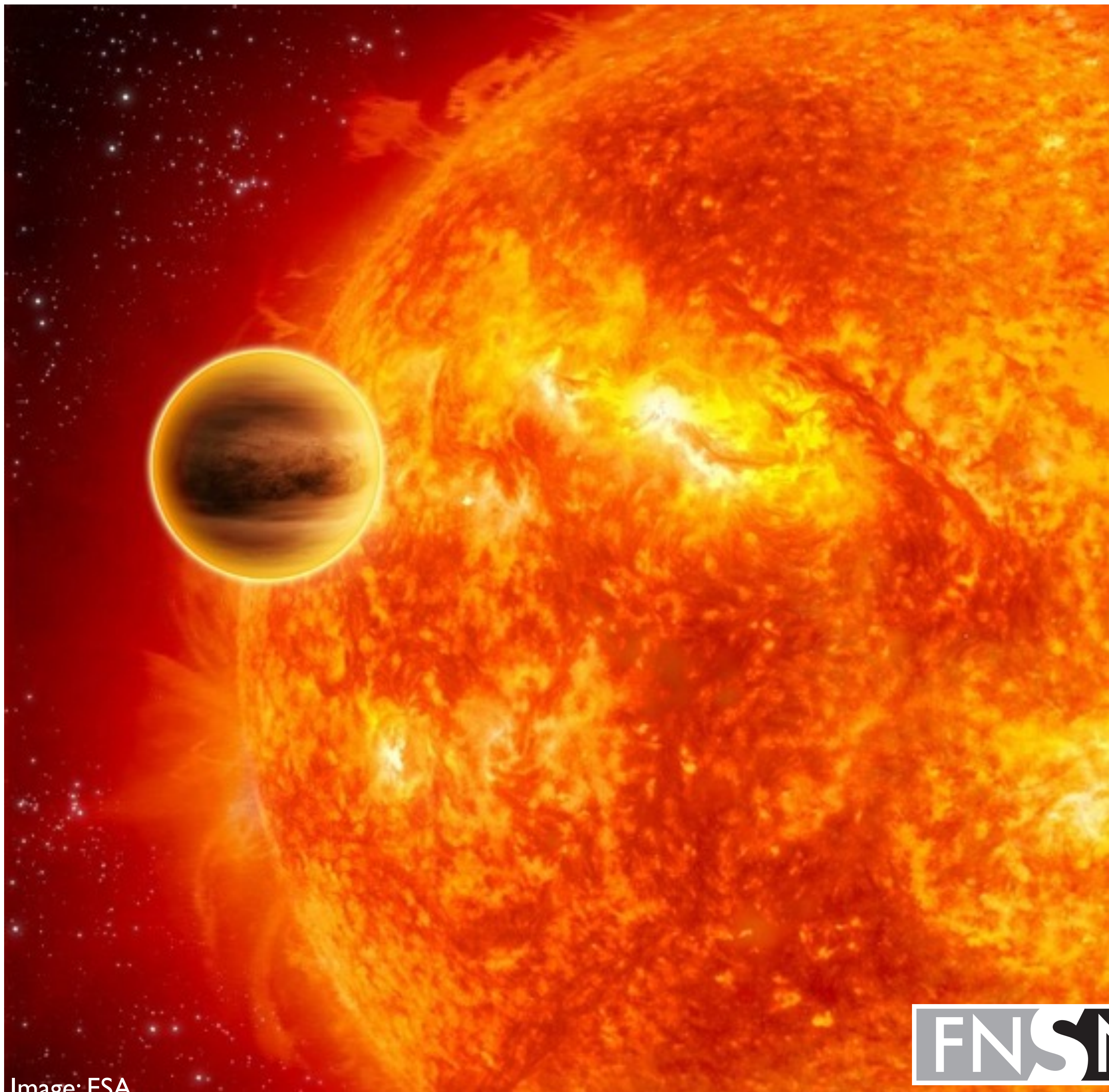
Probing the surfaces of Sun-like stars using transiting planets and 3D MHD simulations

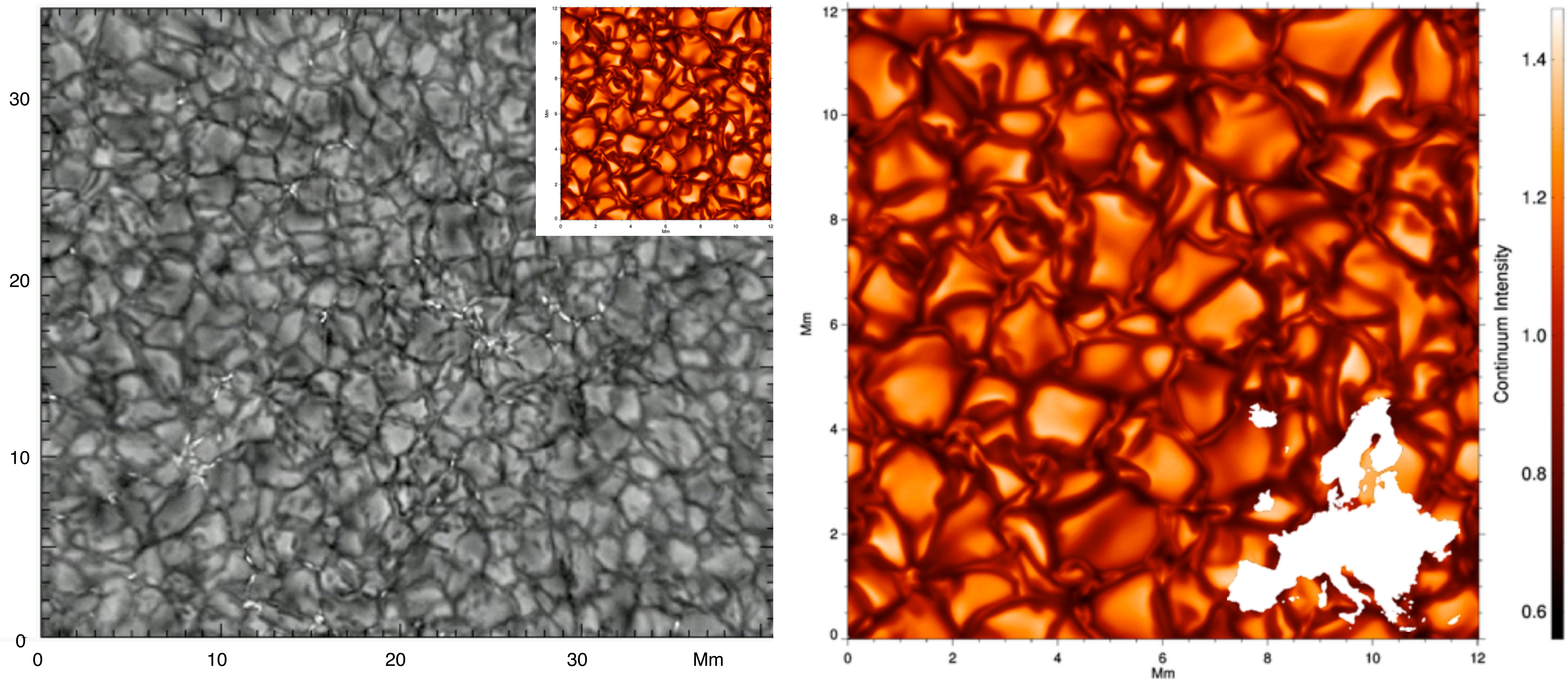


Dr Heather Cegla

CHEOPS Fellow

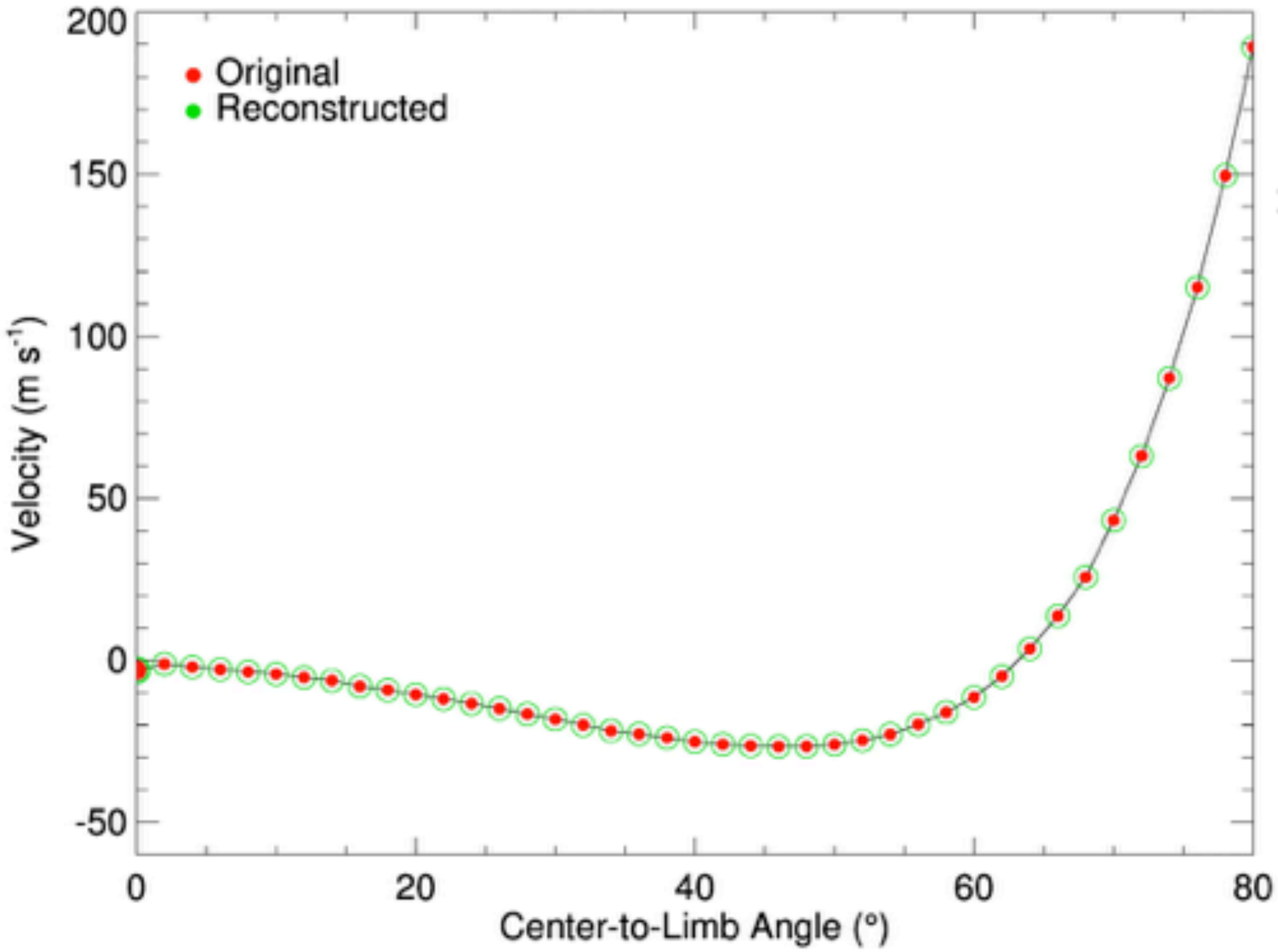
FNSNF PlanetS National Centre of Competence in Research UNIVERSITÉ DE GENÈVE

