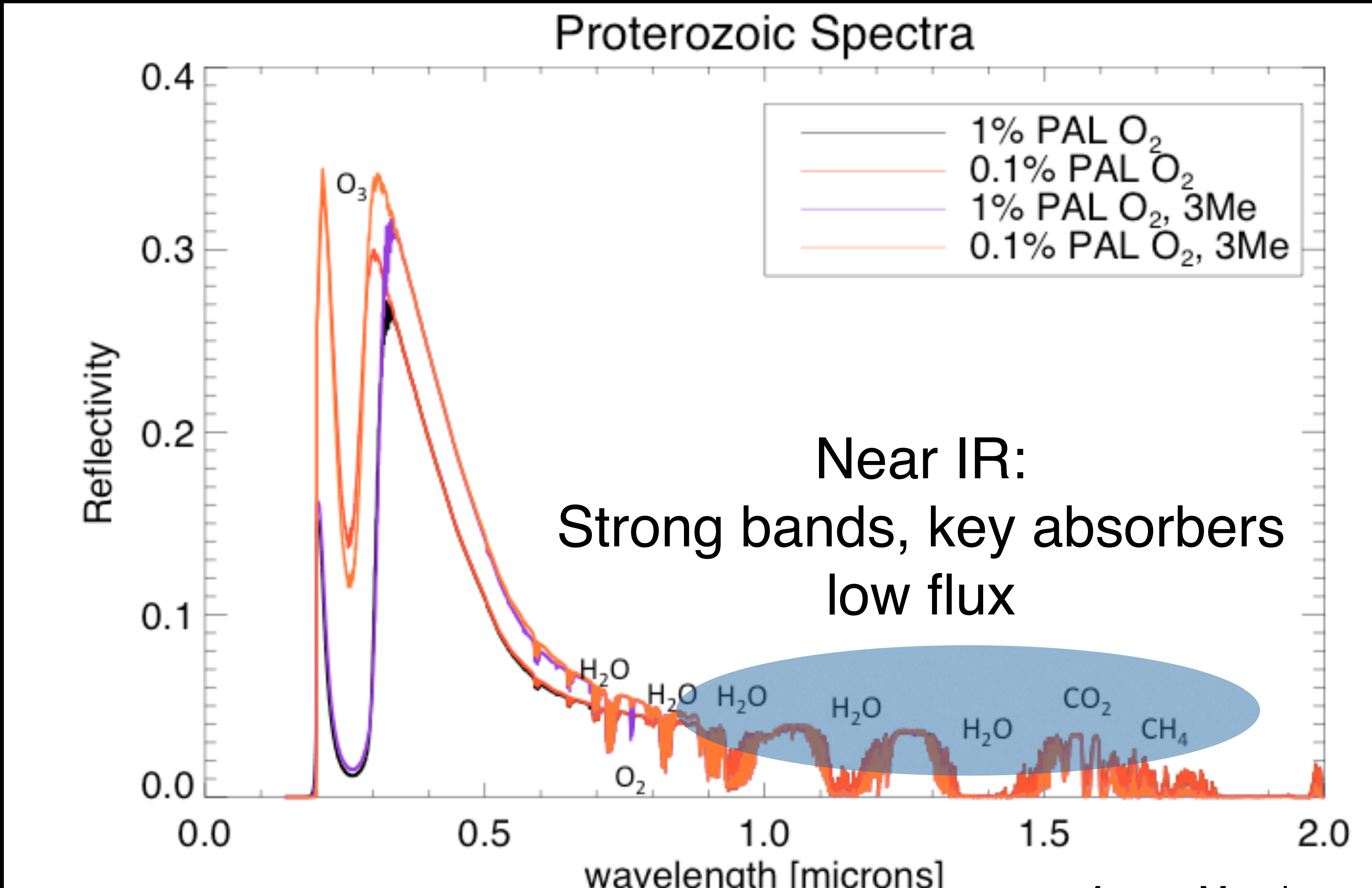
Characterization Drivers

- IWA to near-IR (λ/D)

> All together, we have indicated a spectral range of 0.7-1.5 μm for incremental progress (O_2, O_4, and CH_4), 0.3-2.0 μm for substantial progress (multiple O_2, O_3, and O_4 bands; CH_4, CO_2), and 0.3-2.4 μm for major progress (including CO as well). The question

