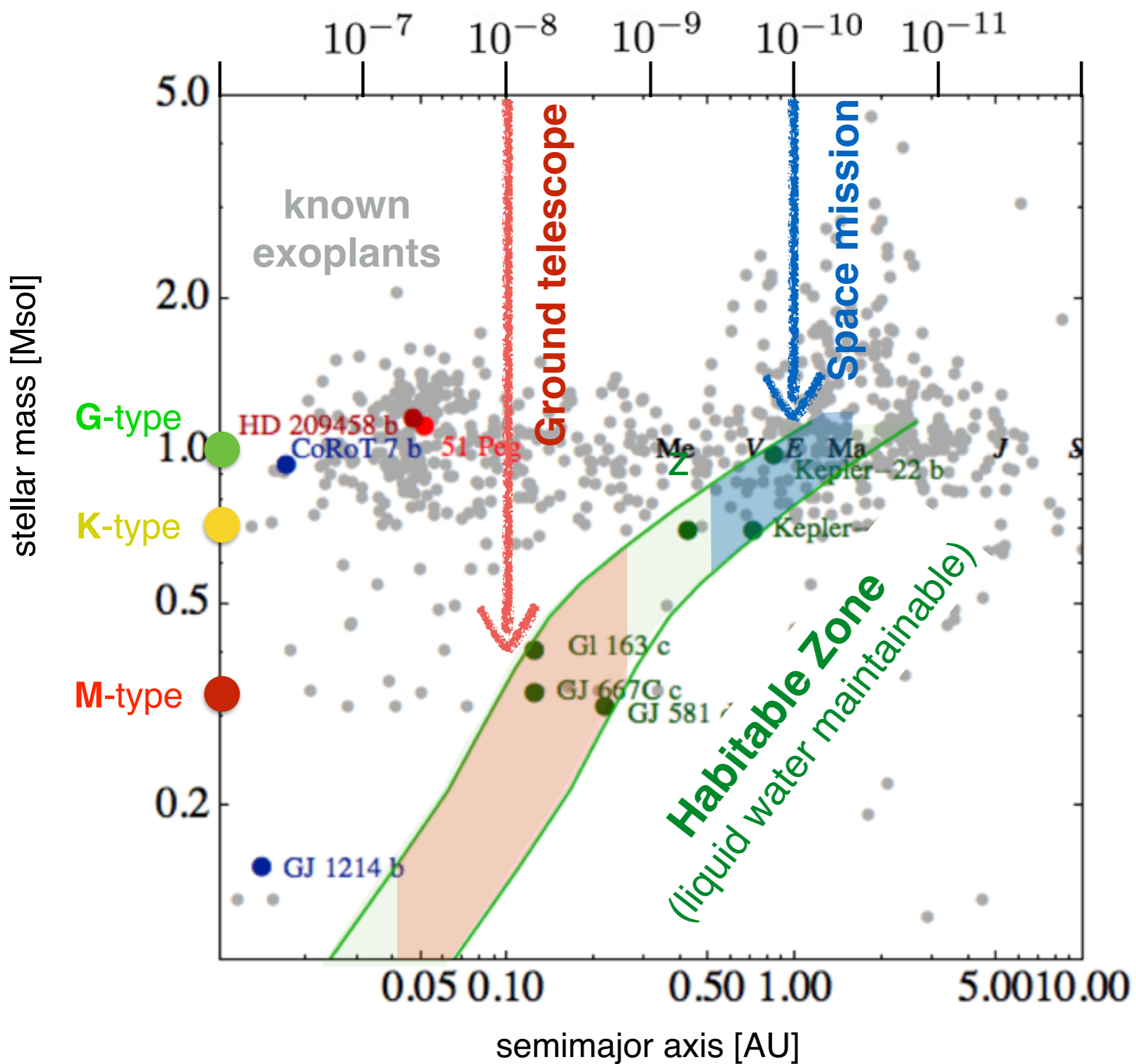


直接撮像装置で探る系外惑星サイエンス：
SEICAからSEITへ

