How Typical is the Sun as a Variable Star

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Stellar Photometric data

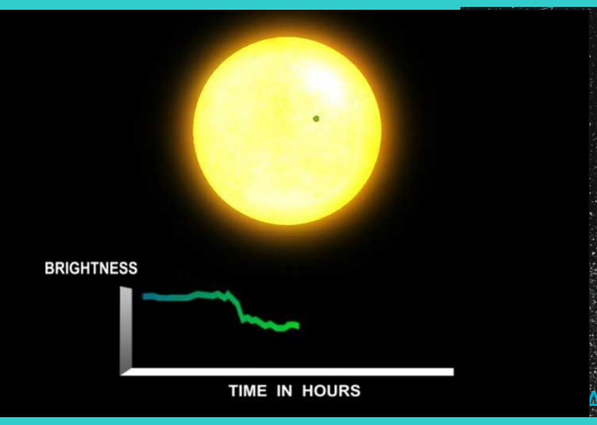
Ground-based data (Strömgren b and y, Ca II index)

21-inch refractor at the Lowell Observatory

Automatic Photoelectric Telescopes at the Fairborn Observatory

~10^2 stars; ~10-20 years

Spaceborne data (broadband photometry)



Kepler

CoRoT

~10^5 stars; ~100 days

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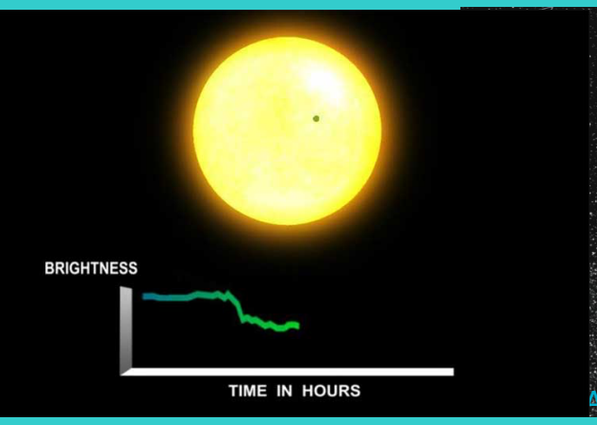
LSST (2021)

Spaceborne data (broadband photometry)



Kepler

CoRoT

~10^5 stars; ~100 days

TESS (2018)

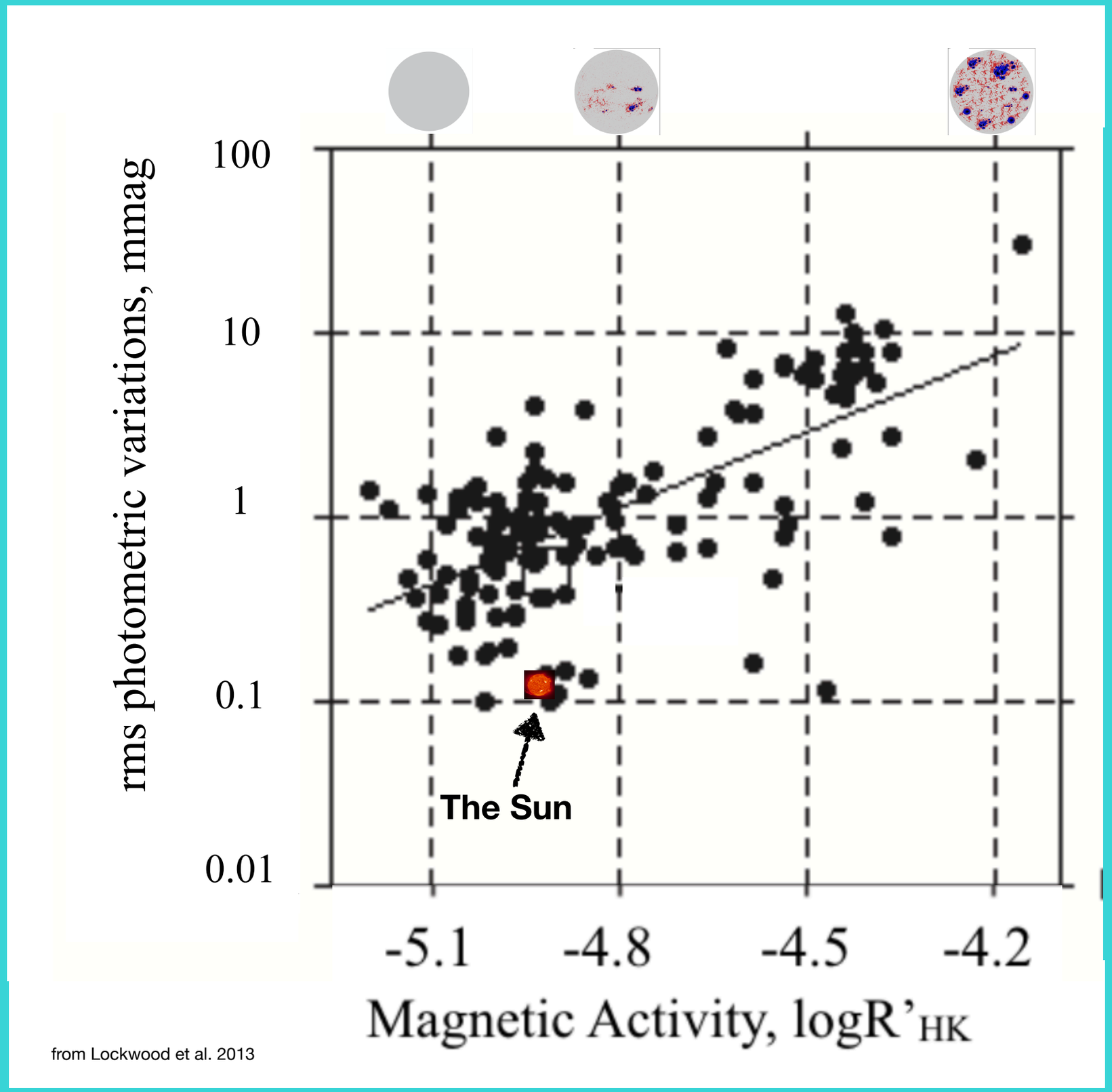
CHEOPS (2018)

PLATO (2026)

Activity cycle timescale. The peculiar case of the Sun

Long-term (year to year) variability

Strömgren *b* (467 nm)



from Lockwood et al. 2013

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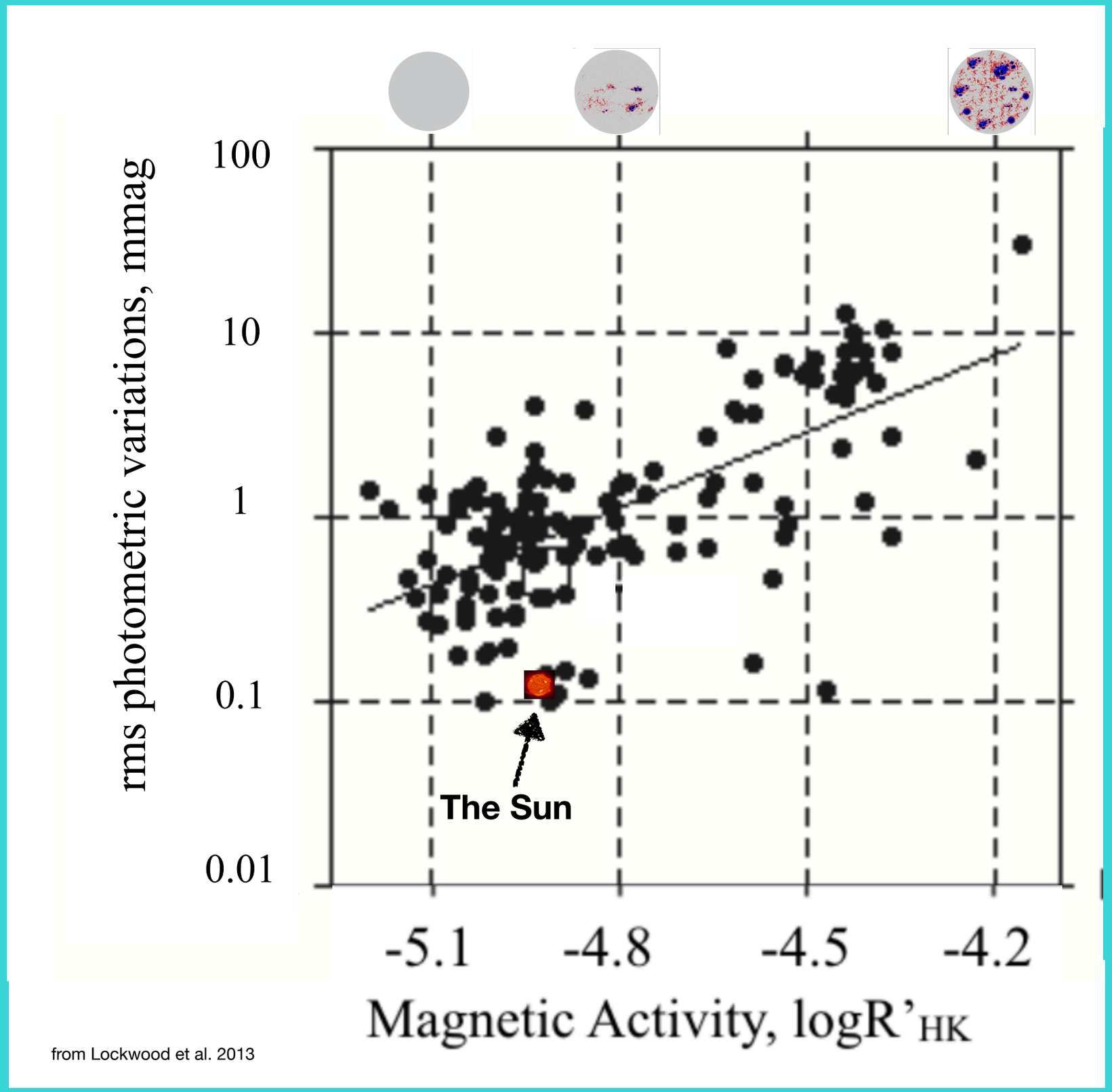

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Is the Sun a Sun-like star?

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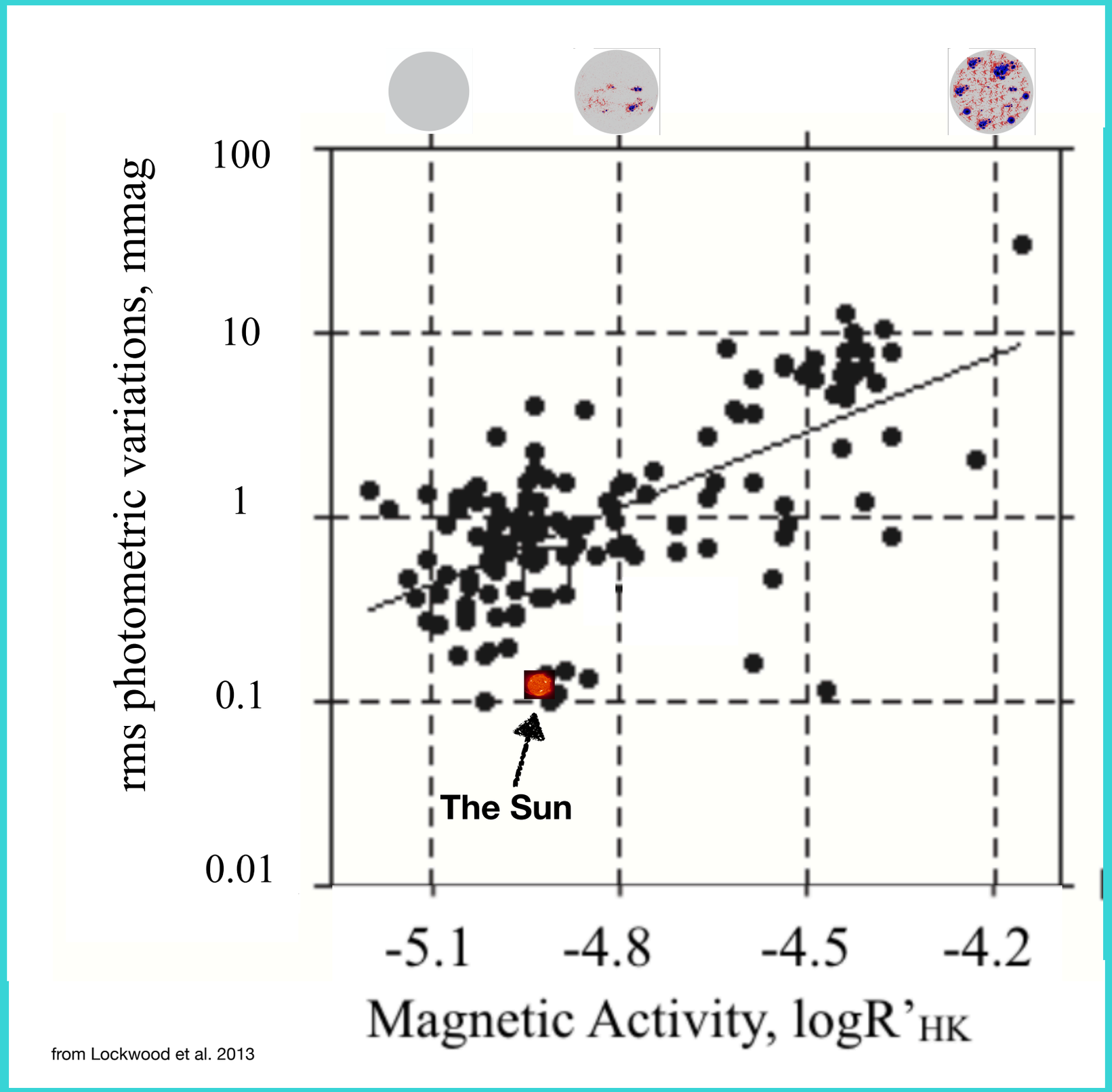

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Is the Sun a Sun-like star?

Is something wrong with the stellar/solar data?

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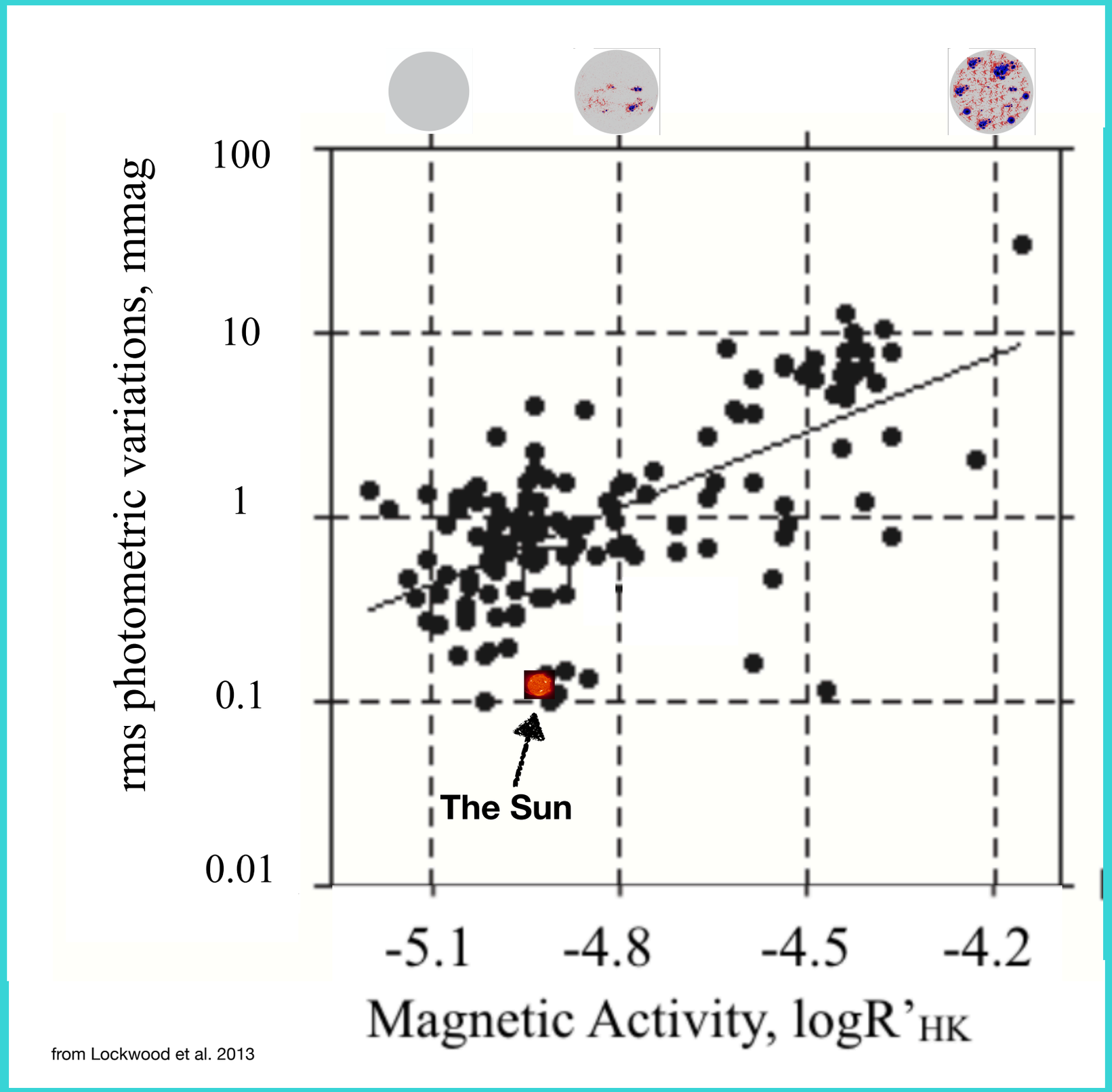

Is the Sun a Sun-like star?

