# Key issues with current data

1. Data are sparse, not enough wl coverage, and often not simultaneous

2. Absolute calibration at the level of 10^{-4} is NOT guaranteed by current instruments: *Caution when we combine multiple datasets*!

3. We are dealing with very low SNR/R observations

4. Instrument systematics are often difficult to disentangle from the signal

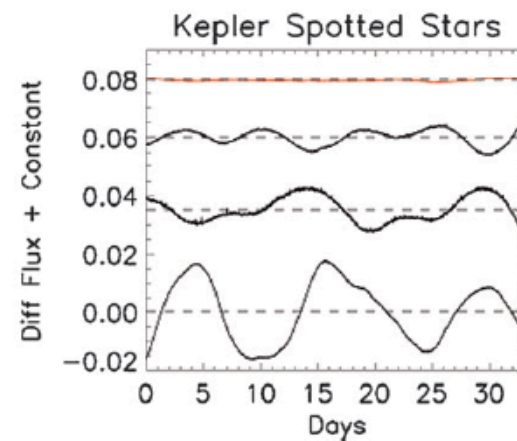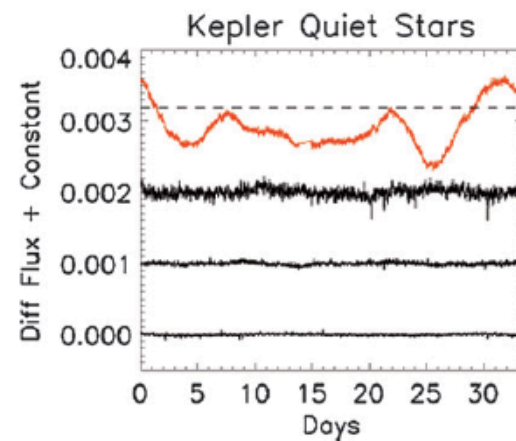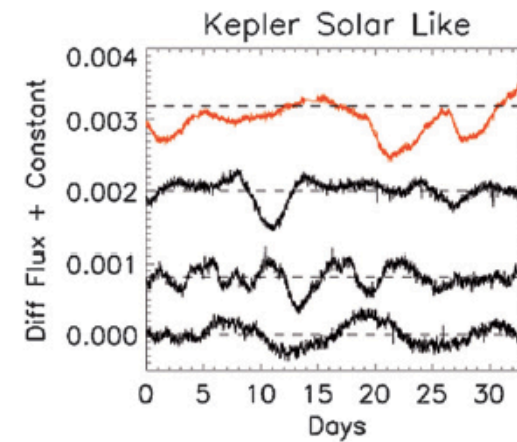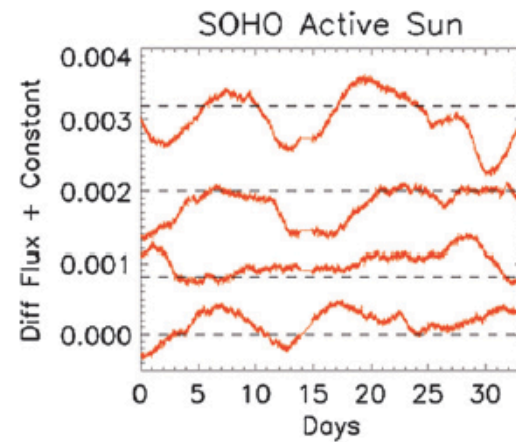5. Stellar activity is the largest source of astrophysical noise