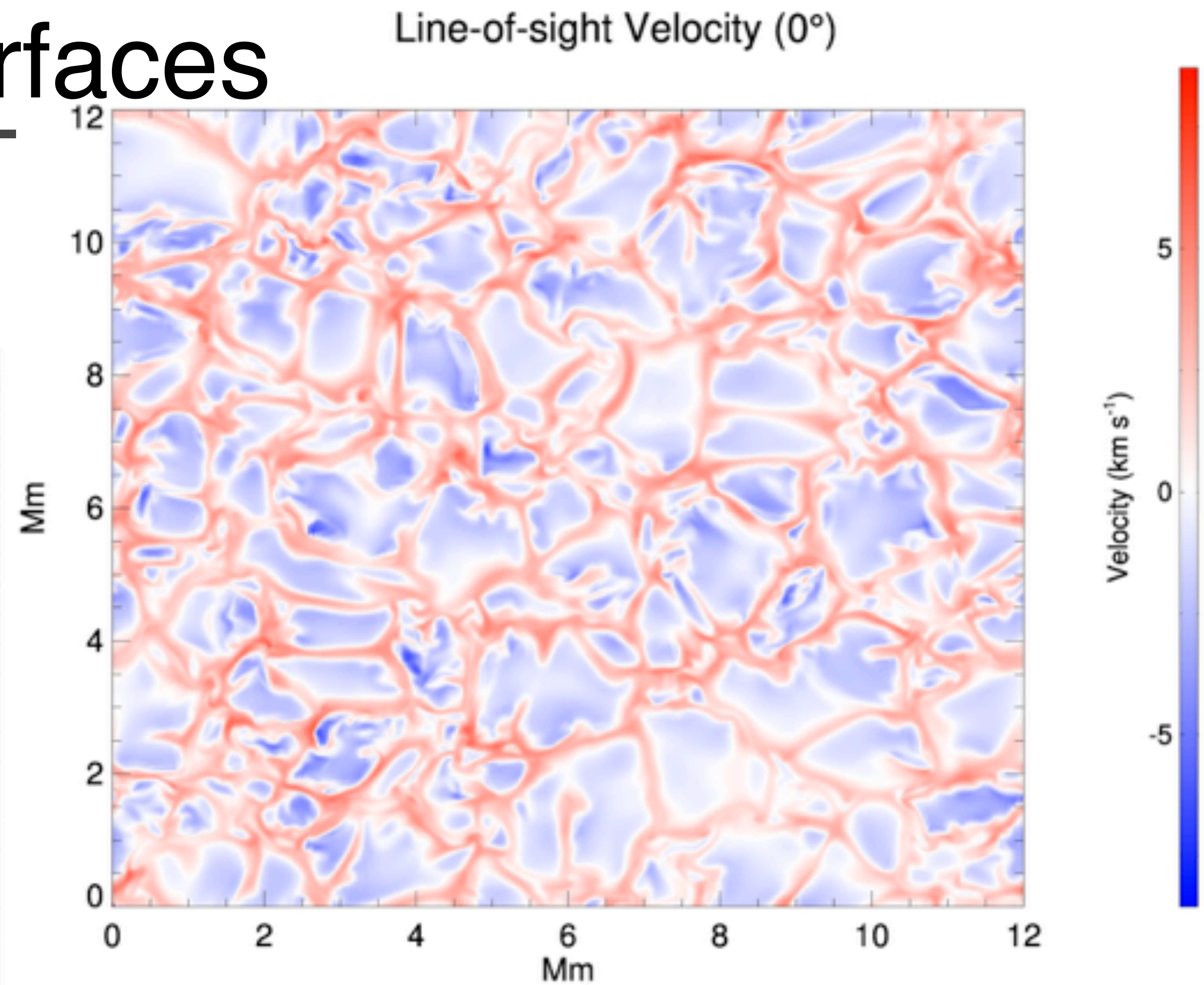
The solar surface

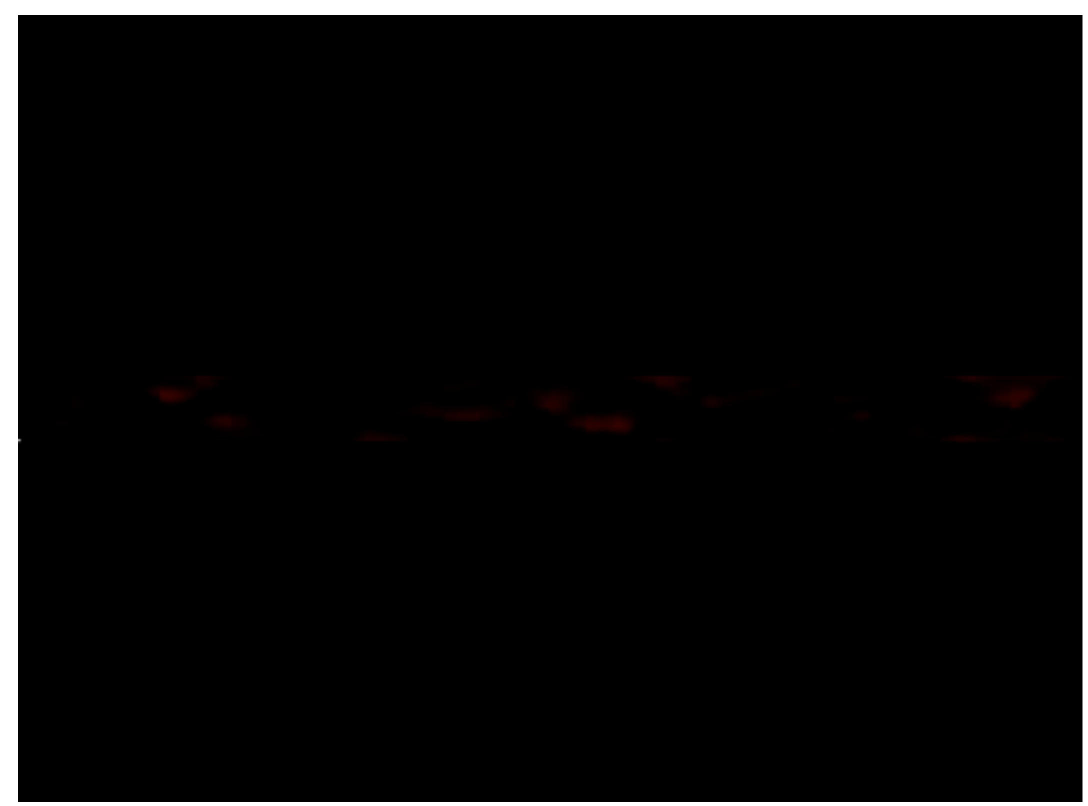


Cegla, H. M. et al. 2013, ApJ, 763, 95

Transiting Stellar Surfaces

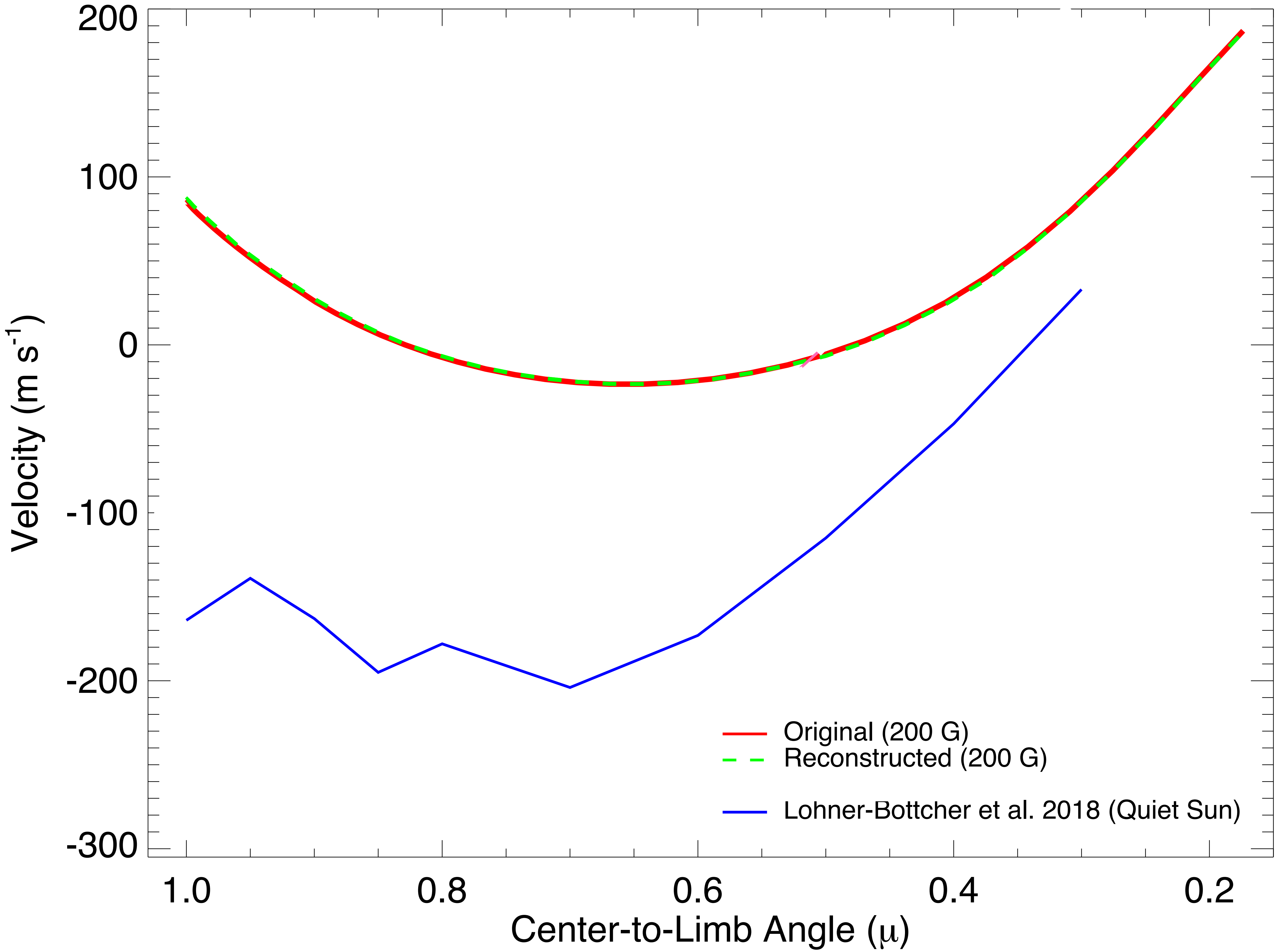






Cegla, H. M. et al, in press ArXiv: 1807.11423

Centre-to-limb Variations on the Sun



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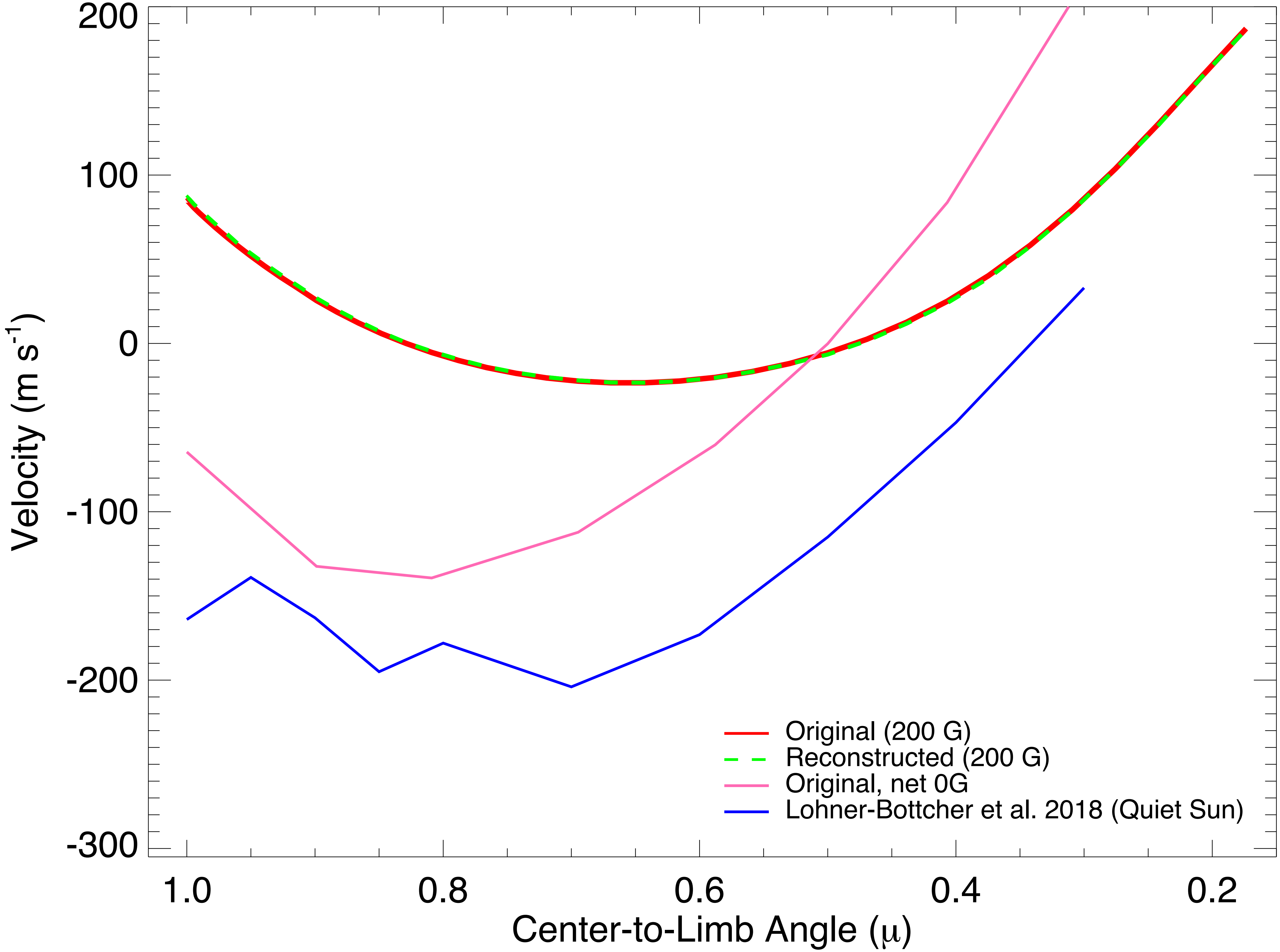

