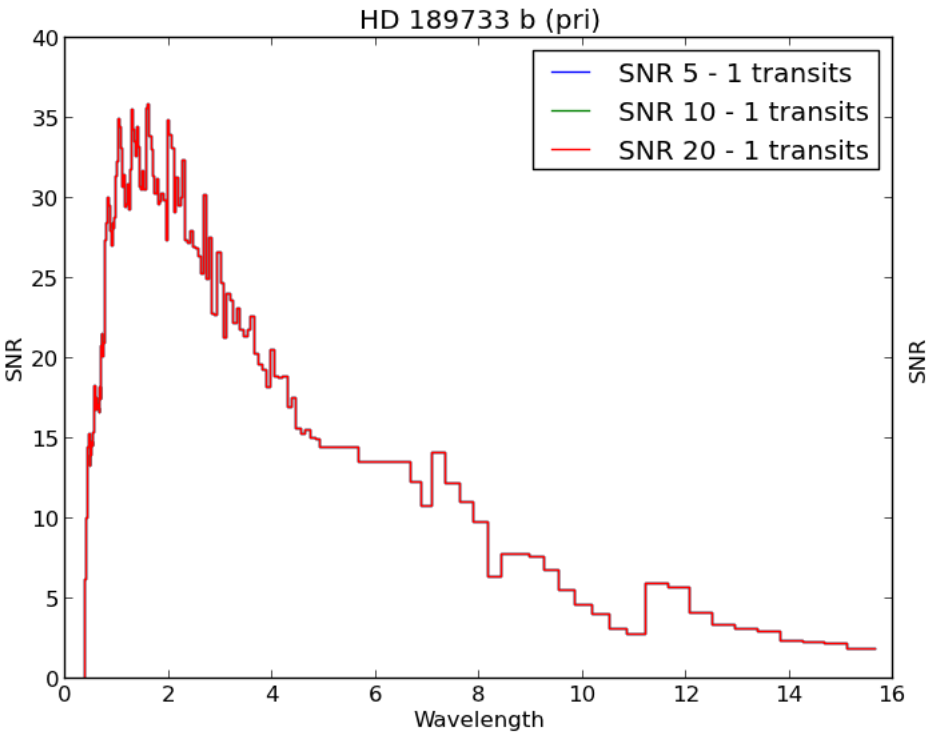
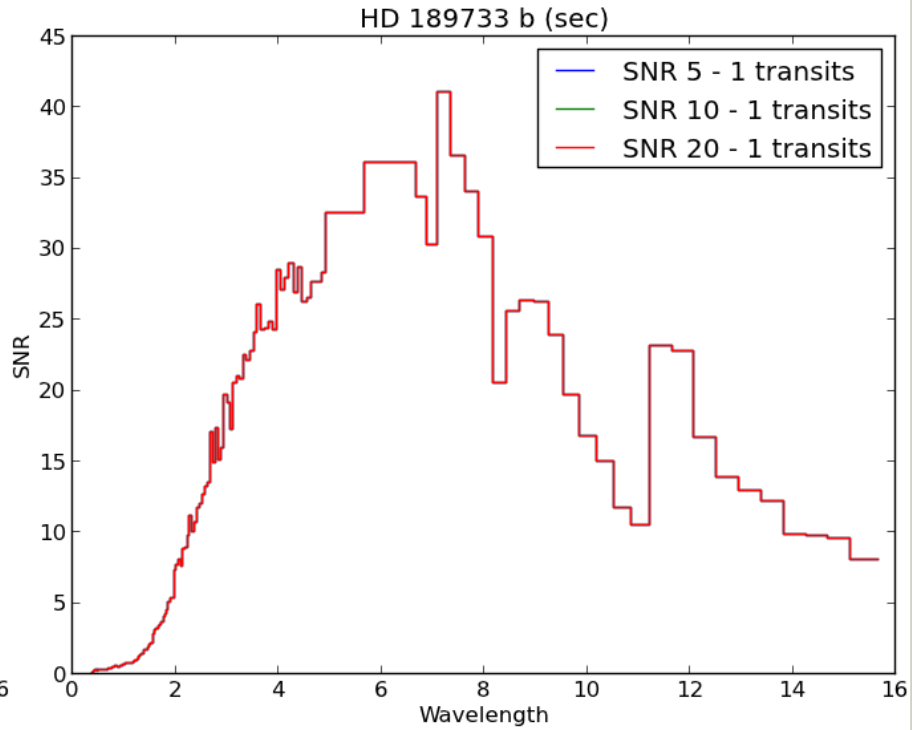
Chemical Census:

SNR~5 & R=50 λ<5μm; R=30 λ>5μm

HD189733b 1 transit & 1 eclipse

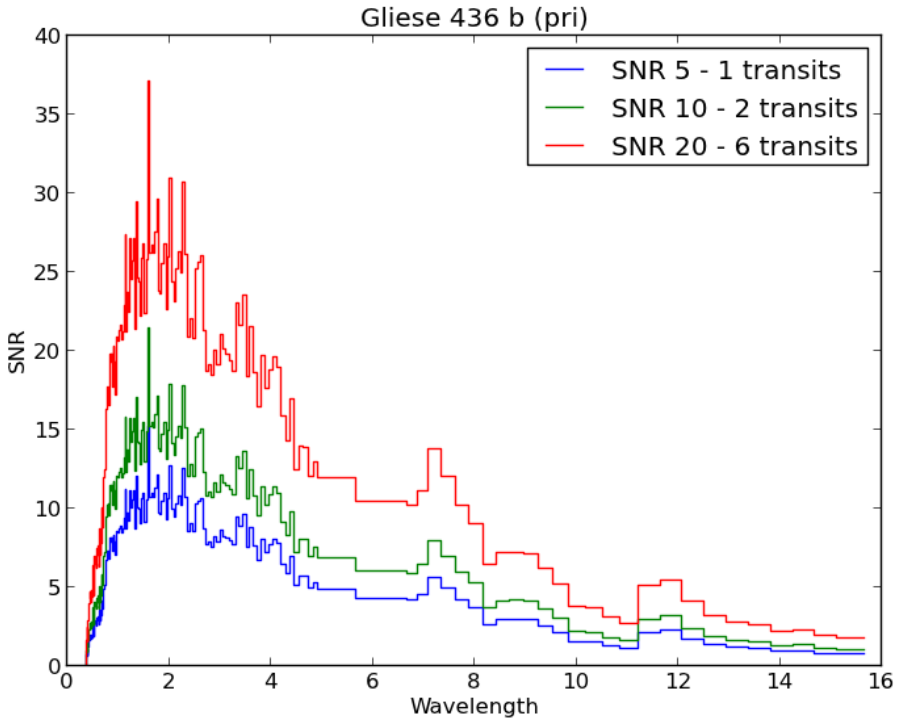


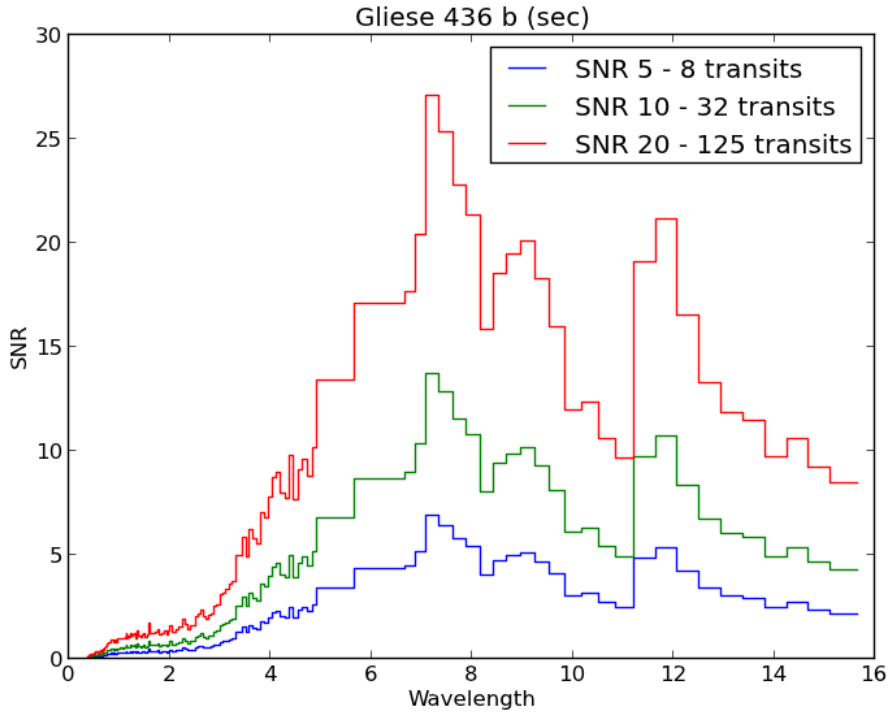


Chemical Census:

SNR~5 & R=50 λ<5μm; R=30 λ>5μm

GJ 436 b 1 transit & 8 eclipses

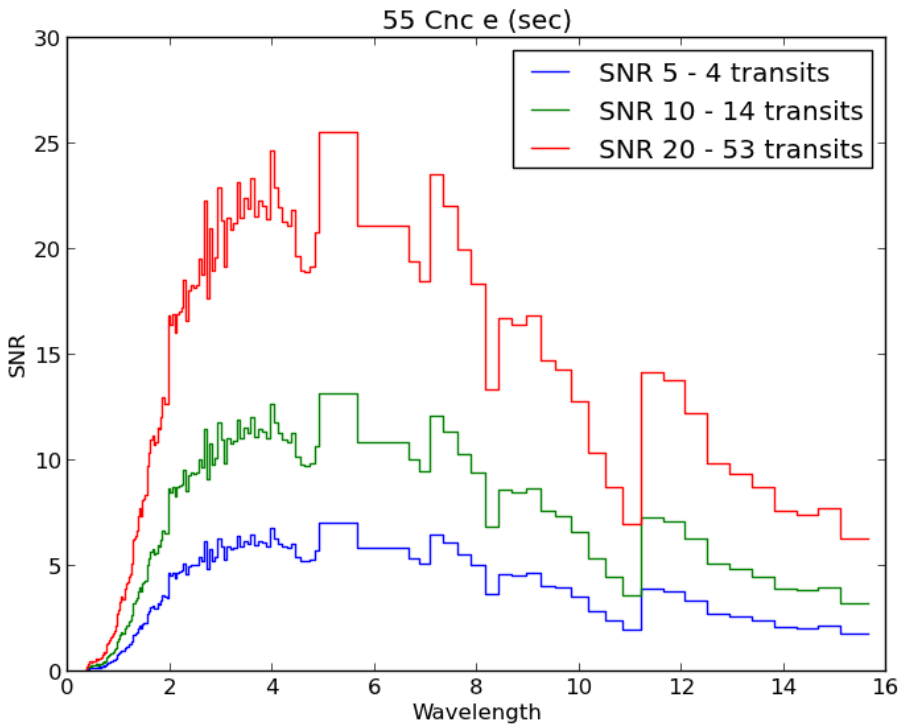


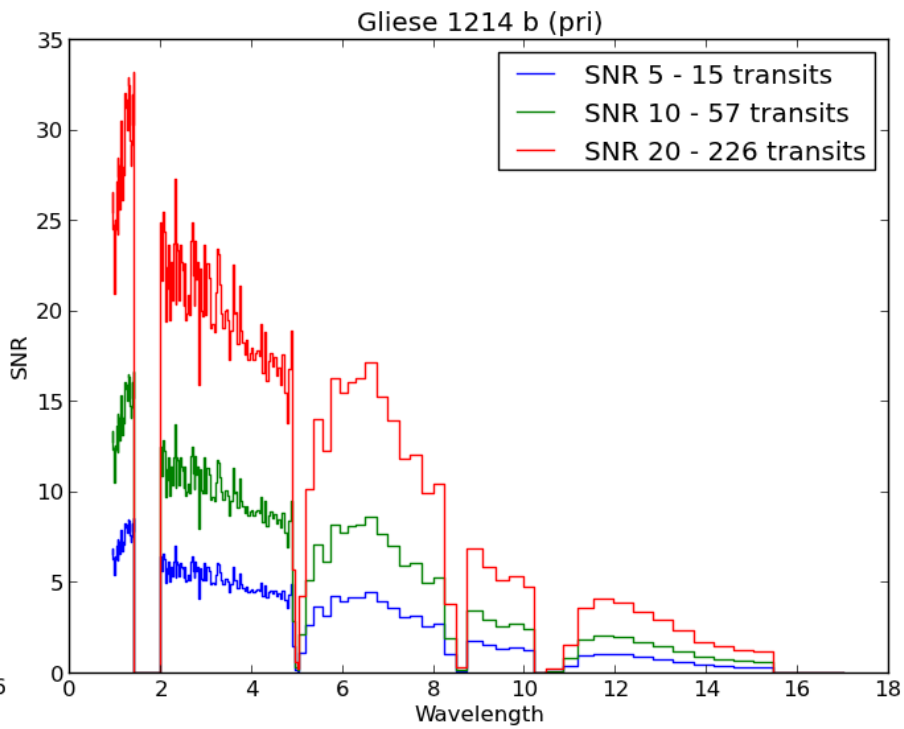


Chemical Census:

