean samples", since most of their members have lost their discs, and the ones that still preserved them are not supposed to be (dynamically) locked by them anymore.

In the case of **TWA**, we collected and analyzed TESS light-curves from which we obtained Prots from spot modulation, assessed possible contamination given the large pixel scale, and complemented this information with Lithium equivalent width (EWLi) values from the literature. **Although we have a small sample, we found that there is a significant spread in EWLi in the temperature range ~3500-4500 K. Moreover, there is a hint that the Li-Rot connection is already operating in this population.**

In the case of **USco**, we collected Prots from Rebull et al. 2018 (based on K2 data) and mined the literature for EWLi measurements. **We show preliminary results for this population highlighting the higher complexity found**. Since multiplicity can impact both, the determined Prot as well as the EWLi, for both populations we thoroughly addressed the multiplicity of their members taking advantage of different Gaia astrometric and photometric diagnostics, multiplicity catalogs and other indicators.

Li-Rotation relation newly found in three stellar populations: Pisces-Eridanus, TW Hya, and Upper Scorpius

Environment effects

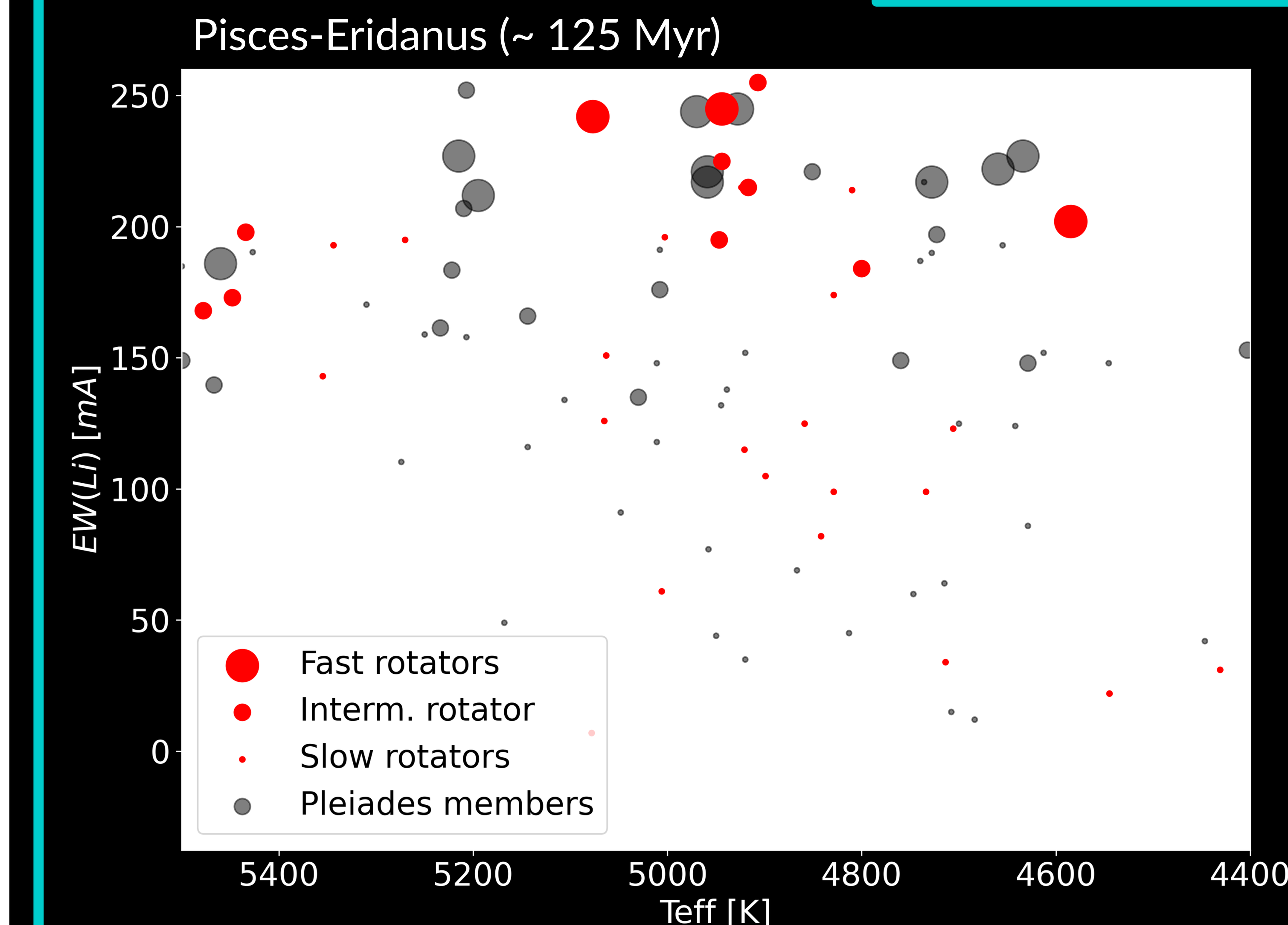

Fig. 1: EW(Li) as a function of effective temperature. Psc-Eri and Pleiades members are represented with red and gray circles, respectively. Symbol sizes highlight three regimes of Prot. "Fast rotators" (0 < Prot / [d] < 2), "Intermediate rotators" (2 < Prot / [d] < 5.5), and "Slow rotators" (5.5 < Prot / [d] < 10).

Li-Rotation relation in PscEri analogous to the one in the Pleiades

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Independent of formation Environment