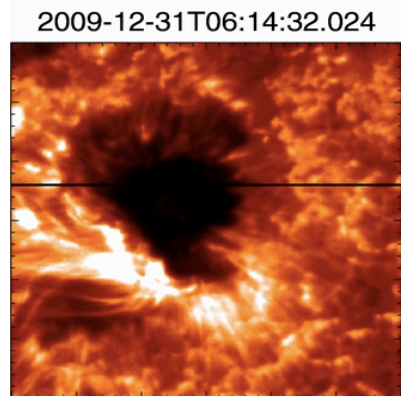# Current data are sparse & often not simultaneous
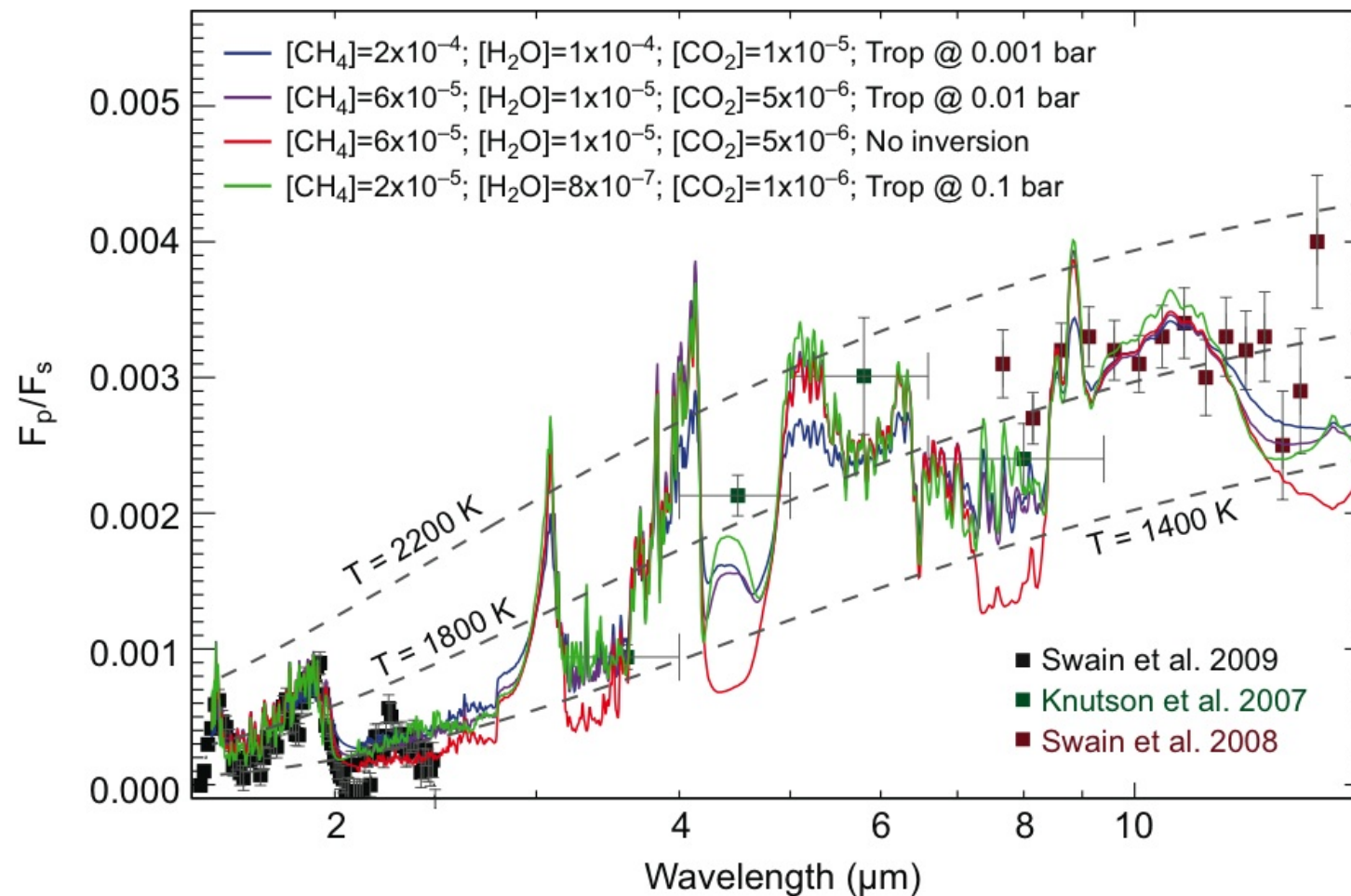
Examples of instrument systematics