SNR~5 & R=50 λ<5μm; R=30 λ>5μm

55 Cnc-e: 4 eclipses & GJ 1214b: 15 transits





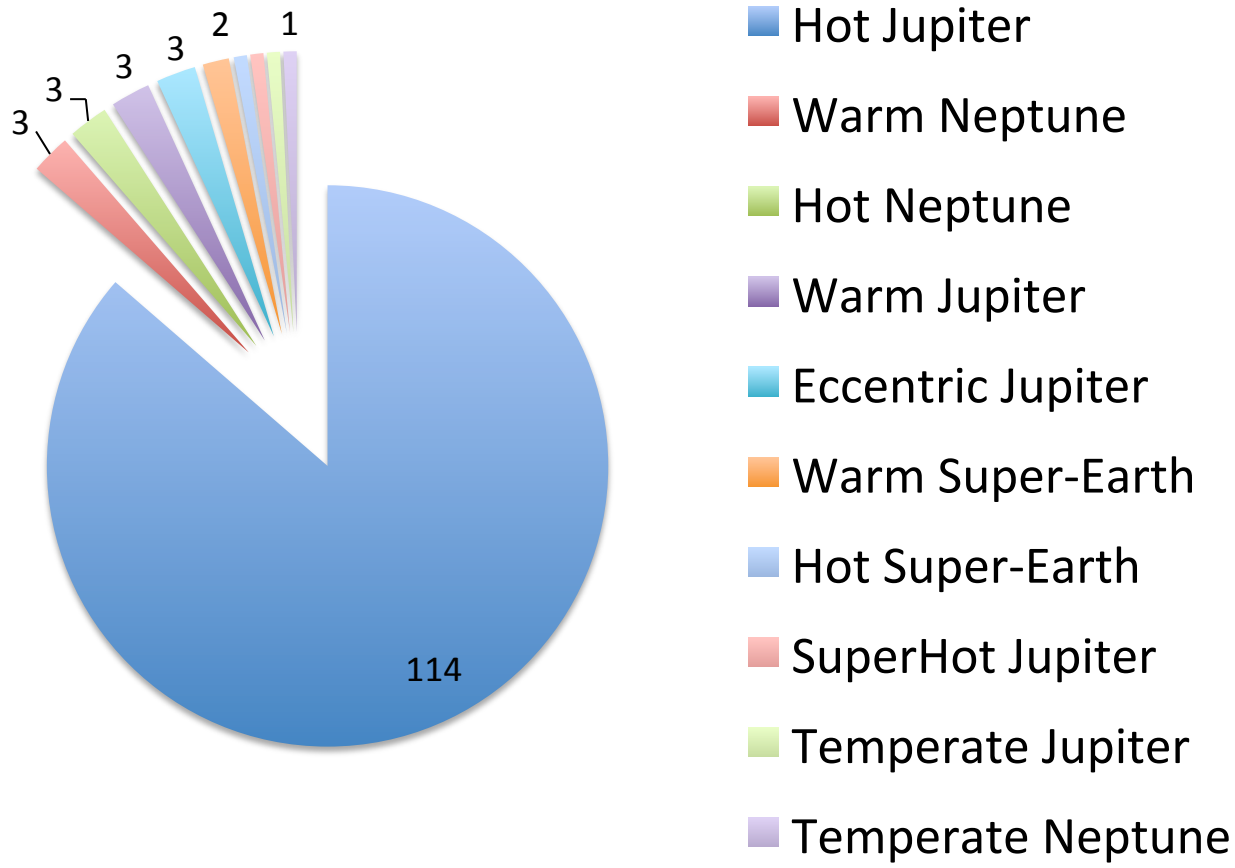
Chemical Census:

Currently observable targets

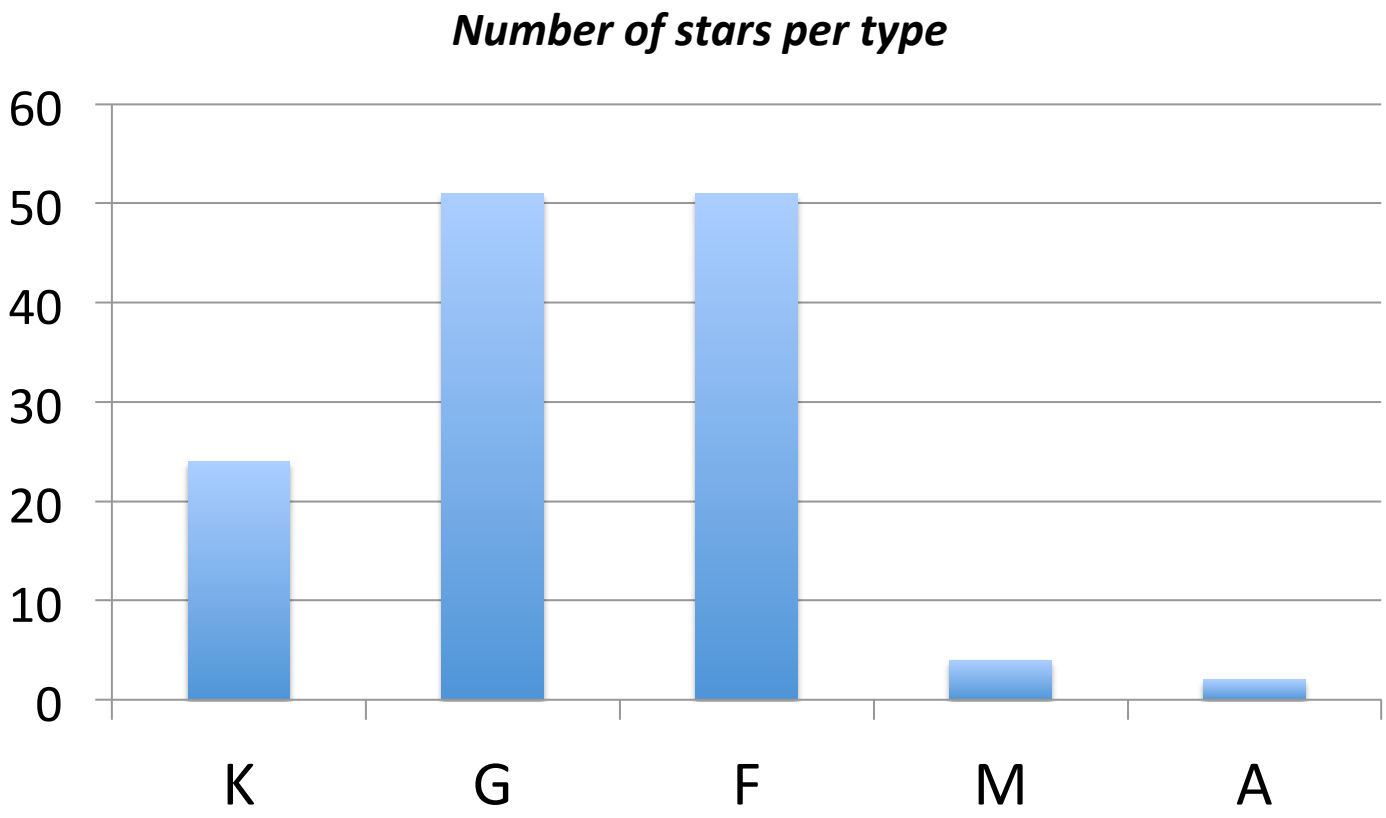
- Today 130 planets out of the 250 transiting are observable by EChO.
- Only 1/3 of them is observed in one mode only (transit or eclipse). The rest can be observed in transit & eclipse.
- In 10 years time more planets around brighter stars and even more diverse.

