Blue Atmosphere or Stellar Activity

Is the Blue Atmosphere of the Exoplanet GJ 3470 b Real?

Silvia Kunz

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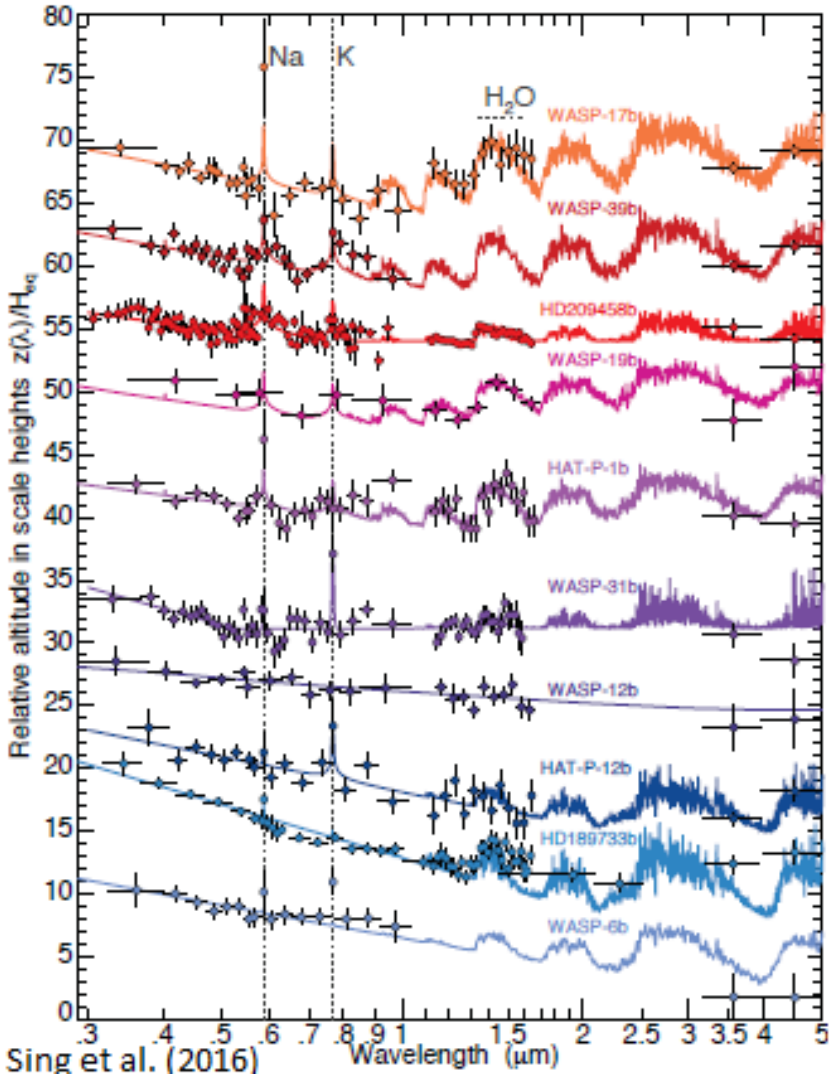
Hot Jupiters Have Blue Atmospheres



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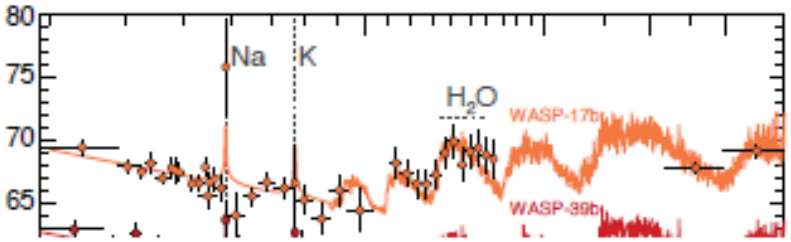
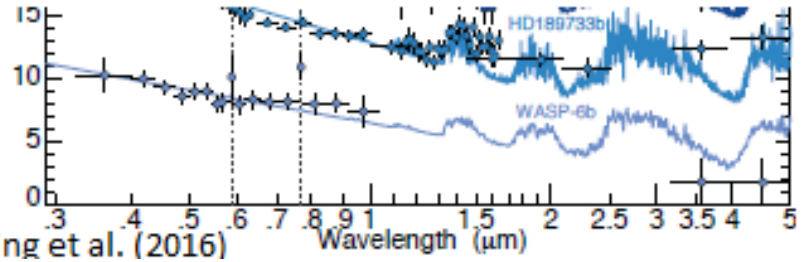


What about low-mass planets?



Sing et al. (2016)

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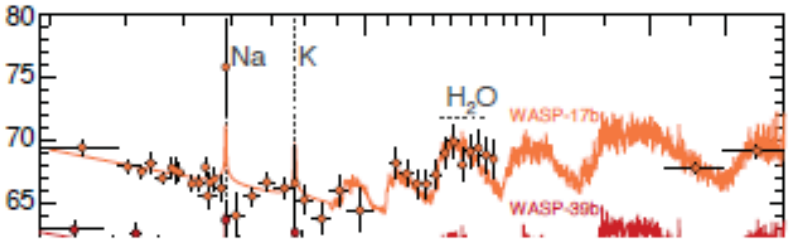
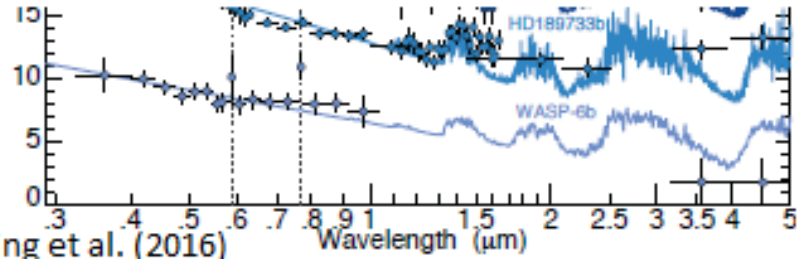


What about low-mass planets?

Up to now only 3 claimed detections!



Sing et al. (2016)

GJ 3470 - Properties of the System

planet mass	$13.73\,M_\oplus$	$\pm$	$1.61\,M_\oplus$
planet radius	$3.88\,R_\oplus$	$\pm$	$0.32\,R_\oplus$
planet mean density	$1.18\,g\,cm^{-3}$	$\pm$	$0.33\,g\,cm^{-3}$
semimajor axis	$0.031\,AU$	$\pm$	$0.0028\,AU$
orbital period	$3.3367\,days$		
spectral type	M 1.4		
distance	$28.82\,pc$	$\pm$	$2.53\,pc$
stellar radius	$0.48\,R_\odot$	$\pm$	$0.04\,R_\odot$
stellar mass	$0.51\,M_\odot$	$\pm$	$0.06\,M_\odot$

