Stellar Evidence of a Solar Dynamo in Transition

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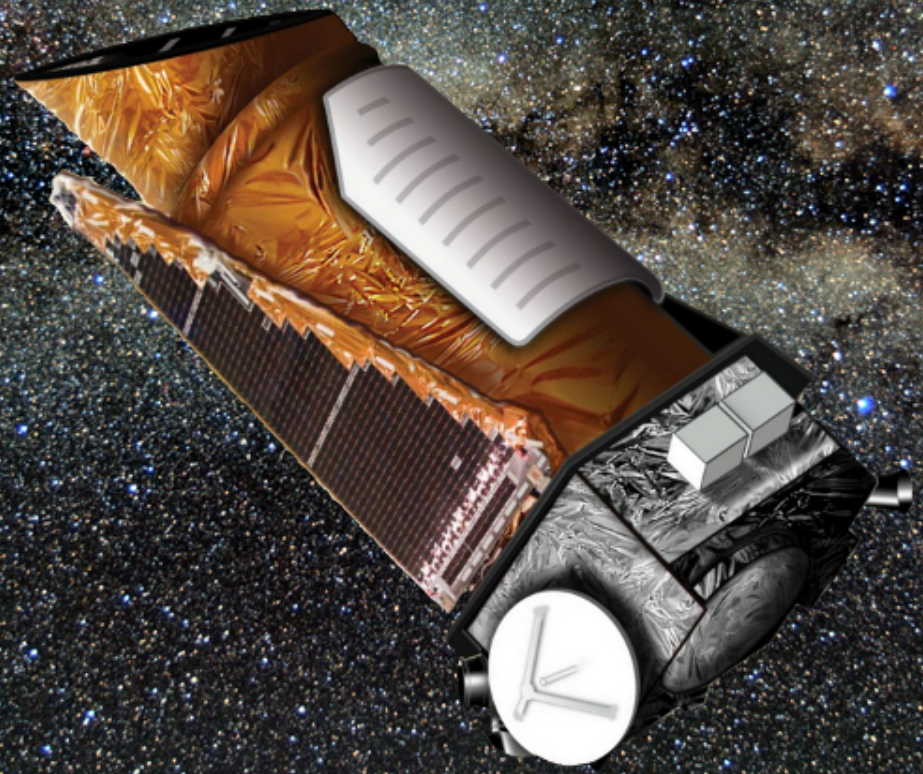
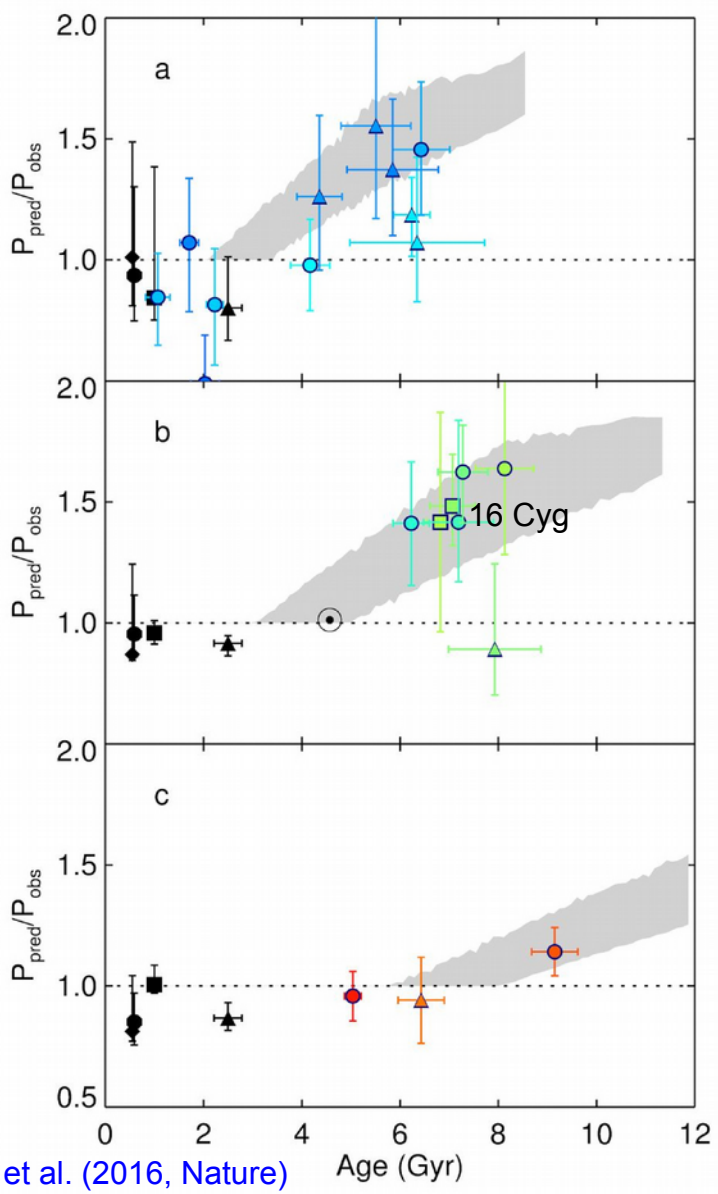


