The Search for Planets at Longer Wavelengths: Prospects, Challenges, and Surprises

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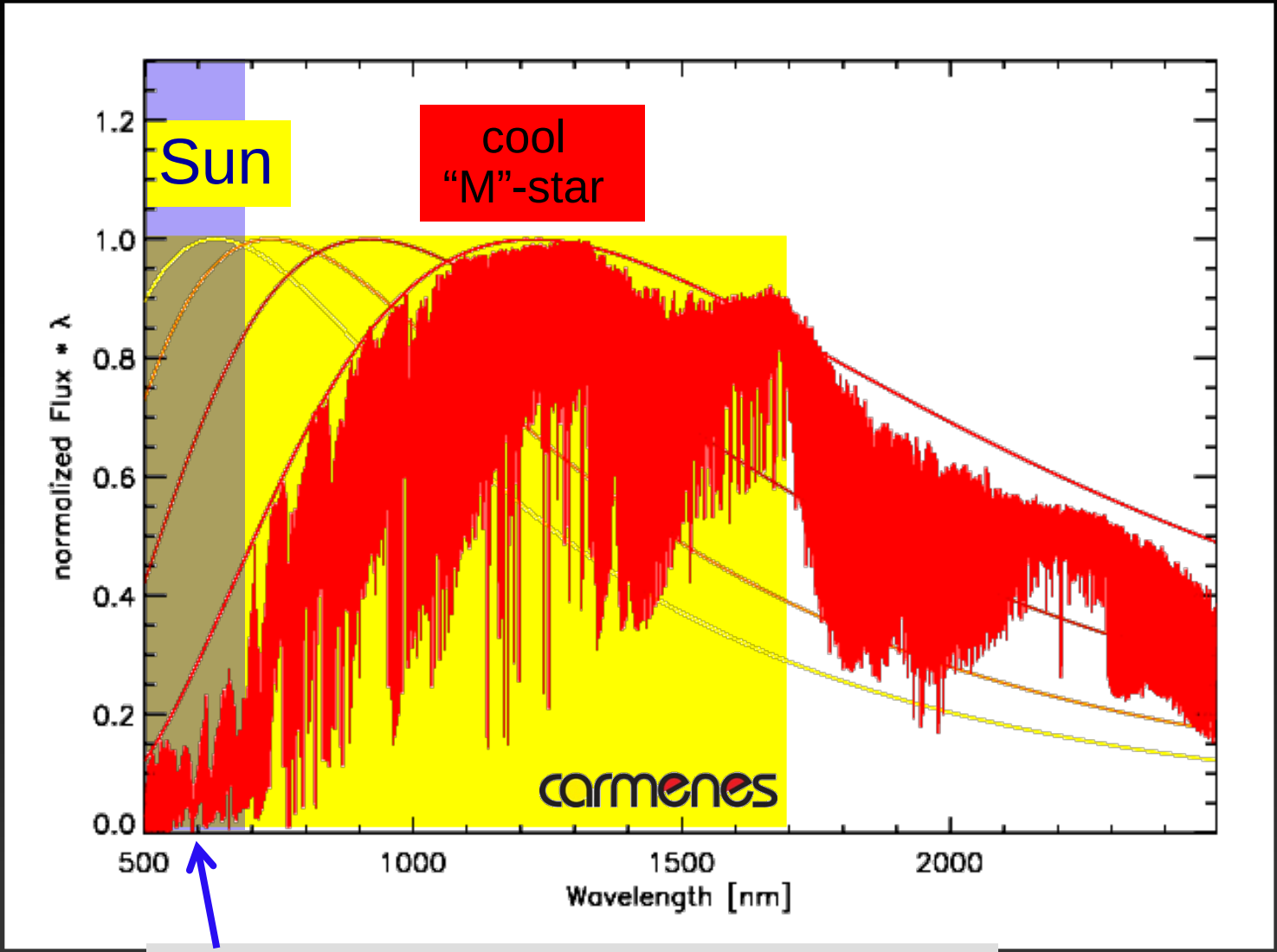
erc

Advantages at NIR

1. For red stars, redder spectra carry more information (Information advantage)
2. At longer wavelength, activity impacts less (Jitter advantage)

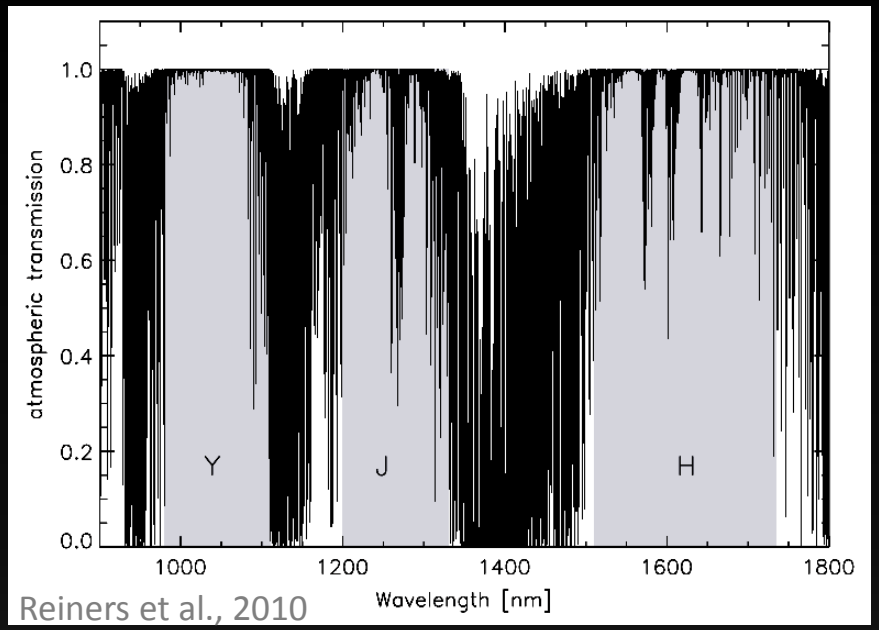
Information advantage:

M-stars emit mostly at near-infrared wavelengths

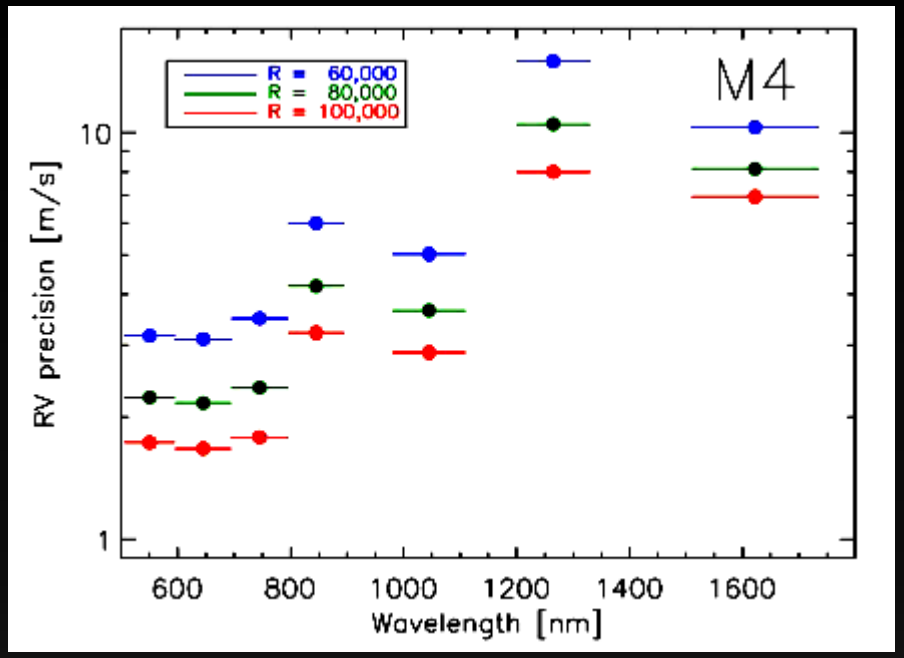


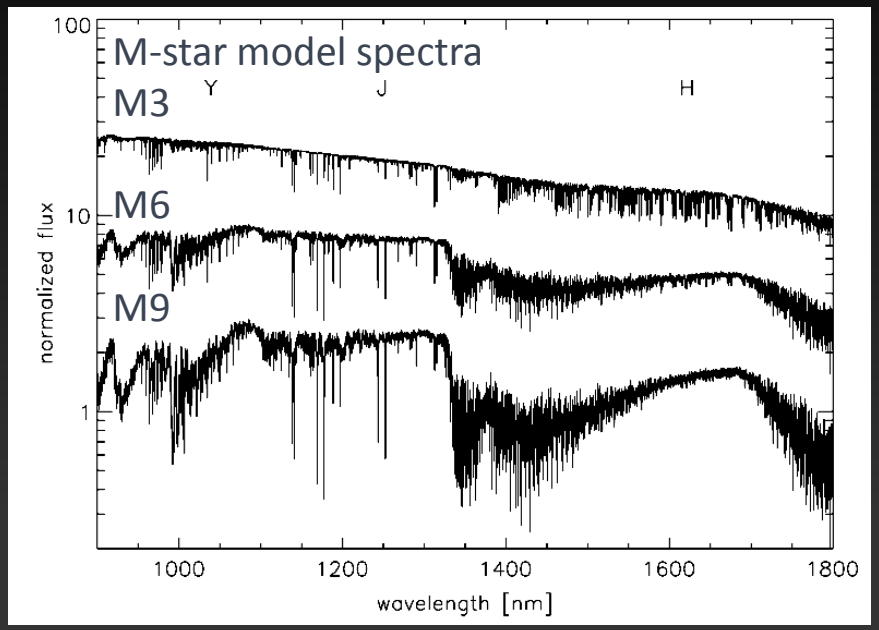
visual-range Radial-Velocity instruments