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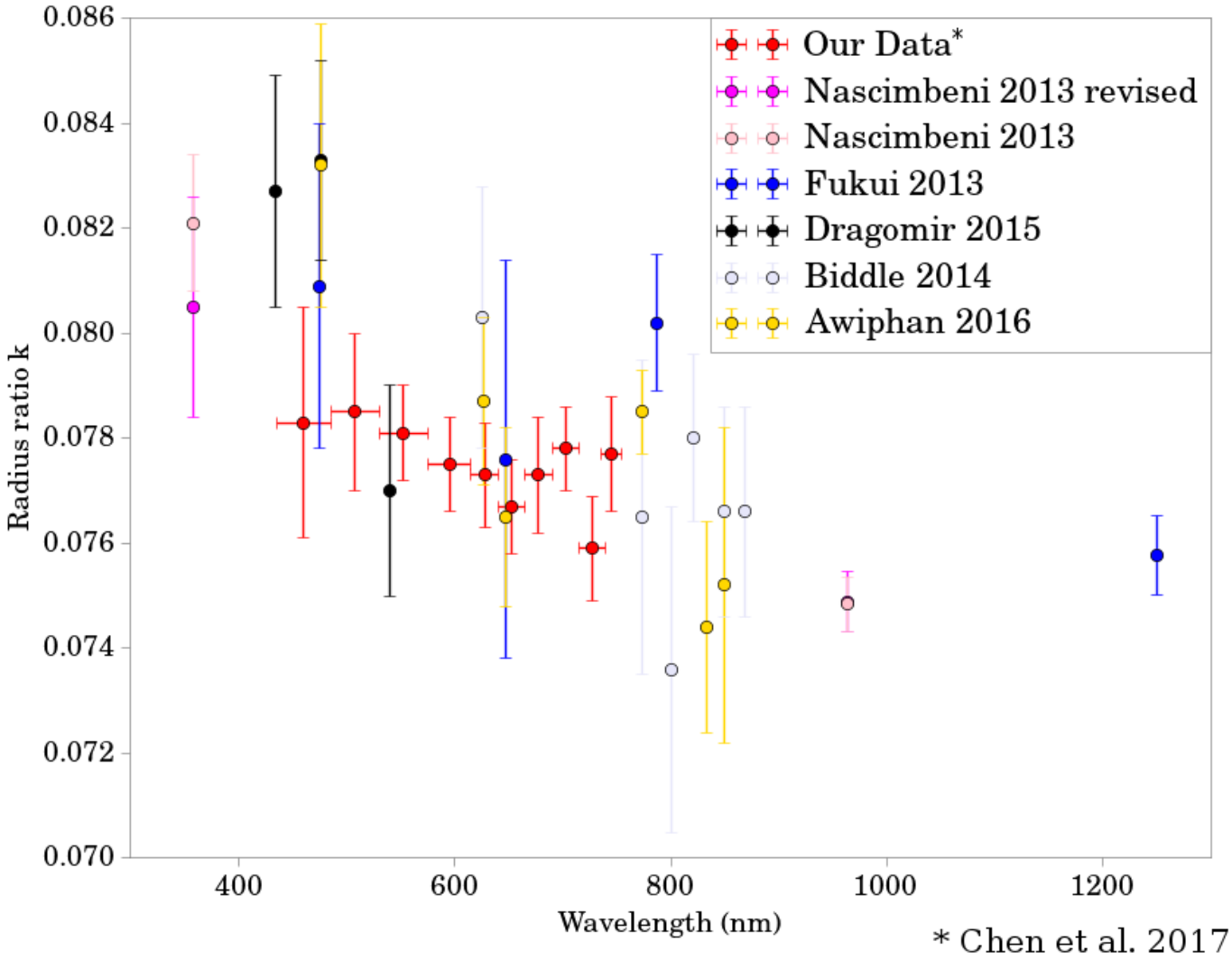
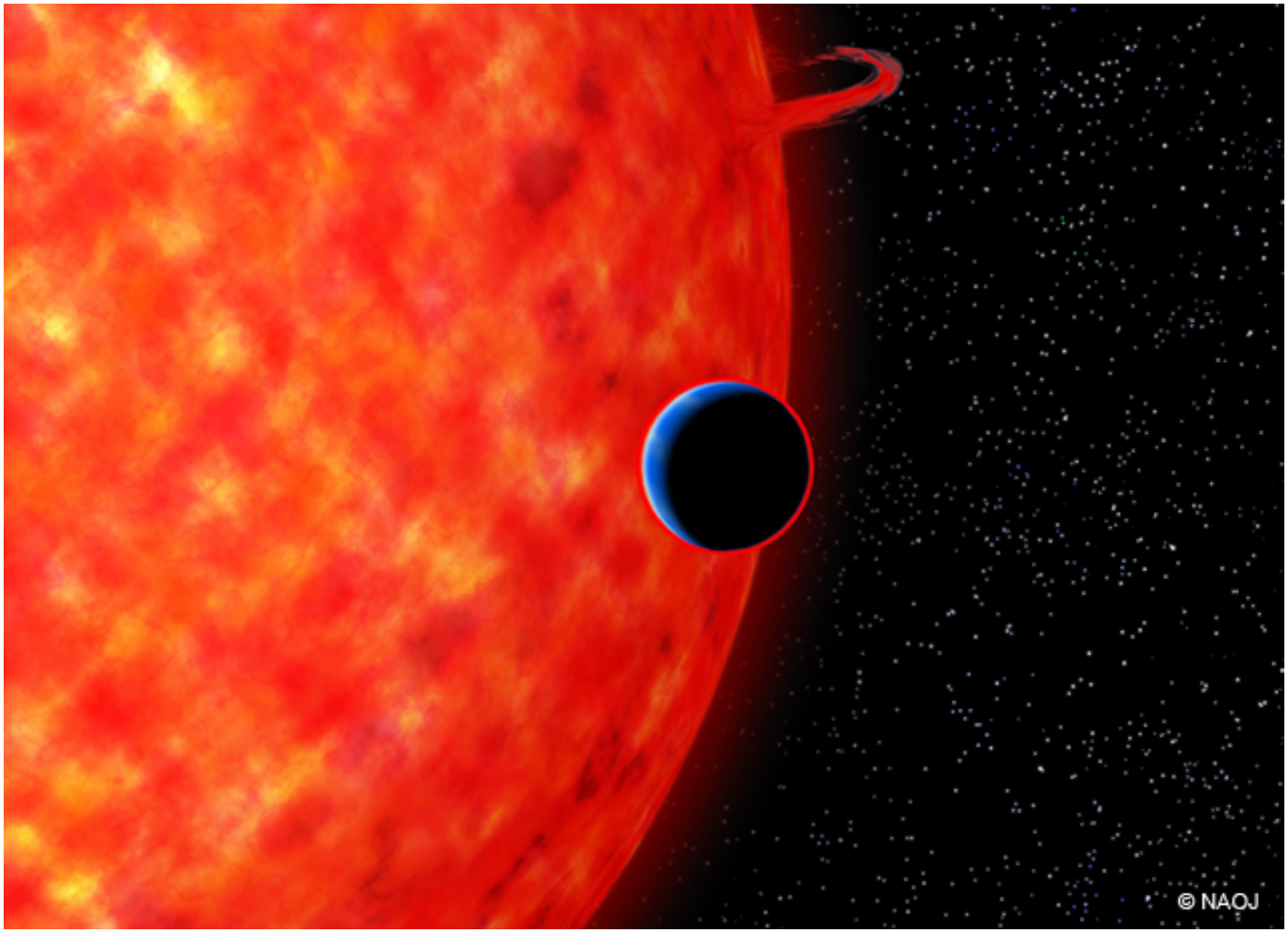
- one of the lightest planets with indications of an atmosphere
- it is still debated if atmospheres can survive in the vincinity of M dwarfs

GJ 3470 b's Blue Atmosphere

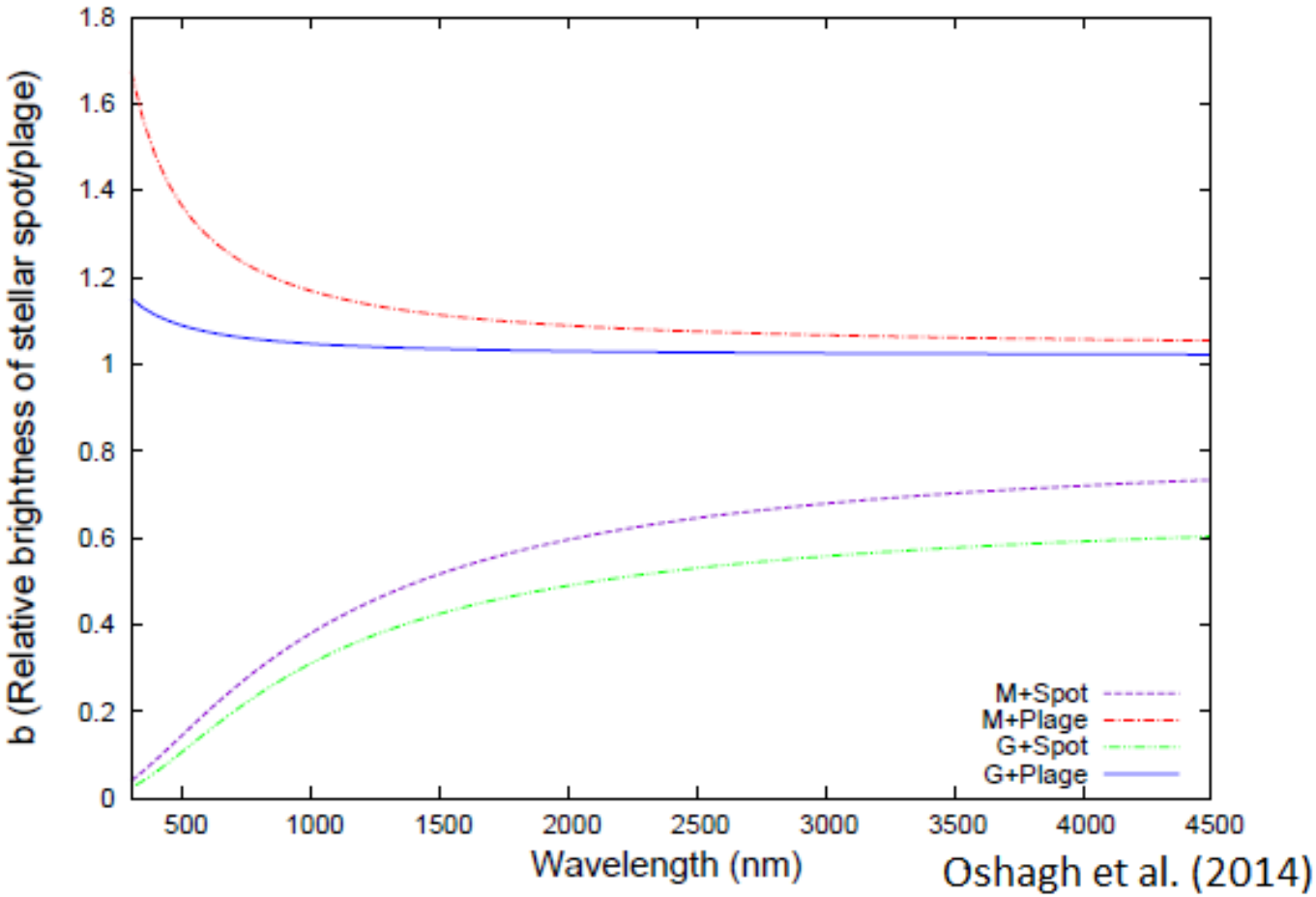


Job done?