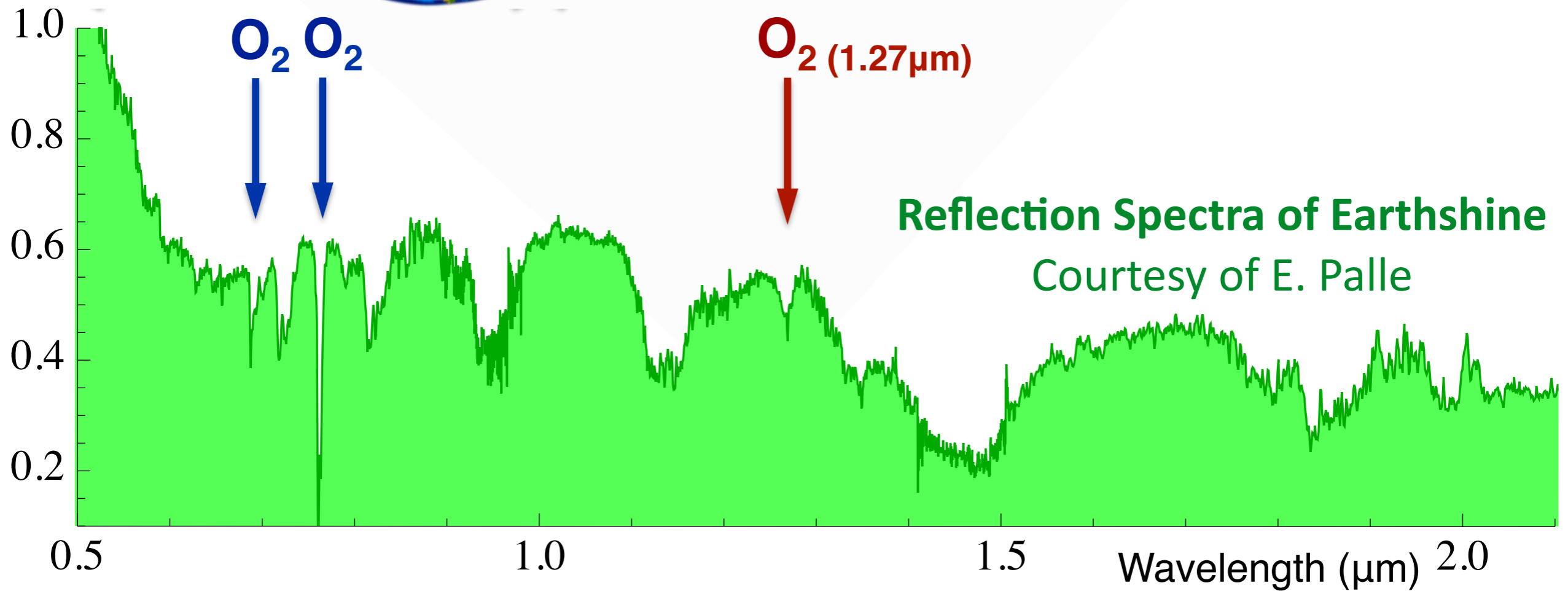
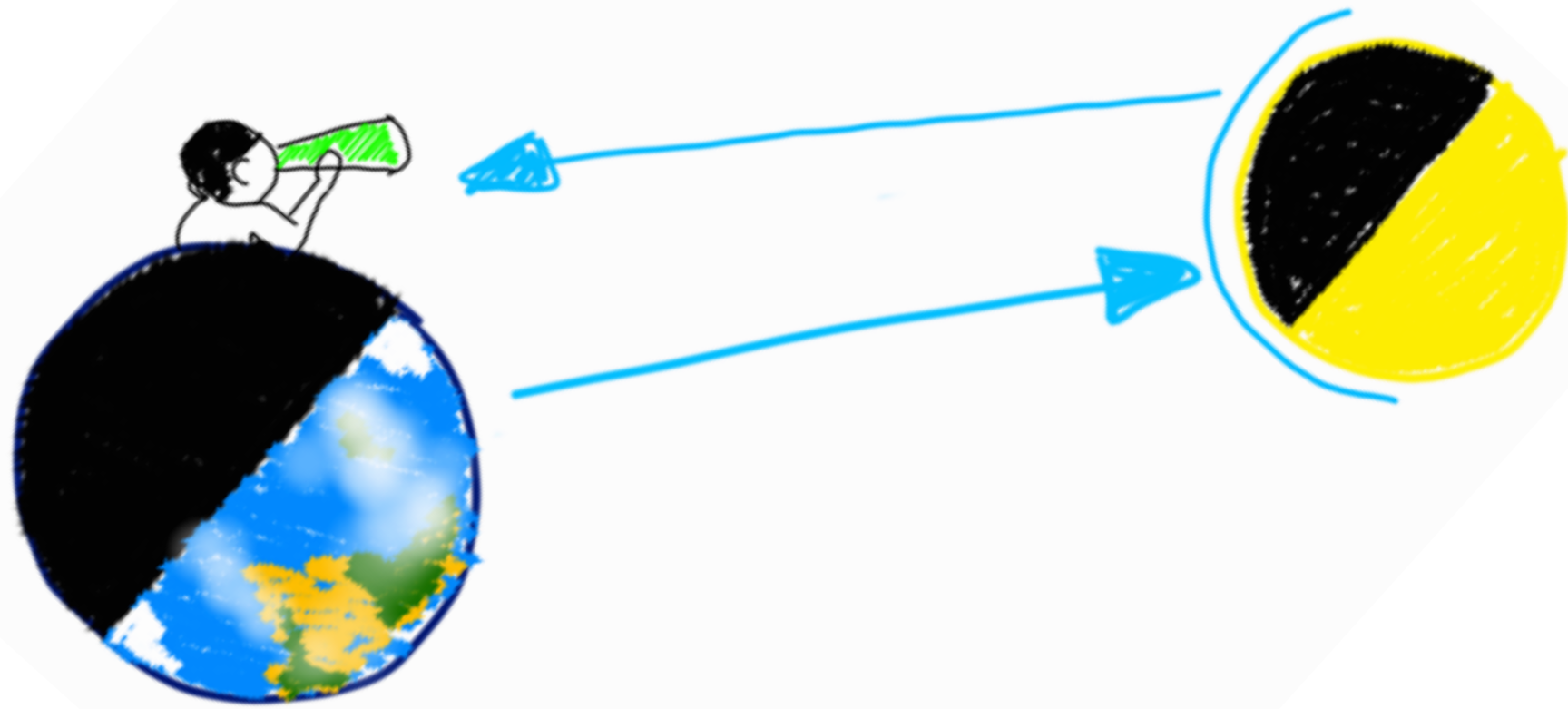
東京大学・地球惑星科学専攻
河原 創

