Magnetic Evolution of Sun-like Activity Cycles

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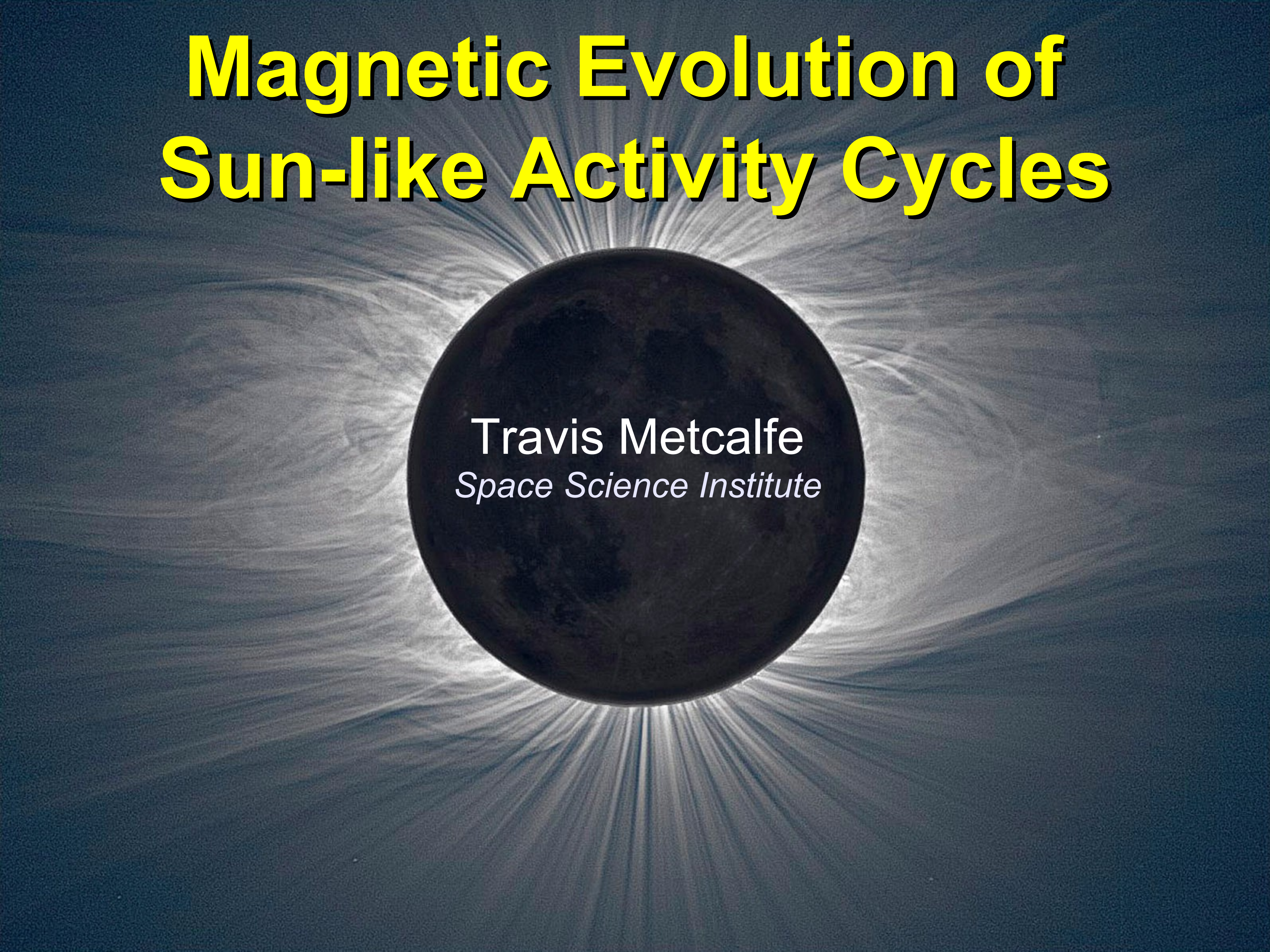
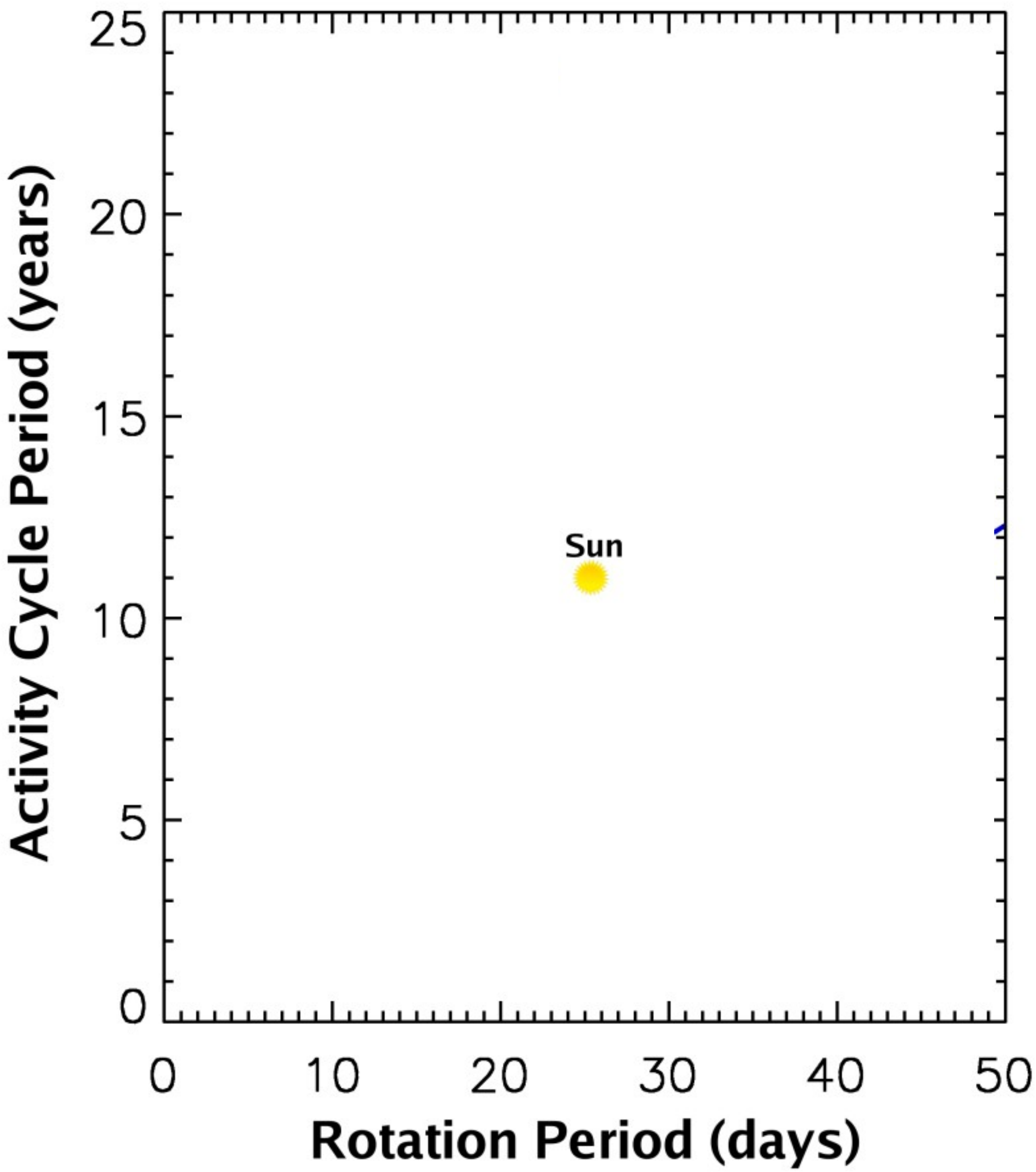


Solar cycle in context



Böhm-Vitense (2007)