Planets probed with CC

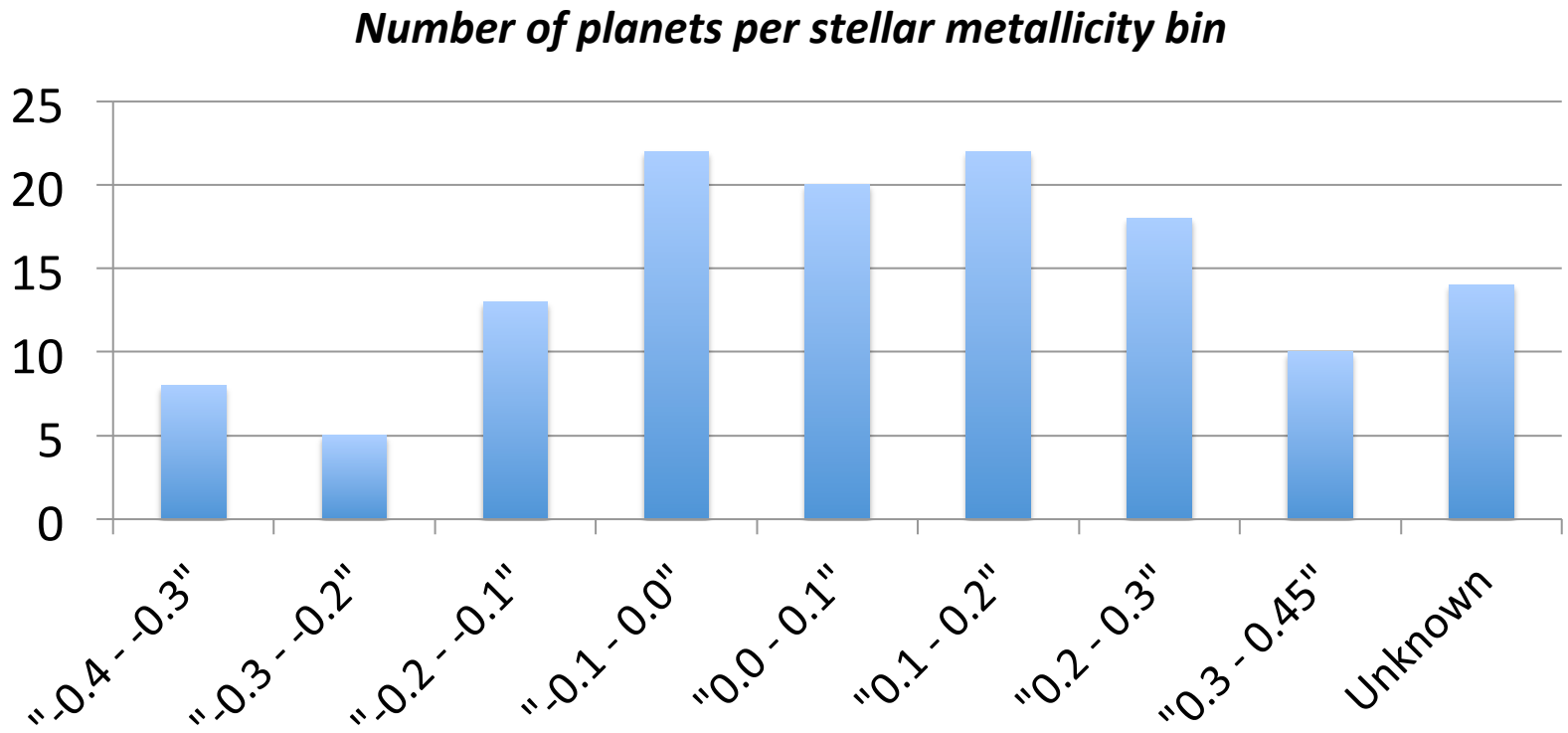
Number of planets per type



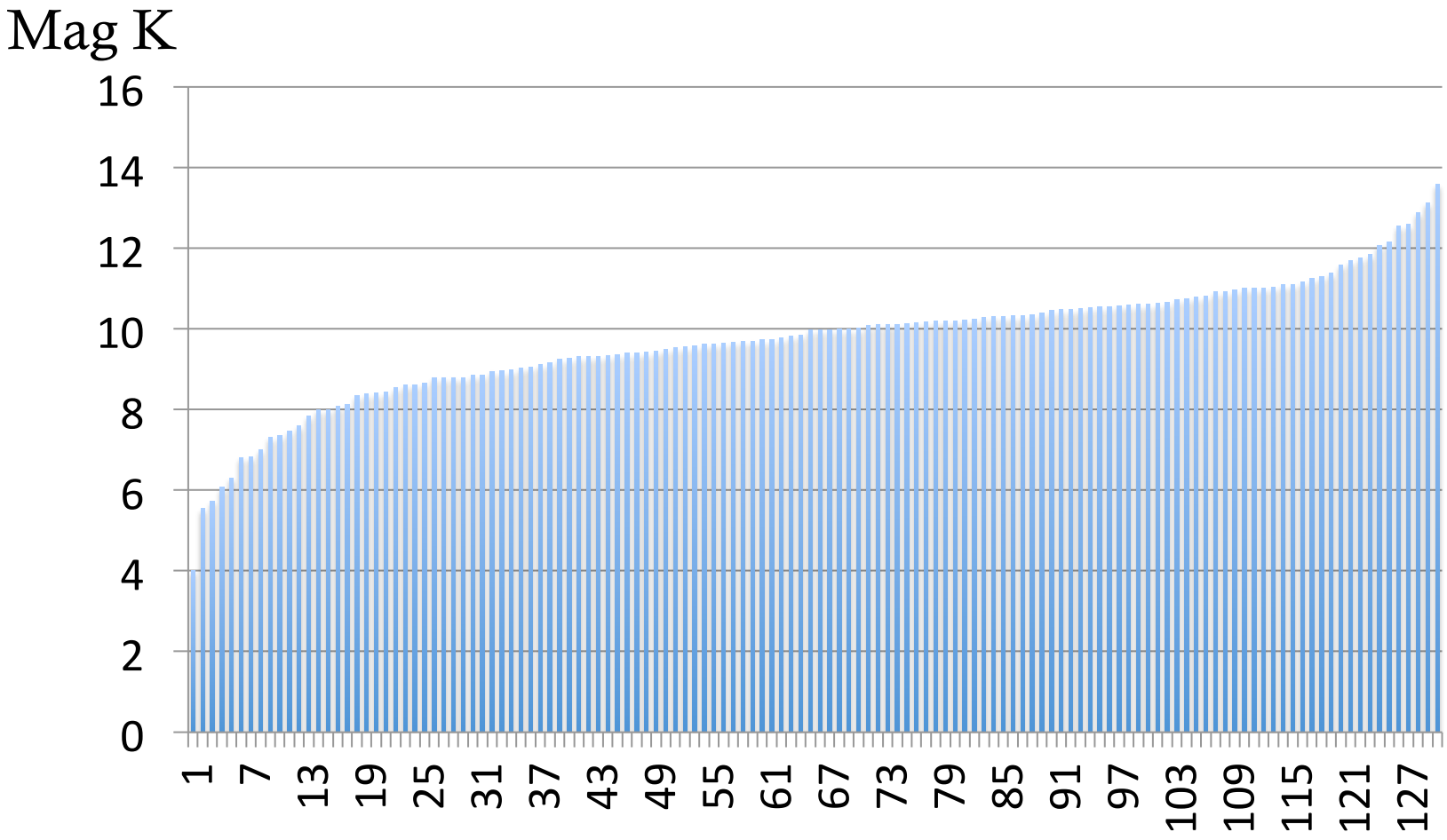
Stellar types



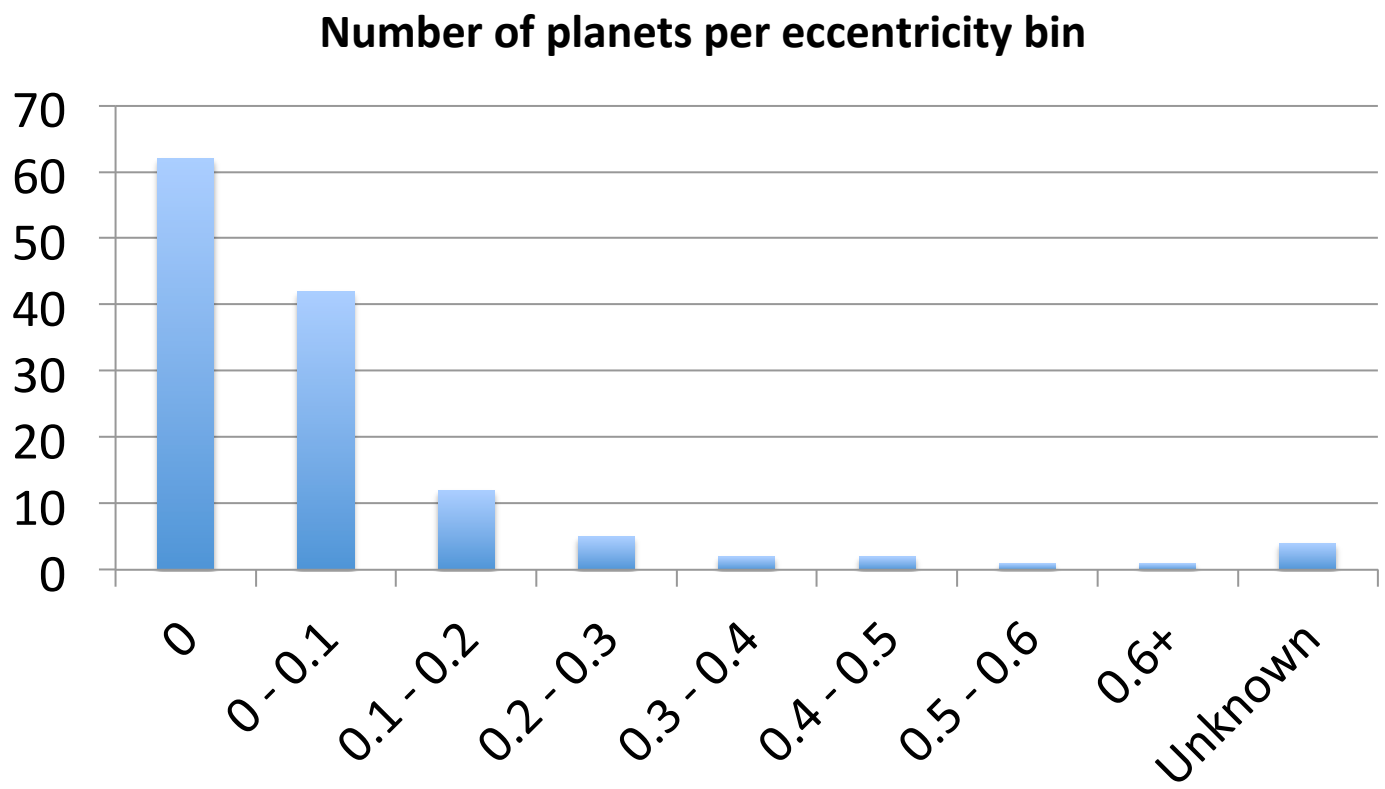
Stellar metallicity



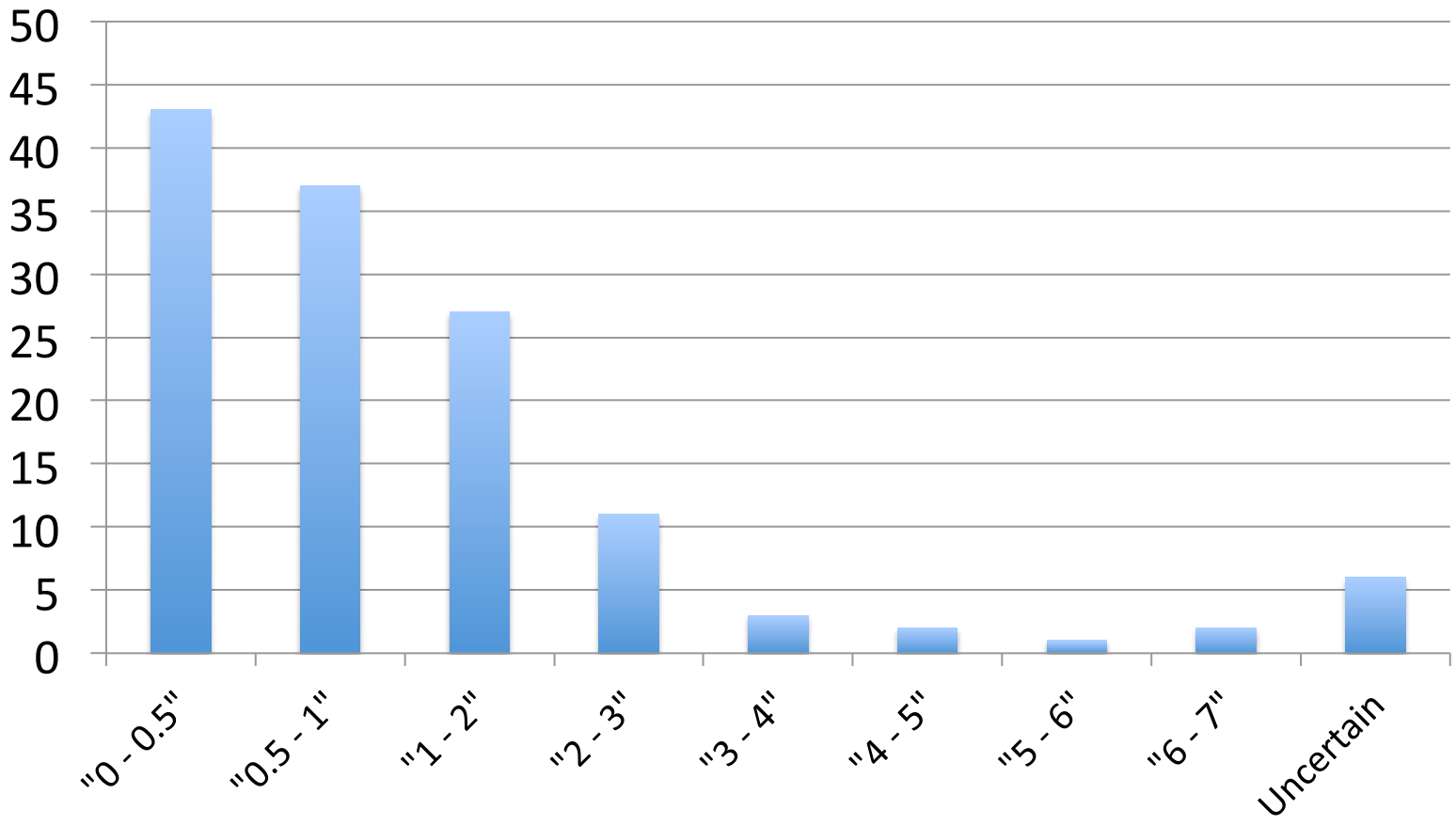
Stellar brightness



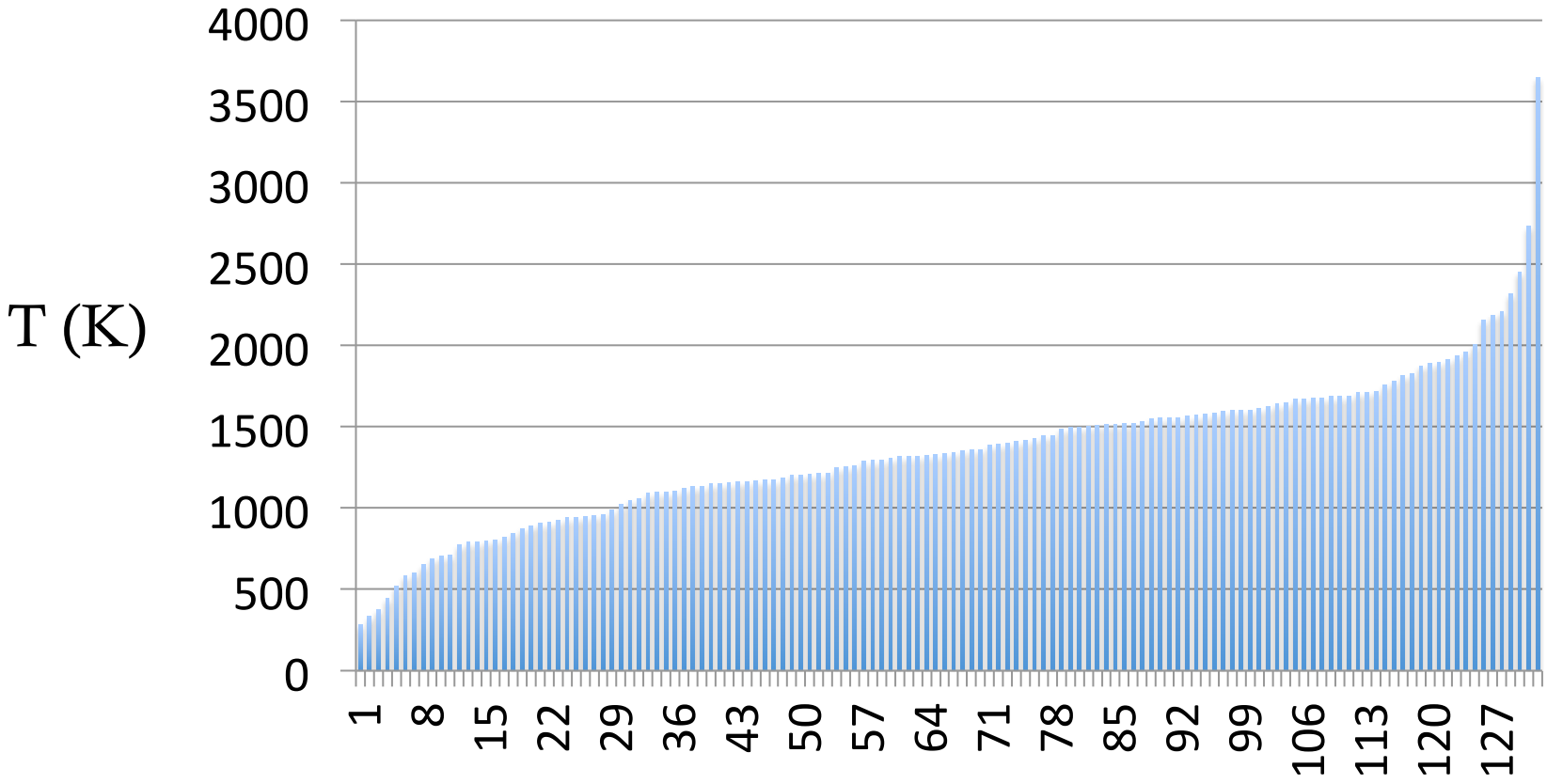
Orbital parameters: *Eccentricity*