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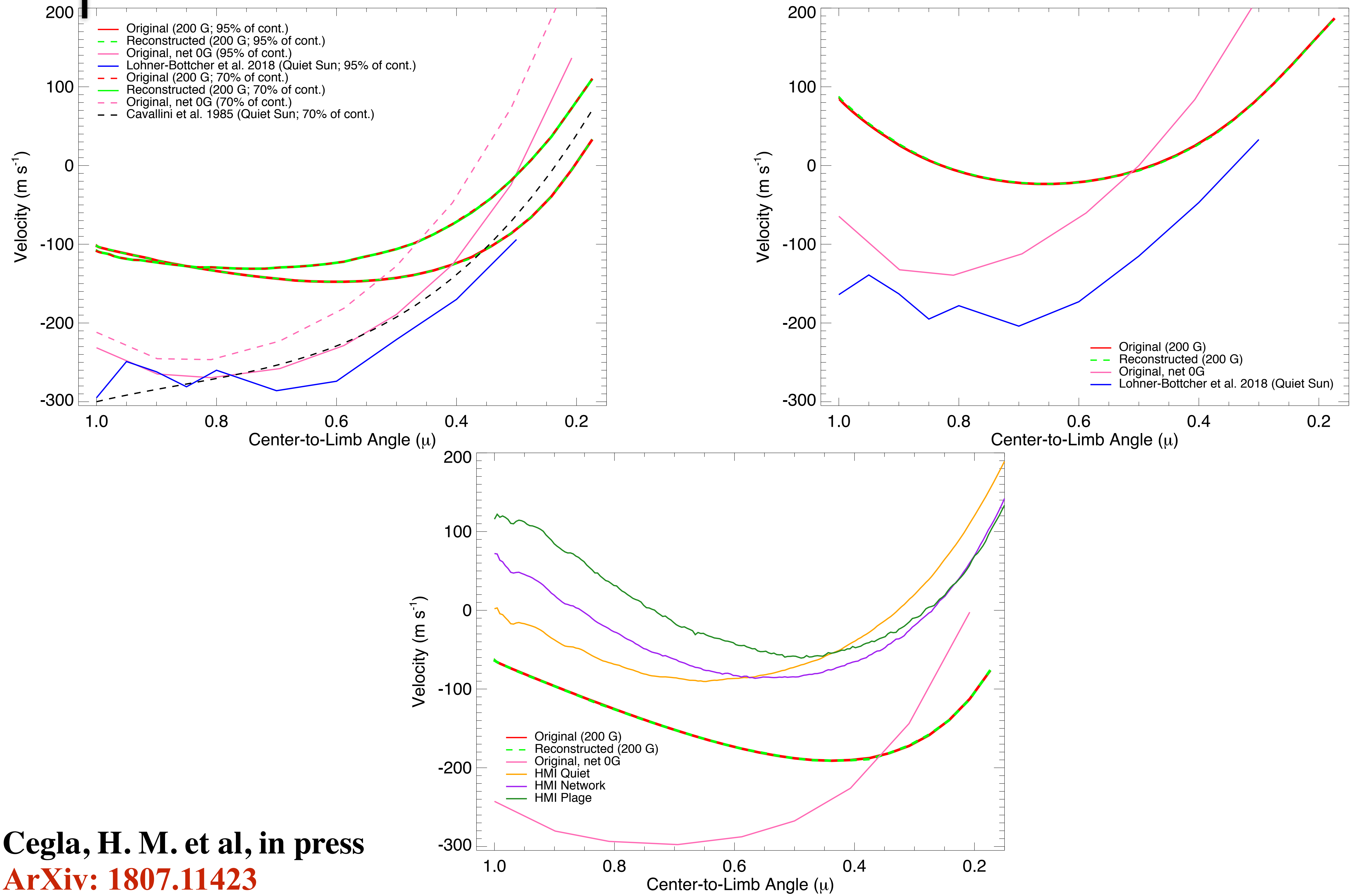
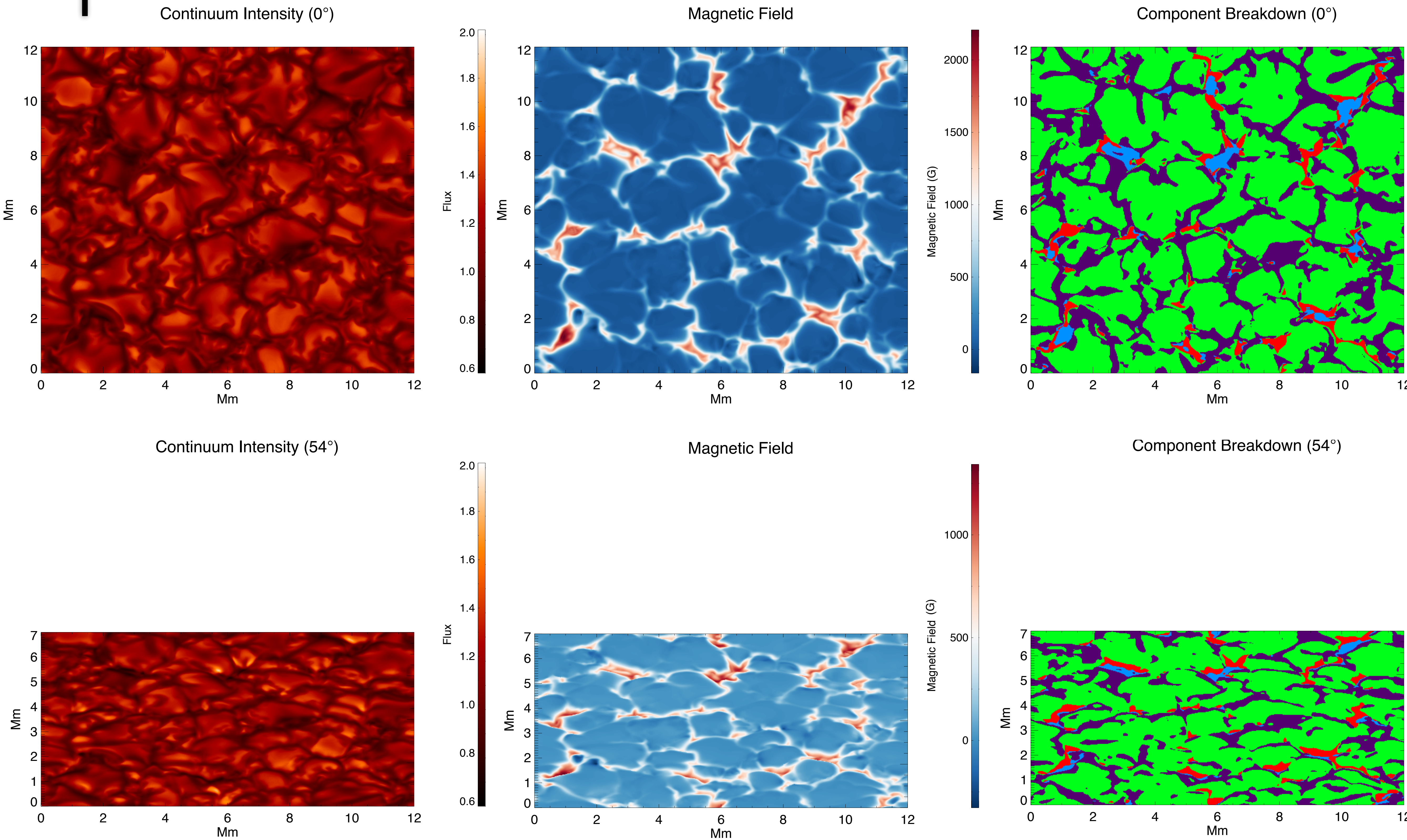


Cegla, H. M. et al, in press

ArXiv: 1807.11423

Parameterising the Granulation



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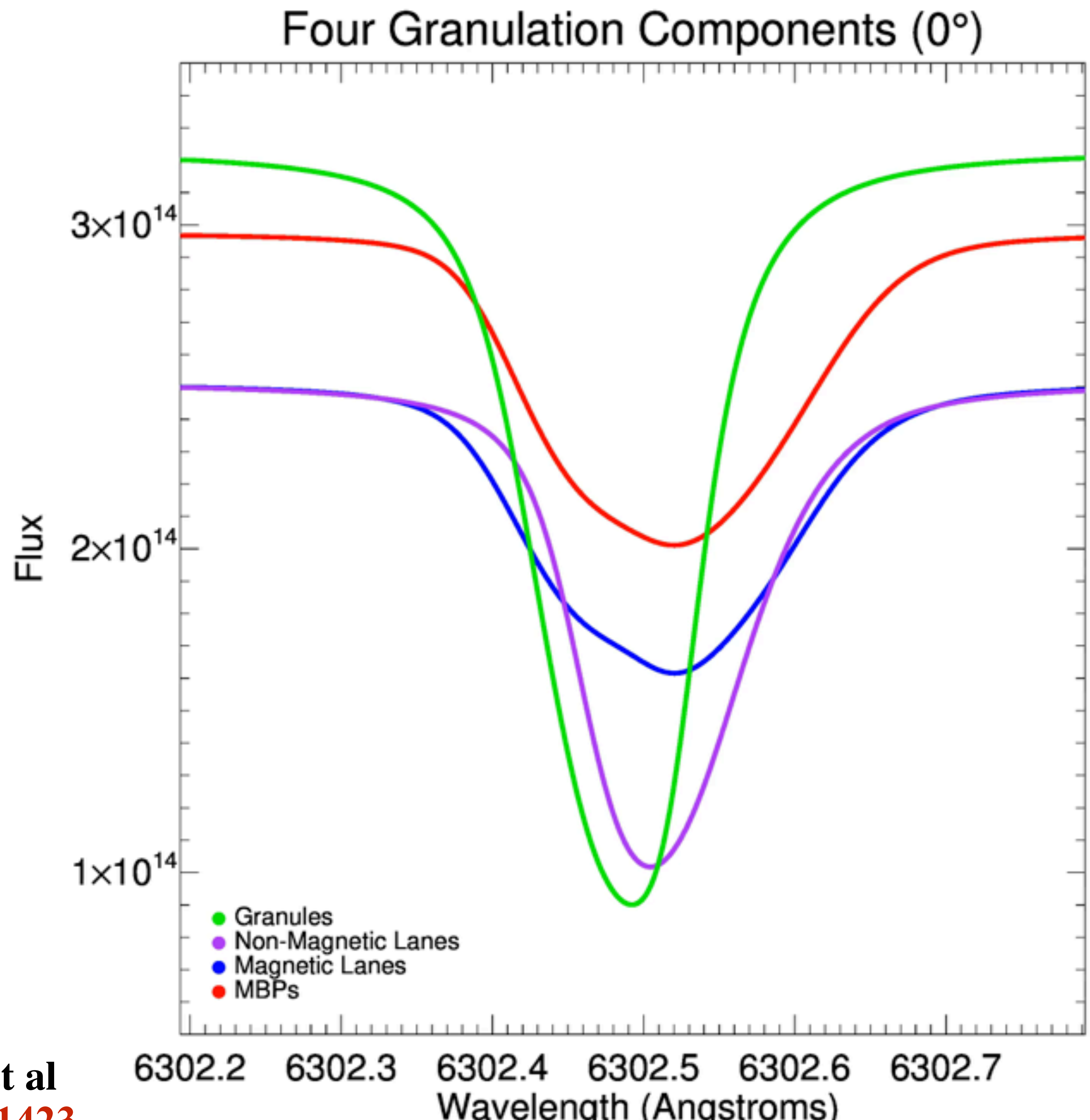

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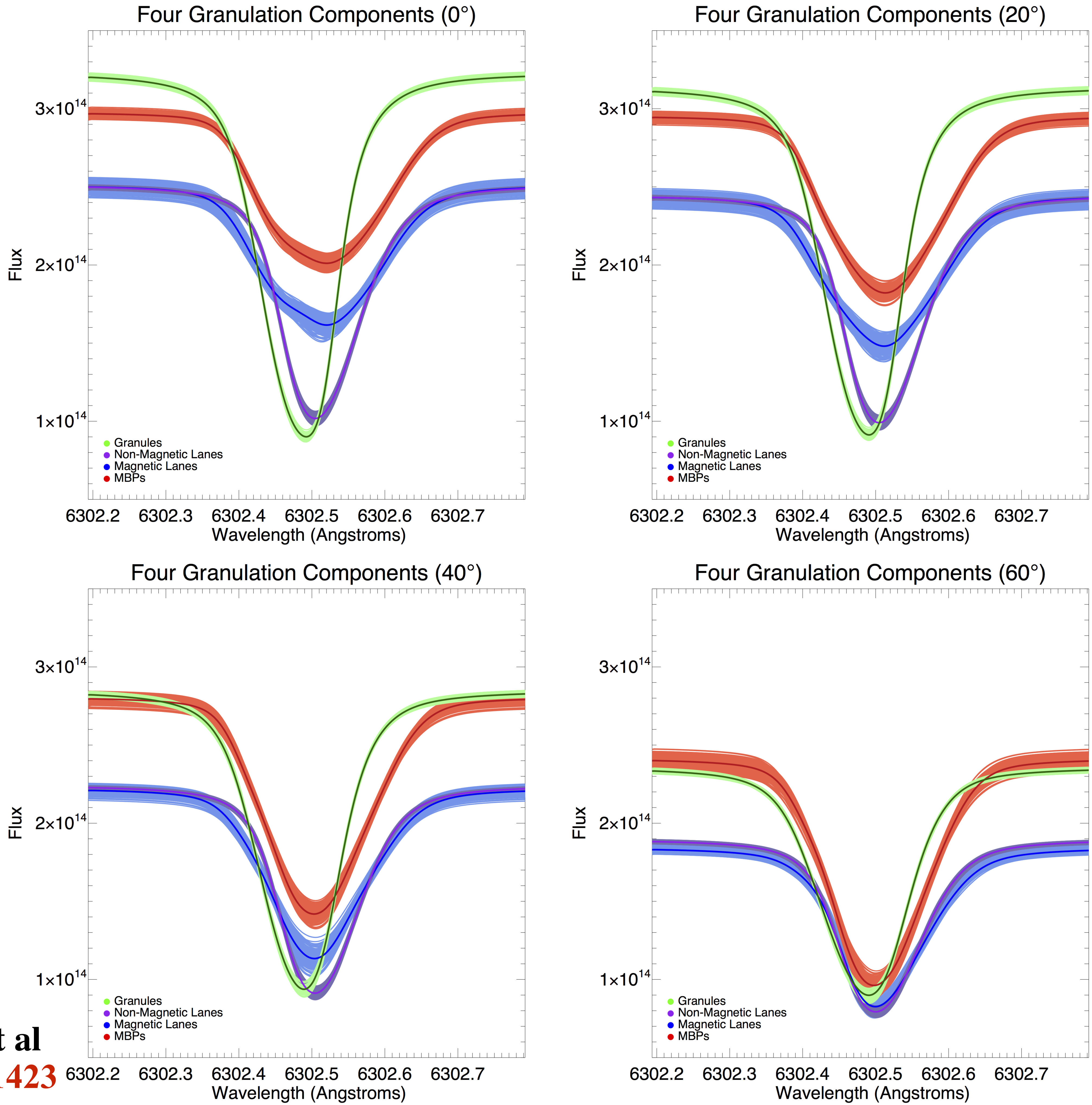