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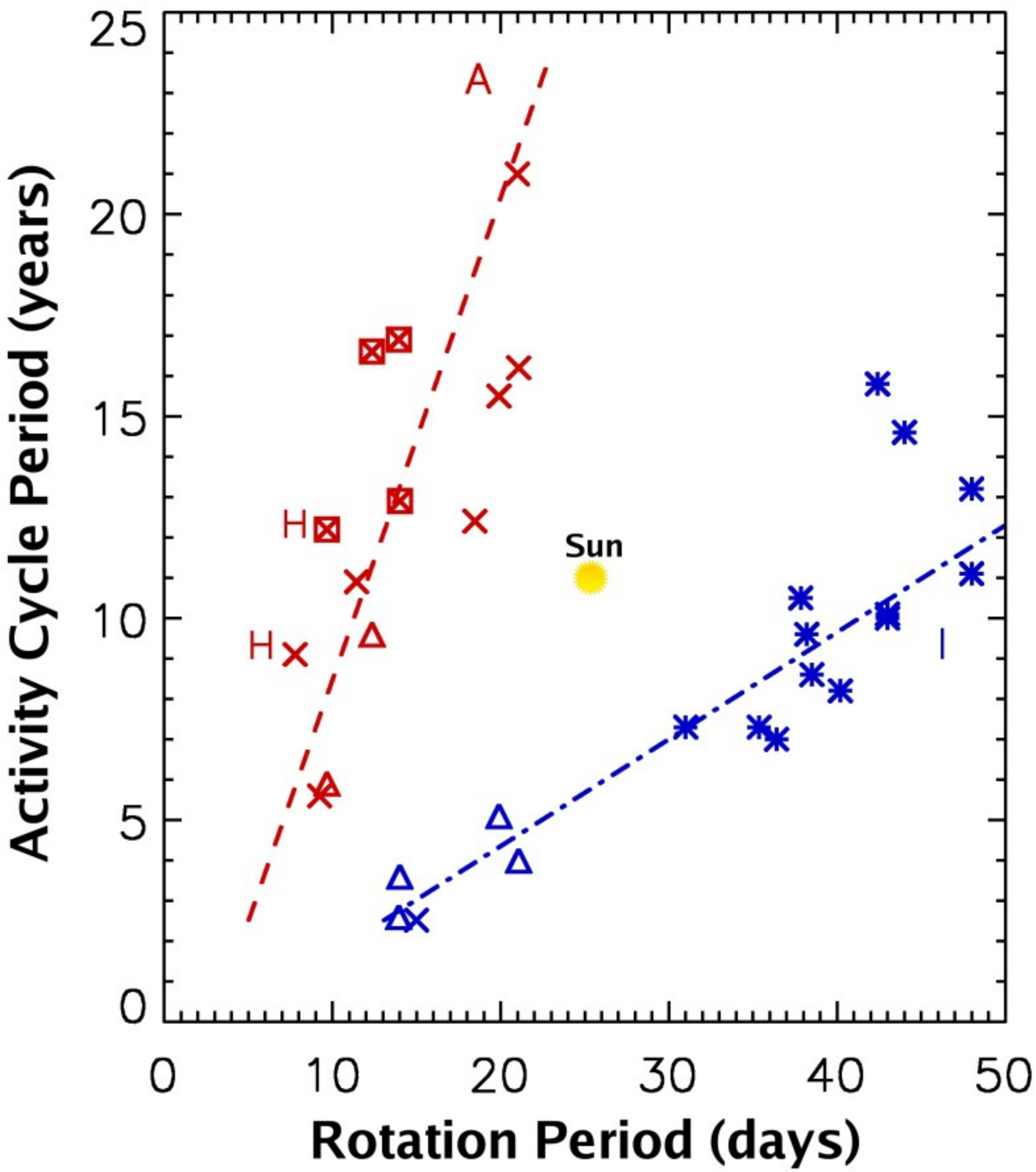
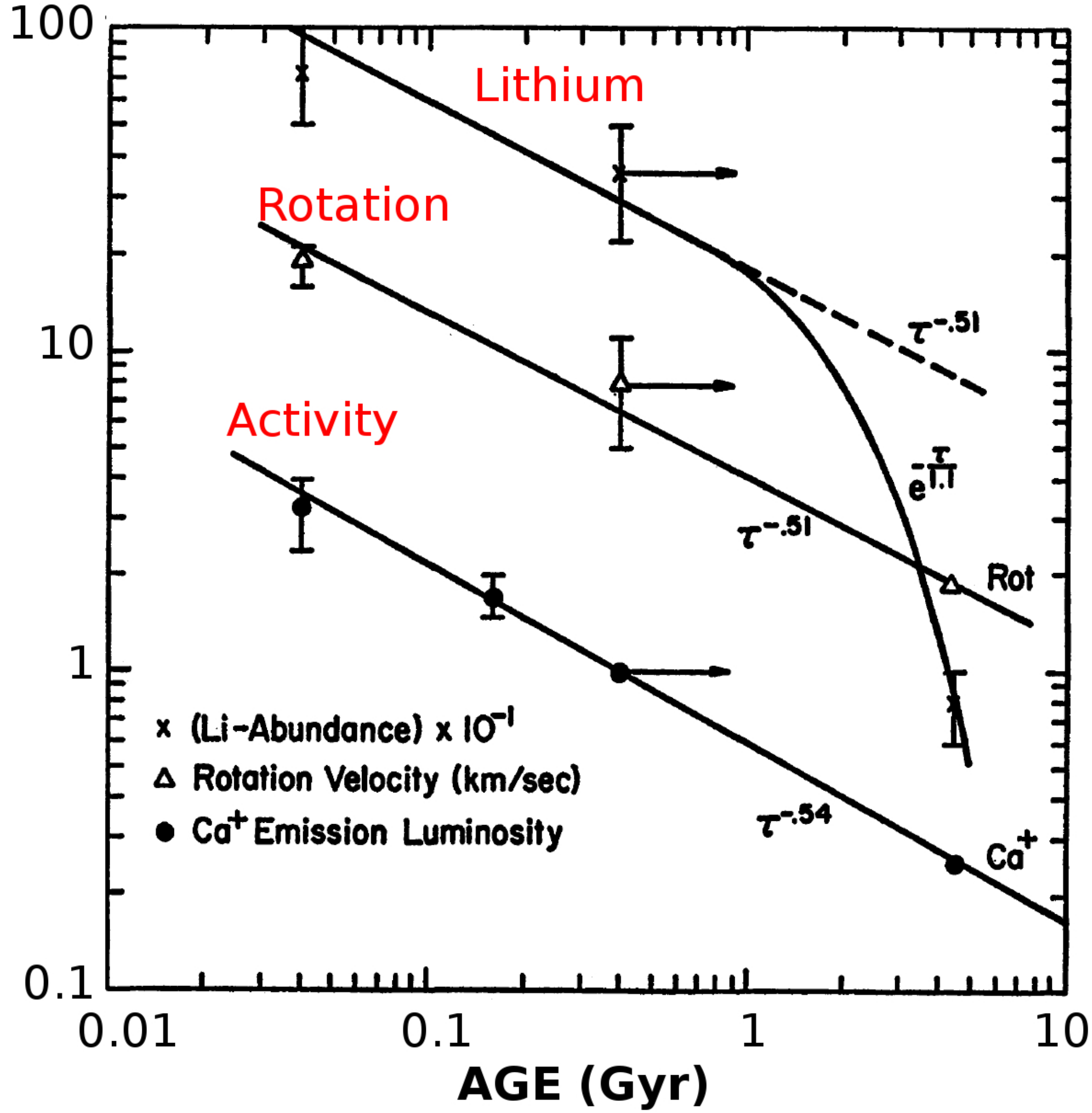


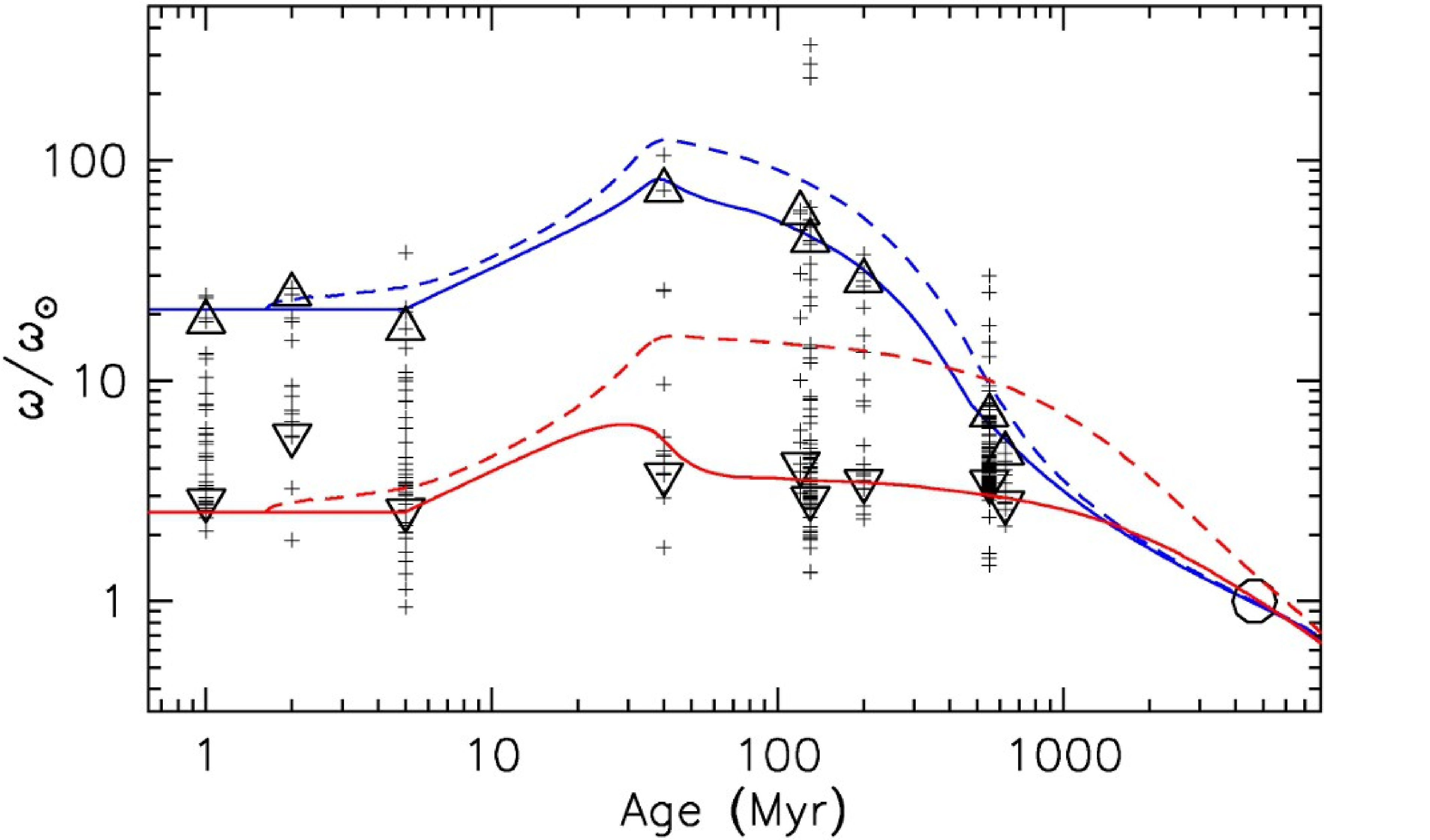
Böhm-Vitense (2007)