Planetary parameters:
Density (g/cm^3)



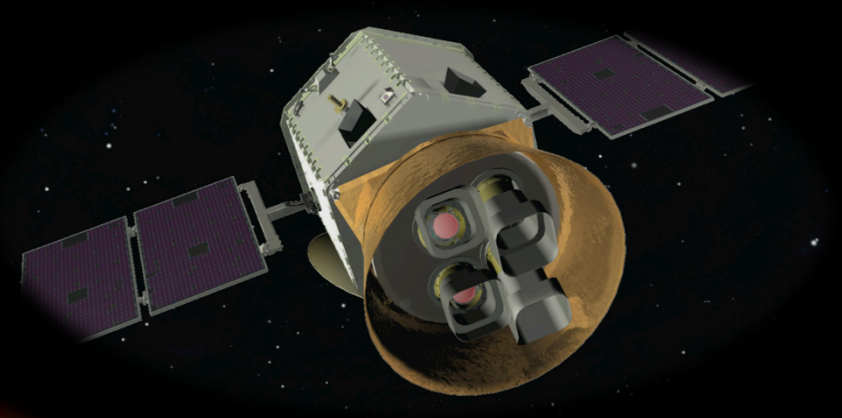
Planetary parameters:
Temperature

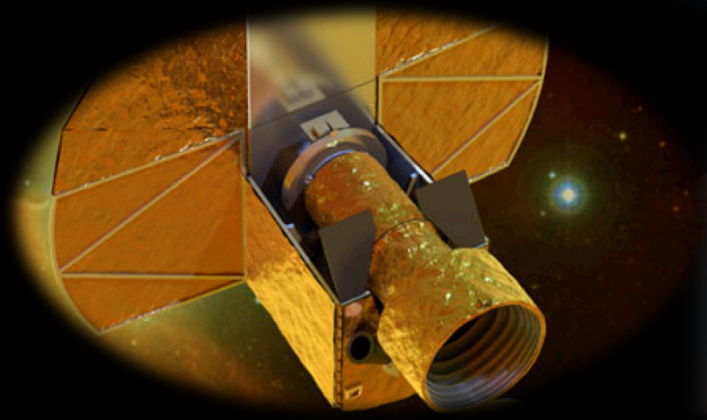


Transit-RV surveys

Expected to provide additional targets for EChO

- Cheops
- TESS
- HARPS North
- HAT-NET
- Super-WASP
- Carmenes
- M-Earth
- NGTS
- APACHI
- Spirou
- MASCARA