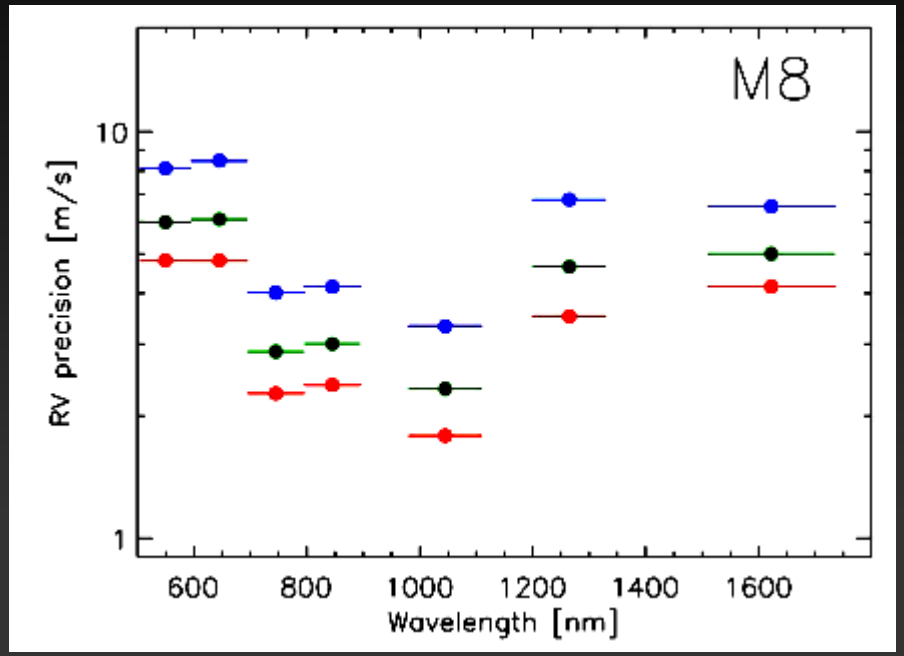
Information advantage



Reiners et al., 2010







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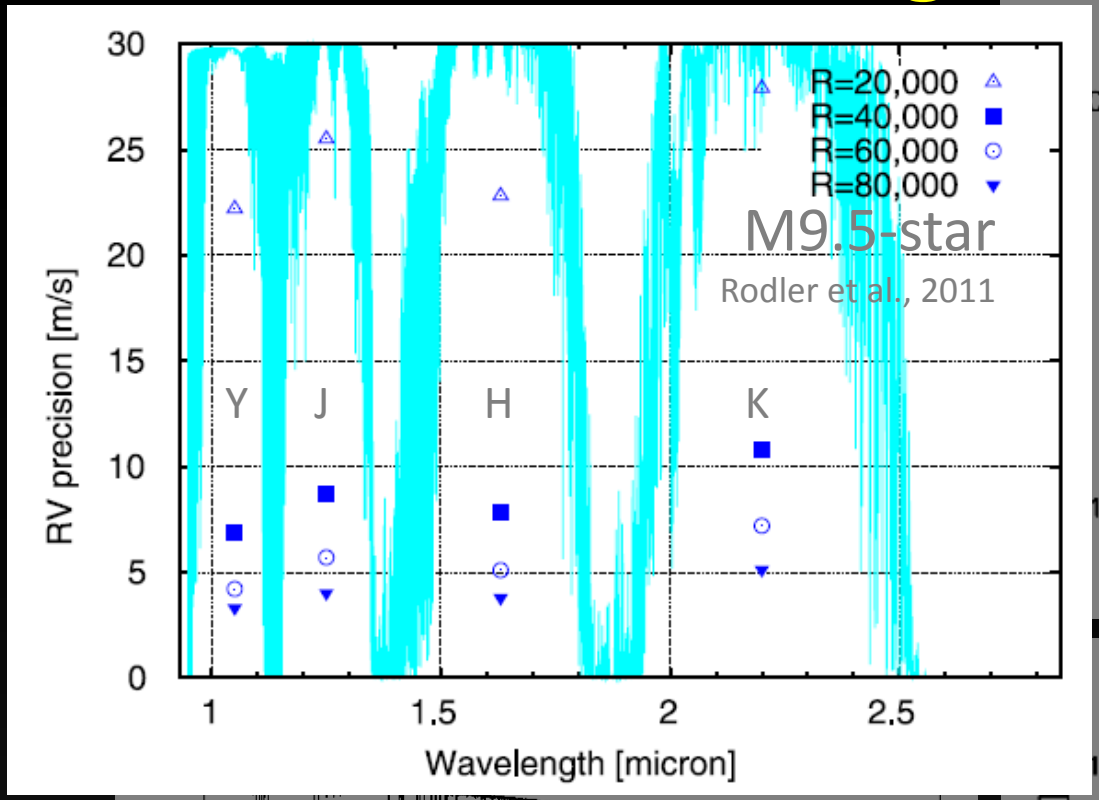
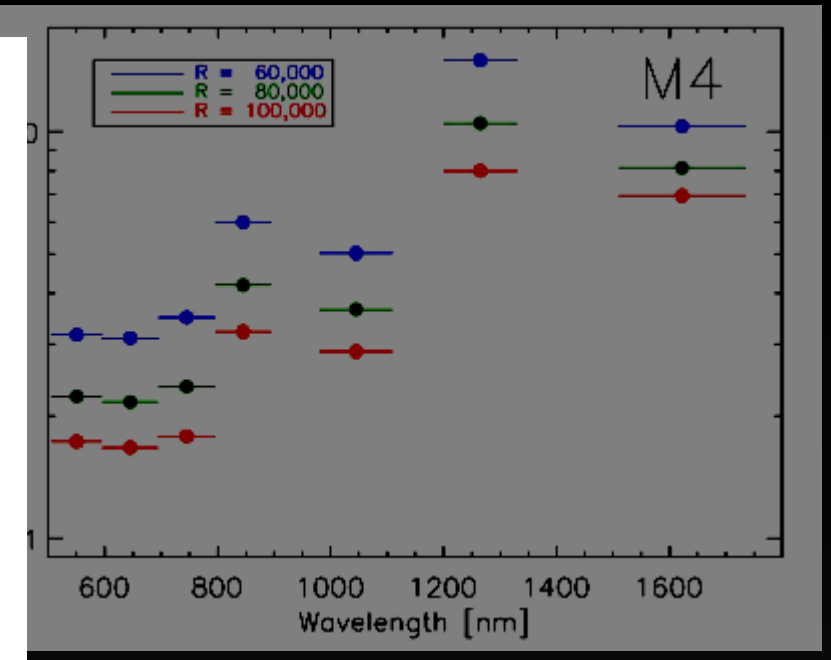
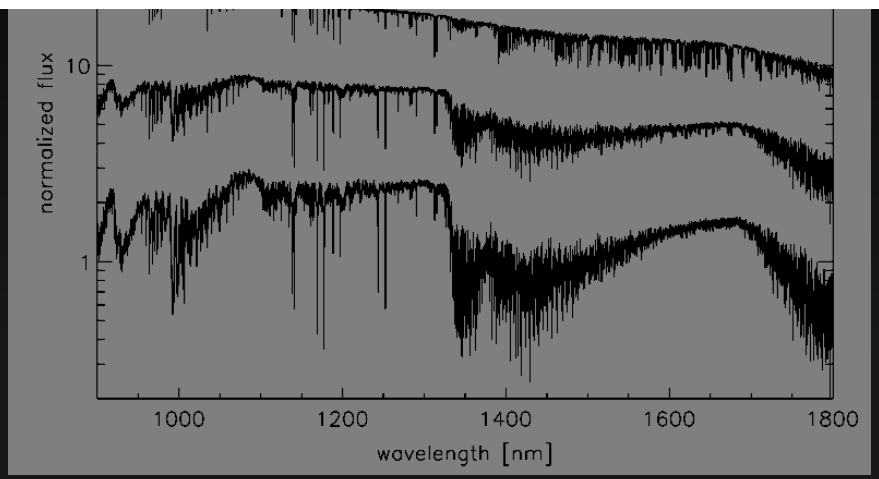
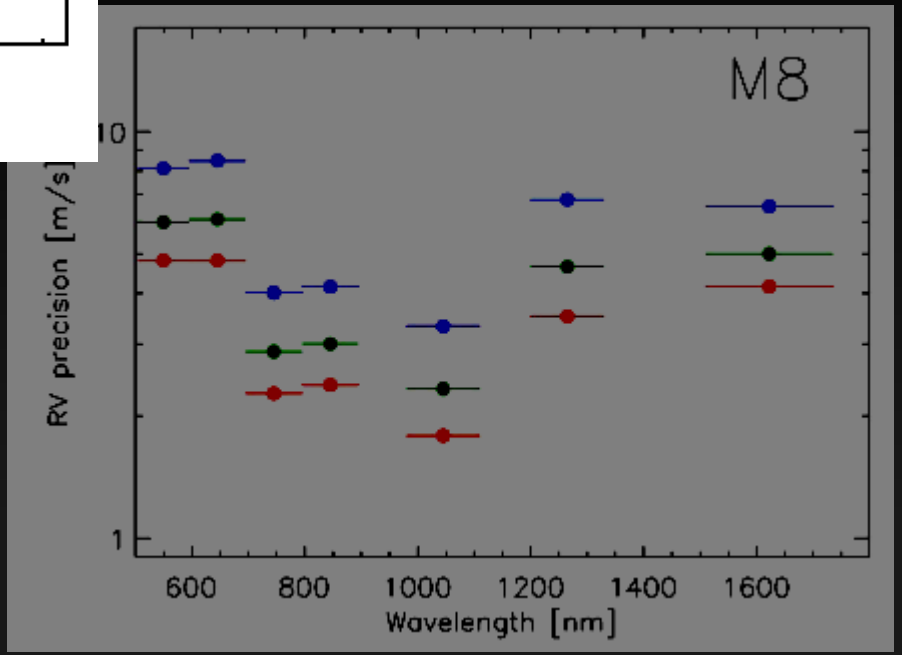
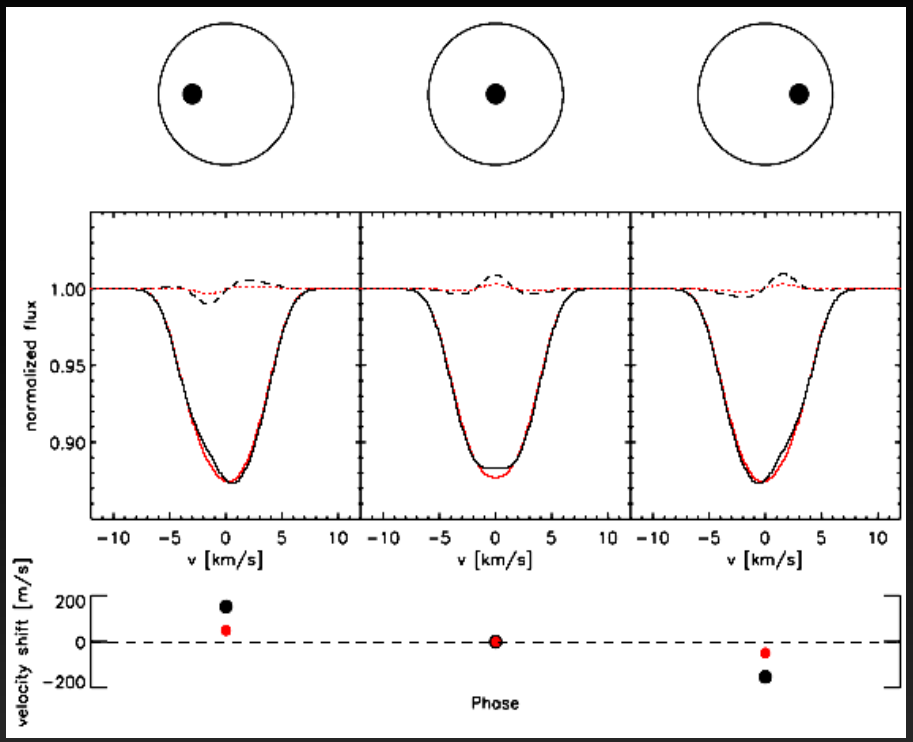




