Constraining Stellar Rotation at the ZAMS

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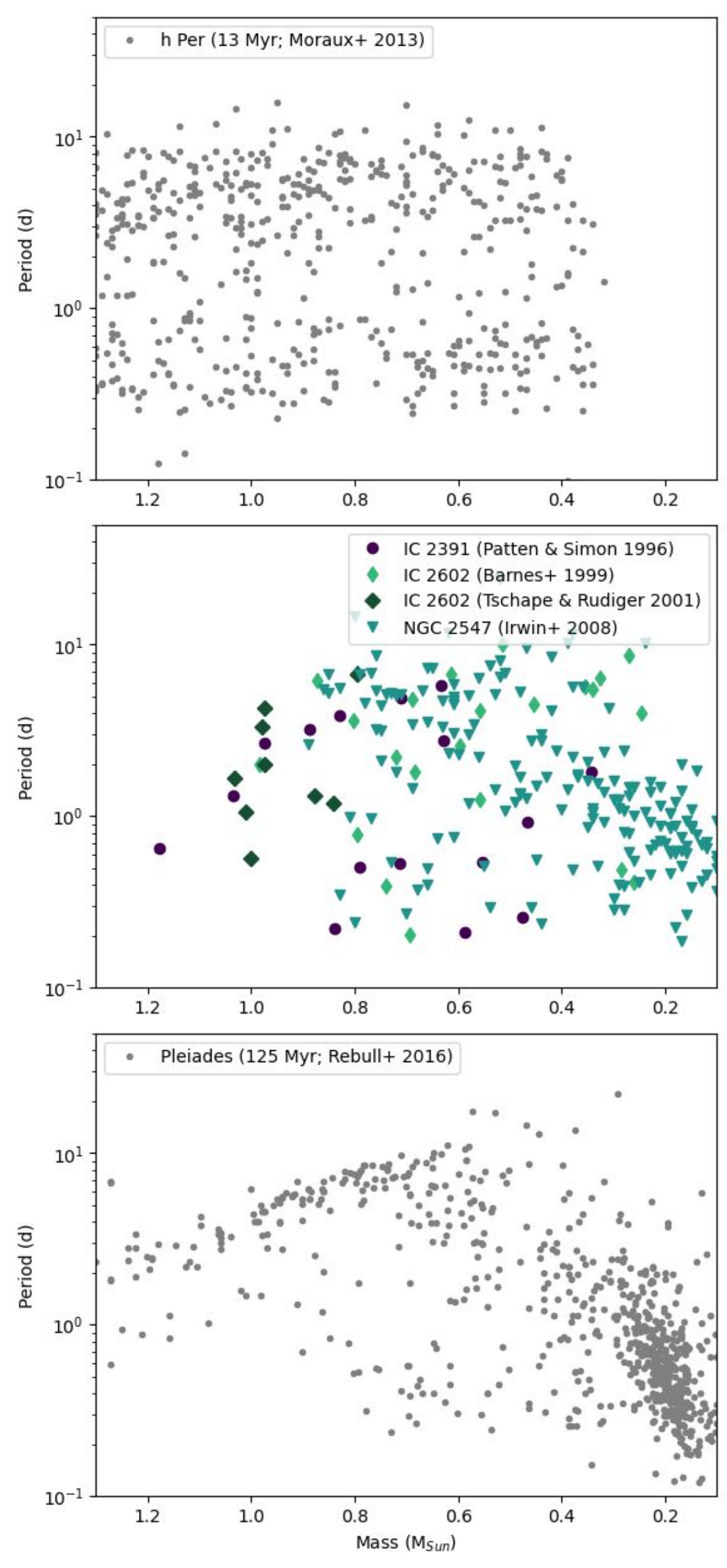
Introduction



Low-mass stars are born with a range of rotation rates. As they contract on the pre-main sequence, they spin up.

Once stars reach the zero-age main sequence (ZAMS), contraction ends, and braking by a magnetized stellar wind begins to spin the star down (e.g., Barnes 2003).

Current models for ZAMS Solar-mass stars are constrained largely by h Per (13 Myr) and the Pleiades (125 Myr).

There are very few observational constraints on the rotation of Solar-mass stars at this critical age.

Using TESS FFI data, we present the first large sample of rotation periods (P_{rot}) for Solar-mass stars between 30-60 Myr.

