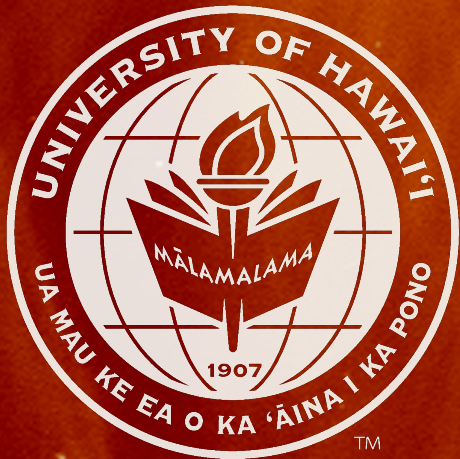


The Sun in Stellar Context: Stellar Windows Into Solar Magnetic Evolution



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Why other stars?

Different ages

Different masses

Different compositions

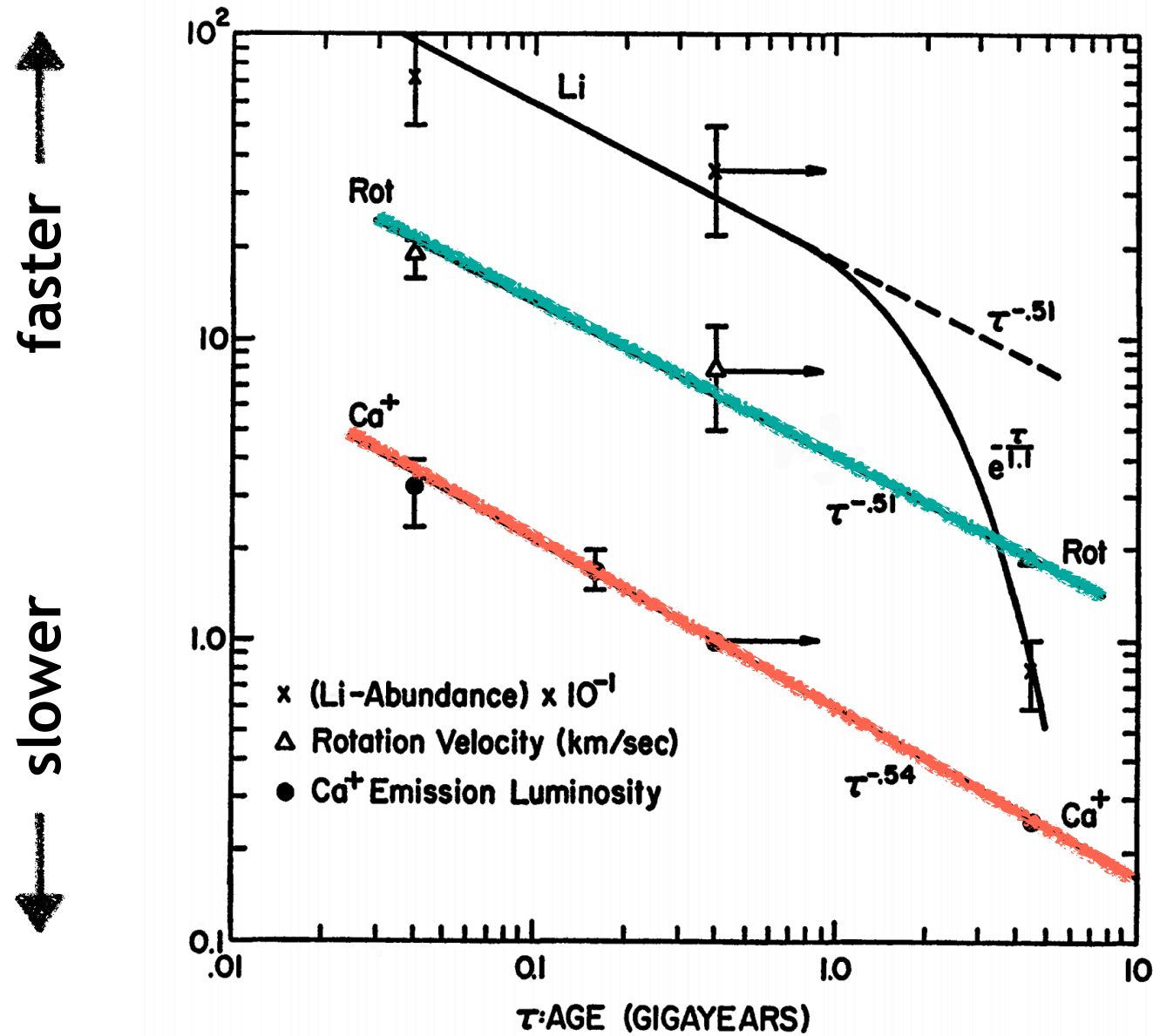
Magnetic phenomena (appear to)
depend on the Rossby number

$$\text{Ro} = \frac{P_{rot}}{\tau_{cz}}$$

increases as the
star spins down
with time

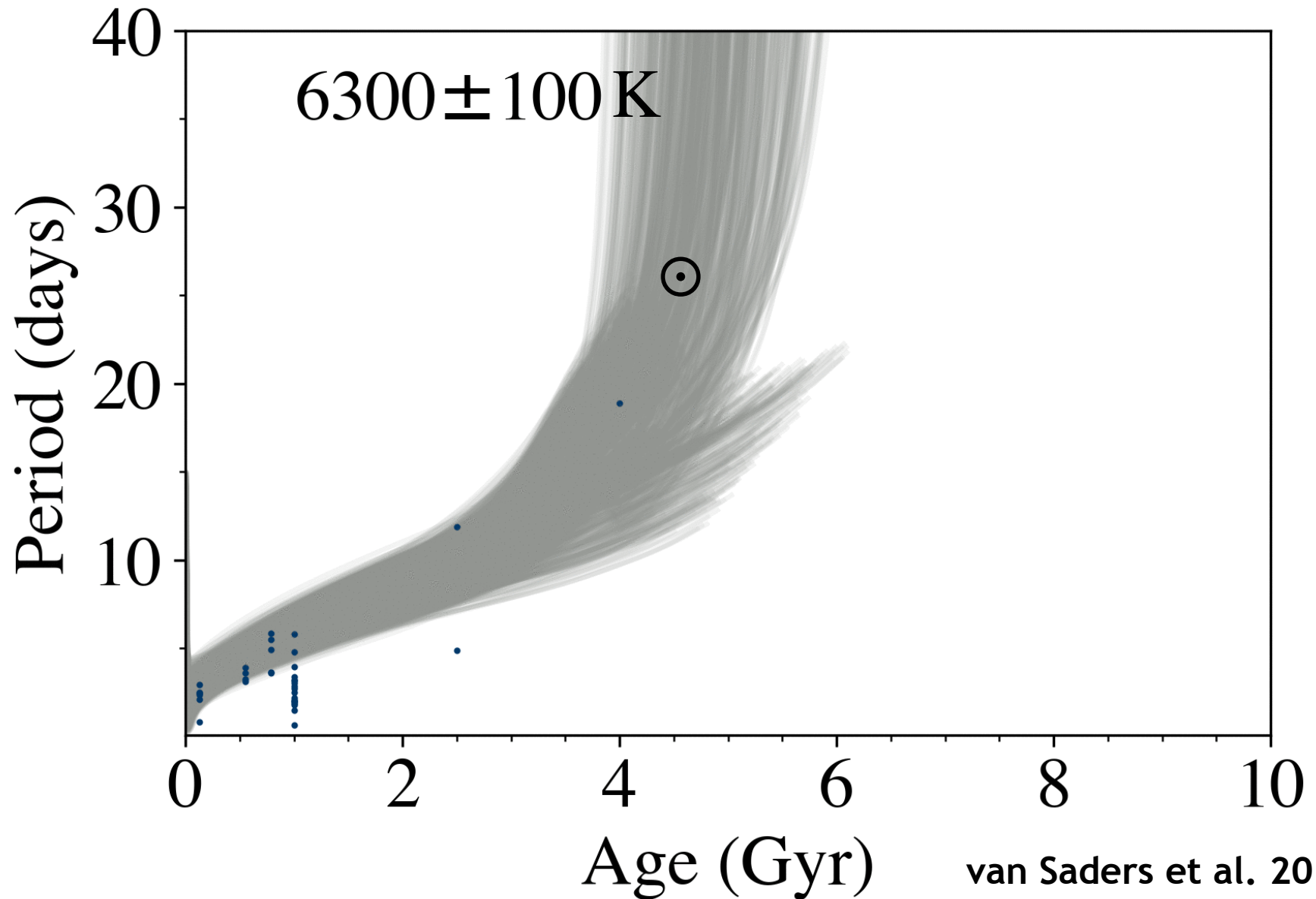
Roughly constant
during the main
sequence, but a
strong function of
mass

Skumanich laws



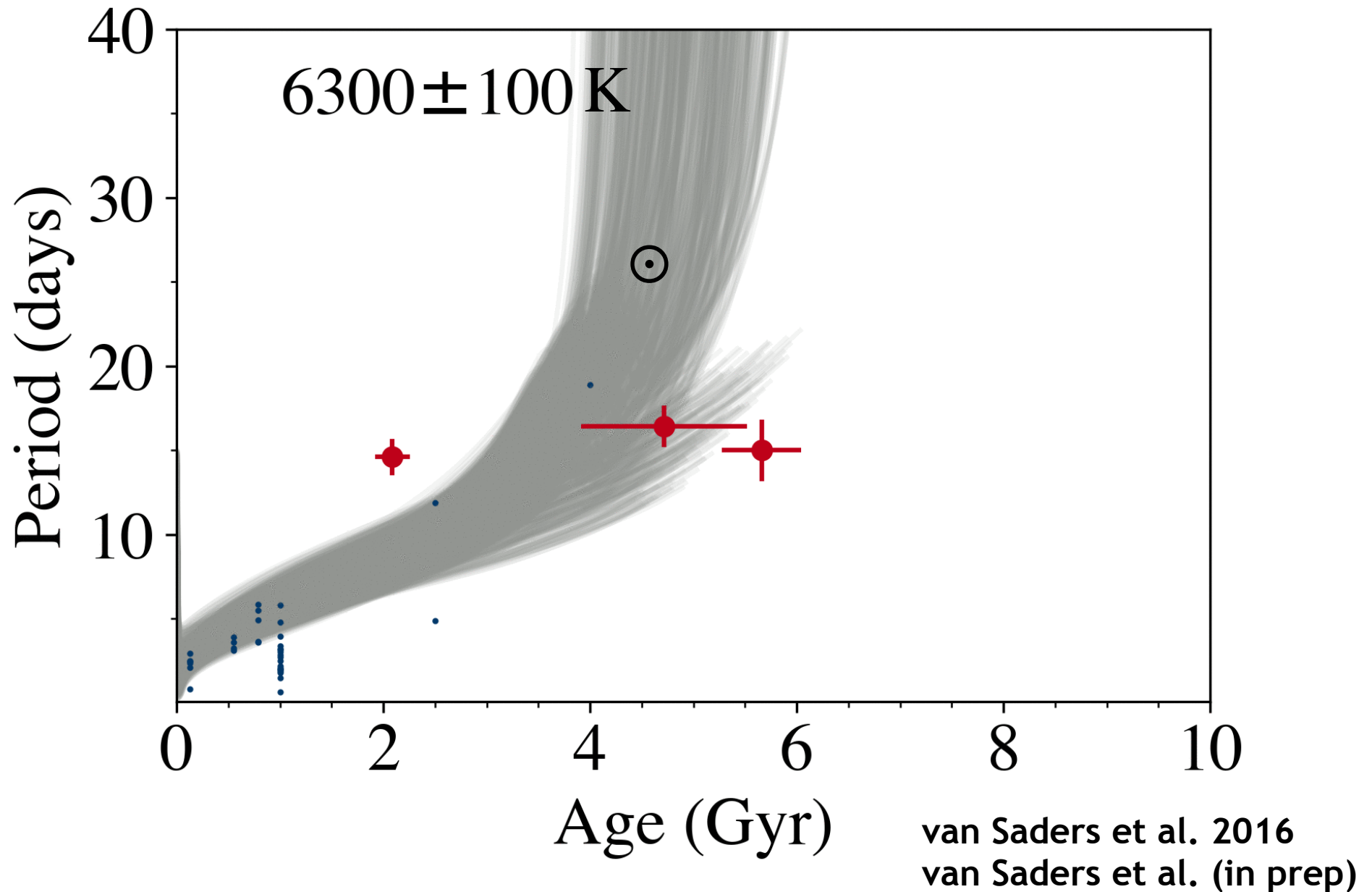
Skumanich 1972

A standard spin-down model



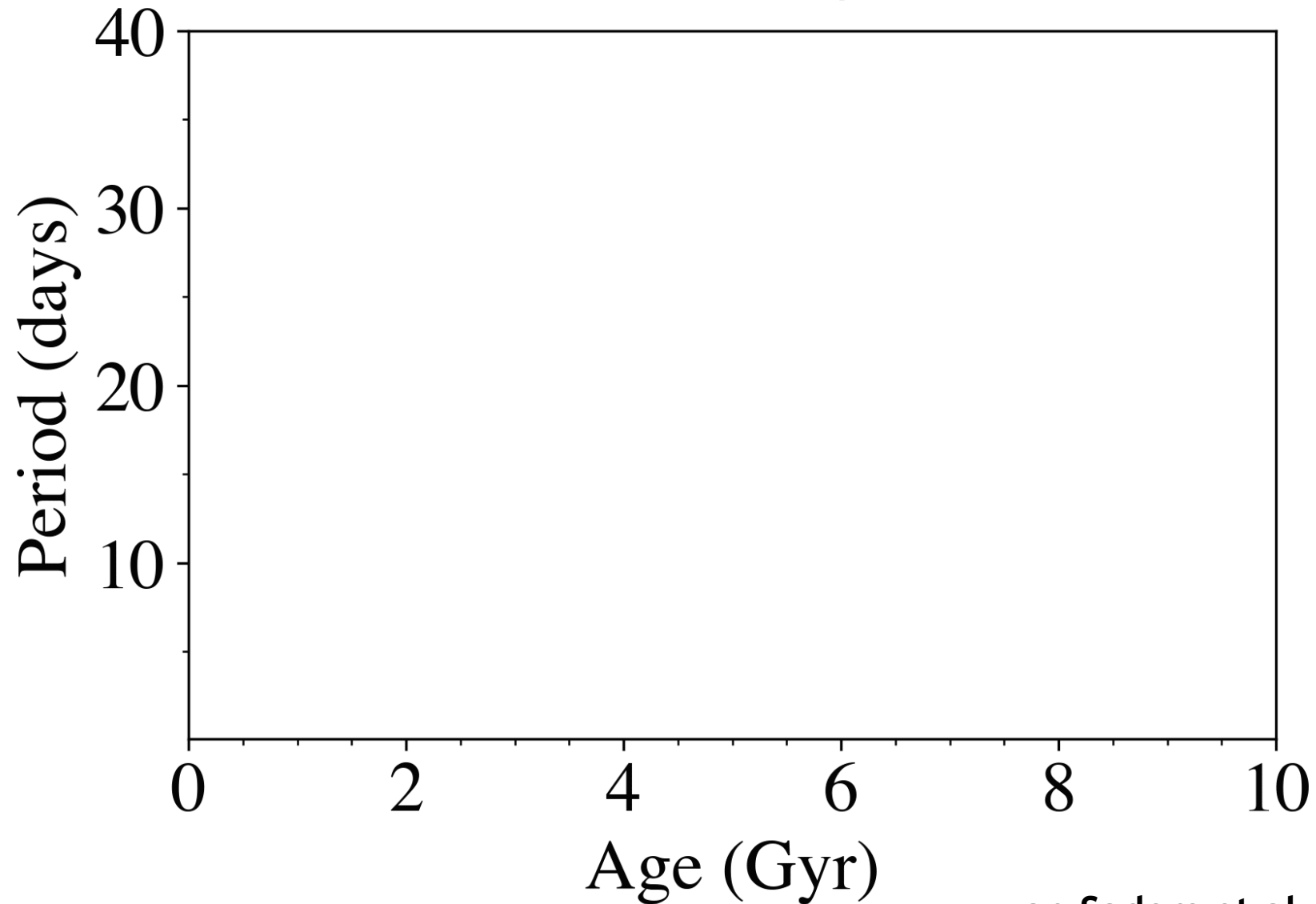
van Saders et al. 2016
van Saders et al. (in prep)