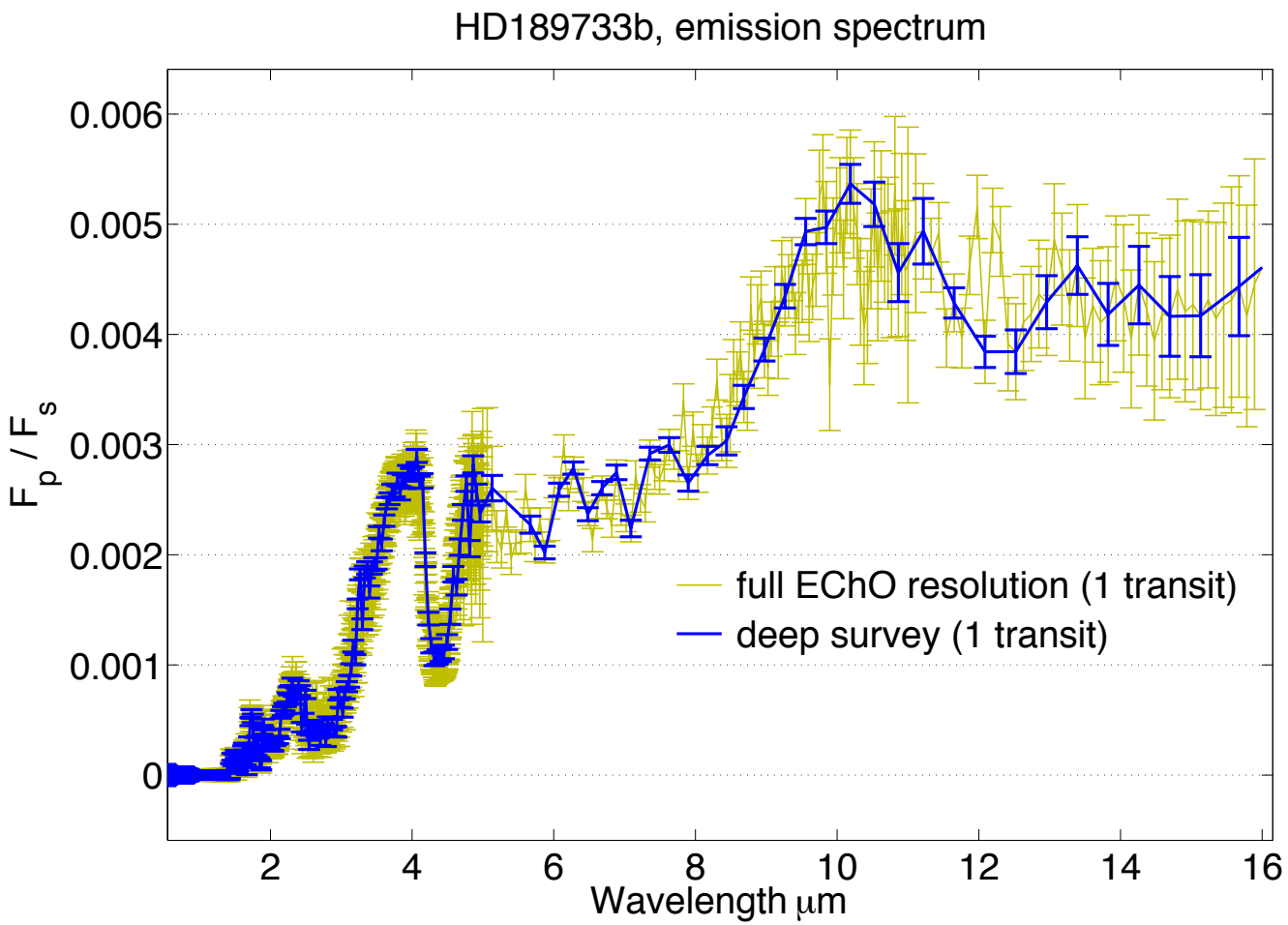


Origin

Understanding the origin of exoplanetary diversity

Origin

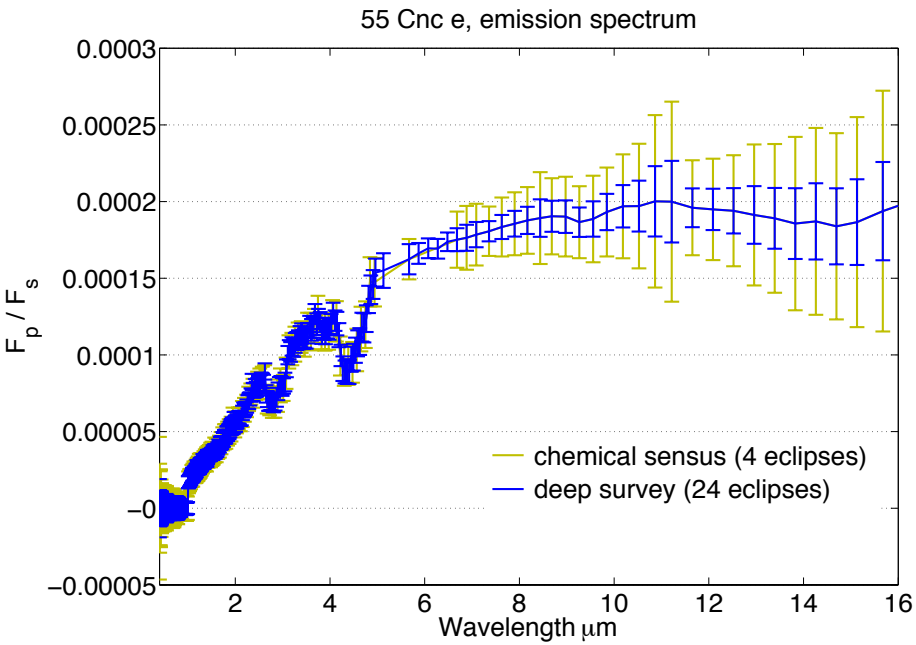
SNR~10 & R=100 λ<5μm; R=30 λ>5μm

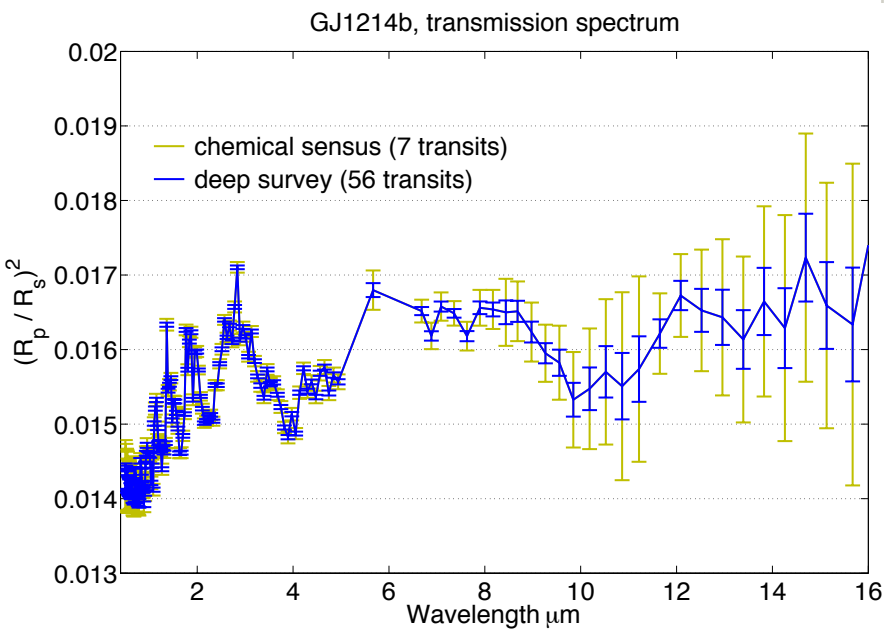


Origin:

SNR~10 & R=100 λ<5μm; R=30 λ>5μm

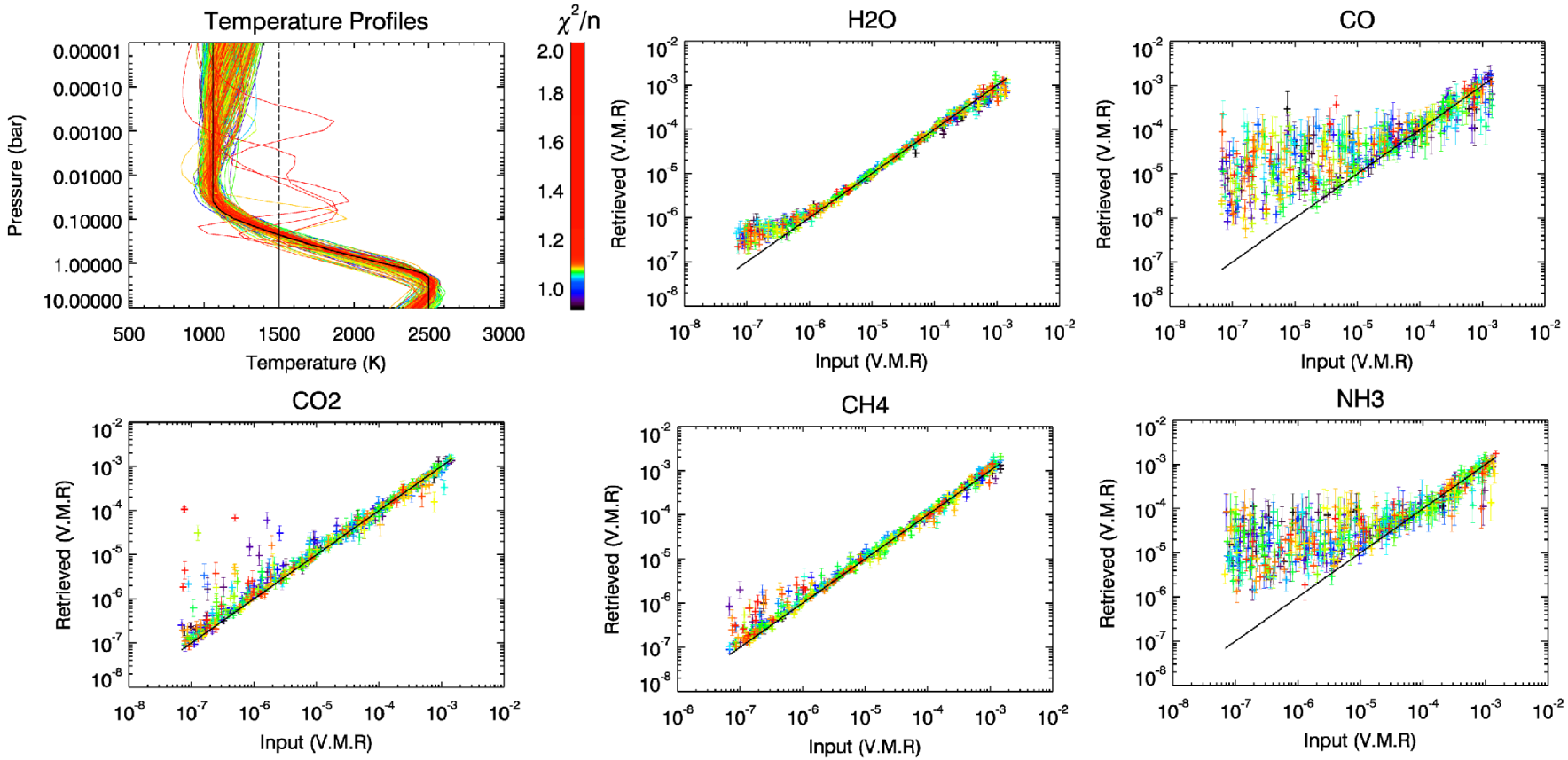
55 Cnc-e: 24 eclipses & GJ 1214b: 56 transits





Origin:

Spectral retrieval T-P & molecular abundances



Barstow et al., 2013

Origin:

Molecular abundances probed (e.g. GJ 436b)

	CH_4		CO		CO_2		
SNR	3.3 μm	8 μm	2.3 μm	4.6 μm	2.8 μm	4.3 μm	15 μm
10 / R=100	10^{-7}	10^{-6}	10^{-3}	10^{-5}	10^{-6}	10^{-7}	10^{-6}
5 / R=50	10^{-6}	10^{-5}	10^{-3}	10^{-4}	10^{-6}	10^{-7}	10^{-5}

	NH_3				HCN		
SNR	2.2 μm	3 μm	6.1 μm	10.5 μm	3 μm	7 μm	14 μm
10 / R=100	10^{-5}	10^{-6}	10^{-6}	10^{-6}	10^{-6}	10^{-5}	10^{-6}
5 / R=50	10^{-4}	10^{-5}	10^{-5}	10^{-5}	10^{-6}	10^{-4}	10^{-5}

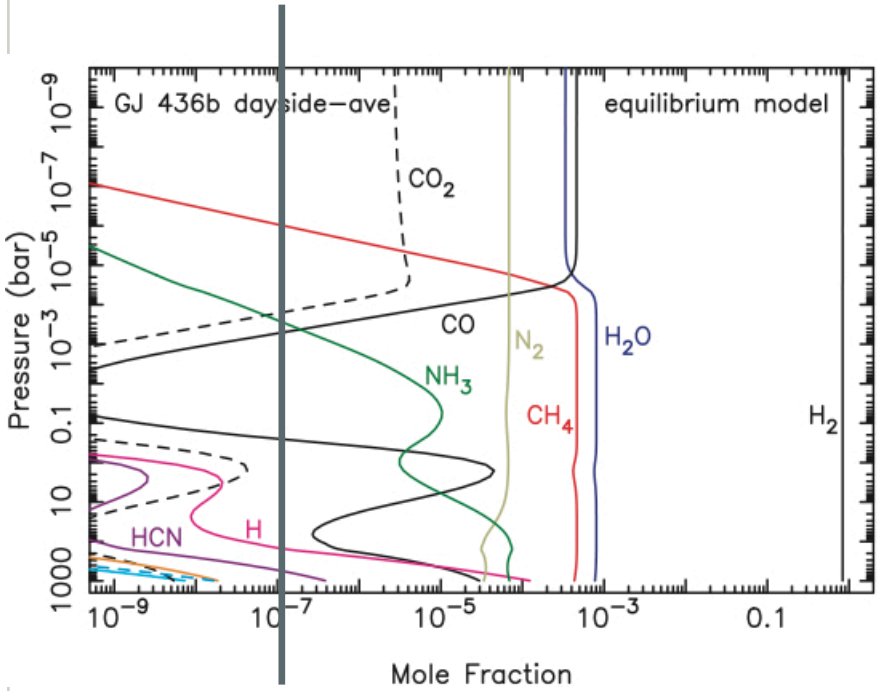
	C_2H_6		H_2S			C_2H_2		
SNR	3.3 μm	12.2 μm	2.6 μm	4.25 μm	8 μm	3 μm	7.5 μm	13.7 μm
10 / R=100	10^{-5}	10^{-5}	10^{-5}	10^{-4}	10^{-3}	10^{-7}	10^{-4}	10^{-6}
5 / R=50	10^{-4}	10^{-5}	10^{-4}	10^{-3}	-	10^{-6}	10^{-3}	10^{-5}