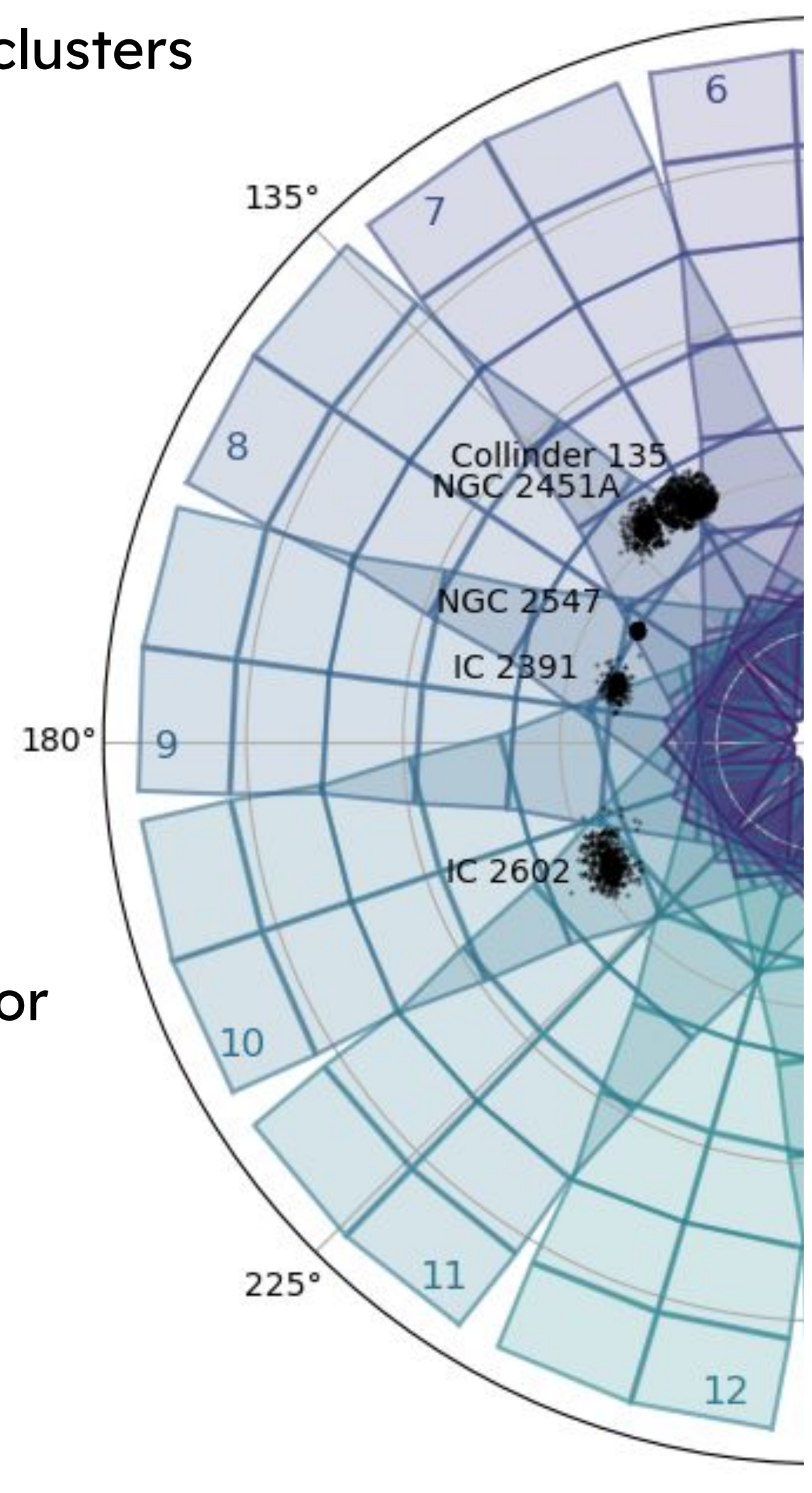
ZAMS clusters in TESS Cycle 1

We focus on five young clusters in the southern sky:

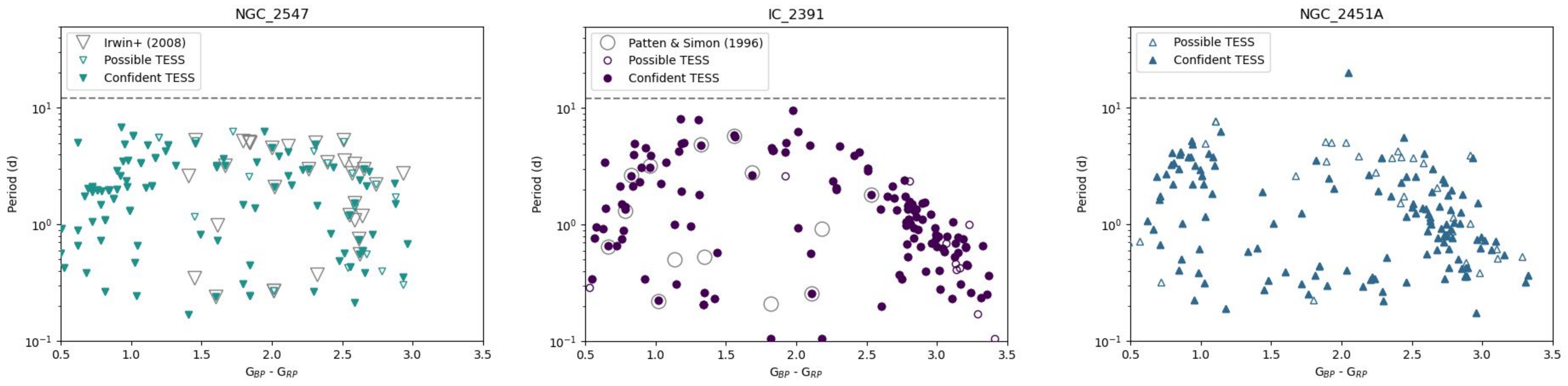
- Collinder 135
- NGC 2451A
- NGC 2547
- IC 2391
- IC 2602

Ages are debated in the literature, but average 30-60 Myr.

Literature ages have a scatter of ~10-20 years for each individual cluster.



New rotation periods from TESS



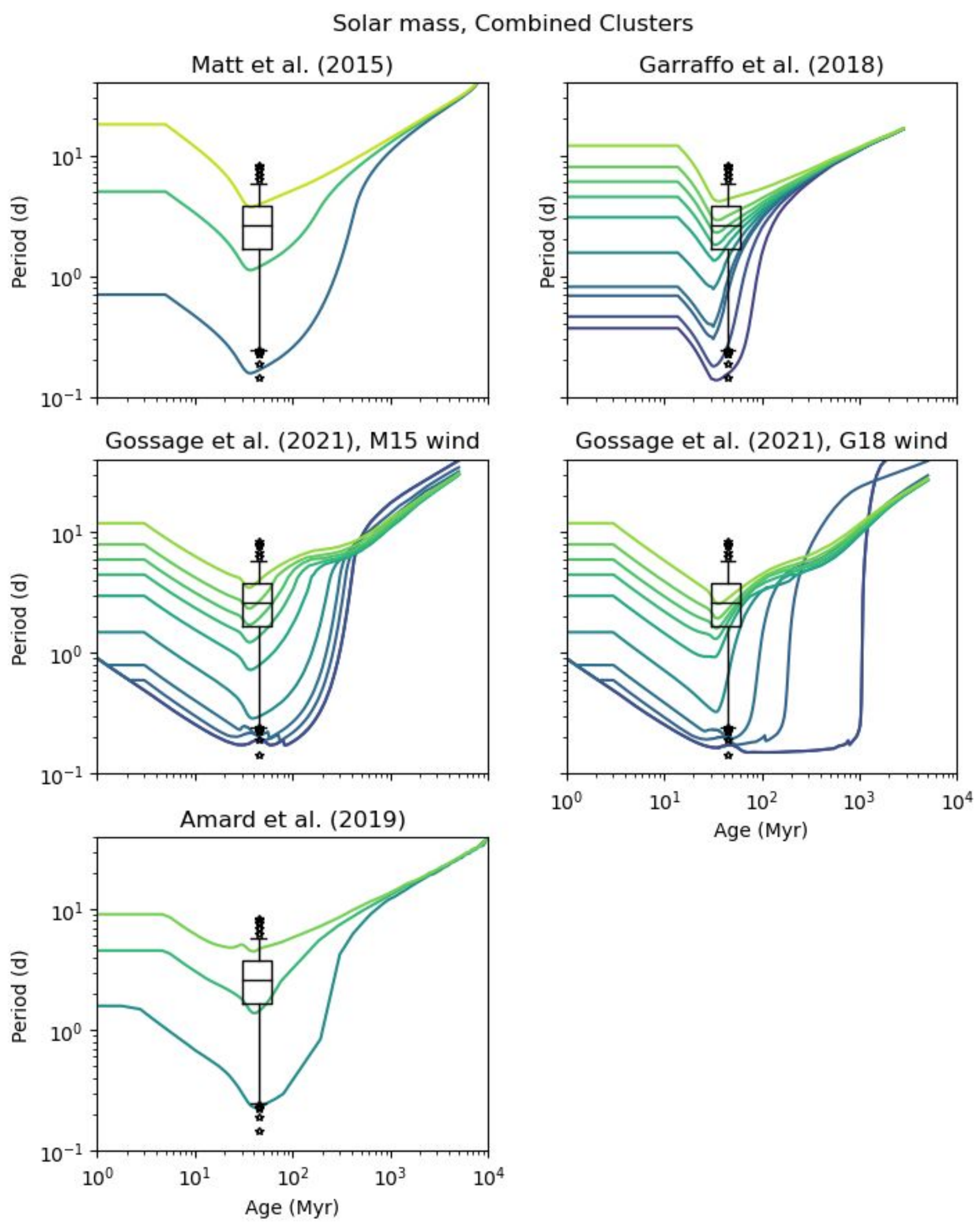
We use TESS light curves from the Cluster Difference Imaging Photometric Survey (CDIPS; Bouma et al. 2019) and the MIT Quick-Look Pipeline (QLP; Huang et al. 2020).