TMT地球型惑星探査のパイロット計画としての
SEICA on 岡山3.8m

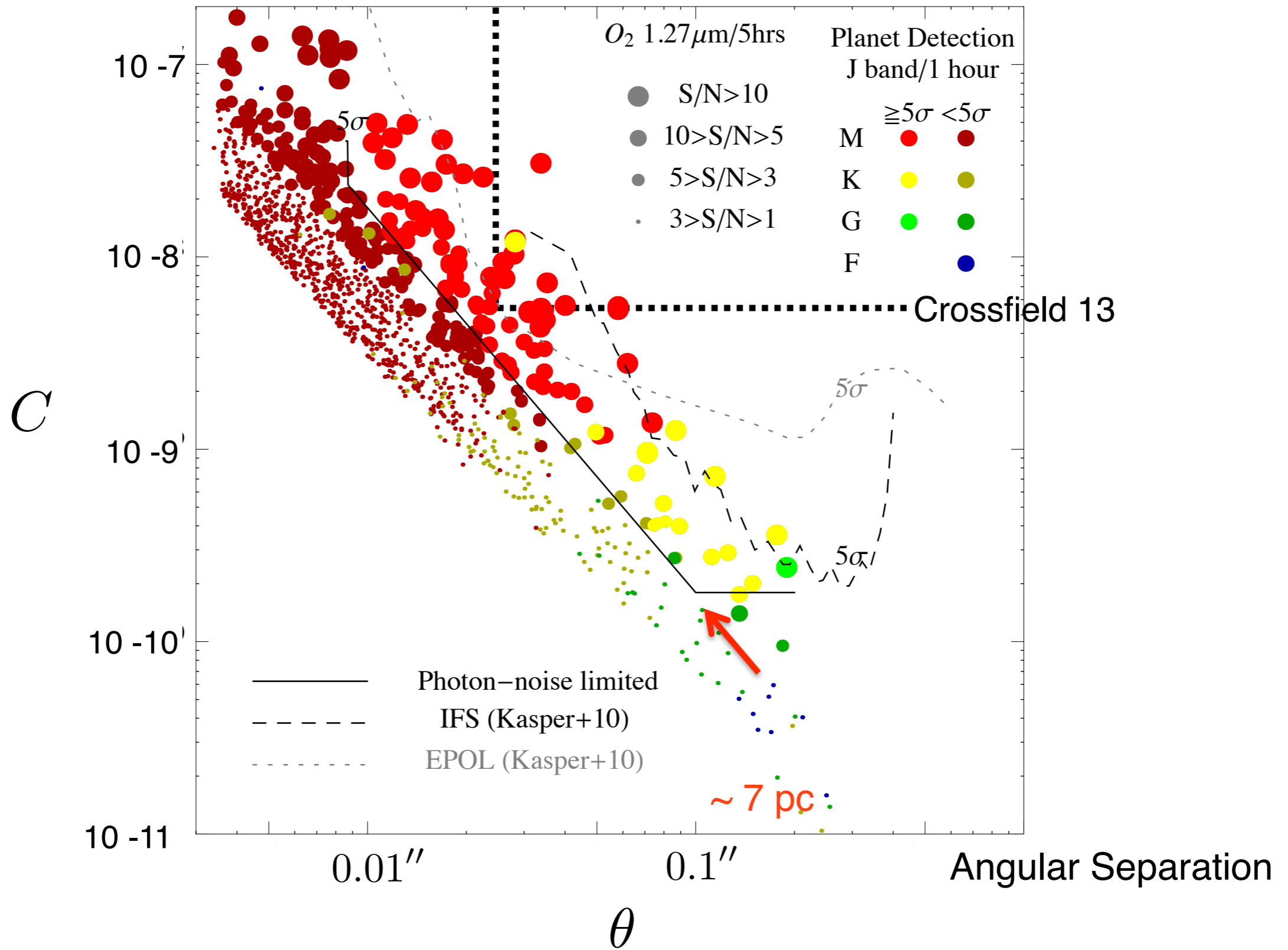
C for Earth-sized Planets



How to characterize second Earths ?