A standard spin-down model



Weakened magnetic braking

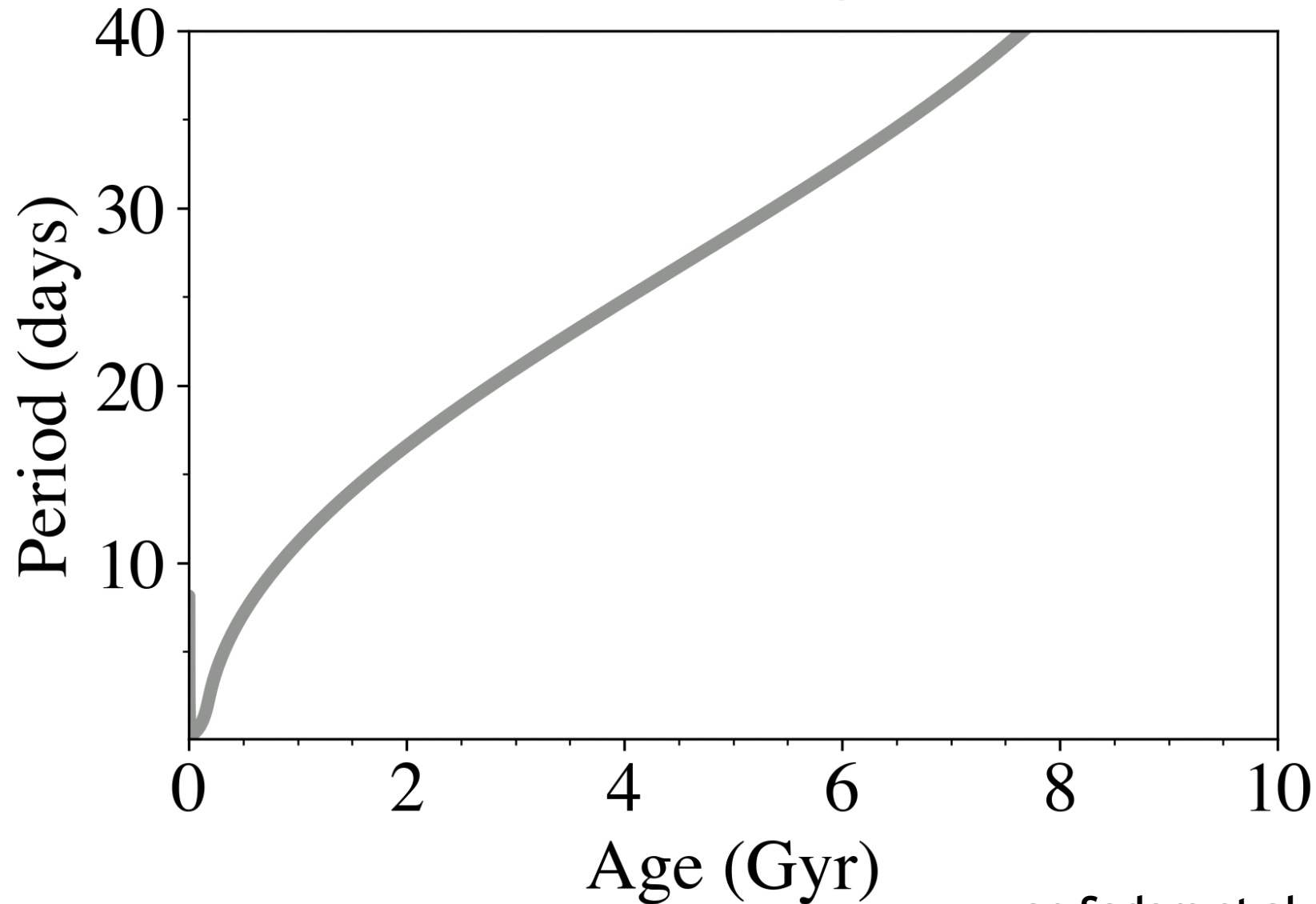
Solar mass, solar composition



van Saders et al. 2016

Weakened magnetic braking

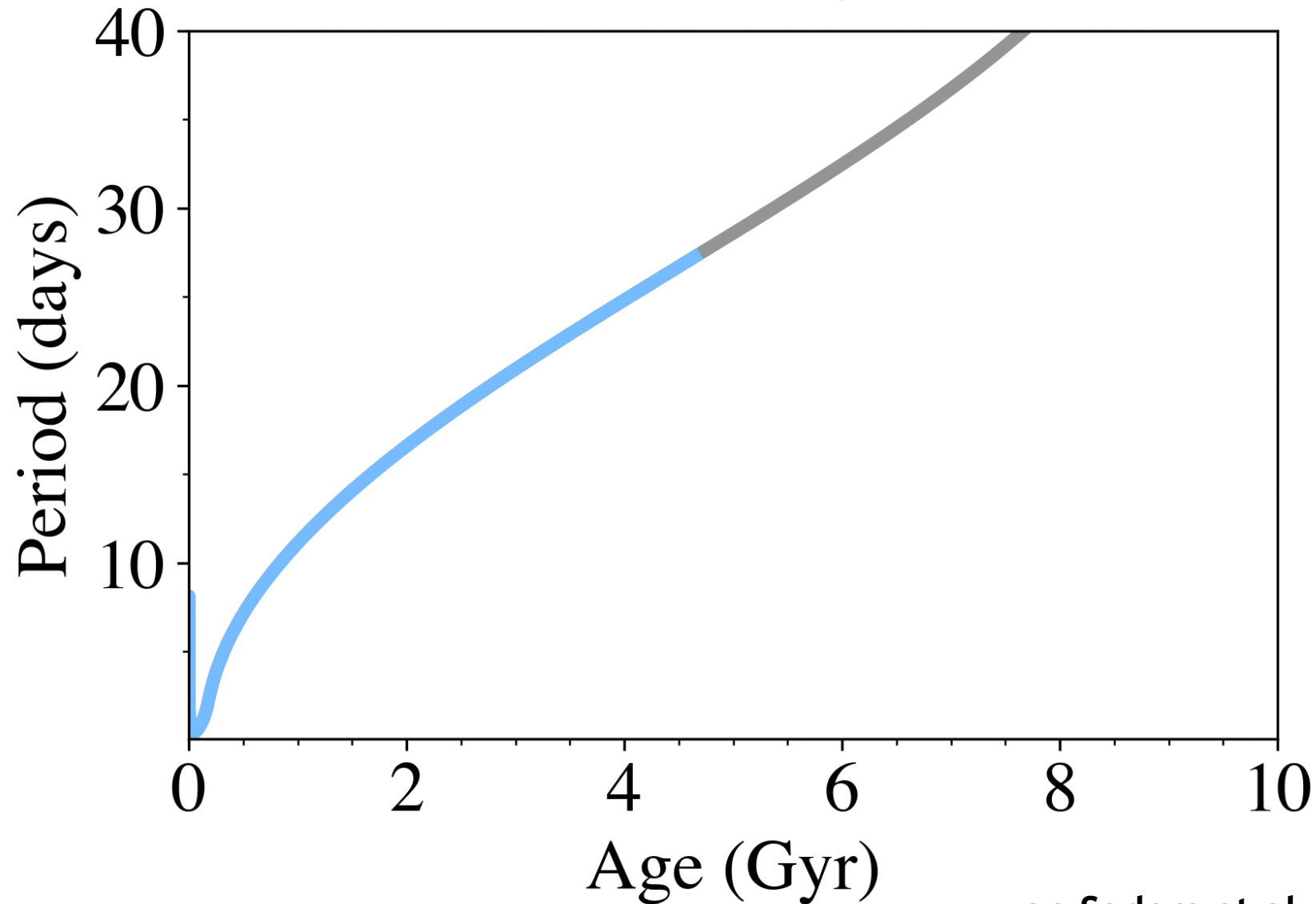
Solar mass, solar composition



van Saders et al. 2016

Weakened magnetic braking

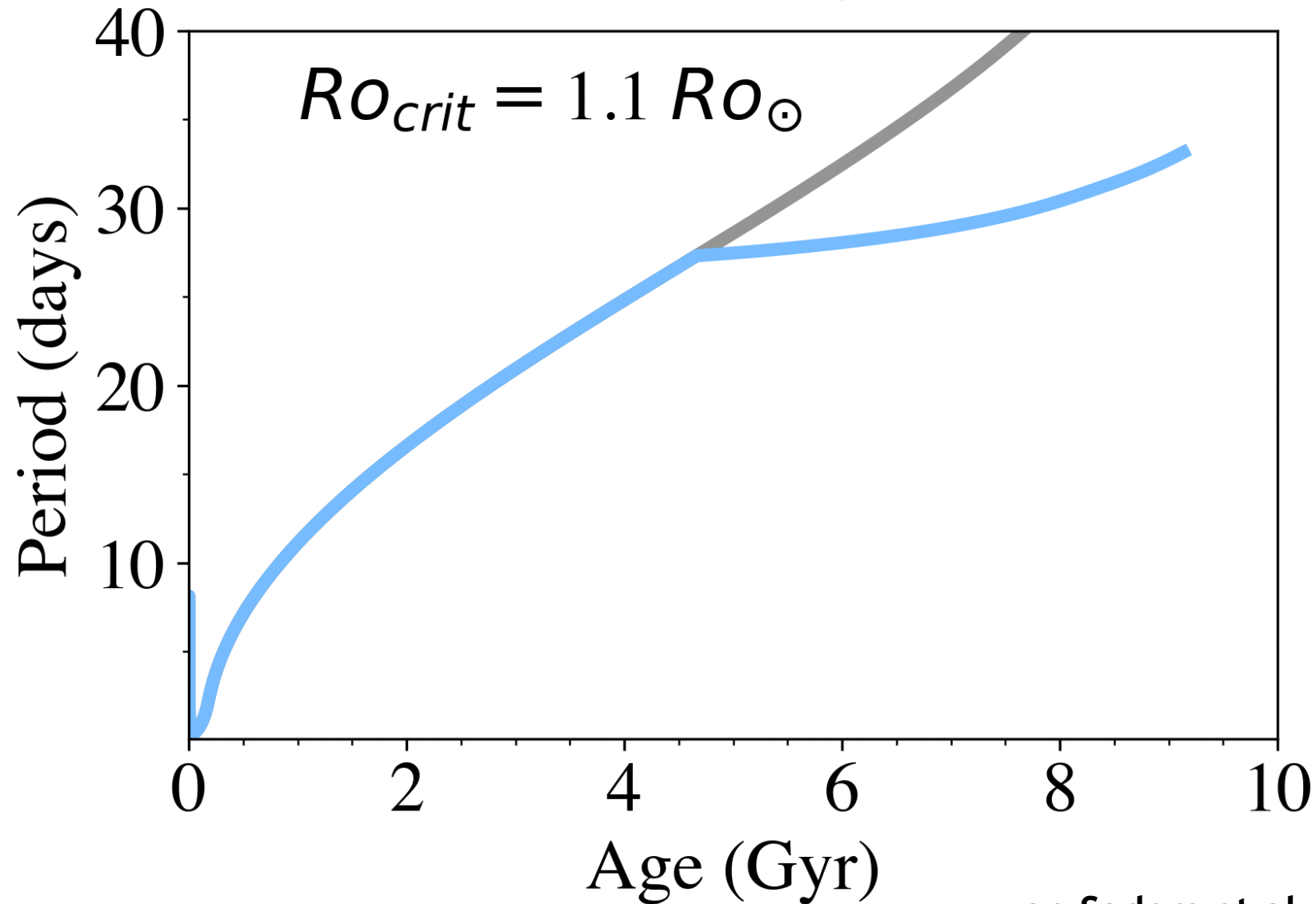