Collaborators: Ricky Egeland, Jennifer van Saders

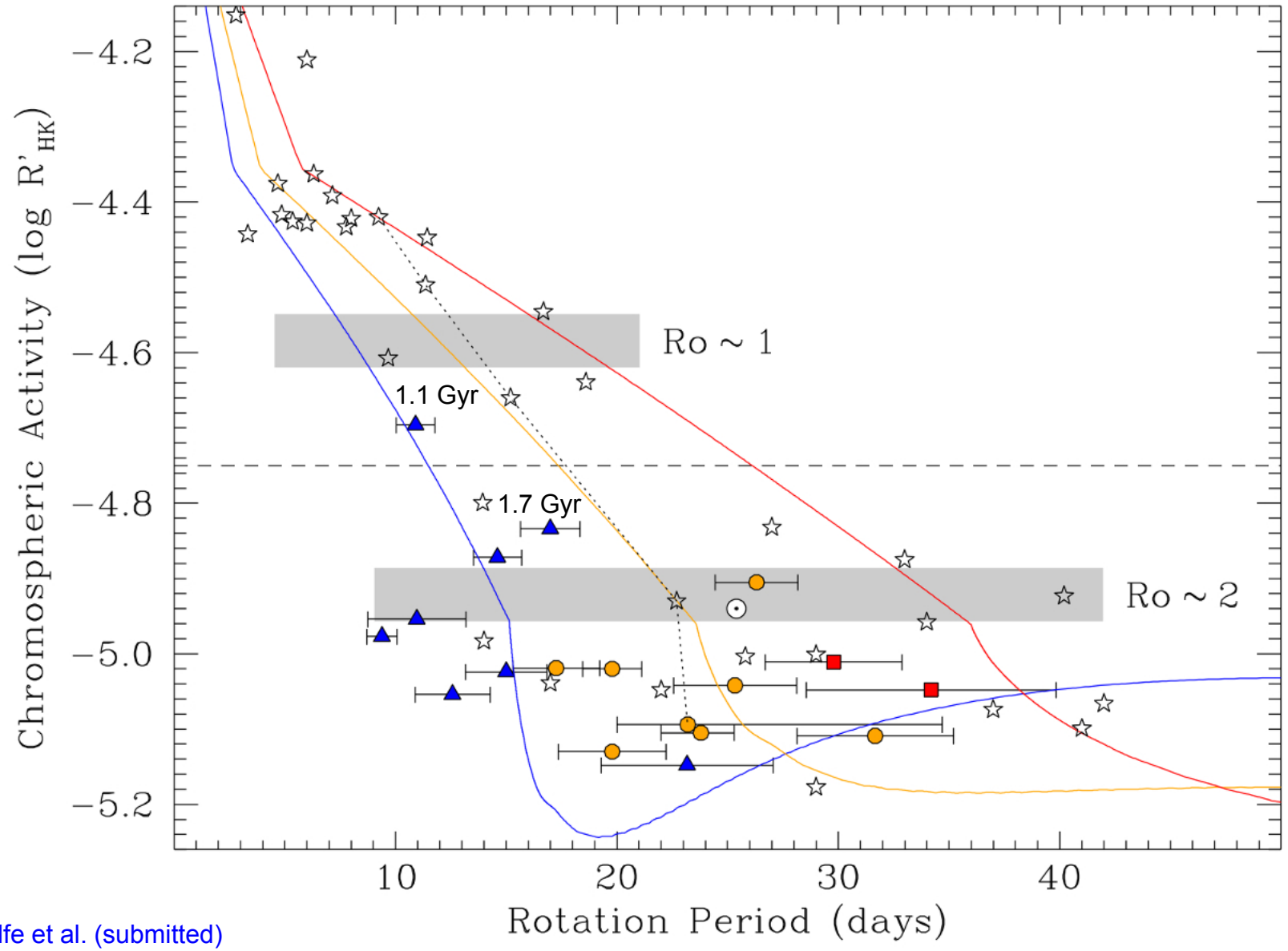
Breaking magnetic braking



van Saders et al. (2016, Nature)