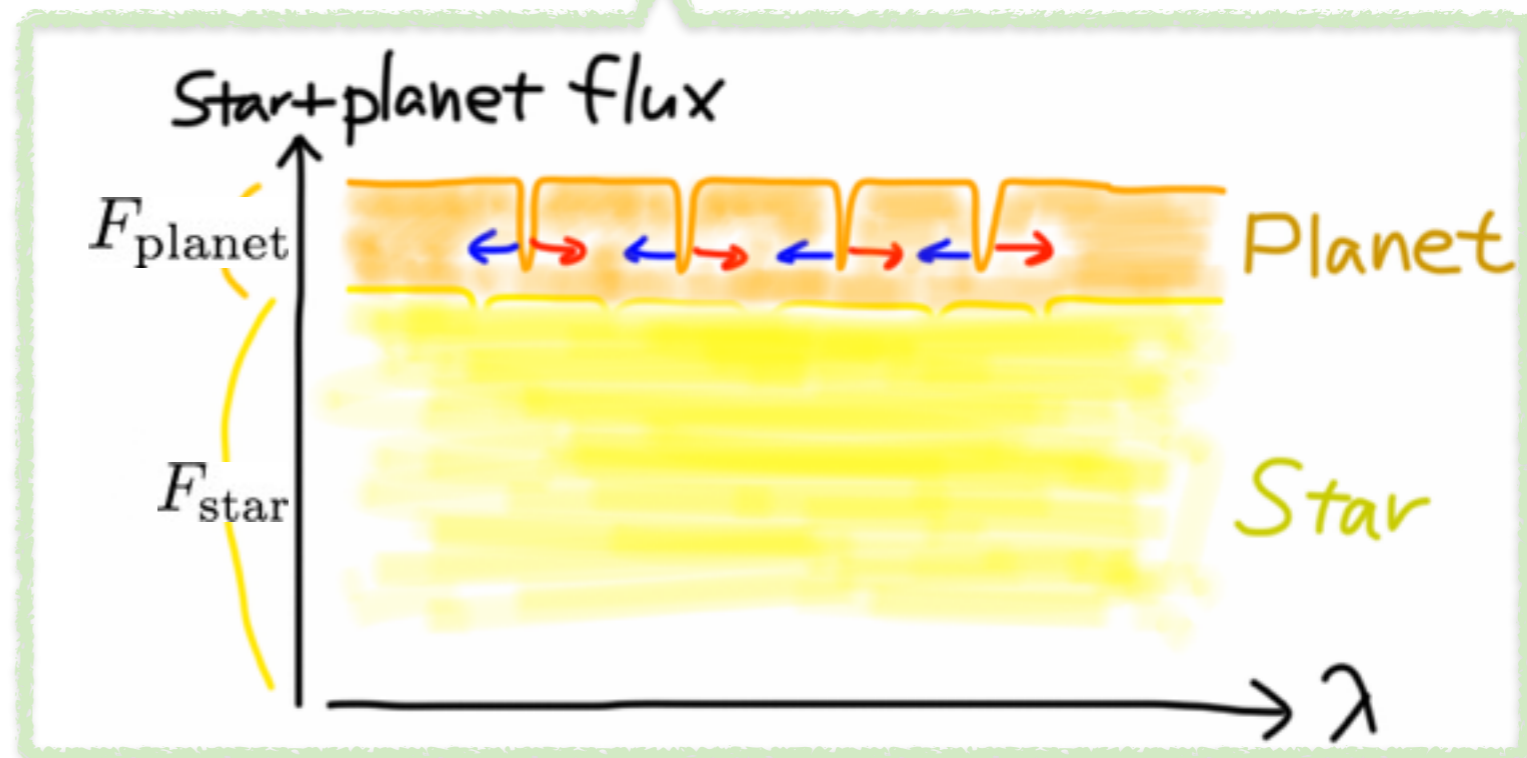
