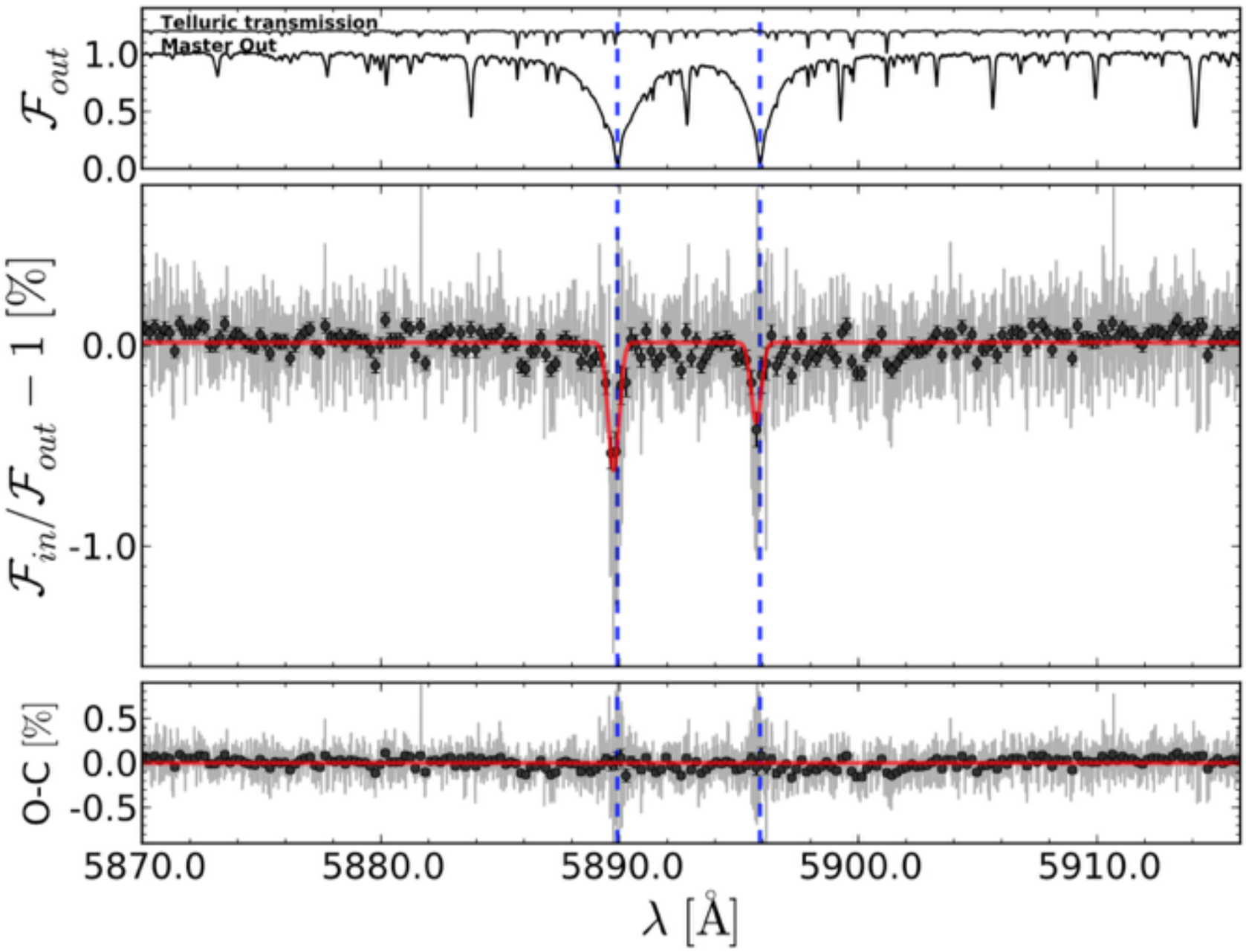
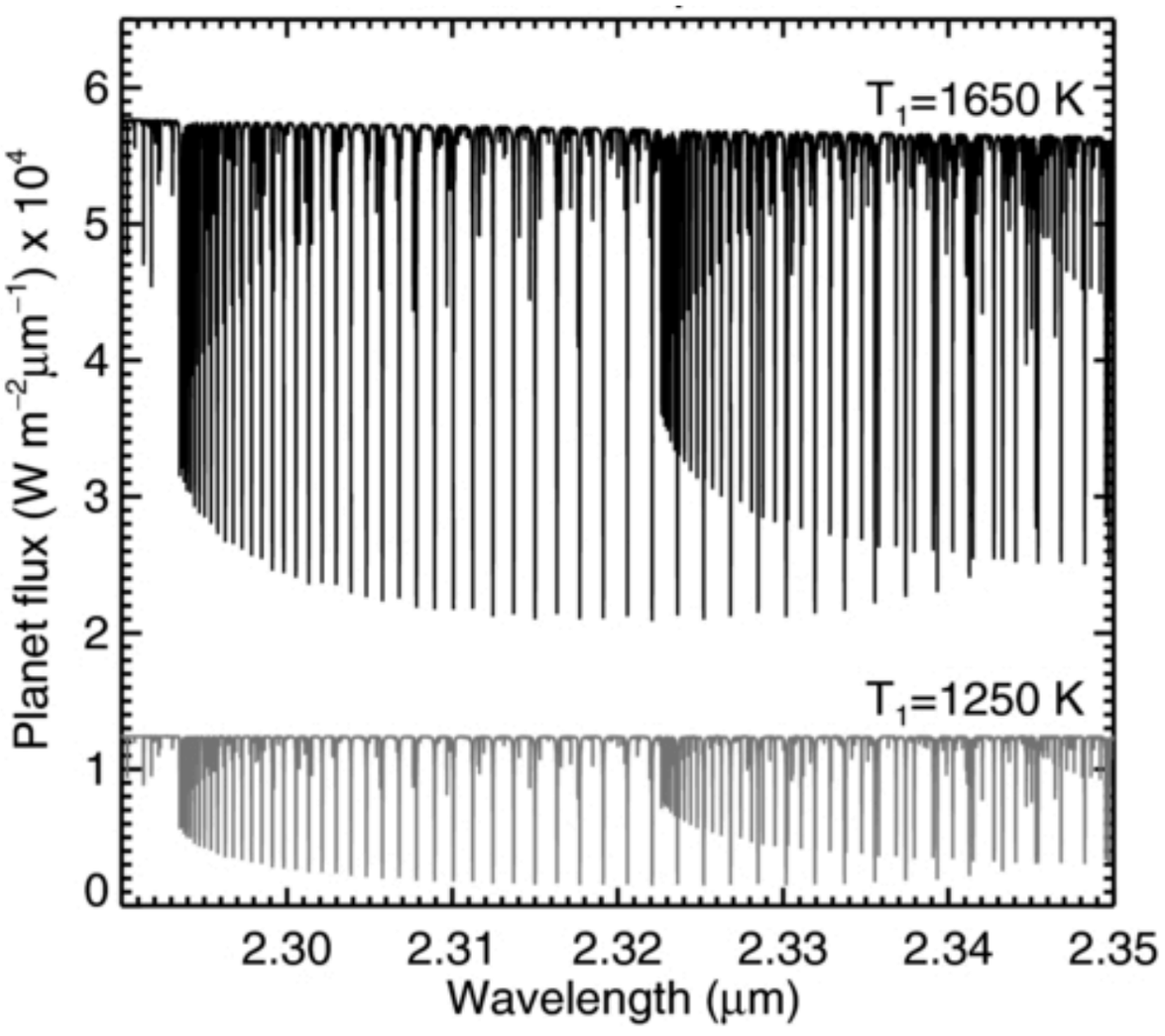
NIRPS Science Cases:
Atmospheric Characterization