Rotation and activity decay together



Skumanich (1972)

Rotational evolution in young stars



Bouvier (2008)

Revised evolution beyond middle age

Evidence of unexpected behavior:

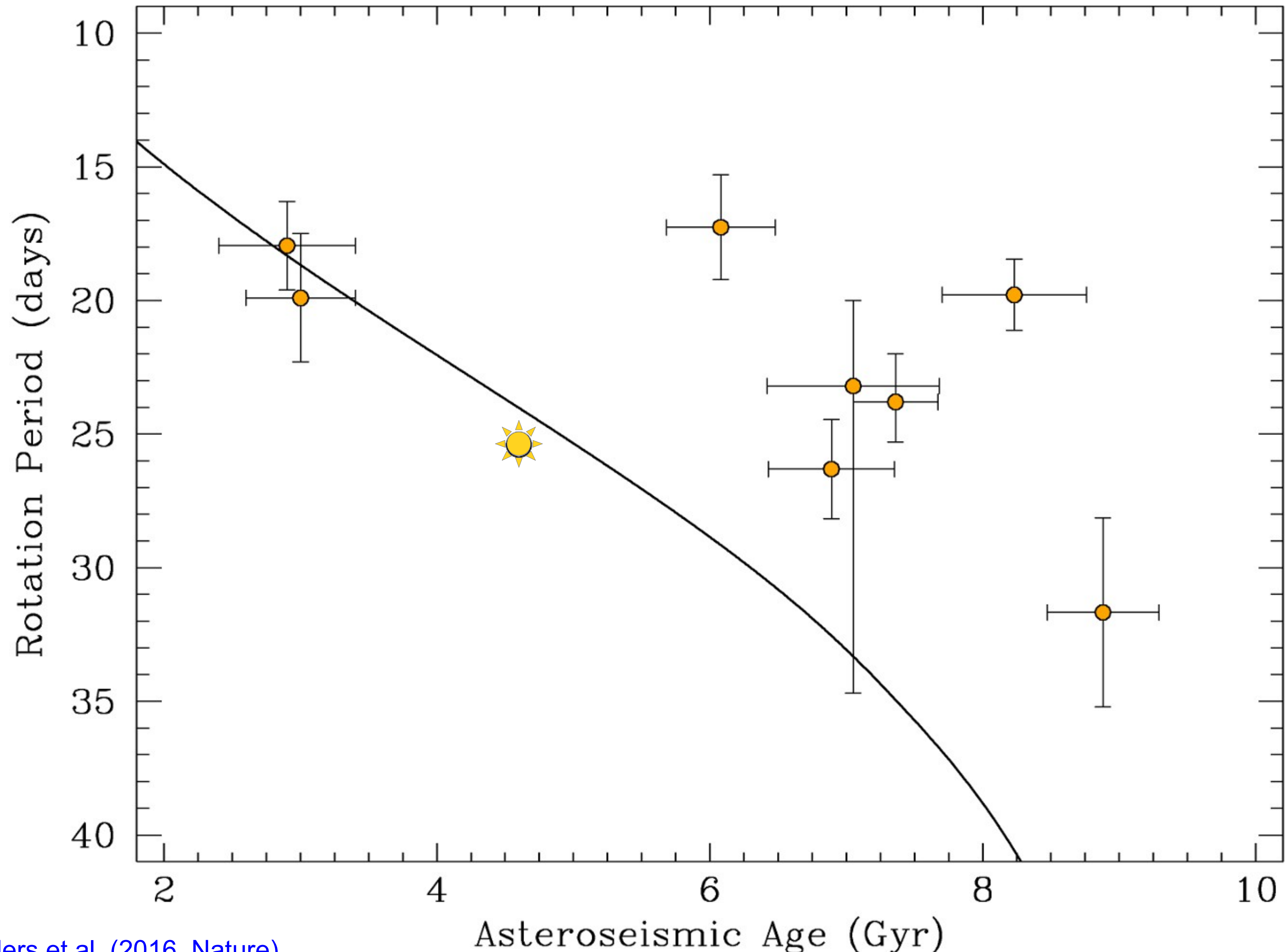
1. Rotation vs. Age

2. Rotation vs. T_{eff} (proxy for Mass)

3. Activity level vs. Rotation

4. Cycle period vs. Rotation

1. Old stars rotate faster than expected



van Saders et al. (2016, Nature)

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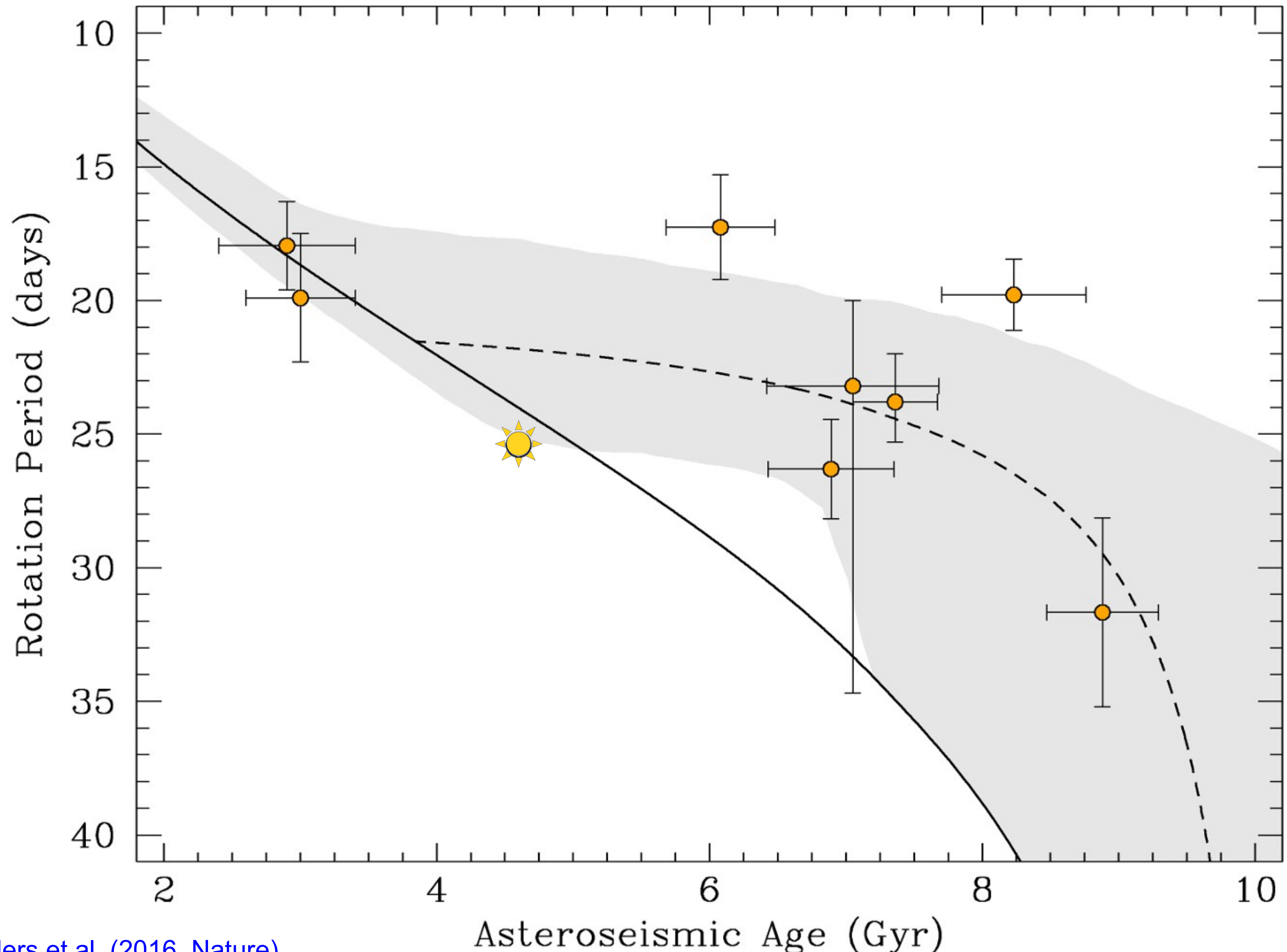