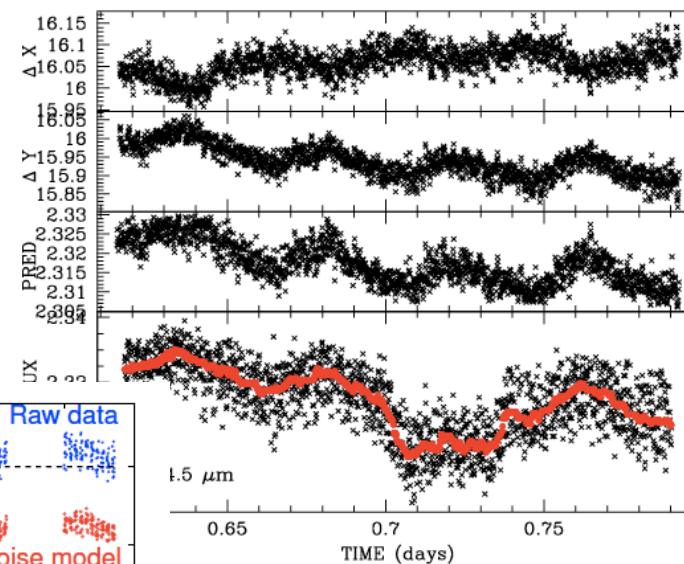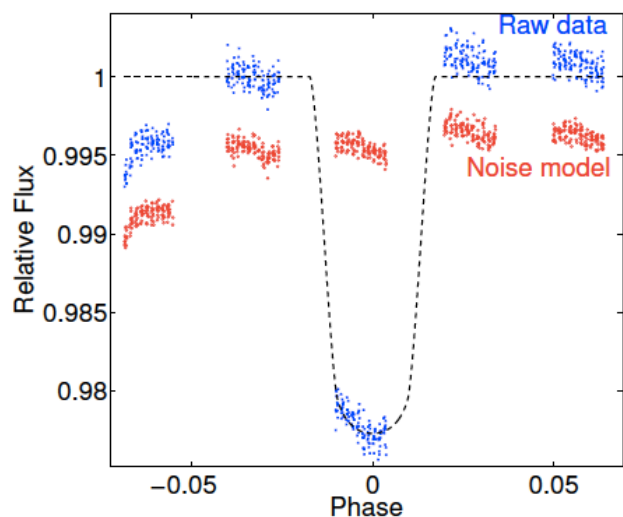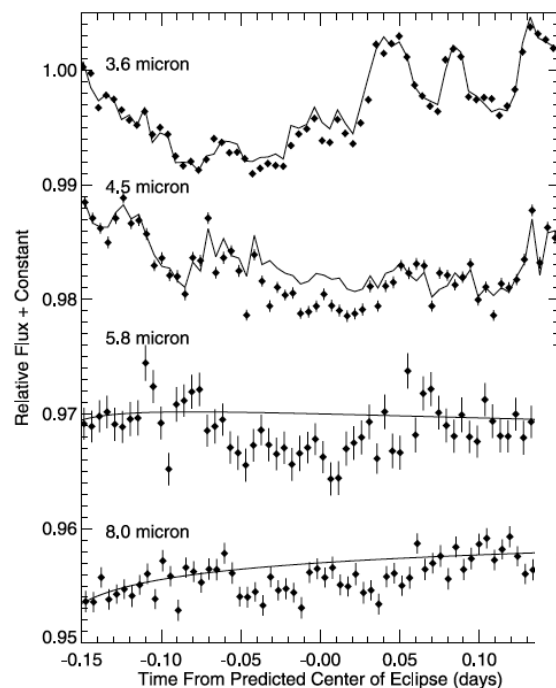
Stellar activity
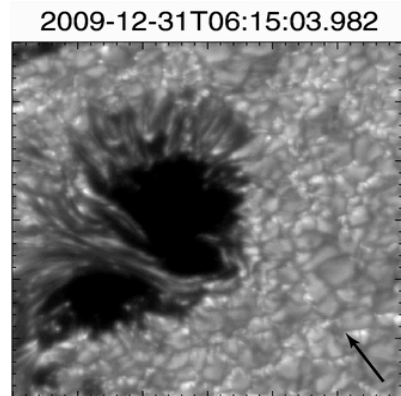
Basri et al, 2010