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Evolution

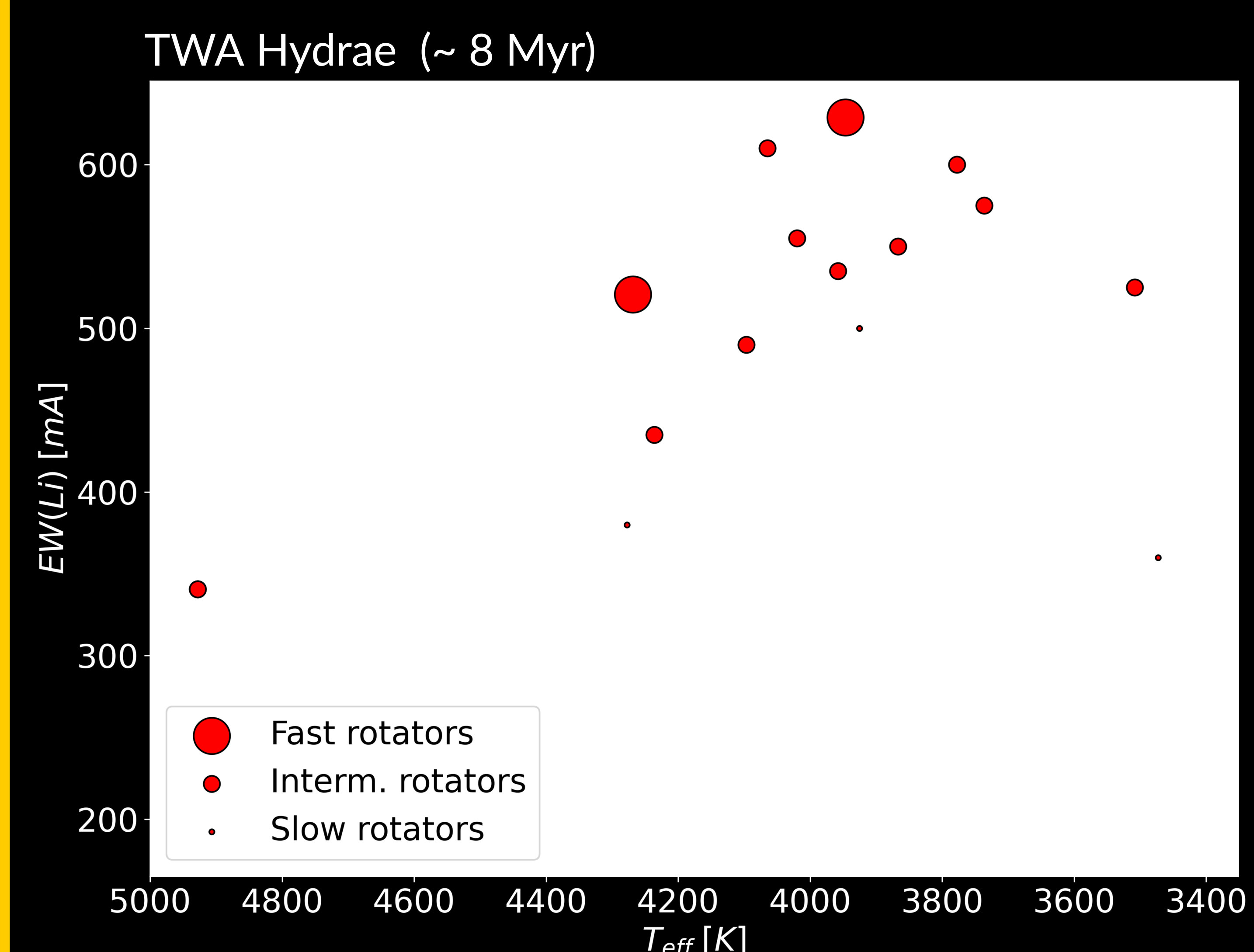

Fig. 2: Same as Fig. 1 but for TWA members. In this case, the three regimes of Prot are: "Fast rotators" (0 < Prot / [d] < 2.5), "Intermediate rotators" (2.5 < Prot / [d] < 7), and "Slow rotators" (P / [d] > 7).