Solar mass, solar composition



van Saders et al. 2016

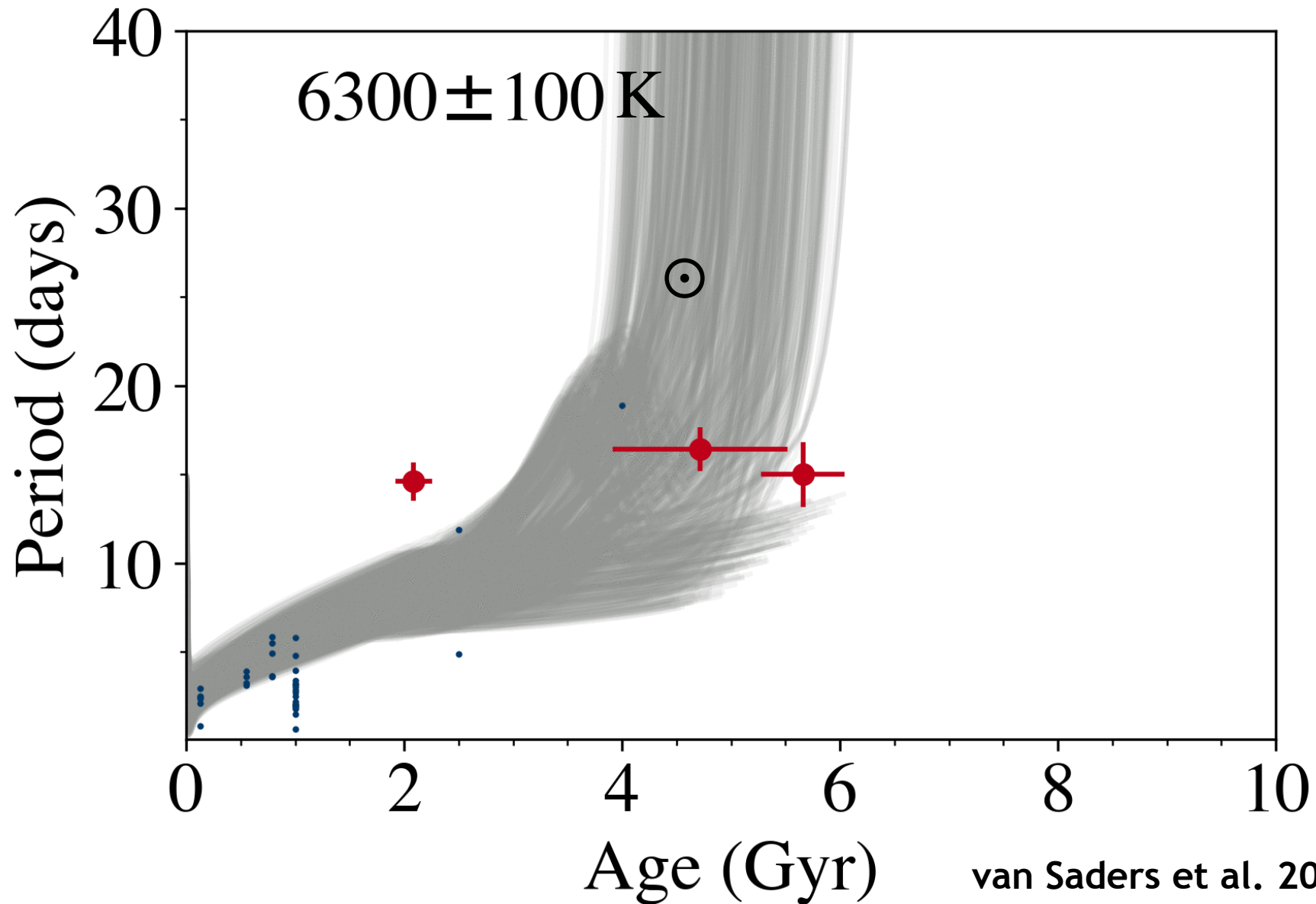
Weakened magnetic braking

Solar mass, solar composition



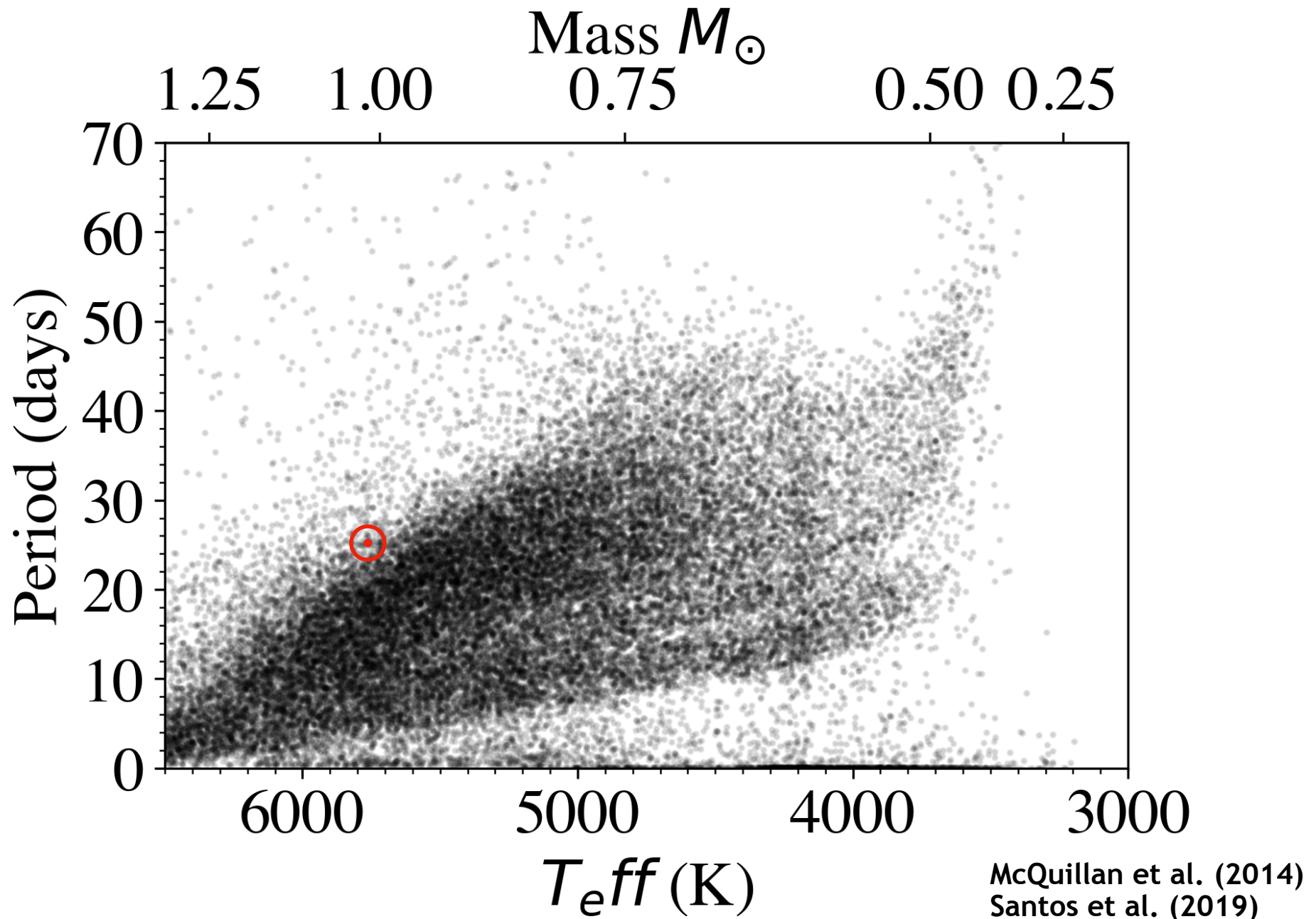
van Saders et al. 2016

Halt spin-down past a critical Rossby number

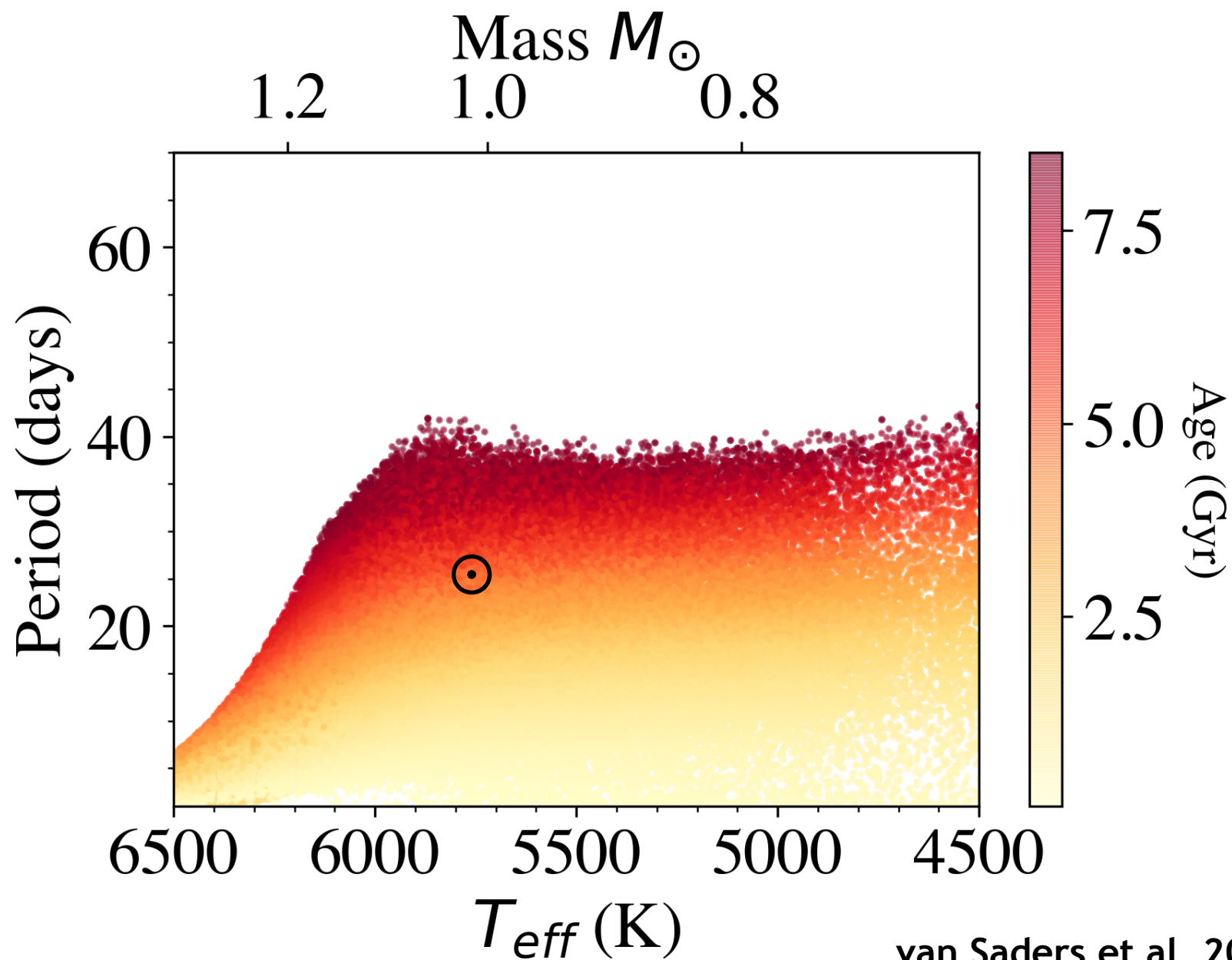


van Saders et al. 2016
van Saders et al. (in prep)