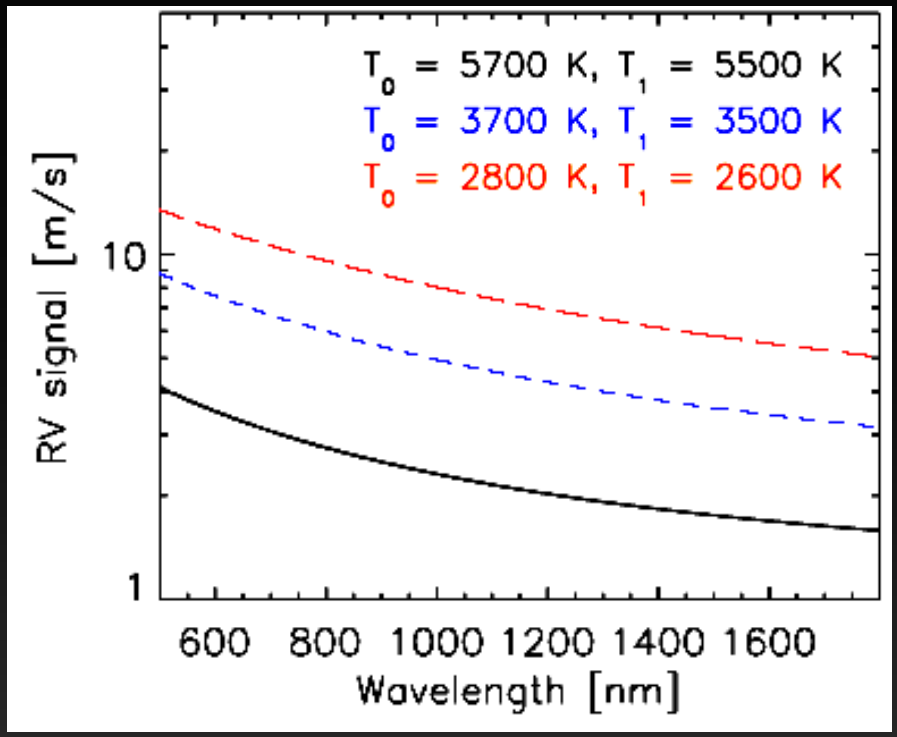




2. Jitter advantage



Reiners et al., 2010



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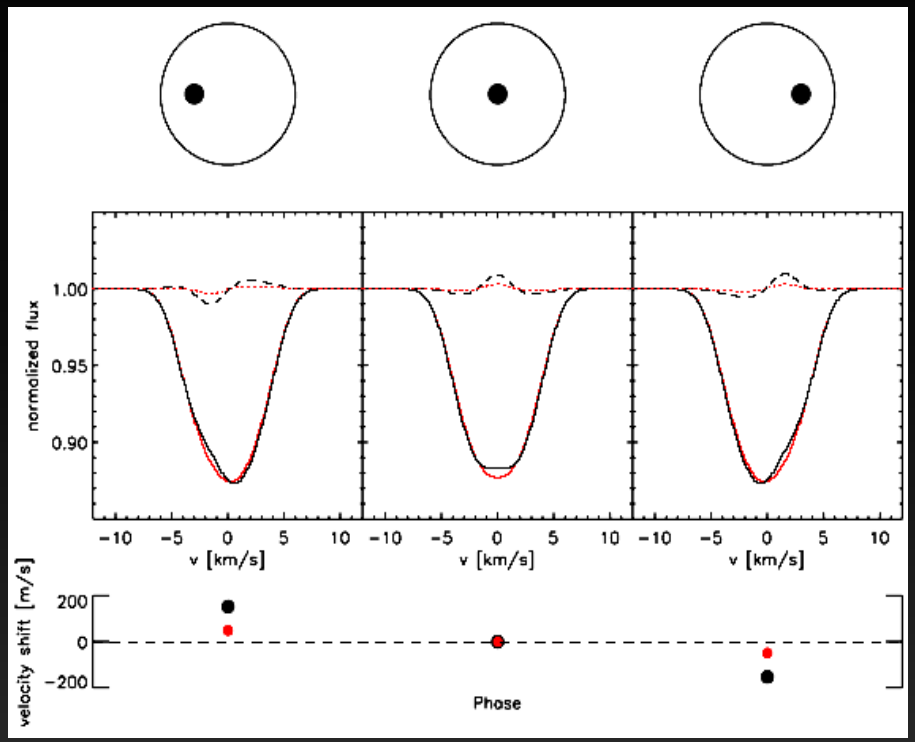
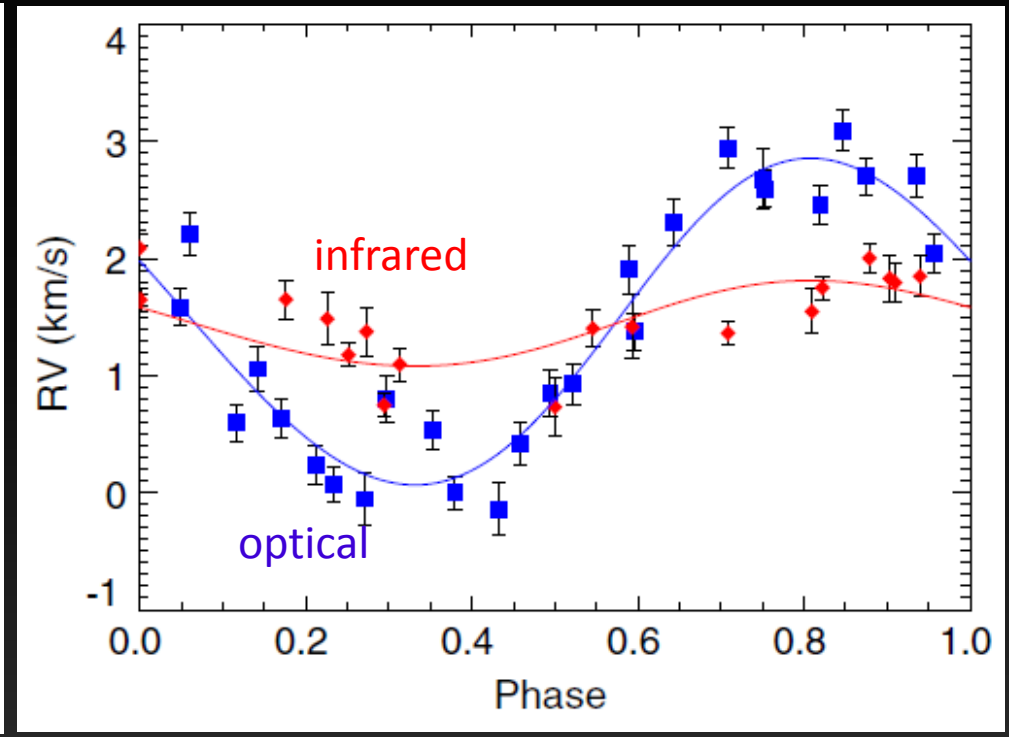
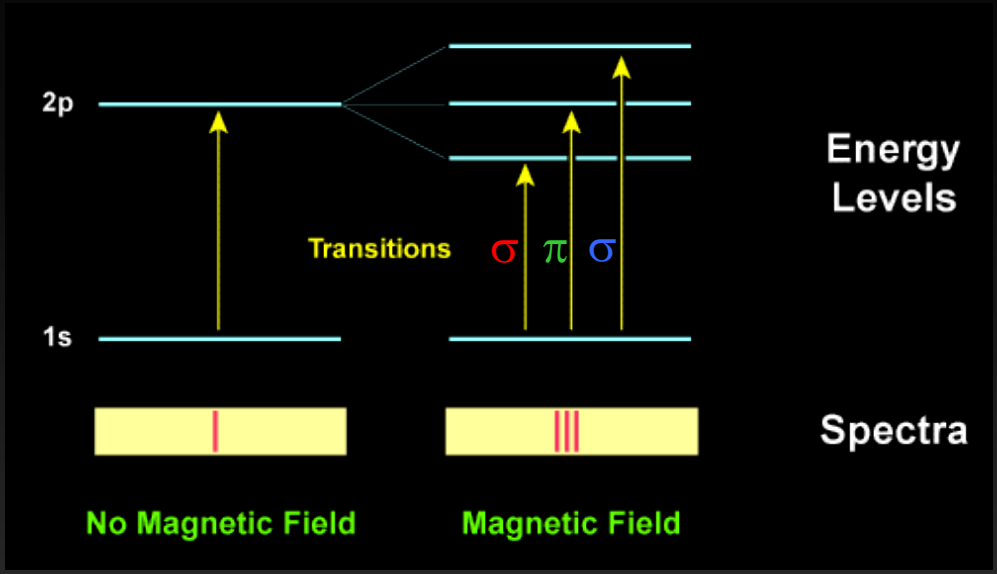