Stars Have Activity Features

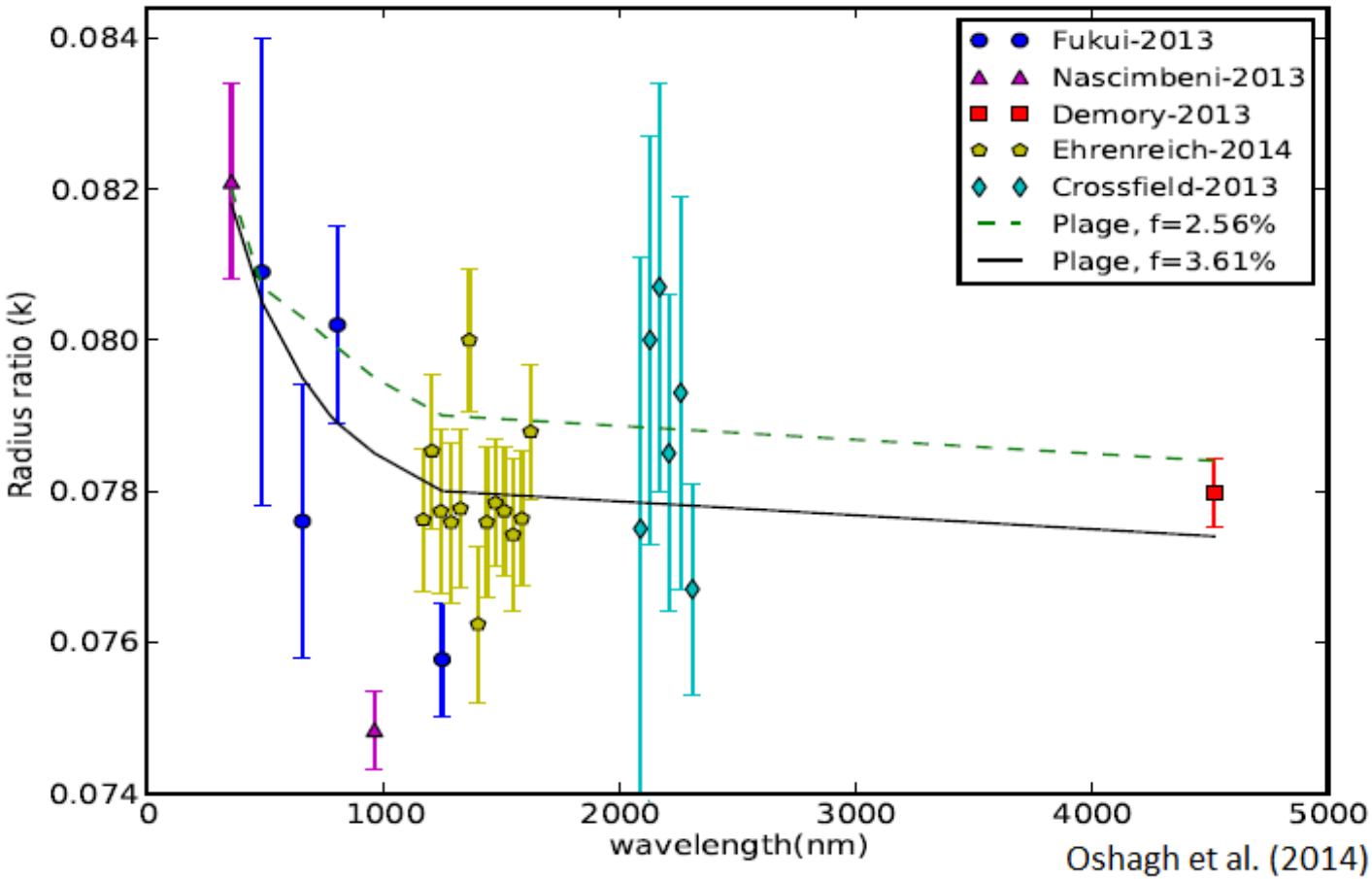


Plage Regions Are Brighter and Spots Are Darker in the Blue



Oshagh et al. (2014)

Bigger Radius in the Blue than in the Red?