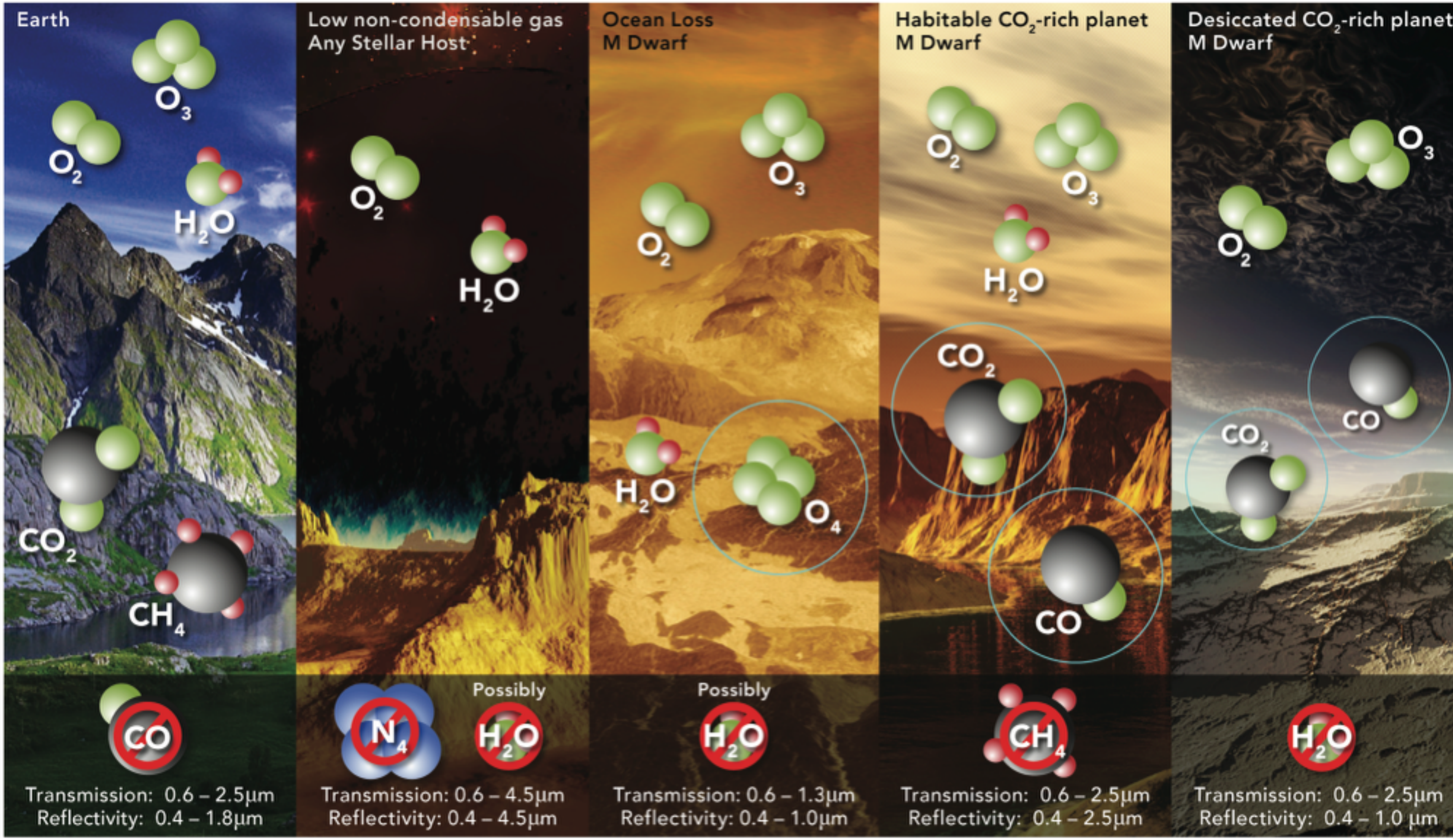
Brogi & Birkby

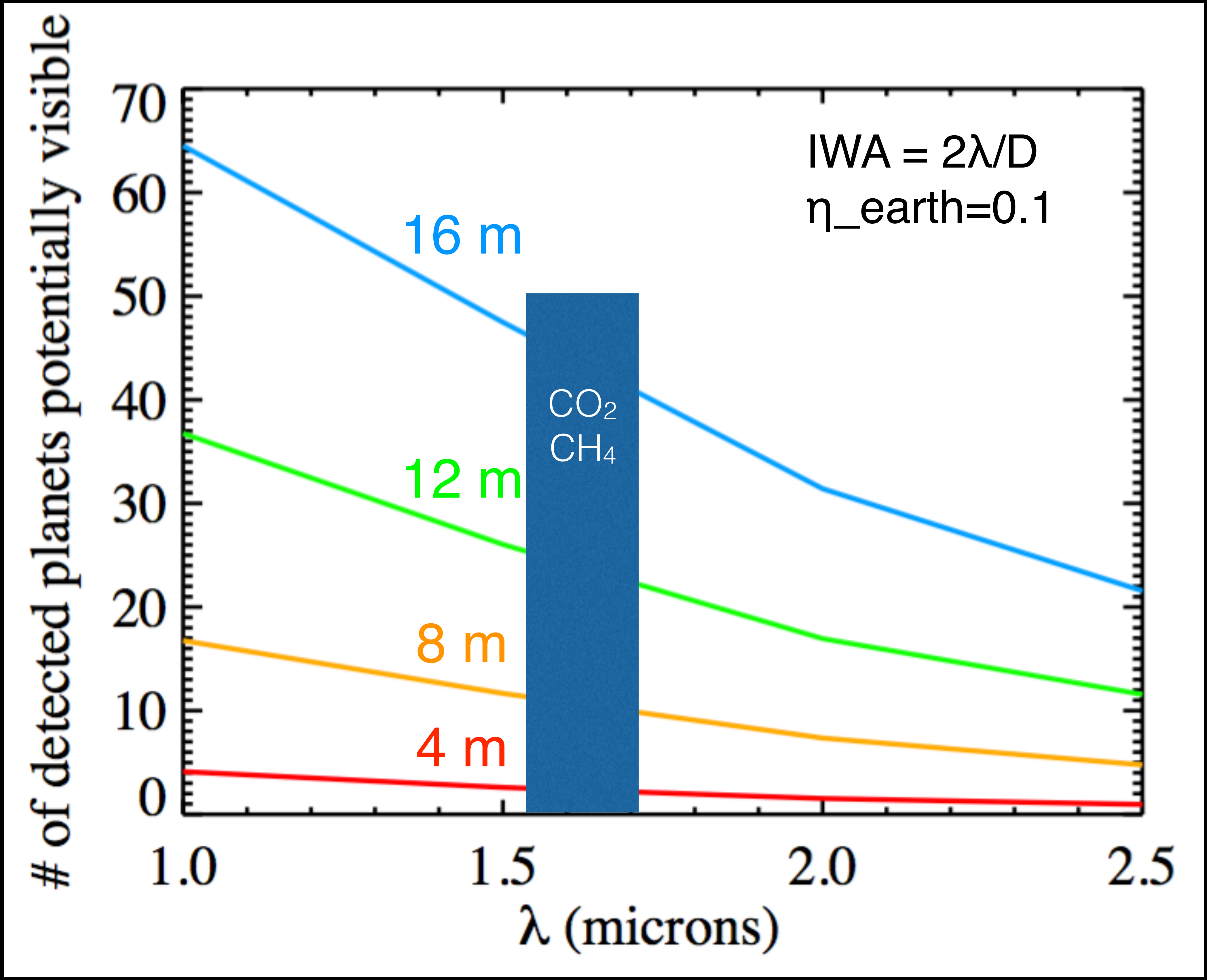
- Spectral resolution (e.g., fiber to spectrograph)
    - $t \propto R^2/D^4$ (detector noise dominated)
    - $t \propto R/D^2$ (planet/leakage dominated)
    - need to carefully consider plausible science case at high R
- more subtle signatures (e.g., glint, rotation)