Reiners et al., 2010



Mahmud et al., 2011
Target: Hubble I 4

…but: the Zeeman effect

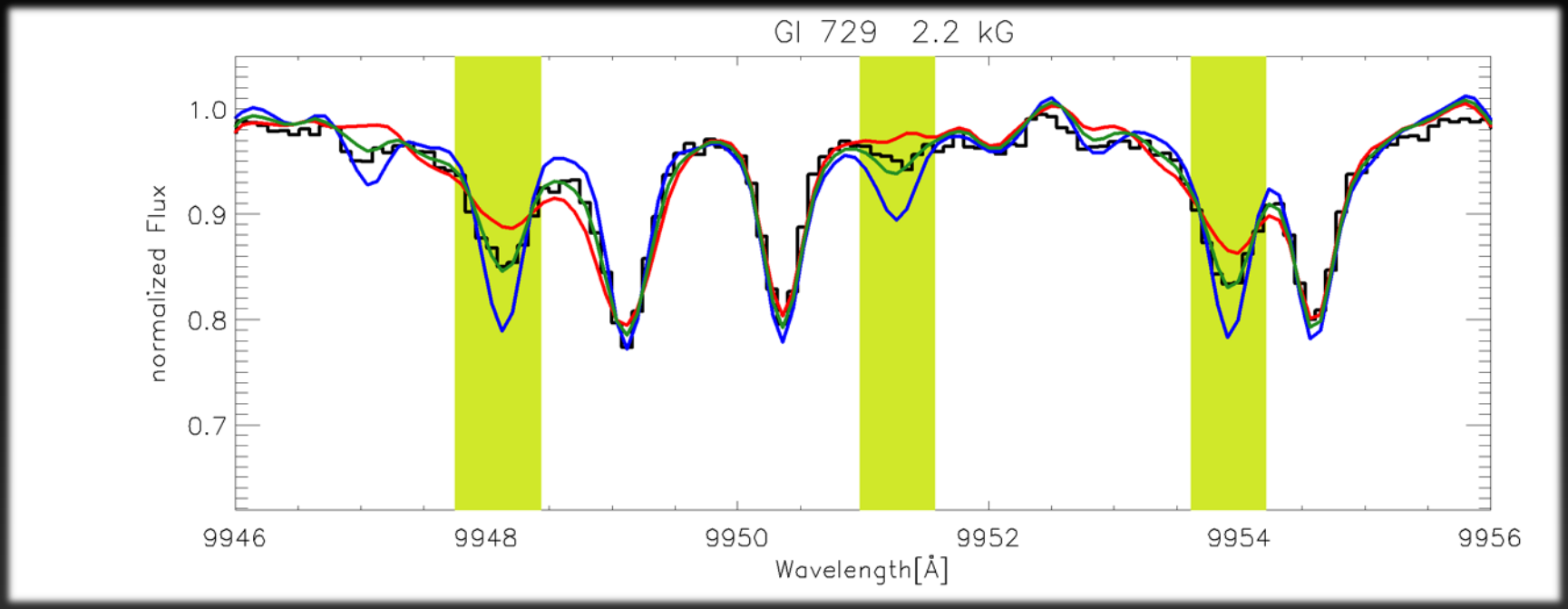


rule of thumb: $1 \frac{\mathrm{m}}{\mathrm{s}} * B/\mathrm{G} * \lambda/\mu\mathrm{m}$

Example of magnetic field measurement

Quite obvious in M-type stars at infrared wavelengths

Here: R=30,000; SNR=100



Reiners & Basri, 2007

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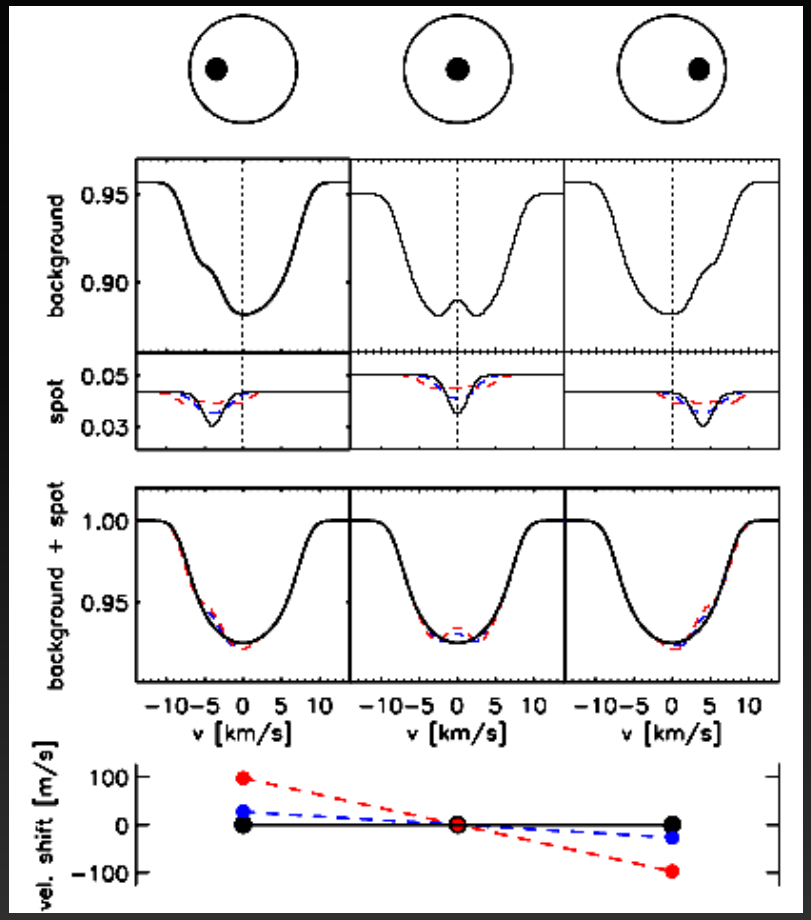
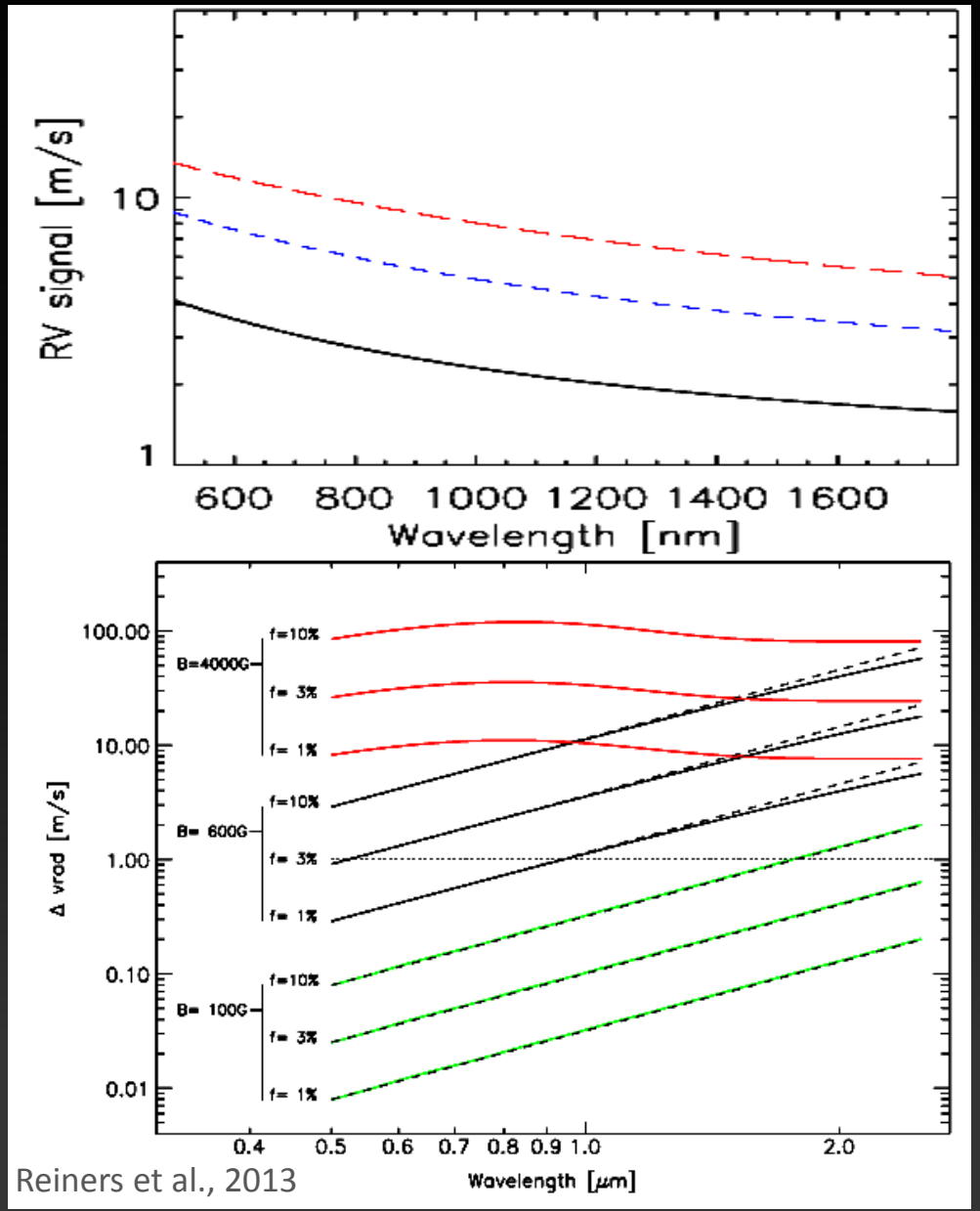
How do contrast and Zeeman compare?