Hint of the Li-rotation relation presence

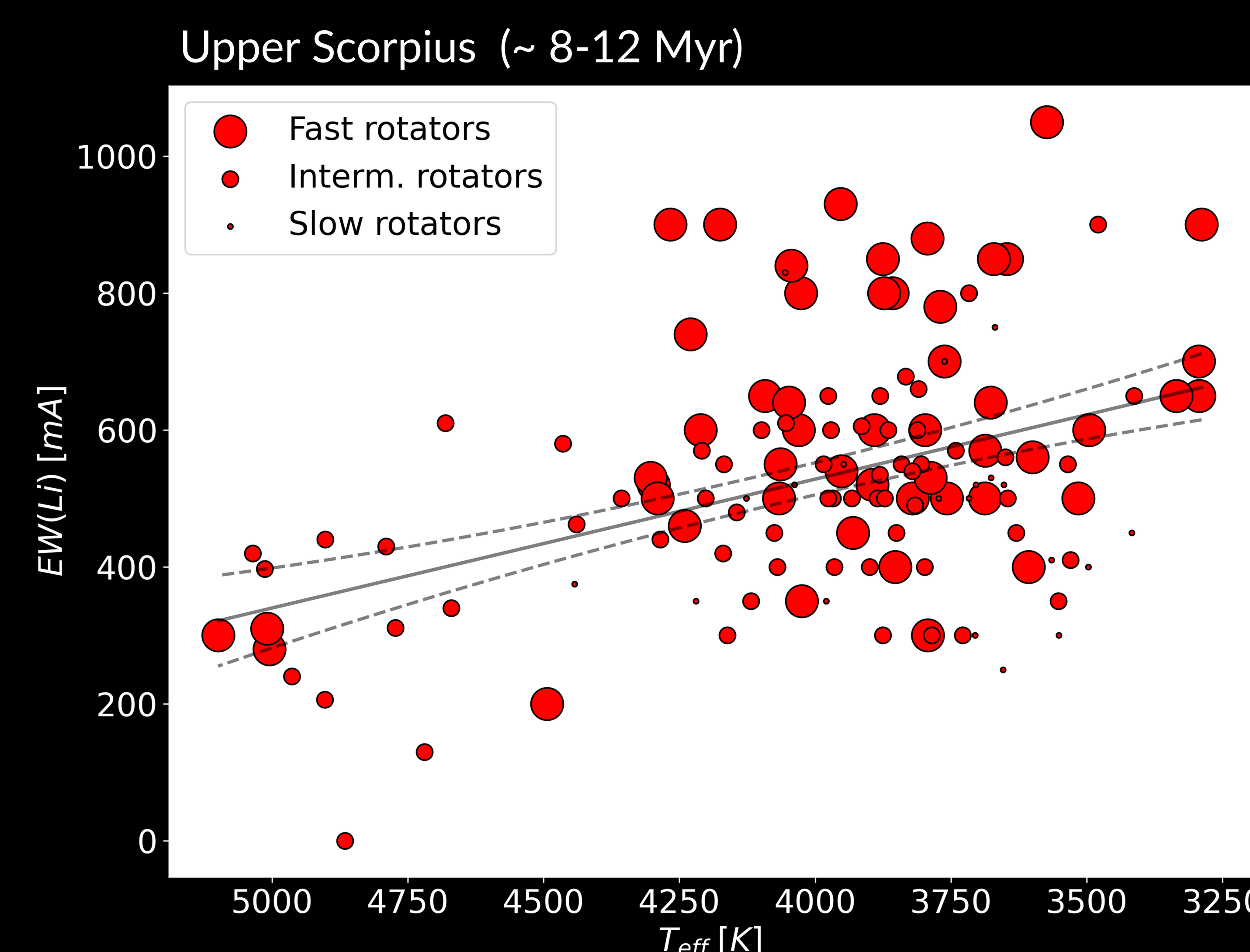

Fig. 3: Same as Fig. 1 but for USco members. In this case, the three regimes of Prot are: "Fast rotators" (0 < P / [d] < 2.25), "Intermediate rotators" (2.25 < P / [d] < 7.3), and "Slow rotators" (P / [d] > 7.3). Black solid and dashed lines highlight the best linear fit and confidence intervals (5-95%) obtained via bootstrapping the "single object" subsample.

Although not so clear compared to the other cases, "Li rich" objects are in general faster rotators (see Fig. 5)