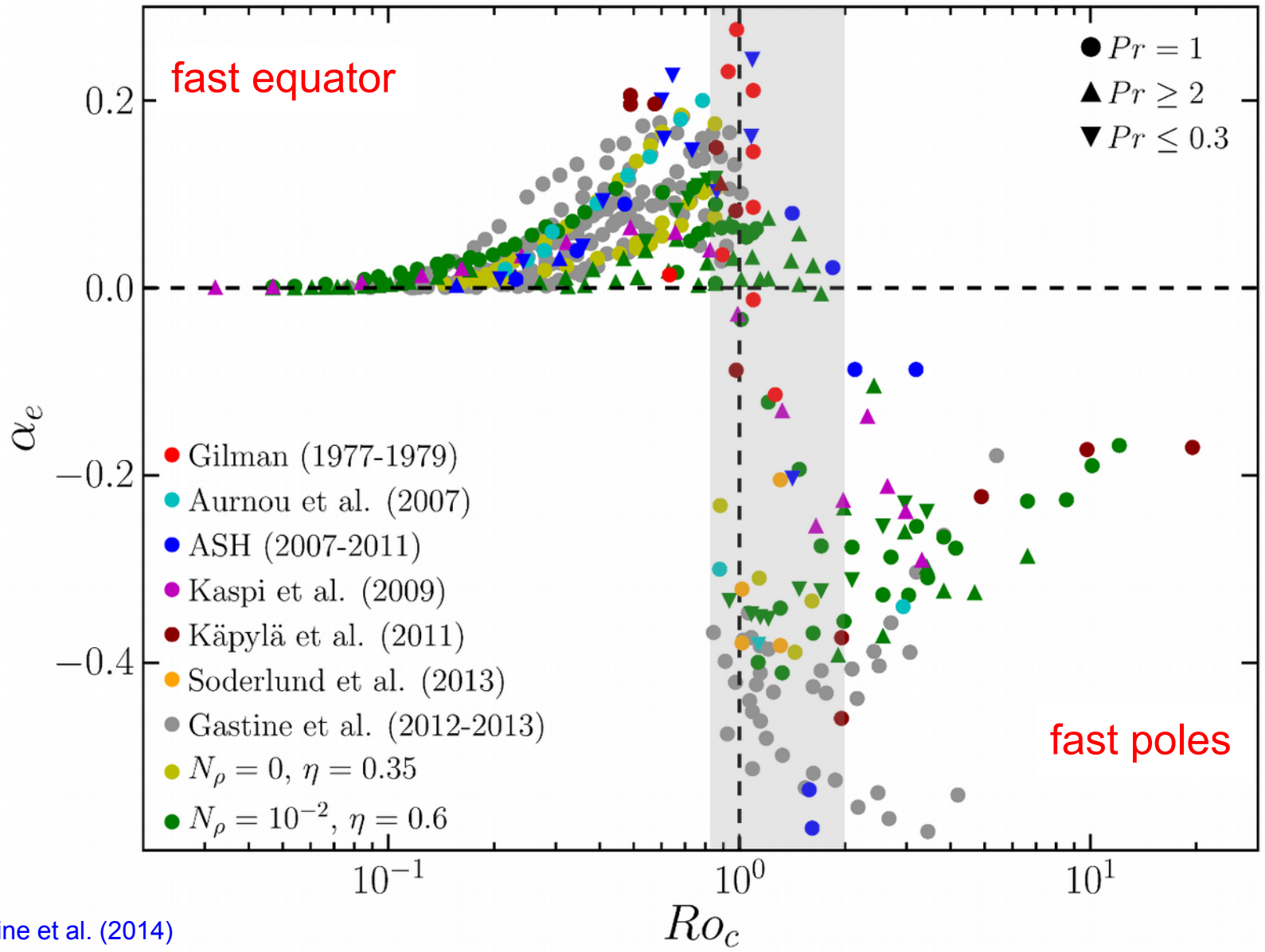
- Stars beyond middle-age rotate more quickly than gyrochronology predicts
- Onset is earlier in F-type, near solar age in G-type, later in K-type stars
- Effect seems to appear beyond a critical Rossby number (Ro ~ 2)