Reiners et al., 2013

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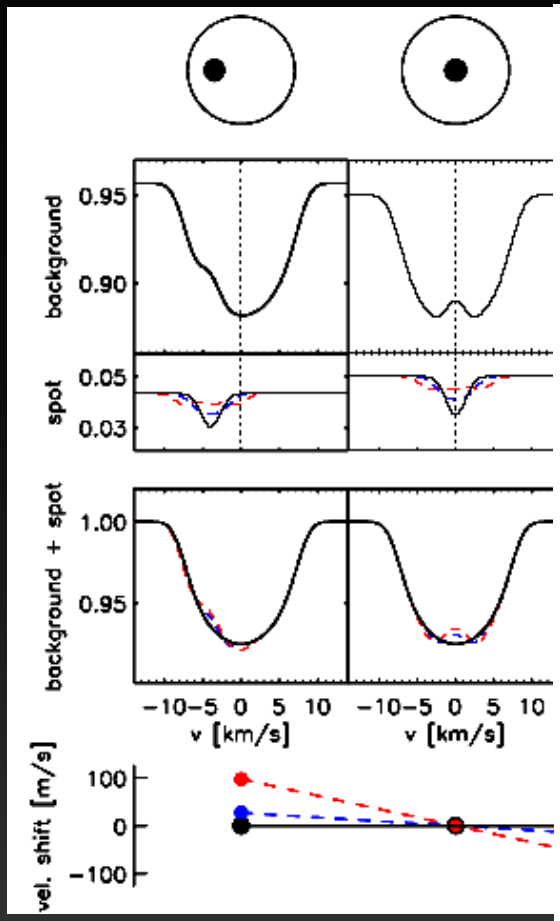

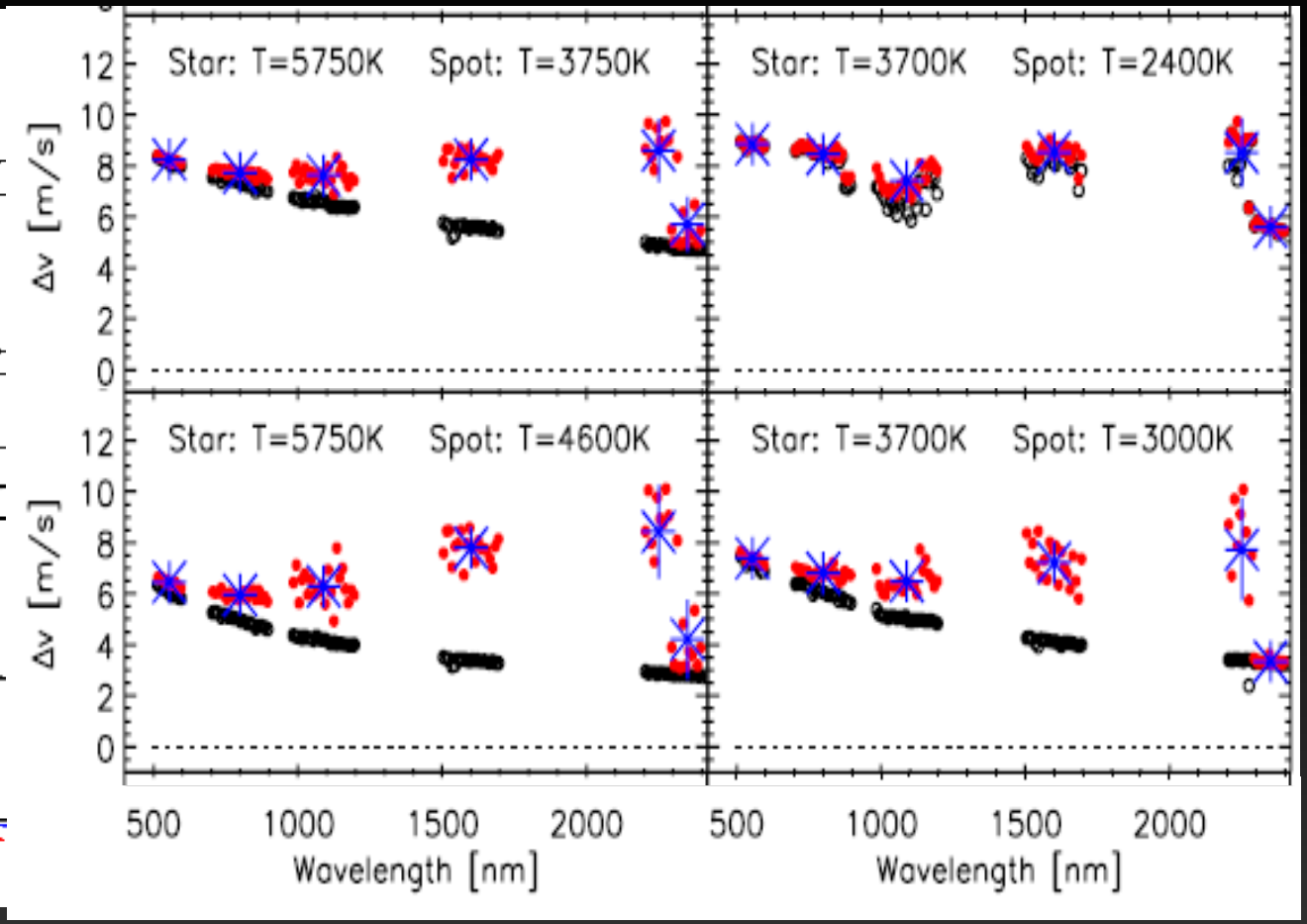

f = 1%, B = 1000G, vsini = 2km/s

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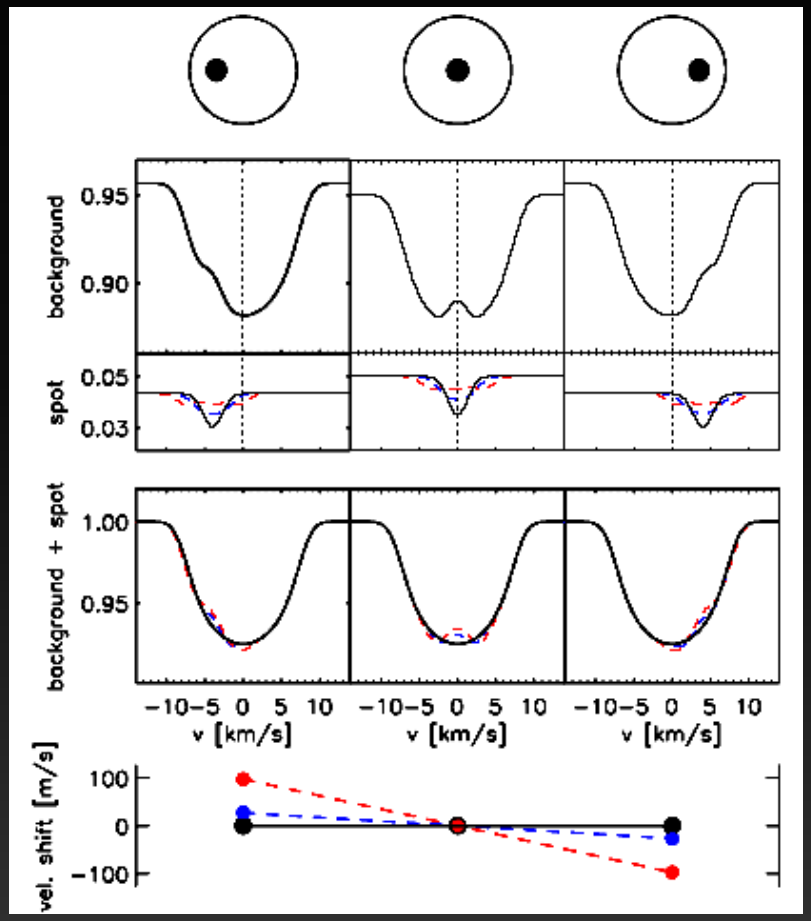