Big picture?

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We need a dedicated mission!

Gaseous planets
formed in situ? elsewhere and migrated?

Planet formation
Enrichment

Energy budget
Albedo/thermal
emission

Planet-star interaction
Photochemistry+
Day/night variation

Weather
Temporal variability/
T-P profile

Planet evolution
Escape/H_3^+
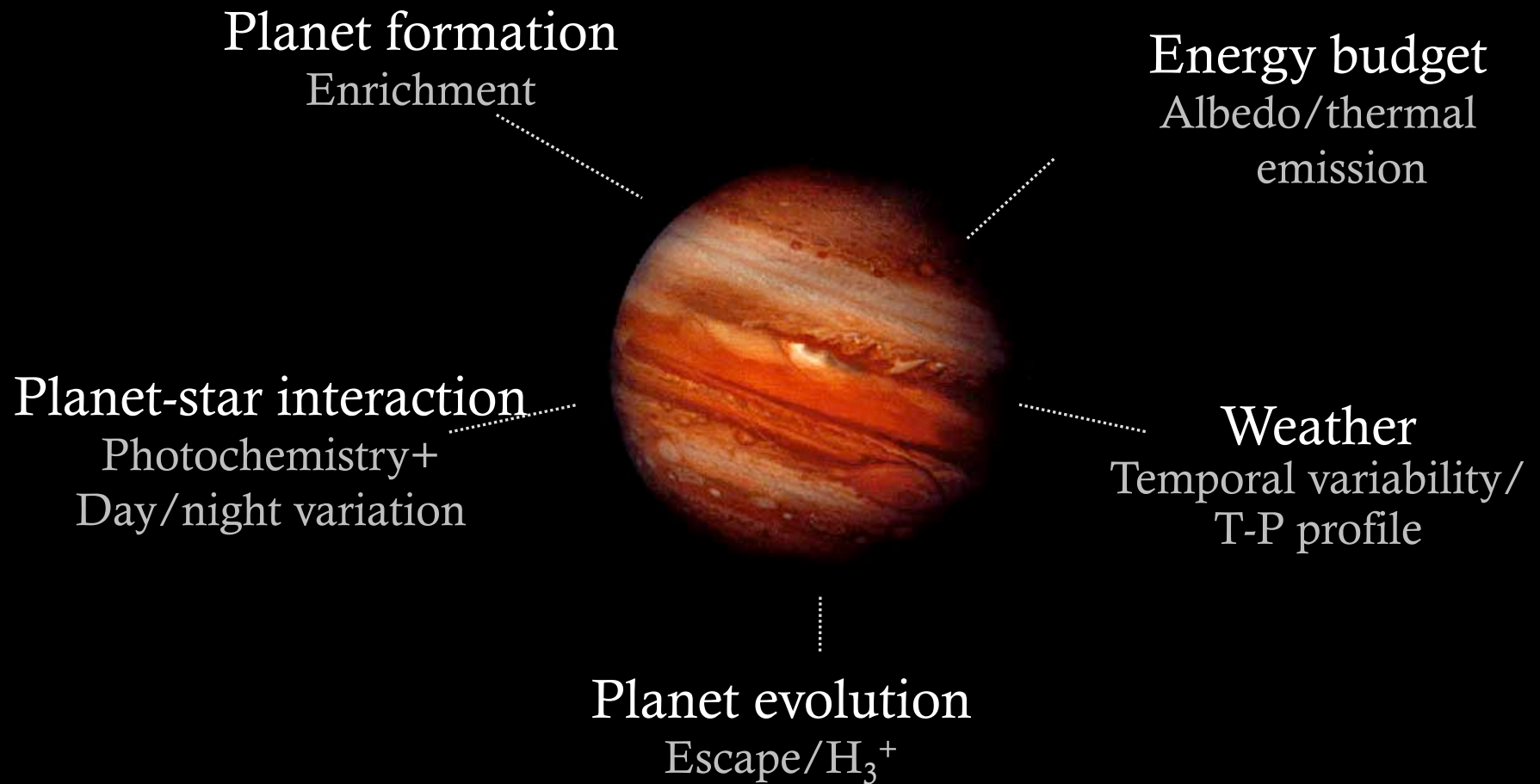
Terrestrial planets