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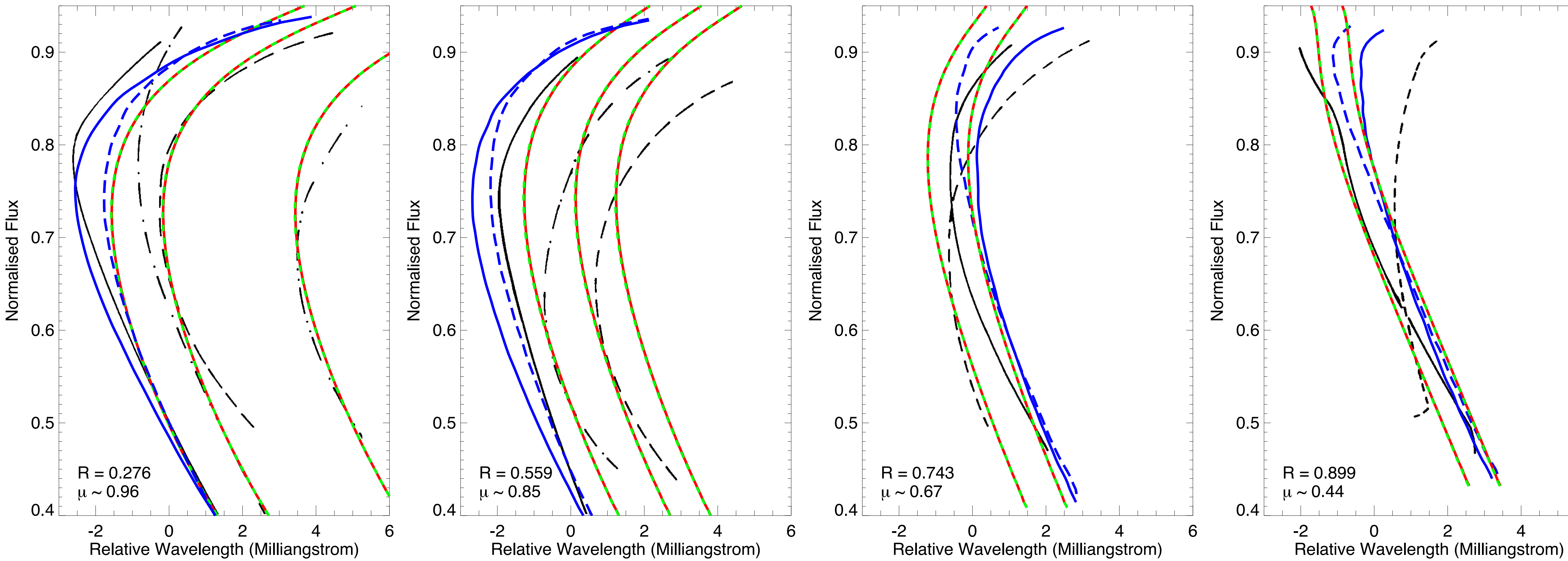
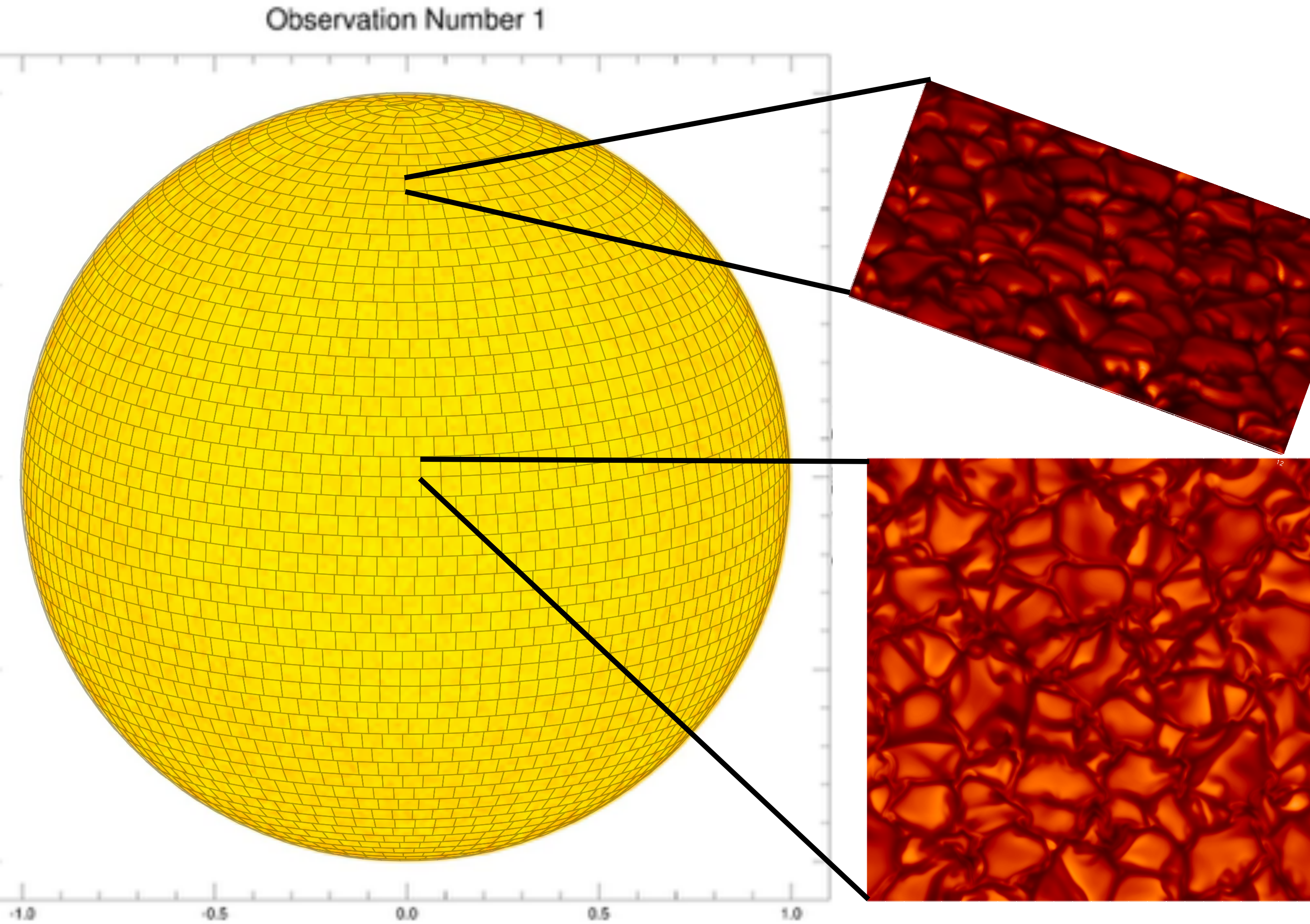
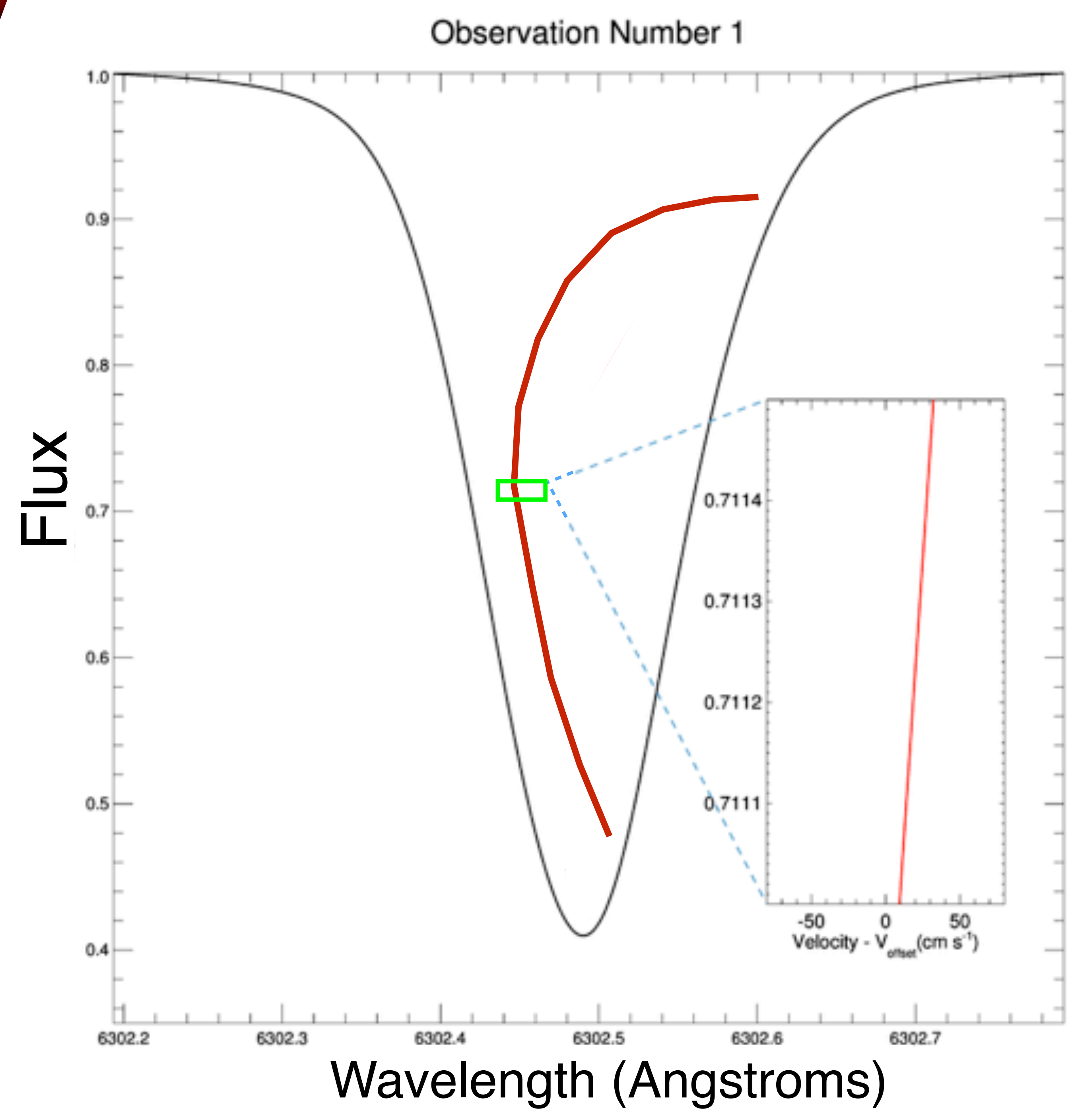