Arney, Meadows+

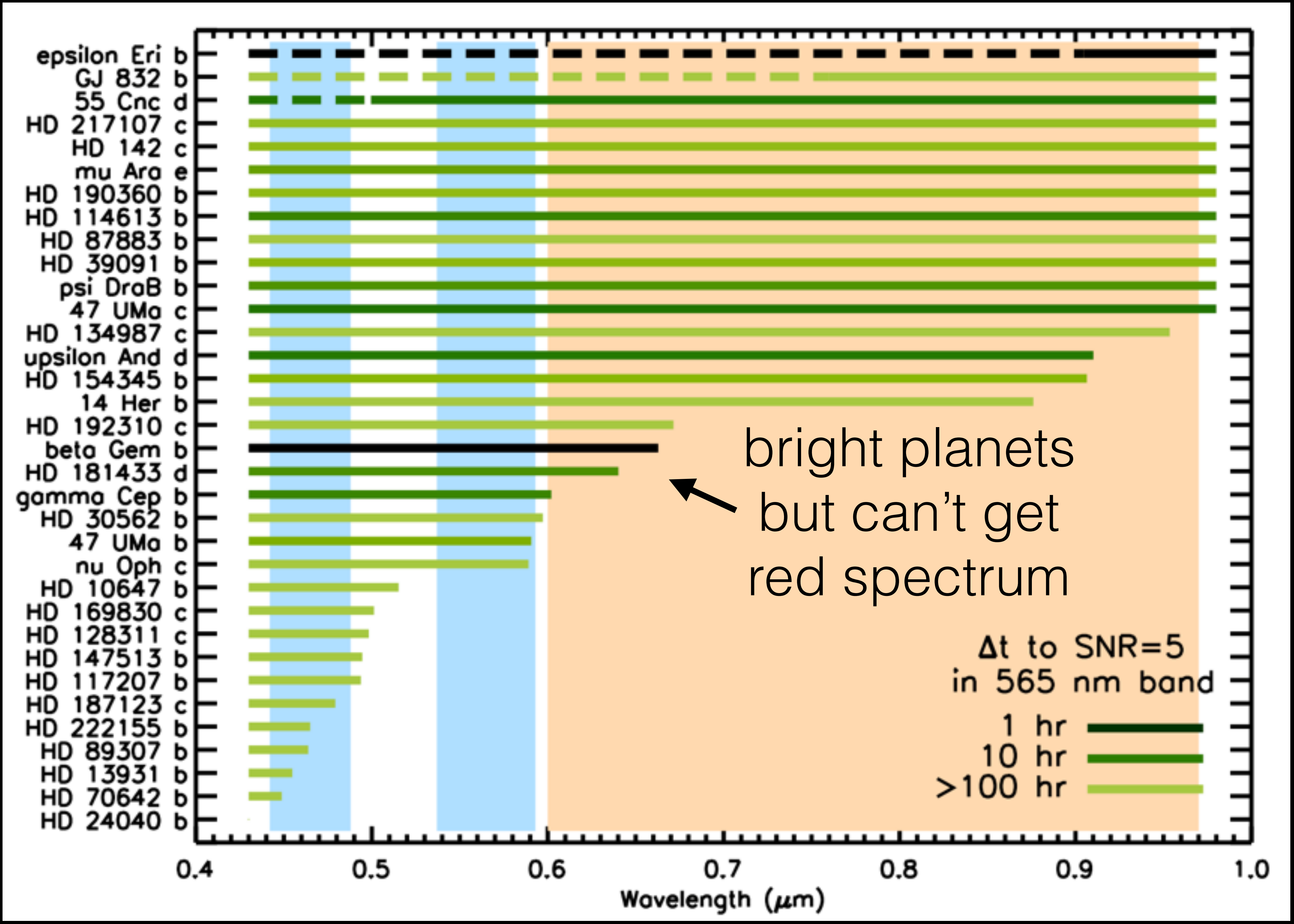
Near-IR Permits False+ Exclusion





IWA = 2λ/D
η_earth=0.1
16 m
12 m
8 m
4 m
CO2
CH4
# of detected planets potentially visible
0
10
20
30
40
50
60
70
1.0
1.5
2.0
2.5
λ (microns)