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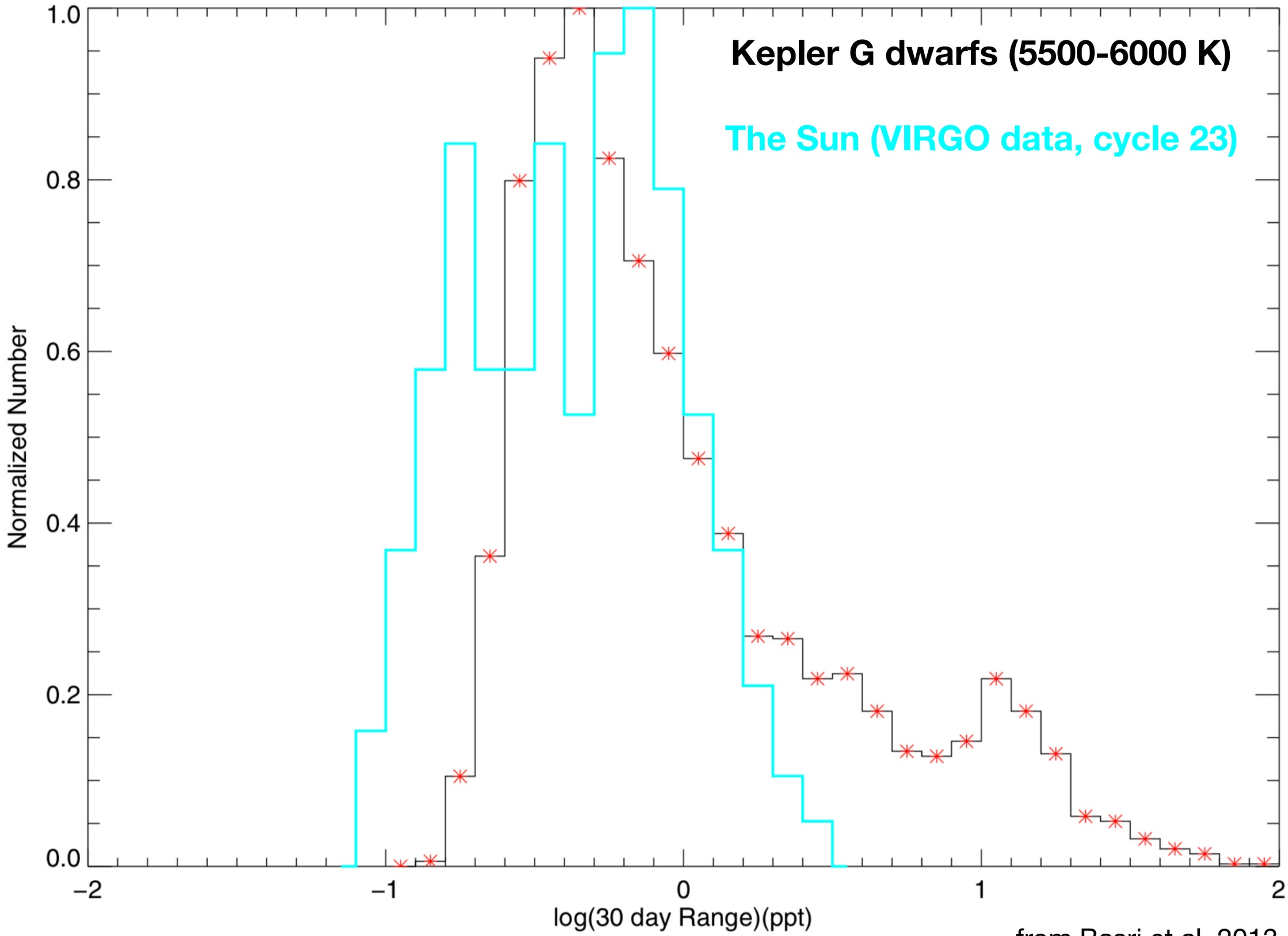
Witzke at al., in prep

Timescales of stellar rotation

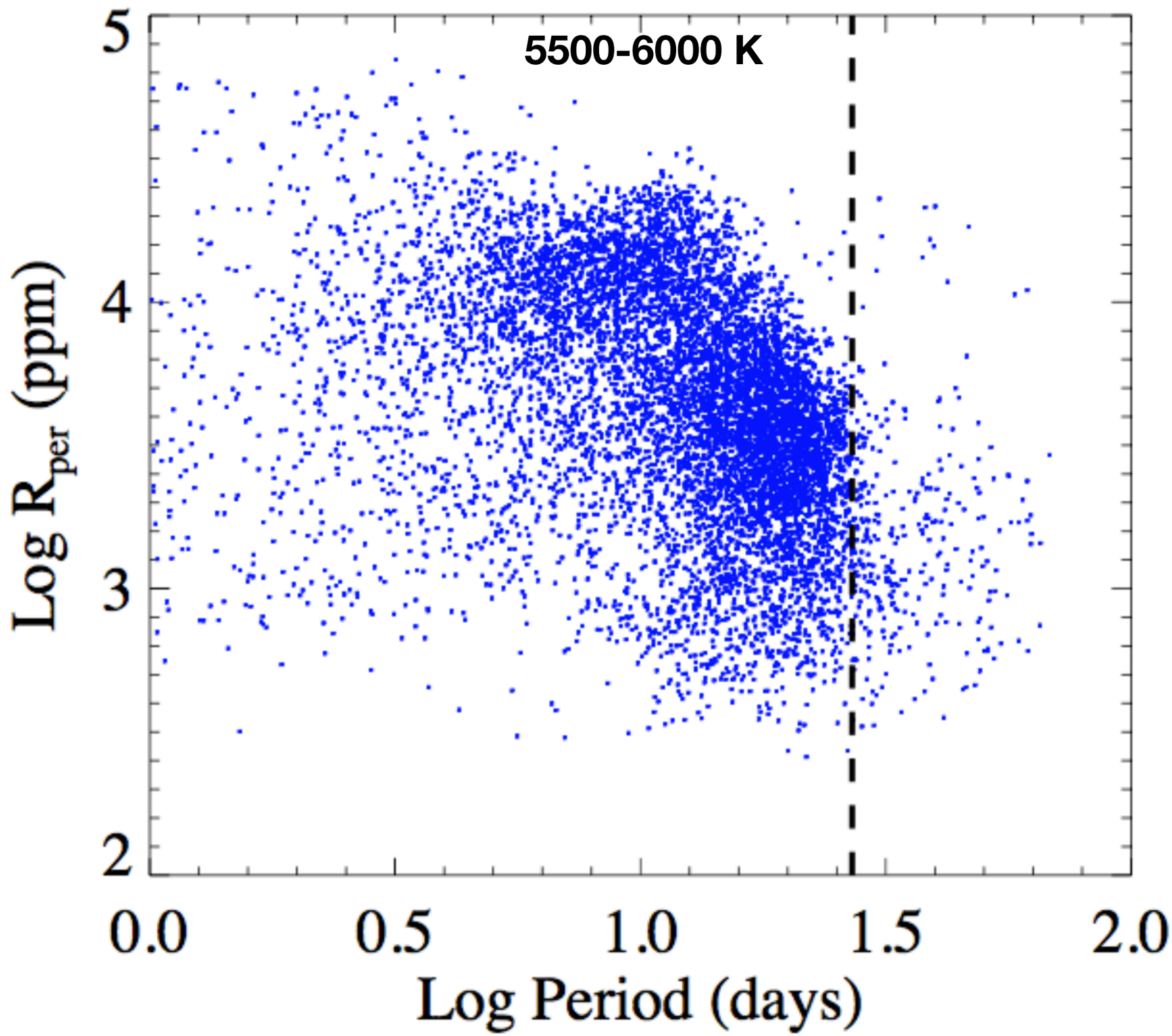


from Basri et al. 2013

Variability

Timescales of stellar rotation. The peculiar case of the Sun

The Sun should be compared to stars with near-solar rotational period



from McQuillan et al. 2013

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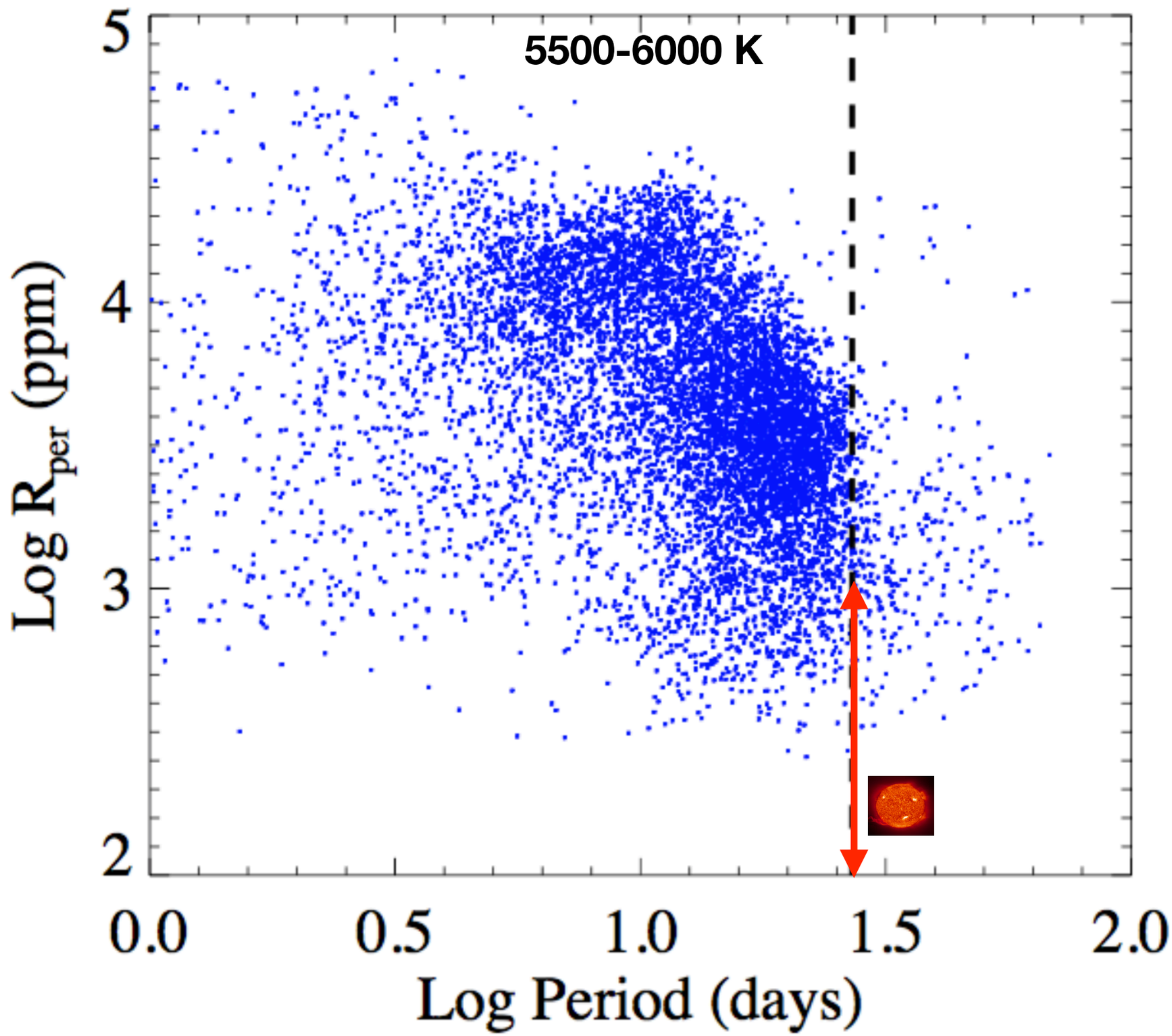

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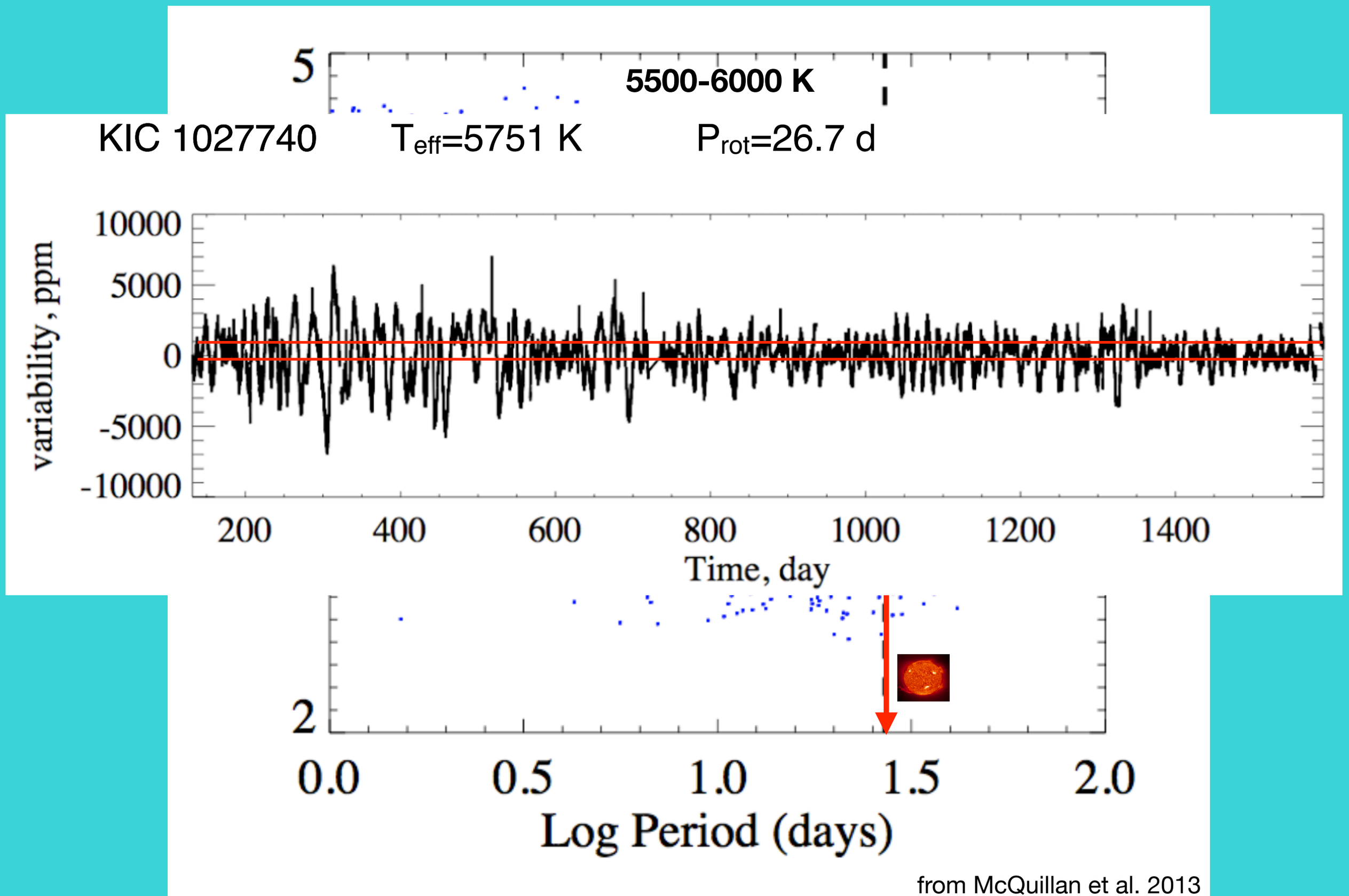