We measure P_{rot} using Lomb-Scargle Periodograms, and visually inspect all light curves to identify false detections due to systematics or instrumental noise

Figures above show P_{rot} vs. uncorrected BP-RP color for three clusters; solid (open) colored symbols indicate confident (possible) detections. Grey open symbols indicate literature periods.

We have significantly increased the number of P_{rot} in these benchmark ZAMS clusters.

Comparison to models of angular momentum evolution

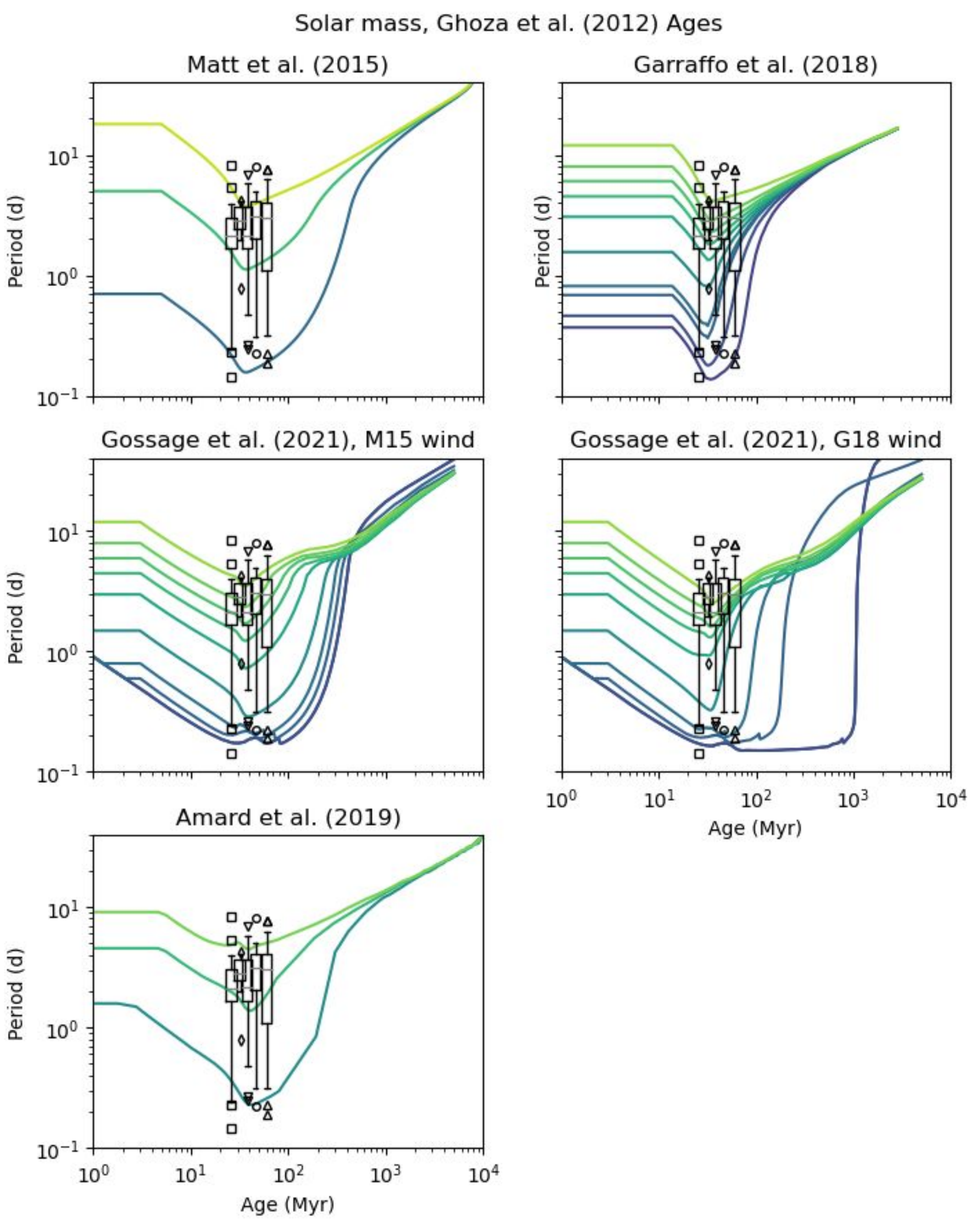


Left: Distribution of rotators in all five clusters; boxes show the 25th-75th percentile data and whiskers extend to the 5th and 95th percentiles. Colored lines show rotational evolution tracks from several models.

Assuming the typical age range found in the literature (30-60 Myr), we find that ZAMS stars extend to slower periods than expected, while rapid rotators roughly match the models.