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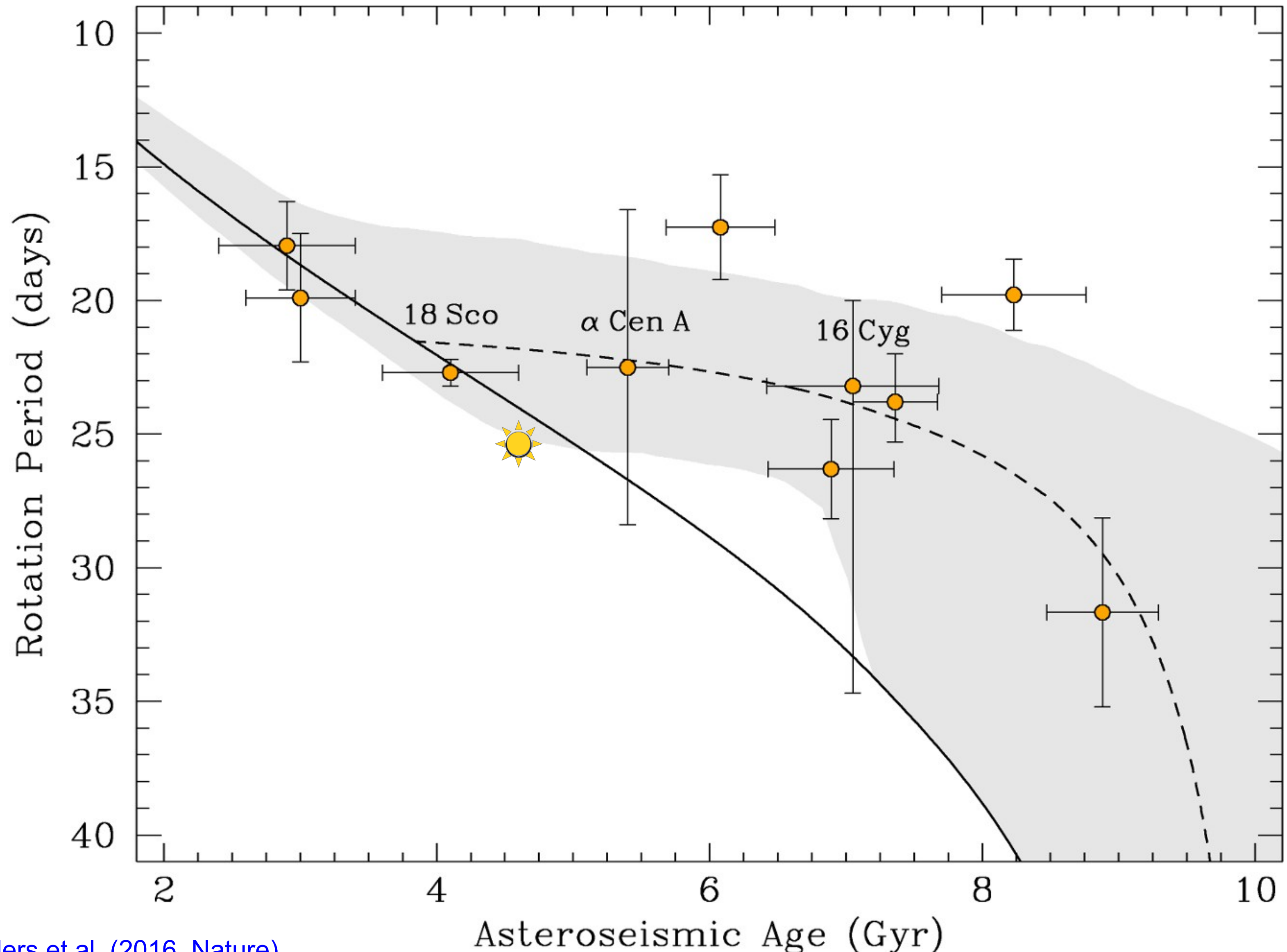
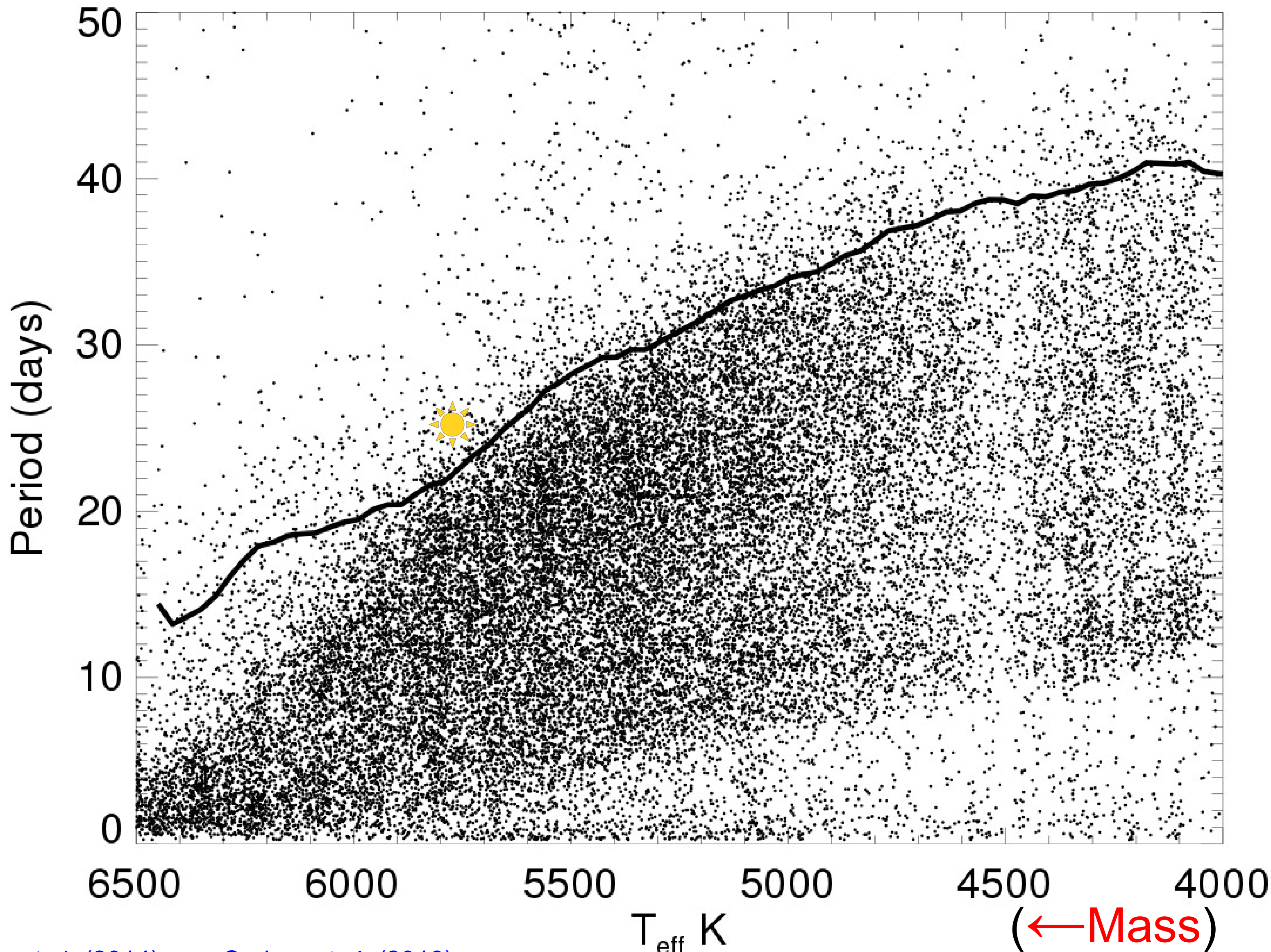


van Saders et al. (2016, Nature)

2. Slow rotators absent or undetected



McQuillan et al. (2014); van Saders et al. (2018)