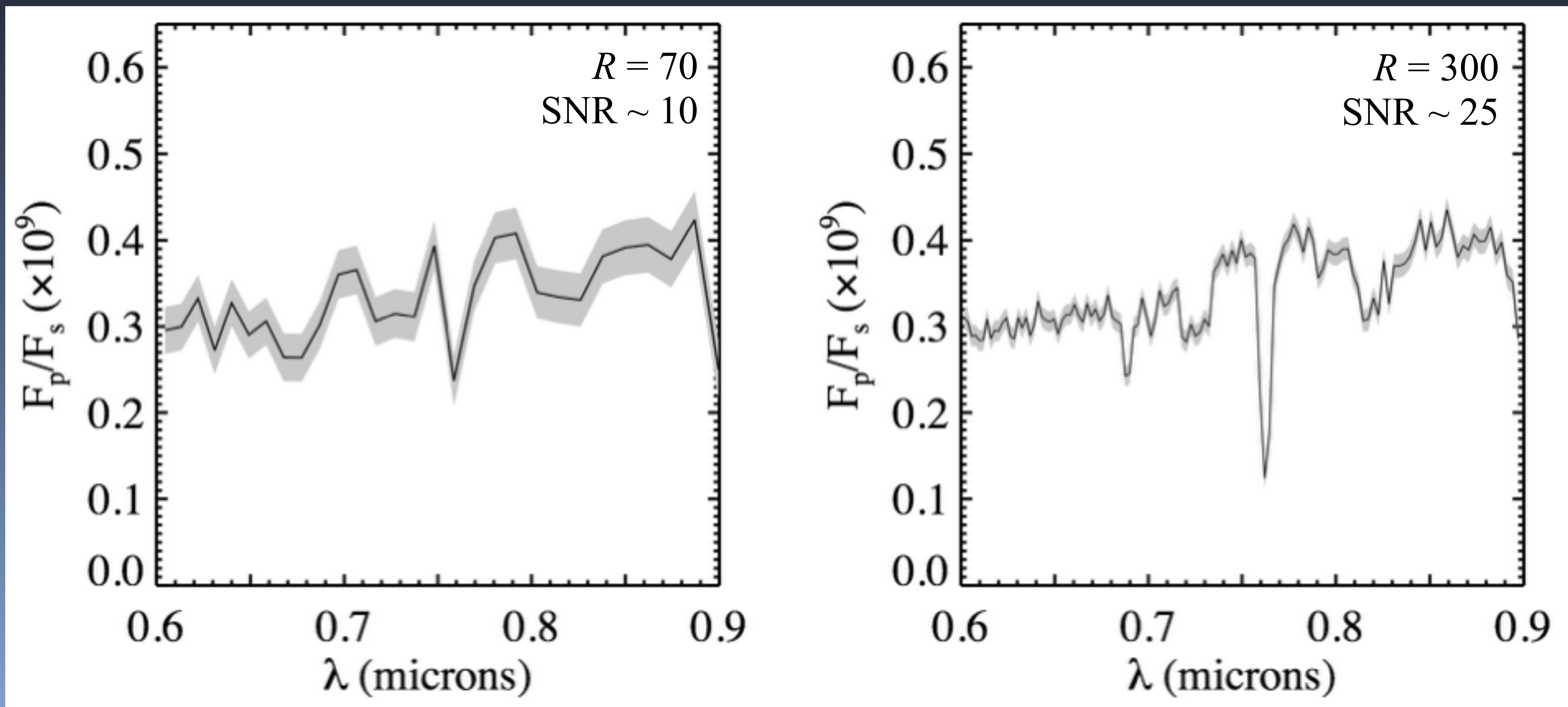
Cautionary WFIRST IWA Example



5. Larger Apertures Provide Shorter Integration Times
Higher R & SNR is Possible

200 hr observations of Earth @ 10 pc