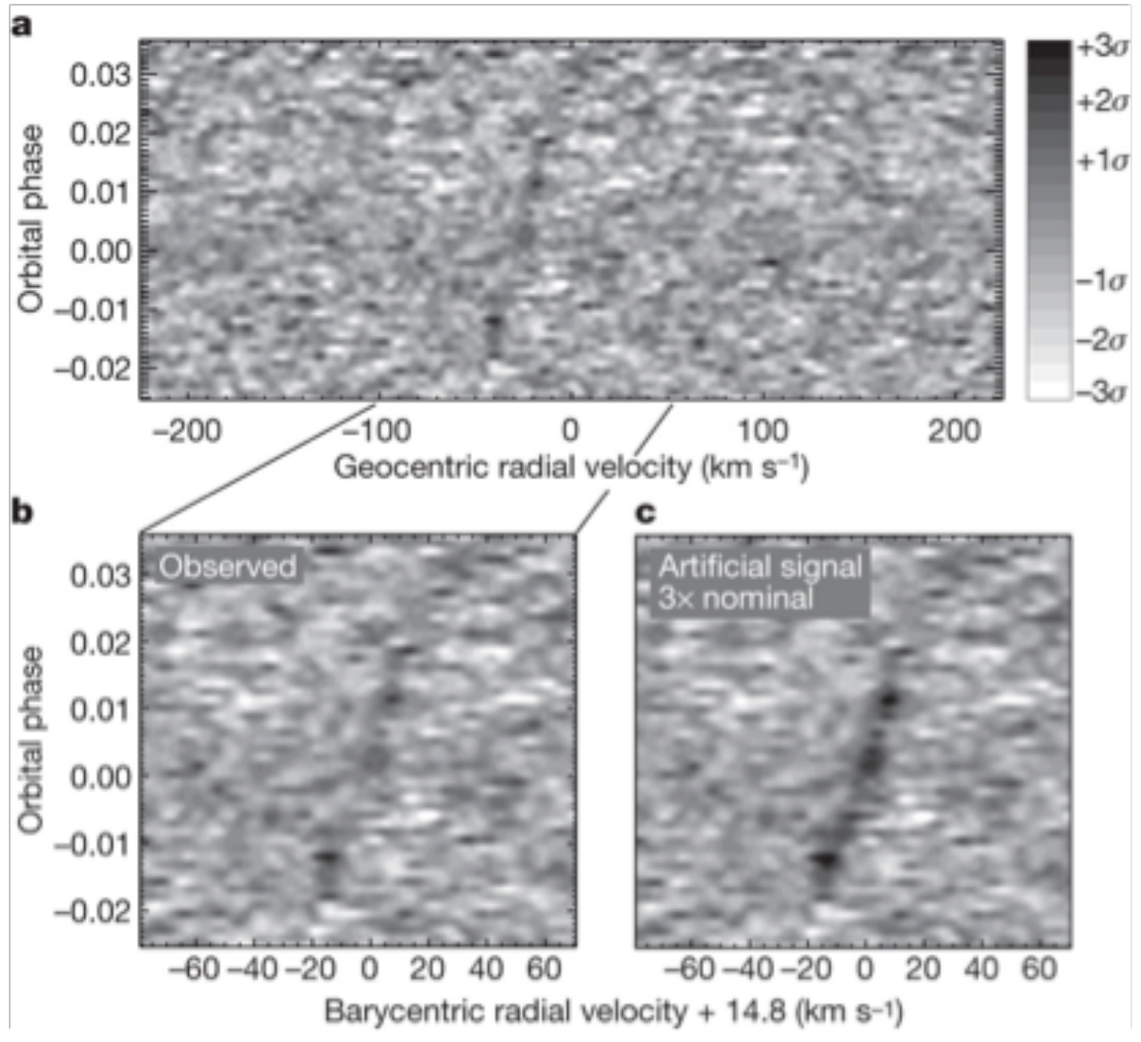
High-resolution transmission spectroscopy