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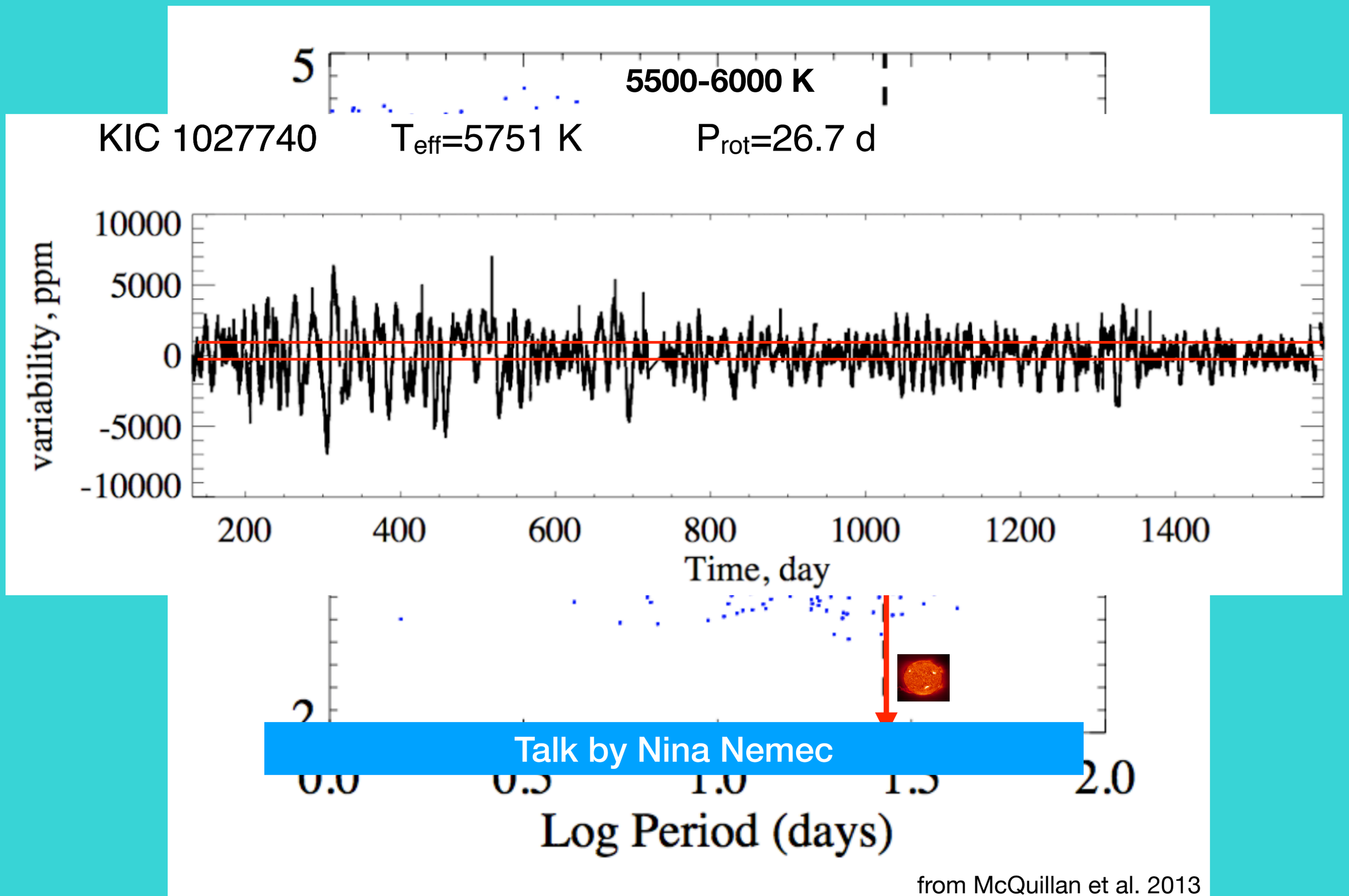
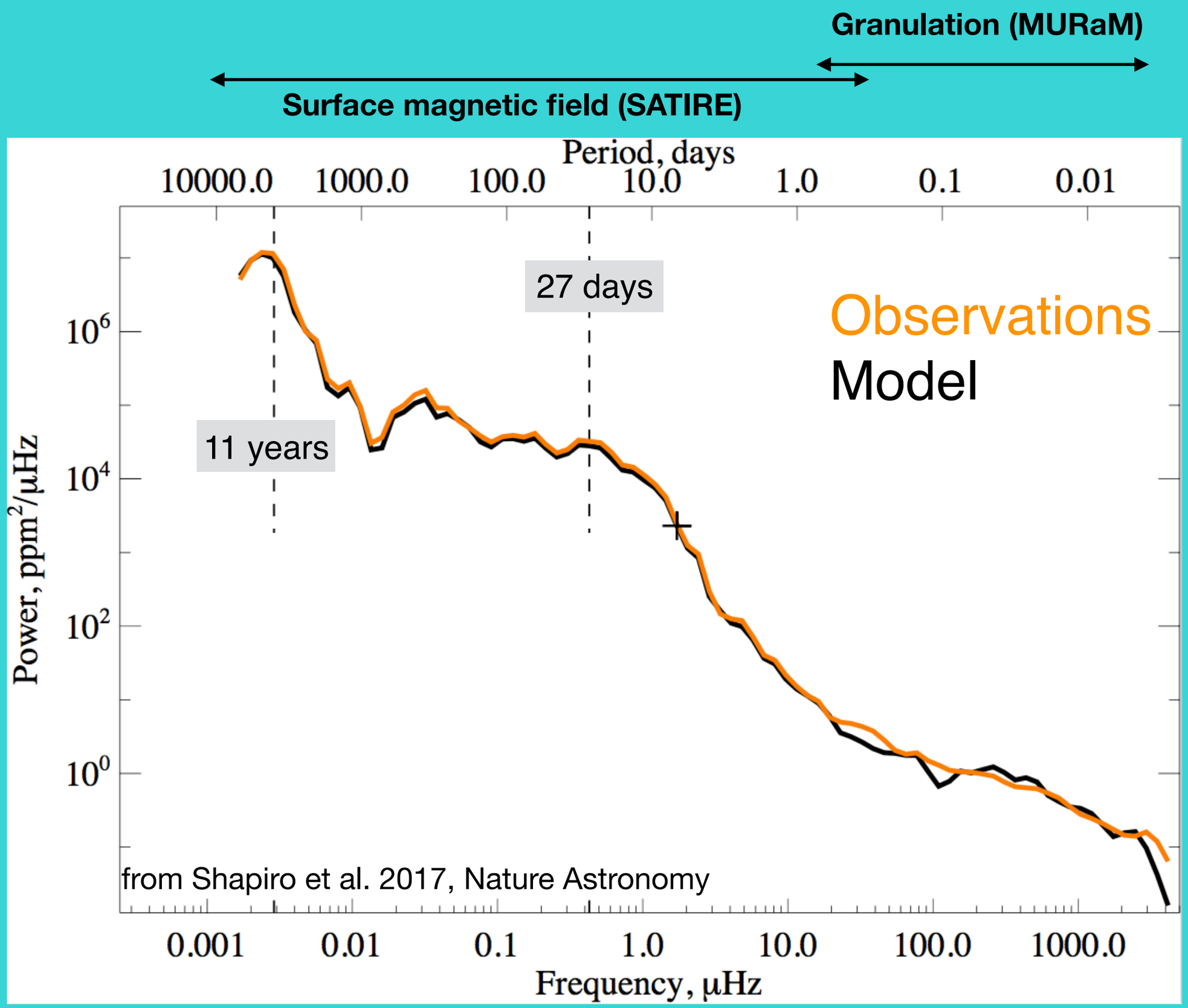


from McQuillan et al. 2013

Power spectrum of solar brightness variations



from Shapiro et al. 2017, Nature Astronomy

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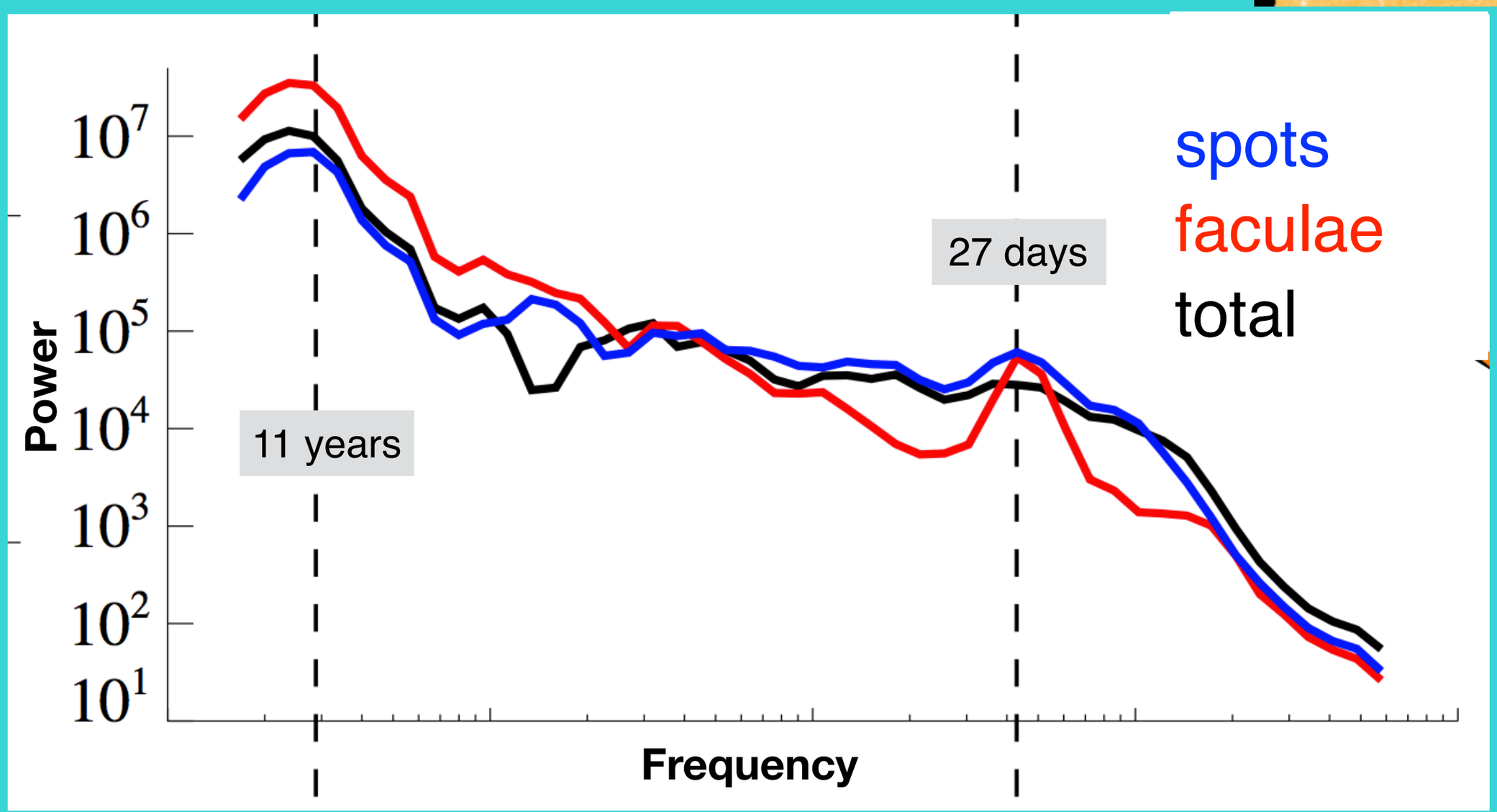
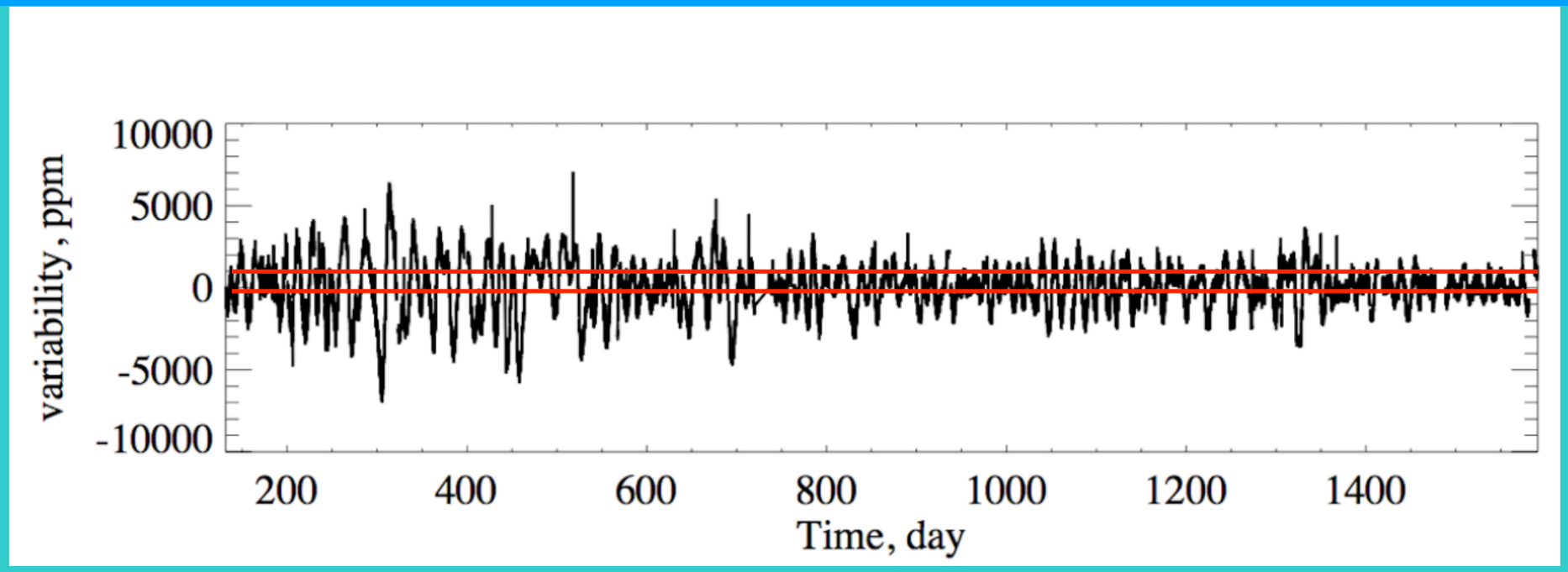
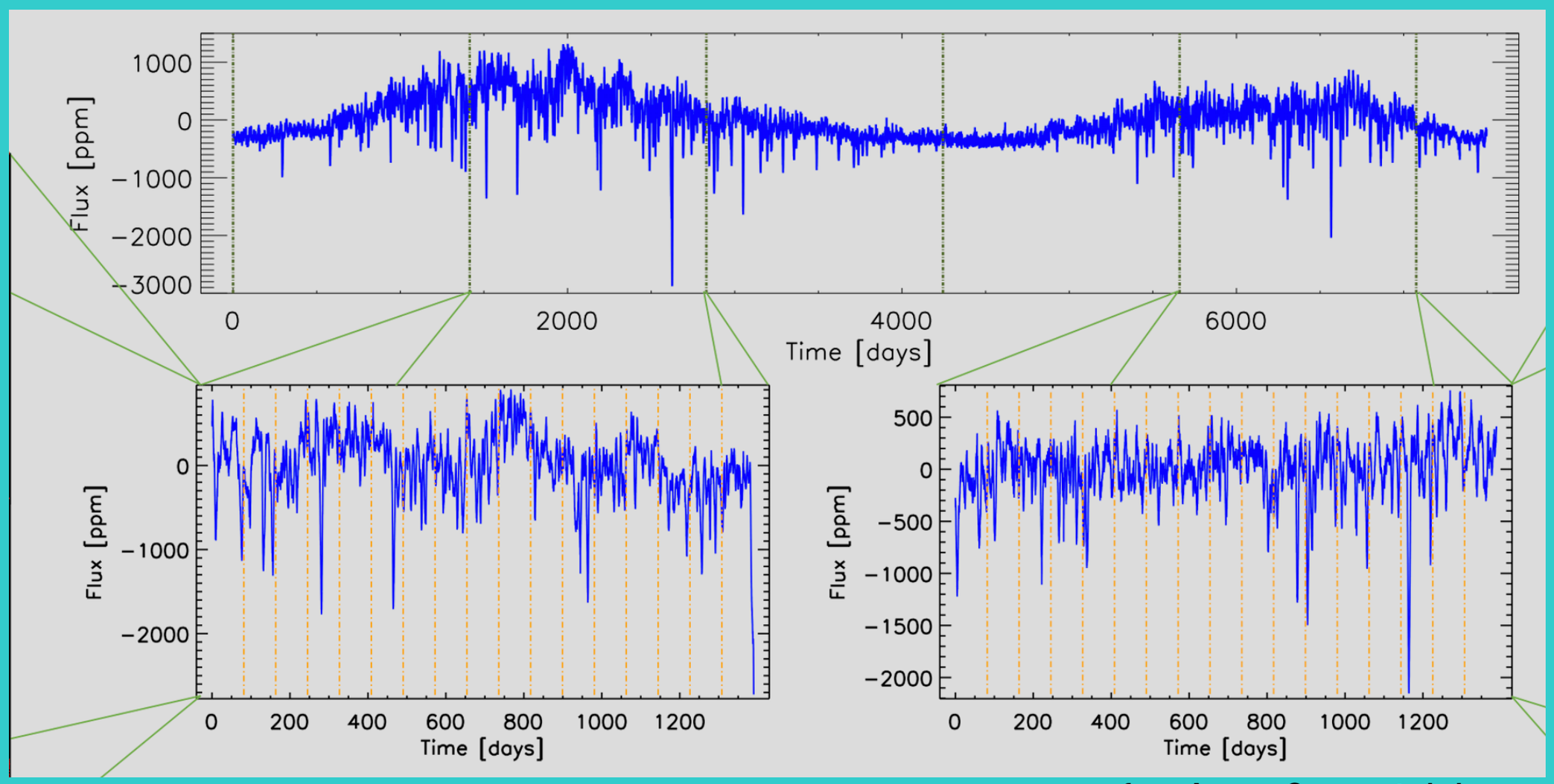


The Sun vs. KIC 1027740



KIC 1027740

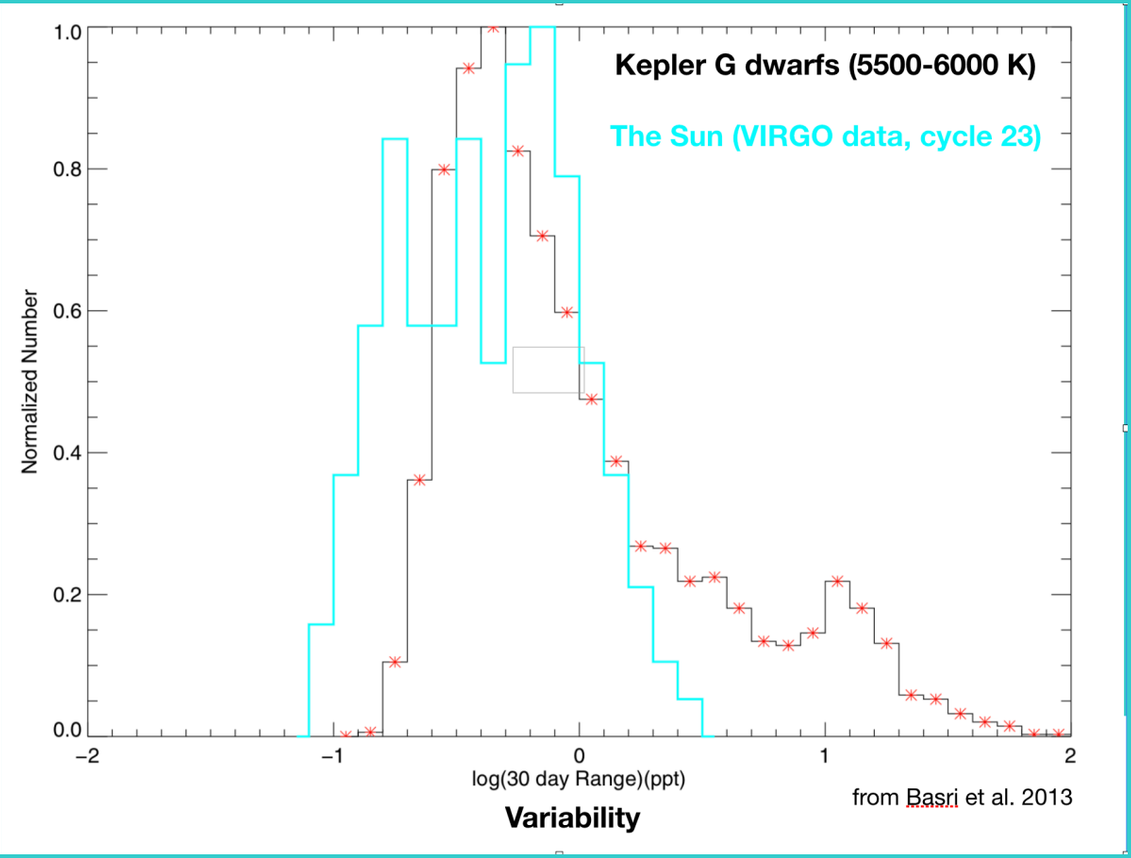


The Sun

from Amazo-Gomez et al., in prep.