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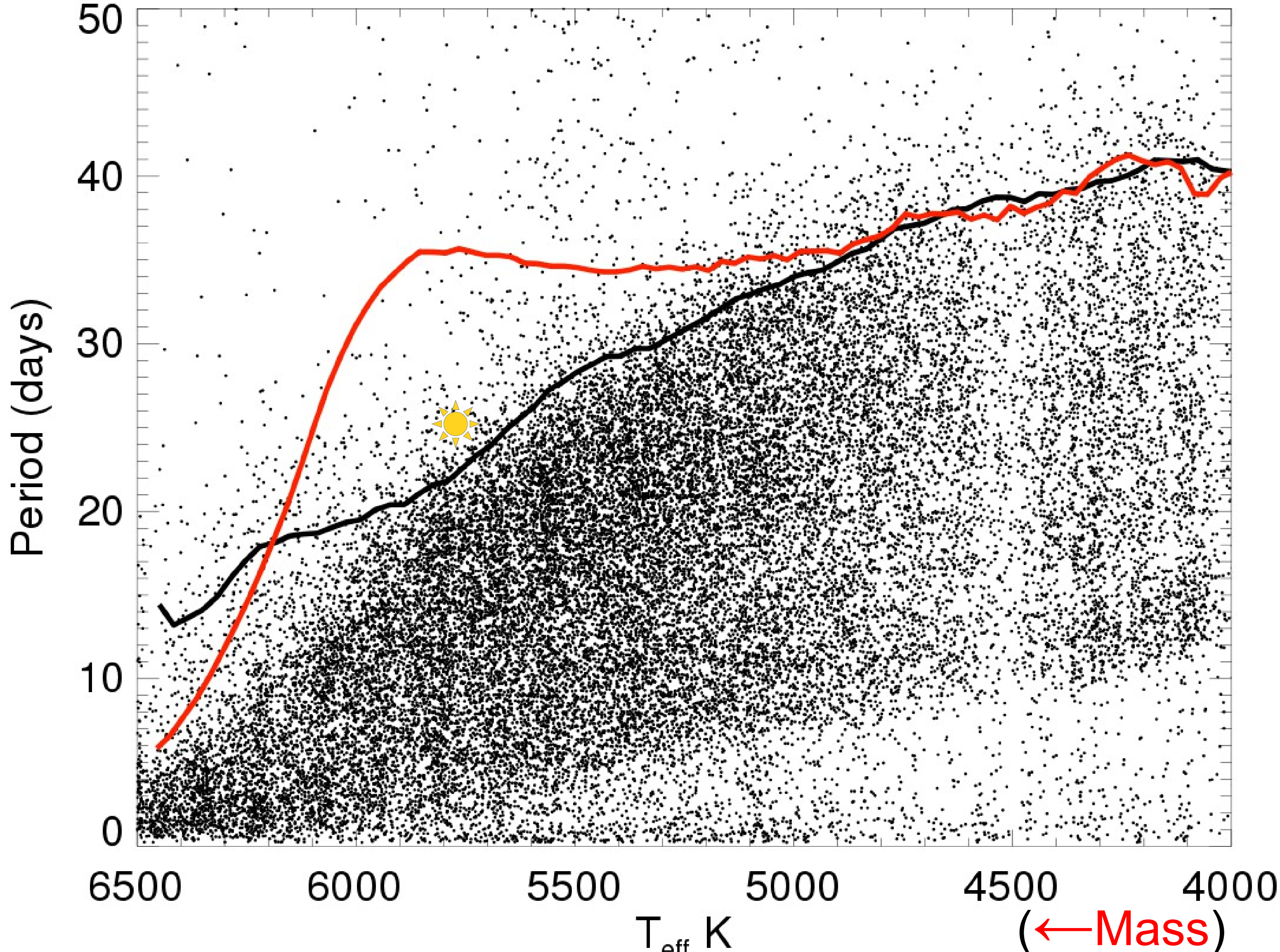

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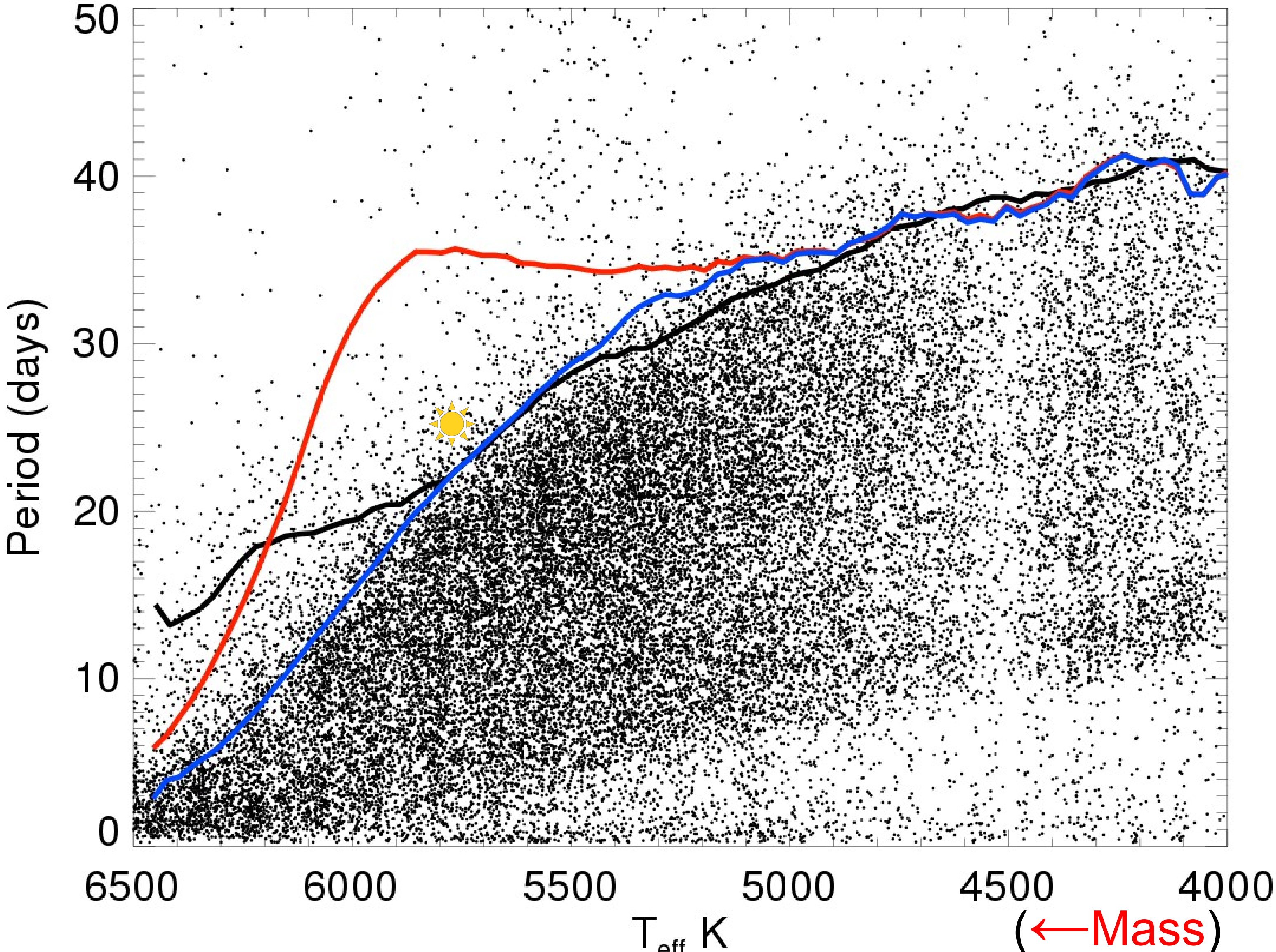