formed in situ? Or remnant of gaseous planets' core?

Primary or secondary atmosphere?
H_2 retained or not

Does the planet have an atmosphere?
Spectral observations

Energy budget
Albedo/thermal emission

Habitable conditions?
Temperature? H_2O?

Main atmospheric component
Primary transit observations

Planet-star interaction
Photochemistry
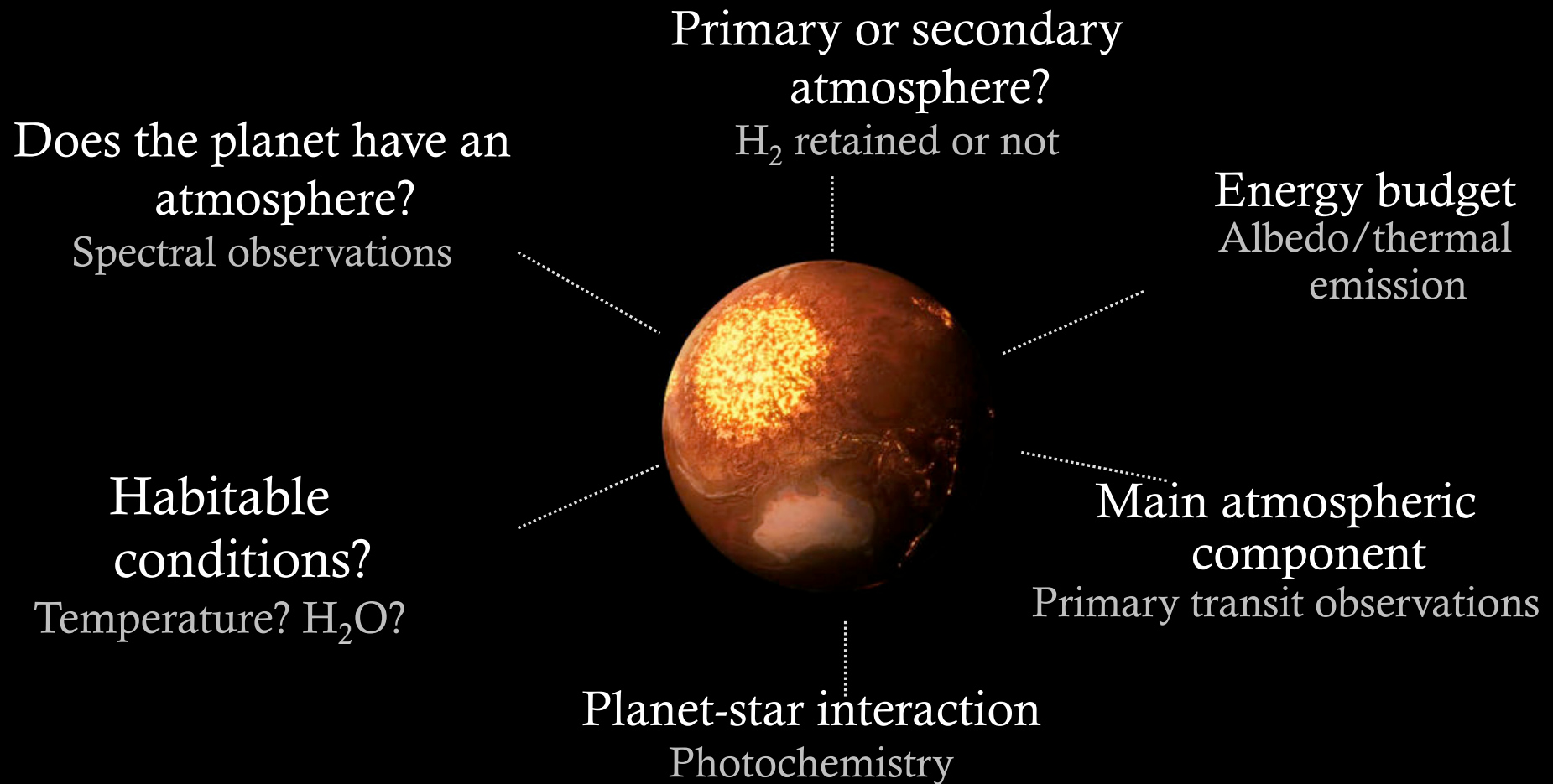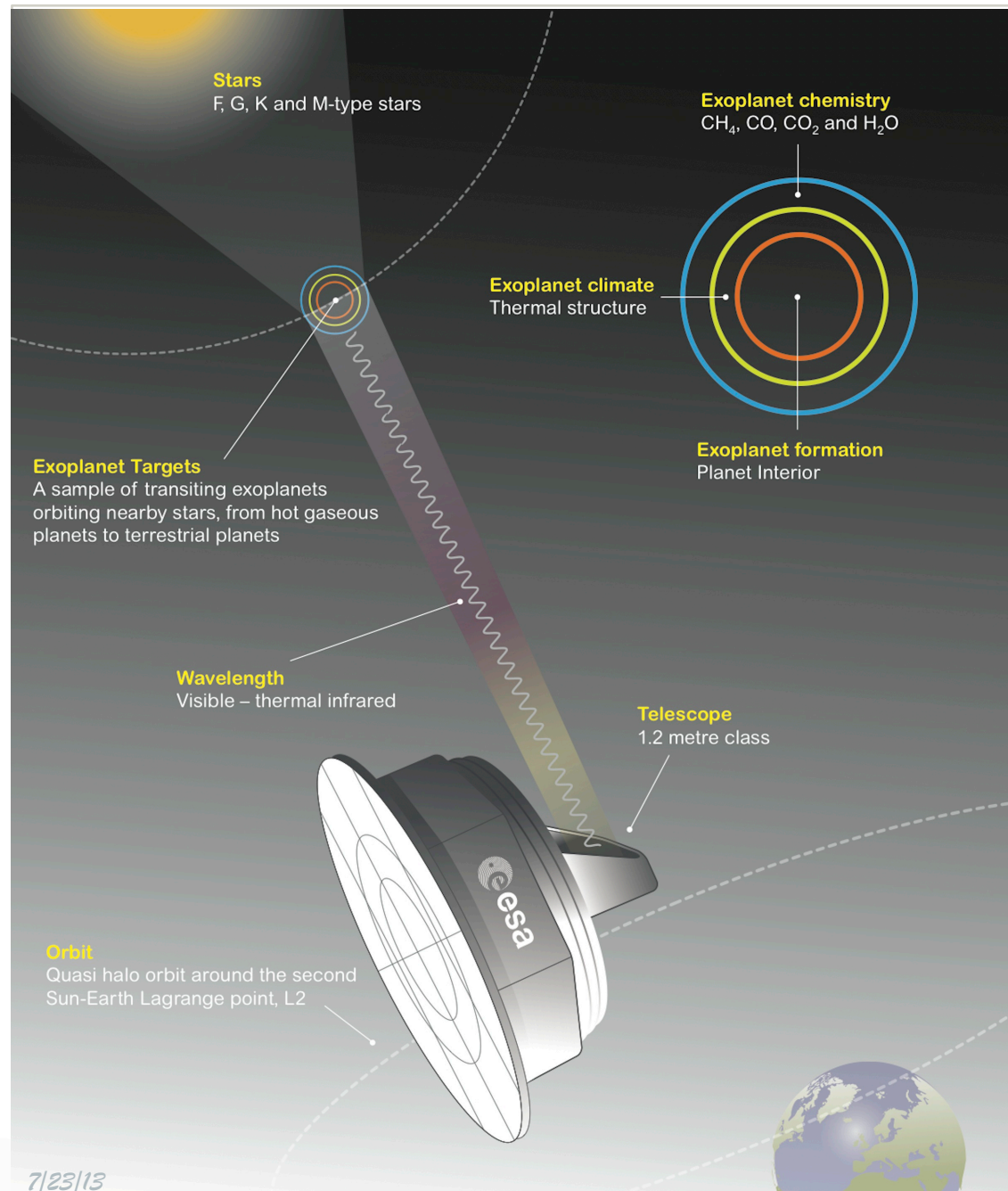
EChO