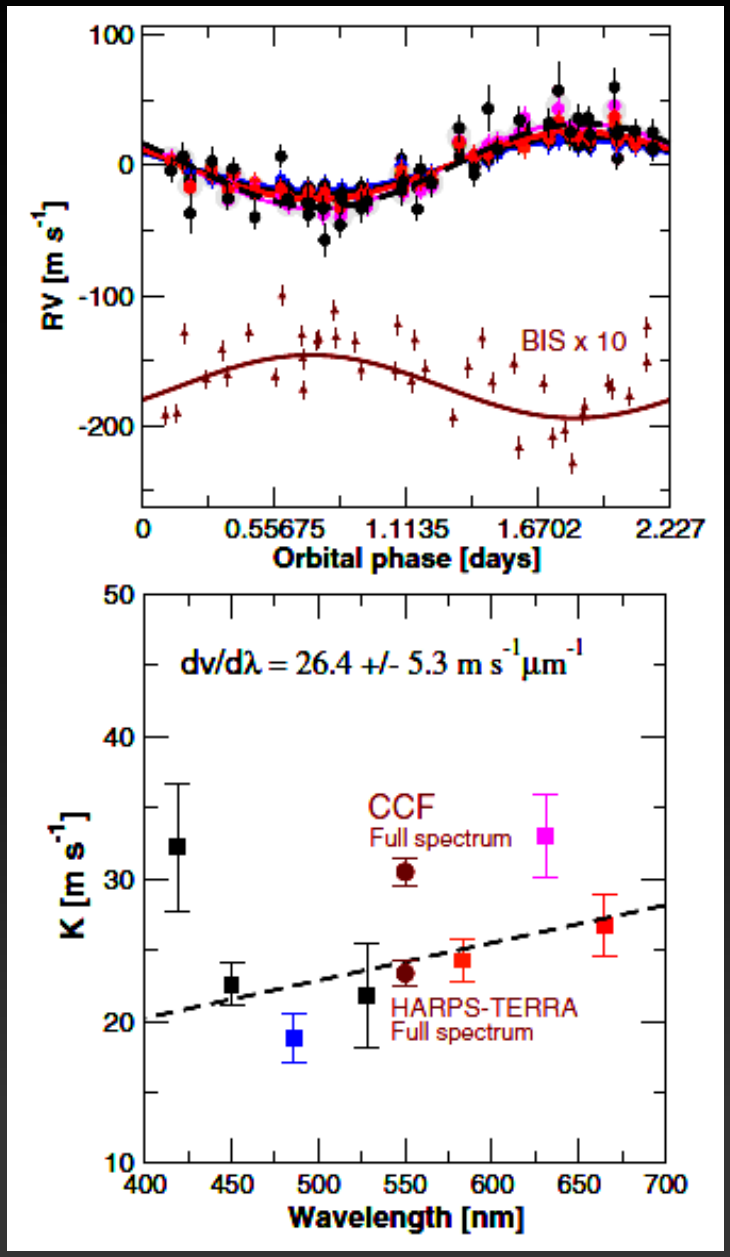

HARPS observations of AD Leo

Further challenges: Size

Further challenges: Size

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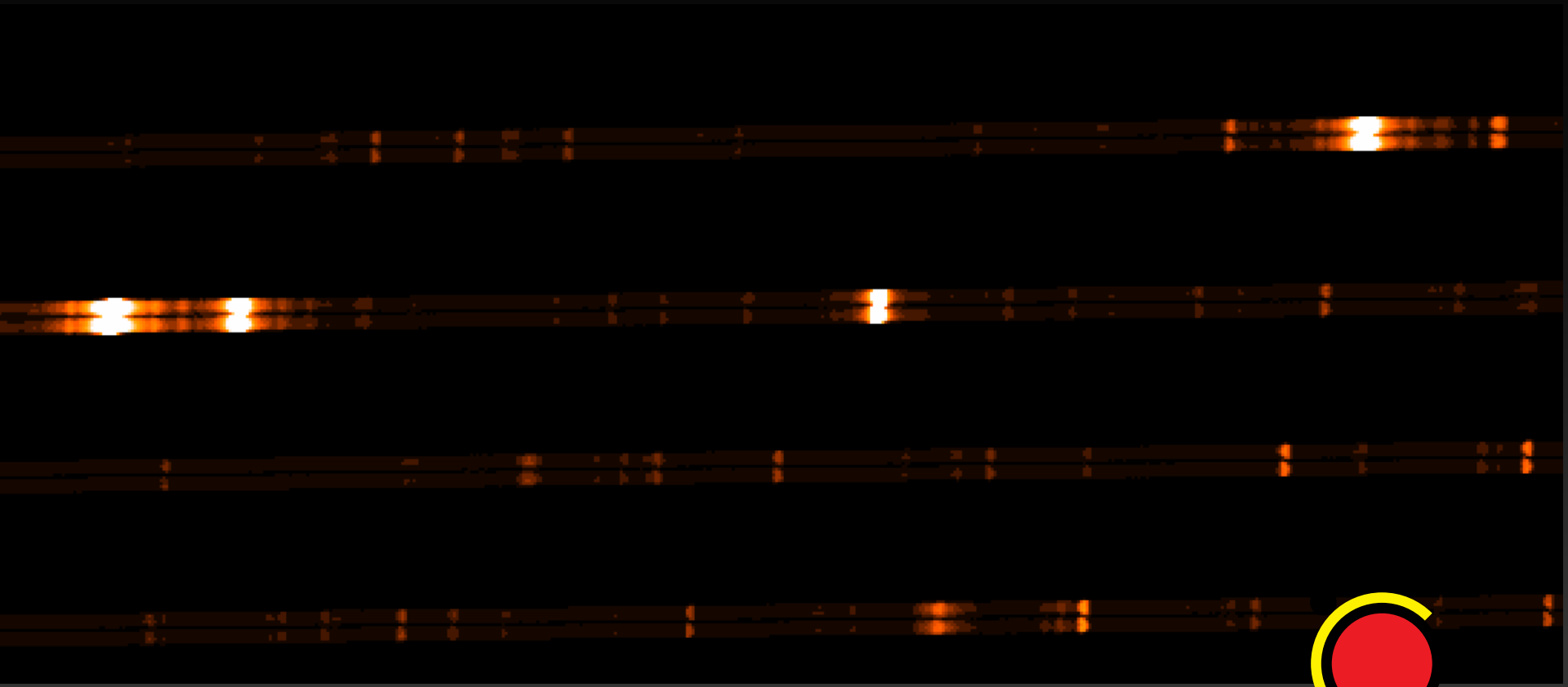
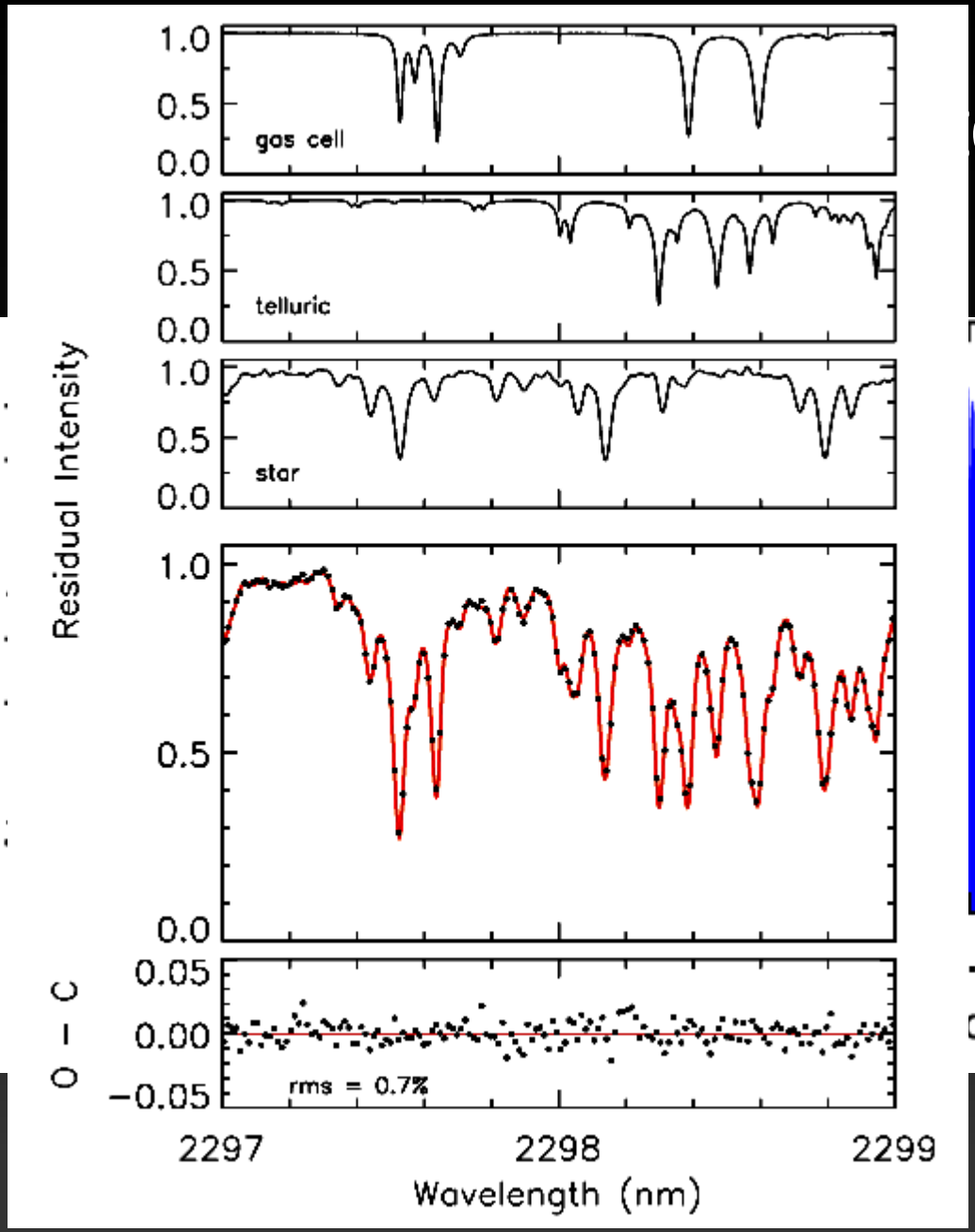
Slicer