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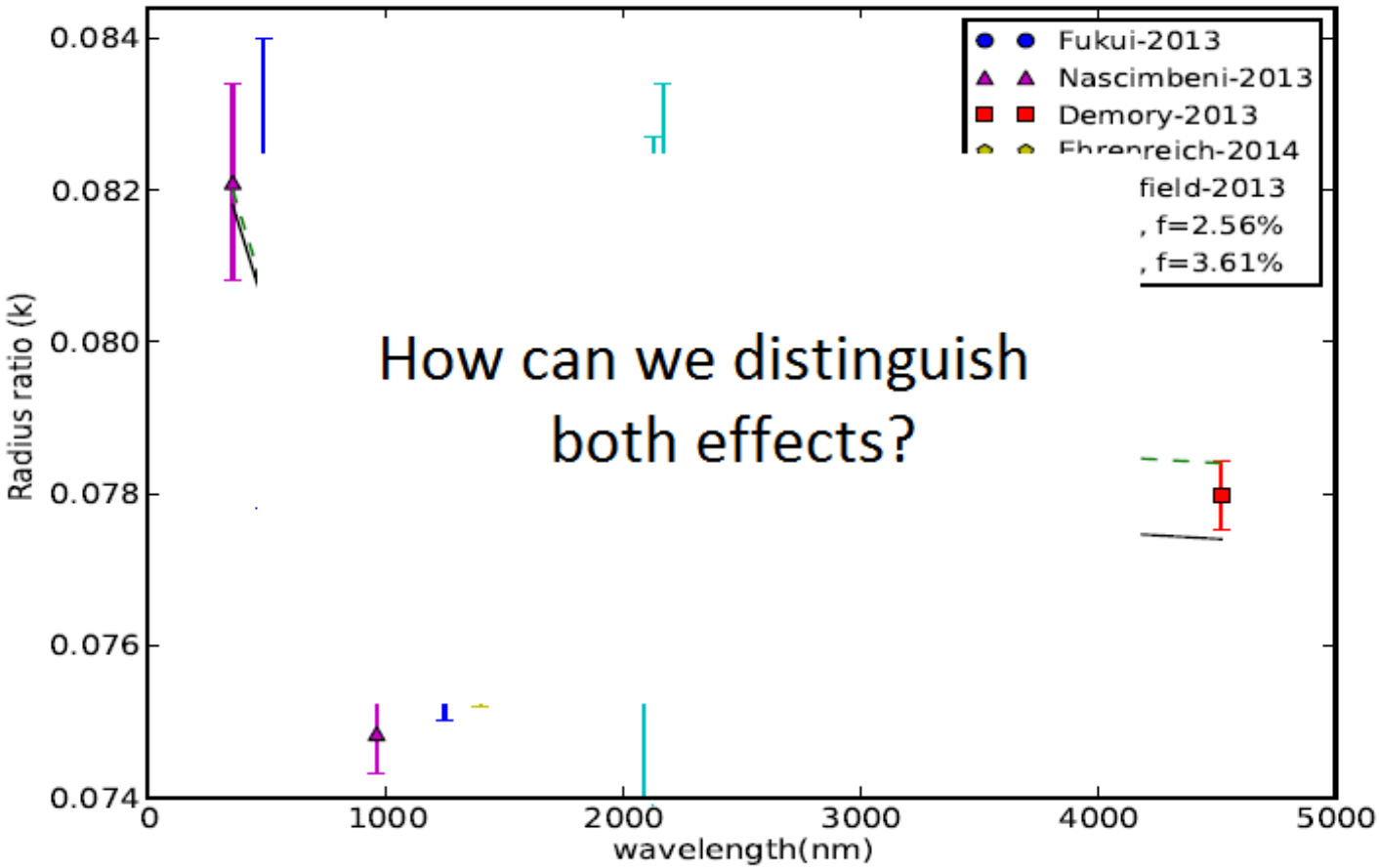
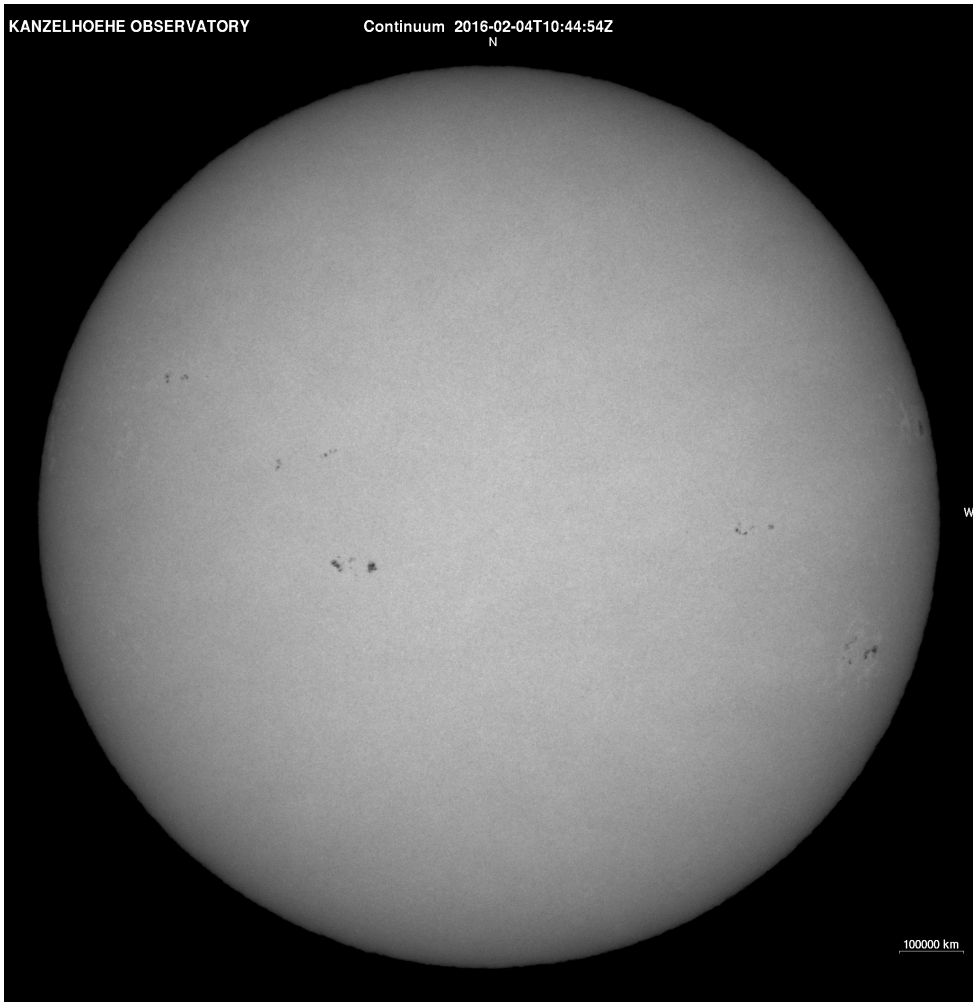
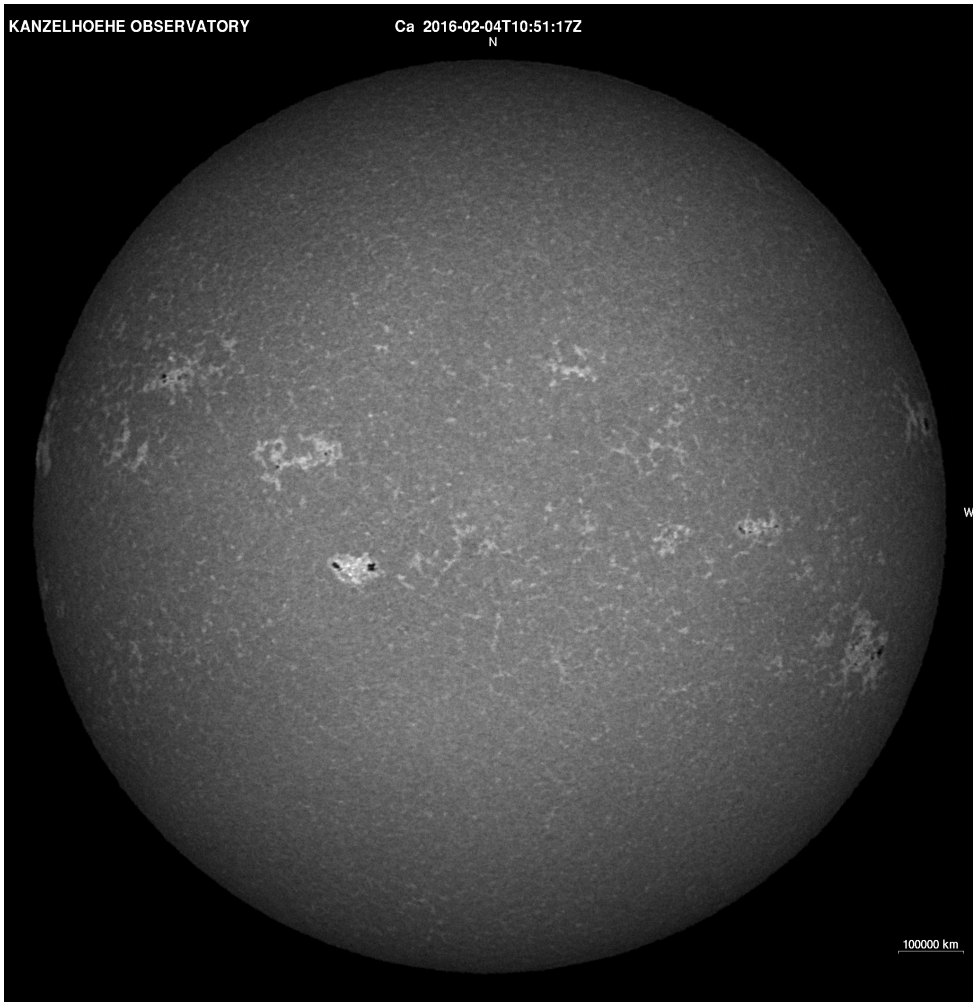


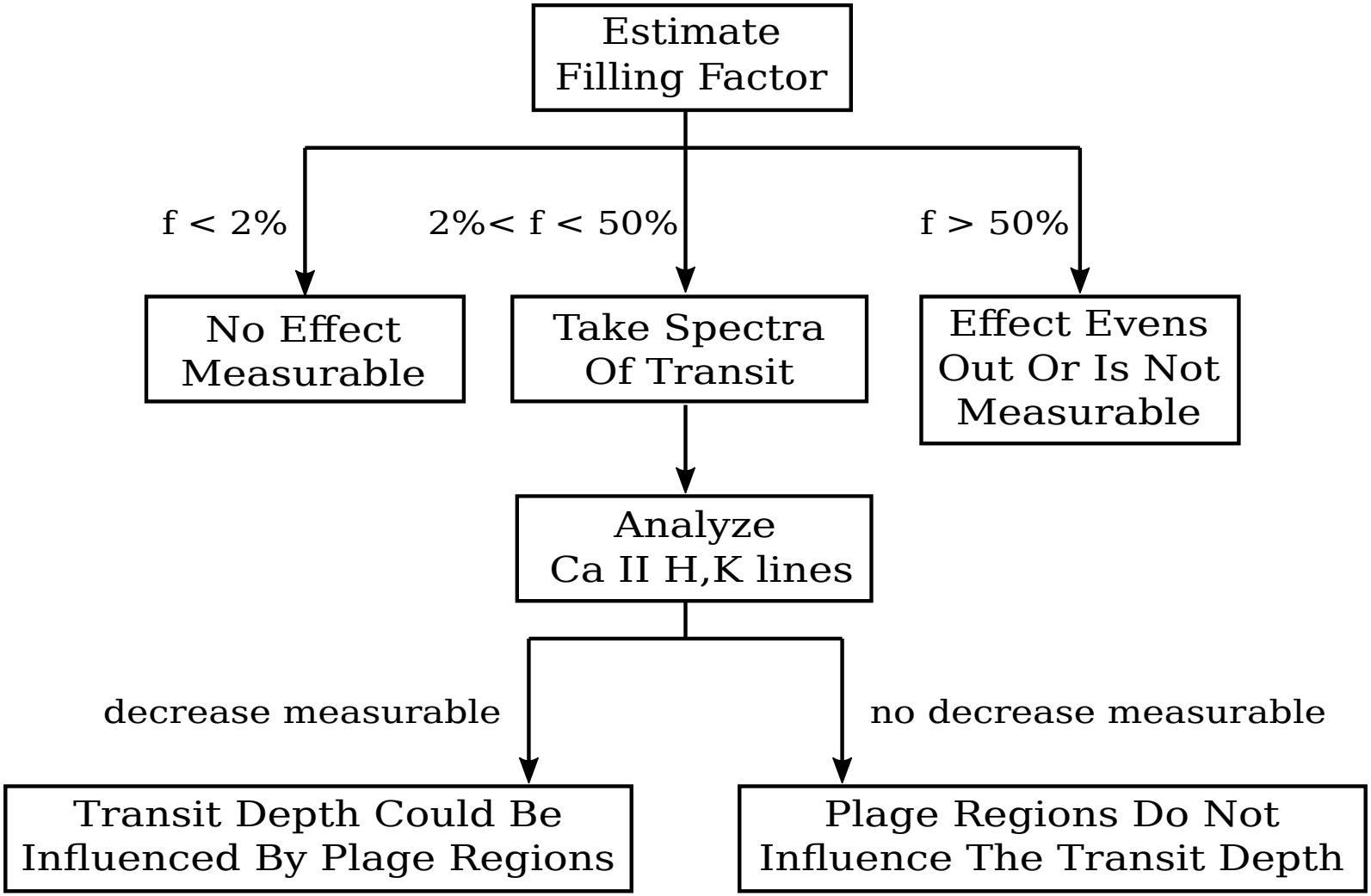
Plage Regions are Hardly Visible in the Continuum...