1.2 m telescope in L2

- *Spectroscopy of exoplanets*
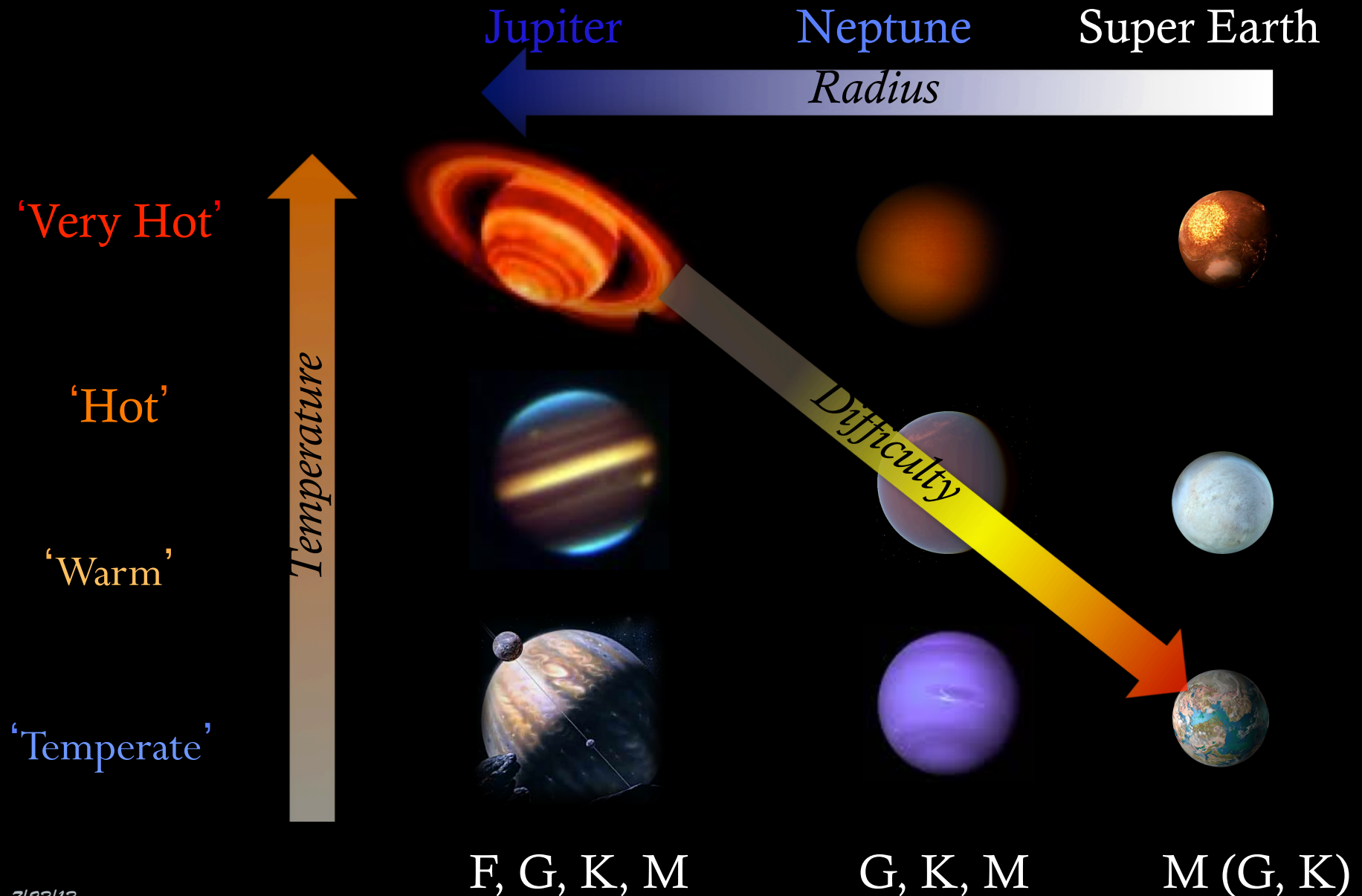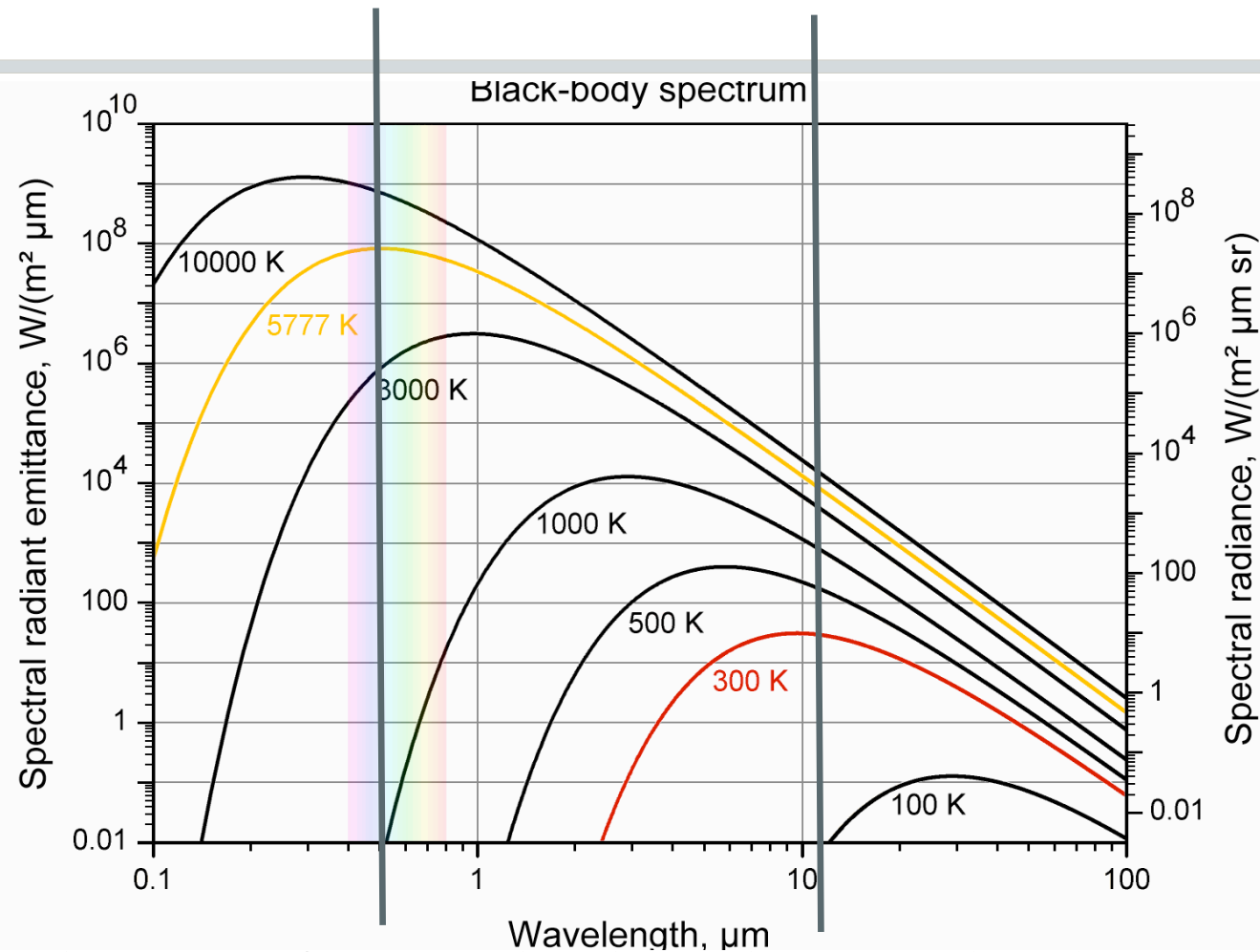
- *Simultaneous 0.55-11 (0.4-16) µm*