Right: the same models, but compared to data for individual clusters. Few studies have measured ages for all five clusters, and those that do sometimes find very different ages.

Model-data agreement depends on the ages chosen for each cluster, and requires further analysis.

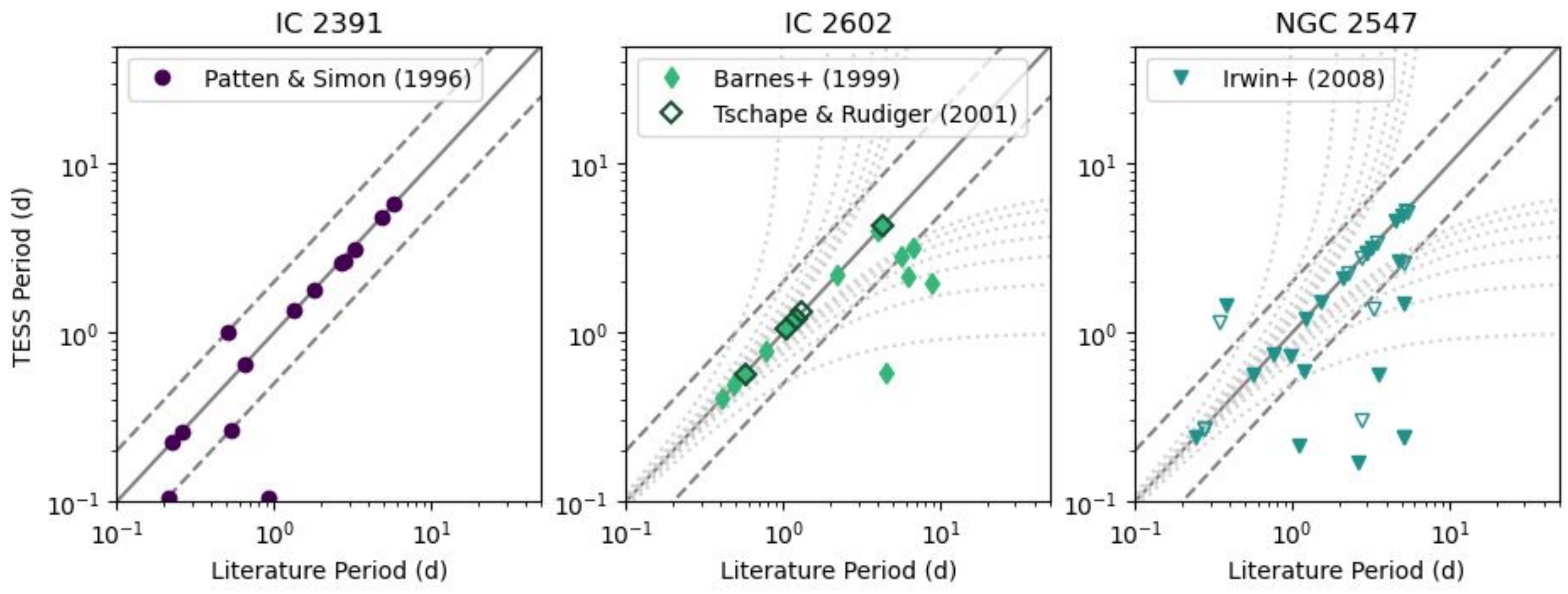


Comparison to previous measurements

Four previous studies have included clusters in our sample. Most literature P_{rot} are for K and M stars, not Solar-mass stars.

In IC 2391 and IC 2602, TESS periods generally match the literature, or are half/double period harmonics.

NGC 2547 has more discrepancies which cannot be explained as aliases or harmonics. Since this is the densest cluster in our sample, there may be problems with blending in the TESS data.



Acknowledgements & References

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