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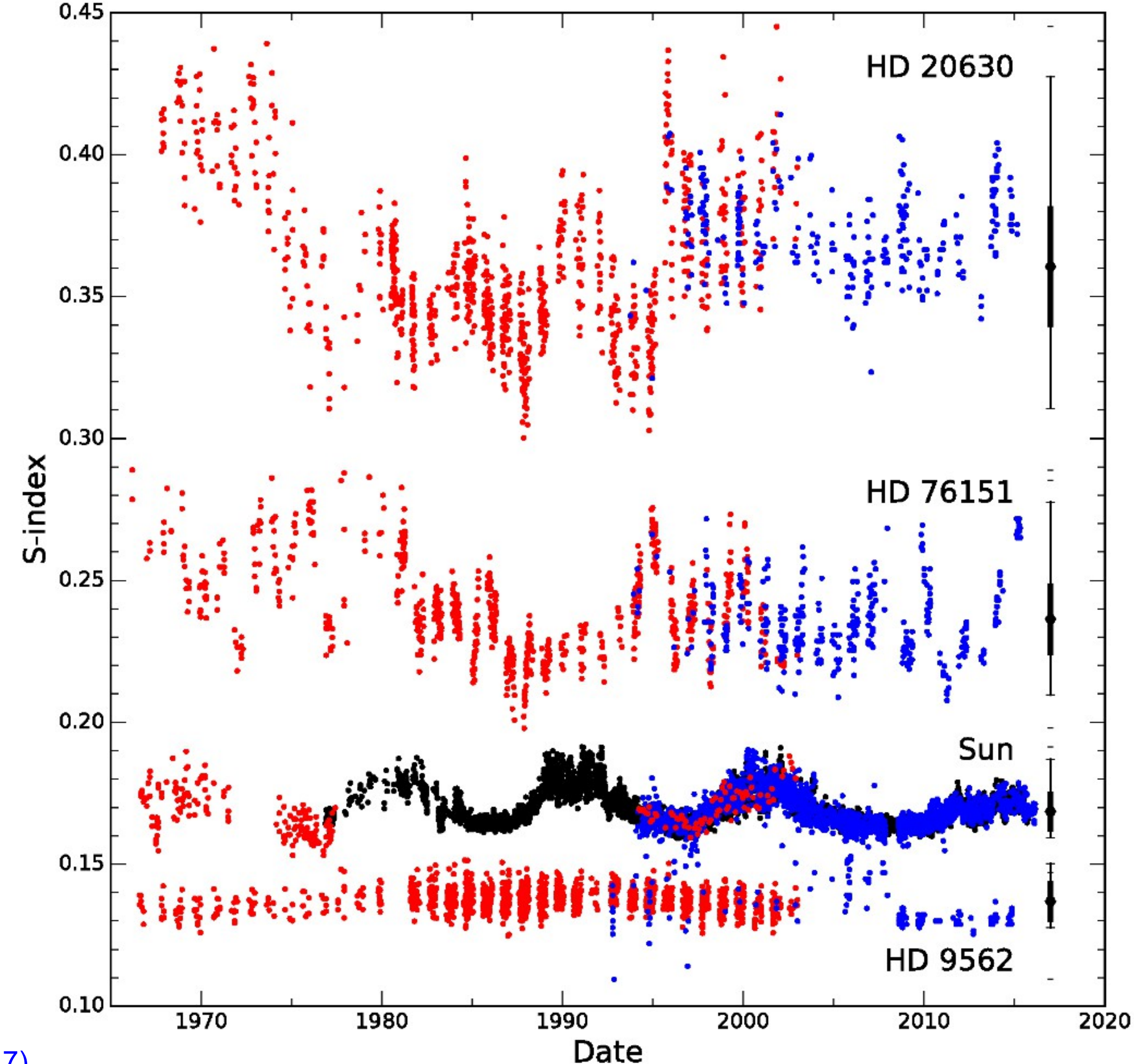
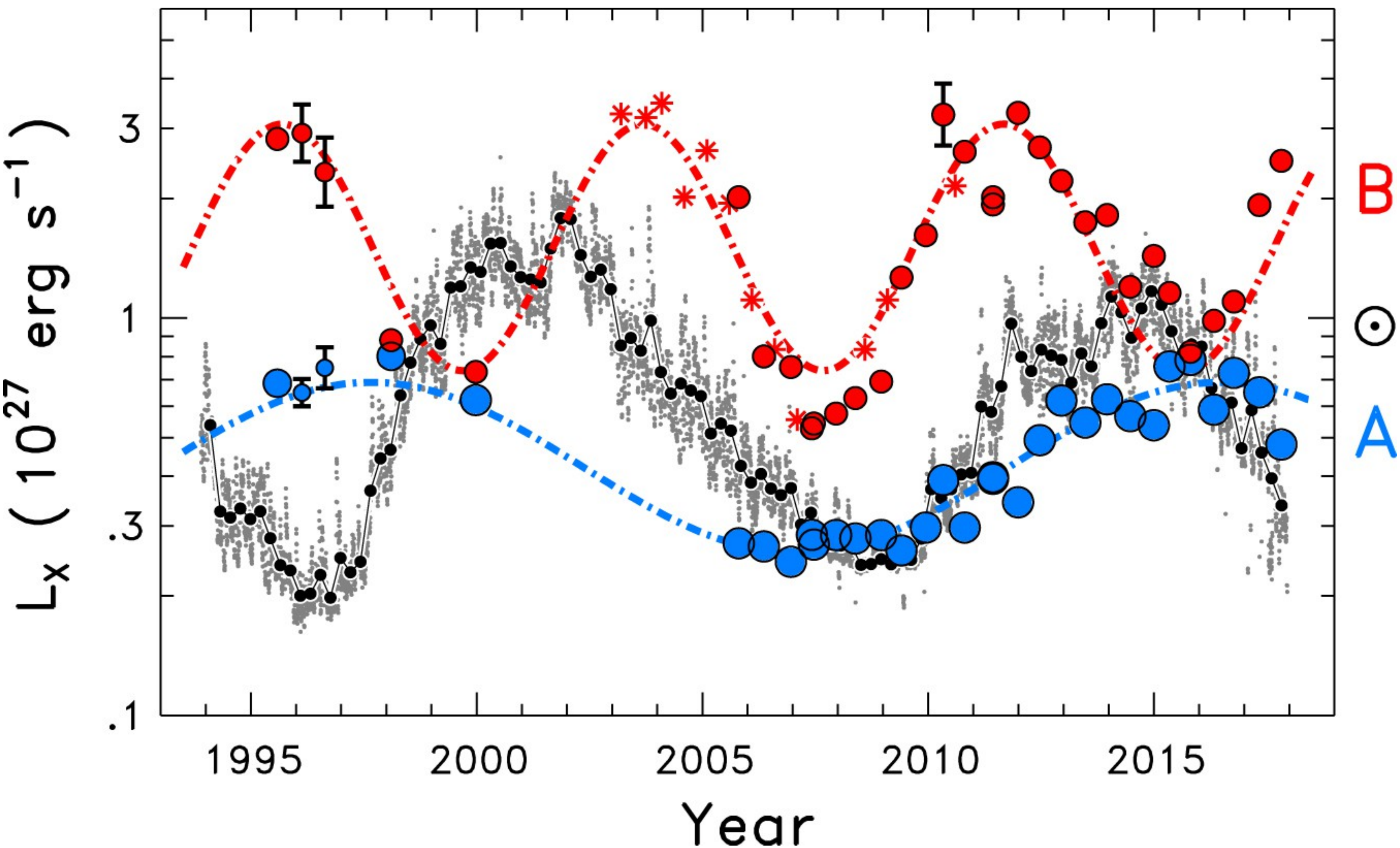
Evolution of Sun-like activity



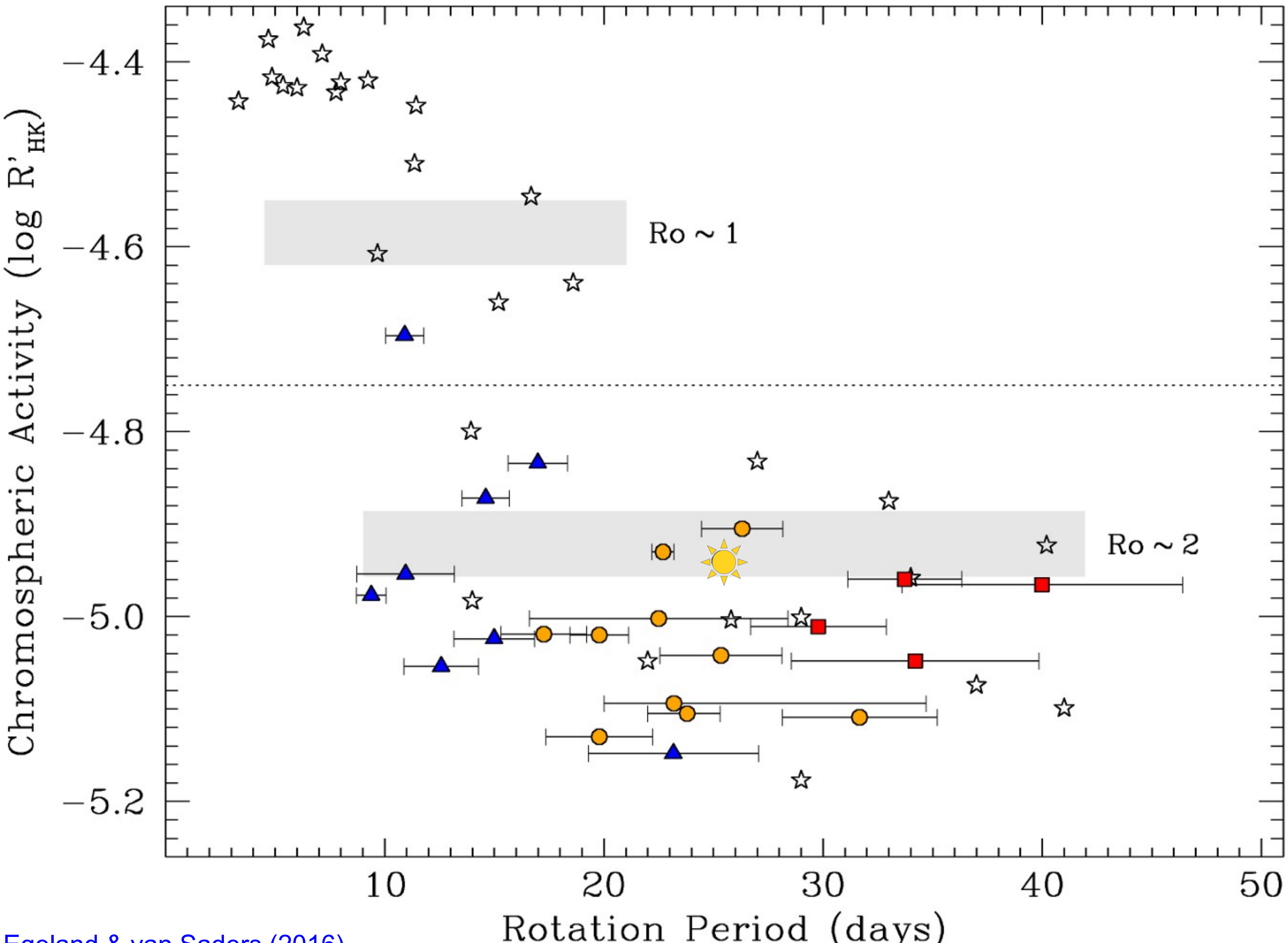
Egeland et al. (2017)