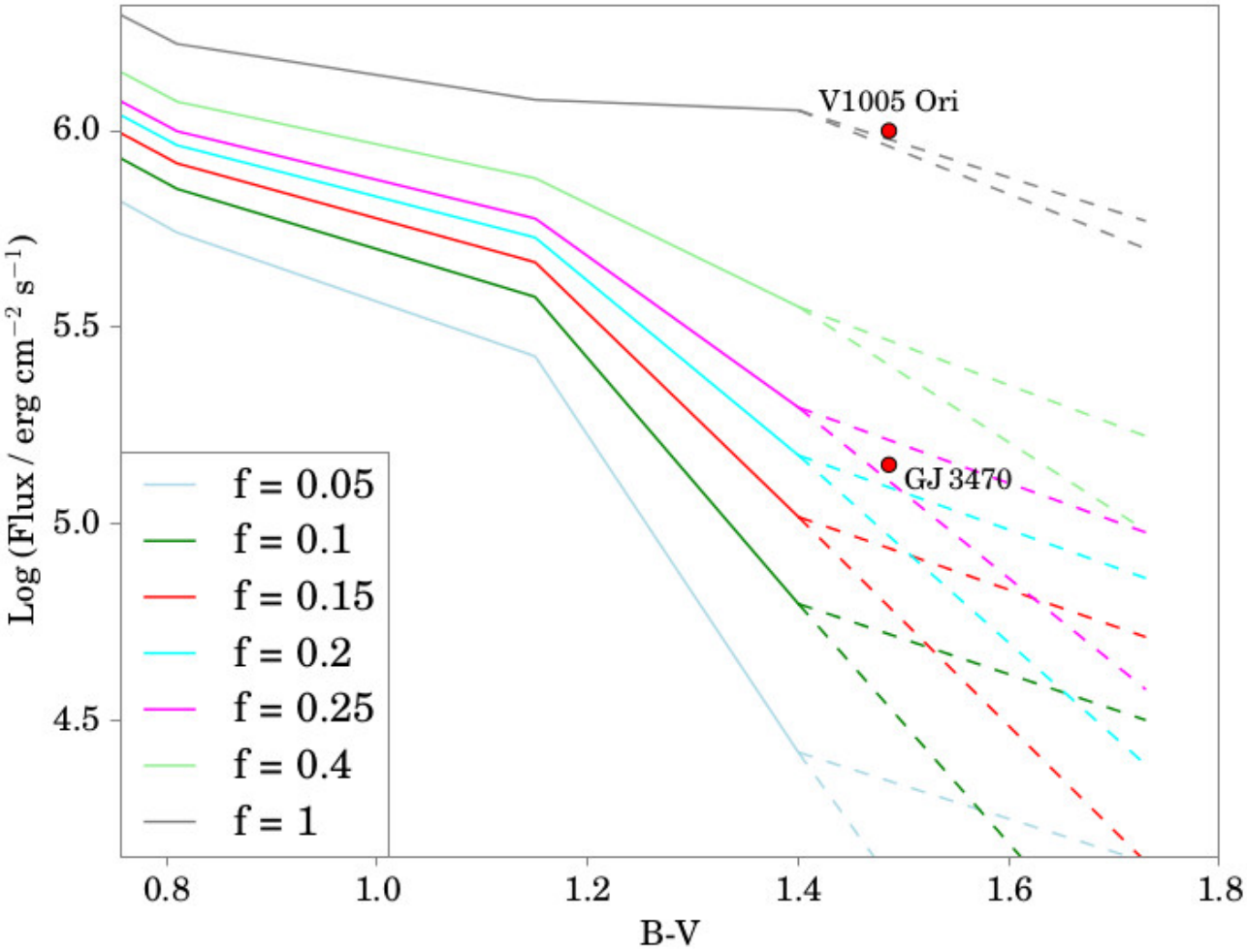
.. but Plage Regions are Visible in a Ca II K Filter



Method


Estimate
Filling Factor
f < 2%
2%< f < 50%
f > 50%
No Effect
Measurable
Take Spectra
Of Transit
Effect Evens
Out Or Is Not
Measurable
Analyze
Ca II H,K lines
decrease measurable
no decrease measurable
Transit Depth Could Be
Influenced By Plage Regions
Plage Regions Do Not
Influence The Transit Depth

Filling Factor of GJ 3470 as in Fawzy et al. (2002)



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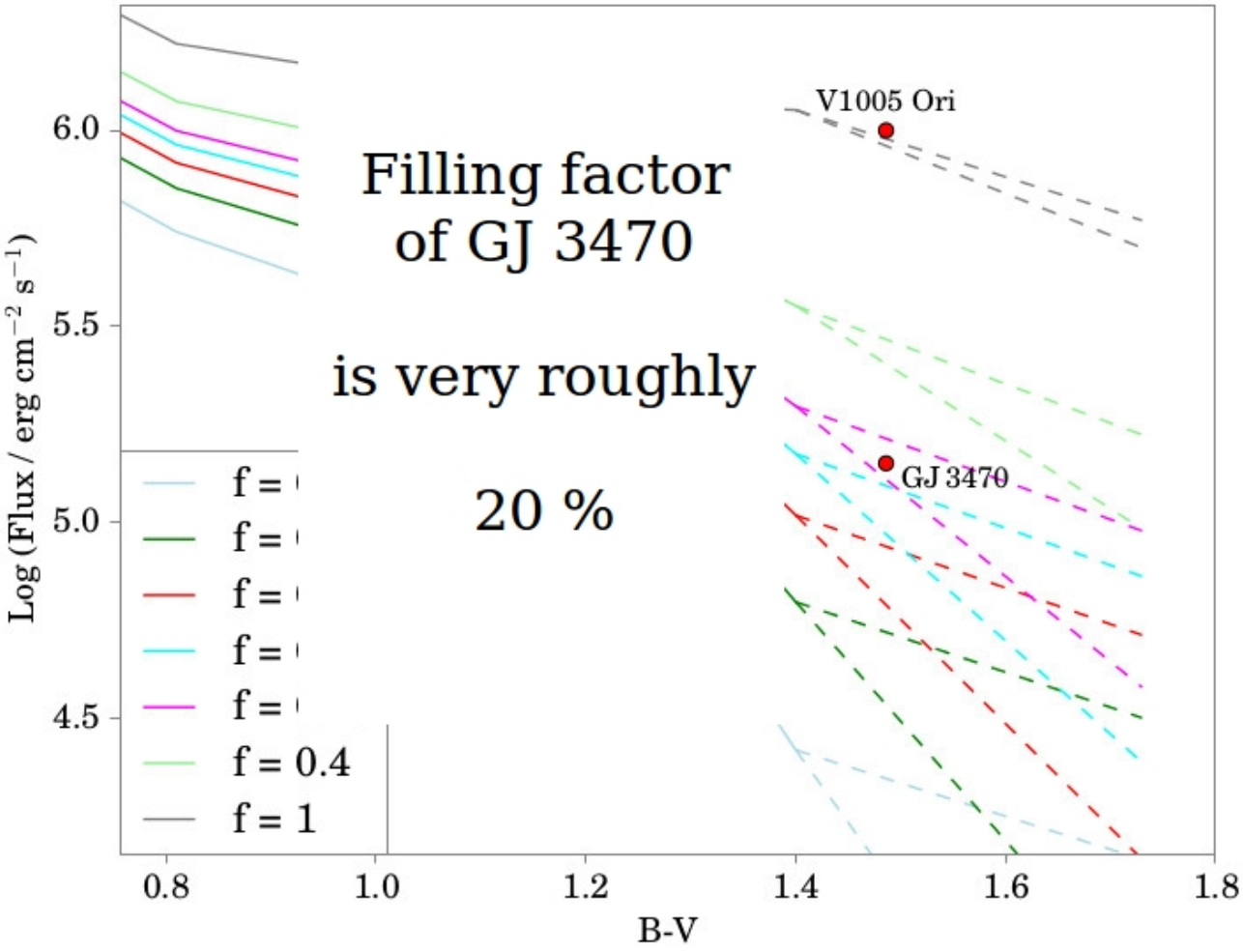