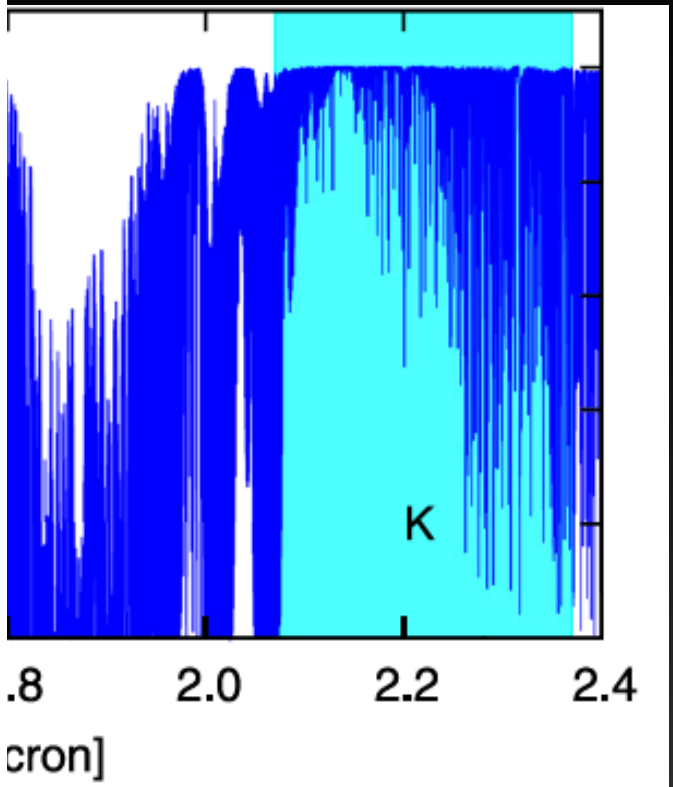


CARMENES simulator and pipeline:
M. Zechmeister, C. Marvin, J. Zhao (P6.4, P6.11)

elluric lines



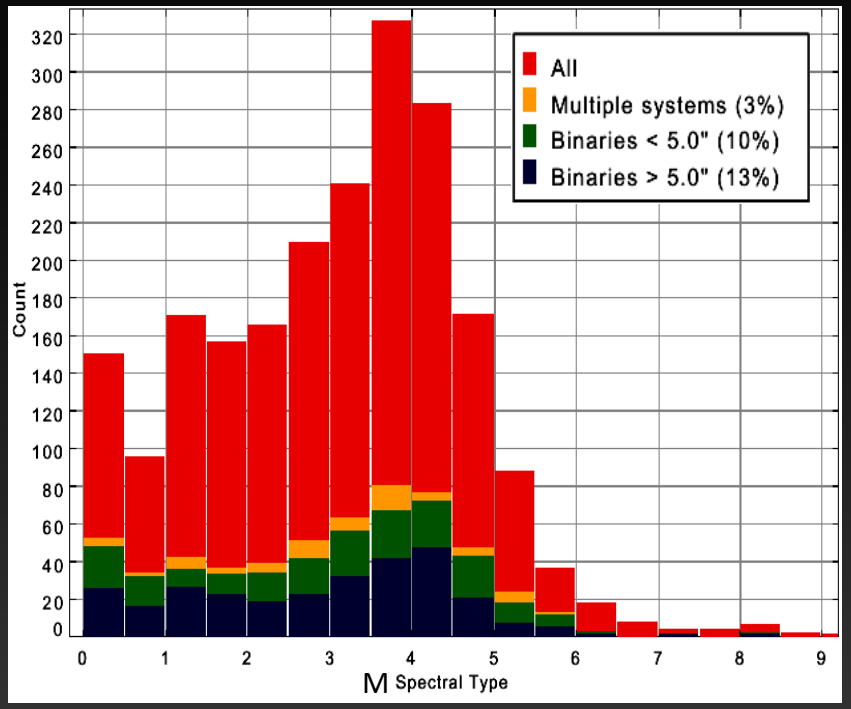
Bean et al., 2011



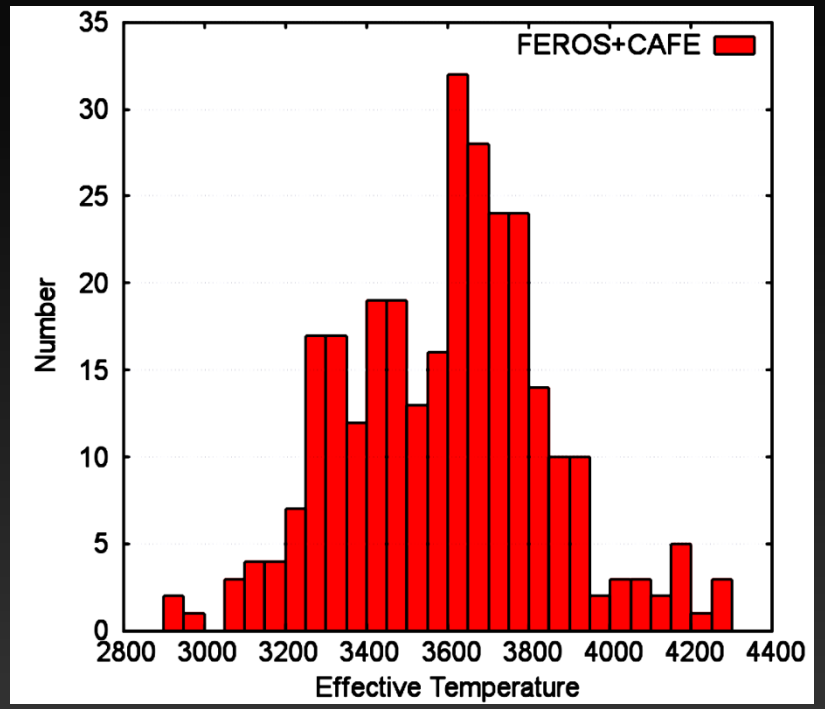
Rodler et al., 2011

Very red stars are very faint

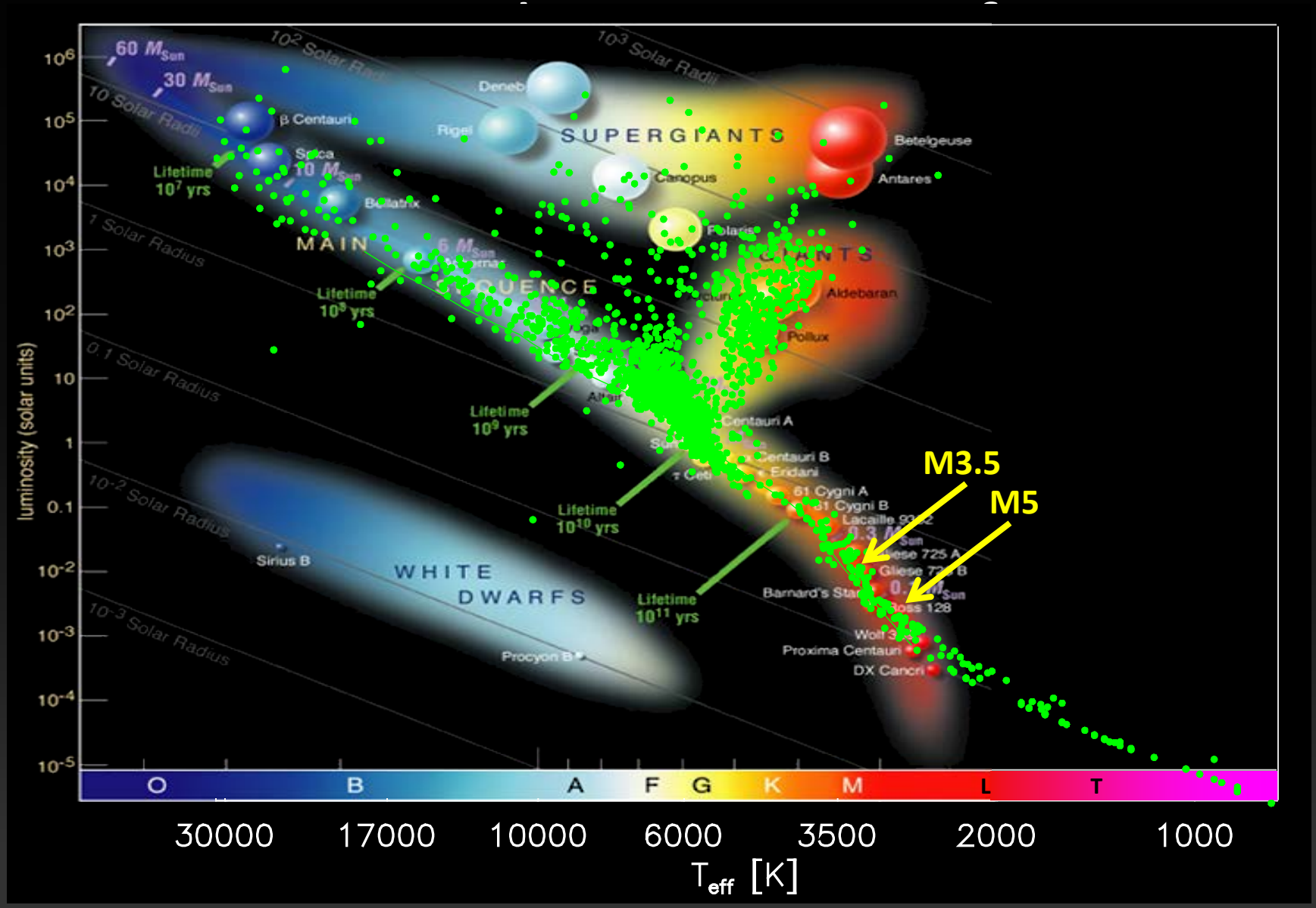
example: CARMENES target characterization