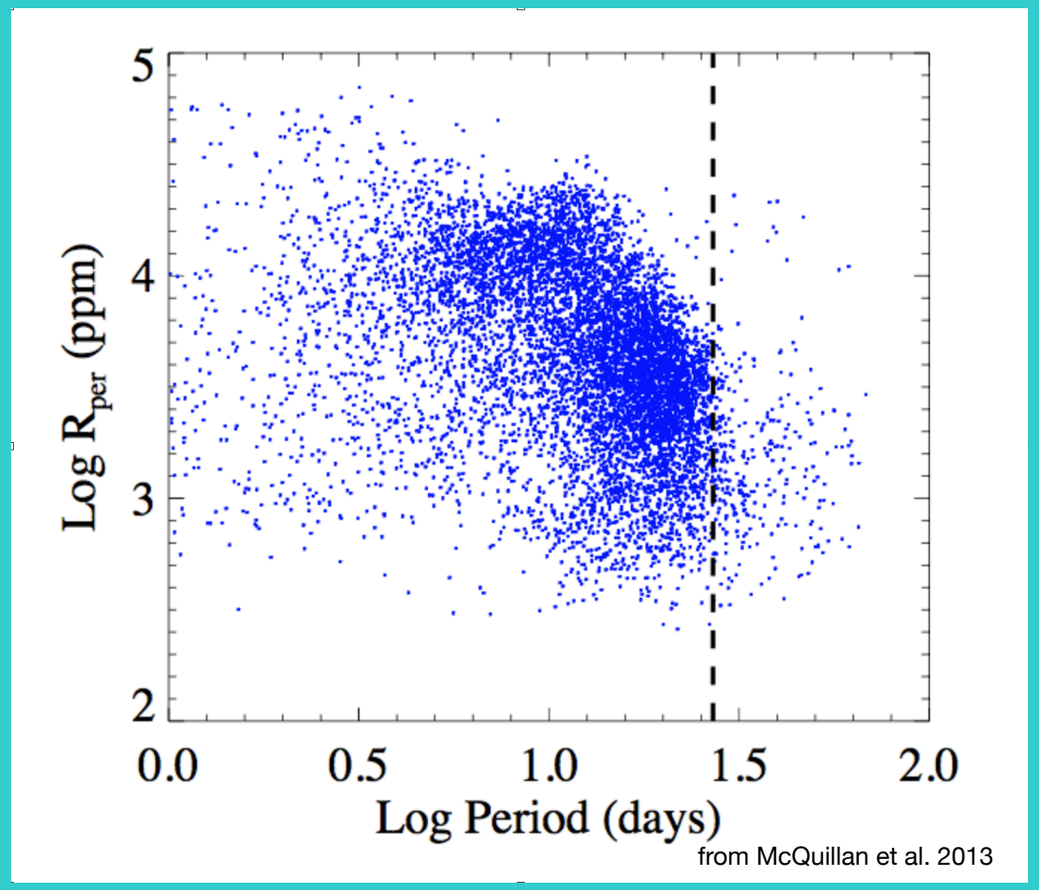
Selection effect

All Kepler stars



from Basri et al. 2013

Kepler stars with known P_{ROT}



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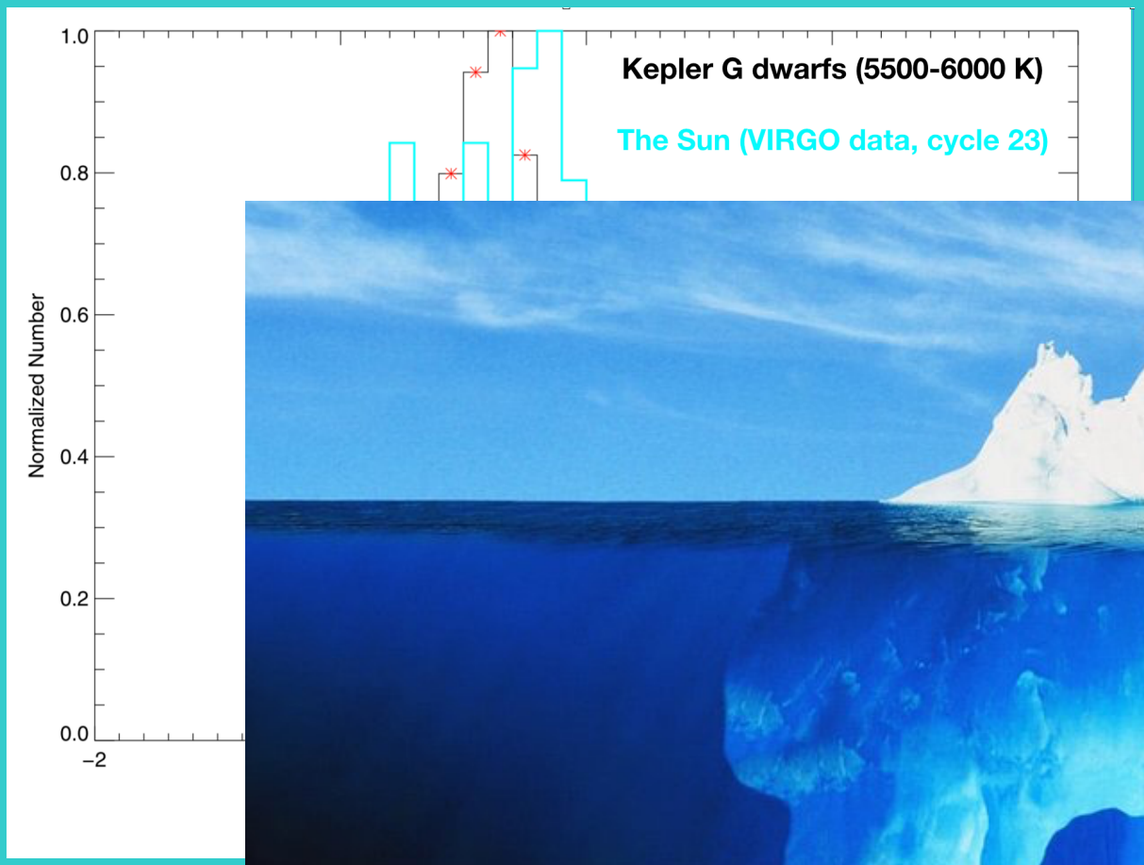

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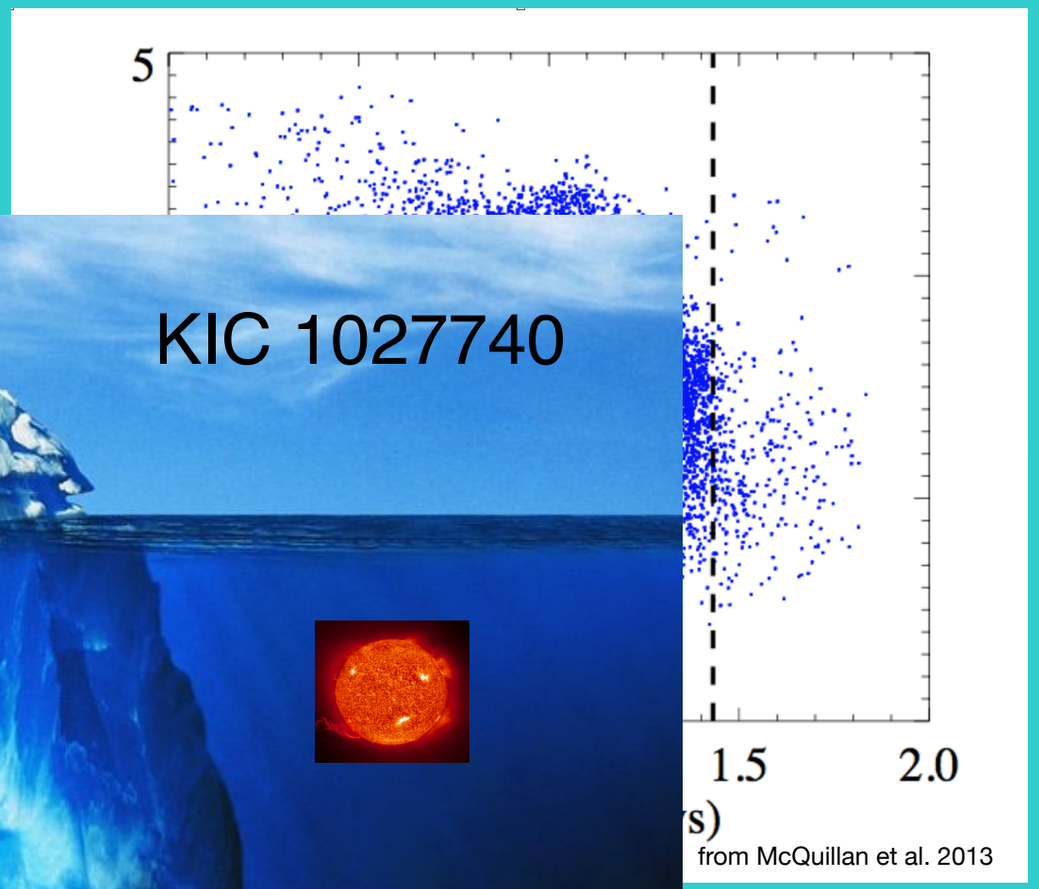

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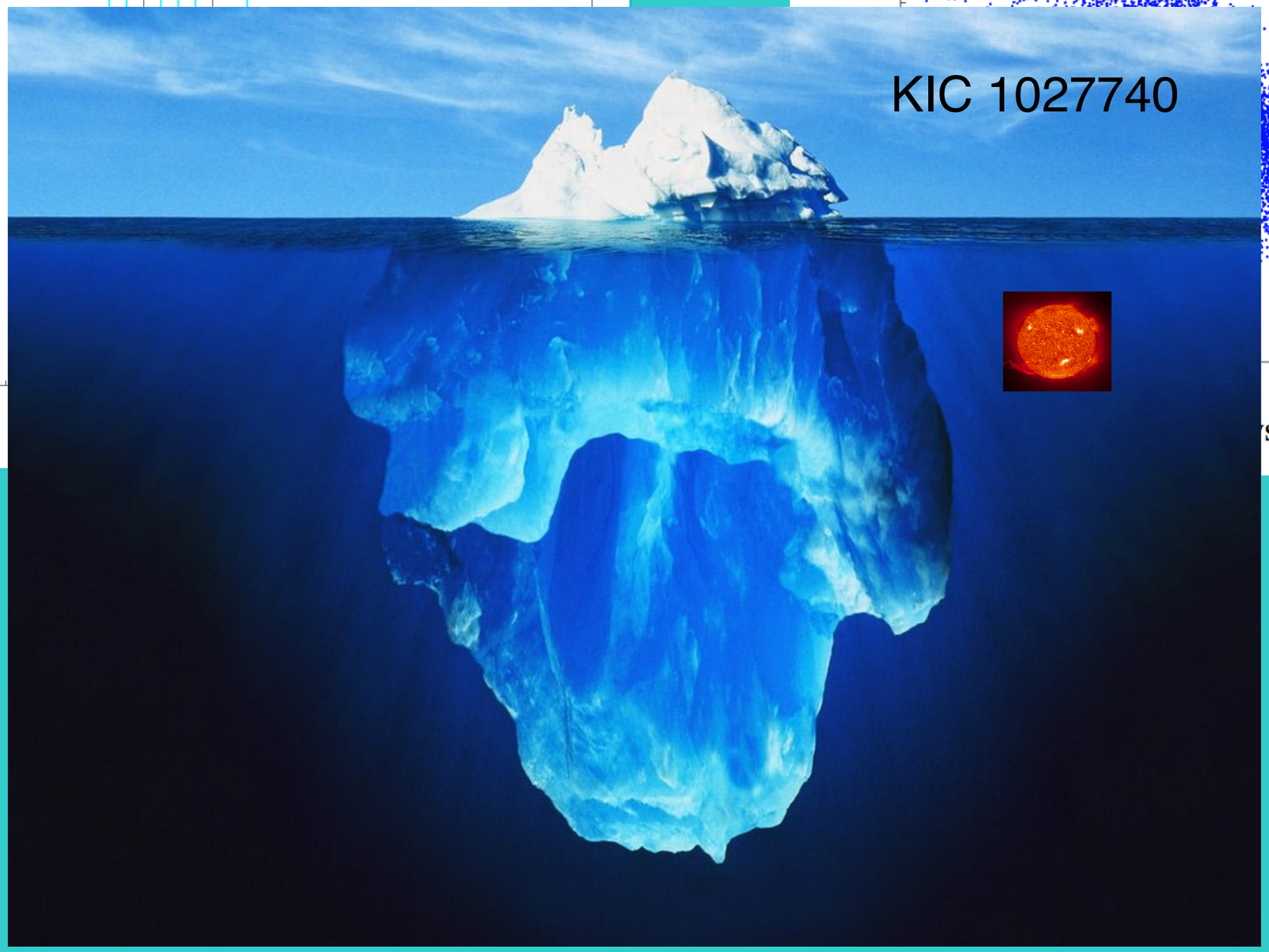
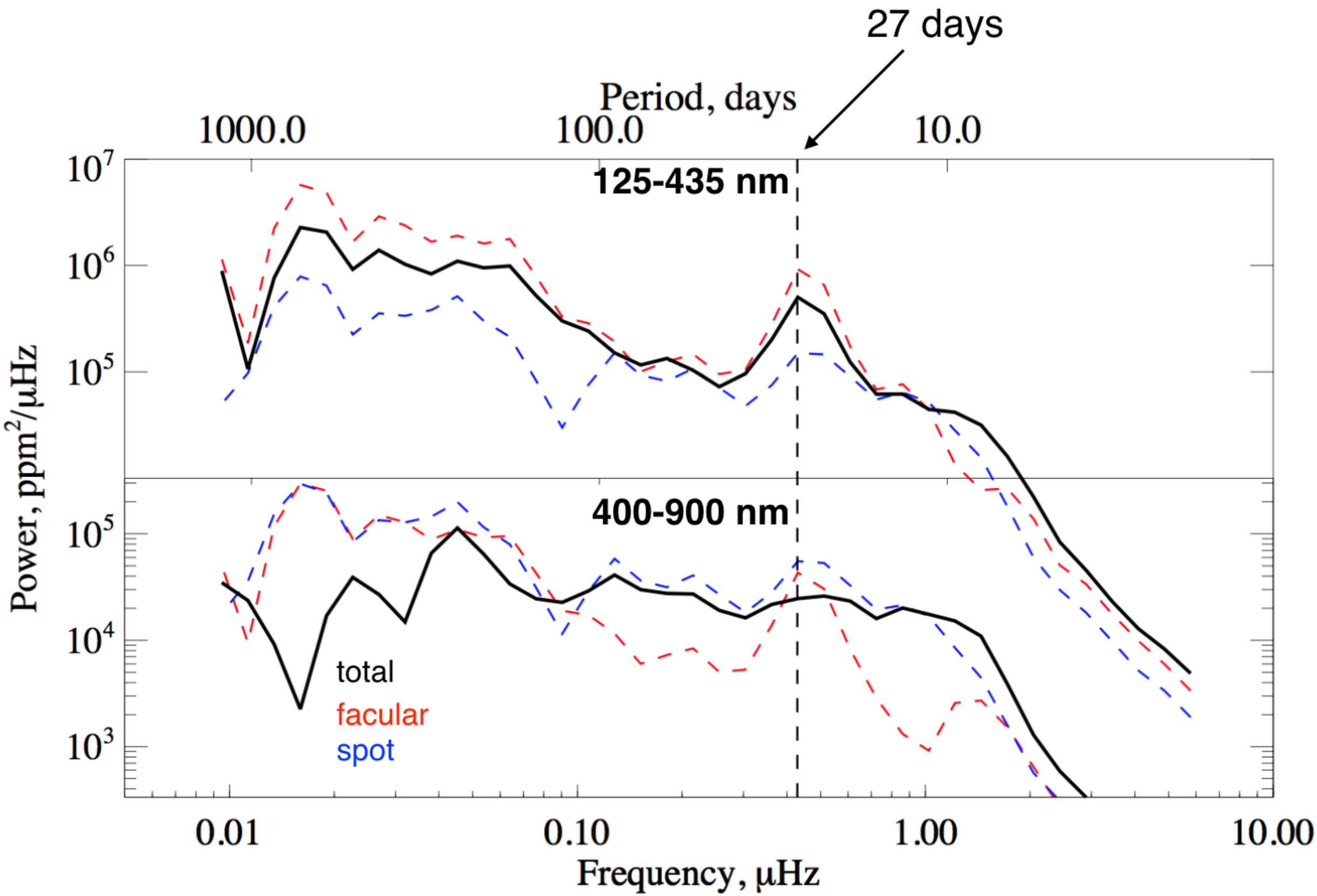
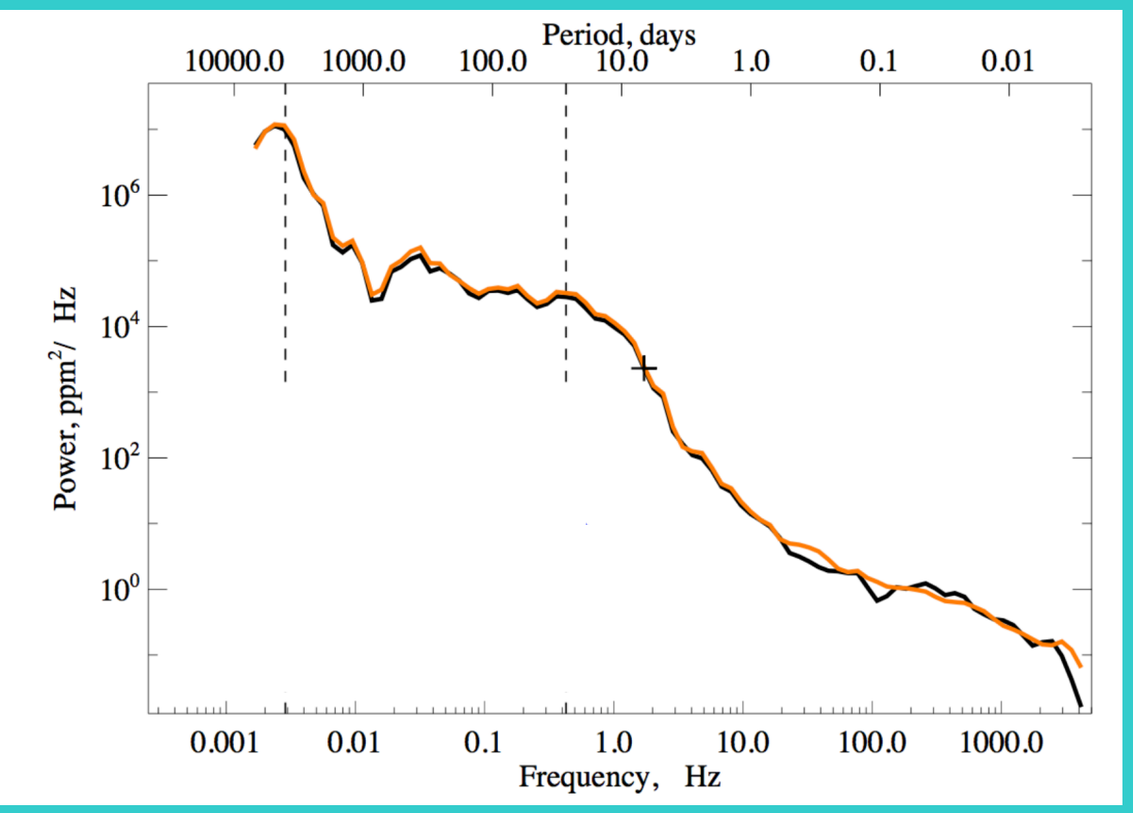