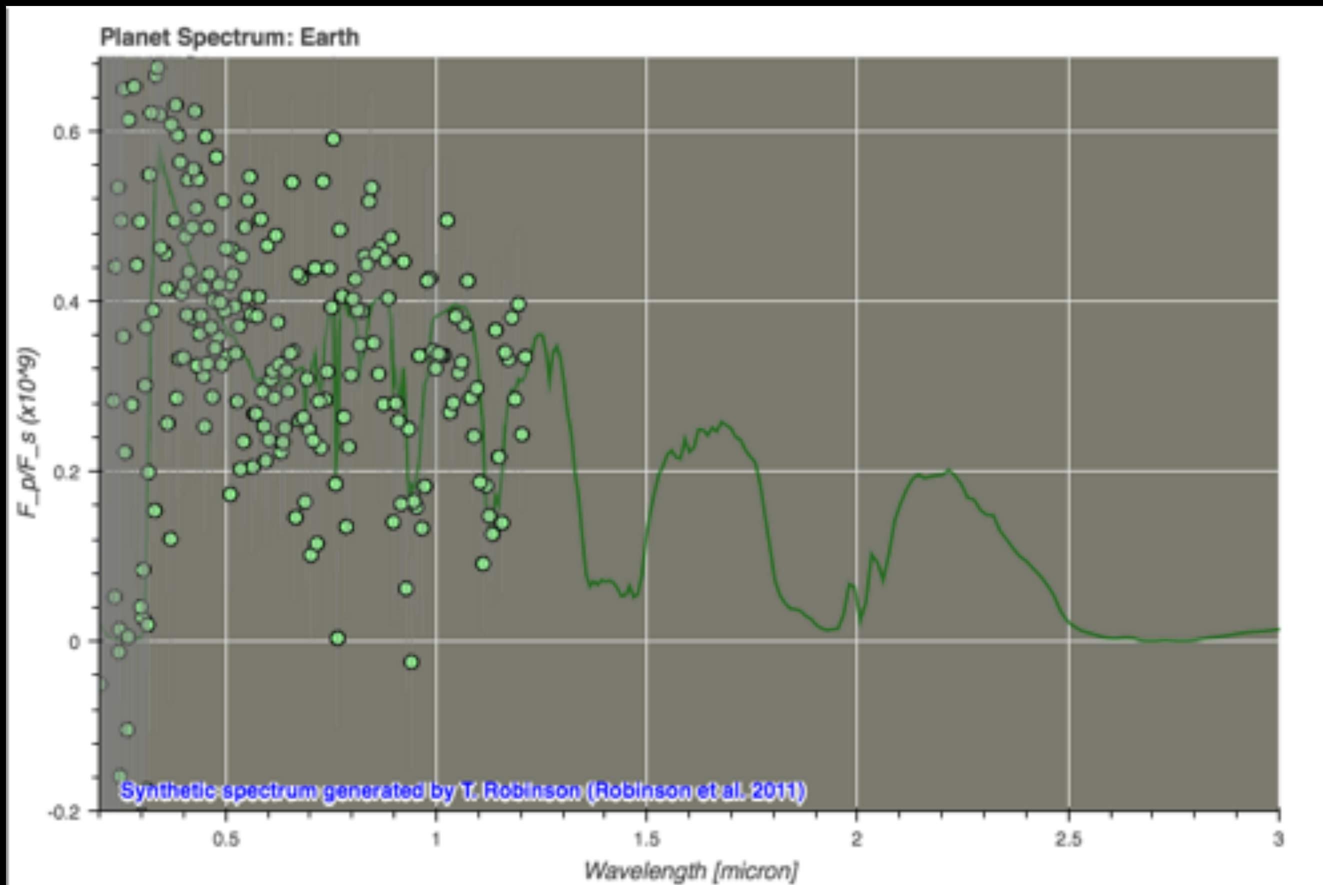
D = 4 m | *D* = 12 m



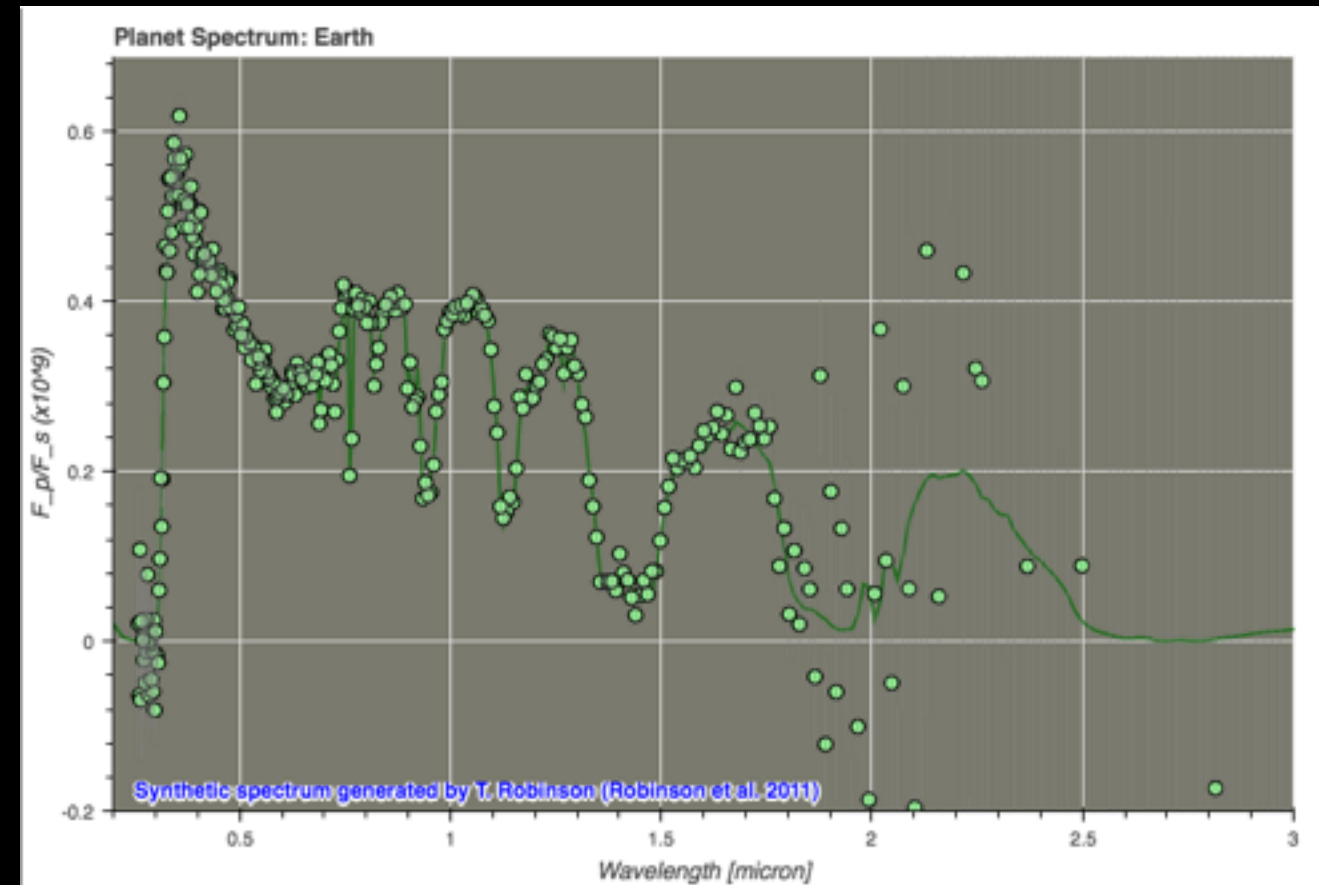
Tumlinson's Online Spectra Tool (Tumlinson, Robinson, Arney, et al)