Cegla, H. M. et al, in press ArXiv: 1807.11423

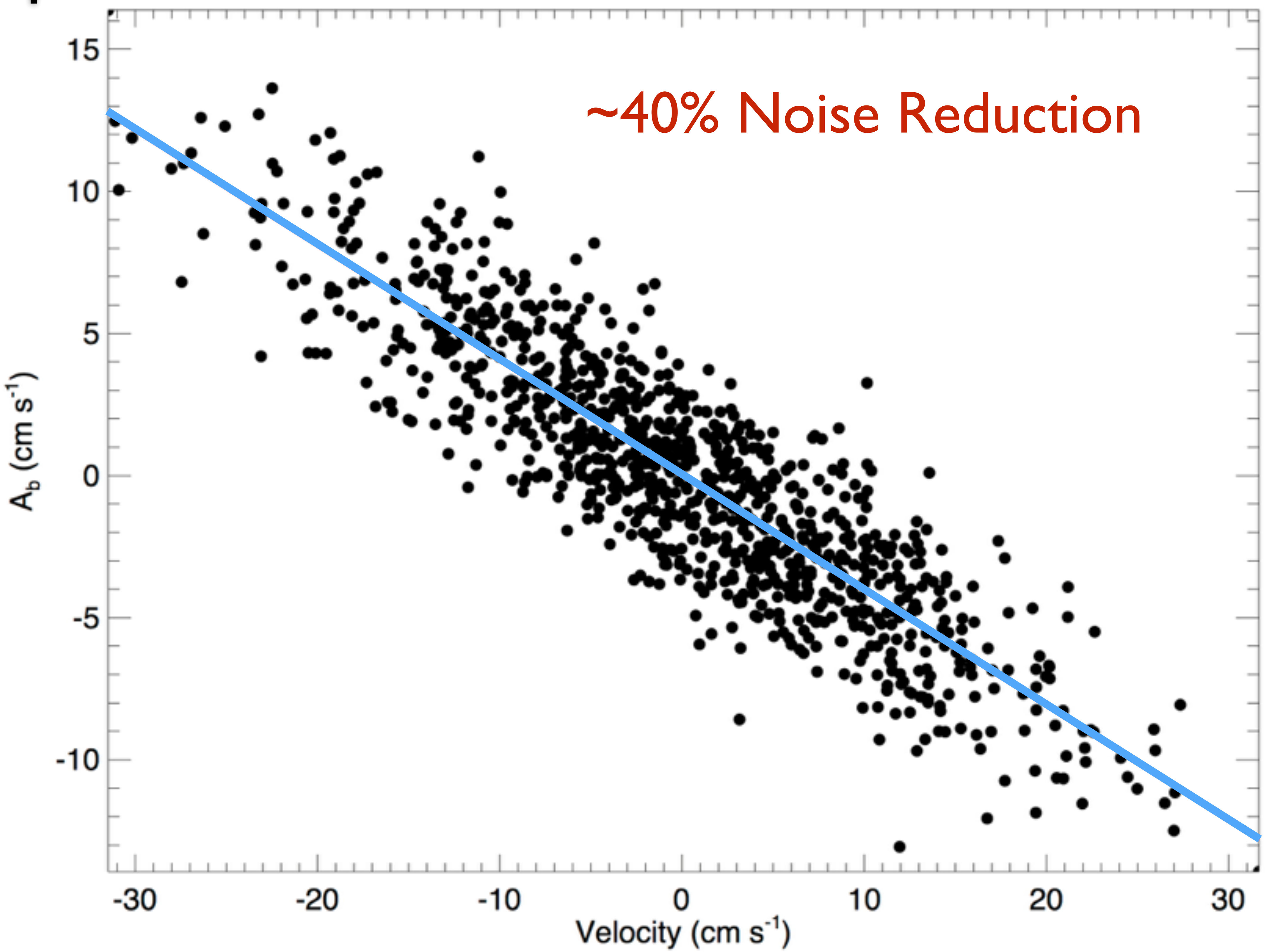
Sun-as-a-star Model Observations

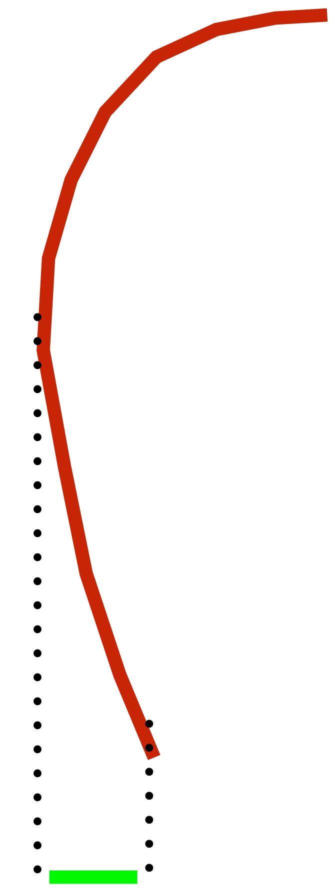




Cegla, H. M. et al in prep for ApJ (next month)

Correlations





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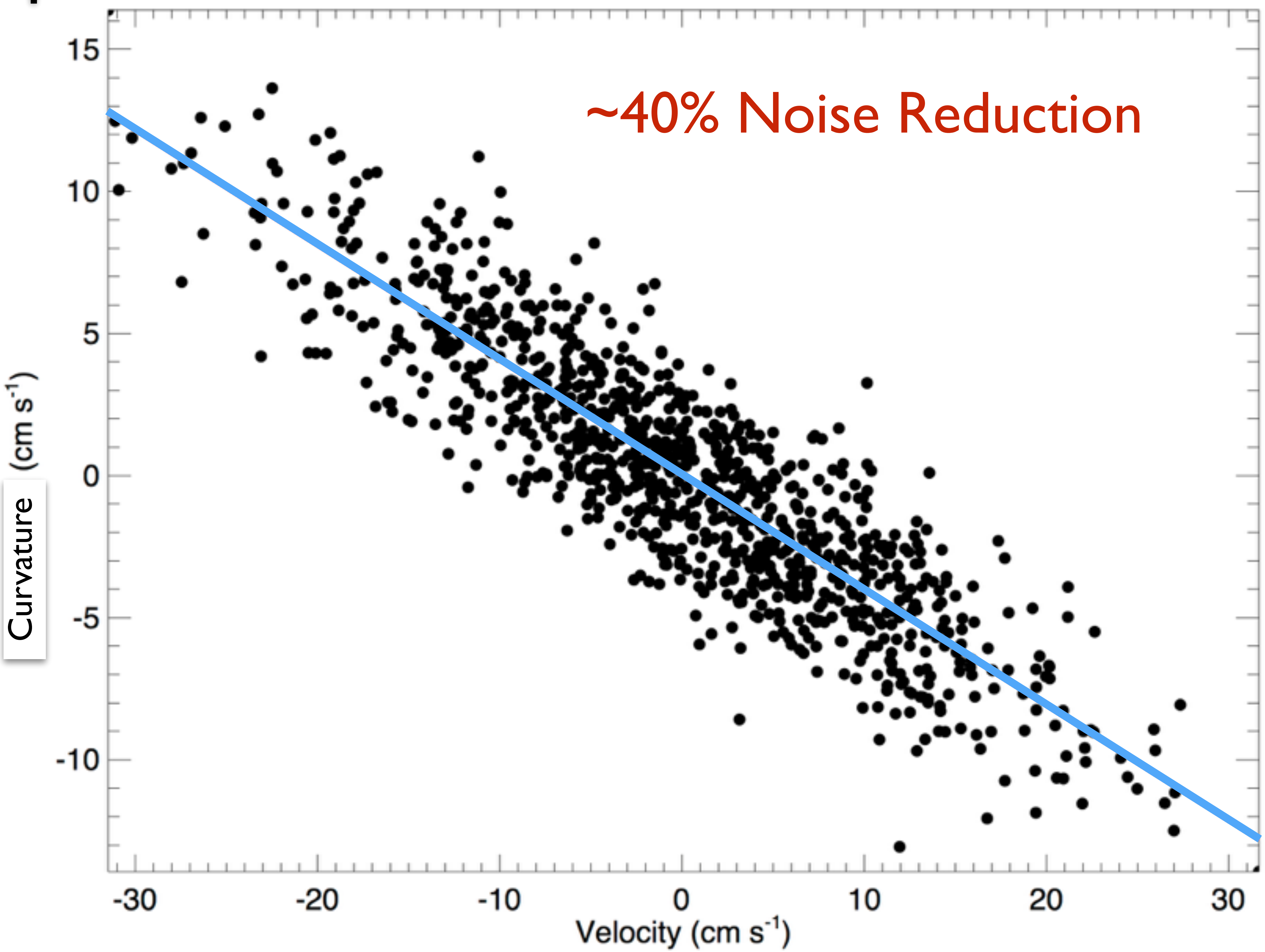