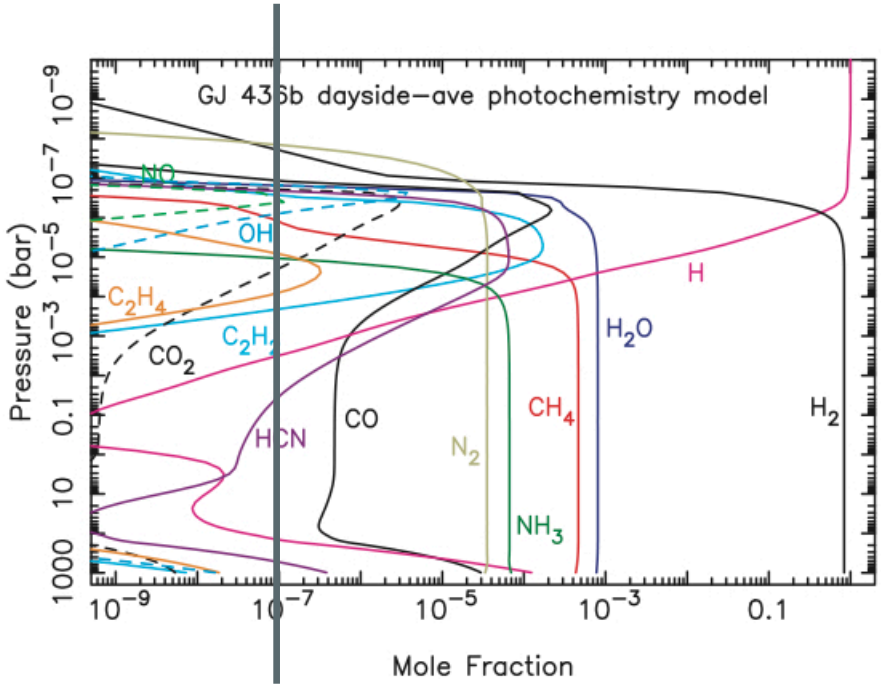
	PH_3		H_2O		
SNR	4.3 μm	10 μm	2.8 μm	5 - 8 μm	11 - 16 μm
10 / R=100	10^{-7}	10^{-6}	10^{-6}	10^{-5}	10^{-4}
5 / R=50	10^{-6}	10^{-5}	10^{-5}	10^{-5}	10^{-4}

Tessenyi et al., 2013

Origin:

Understanding the role of non-equilibrium chemistry





Moses et al., 2013

Origin:

Understanding planet formation / migration processes

Formation by gravitational instability

↓

Planet is characterized by solar bulk composition

Formation by nucleated instability

↓

Planet is characterized by over-abundances in high-Z elements

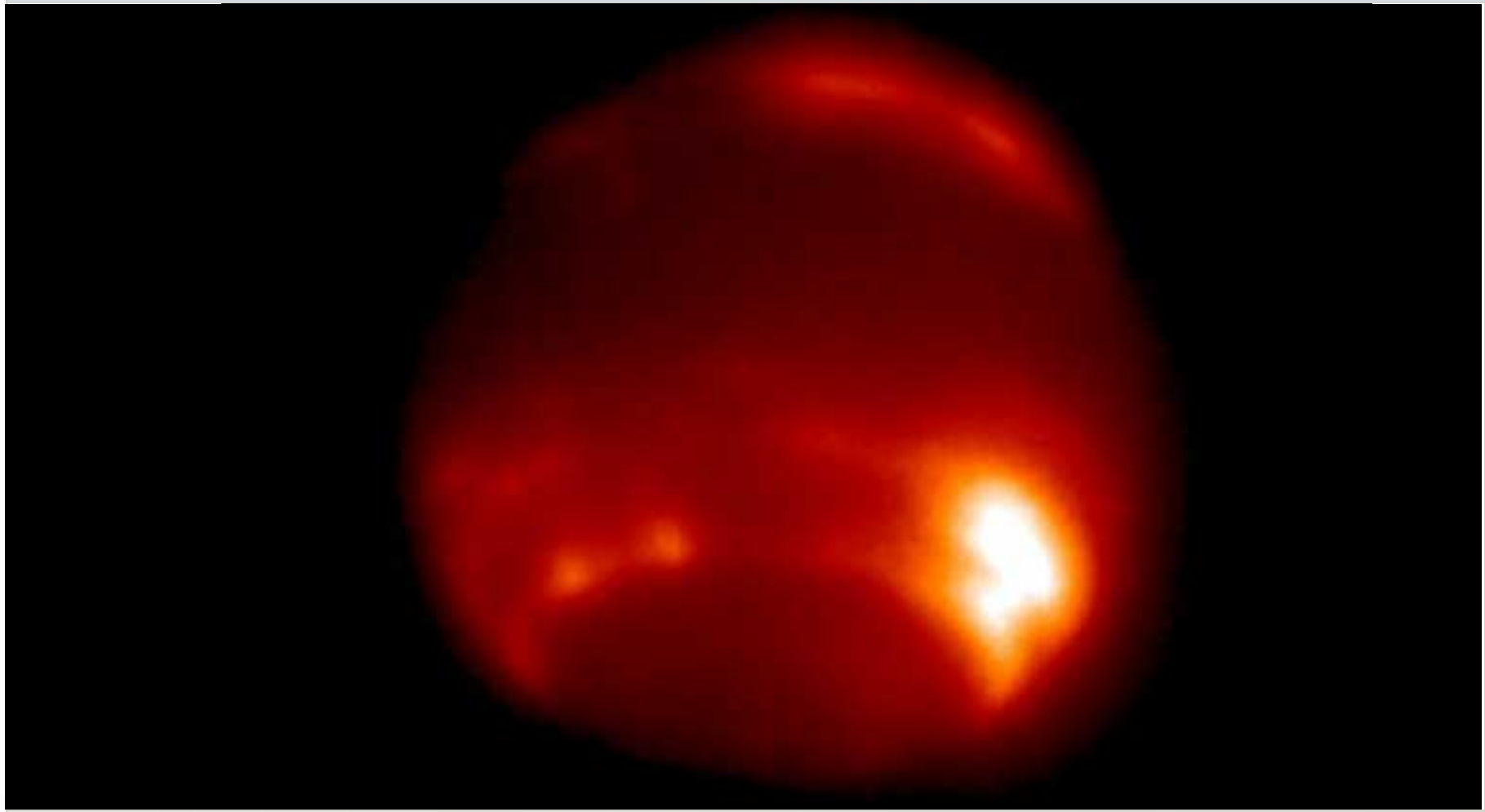
Courtesy of Turrini & Nelson

Origin:
Currently observable targets

- Today 50-60 planets out of the 130 are observable in Origin mode.
- Most of them could be in transit & eclipse.
- What % Chemical Census and what % Origin? A bit a matter of choice… Important feedback from open community