Interesting behavior in the rotating population

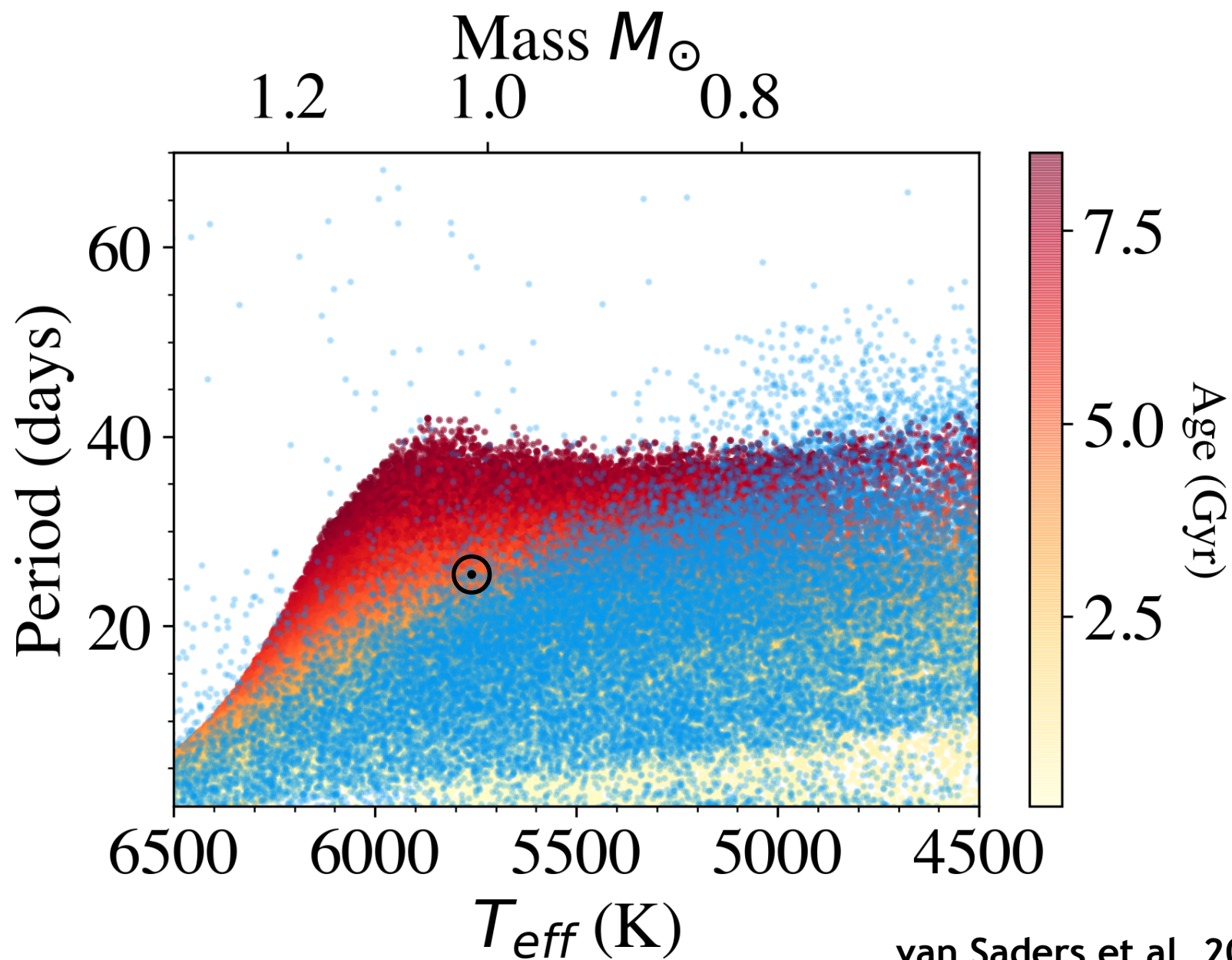


Model Expectation



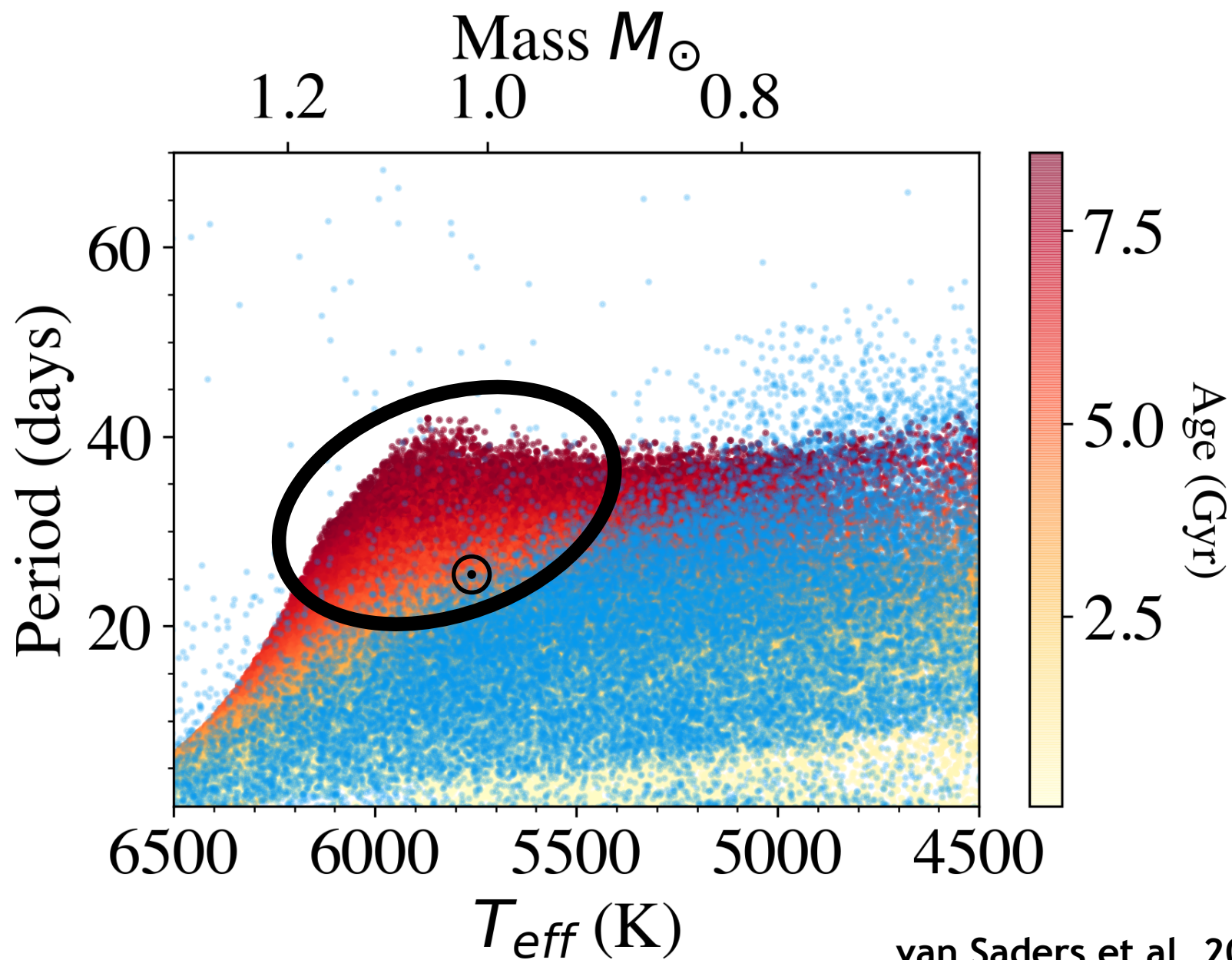
van Saders et al. 2019

Model Expectation



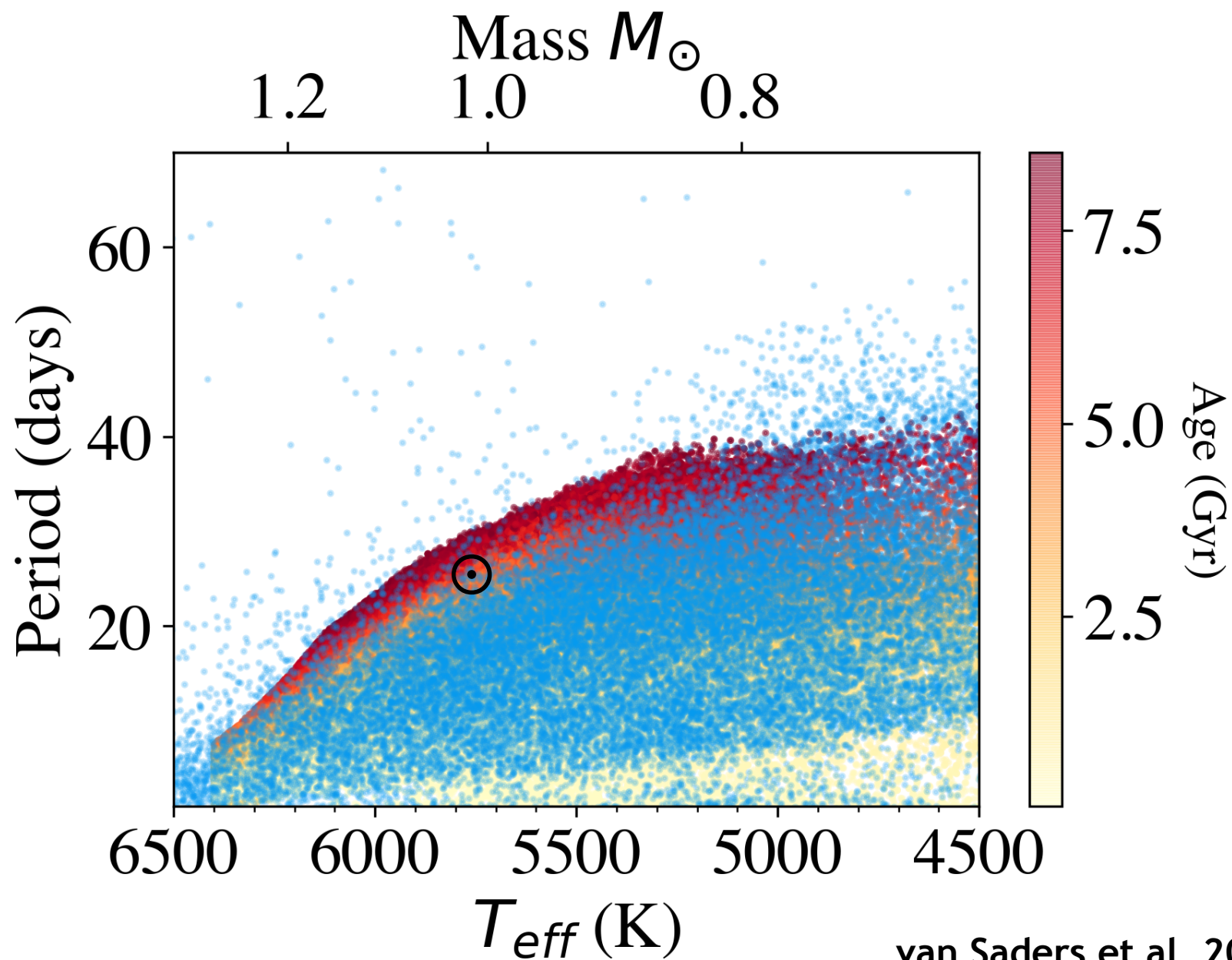
van Saders et al. 2019

Model Expectation



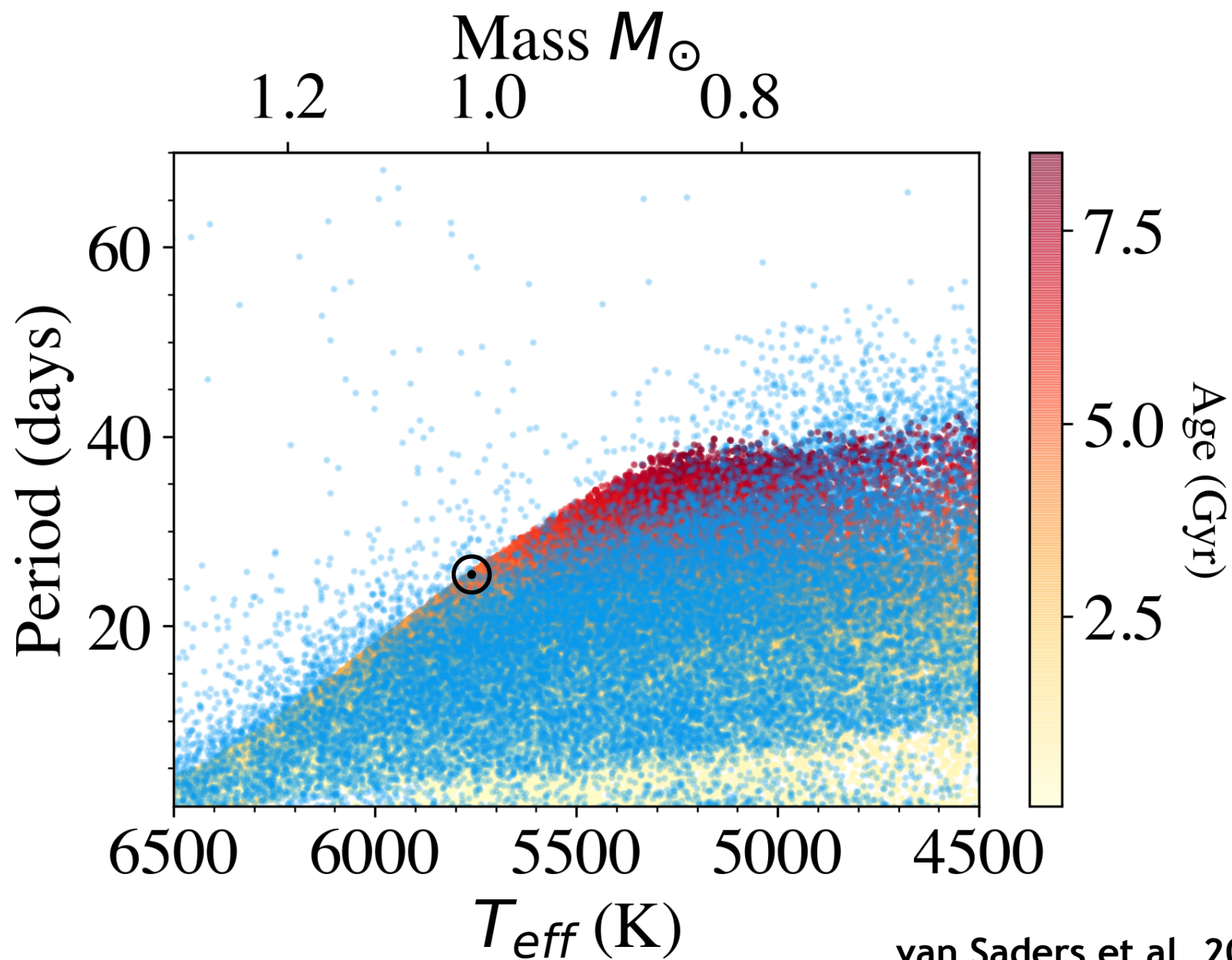
van Saders et al. 2019

Model Expectation



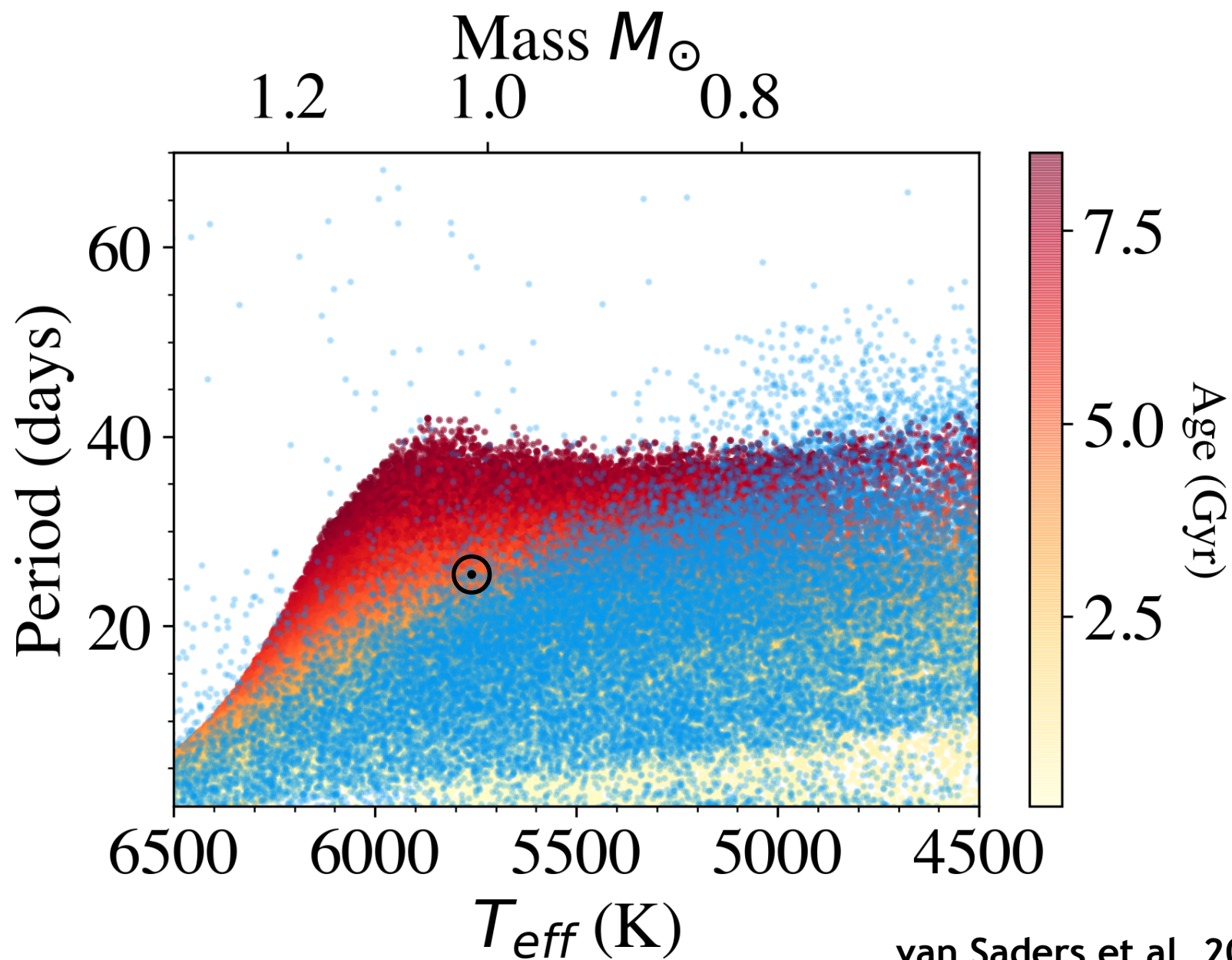