Wyttenbach et al. 2015

High-resolution emission spectroscopy





Snellen et al. 2010

The physics at high spectral resolution

- Each molecule has a unique « fingerprint » : no confusion!
- Constraints on chemical abundances
- Constraints on pressure-temperature profile
- Constraints on Rayleigh/Mie scattering signatures
- Access to Doppler shifts and broadening processes: planet rotation, 3D atmospheric circulation patterns
- Constraints on atmospheric evaporation

Uniqueness of HARPS+NIRPS

- Simultaneous wavelength coverage 0.38-1.8 (2.4) micron
- Simultaneous access to all major molecules: H_2O, CO, CH_4, CO_2
- Ability to constrain chemical abundances and presence of clouds/ hazes from multi-wavelength detections of a given molecule
- Southern hemisphere
- Pathfinder for E-ELT HIRES

Detectability of major molecules: transmission

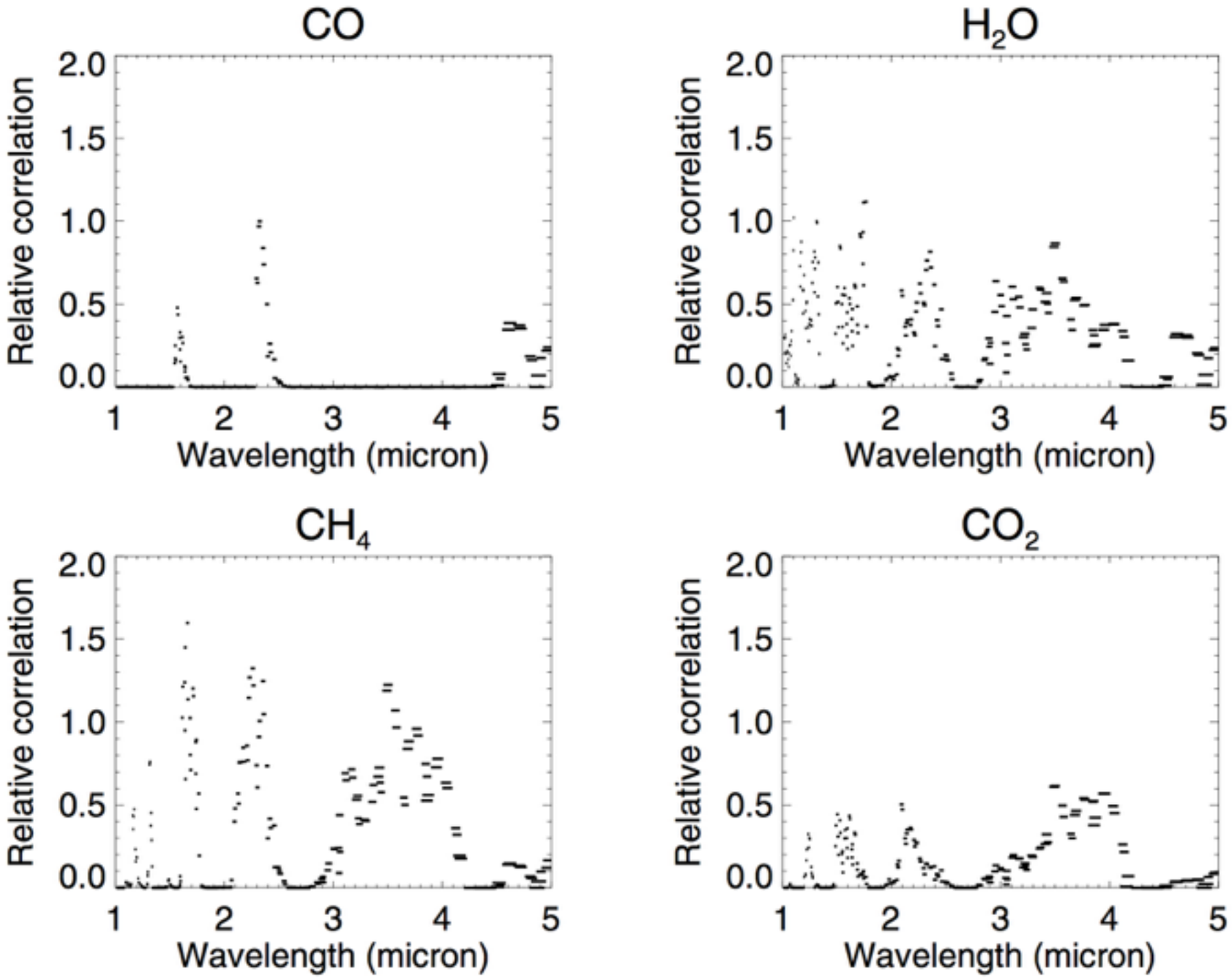


Fig. 6. Expected cross-correlation values, divided by the correlation of CO at 2.3 μm, for the different wavelength settings of CRIRES, for the transit spectrum of a single trace gas in a hydrogen-dominated atmosphere.