What to do? I. Change the filter



What to do? II. Think



I. Foreshortening;

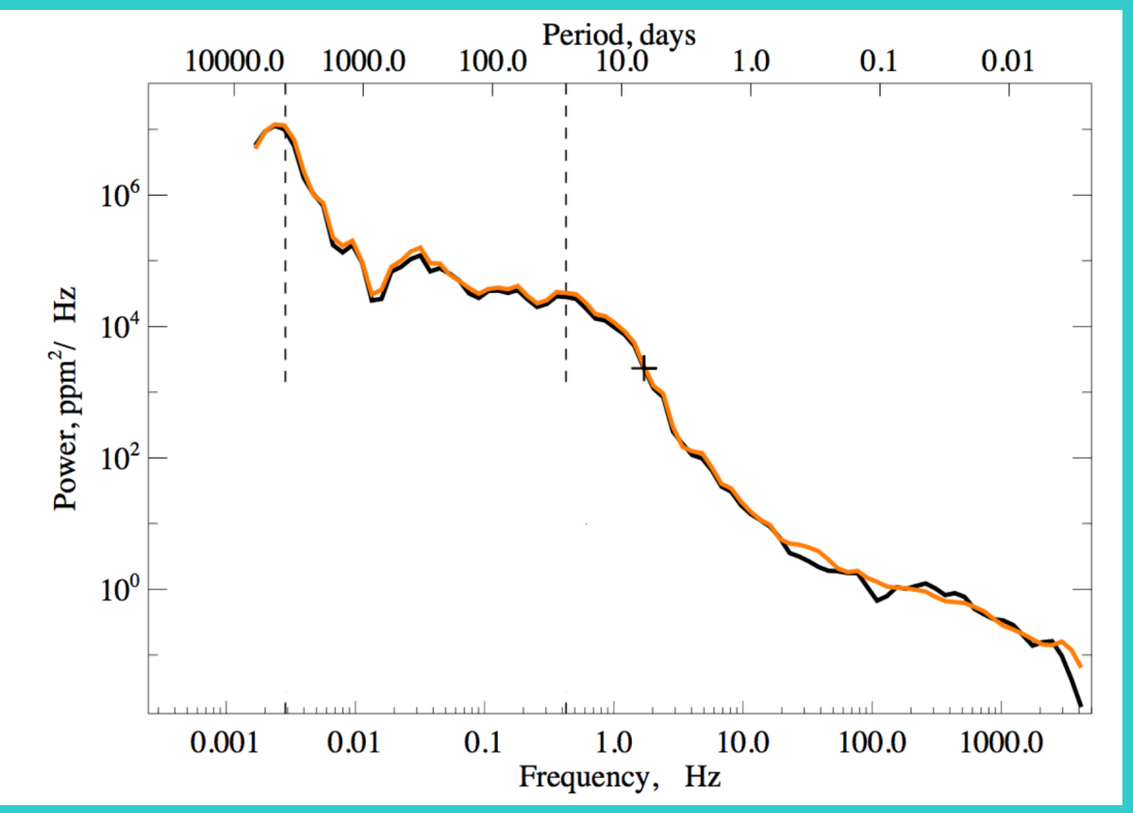
II. centre-to-limb variations;

III. hide-and-seek effect;

IV. evolution of magnetic features;

V. distribution of magnetic features.

What to do? II. Think



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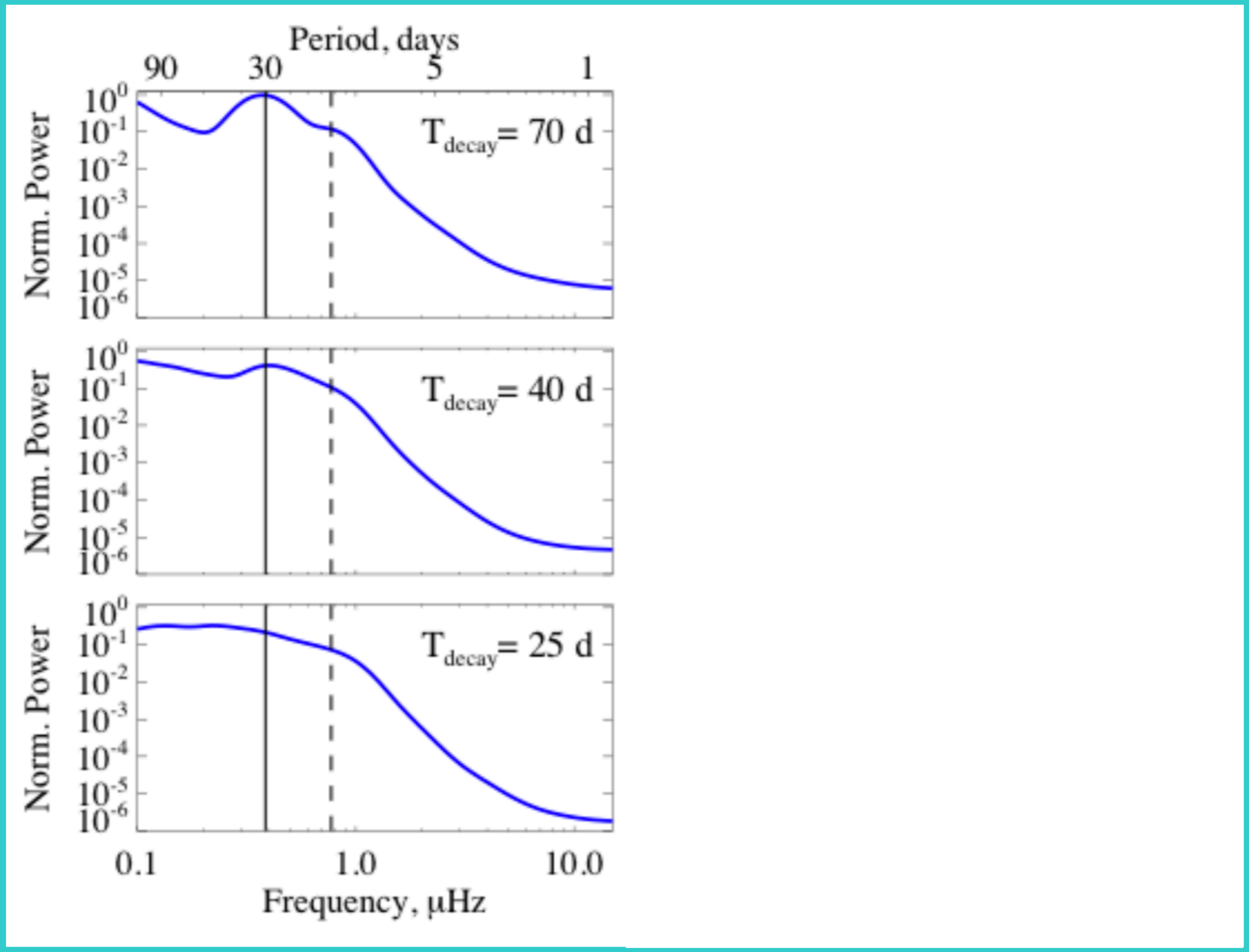
Monte Carlo simulations of a star with P_{rot}=30 days



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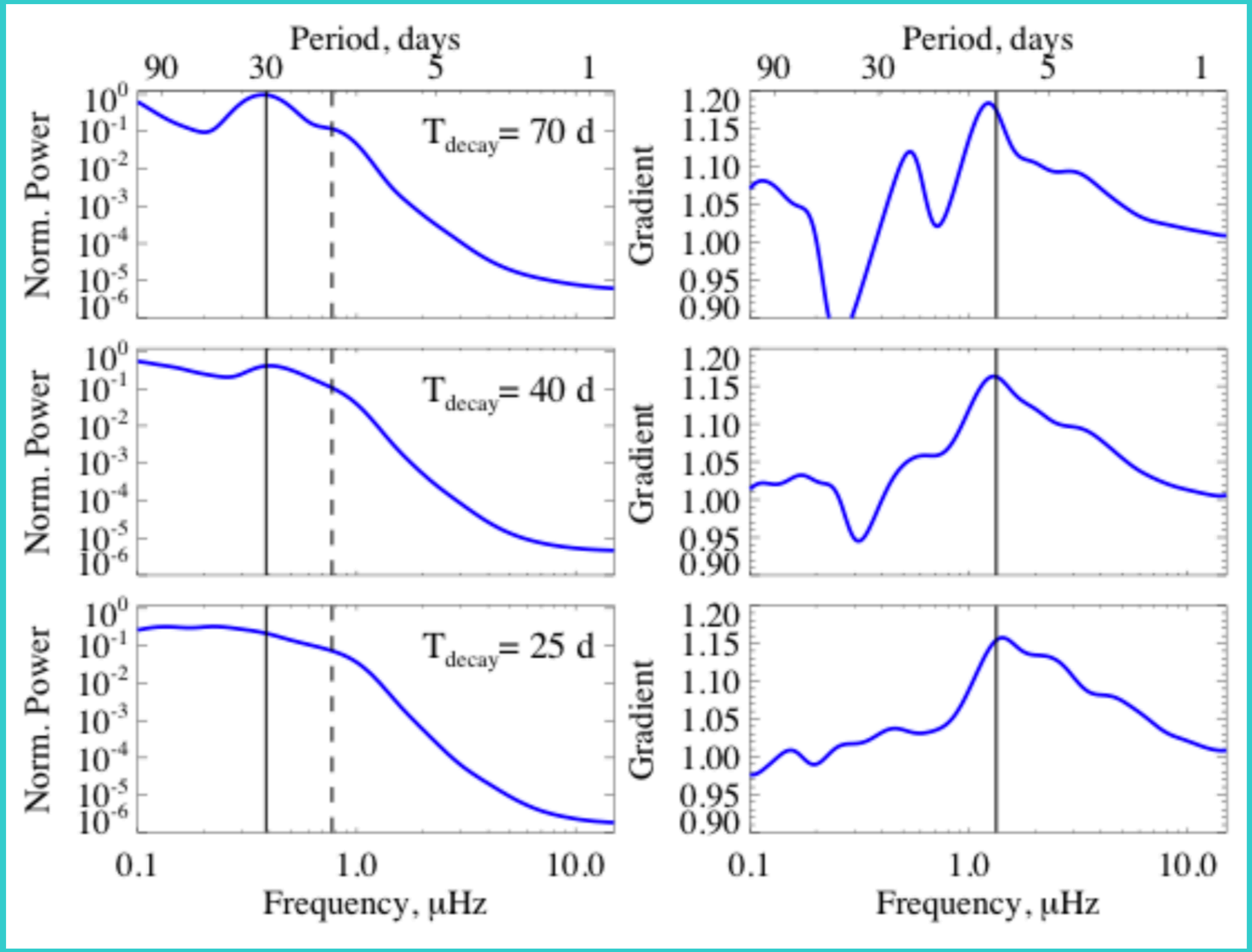
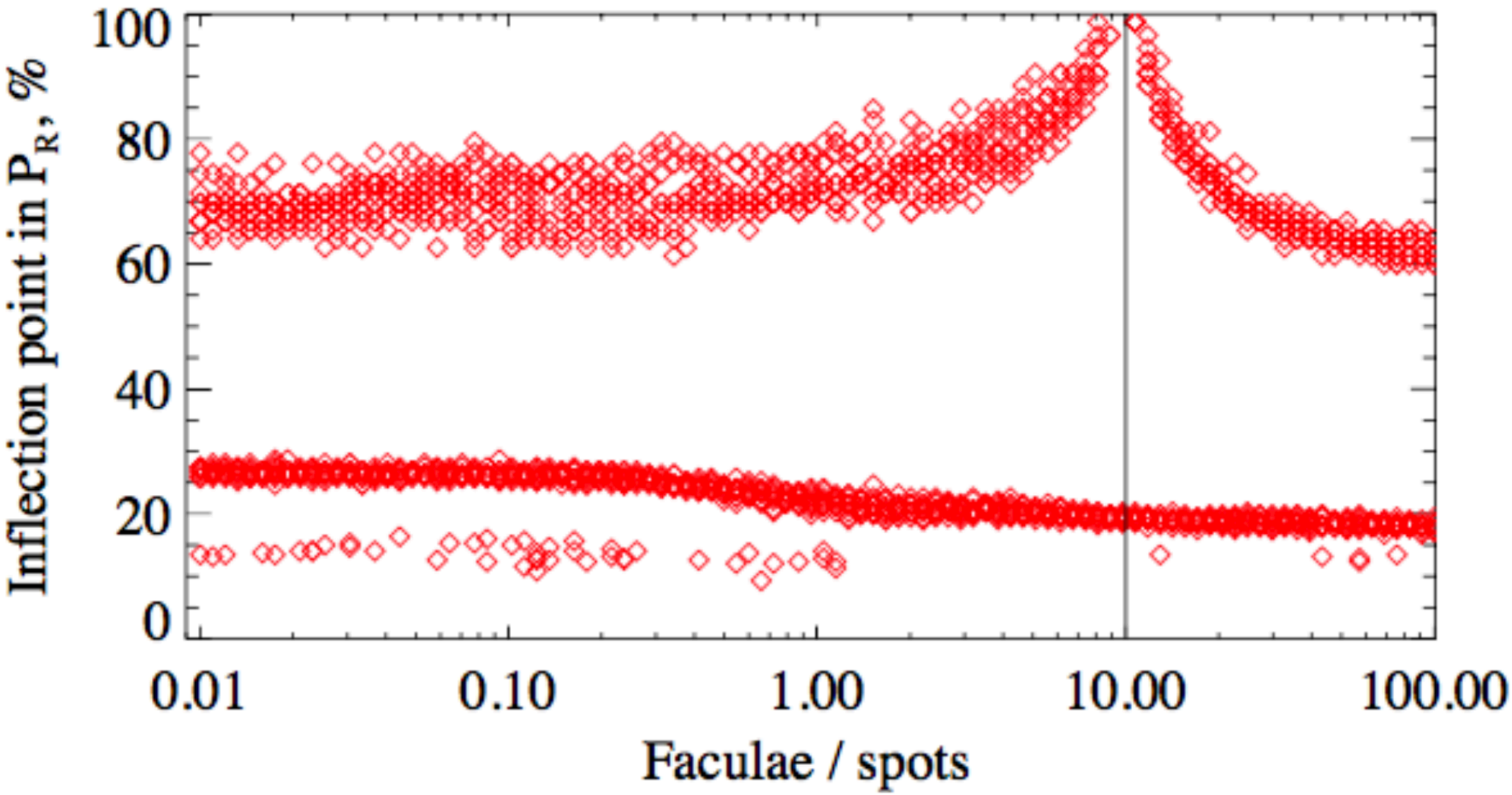