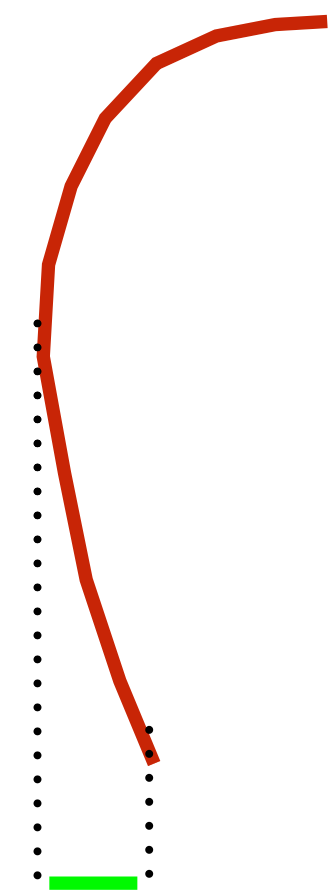

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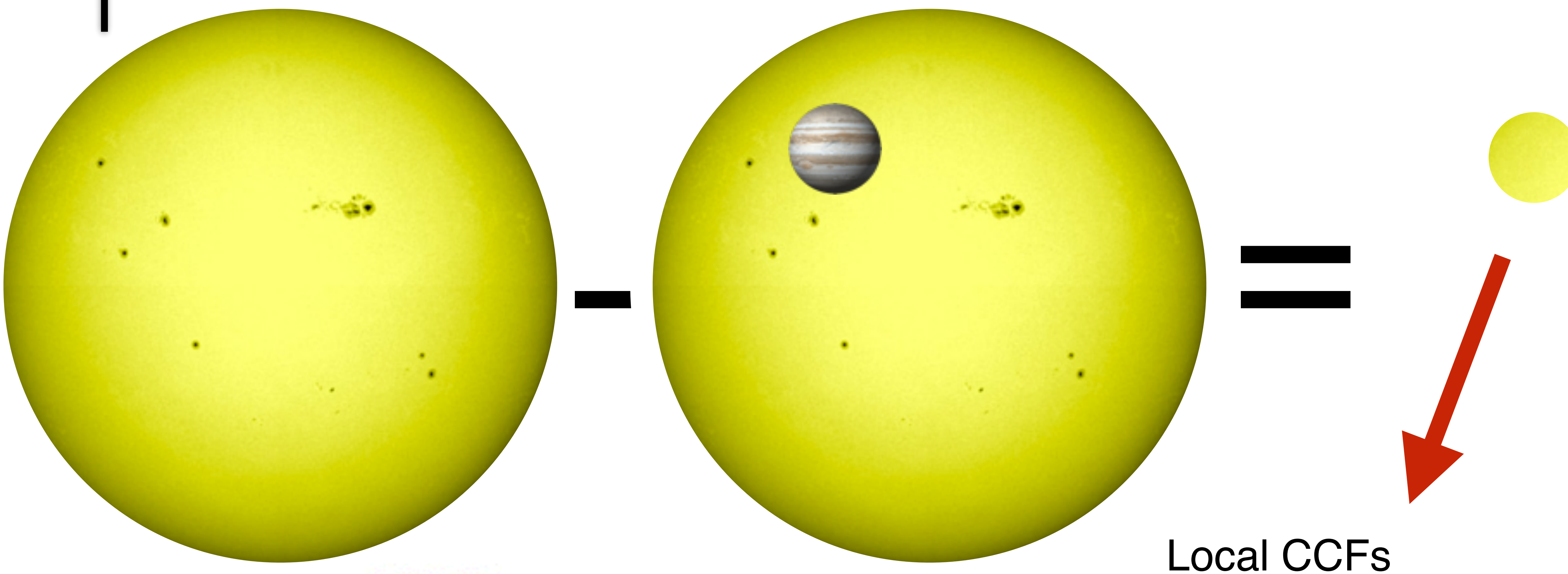
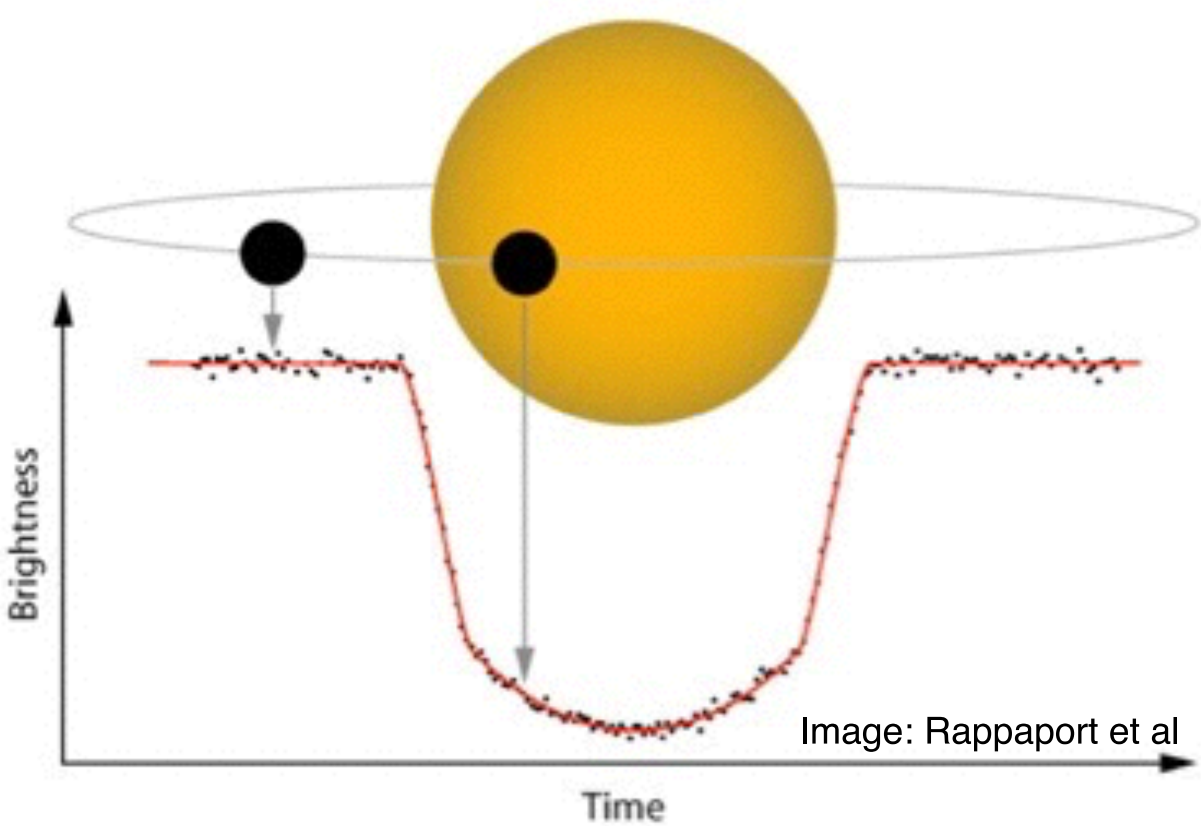
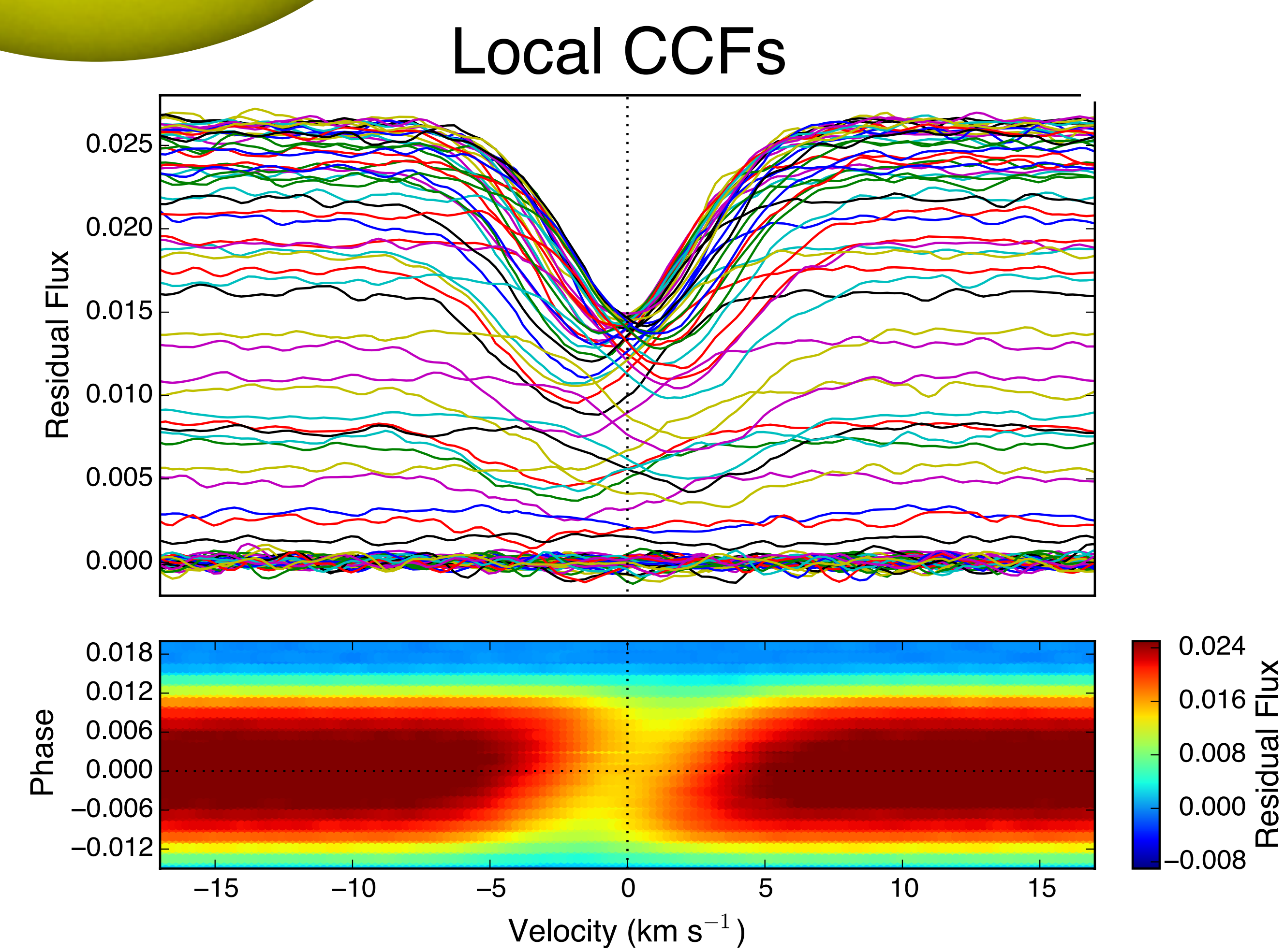
Planets as Probes