van Saders et al. 2019

Model Expectation



van Saders et al. 2019

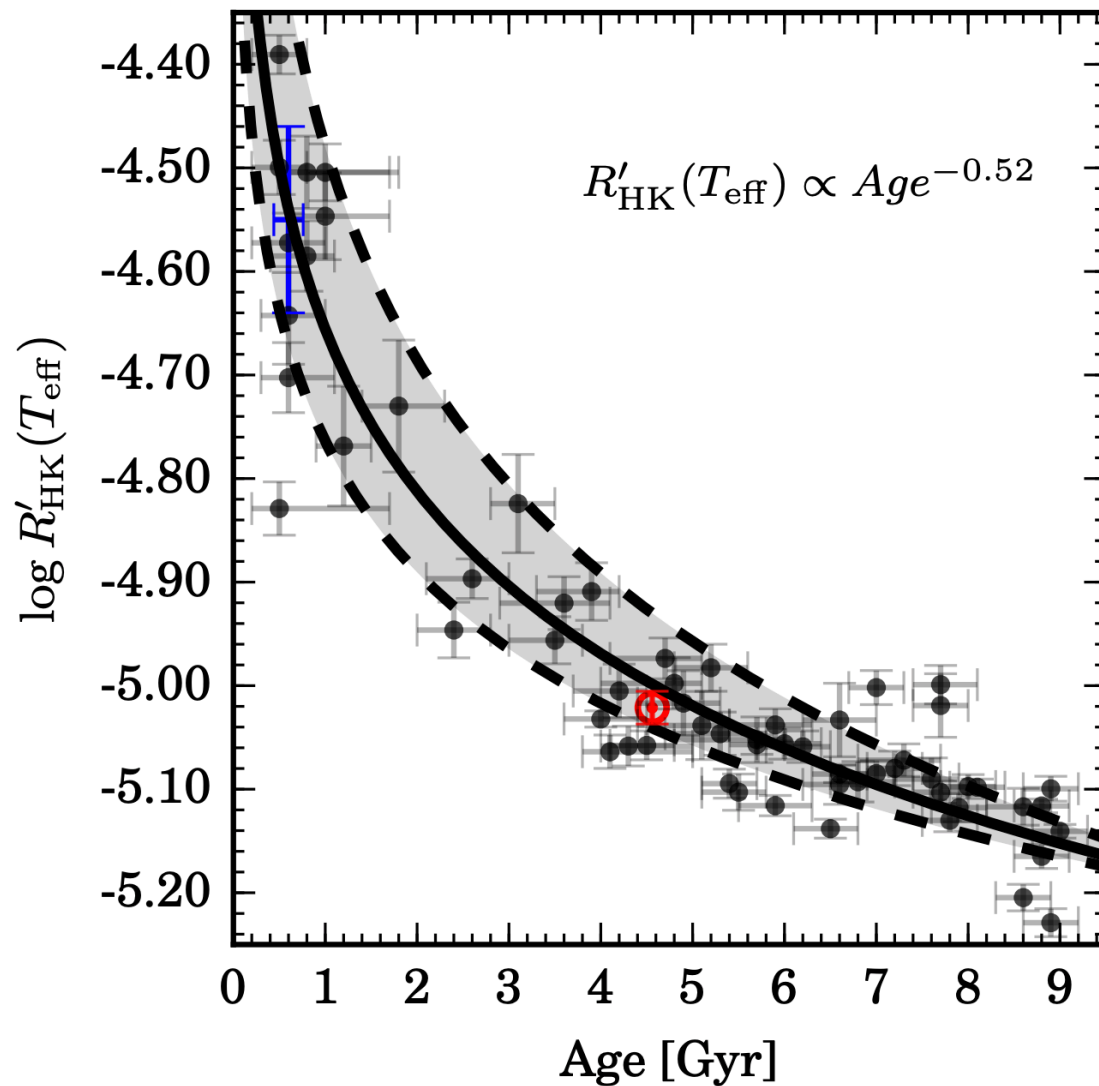
Model Expectation



van Saders et al. 2019

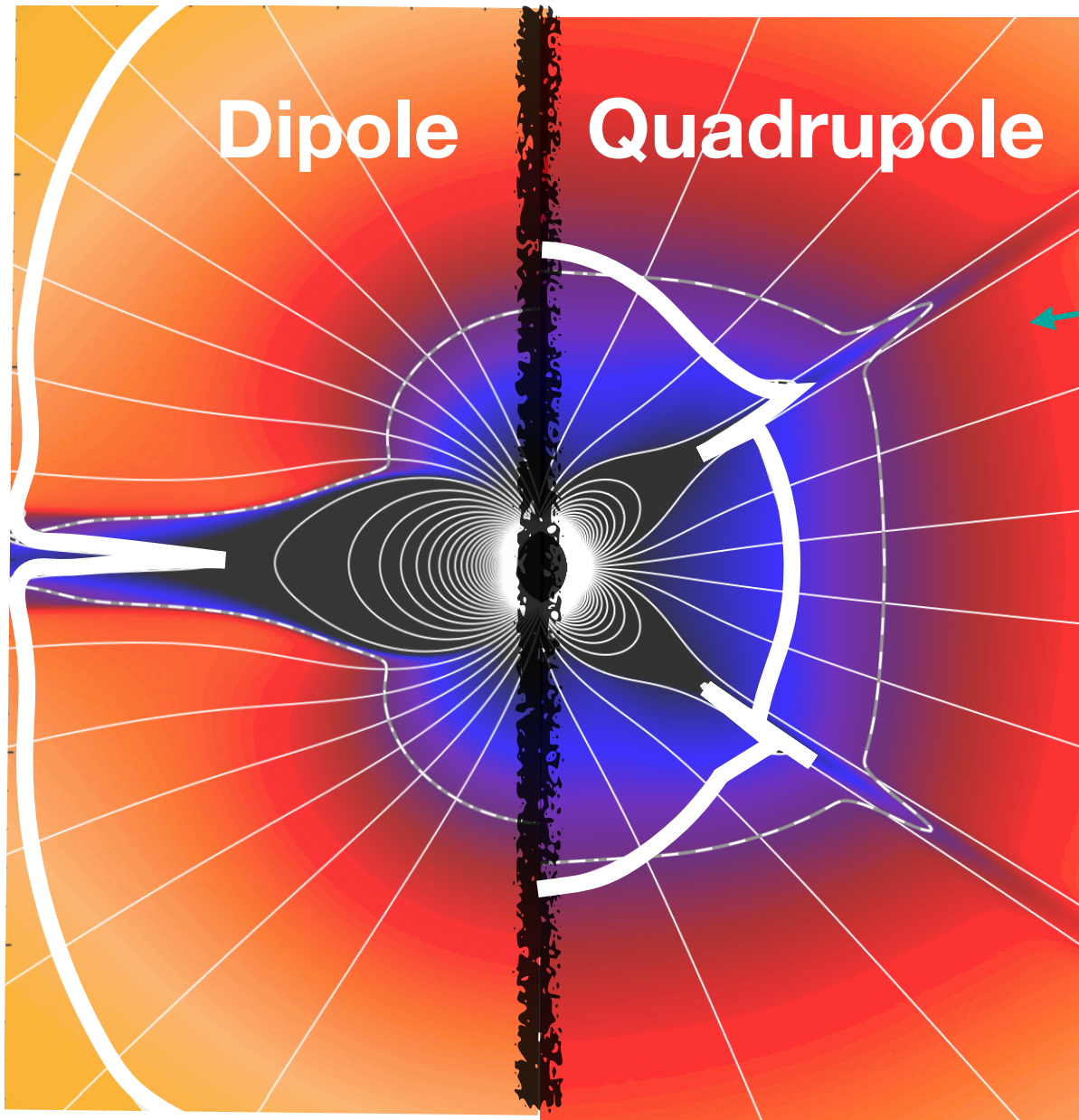
Magnetic braking is
weaker (and spots rarer?)
after the solar Rossby
number

Meanwhile, in the chromosphere...



Lorenzo-Oliveira et al. 2018

A shift in magnetic field morphology?