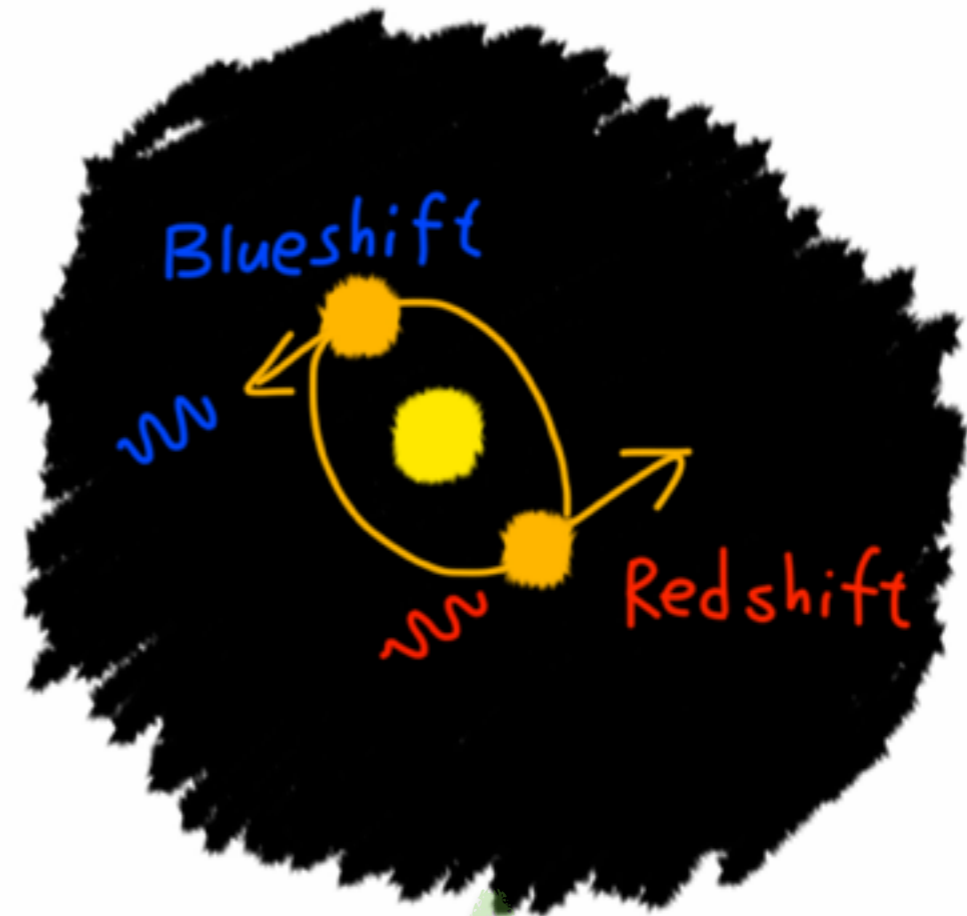
Planet - Star Contrast