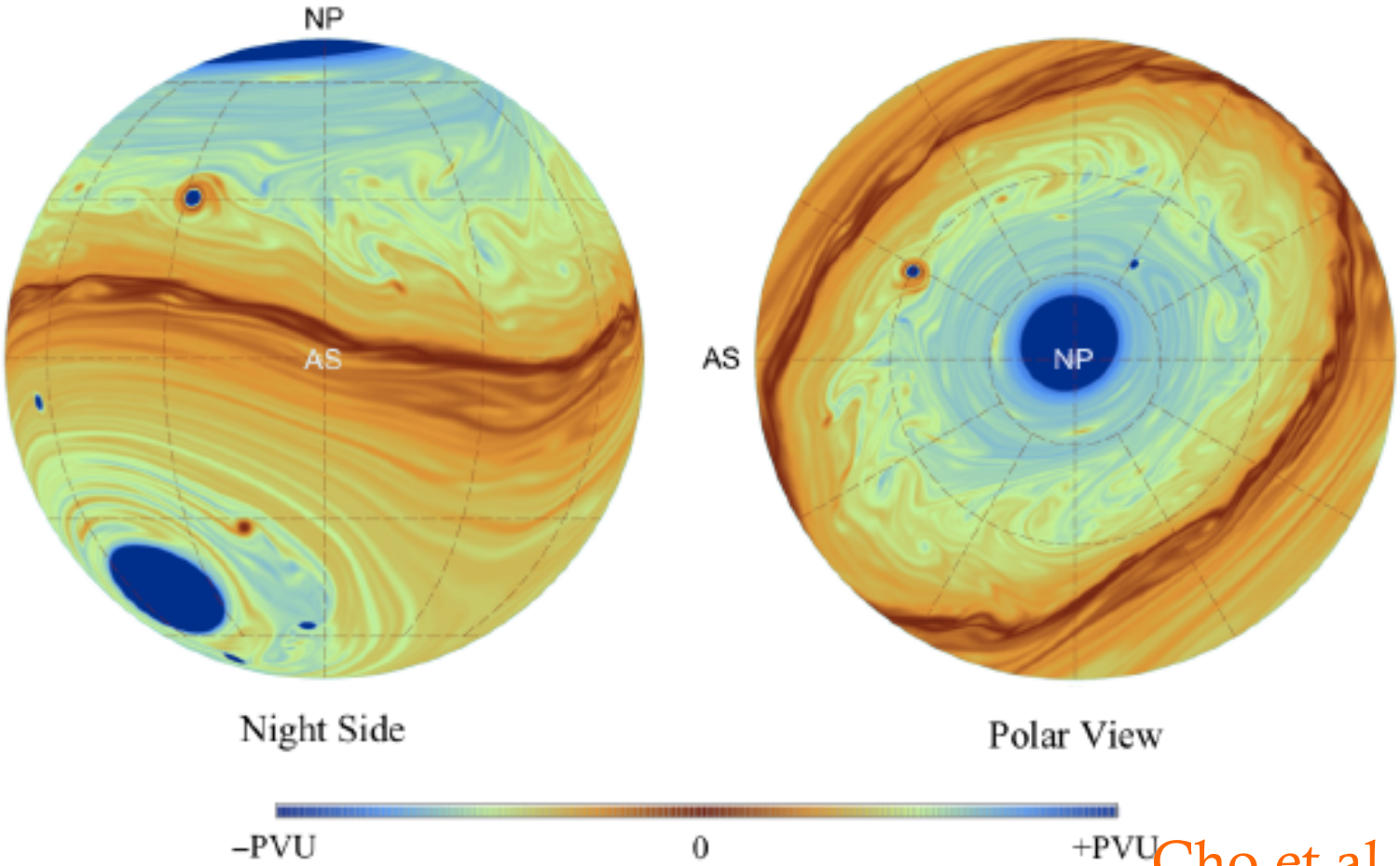
Exo-meteo/maps & Rosetta Stones

Weather, 2D-3D maps & Benchmark cases



Weather: temporal variability

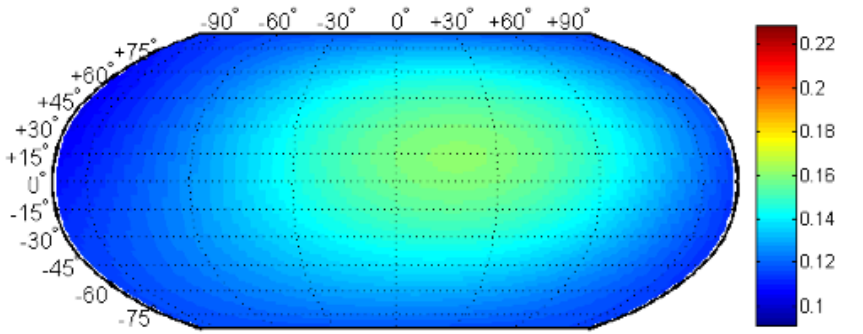
Understanding the role of dynamics

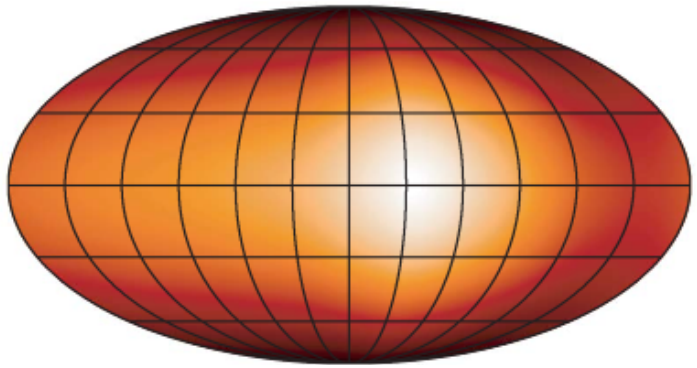


Cho et al, 2006

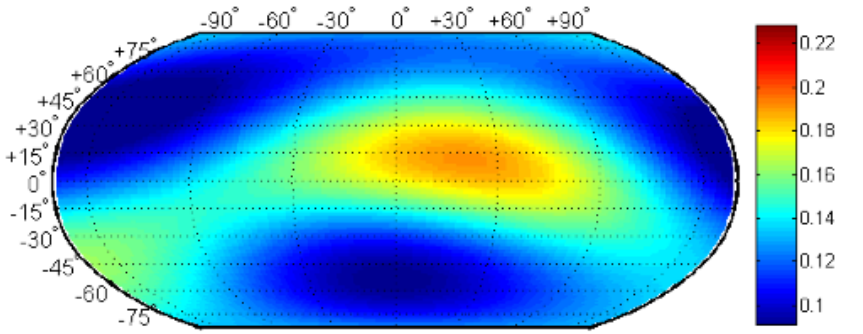
Climate: orbital phases

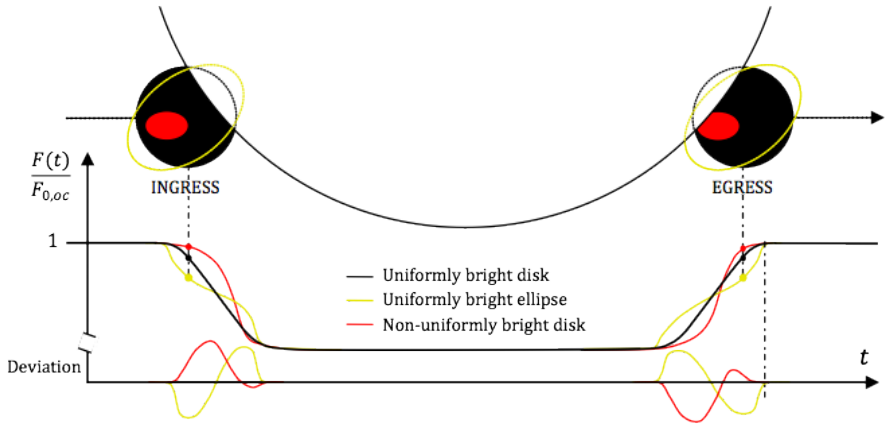
Understanding the role of dynamics





(a)

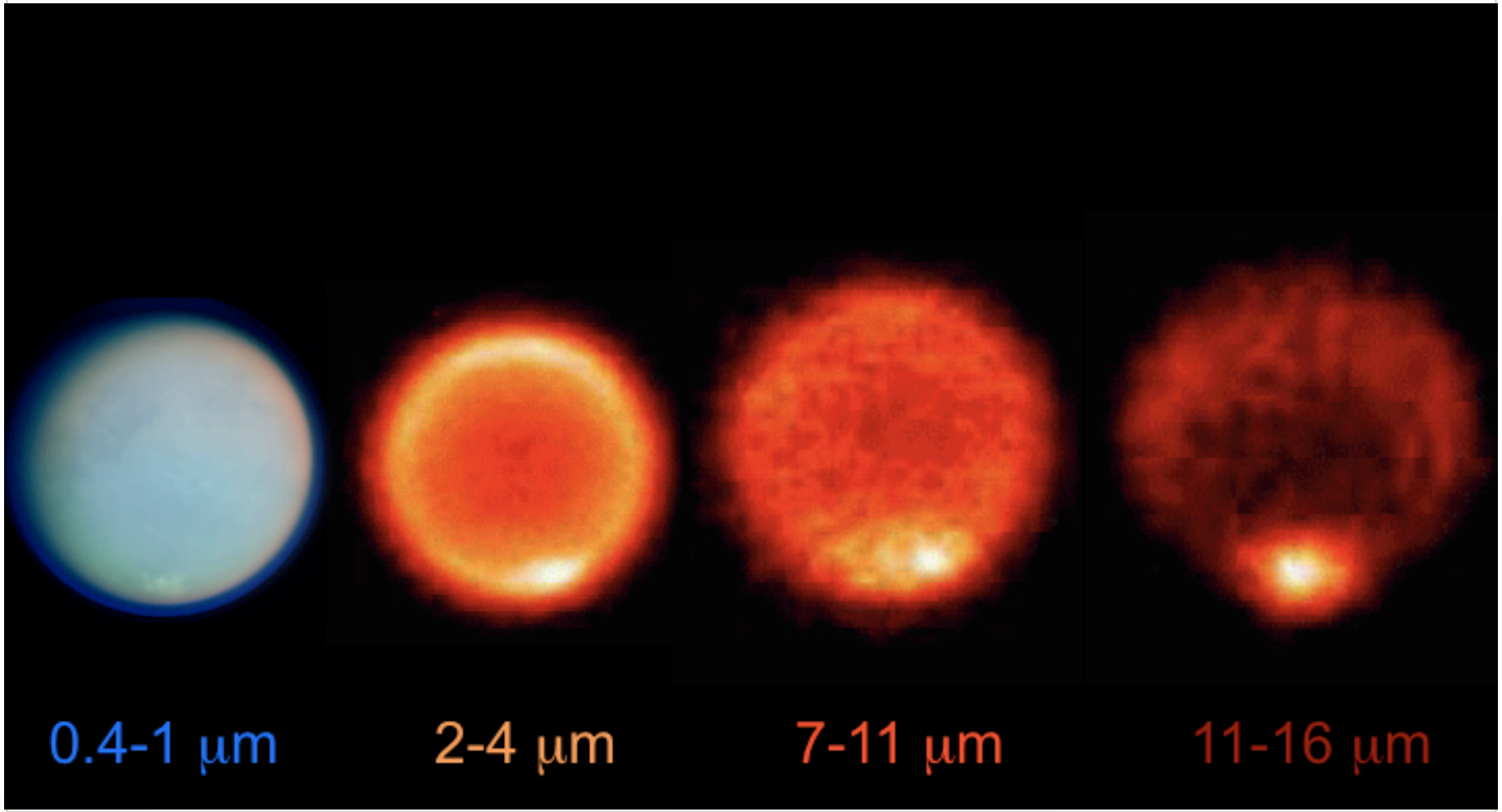




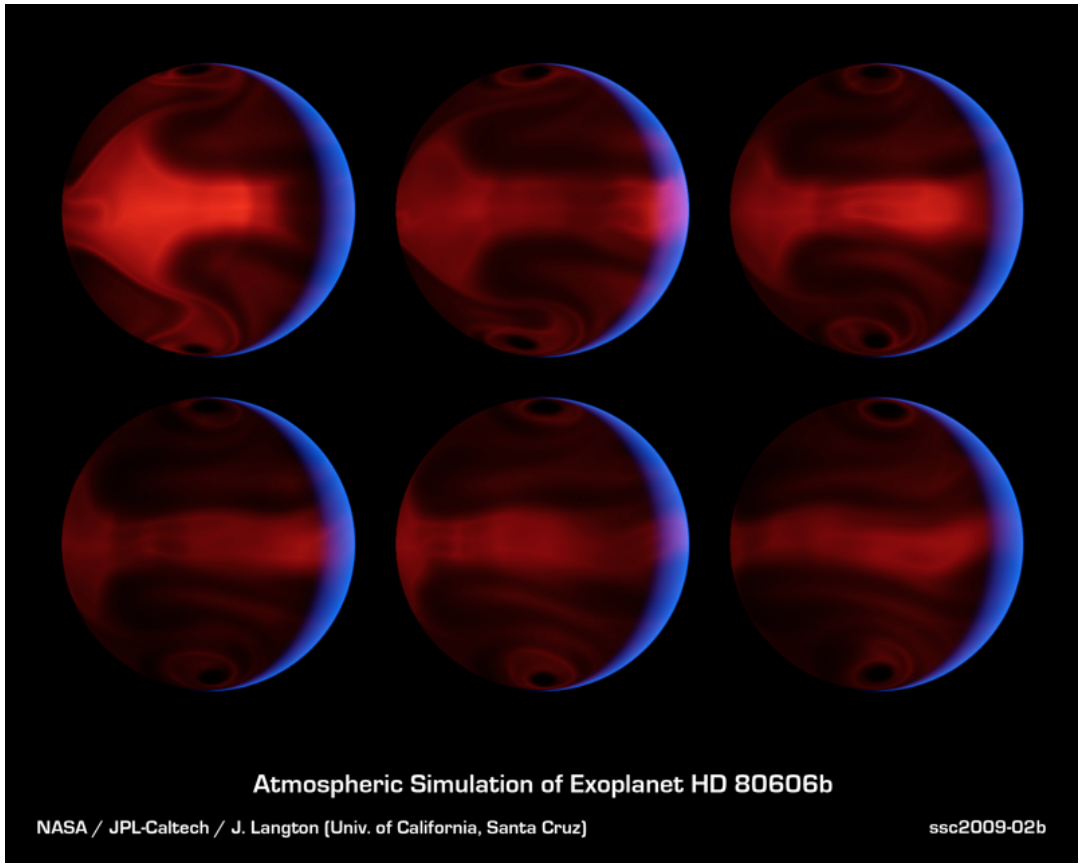
Knutson et al, 2008; De Wit et al., 2012