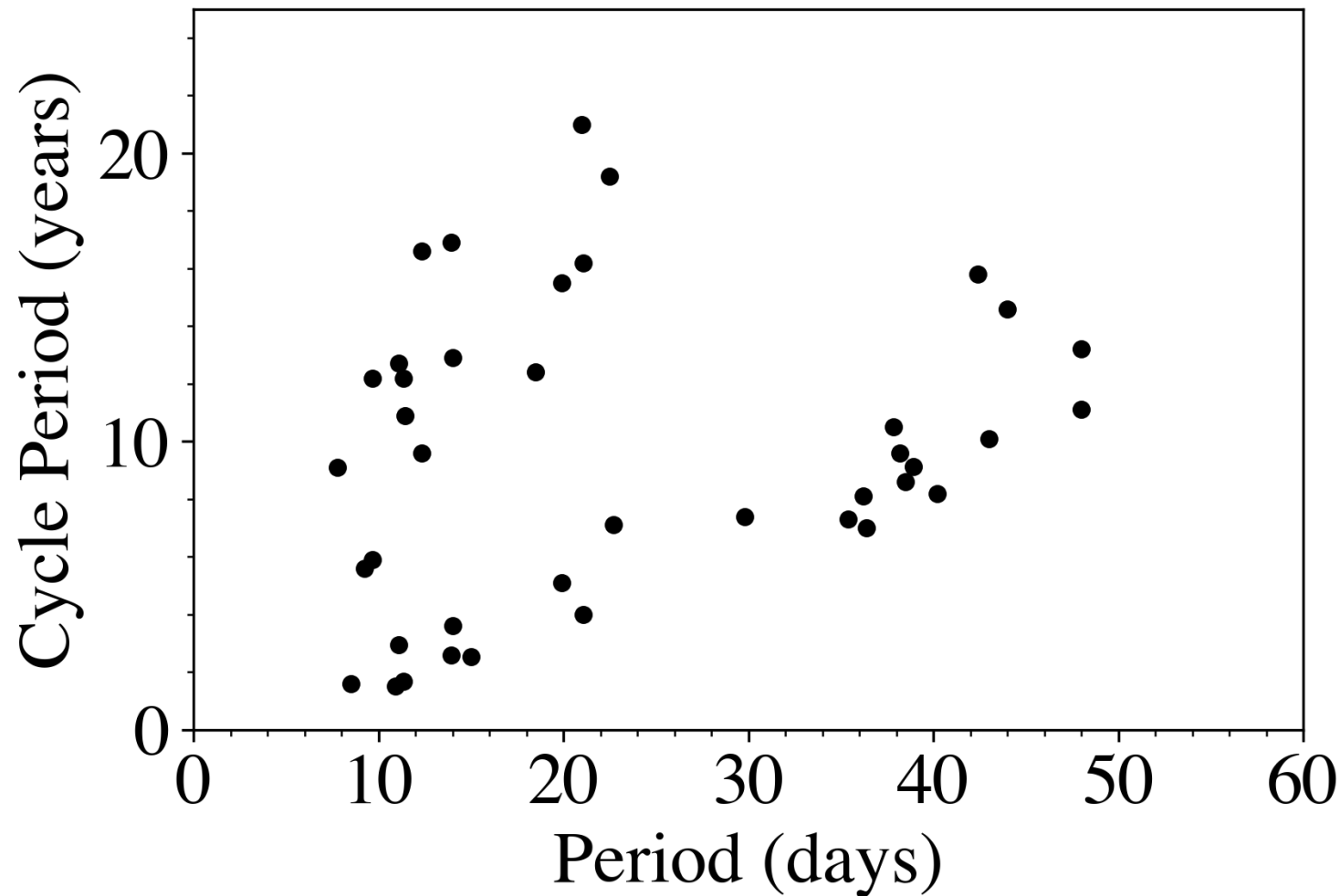
Models

Reville et al. 2015
Garraffo et al. 2016
Garraffo et al. 2018
See et al. 2019

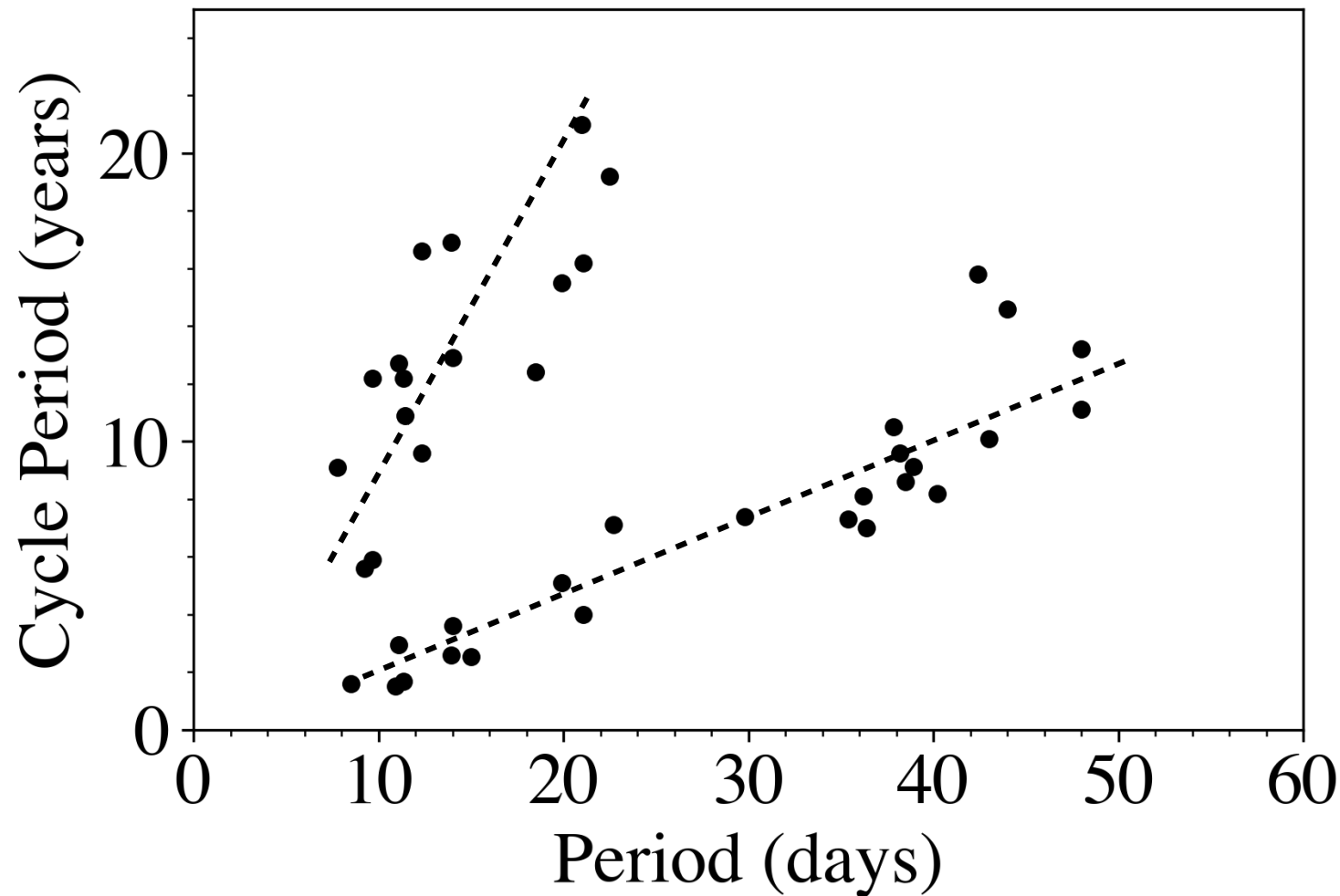
Observations

Metcalfe et al. 2019
Metcalfe & van Saders 2017
Metcalfe, Egeland &
van Saders 2016

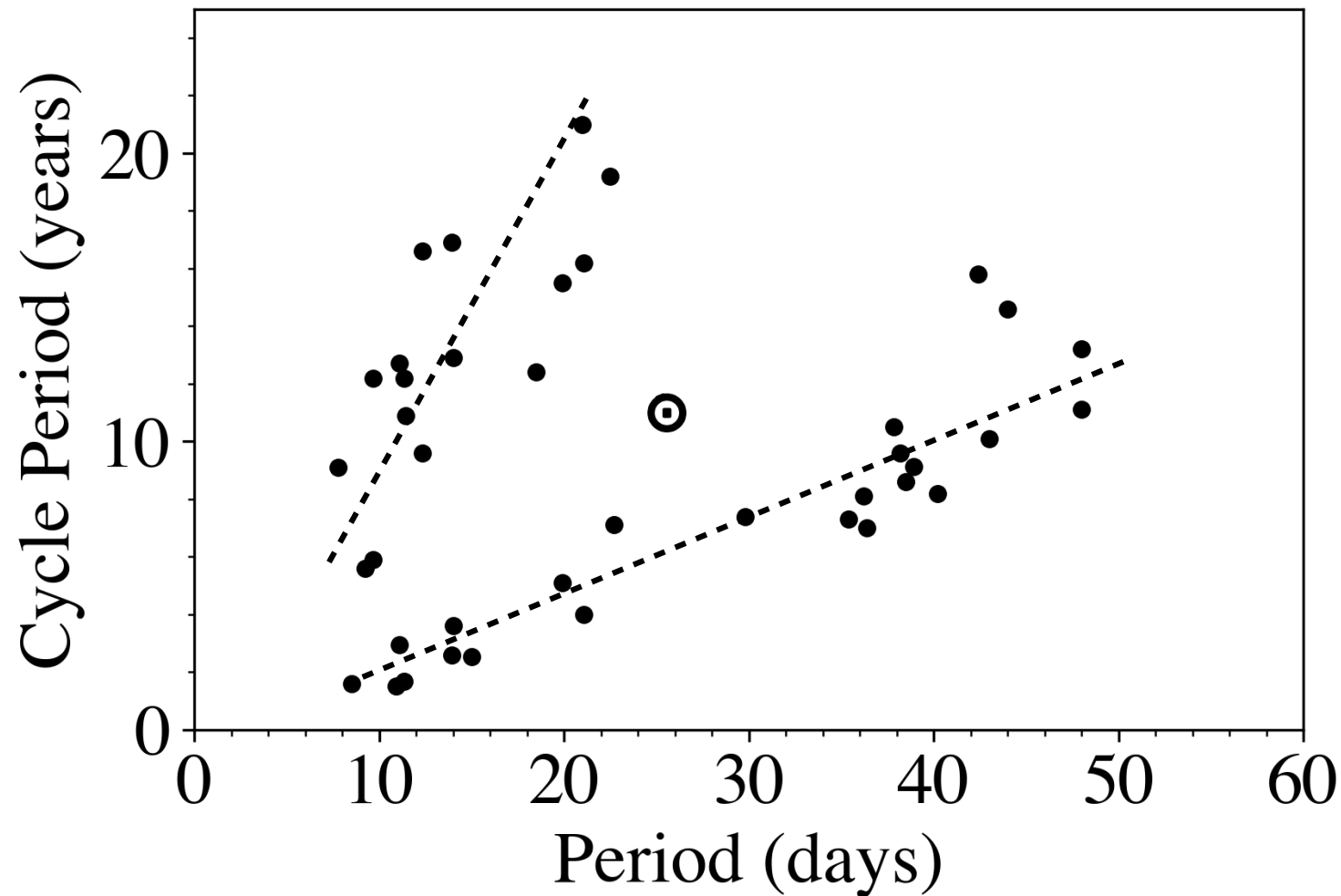
Something that should bother you about the Sun



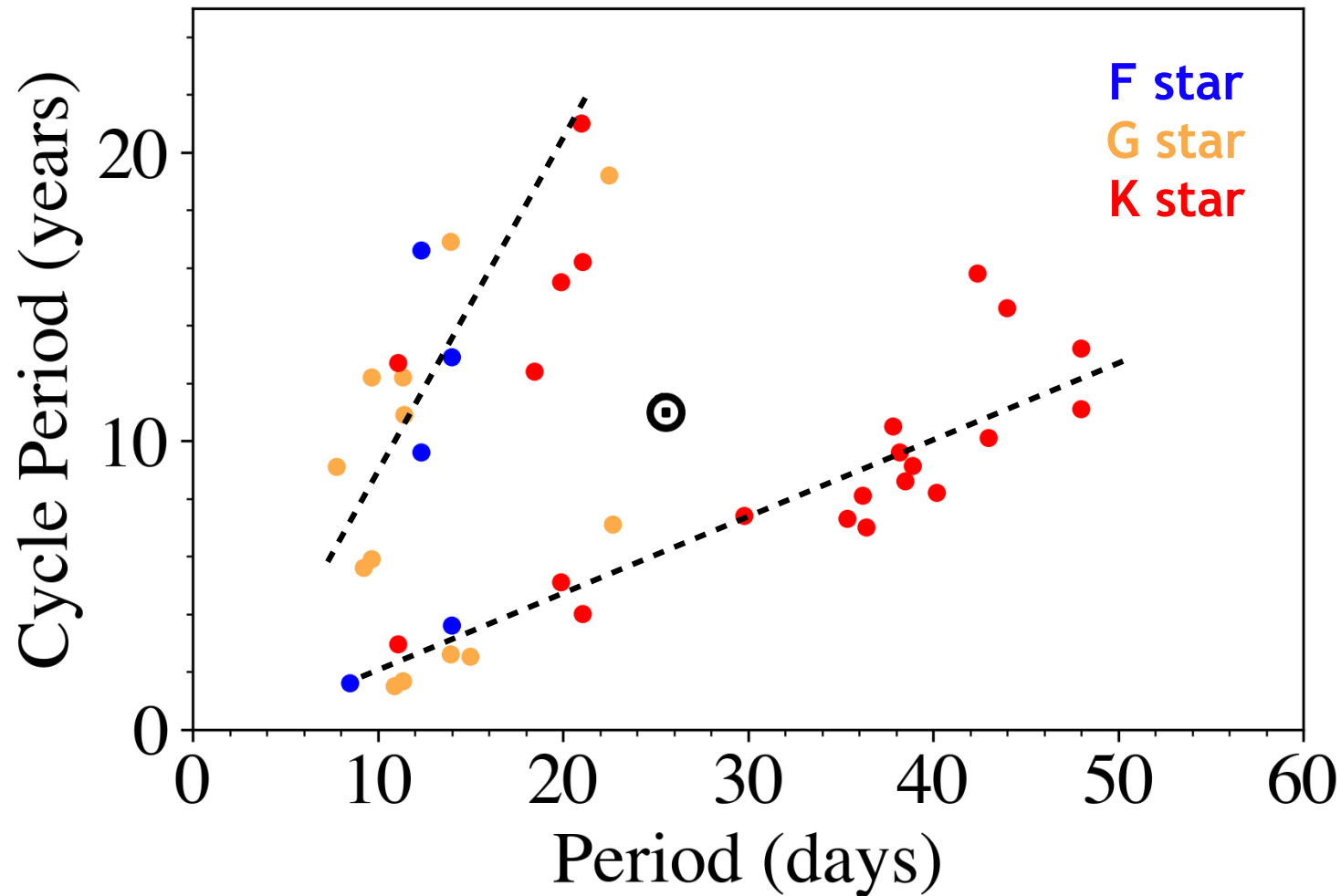
Something that should bother you about the Sun



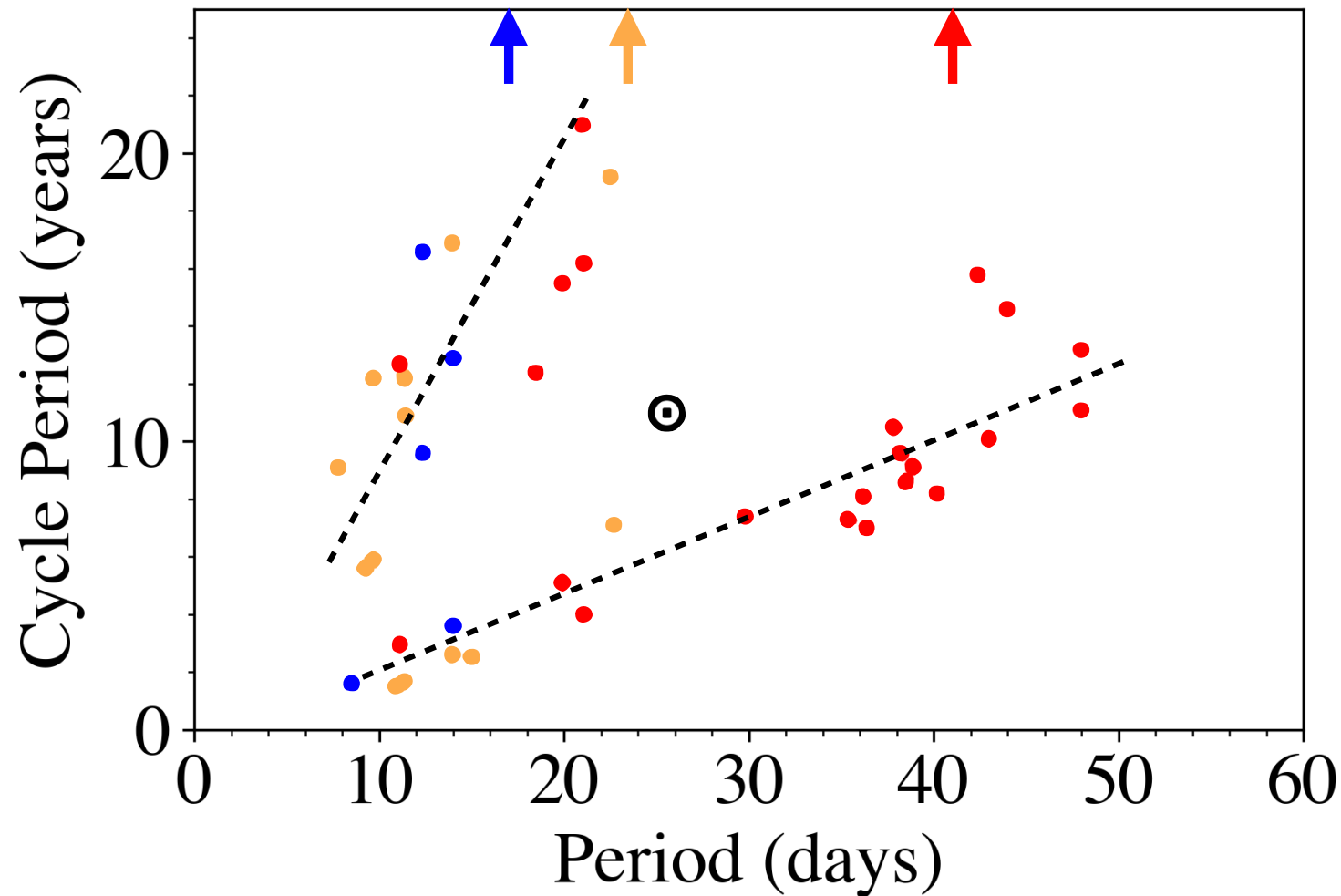
Something that should bother you about the Sun