Additional figures

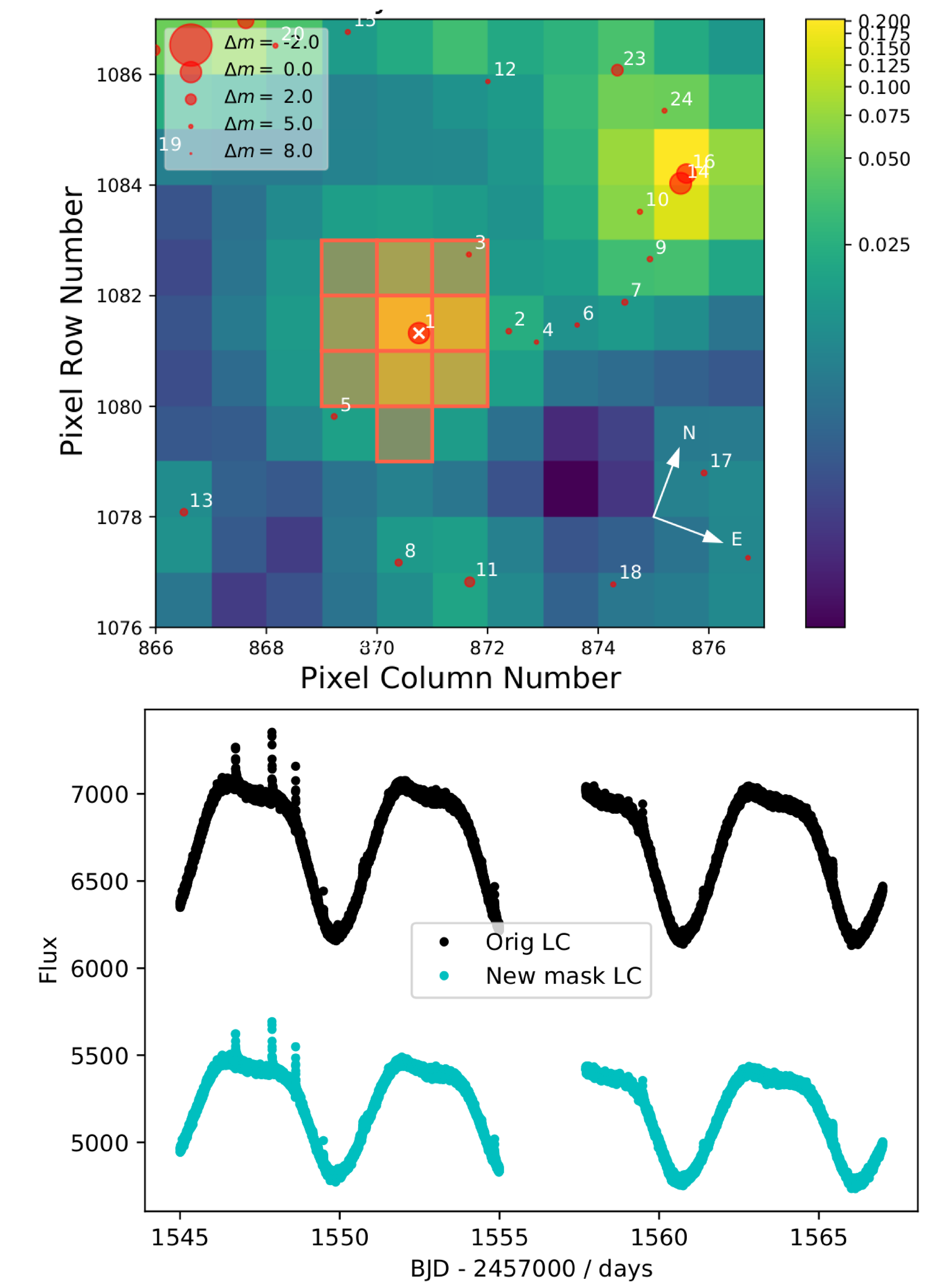

Fig. 4: Top panel: Example of a TESS stamp with the mask used by the pipeline. Bottom panel: Example of the light curve obtained by using the pipeline mask ("orig LC") vs. using a new mask that excludes the contaminated pixel ("new mask LC").