Credit: M. Cortéz-Contreras

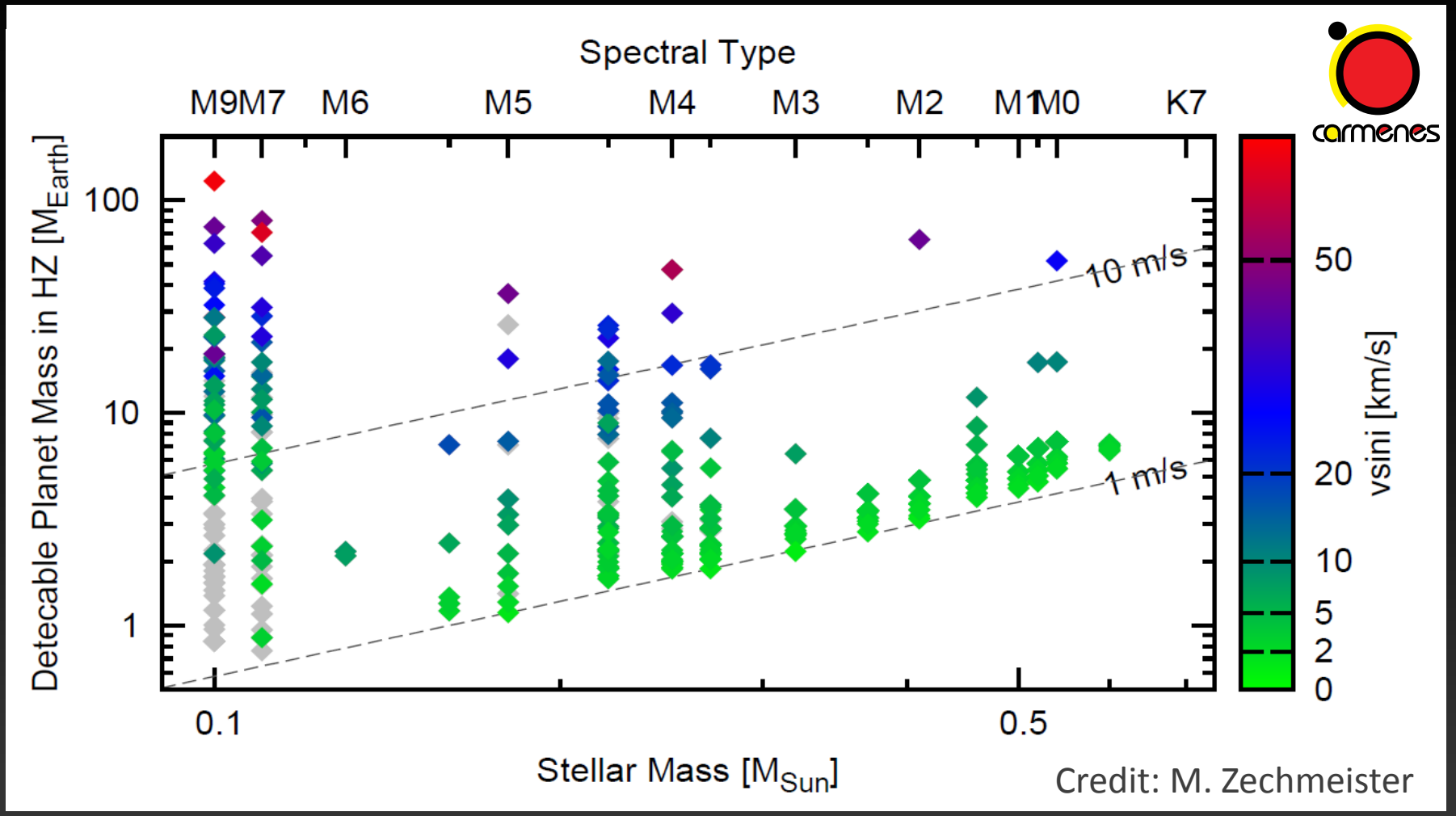


V.M. Passegger (P6.3)



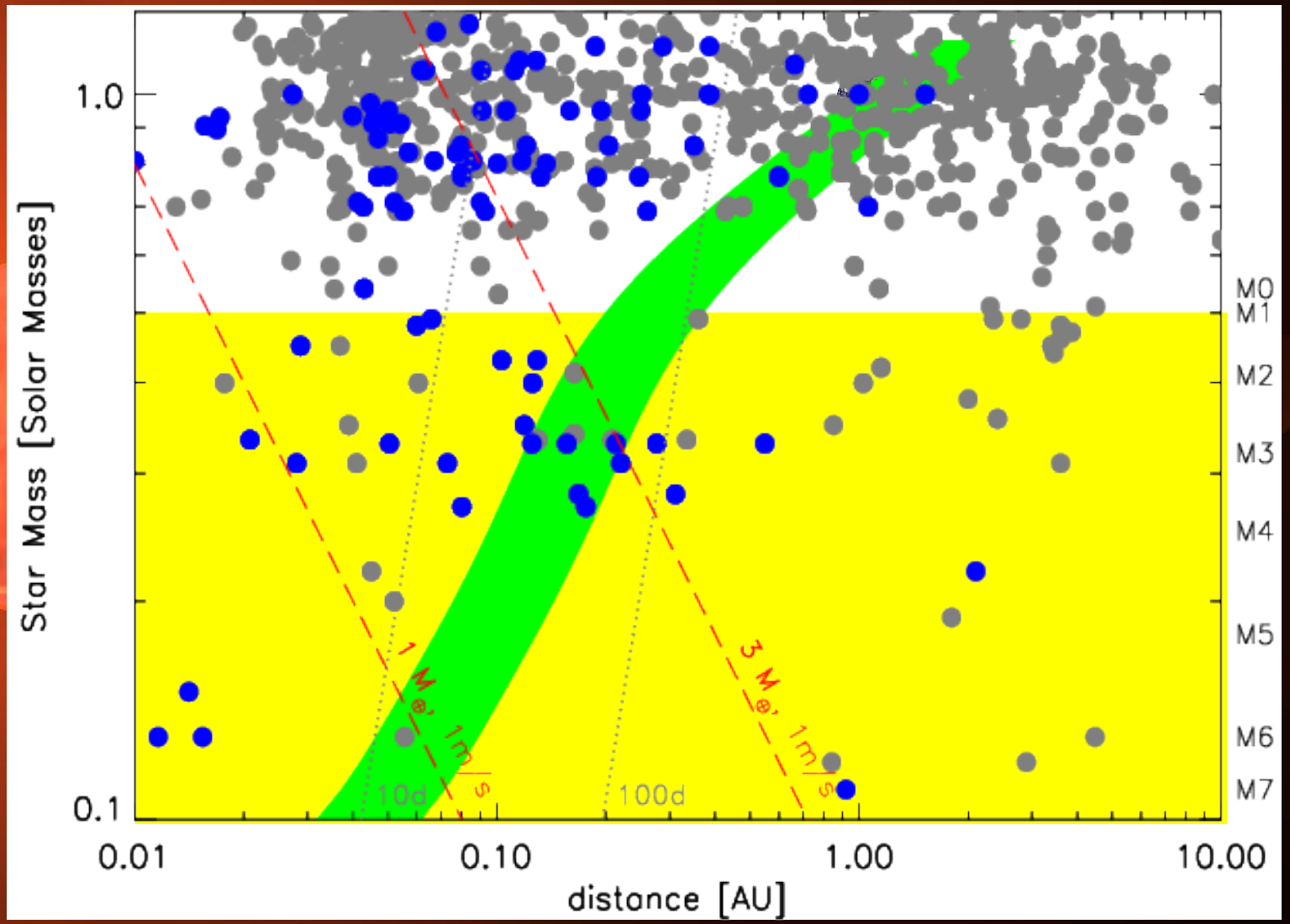
Addison-Wesley

Which planets can we hope to find?



Towards longer wavelengths:

1. More photons but less features
2. Less contrast but more Zeeman
3. Things we have to learn:
   Size, Slicing, Telluric lines, Detectors …



● "Super-Earths"