Will the unresolved O_2 line on the left be sufficient for the most profound discovery NASA has ever made?

4 m Earth

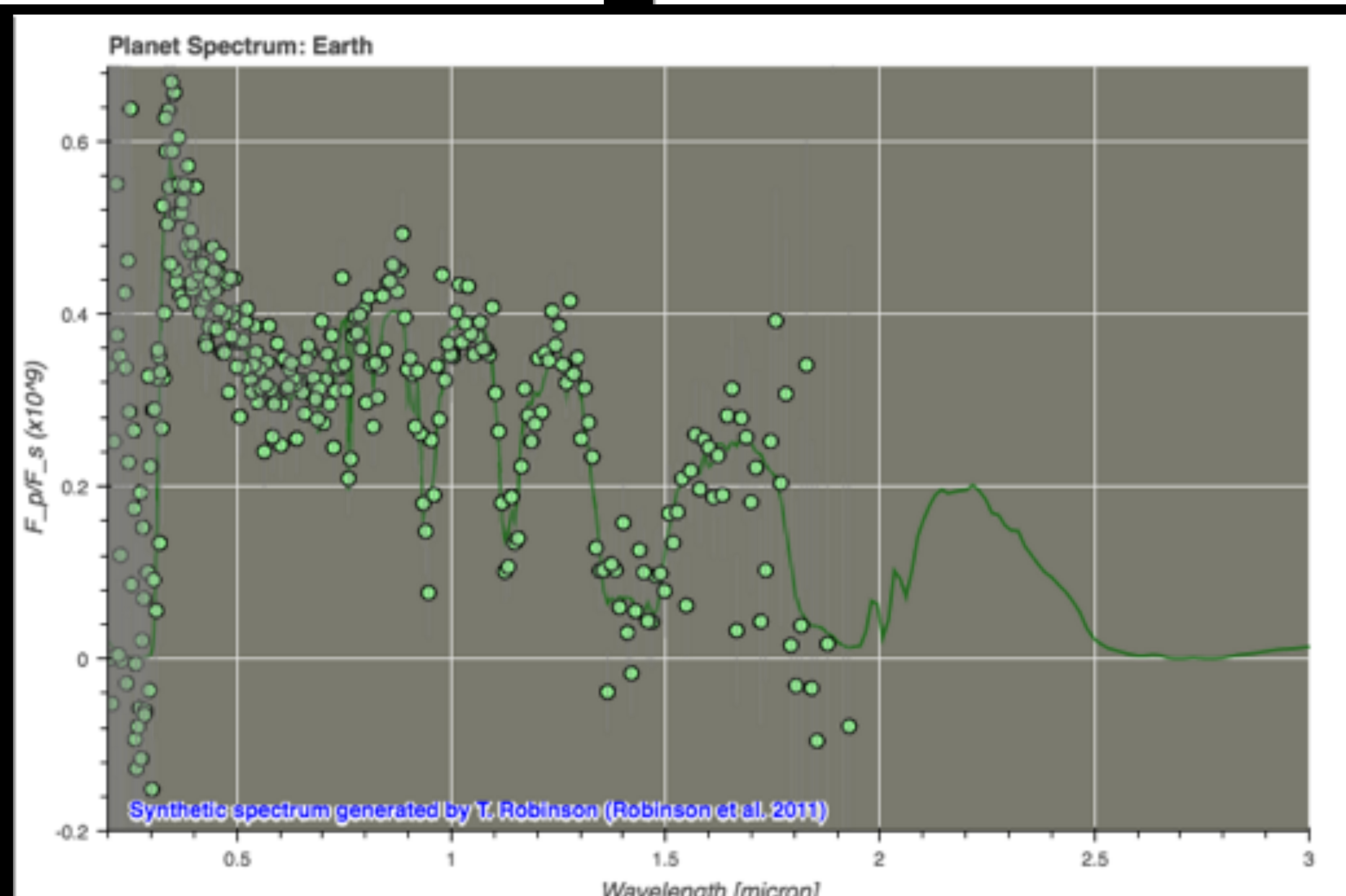


16 m



Modern Earth at 10 pc

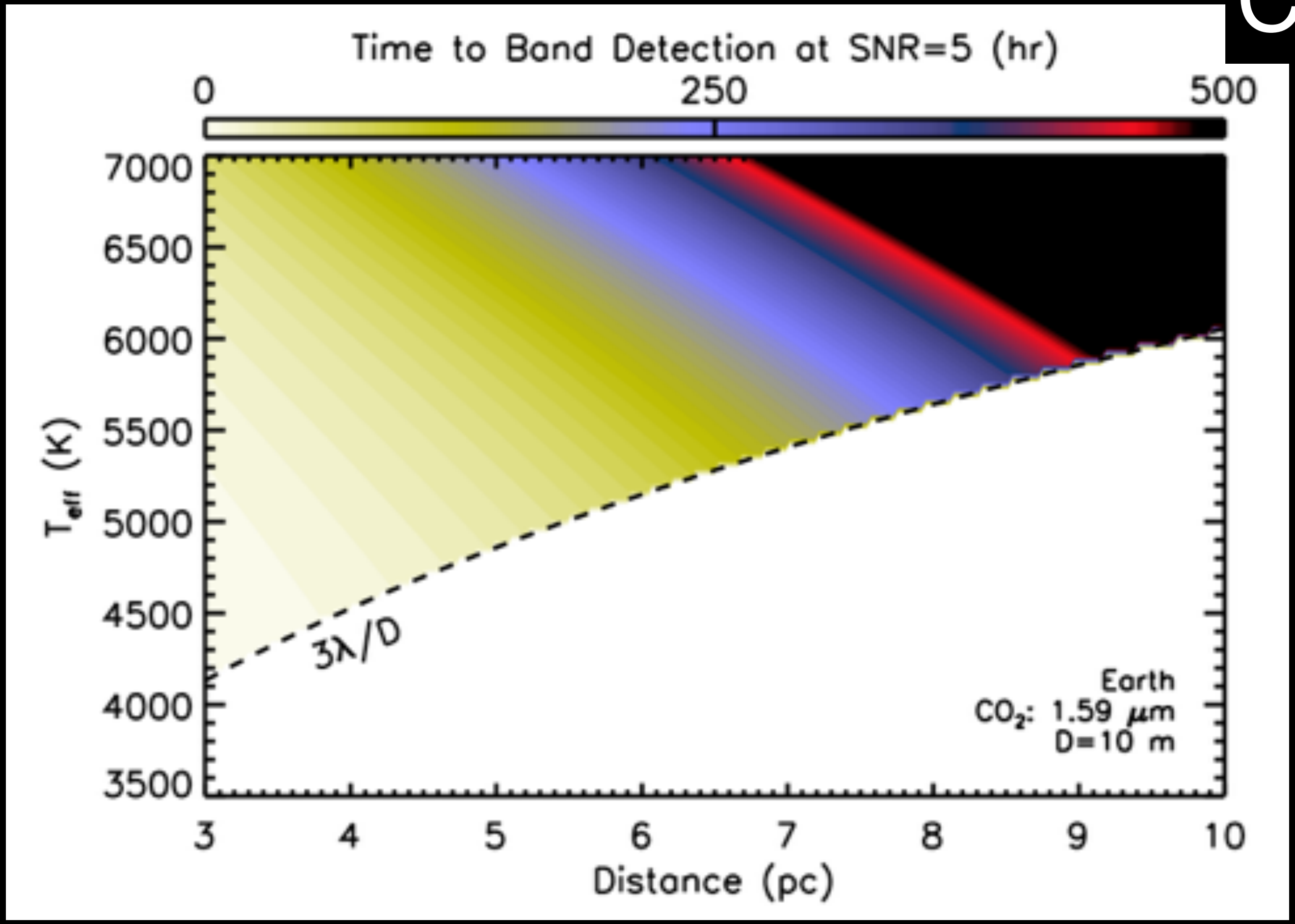
Integration time = 1 day
R = 150
Telescope T = 270 K