Rotation-activity relation



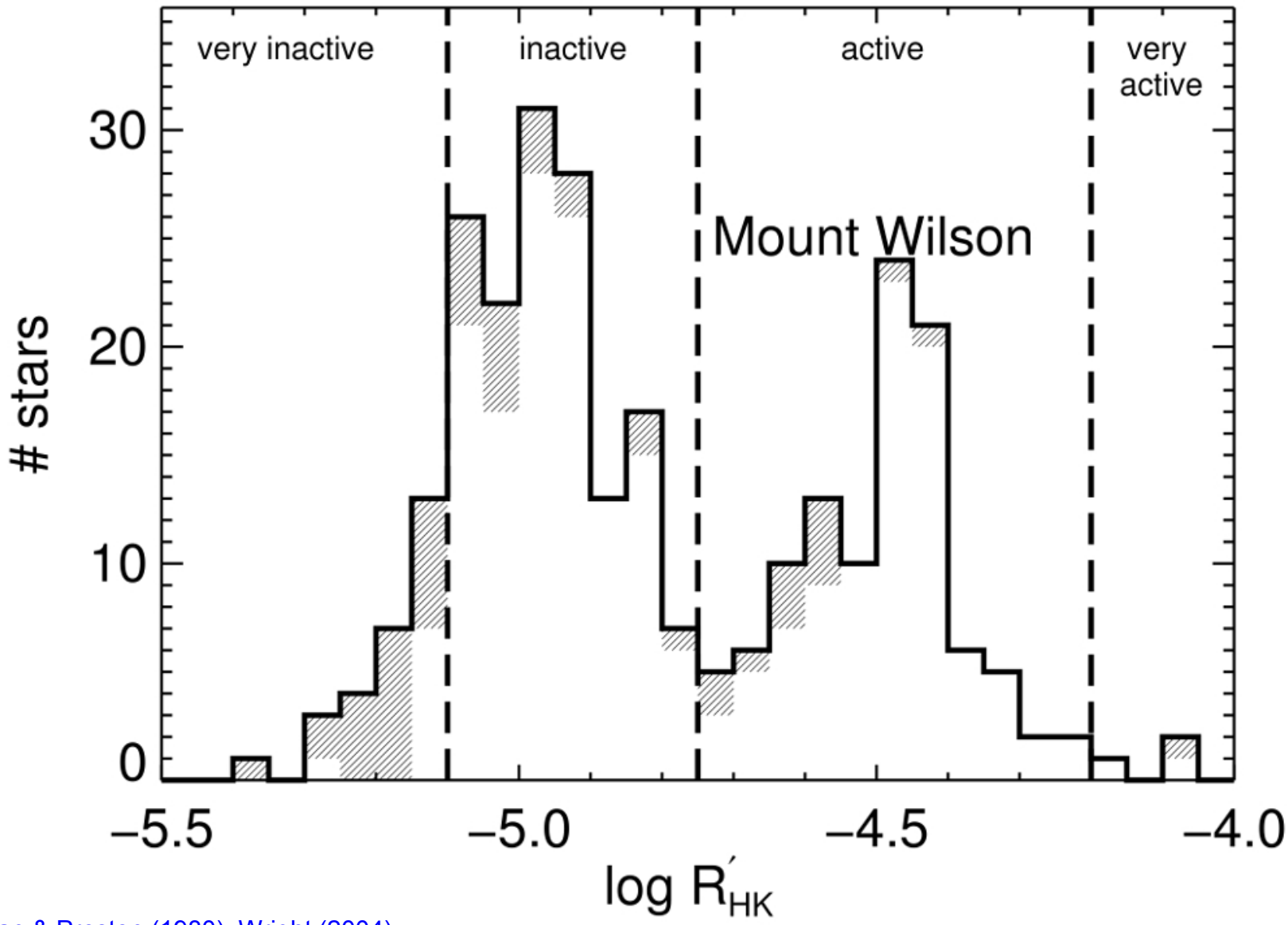
Metcalfe et al. (submitted)