Evolution of Sun-like activity



Ayres (2018)

3. Chromospheric activity plunges



Metcalfe, Egeland & van Saders (2016)

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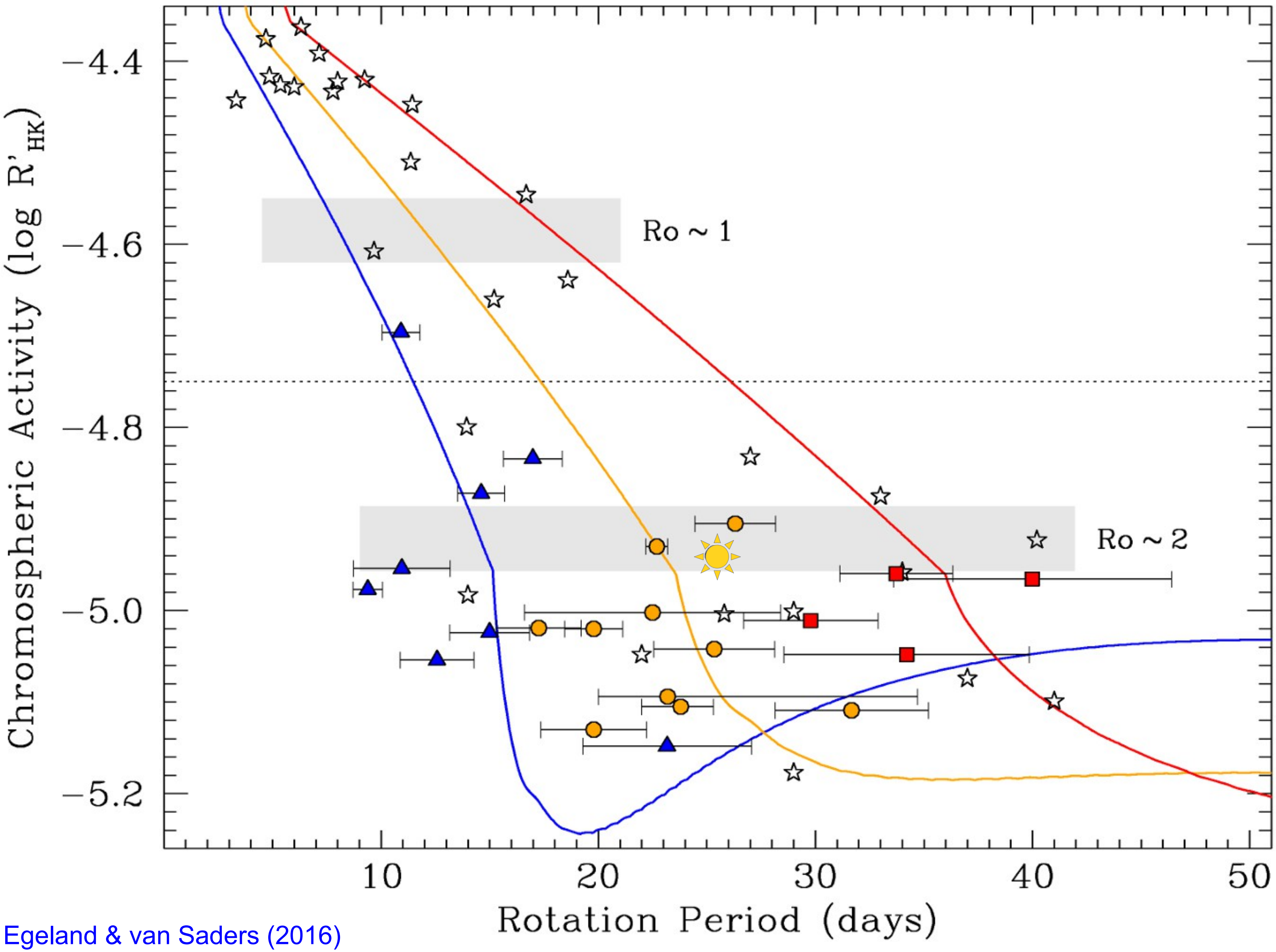

Metcalfe, Egeland & van Saders (2016)