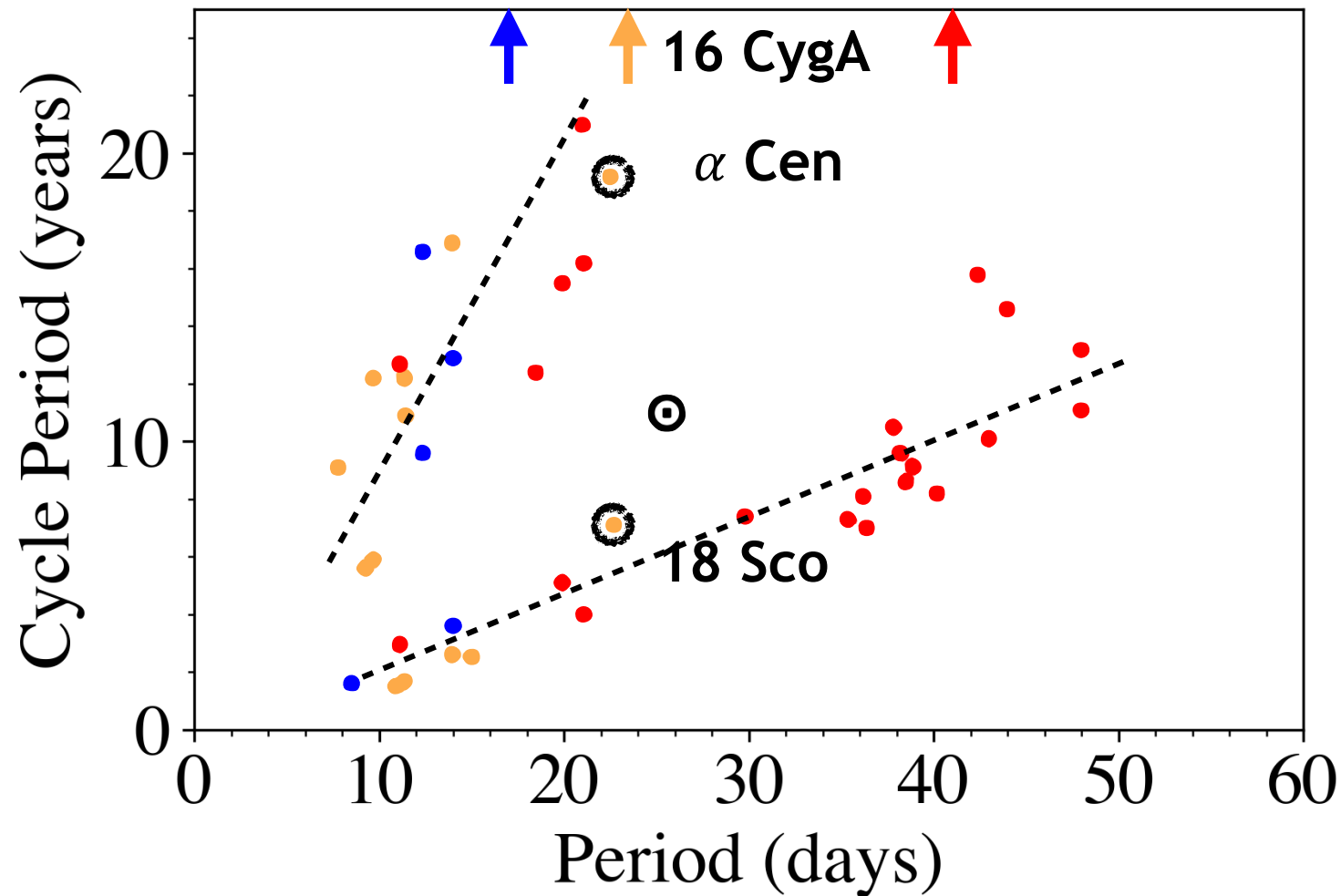
Something that should bother you about the Sun



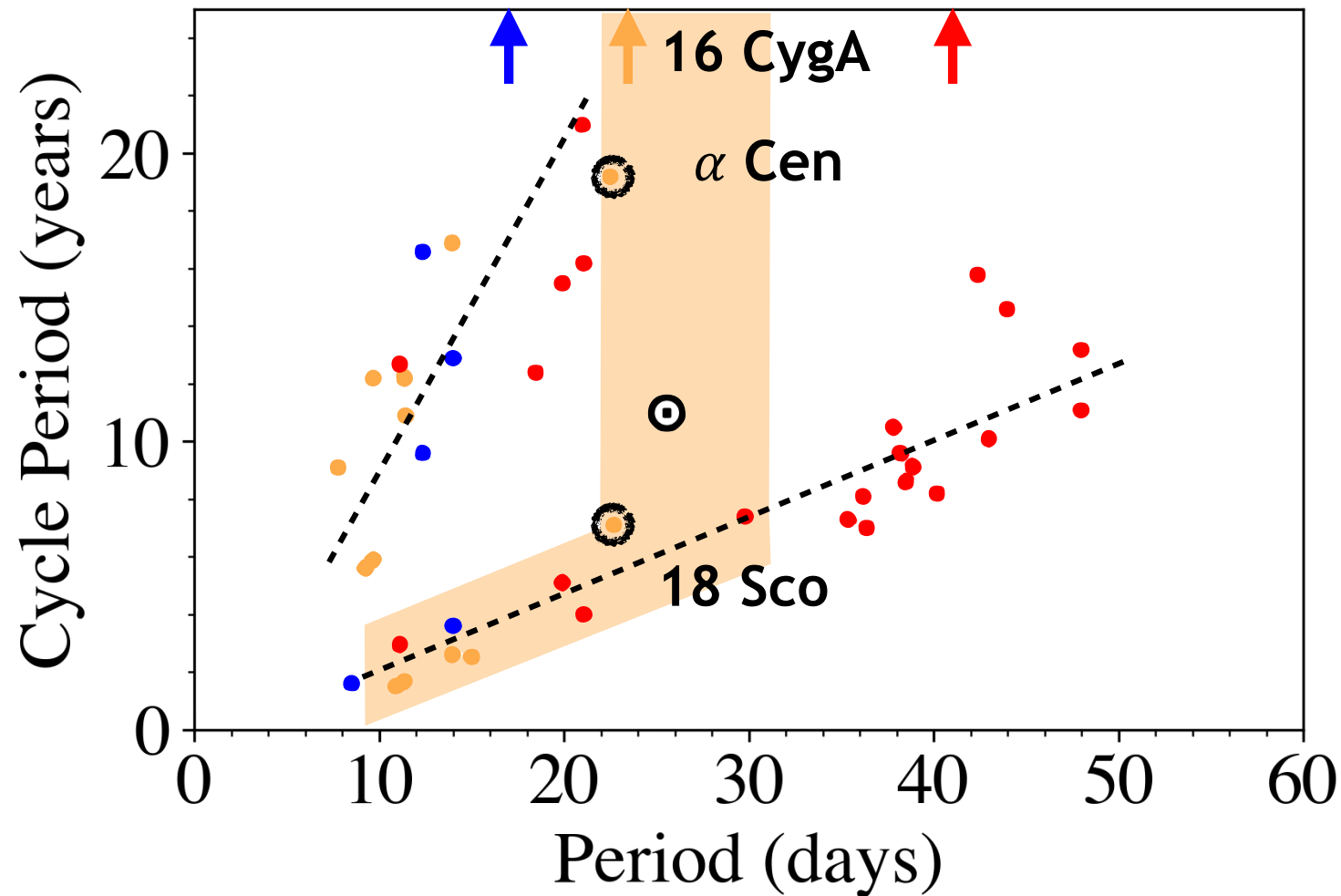
Something that should bother you about the Sun



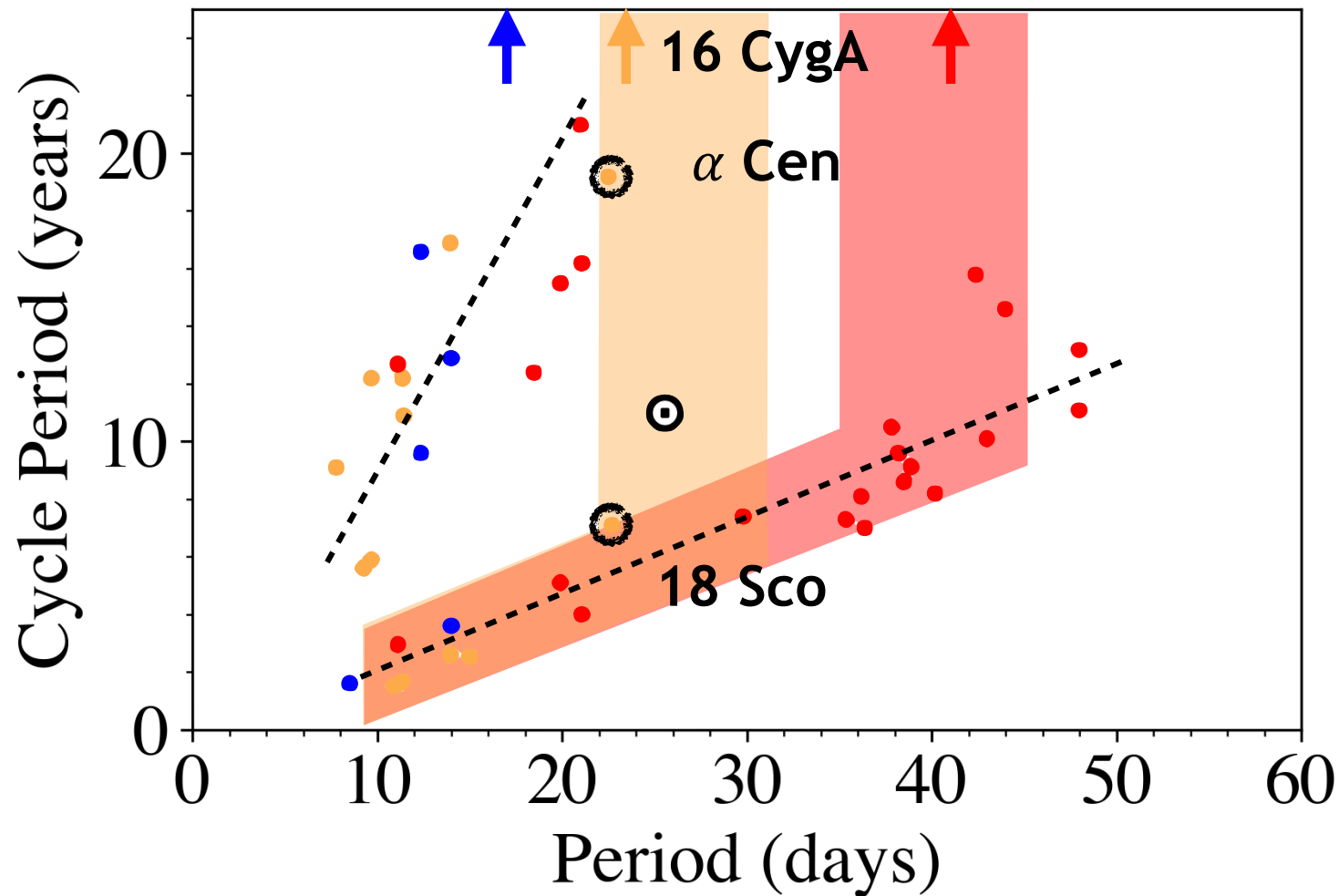
Something that should bother you about the Sun



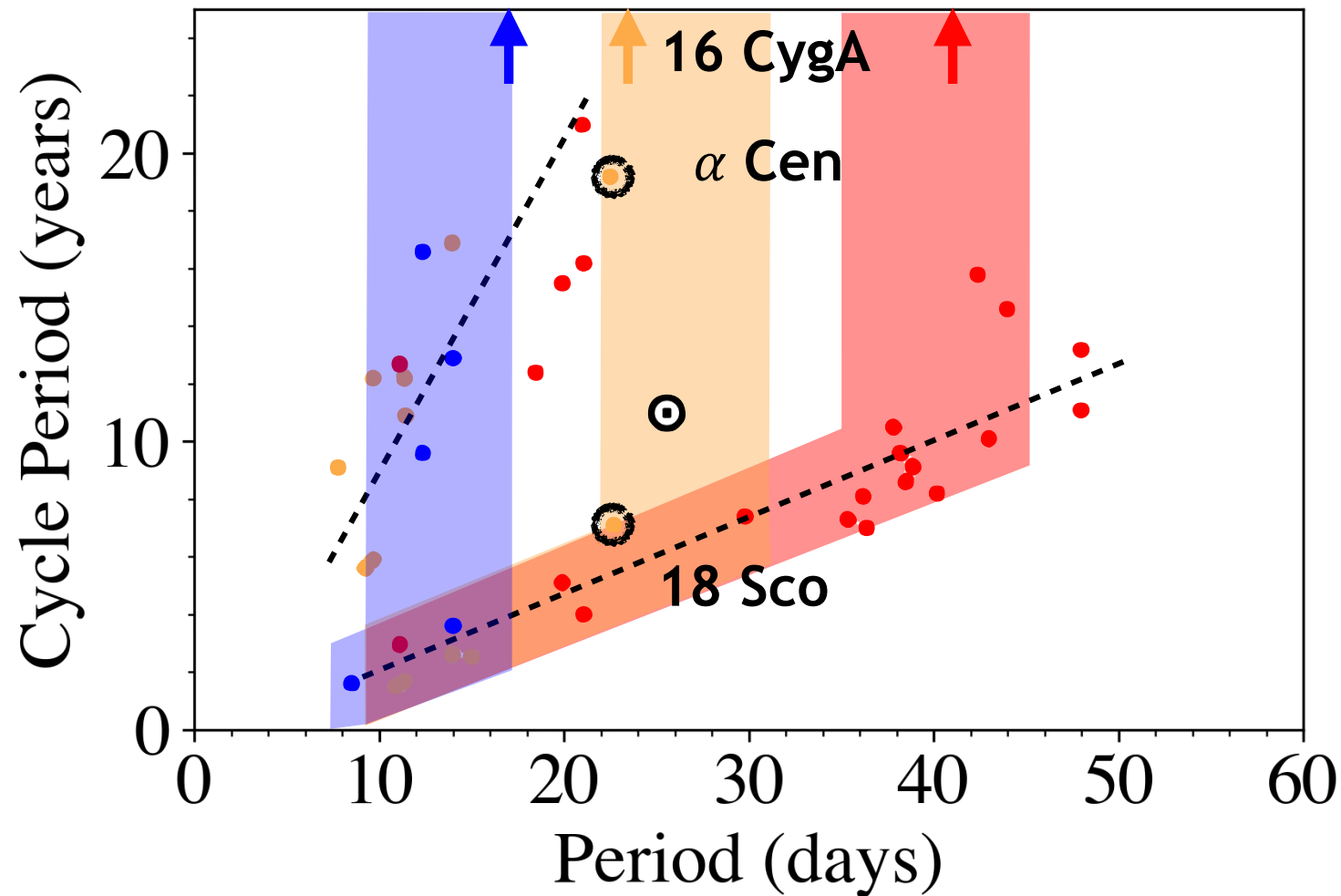
Something that should bother you about the Sun