Differential rotation



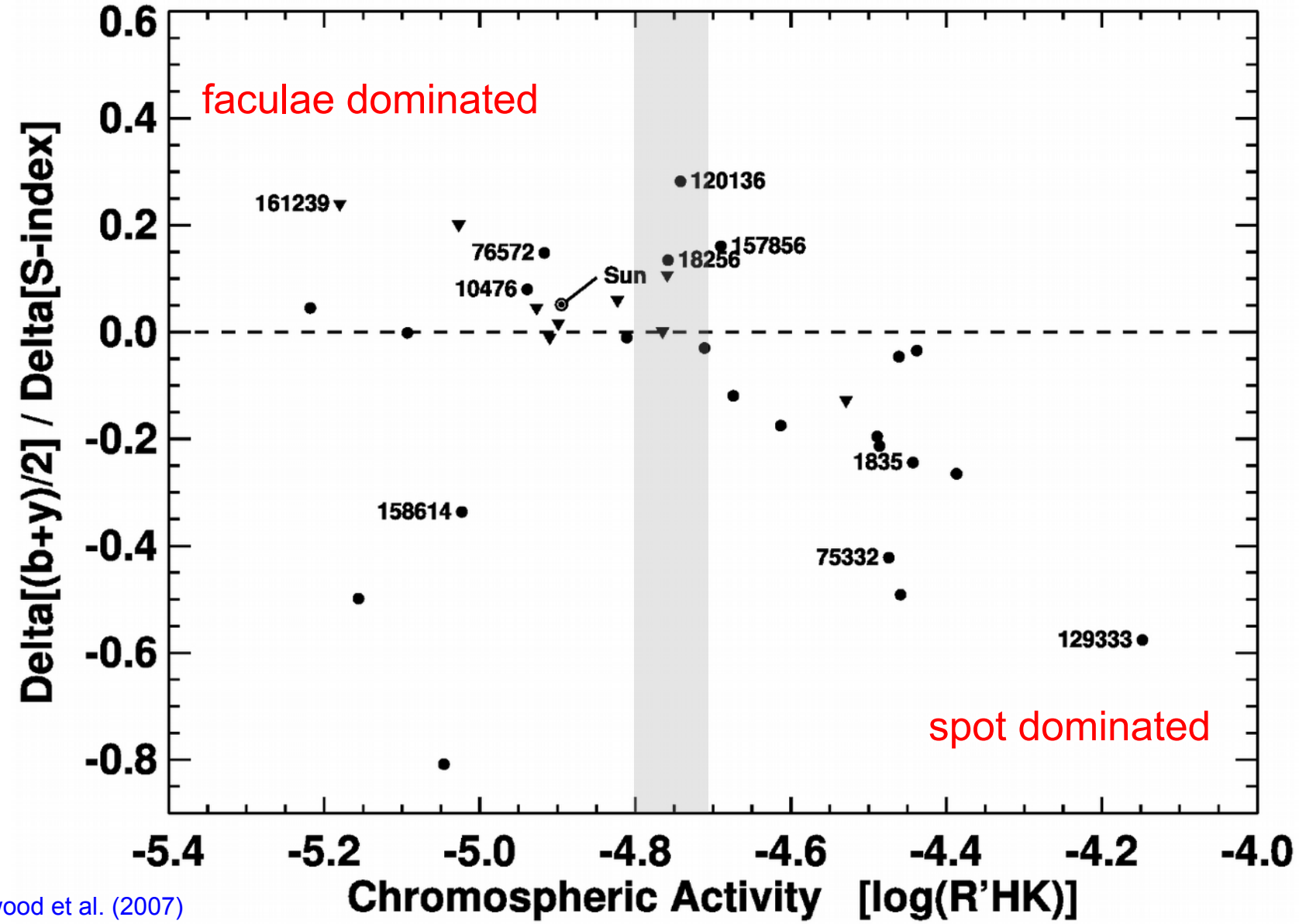
Gastine et al. (2014)

Vaughan-Preston gap



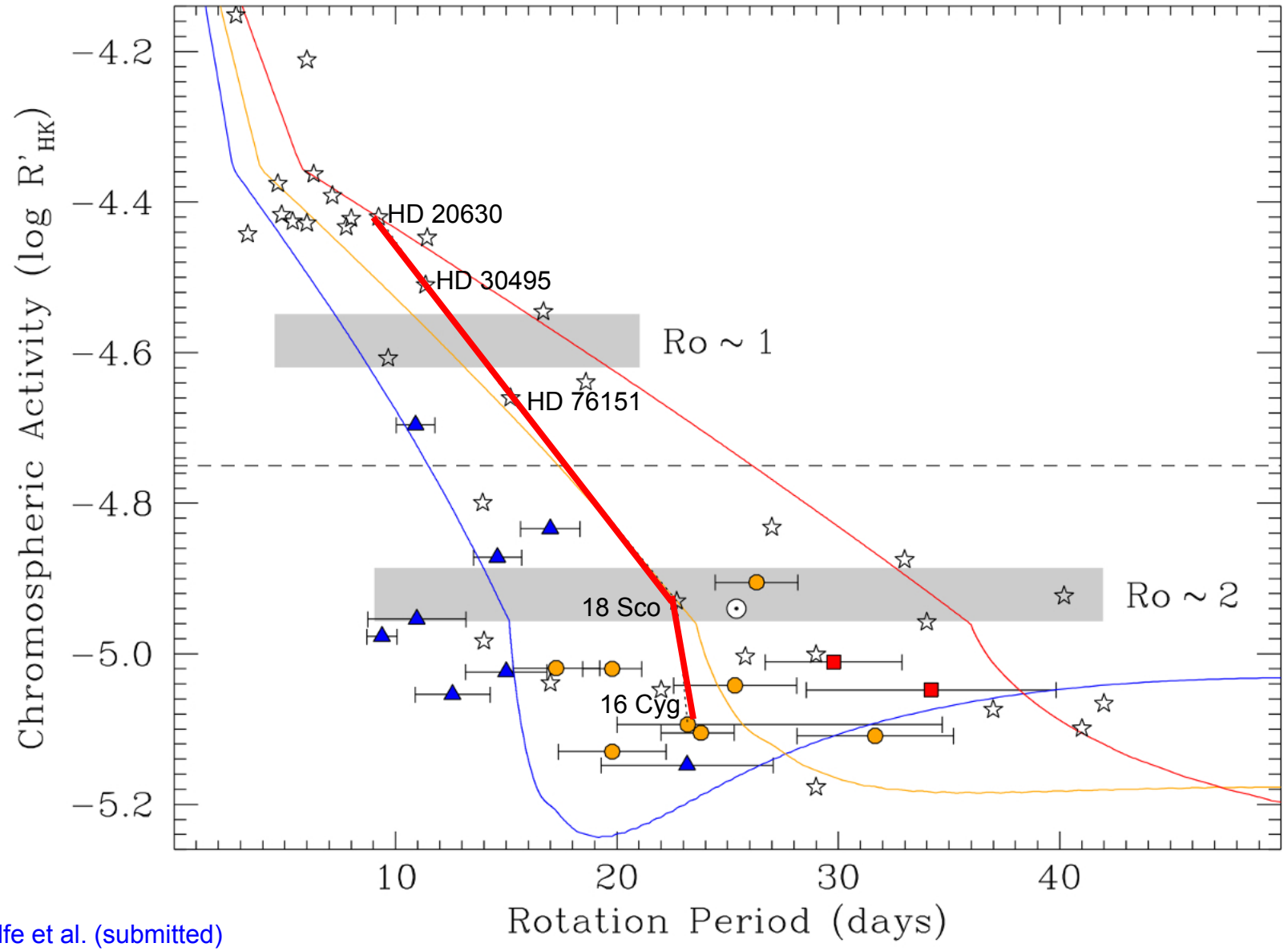
Vaughan & Preston (1980); Wright (2004)