Monte Carlo simulations of stellar light curves

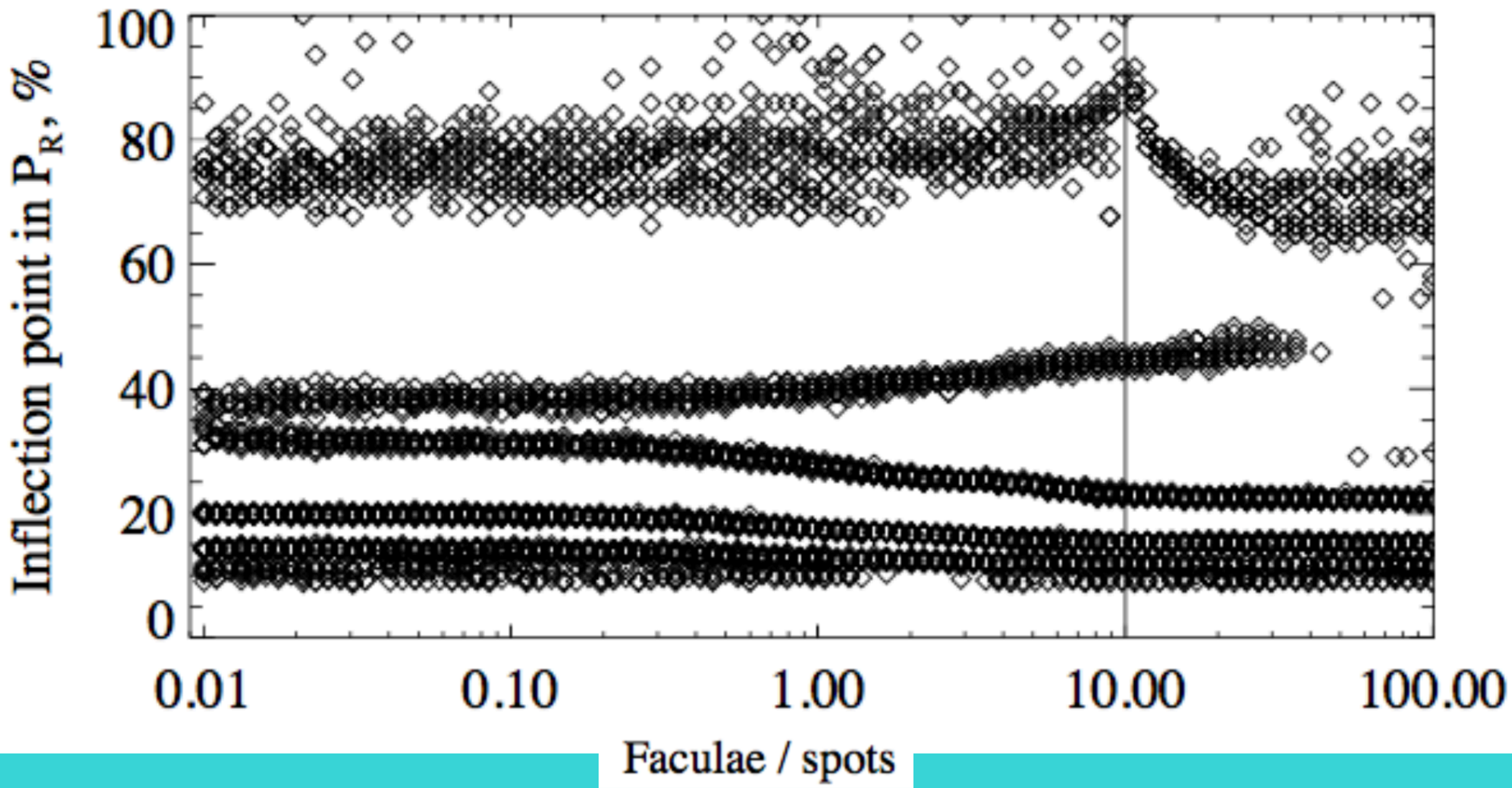
Inflection point as a proxy for the rotational period



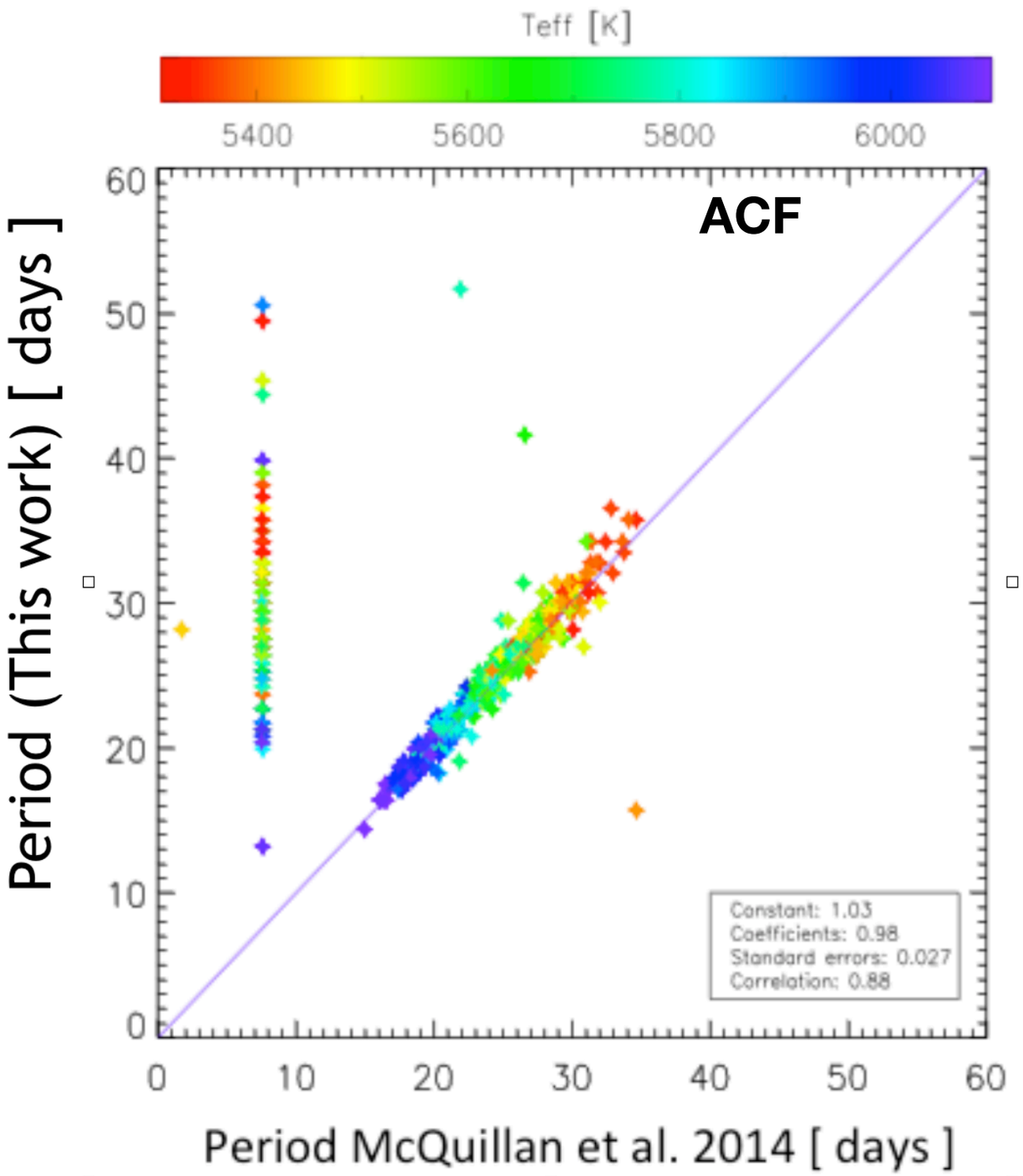
Monte Carlo simulations of stellar light curves

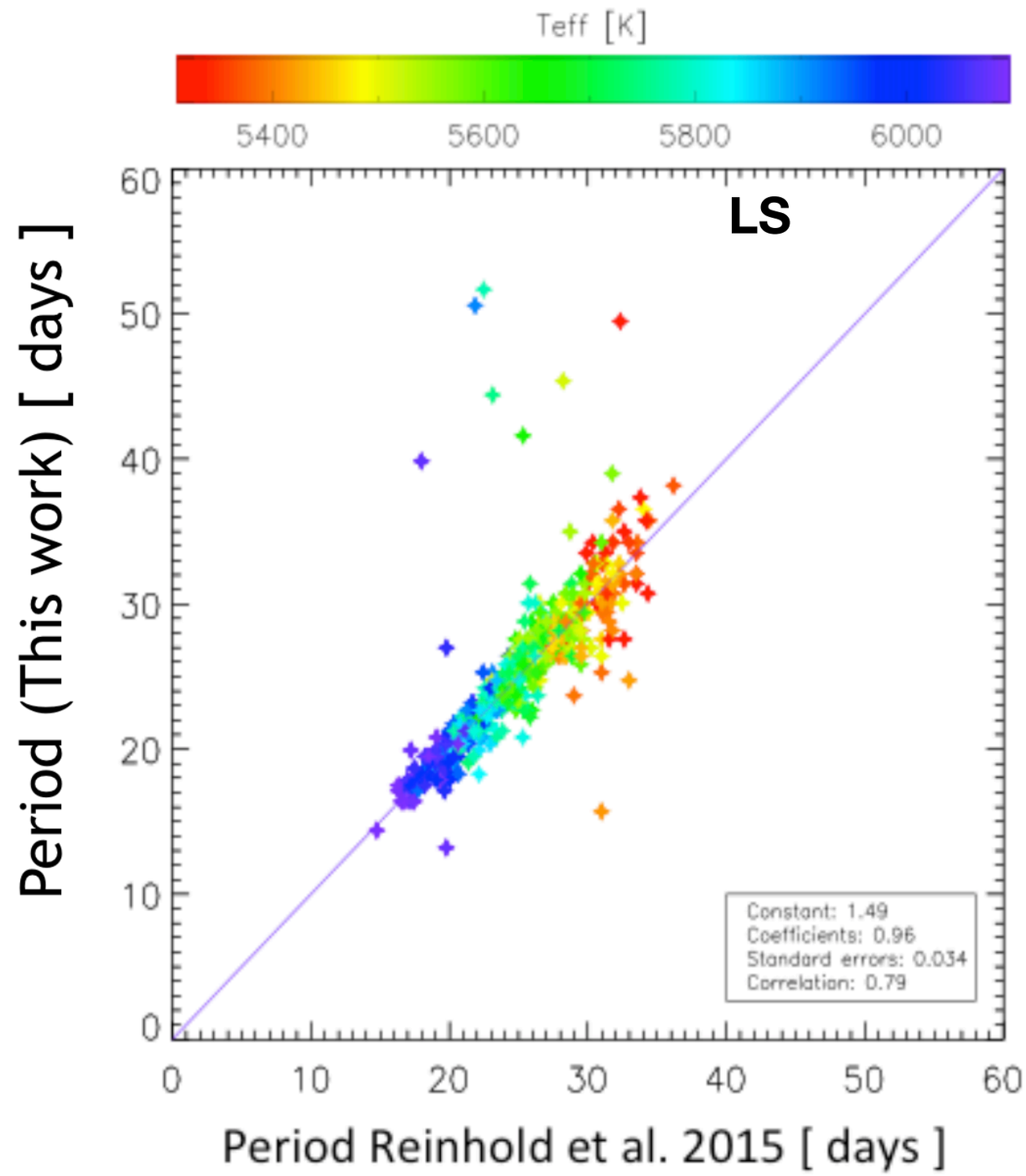
Inflection point as a proxy for the rotational period and more…

Morlet m=6

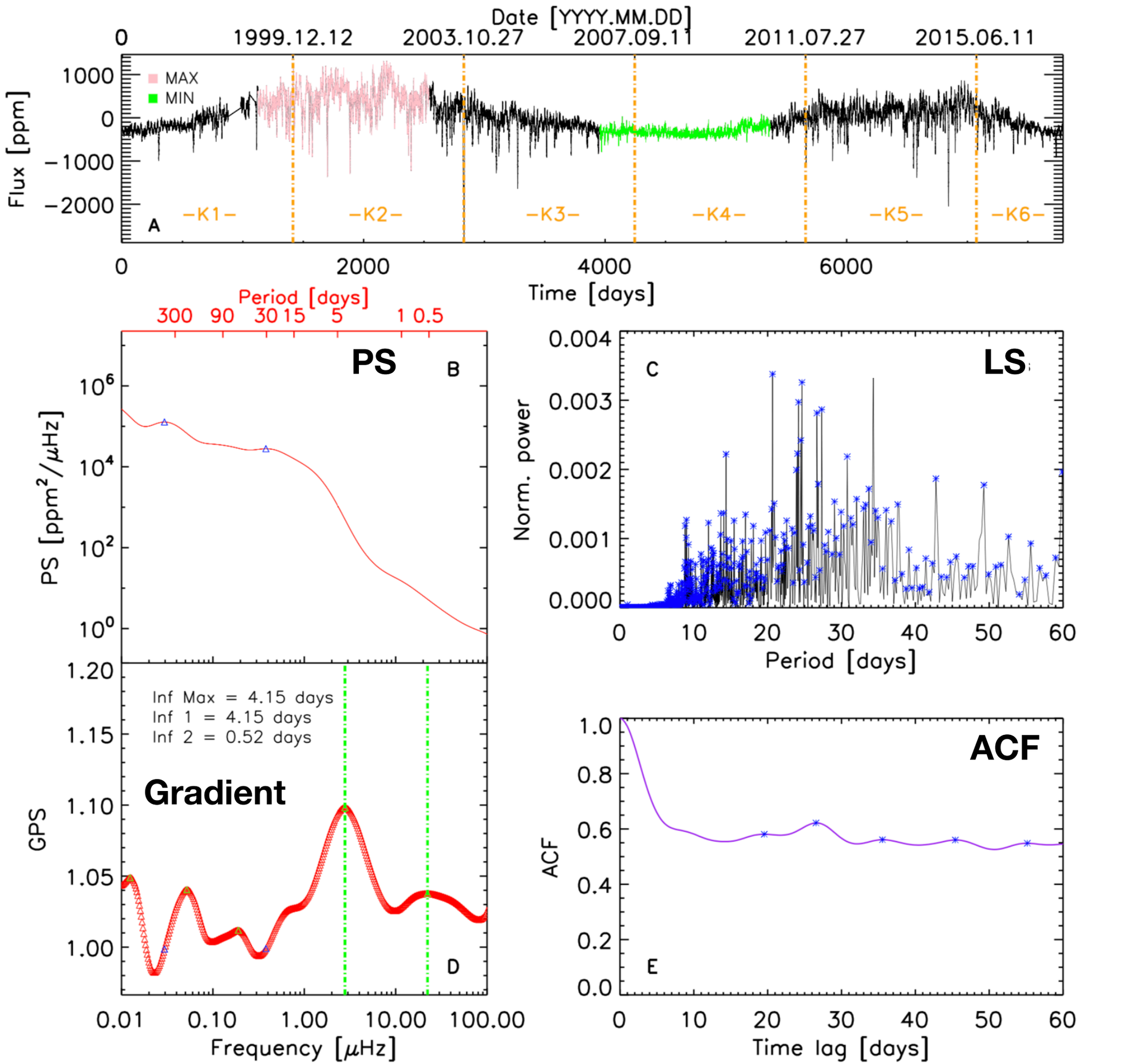


Our method vs. other methods





from Amazo-Gomez et al., in prep.



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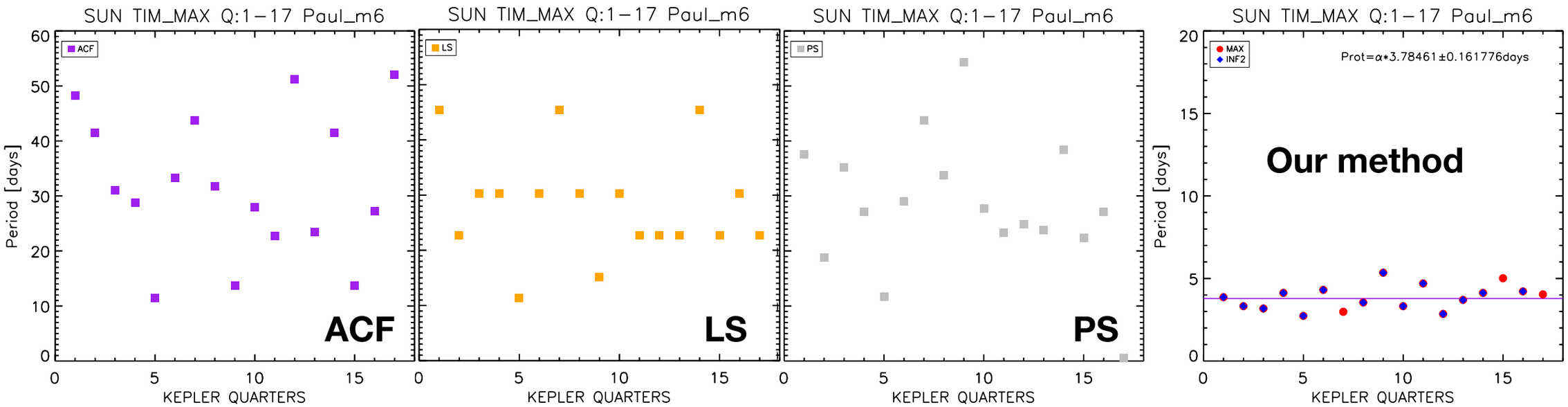
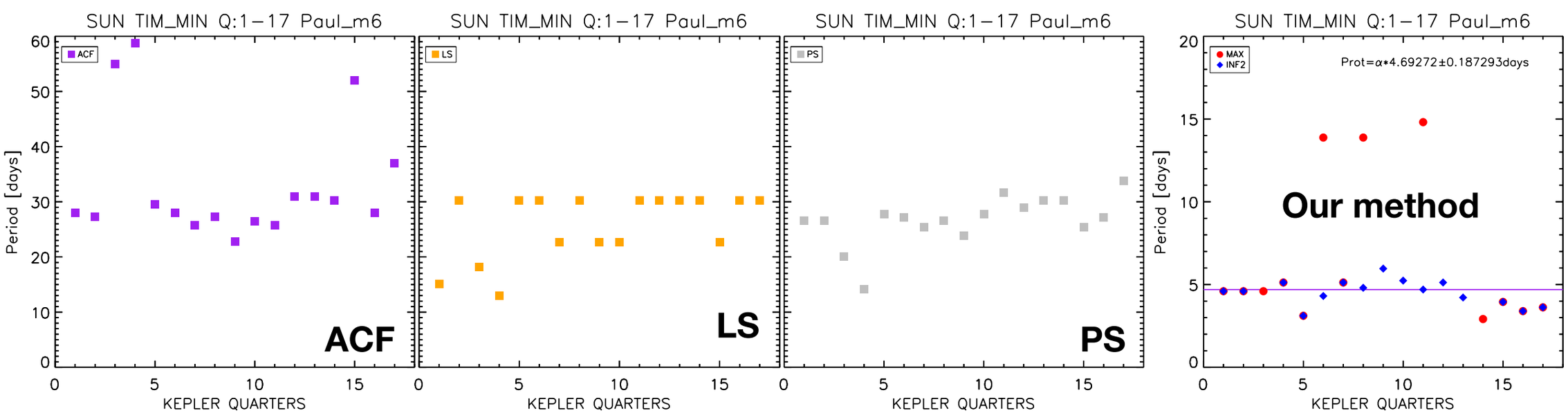
Solar rotational period from SORCE/TIM