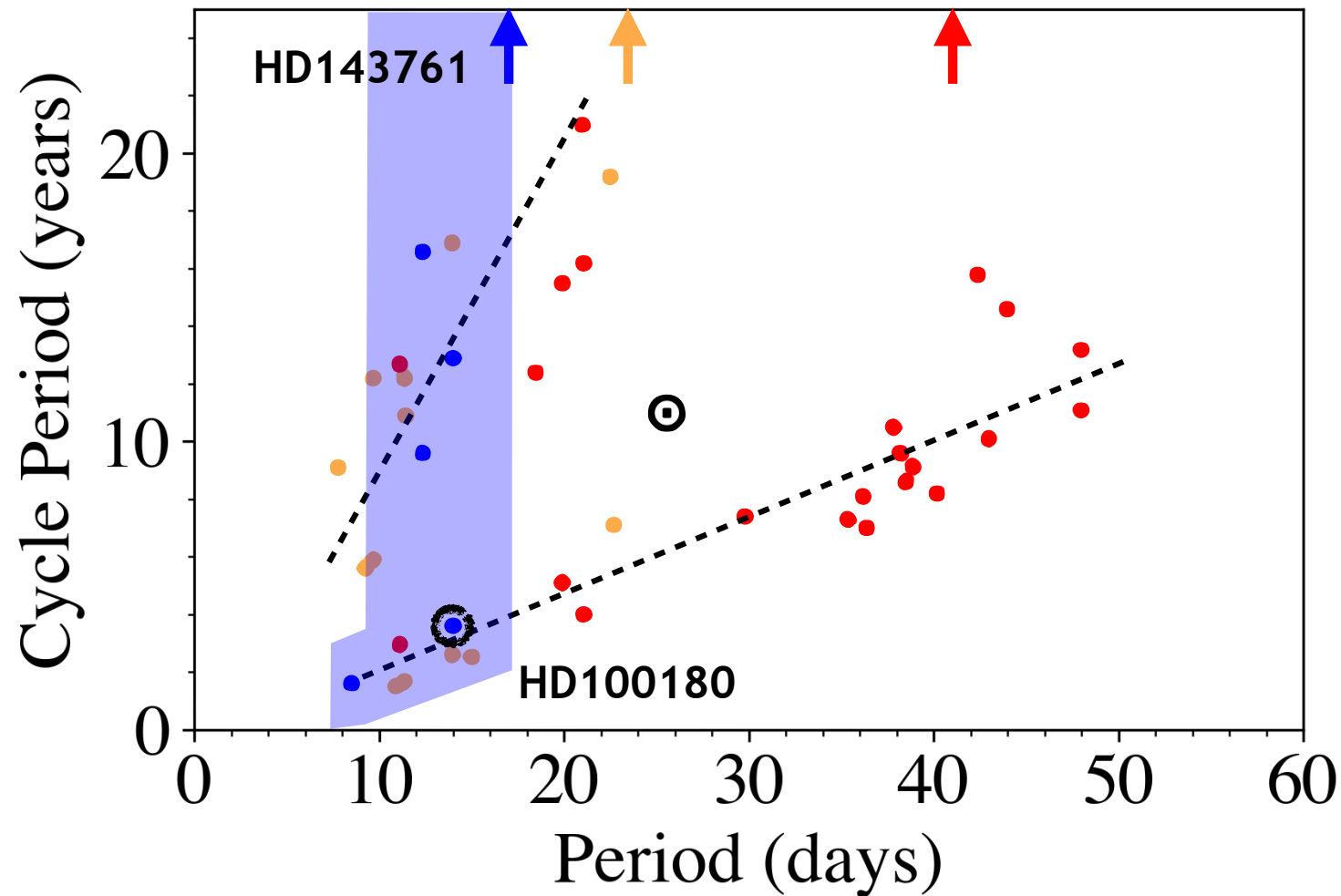
Something that should bother you about the Sun



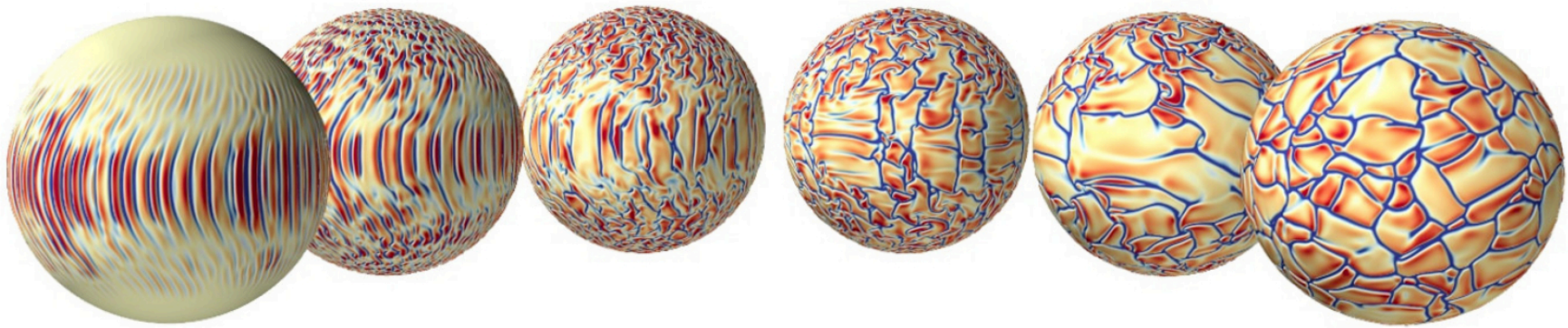
Something that should bother you about the Sun



Something that should bother you about the Sun



A scenario

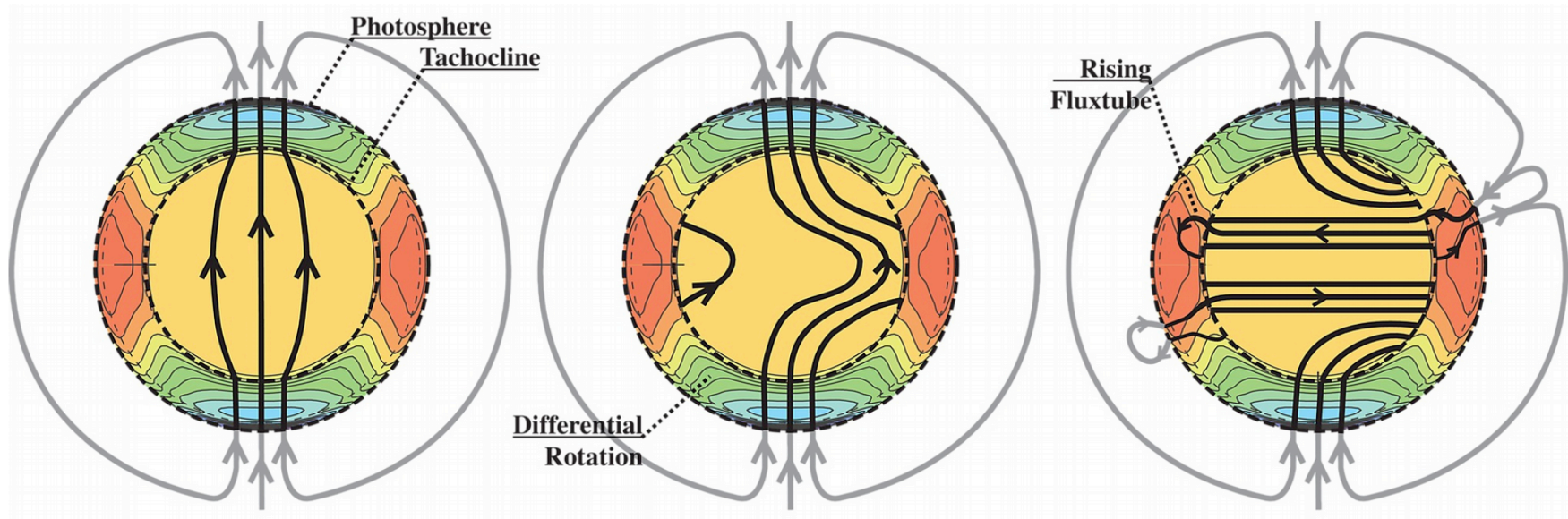


Slower Rotation →

The magnitude of differential rotation decreases as stars spin down (and age)

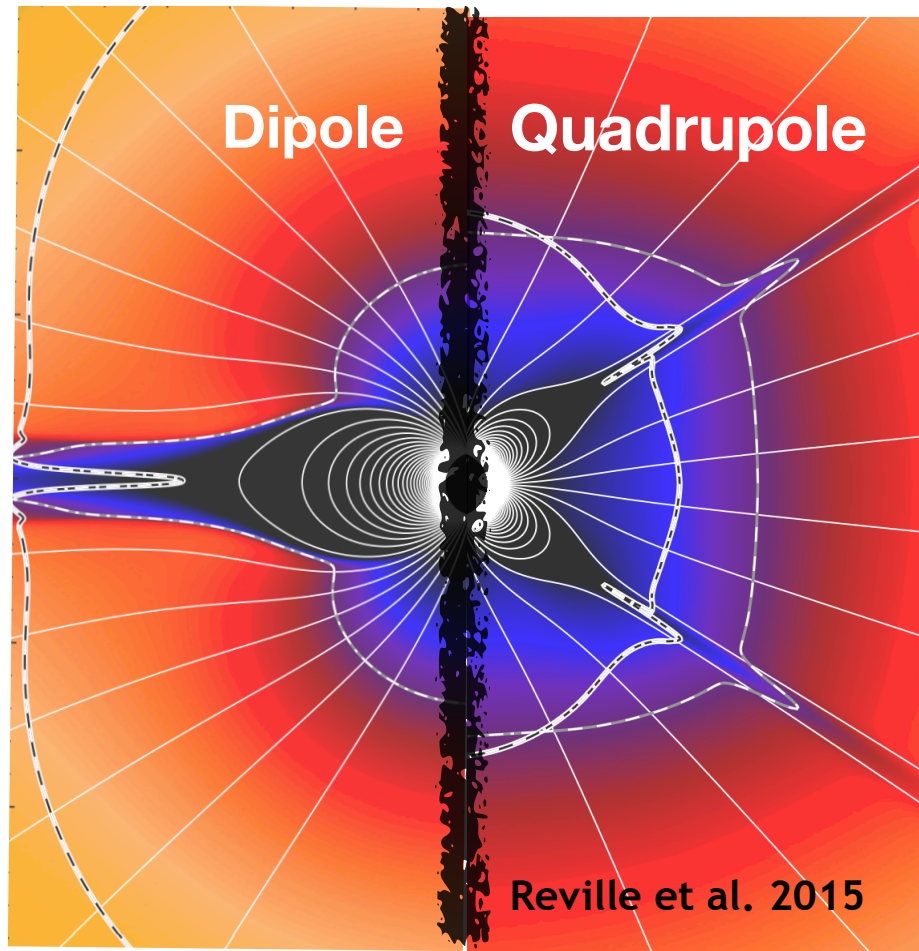
Featherstone & Hindman 2016, & priv comm.

A scenario



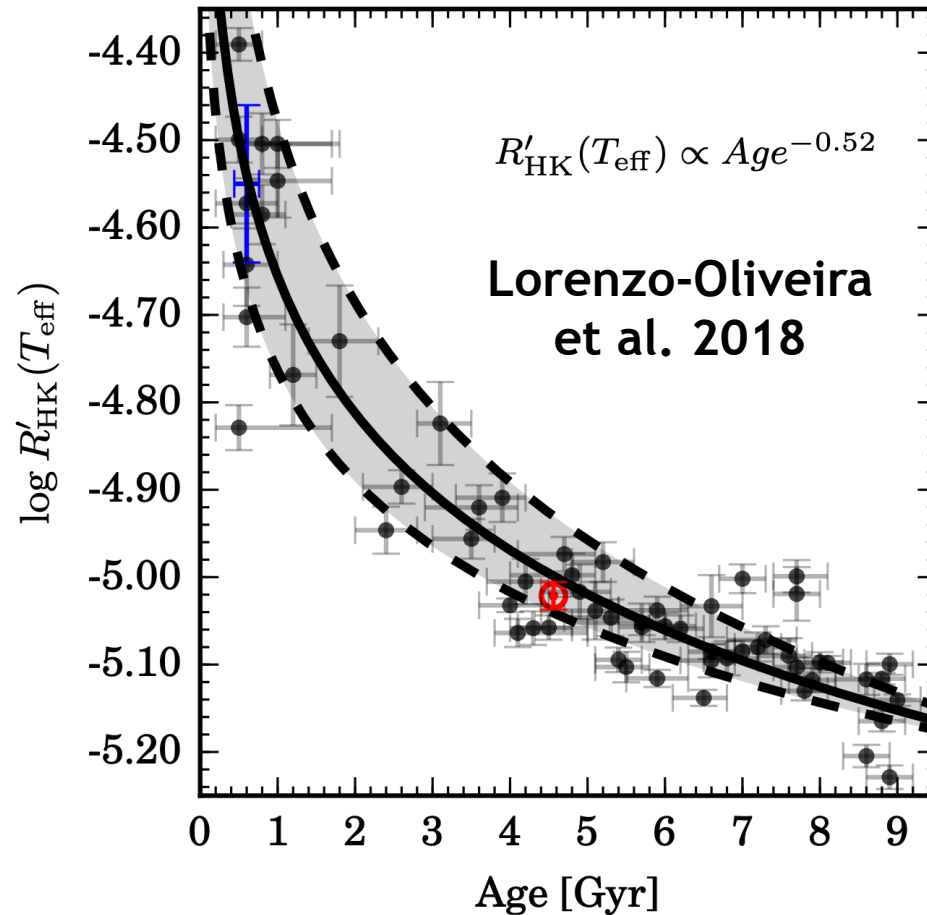
Without differential rotation, the cycling of poloidal to toroidal fields is disrupted

A scenario



**The decay of large scale fields weakens
the magnetic braking**

A scenario



...but doesn't have as strong an effect on the
chromosphere

Take-away:

Stars appear to undergo a transition in their (large scale) magnetic properties at roughly the Solar Rossby number.

A larger collection of stars with the full complement of measurements will test this idea: stars with ages, magnetic field measurement, and detected activity cycles