Spots and faculae



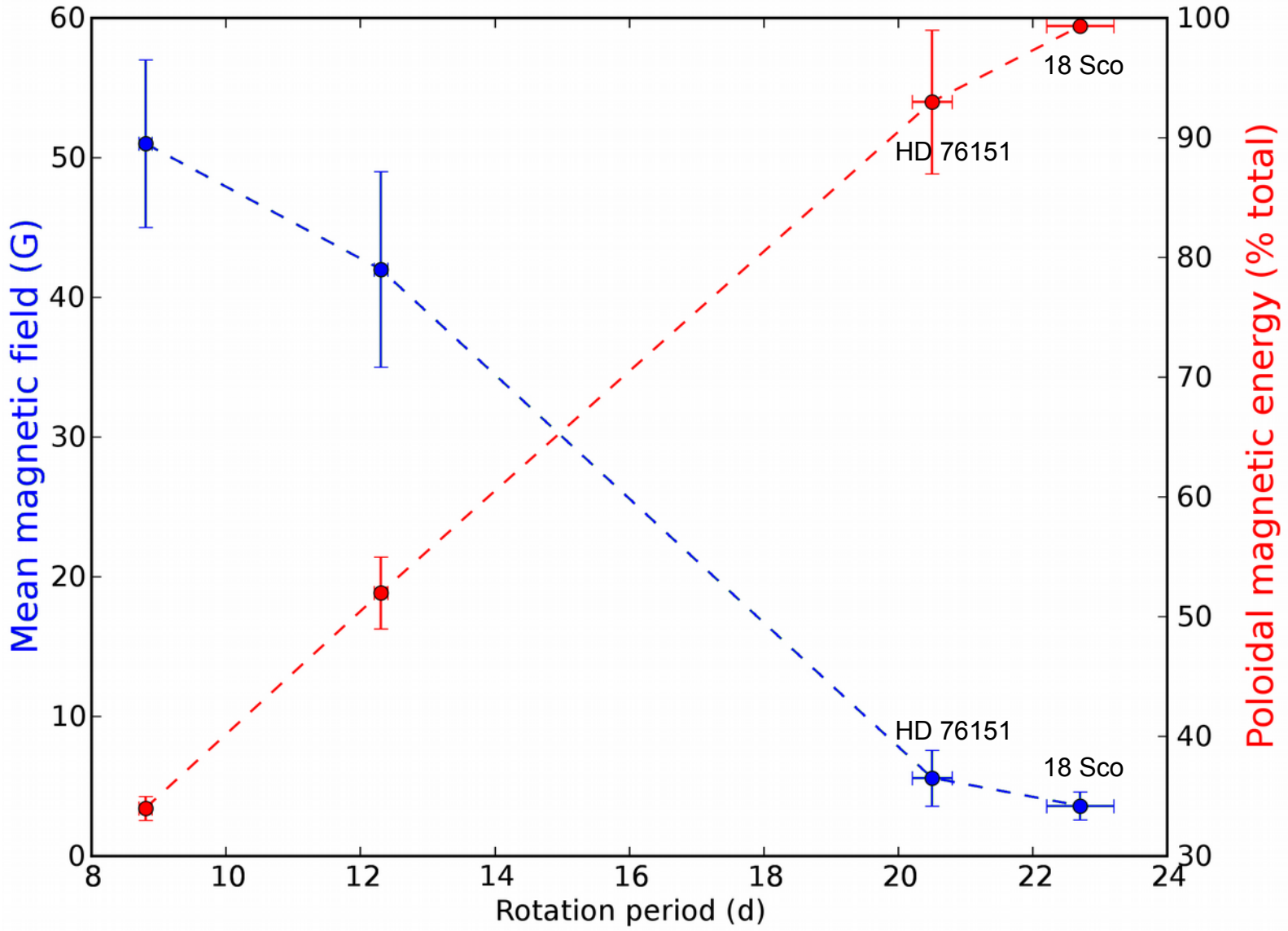
Lockwood et al. (2007)