Solar maximum



Solar minimum



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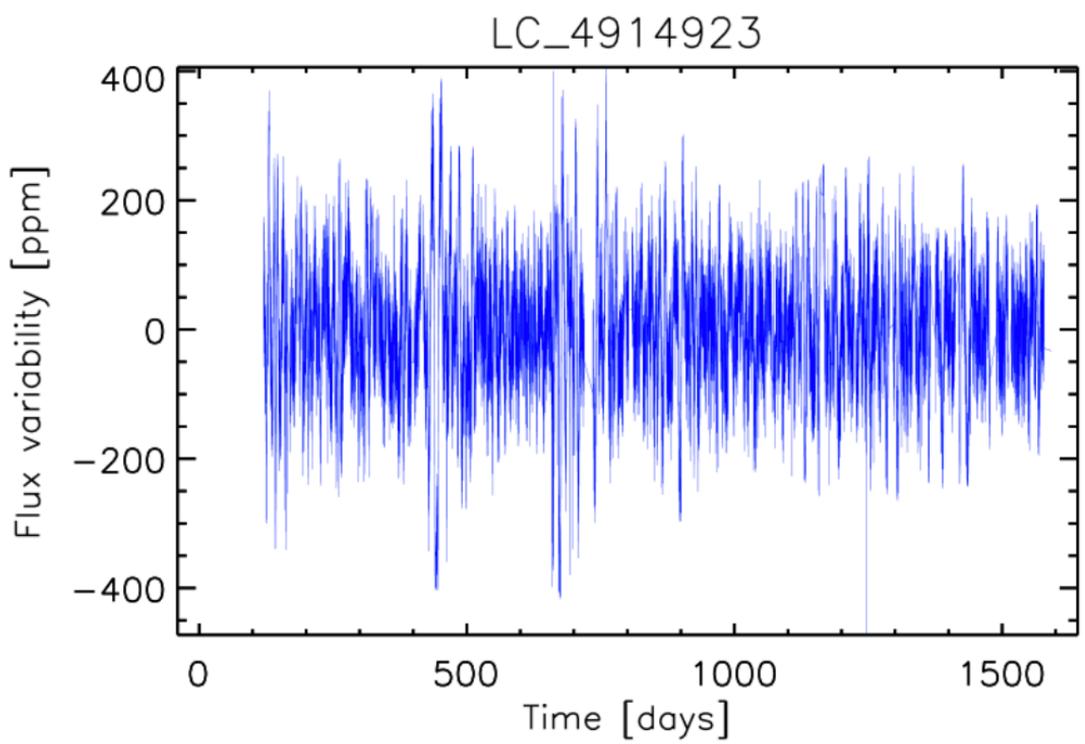
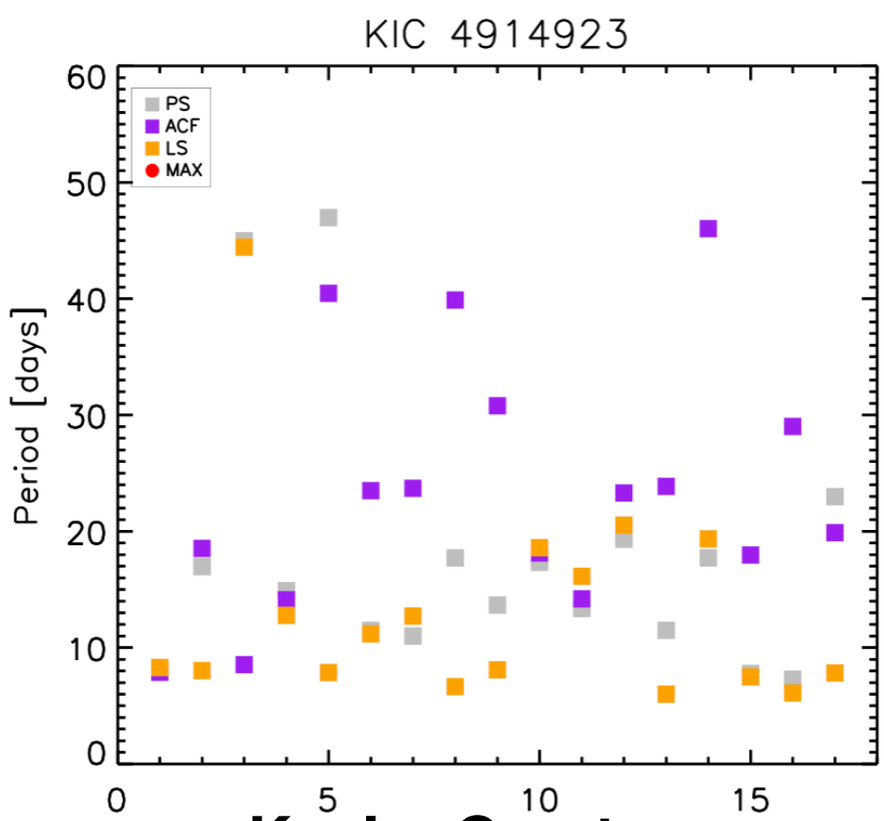
KIC 4914923

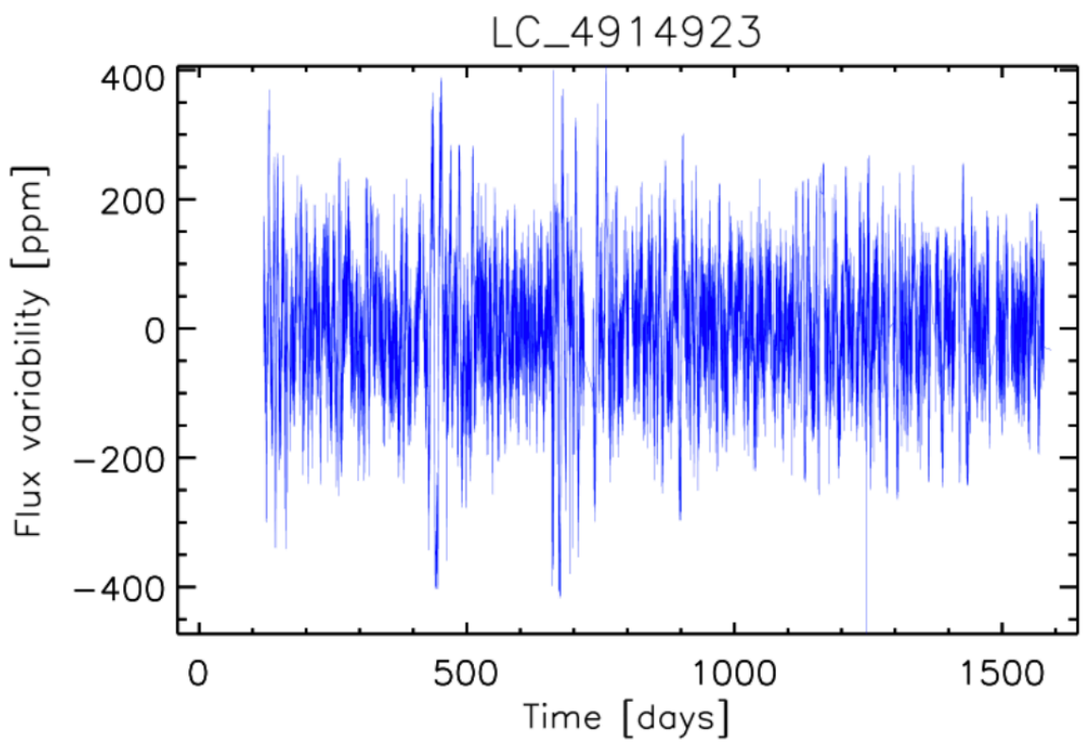


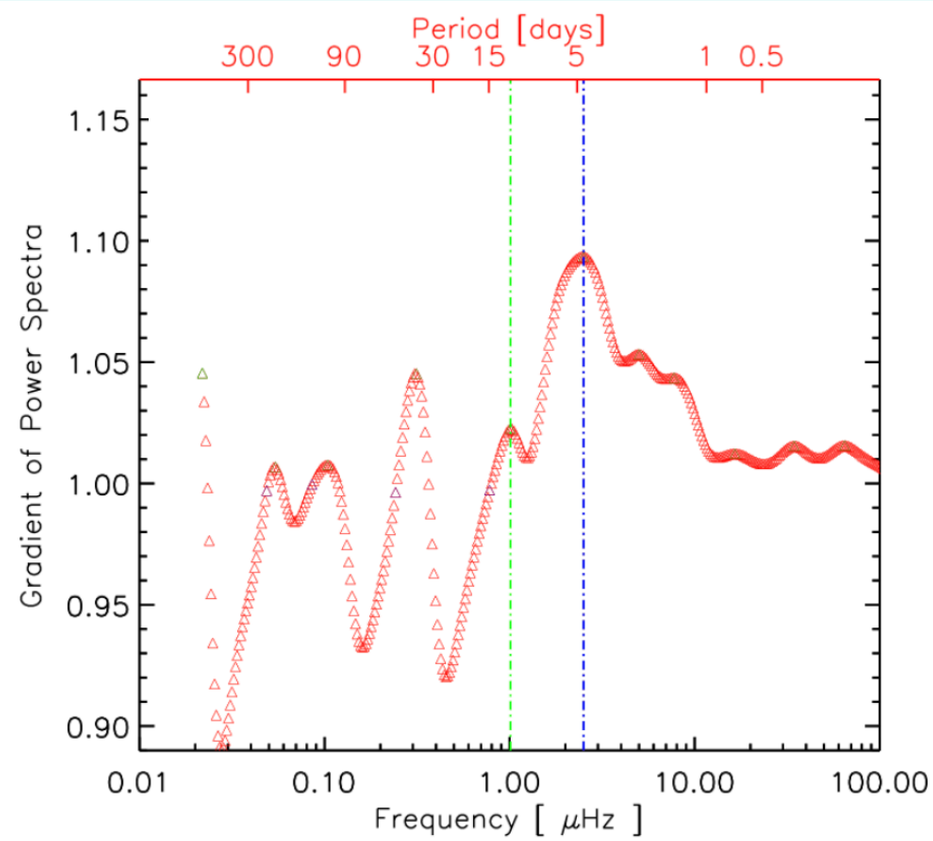


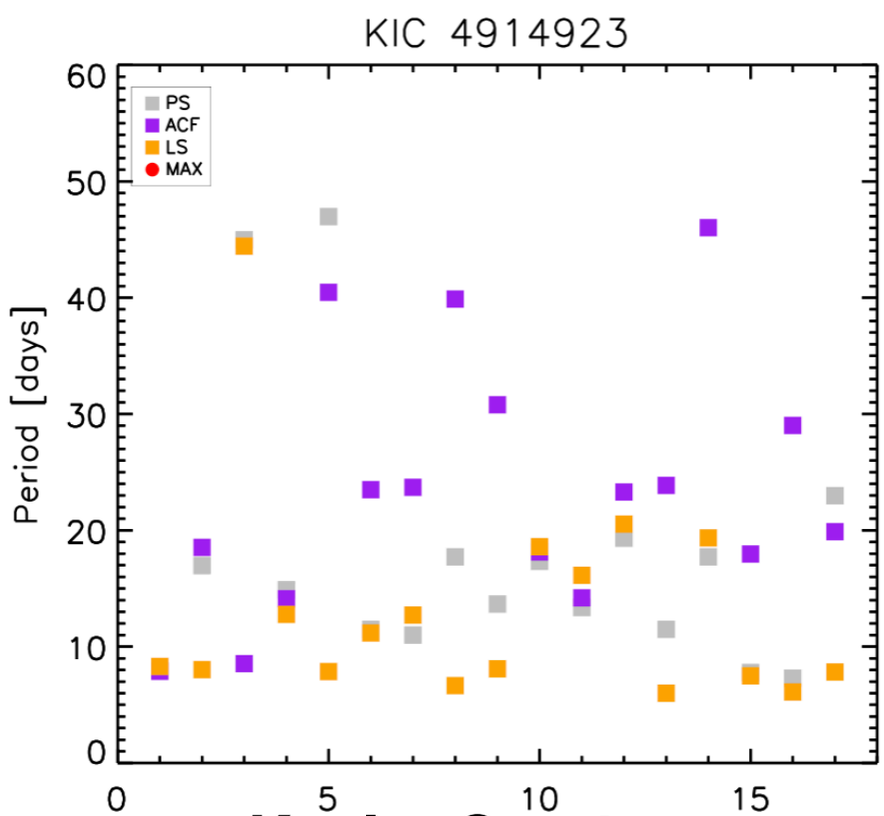
Kepler Quarter

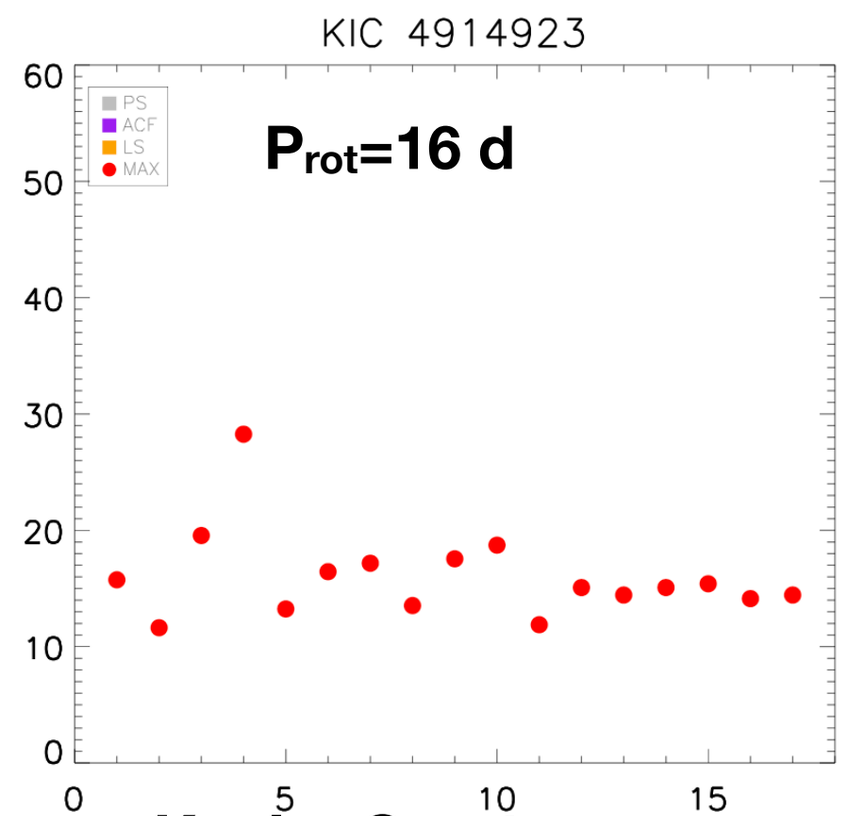
from Amazo-Gomez et al., in prep.

KIC 4914923









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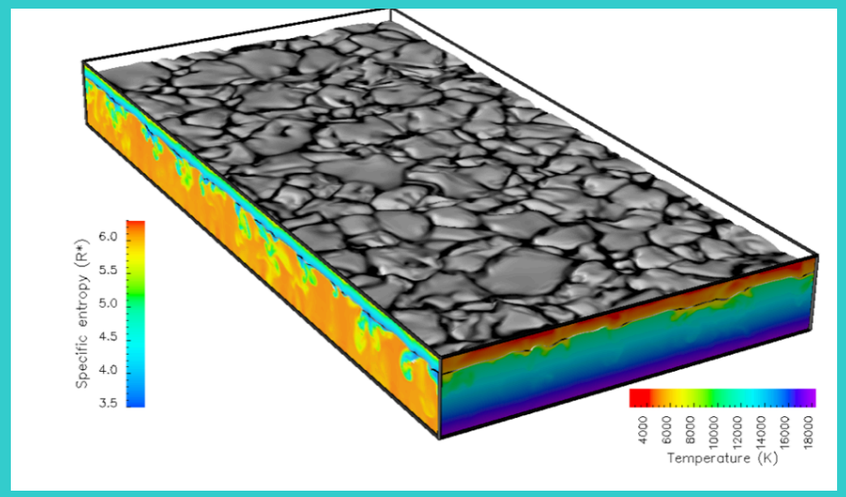
Outlook

3D MHD simulations with MURaM



Structure of the magnetic features
(Teff, Fe/H, log g)

+

1.5D radiative transfer

Outlook

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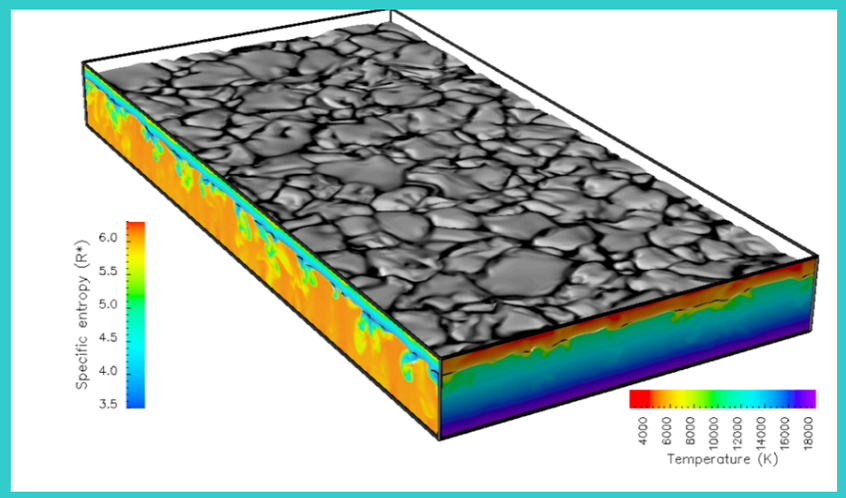