2D Images of the planet

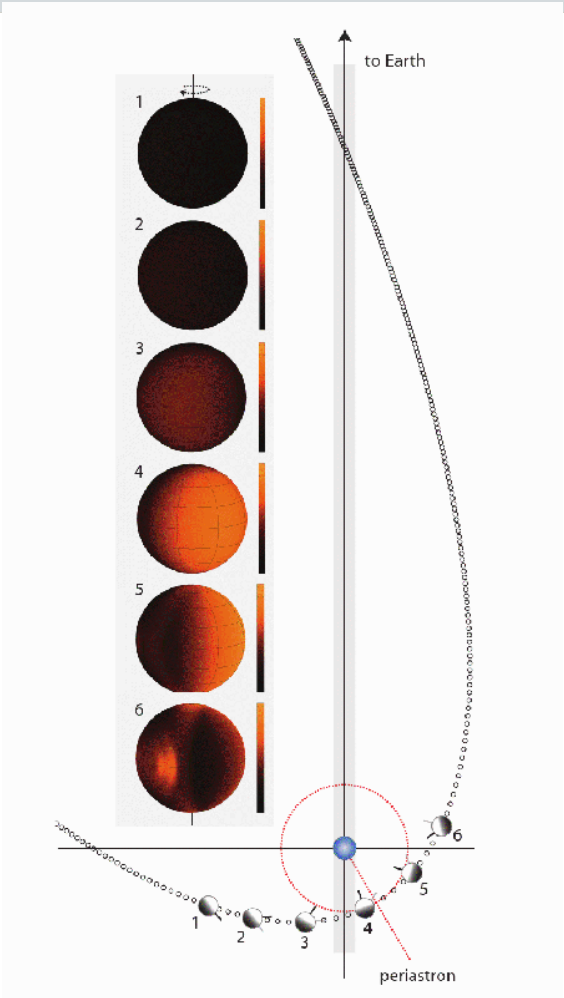
Spatial variability



Climate on highly eccentric planets

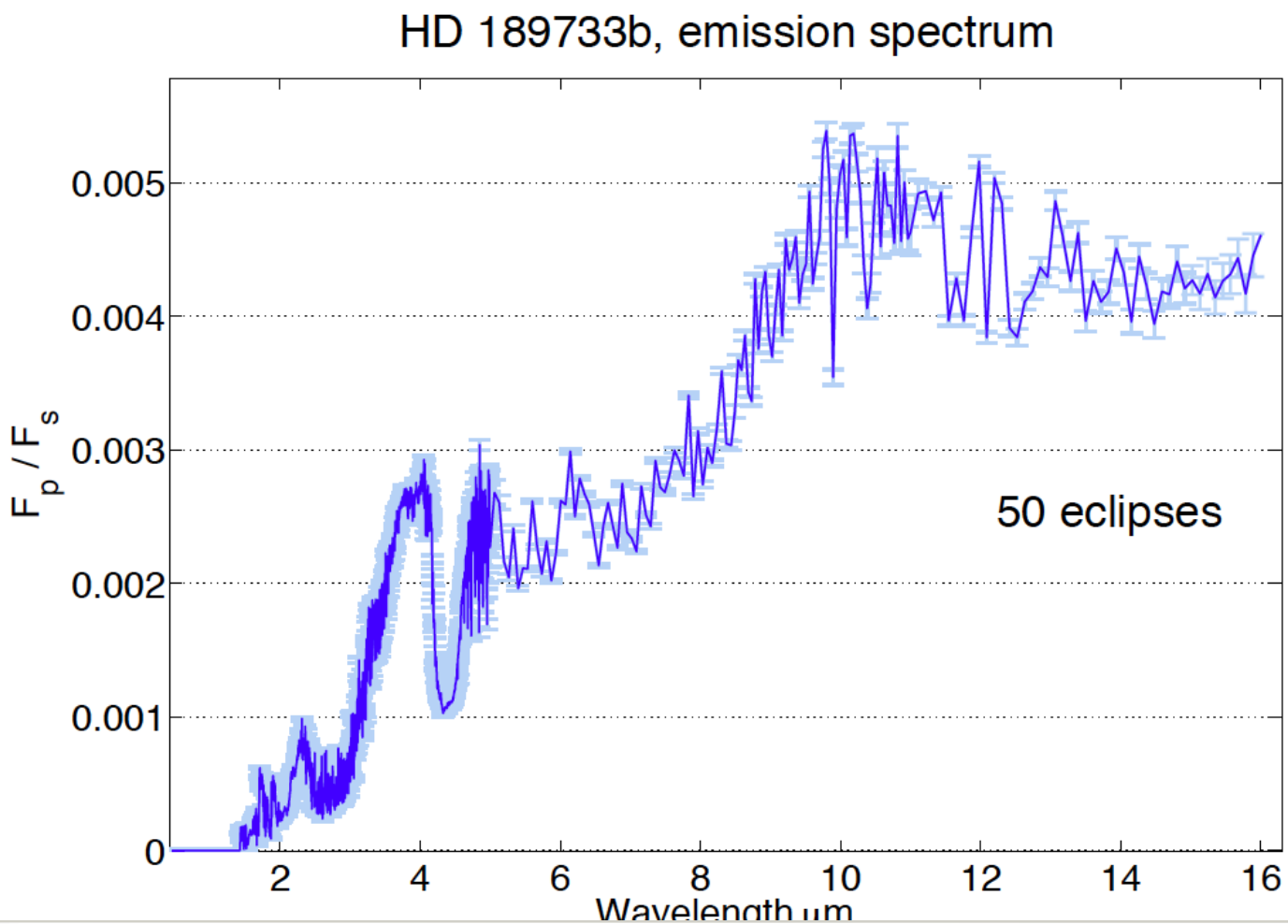


Laughlin et al., 2009



Rosetta Stones

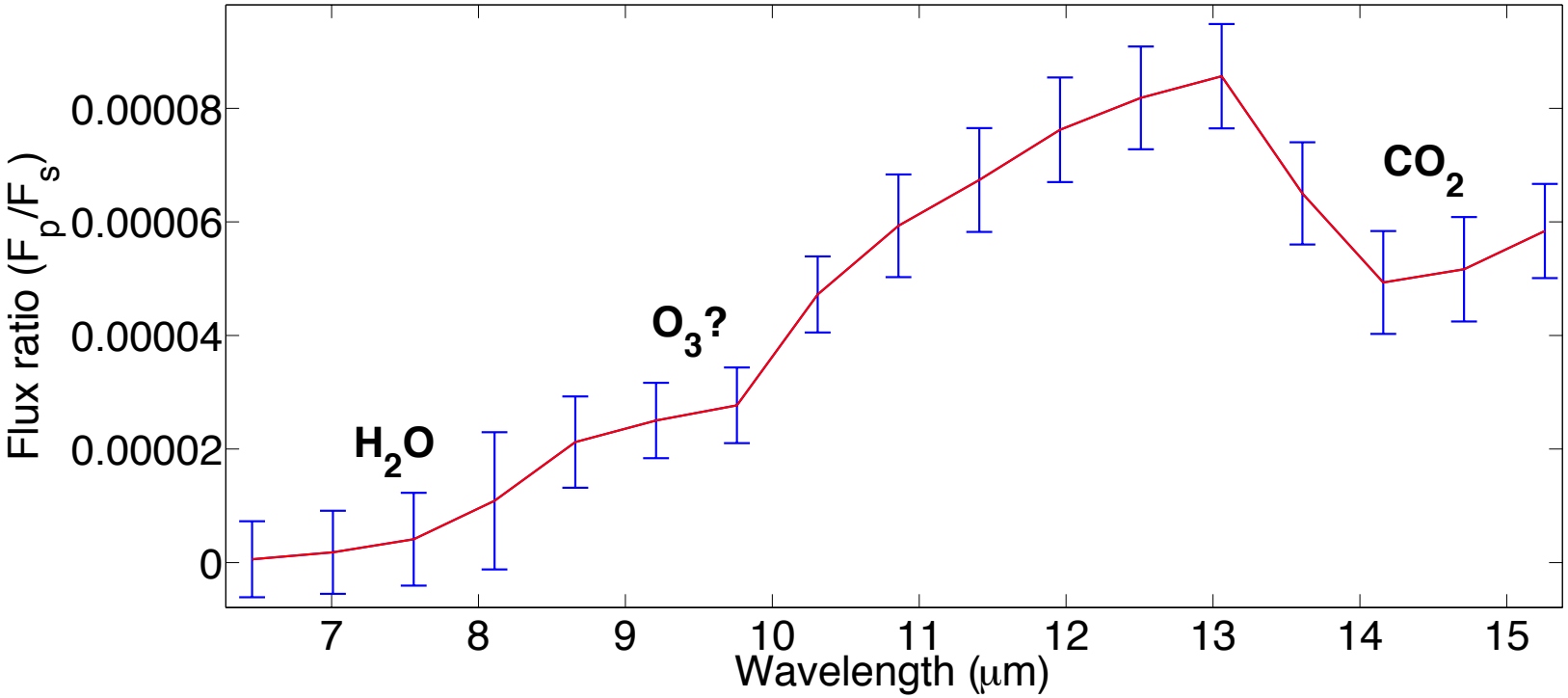
Benchmark cases to understand classes of planets



Rosetta Stones

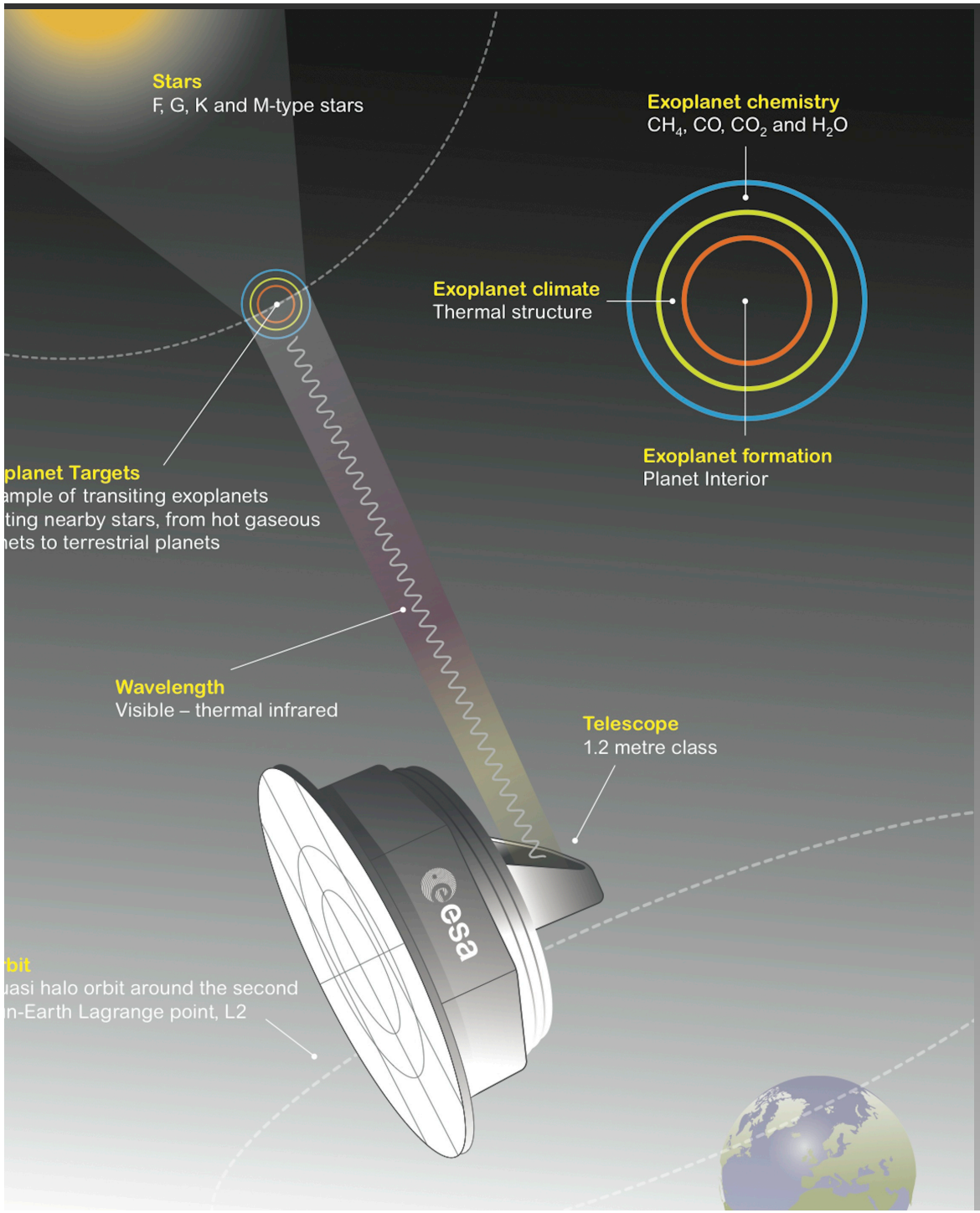
SNR~5, low R

Temperate super-Earth around a late M?



Exo-Meteo/Maps, Rosetta Stones

- HD189733b (~ 30 days for 100 transits)
- HD209458b (~ 40 days for 100 transits)
- WASP-33b & WASP-18b (eclipse)
- GJ436b
- GJ 3470b
- GJ1214b
- 55 Cnc e
- …….


Stars
F, G, K and M-type stars
Exoplanet chemistry
CH_4, CO, CO_2 and H_2O
Exoplanet climate
Thermal structure
Exoplanet formation
Planet Interior
planet Targets
ample of transiting exoplanets
ting nearby stars, from hot gaseous
ets to terrestrial planets
Wavelength
Visible – thermal infrared
Telescope
1.2 metre class
esa
bit
asi halo orbit around the second
n-Earth Lagrange point, L2

Join

ECh O!

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