- *Stable (10^{-4} in 10 hours)*

Planets considered by EChO

Jupiter   Neptune   Super Earth

Radius

'Very Hot'

'Hot'

'Warm'

'Temperate'

Temperature

Difficulty

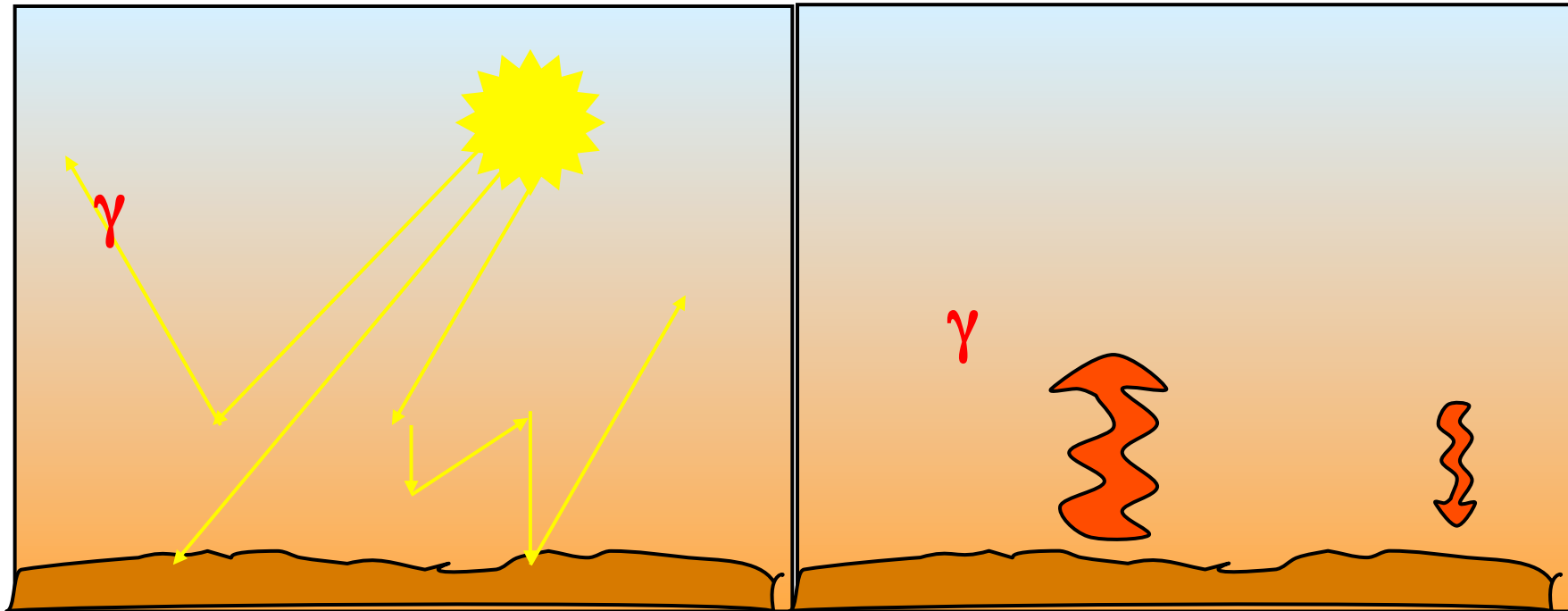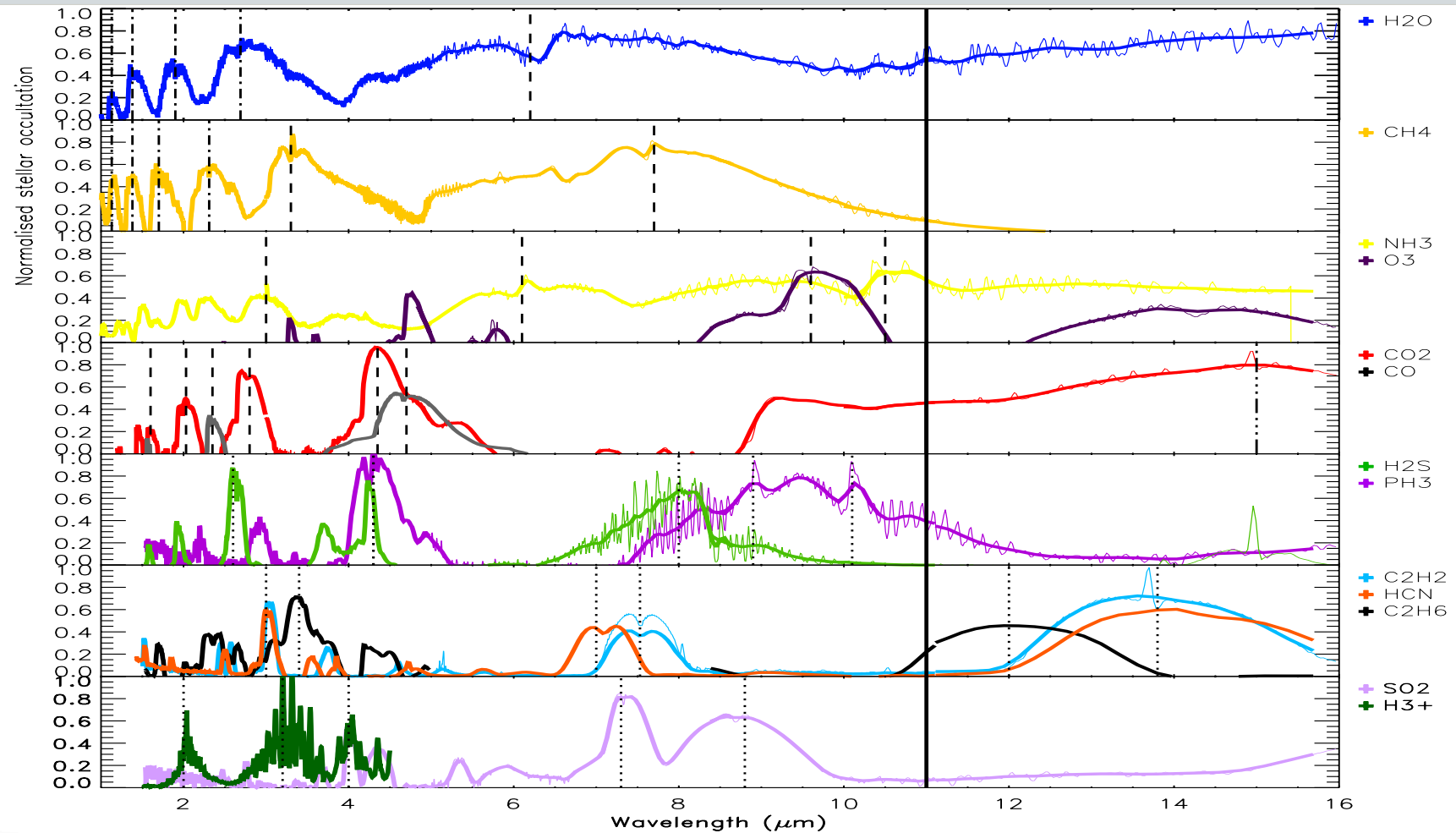F, G, K, M   G, K, M   M (G, K)

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Spectral coverage

Given the range of T considered, need to extend to the Mid-IR

Energy budget

Need for both VIS and IR to understand the planetary energy budget.

Broad wavelength coverage:
redundancy for molecular detections

EChO's 3 observing modes

- **Chemical census** (survey)
  - *Exploring exoplanet chemical diversity*

- **Origin** (deep survey)
  - *Understanding the origin of exoplanet diversity*

- **Exo-Meteo/Maps, Rosetta Stones** (ultra-deep survey)
  - *Weather, 2D-3D Maps, Benchmark cases*

Chemical Census

Exploring the exoplanetary chemical diversity