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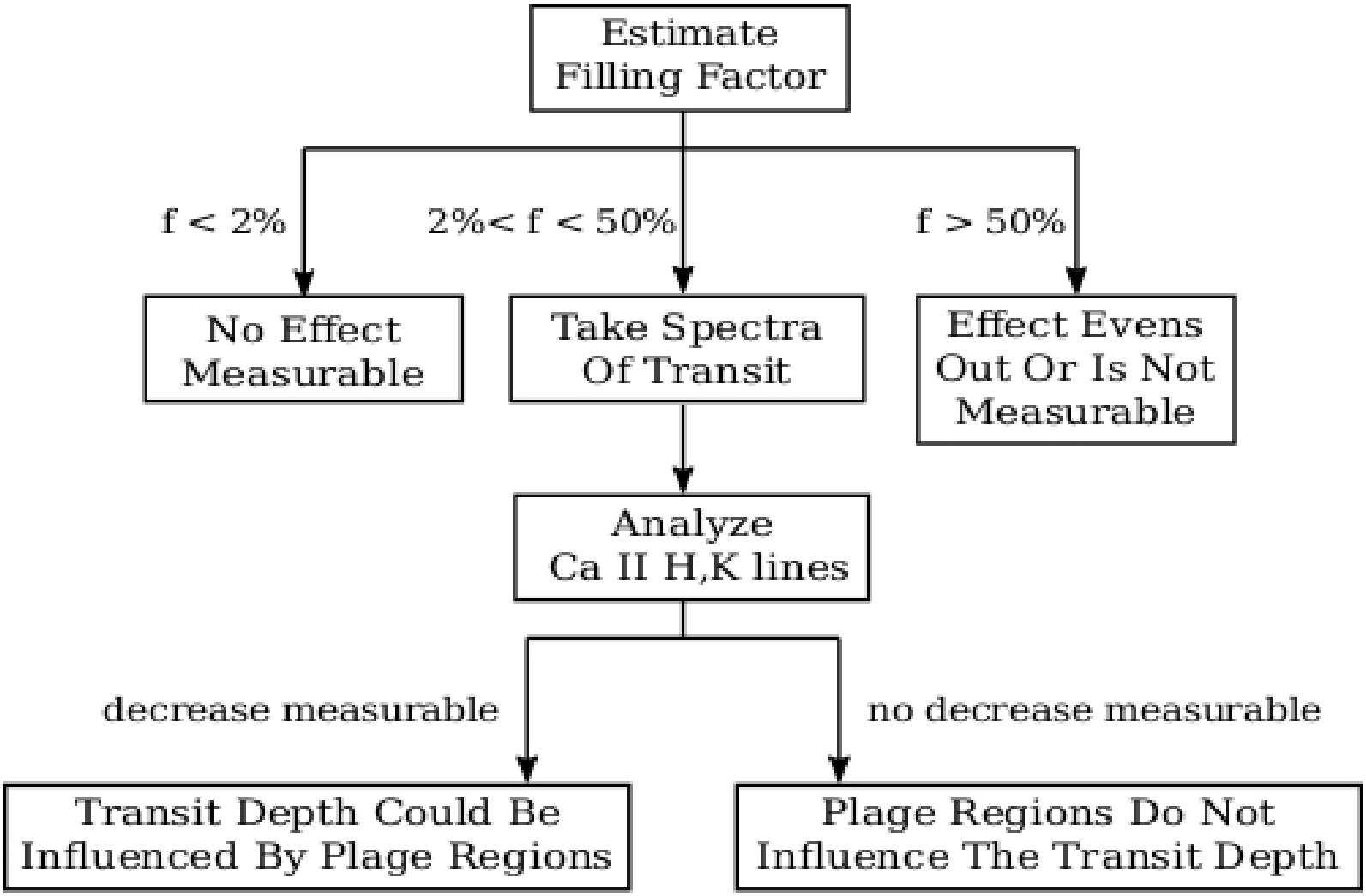
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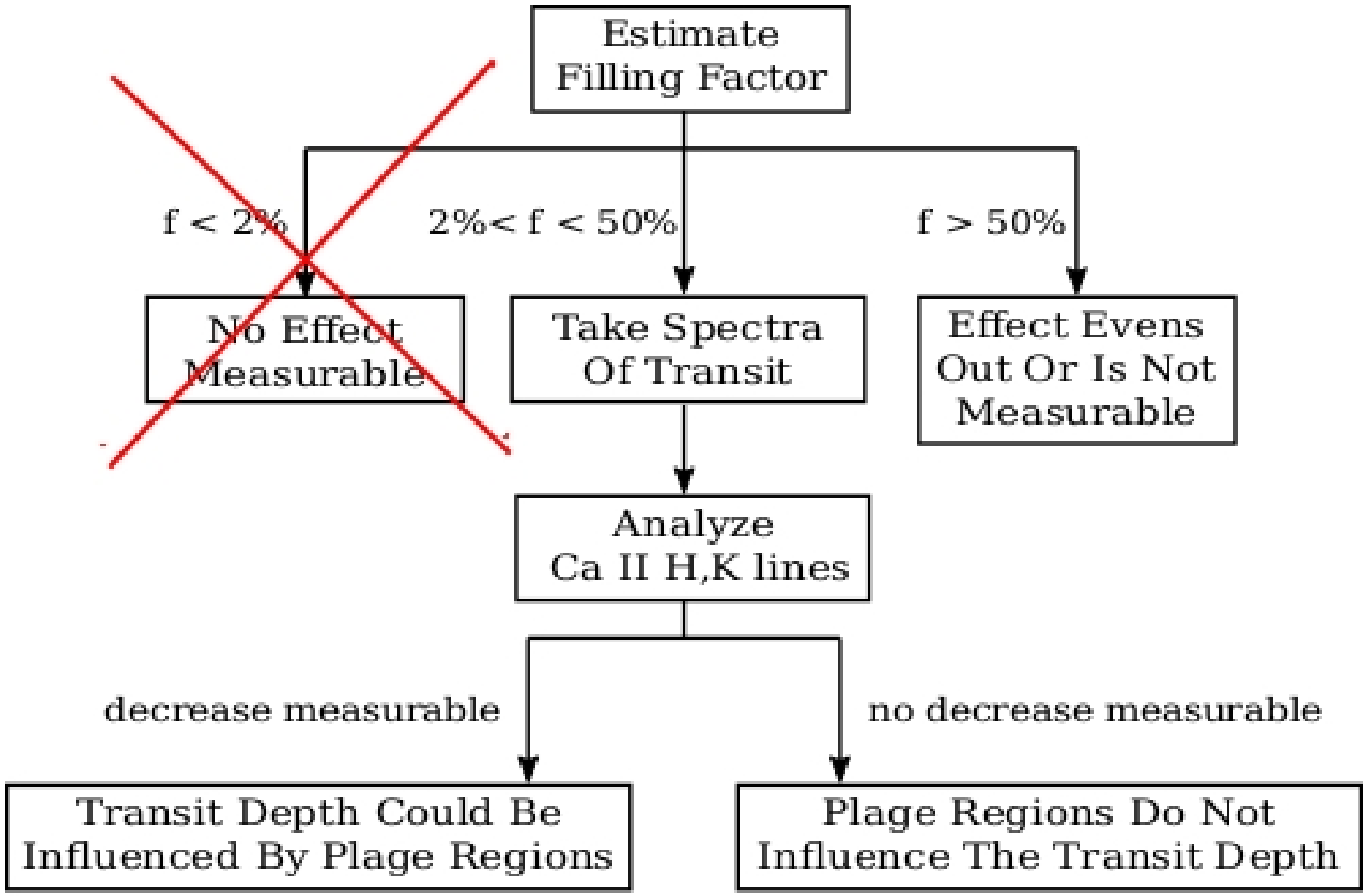
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