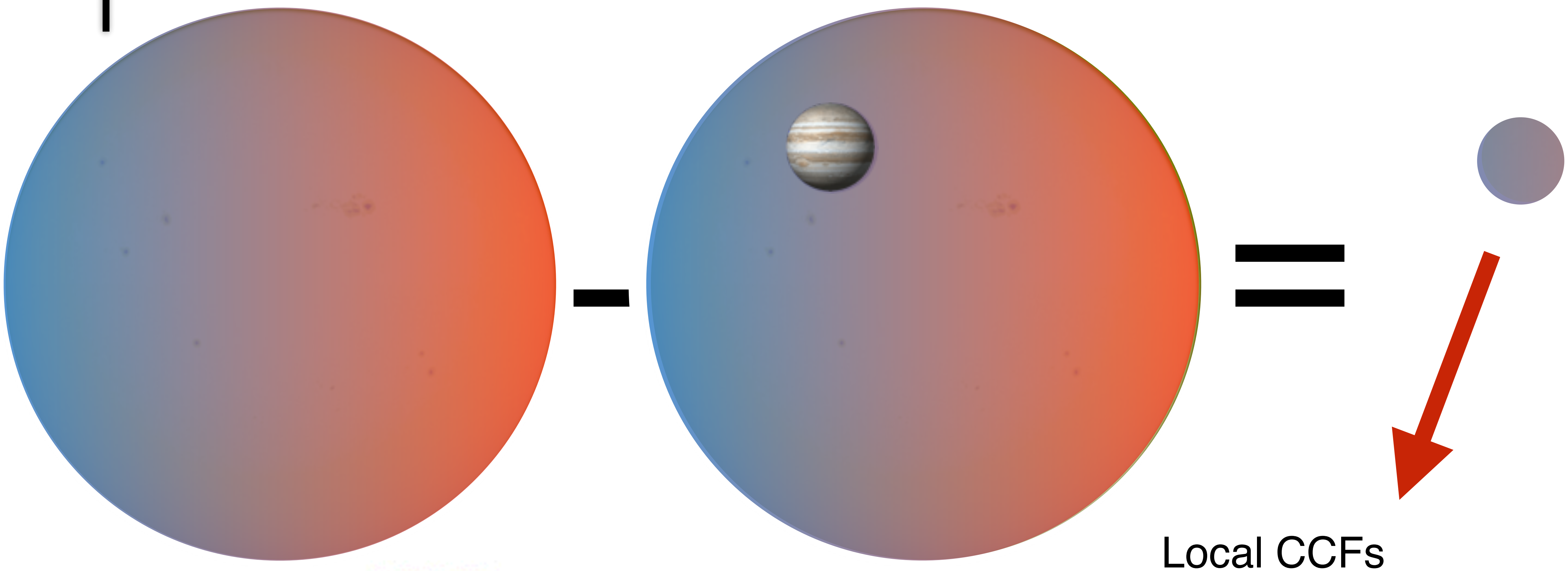


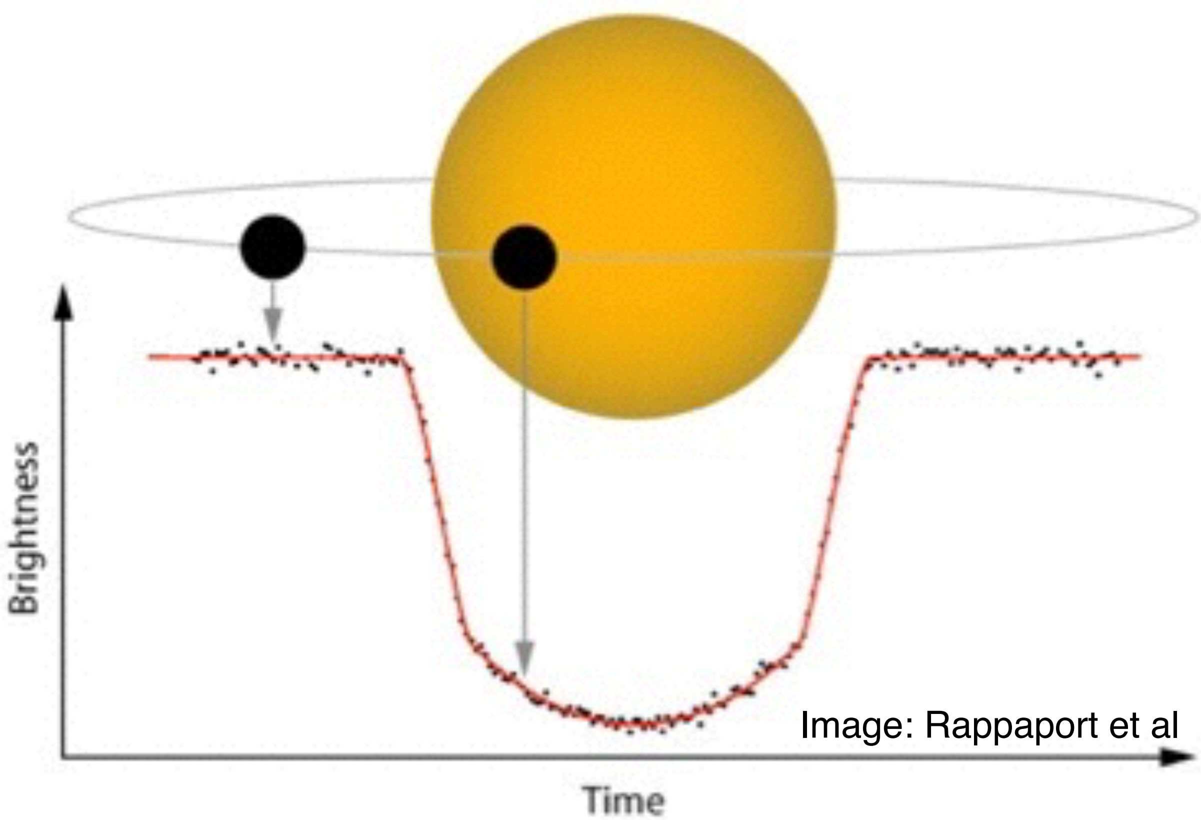


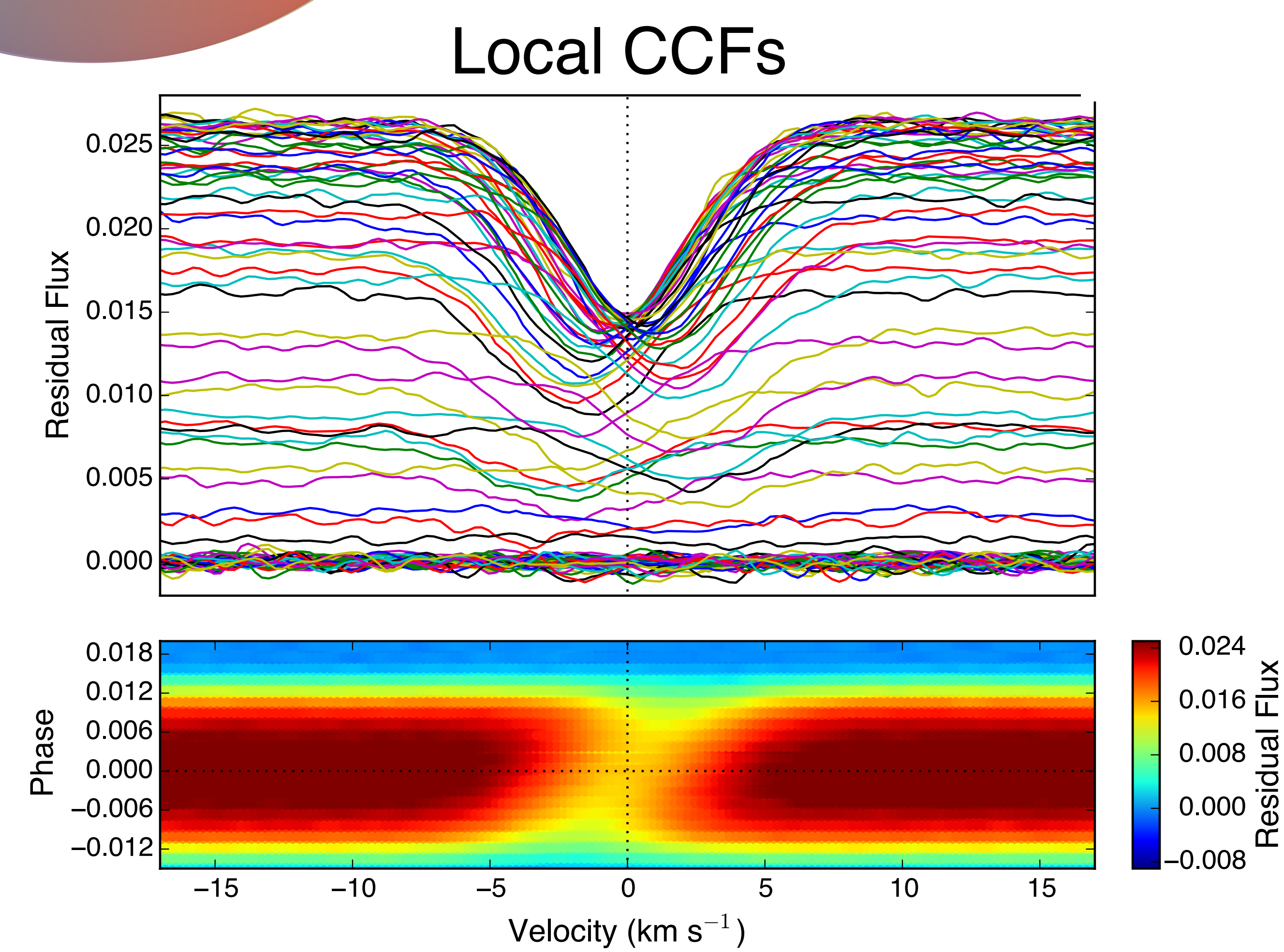


Cegla, H. M. et al 2016b, A&A, 588, A127

The Rossiter-McLaughlin effect RELOADED

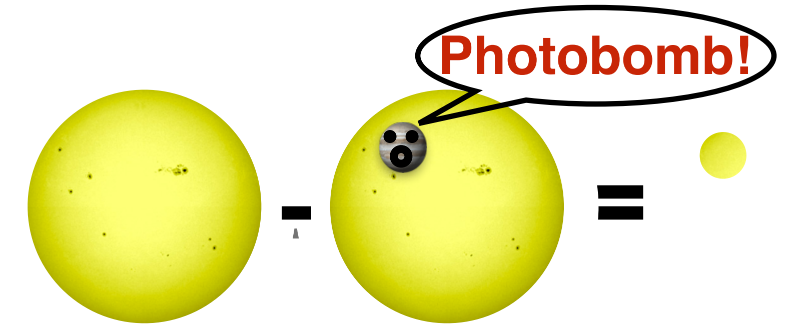


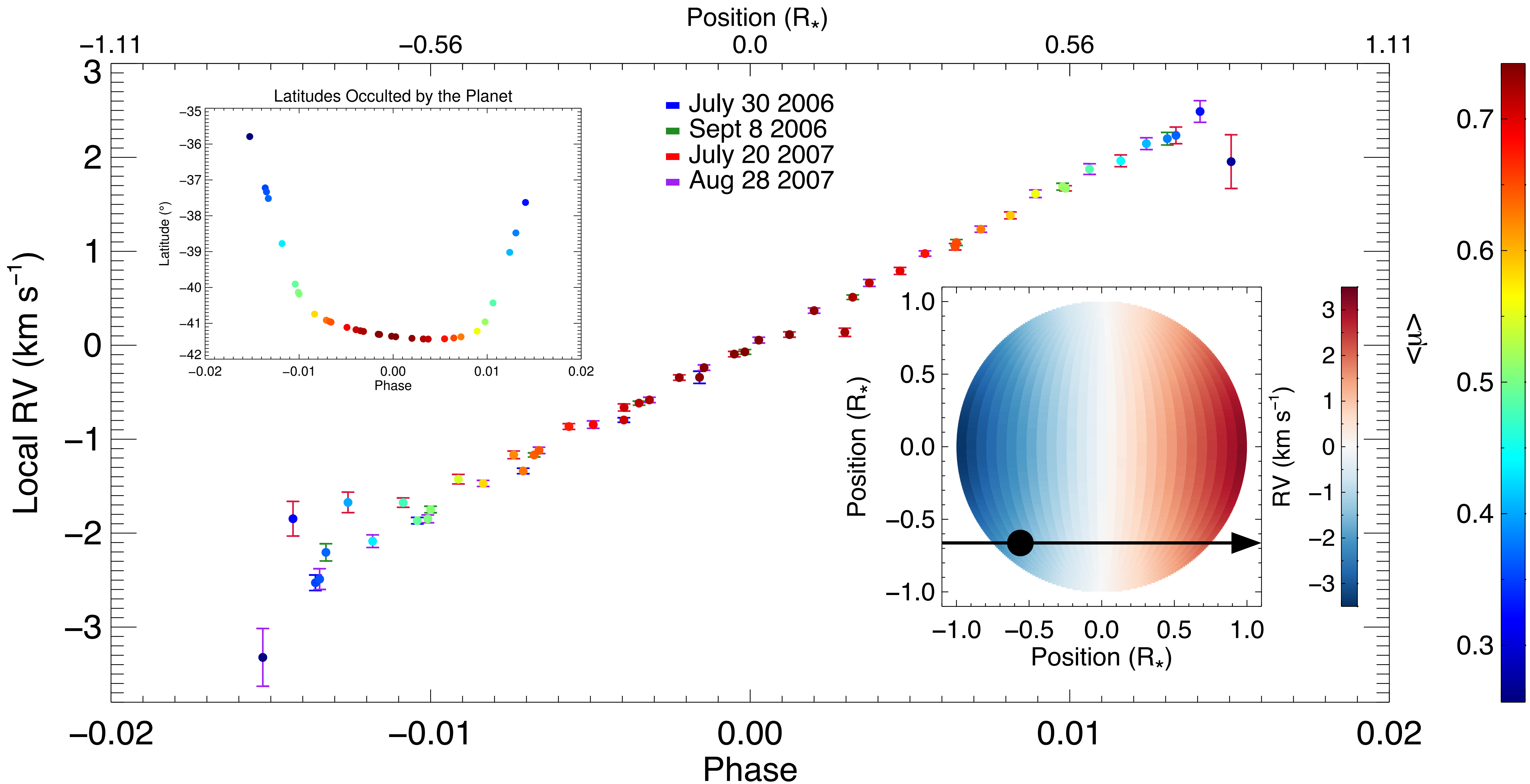




Cegla, H. M. et al 2016b, A&A, 588, A127

Planets as Probes: HD 189733





$v_{eq} \approx 4.5^{+0.5}_{-0.4}$ km s^{-1}; $\boldsymbol{\alpha}$: 0.3-0.9; > 0.1; $i_\star \approx 92^{+12}_{-14}{}^\circ$;

$\lambda \approx -0.4 \pm 0.2^\circ$; $\psi \approx 7^{+12}_{-4}{}^\circ$

Cegla, H. M. et al 2016b, A&A, 588, A127

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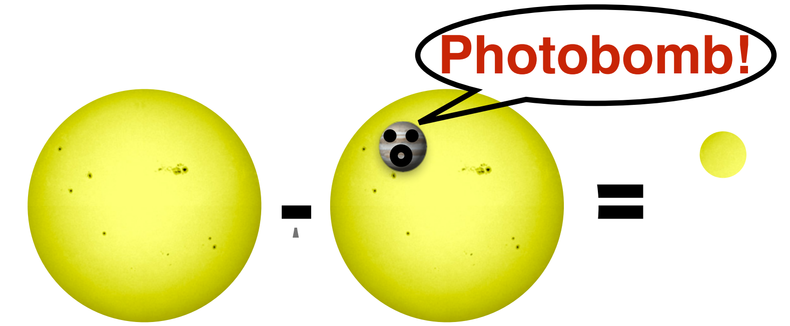

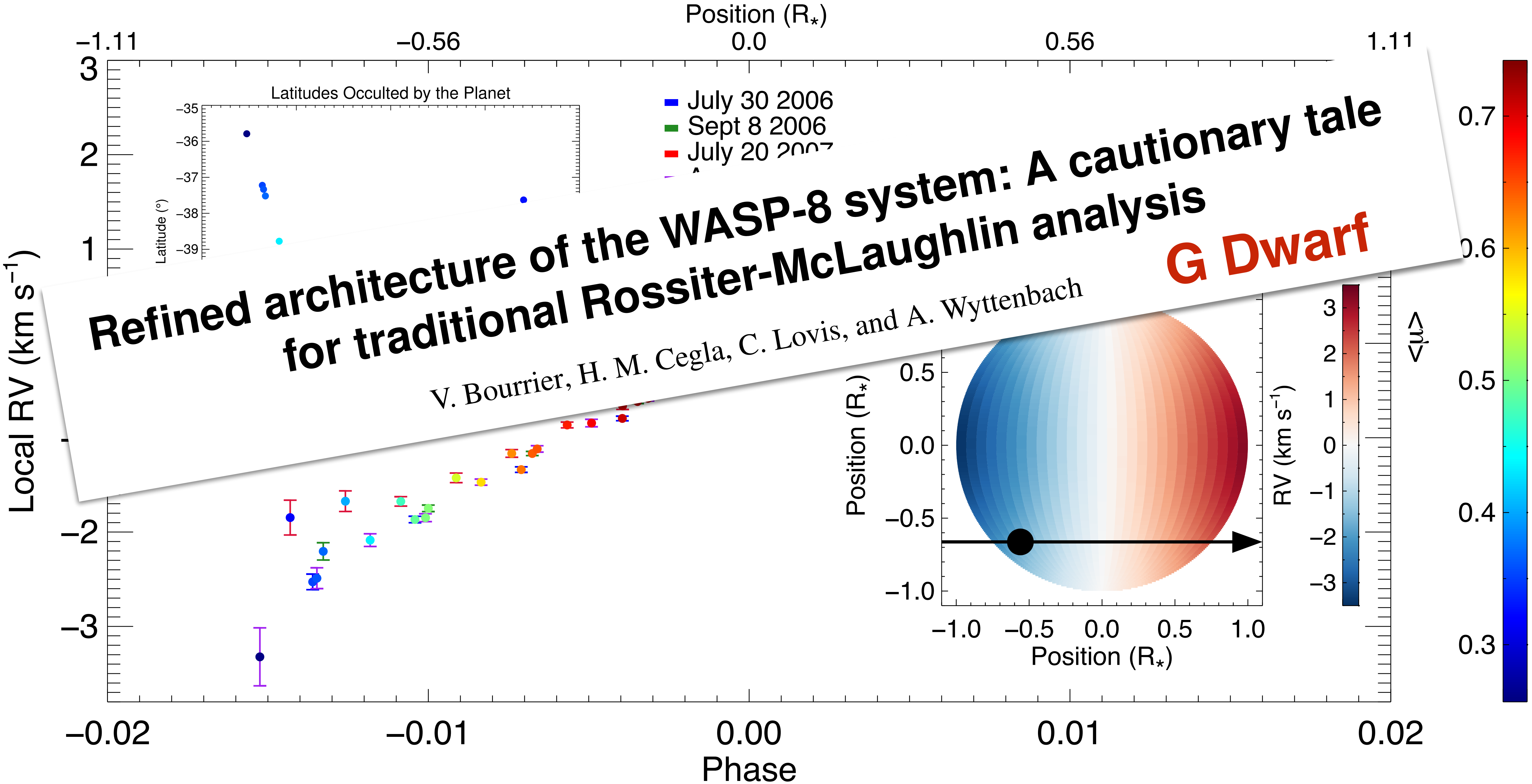

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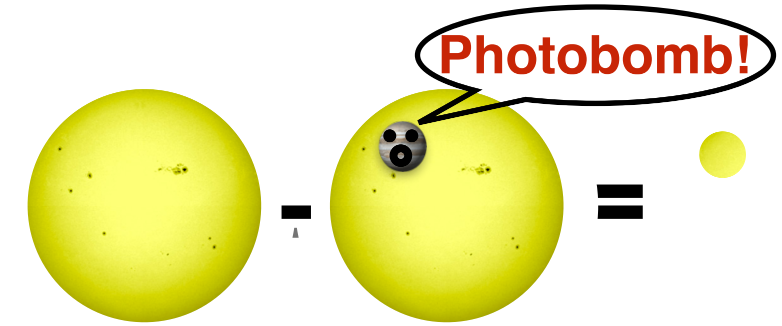