Solar analogs



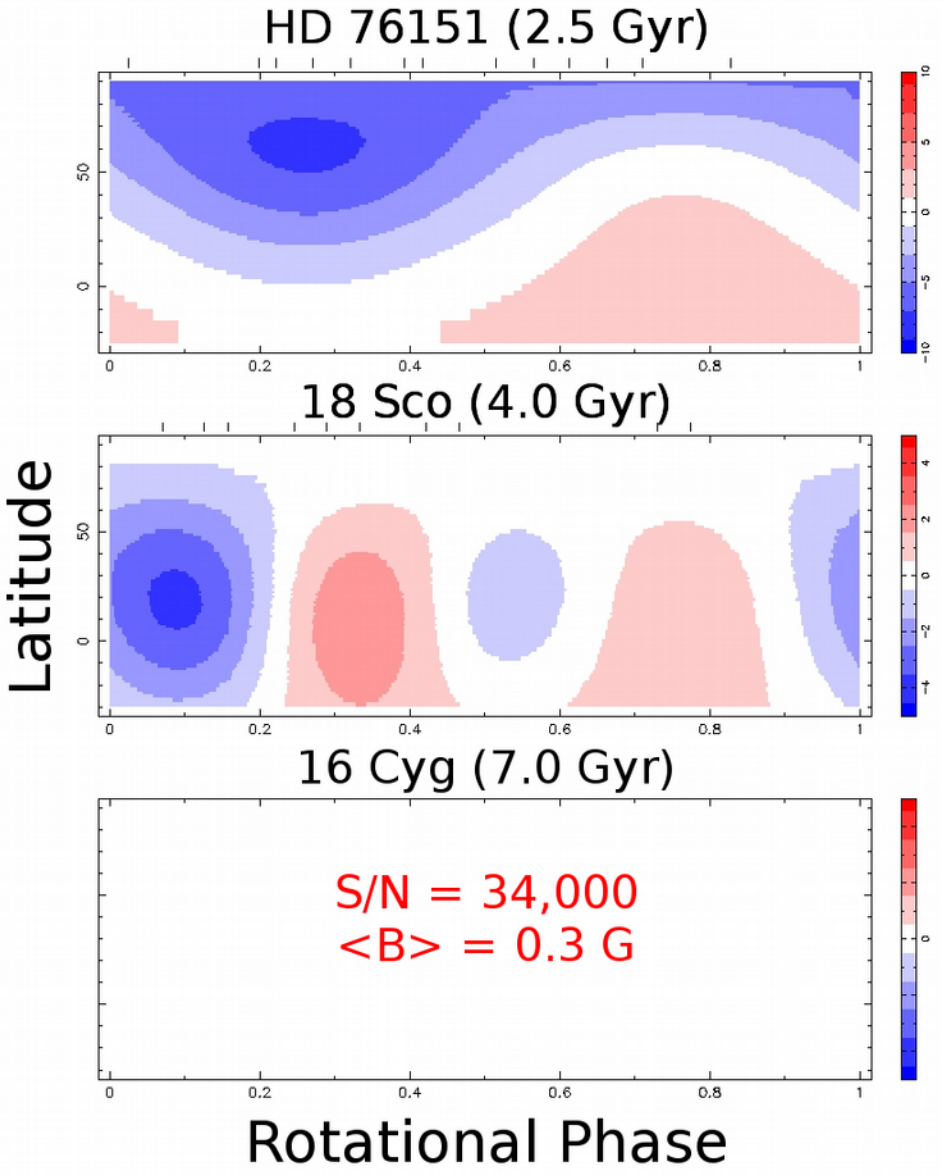
Metcalfe et al. (submitted)

Zeeman Doppler imaging



Petit et al. (2008)