de Kok et al. 2014

Detectability of major molecules: thermal emission

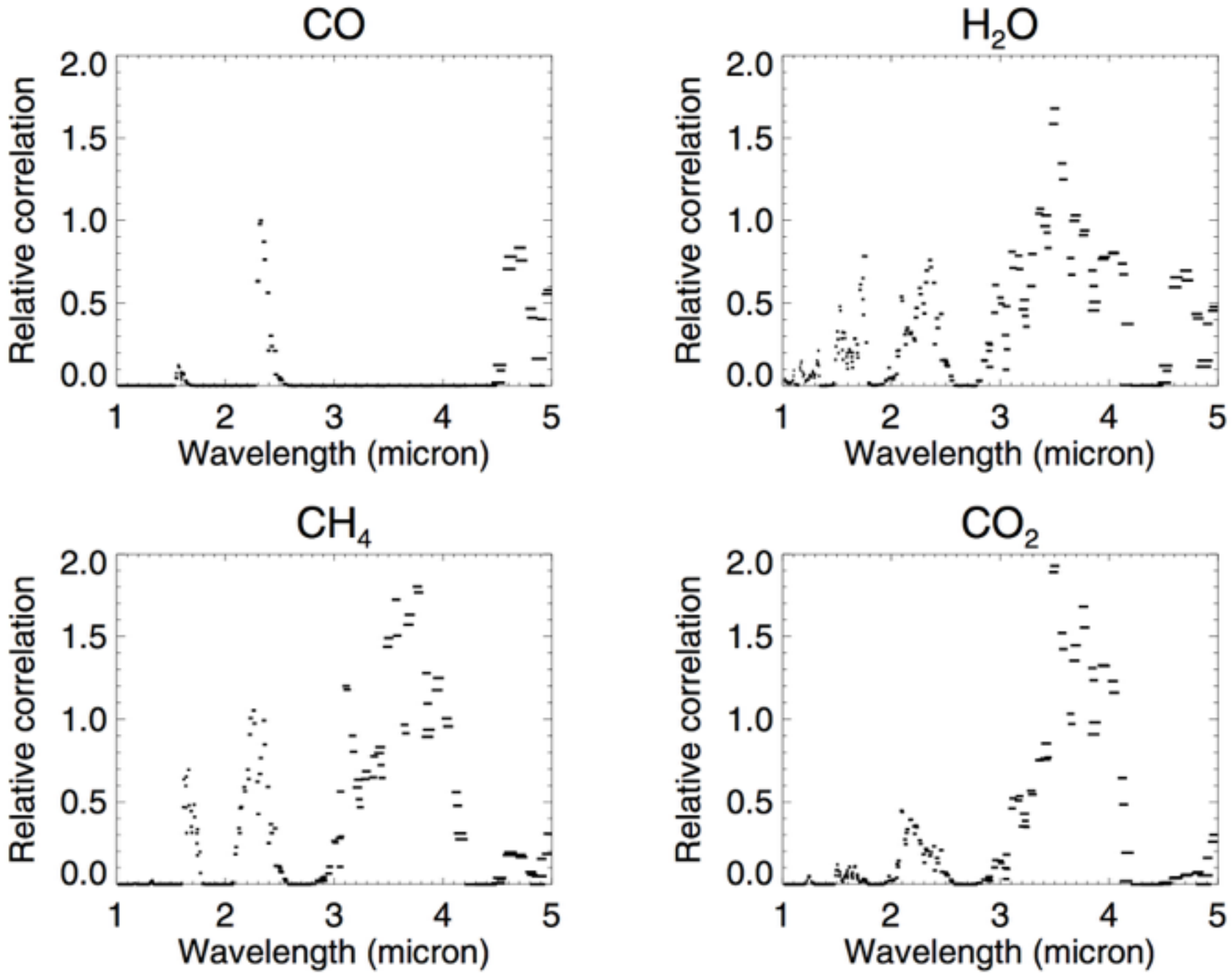


Fig. 1. Expected cross-correlation values, relative to the correlation of CO at 2.3 μm, for the different wavelength settings of CRIRES, for the thermal emission of a single gas in a hydrogen atmosphere.

de Kok et al. 2014

How critical is the K-band?

- For transmission spectroscopy: maybe not so critical…?
- For emission spectroscopy: critical (blackbody slope)

à-la-Snellen technique

- Use of AO to spatially (partially) separate star and planet
- We are talking about young, self-luminous objects on wide orbits
- K band is mandatory (K-band-only science?)
- Direct competition with CRIRES+
- Therefore, not a major science case for NIRPS; IFU mode dropped