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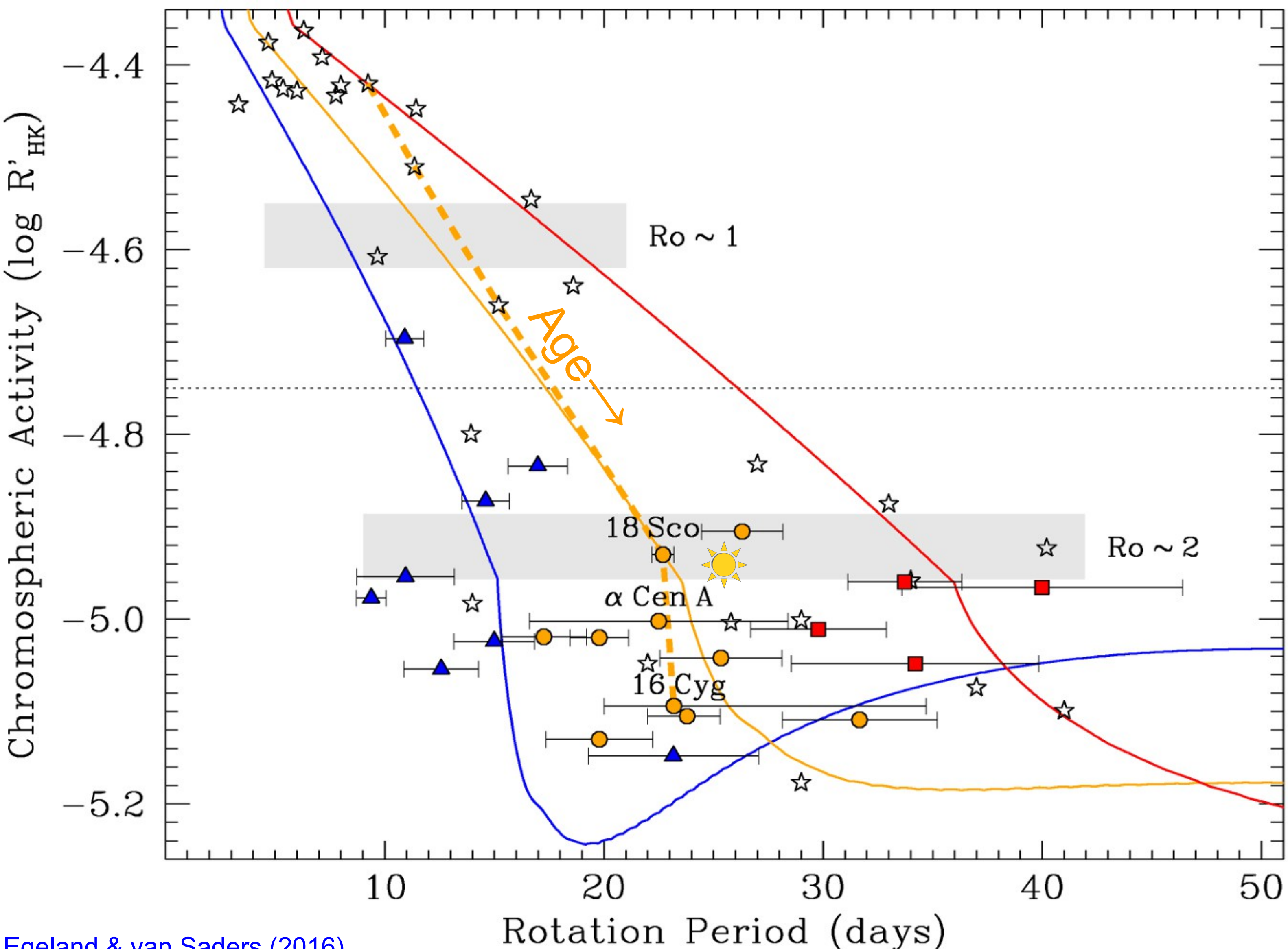
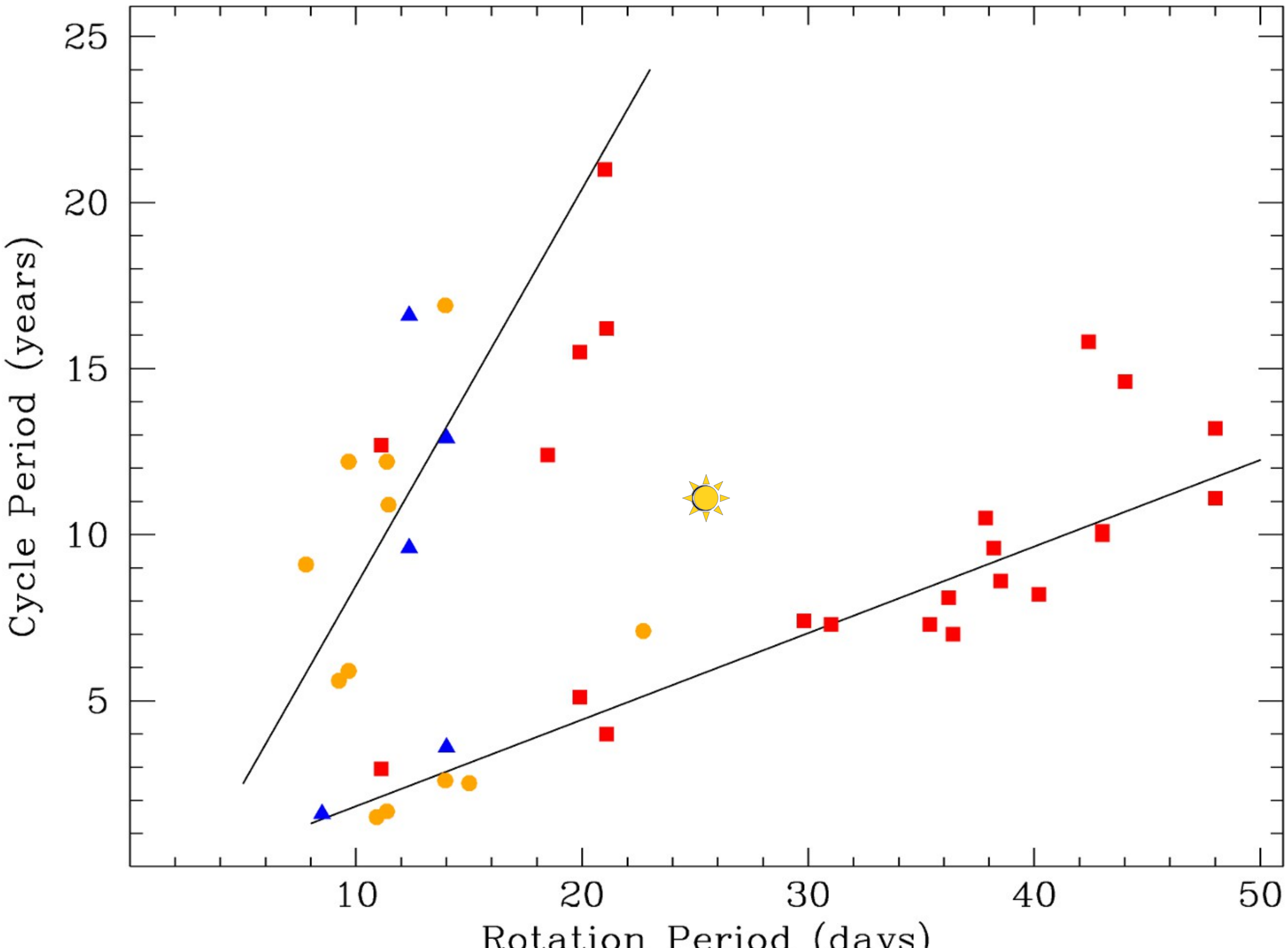


Metcalfe, Egeland & van Saders (2016)

4. Activity cycles get longer, disappear



Metcalfe & van Saders (2017)

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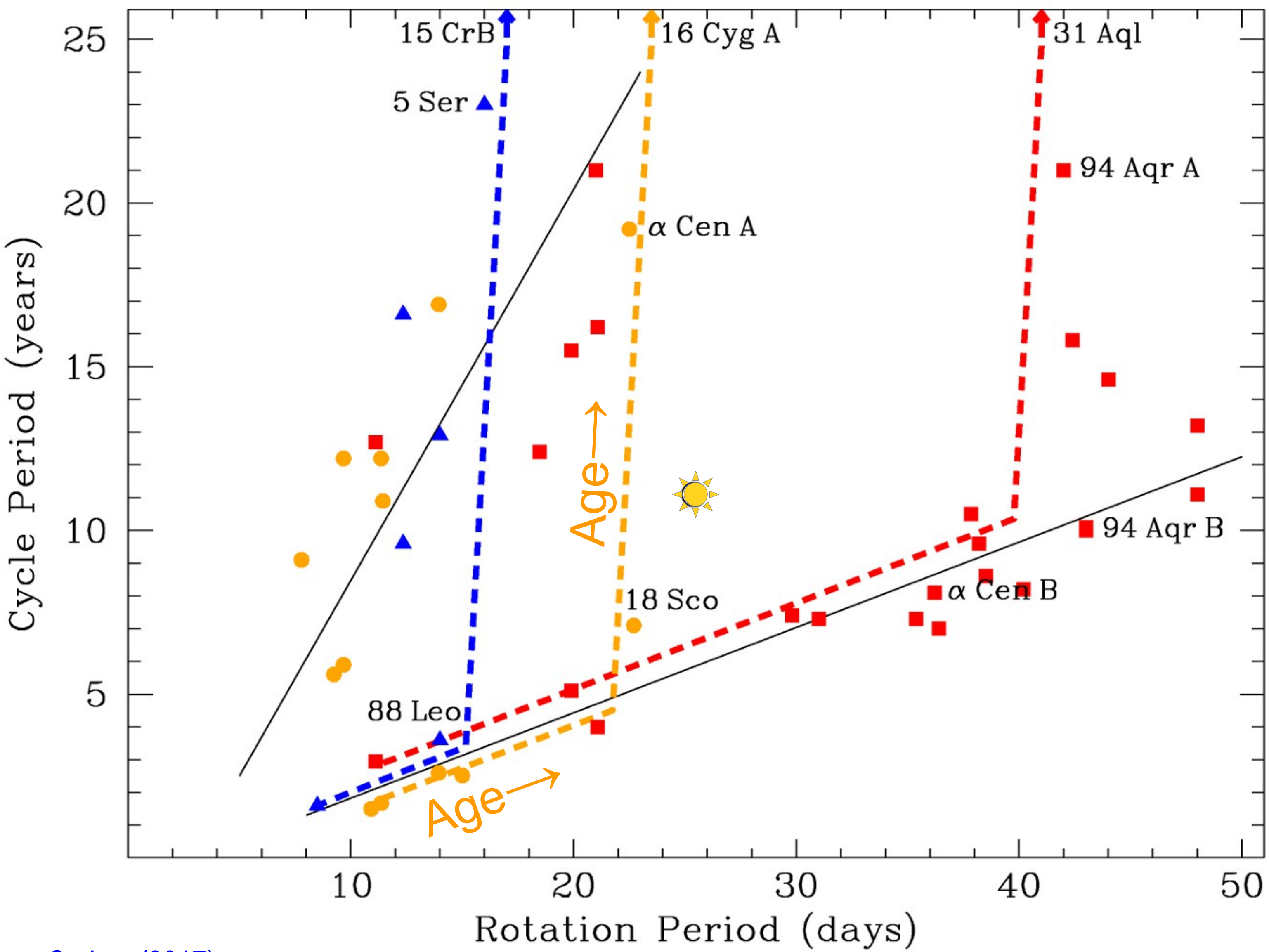

Metcalfe & van Saders (2017)

Future observational tests

- Constraints on solar angular momentum loss from *in situ* data and magnetic field geometry
- Measurements of stellar differential rotation below a critical activity level (log R'hk < -5)
- Zeeman Doppler Imaging observations of stars to determine large-scale magnetic field topology
- Asteroseismology with the TESS mission to determine precise masses and ages for Mount Wilson stars with known activity cycles
- Ground-based chromospheric activity monitoring for Kepler targets spanning the transition