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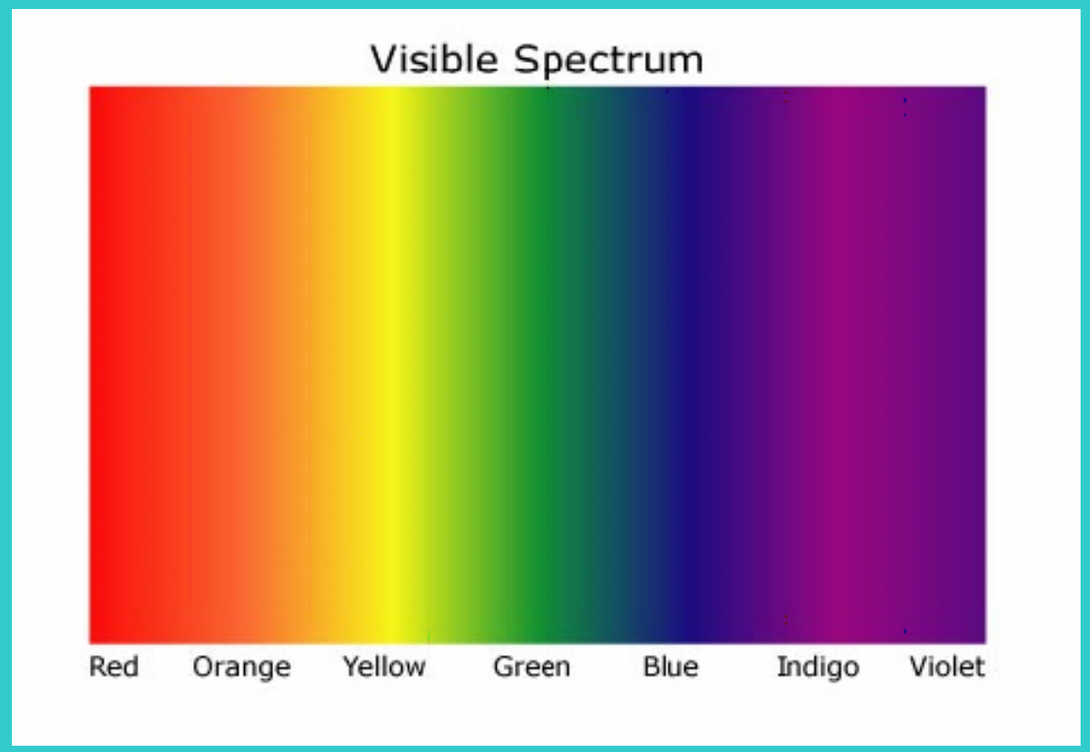
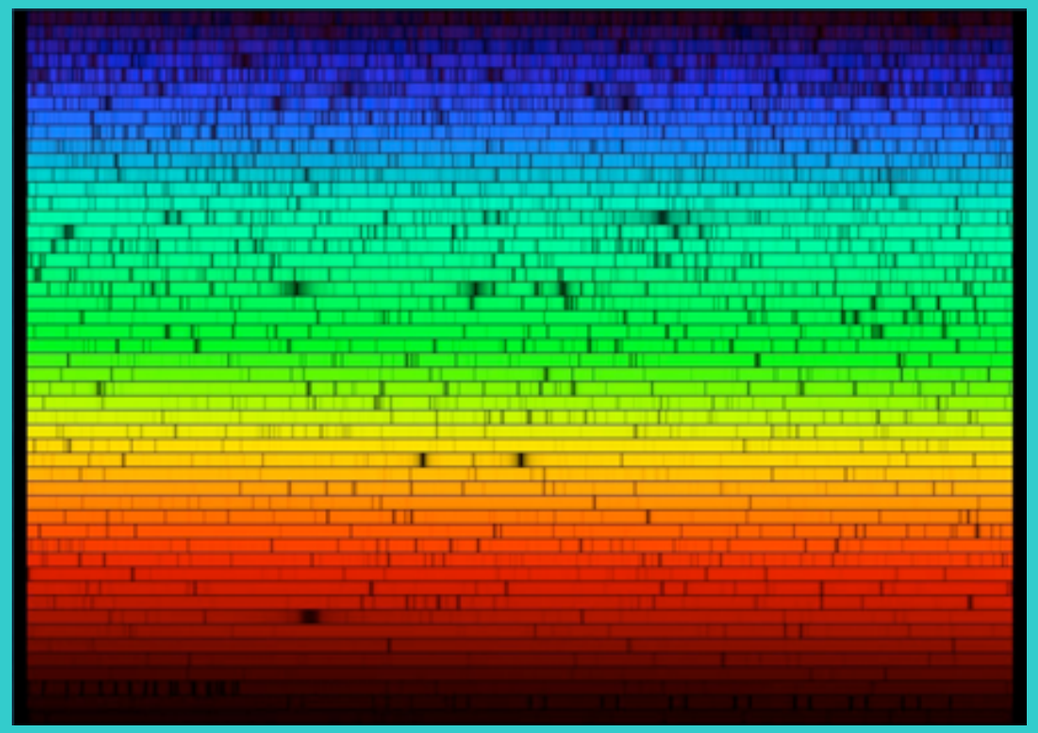


vs.



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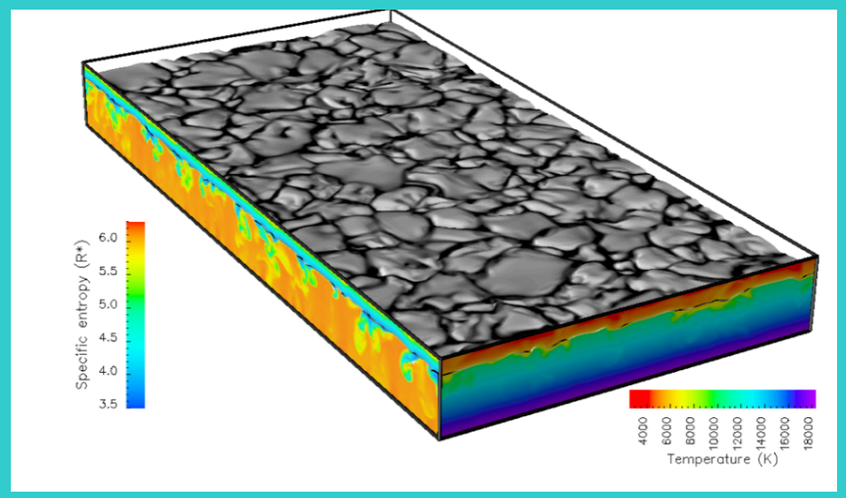

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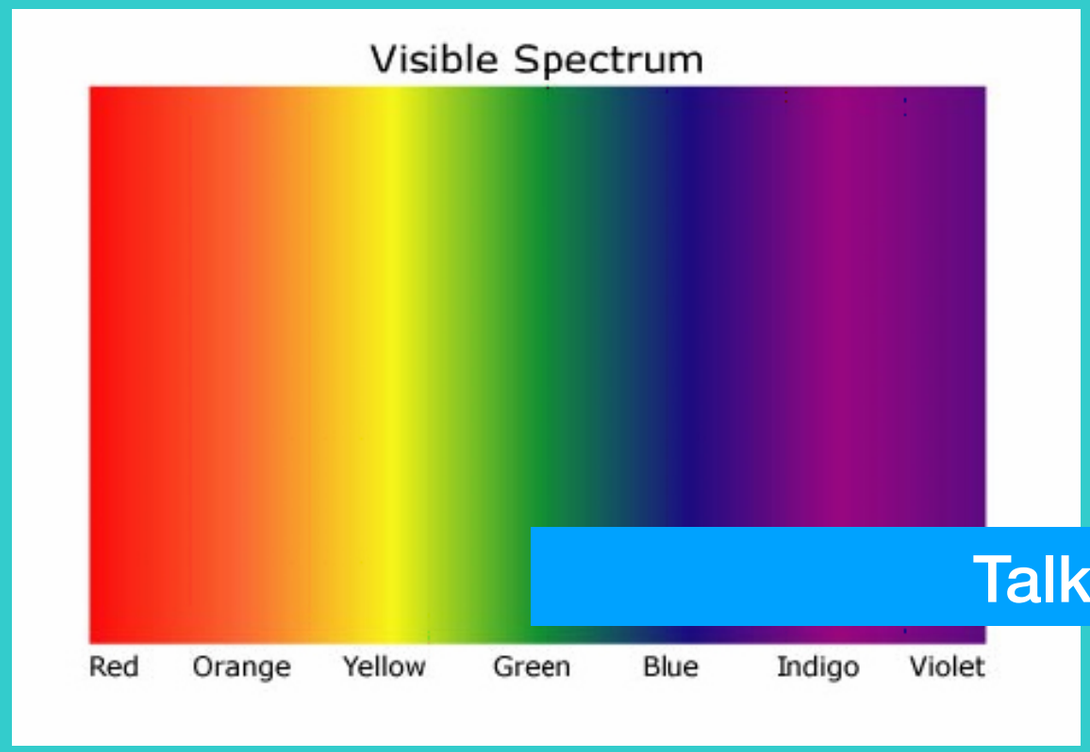

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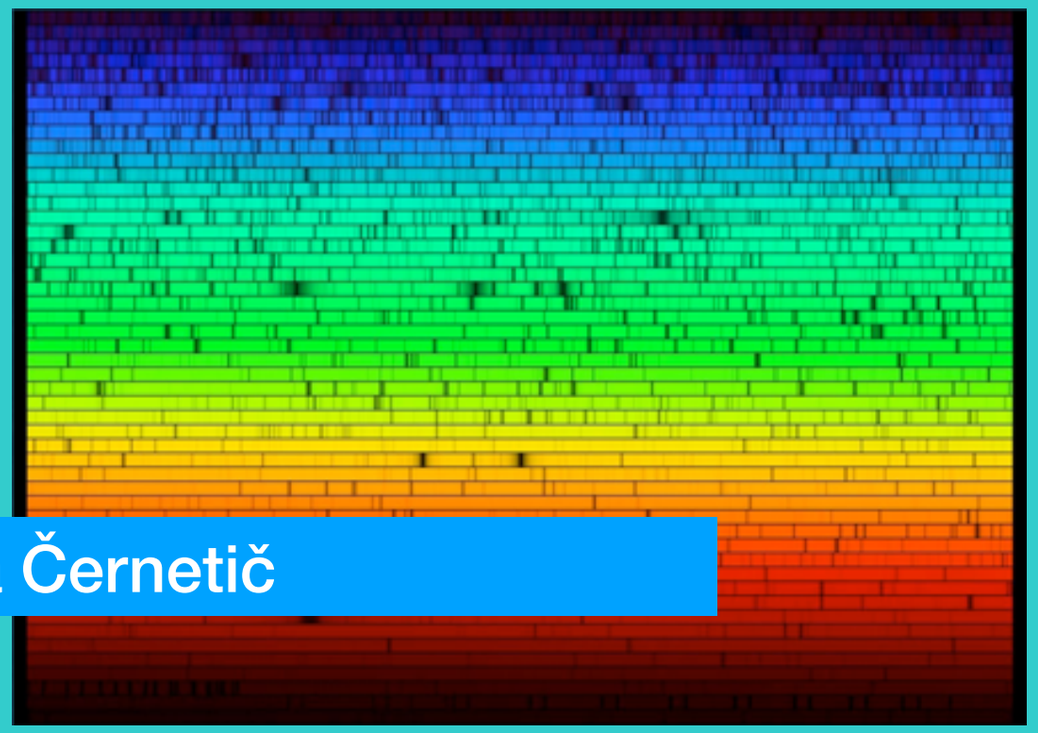

Talk by Miha Černetič

Outlook

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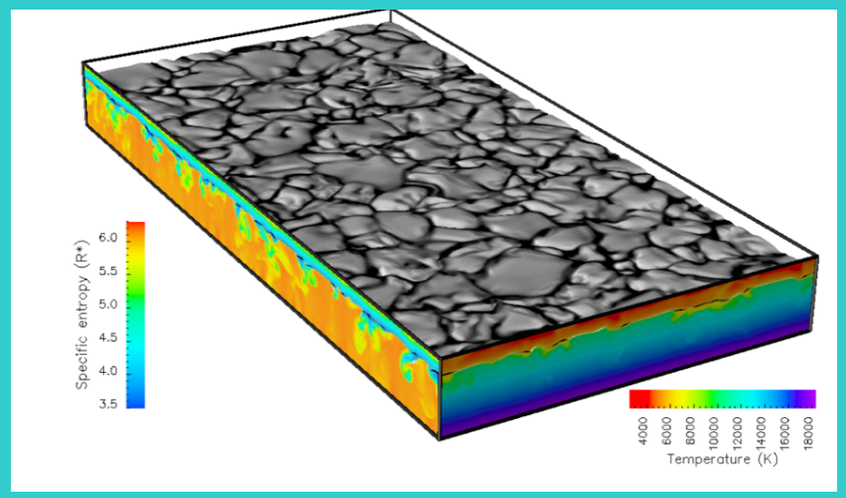

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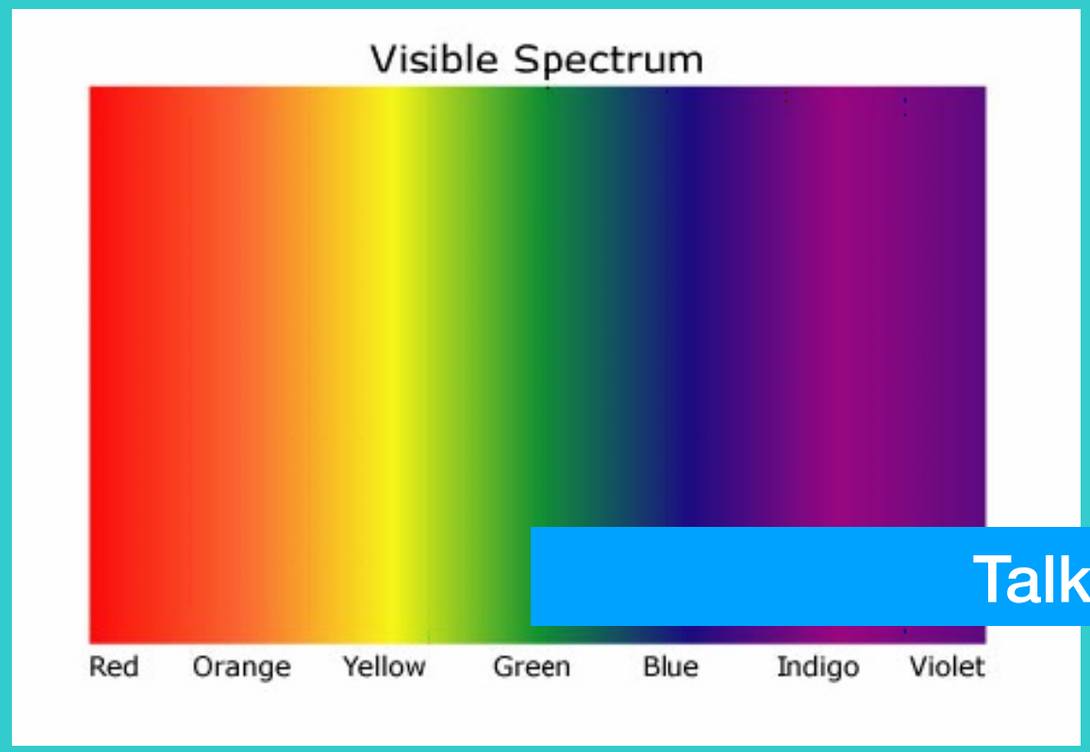

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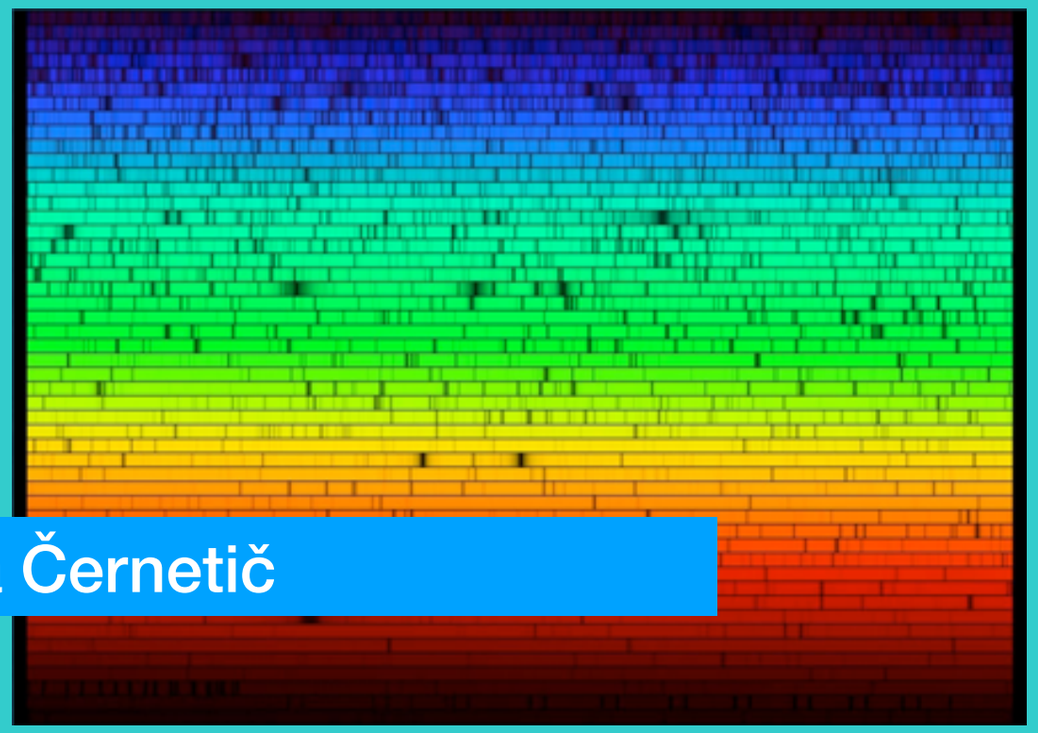

Talk by Miha Černetič

THANK YOU!