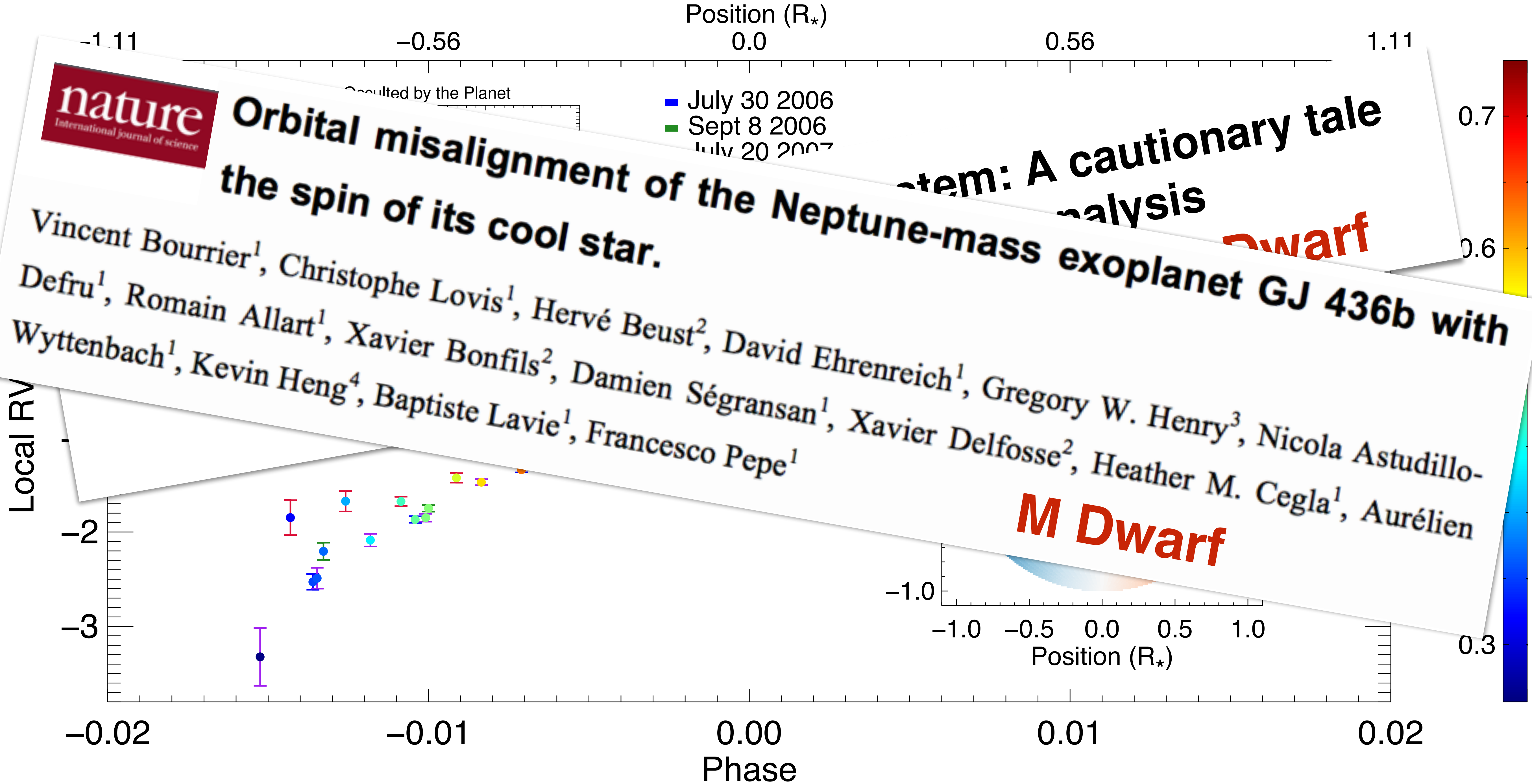

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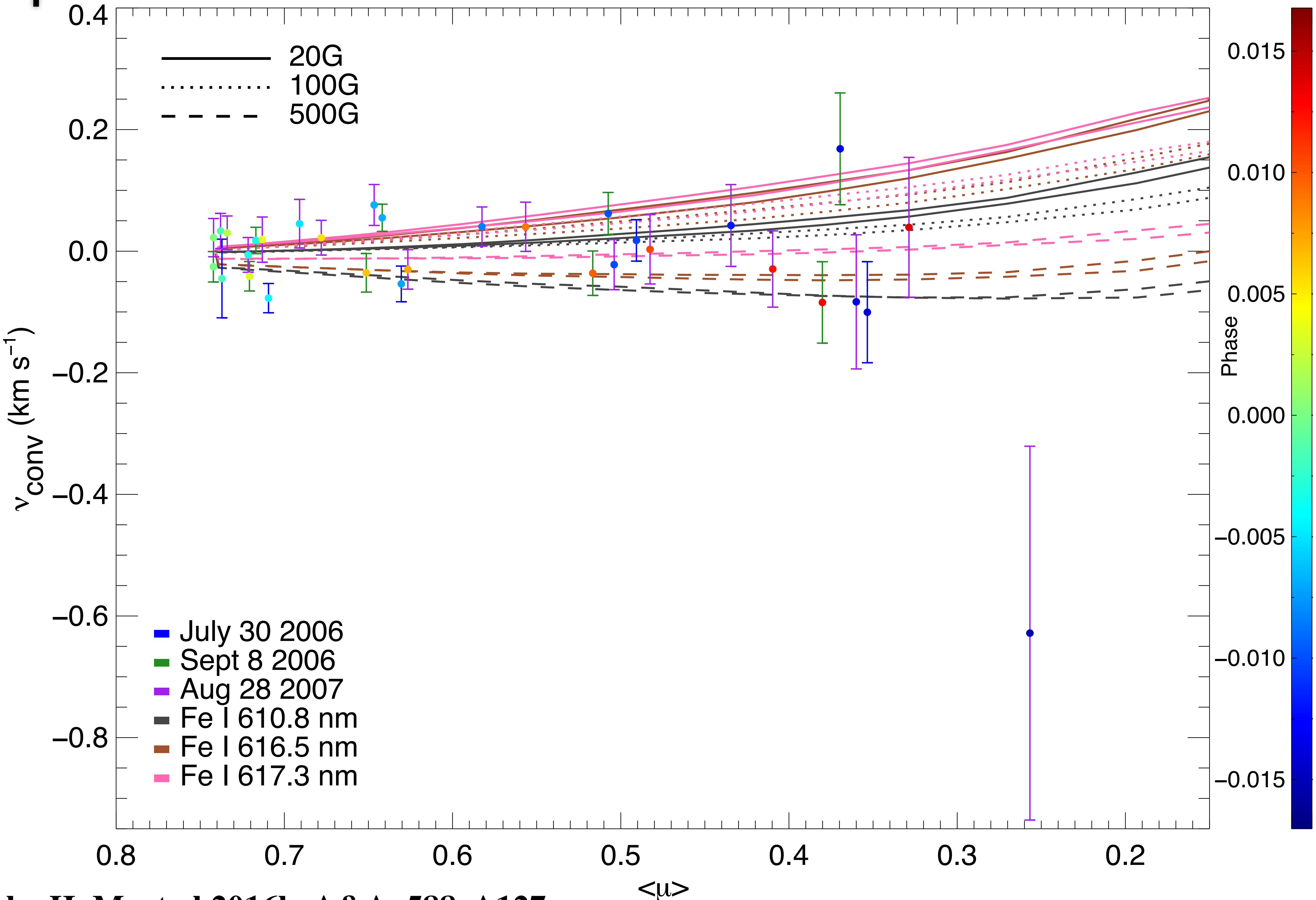
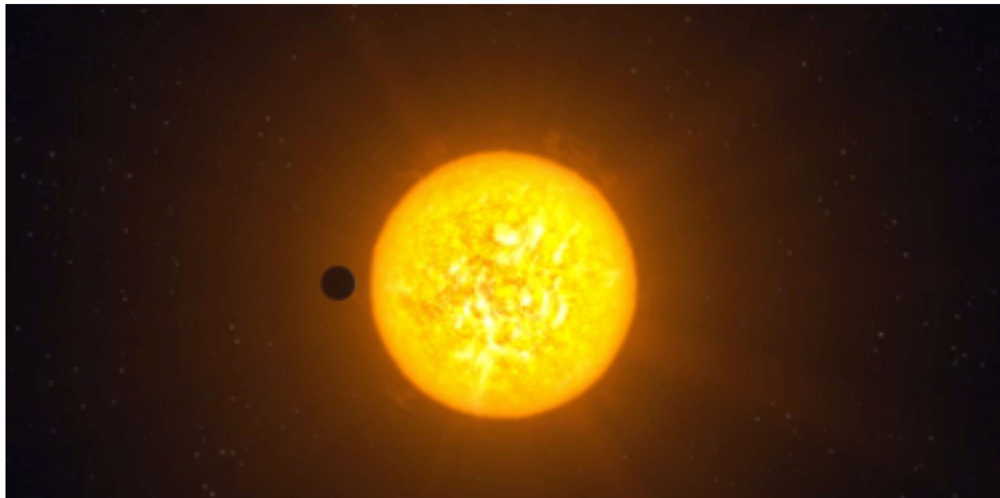


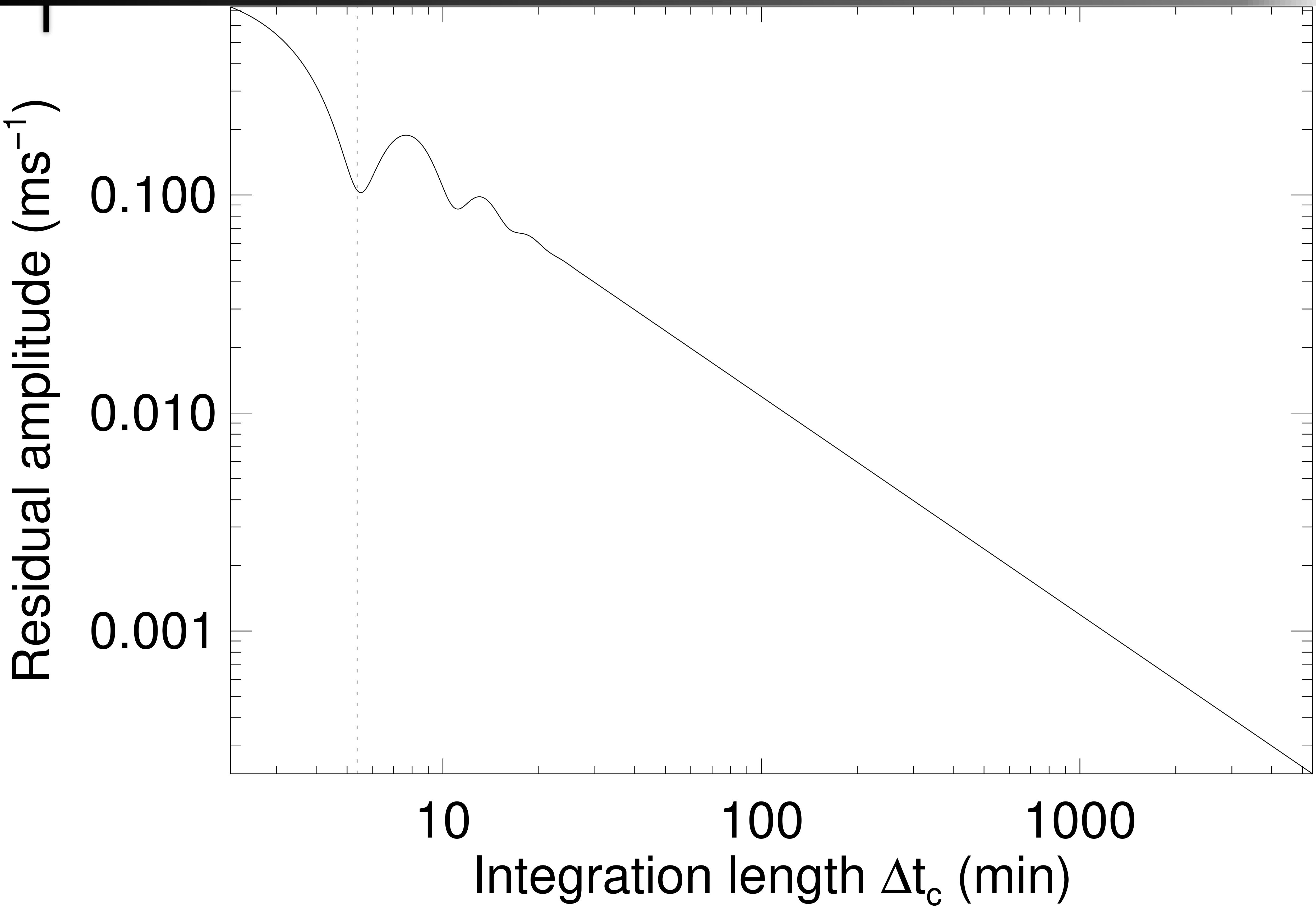
Cegla, H. M. et al 2016b, A&A, 588, A127

Summary

- Stellar surface phenomena alter line profiles & RVs
  - Impacts planet detection/confirmation/characterisation
  - Poses fundamental RV precision limit
  - MHD simulations offer pathway to characterise and disentangle
- Can use planets to spatially resolve stars
  - Probe convection, differential rotation etc.
  - Validate MHD simulations (beyond the Sun!)
  - Study evolution of star-planet systems
- Ask me about oscillations!



What about oscillations…?



Chaplin, W. J., **Cegla, H. M.**, Watson, C. A., Davis, G. R. in prep for ApJ (hopefully submit next week!)