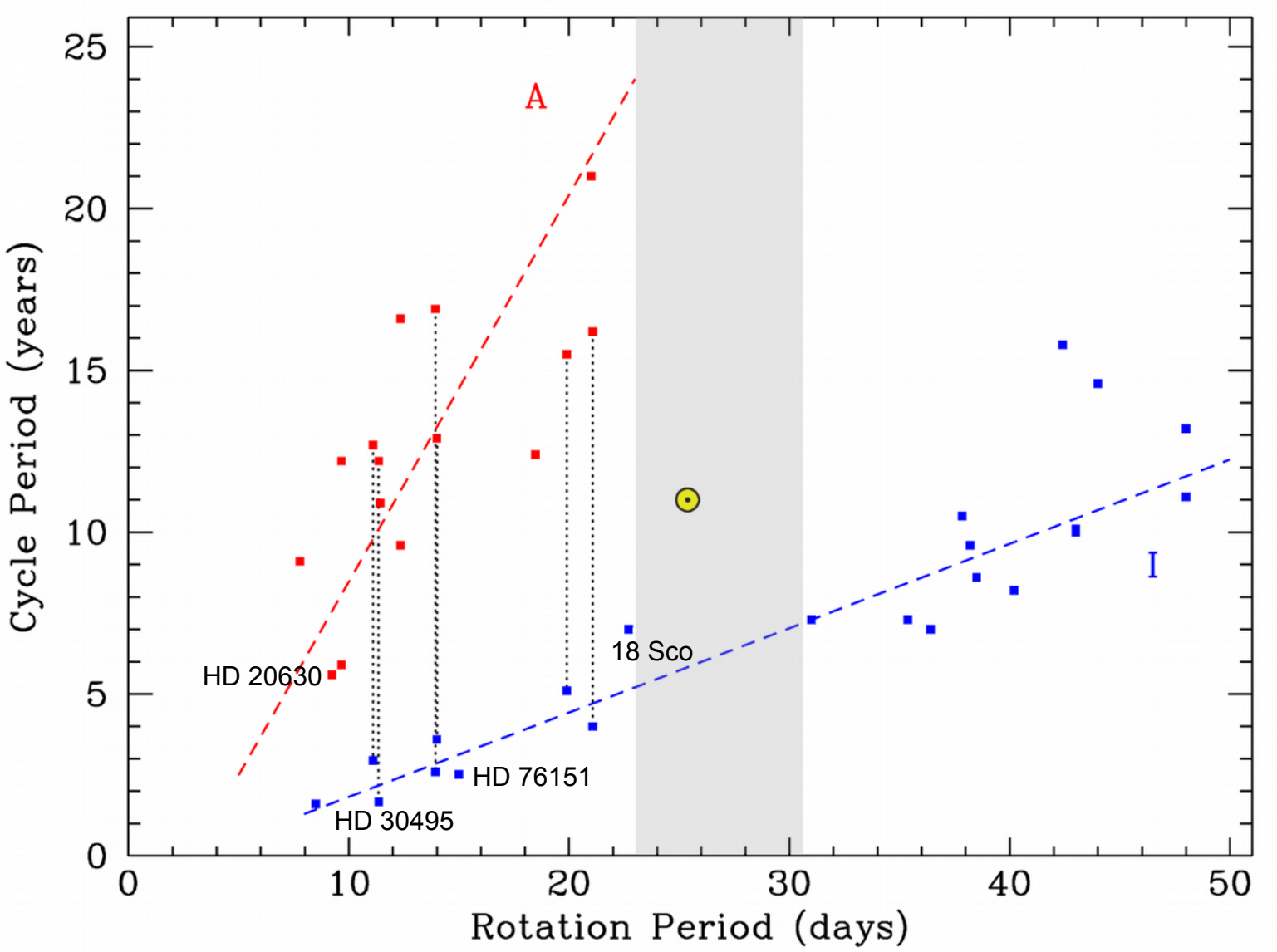
Zeeman Doppler imaging



- Young solar analog is dominated by a dipole (80% of poloidal field)
- Dipole (35%) is already disappearing in 18 Sco, with 55% in quadrupole
- Old solar analog has no Zeeman signatures, weak average line-of-sight field

Petit et al. (2008, + priv. comm.)

Stellar activity cycles



Saar & Brandenburg (1999); Böhm-Vitense (2007); Hall et al. (2007); Metcalfe et al. (2010, 2013); Egeland et al. (2015)

Summary

- A change in differential rotation at Ro ~ 1 pushes stars across the V-P gap, rapidly decreases spot area, then disrupts magnetic braking at Ro ~ 2
- The Sun is in a transitional evolutionary phase, and its 11-year activity cycle may represent a special case of stellar dynamo theory
- Future ZDI measurements, more constraints on differential rotation, and asteroseismology of the Mount Wilson sample will help test this scenario

More details on arXiv:1606.01926