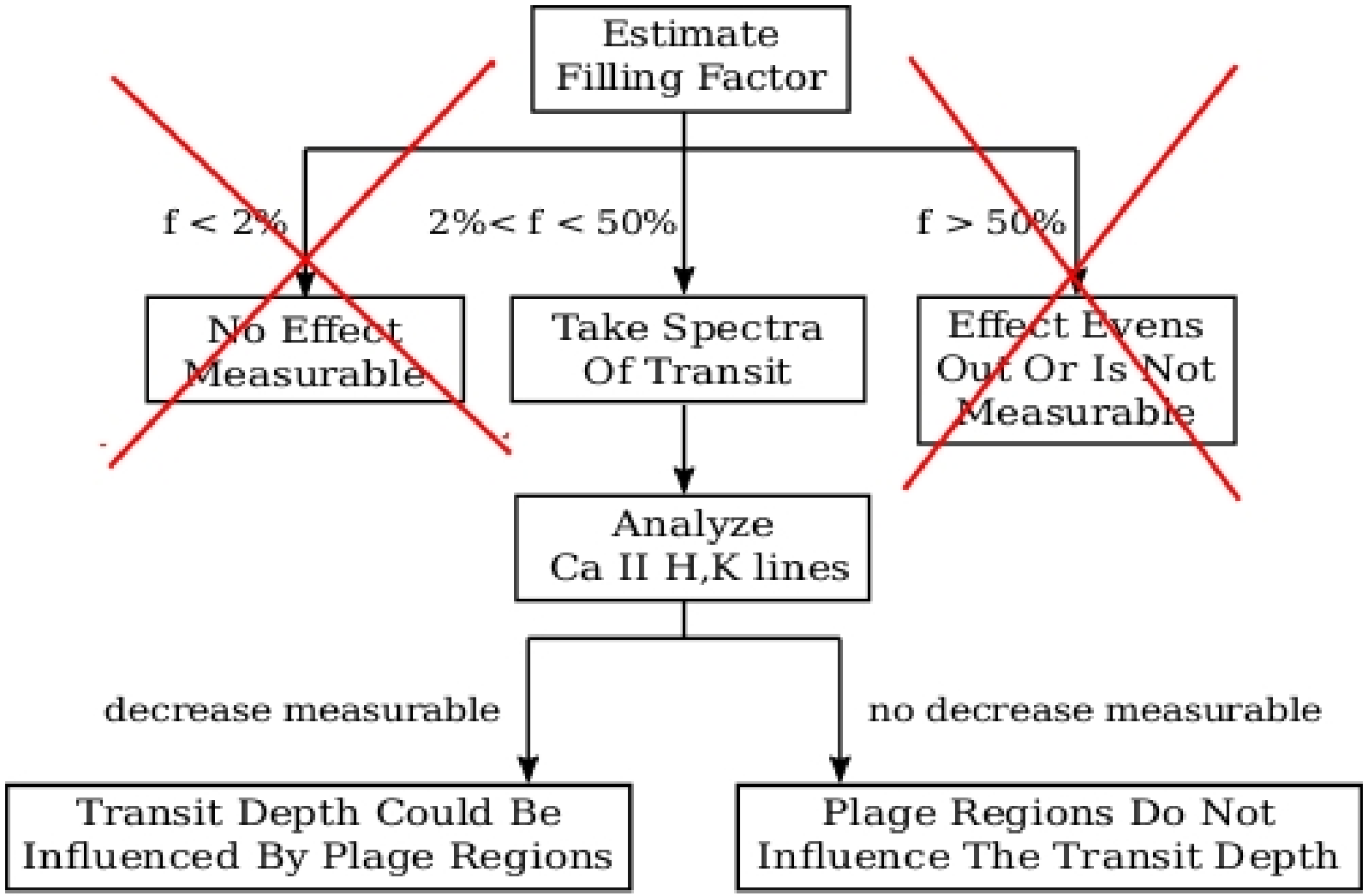
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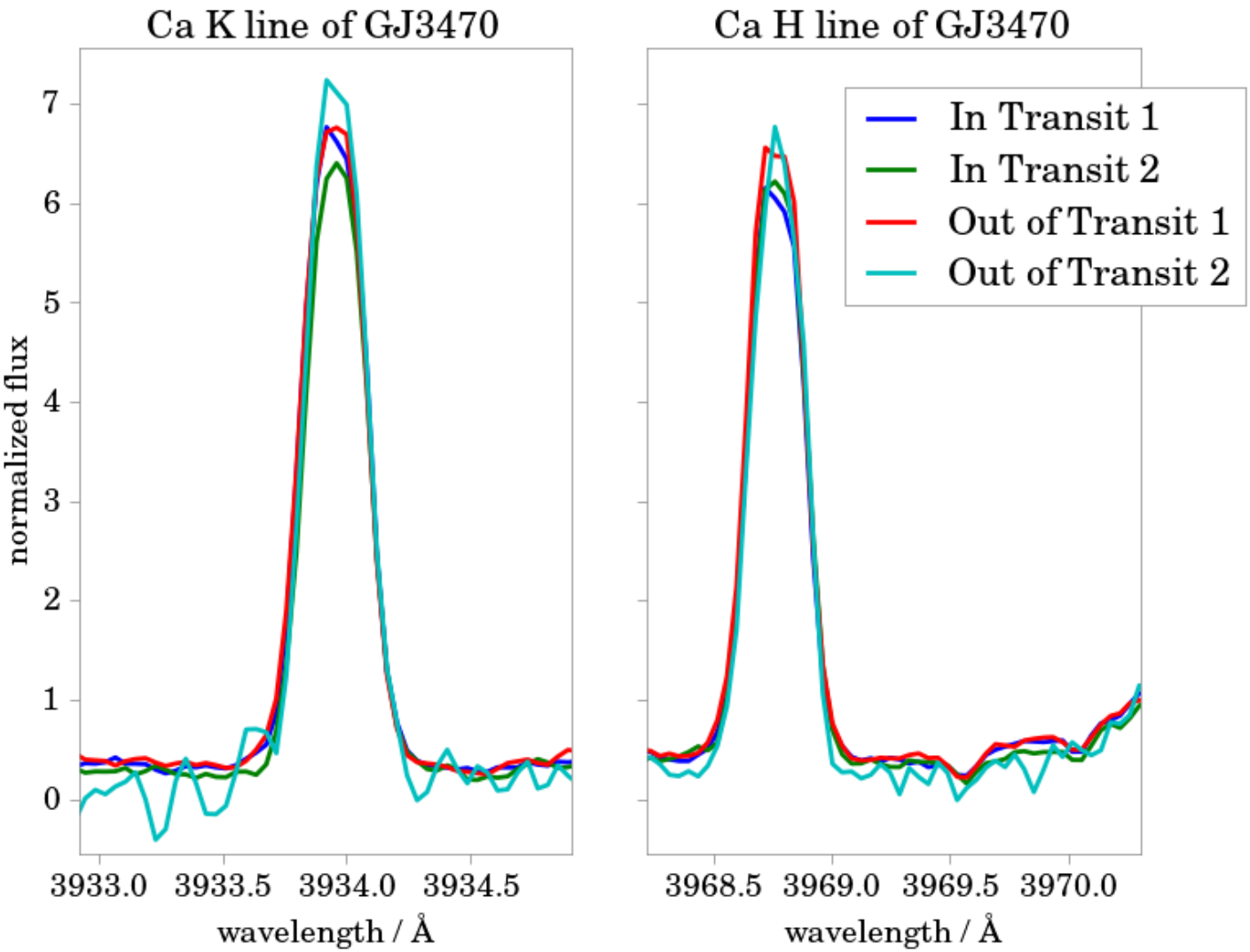
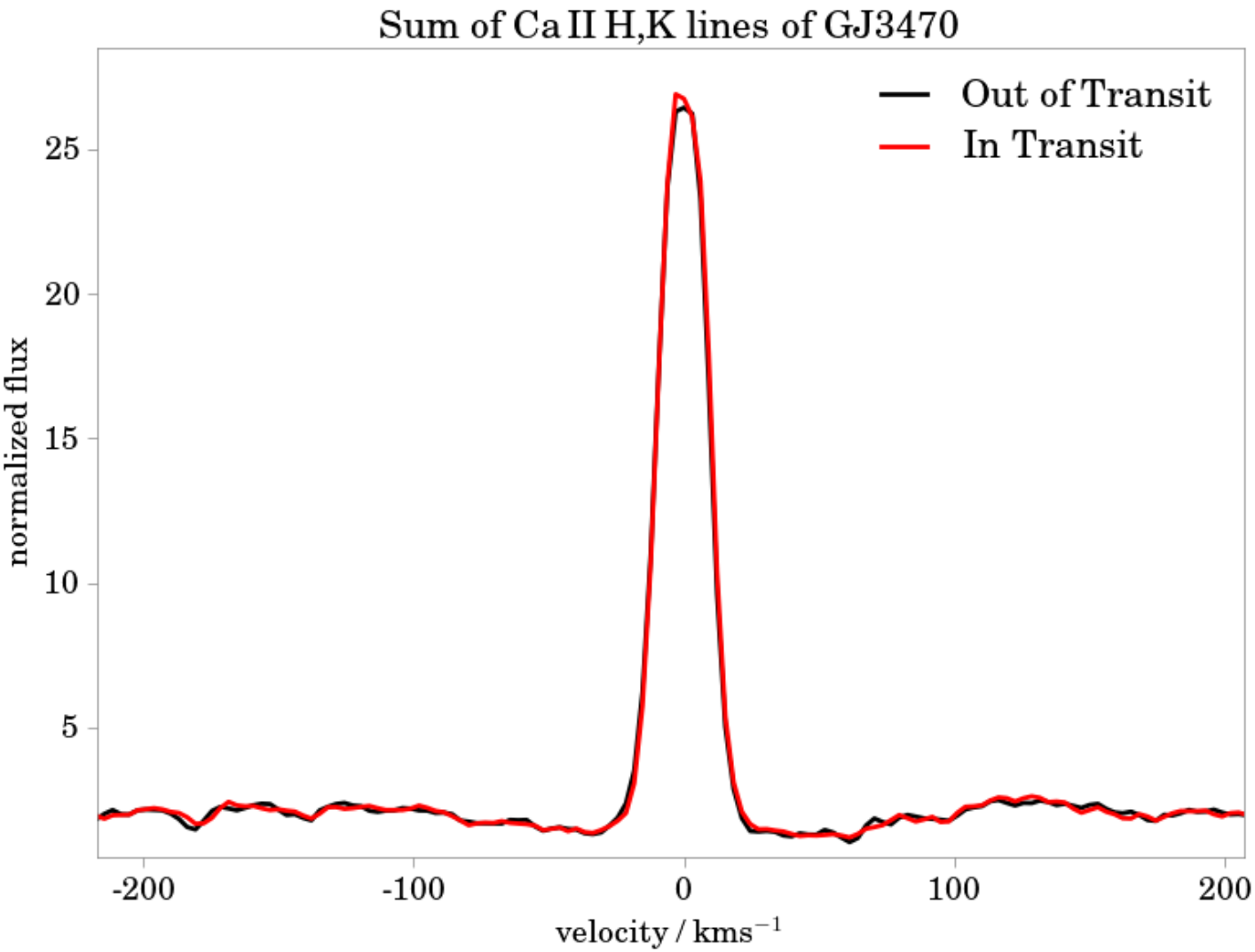
GJ 3470 b – No Difference in Ca II H,K lines