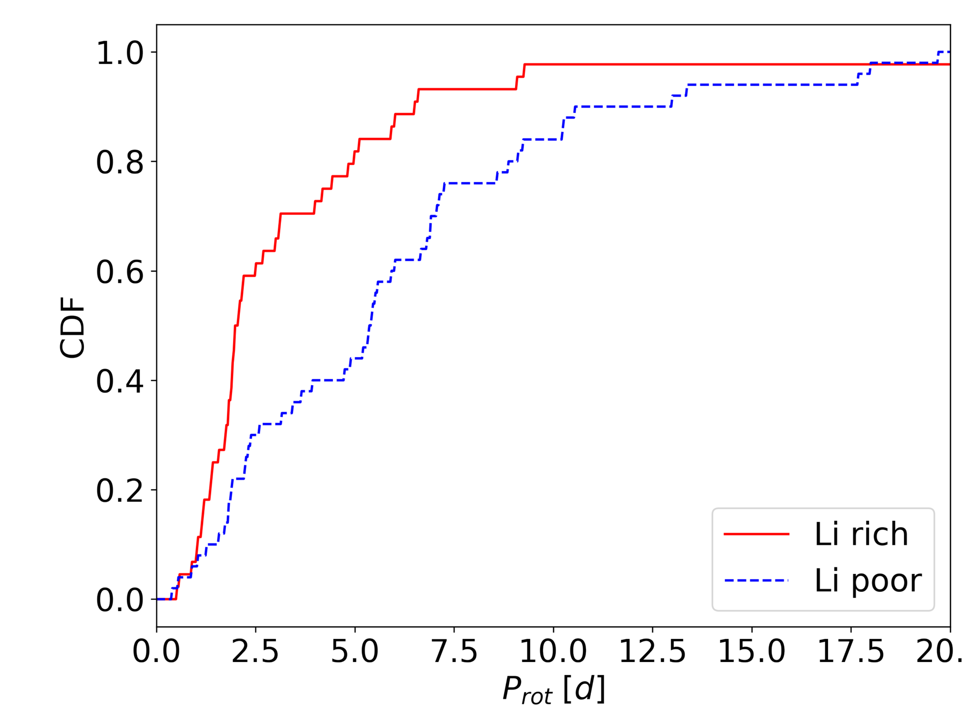

Fig. 5: Cumulative distribution functions for the "Li rich" (EW(Li) over the linear fit from Fig. 3) and "Li poor" (EW(Li) below the linear fit) subsamples in USco.

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