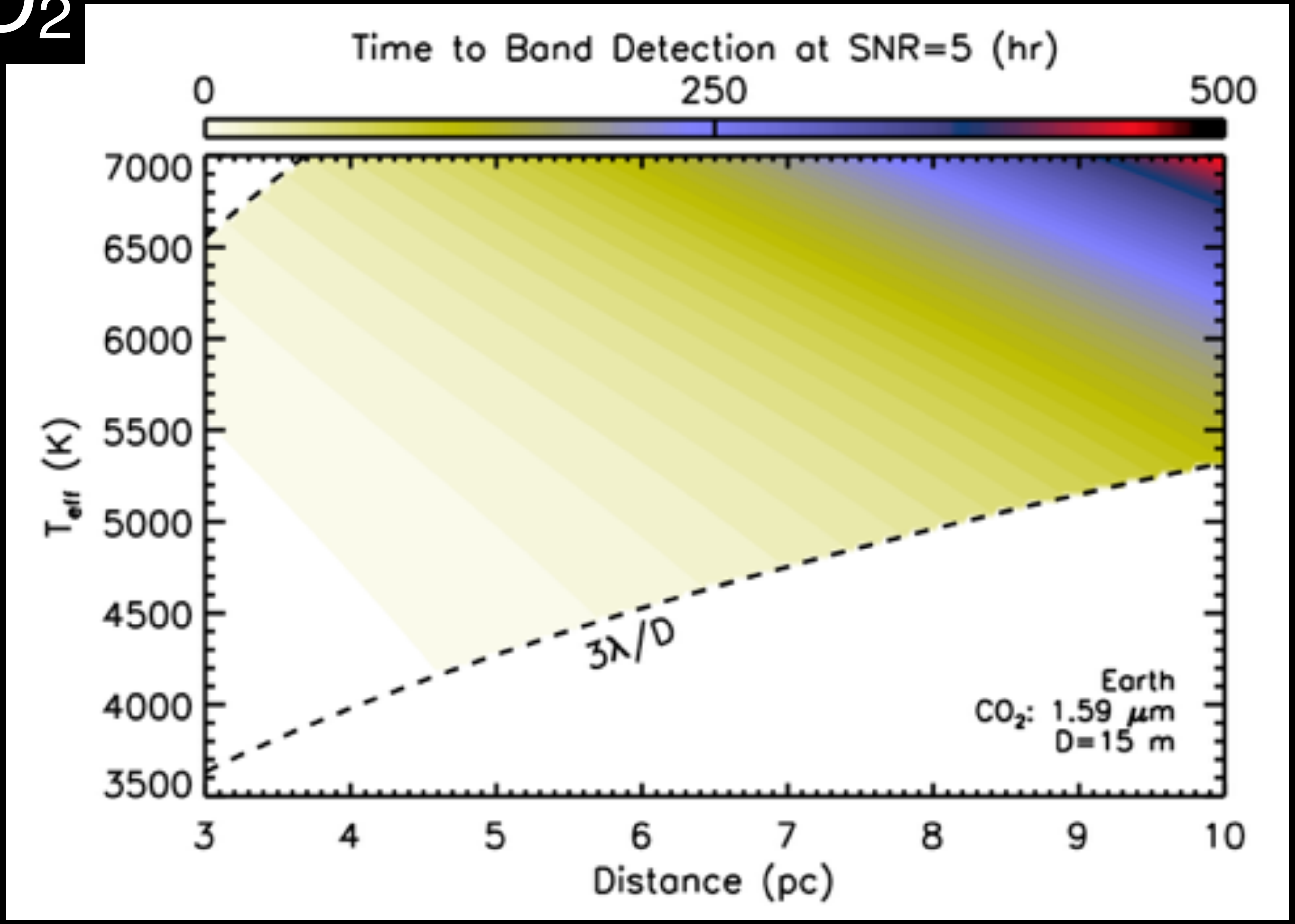


8 m

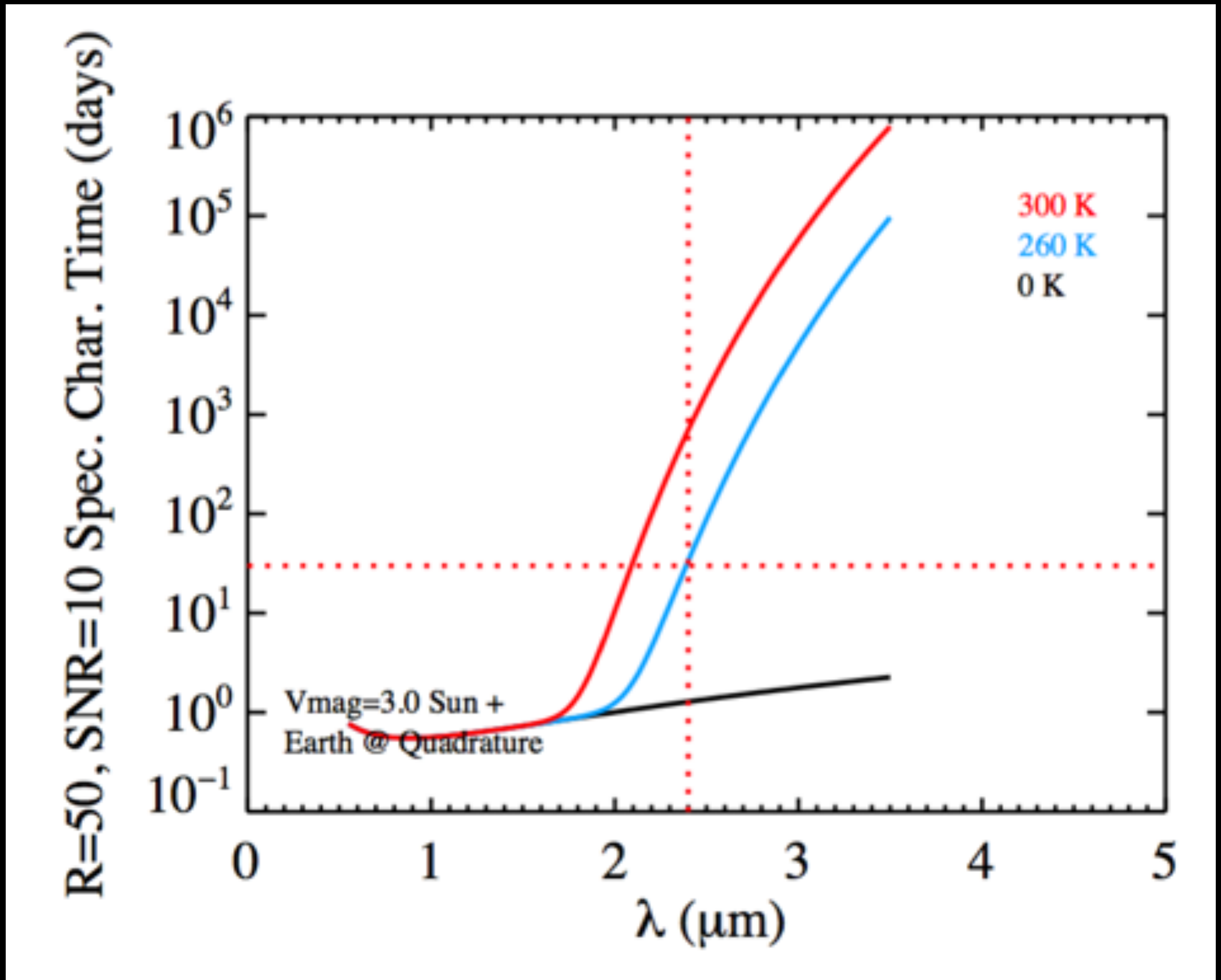
Arney+

CO_2



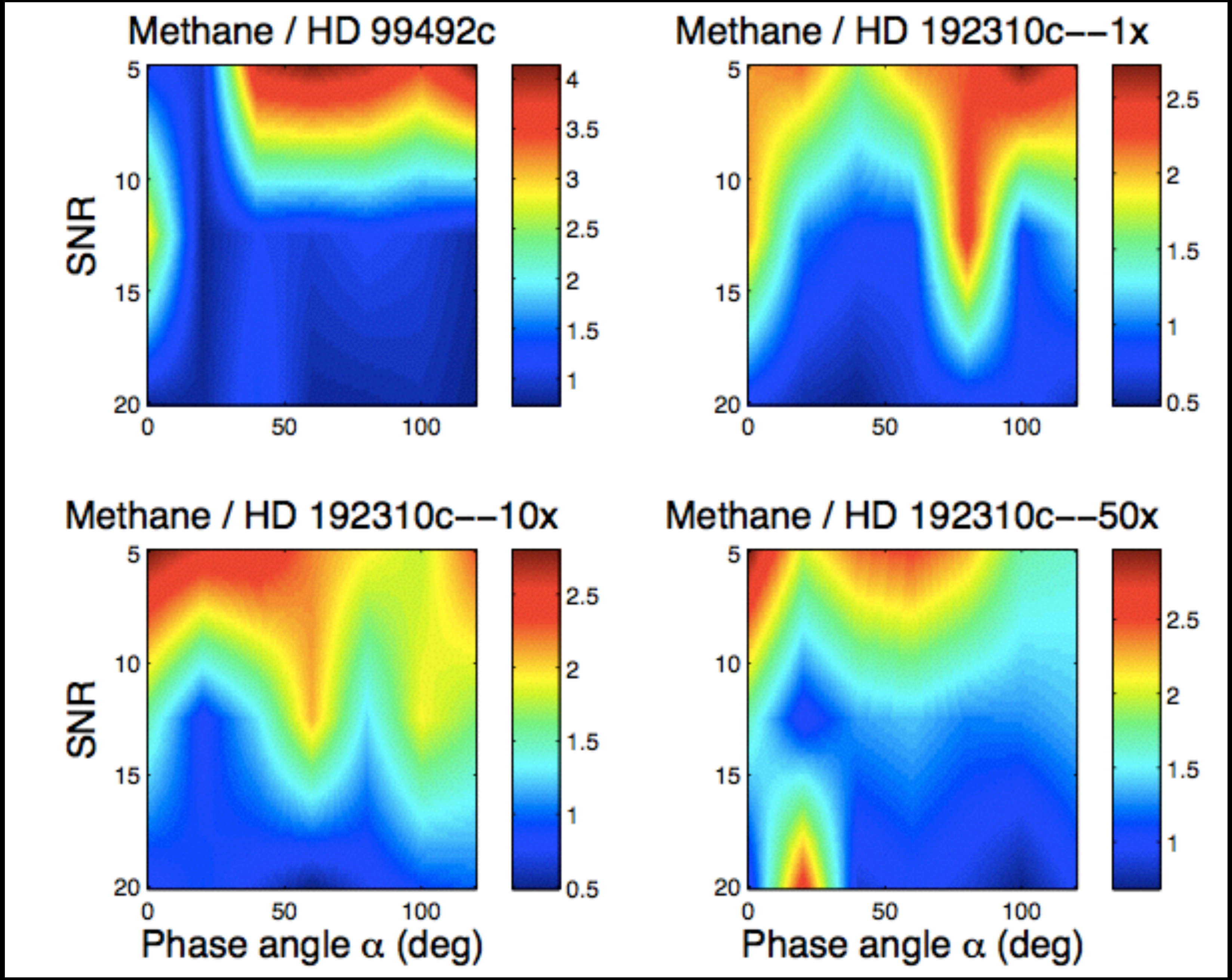


Robinson



Stark

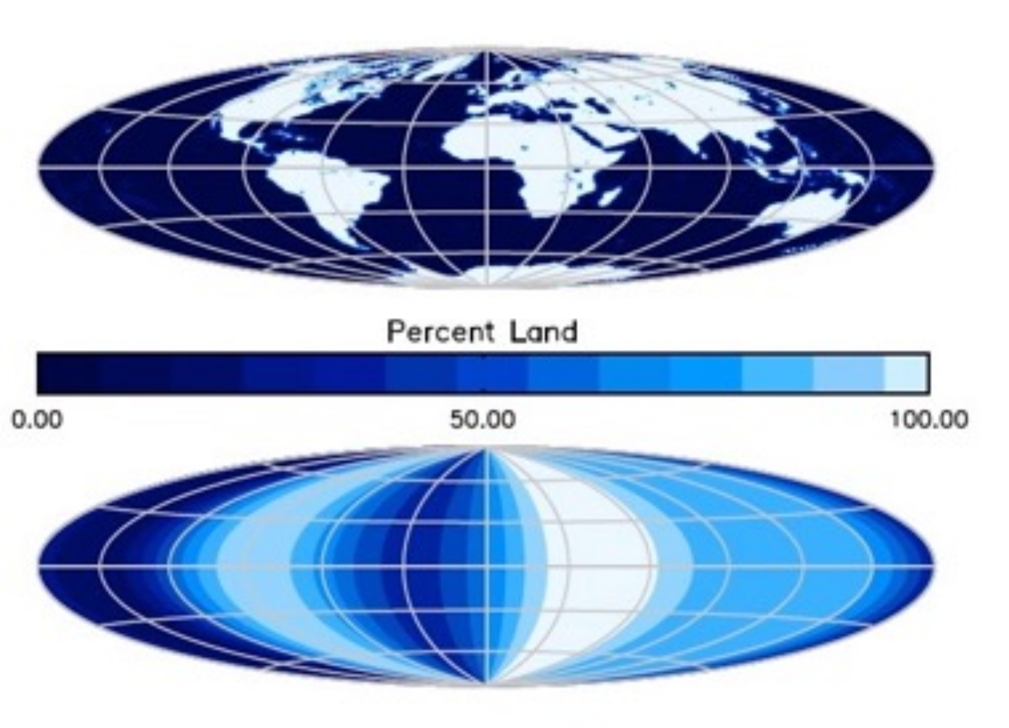
WFIRST Study: Need SNR > 20 for Useful Abundances

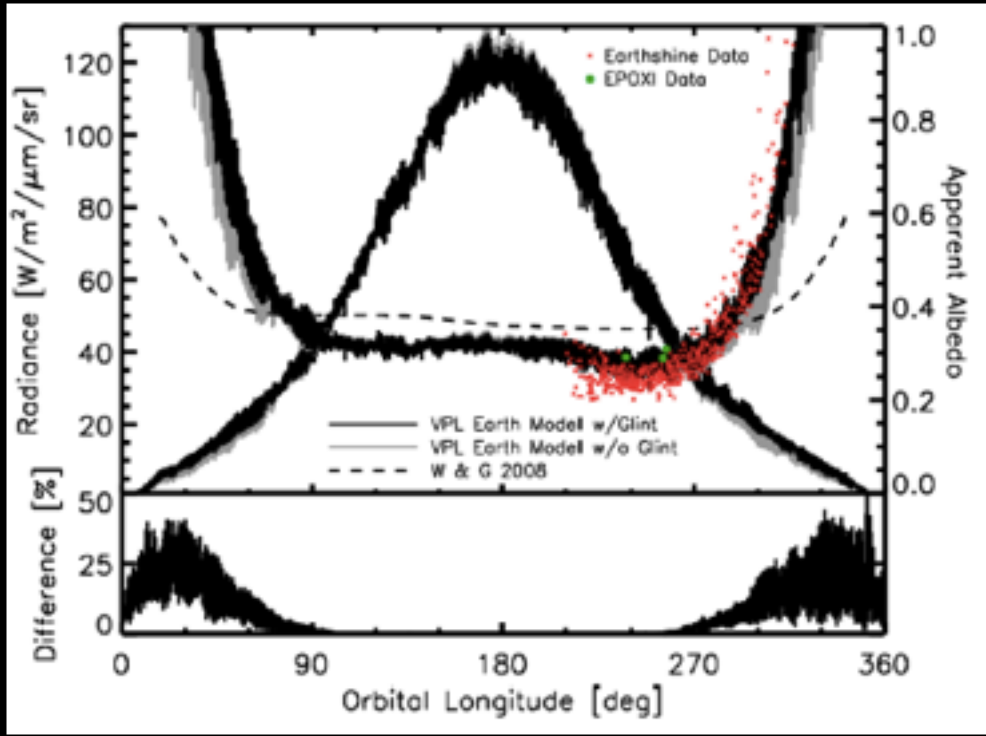


Nayak, Lupu, Marley+ (2016)

Other Signatures

- Lightcurves (annual, daily)
- Glint
- Polarization





Exoplanet Imaging

- Large D case hinges on near-IR, SNR, R
- Really need systematic retrieval studies to really define sweet spot
- Qualitative sweet spot likely is 12 - 15 m