Still No Difference in Sum of Ca II H,K lines

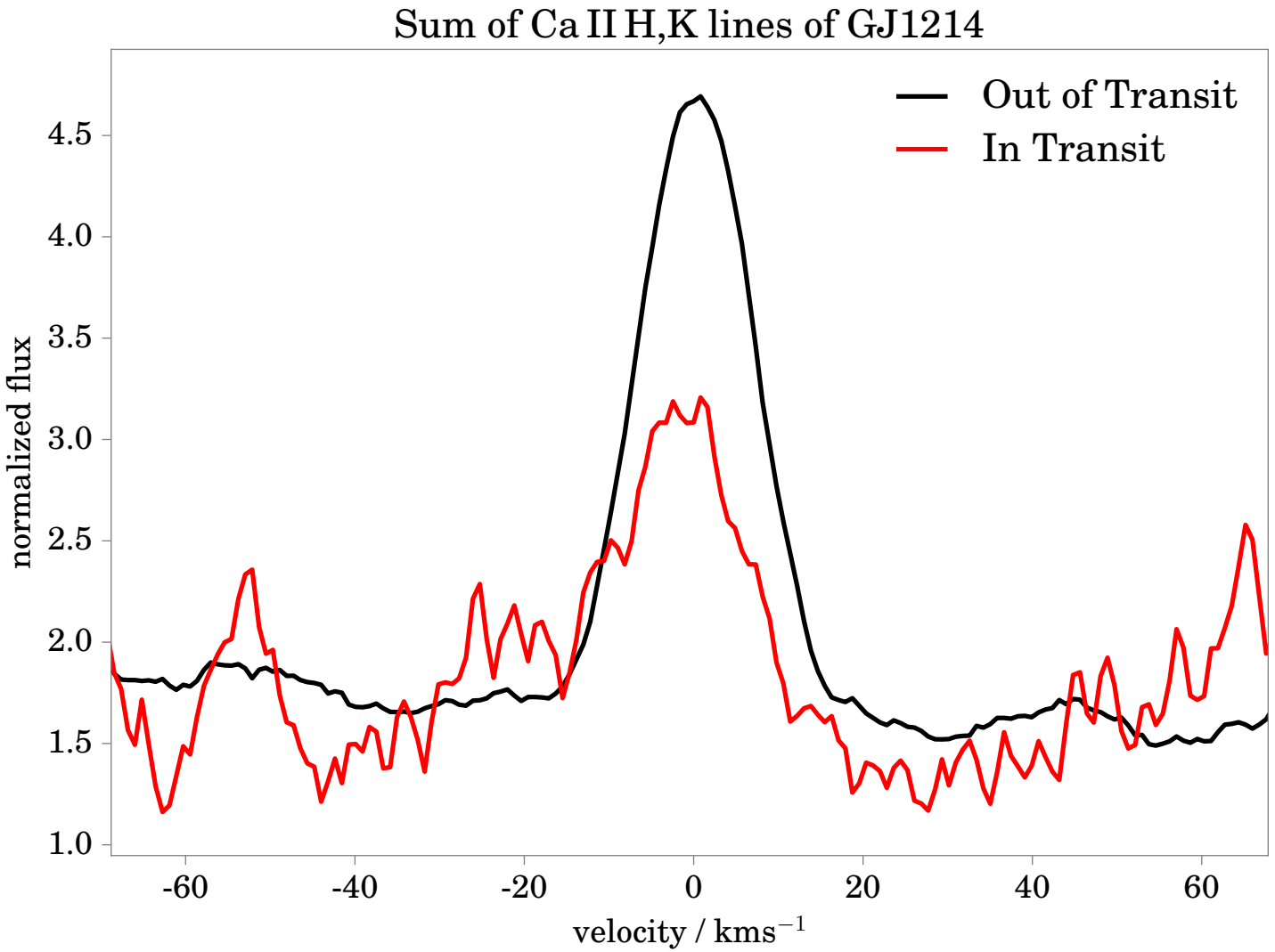


Maybe we do not have to care about plage regions at all?

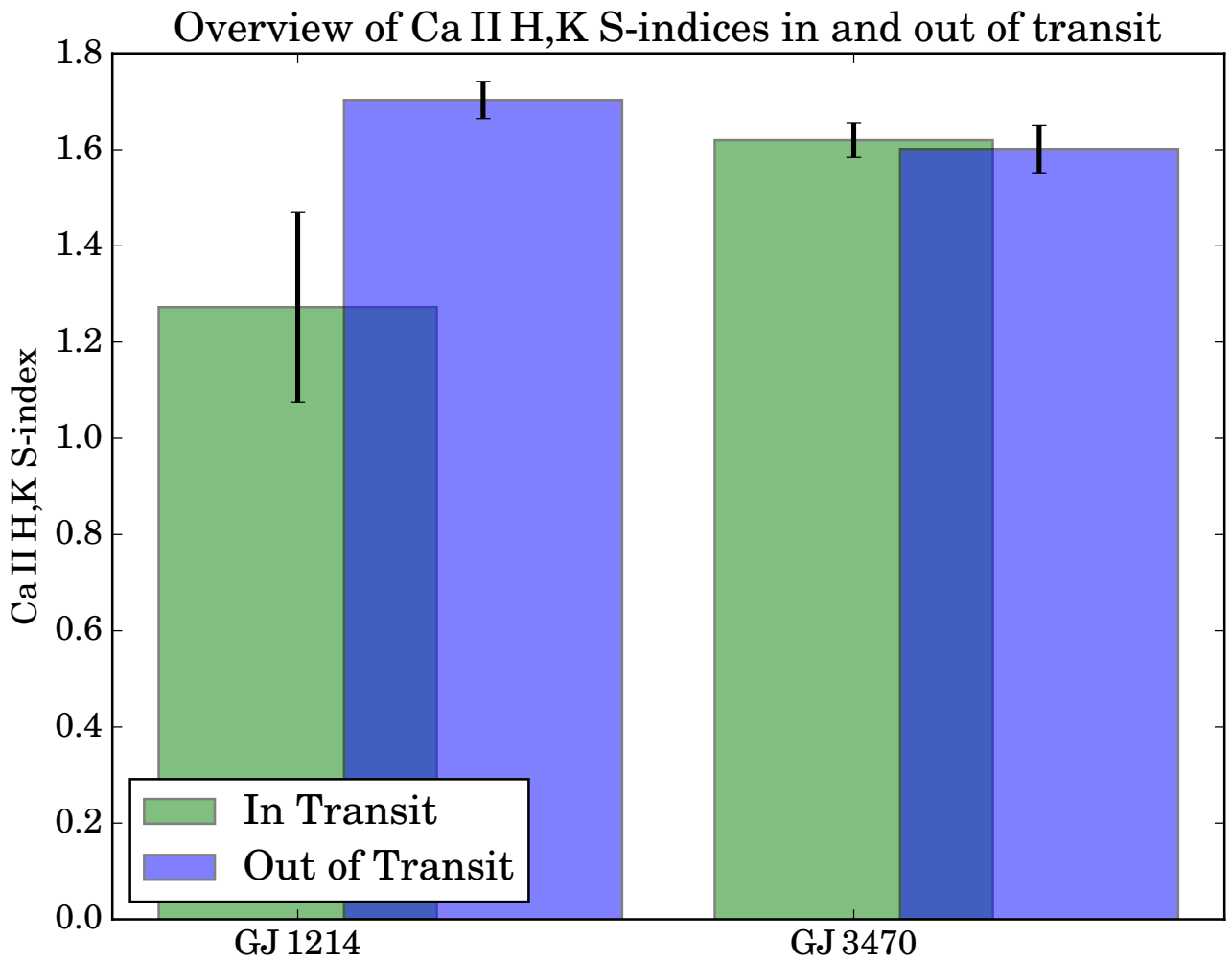
GJ 1214 - Properties of the System

planet mass	$6.26\,M_\oplus$	$\pm$	$0.91\,M_\oplus$
planet radius	$2.80\,R_\oplus$	$\pm$	$0.24\,R_\oplus$
planet mean density	$1.56\,g\,cm^{-3}$	$\pm$	$0.40\,g\,cm^{-3}$
semimajor axis	0.0141 AU	$\pm$	0.0003 AU
orbital period	1.5804 days		
spectral type	M 4.5		
distance	14.55 pc	$\pm$	0.3 pc
stellar radius	$0.213\,R_\odot$	$\pm$	$0.011\,R_\odot$
stellar mass	$0.176\,M_\odot$	$\pm$	$0.009\,M_\odot$

Sum of the Lines is Smaller During Transit



Final Result



This Work was Published this Year

- Authors:
  G. Chen, E.W. Guenther, E. Pallé, L. Nortmann, G. Nowak, S. Kunz, H. Parviainen and F. Murgas
- The GTC exoplanet transit spectroscopy survey
  V. A spectrally-resolved Rayleigh scattering slope in GJ 3470 b
- Astronomy & Astrophysics, 600:A138, 2017.

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- GJ 1214 b: significant decrease during transit
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- if Rayleigh scattering is observed follow up measurements should be made