今日の話題

岡山3.8m新望遠鏡に近赤外高分散分光装置を

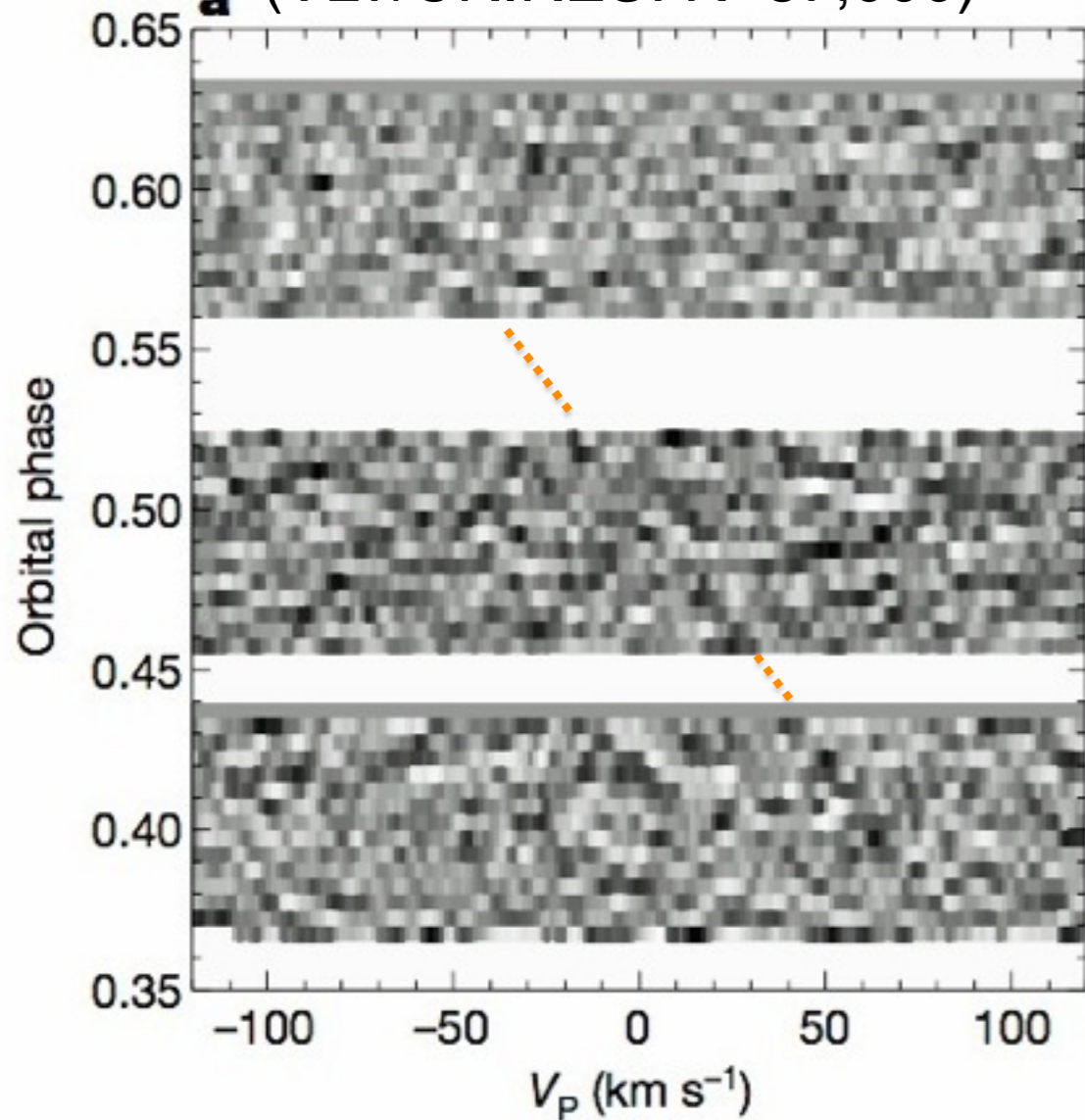
Spectroscopic Direct Detection



CO & H₂O were detected for hot Jupiters ($C \gtrsim 10^{-4}$) (Brogi+12, Rodler+12, Birkby+13 etc)

~50 CO lines $v=110 \pm 3$ km/s

(VLT/CRIRES: $R \sim 87,000$)



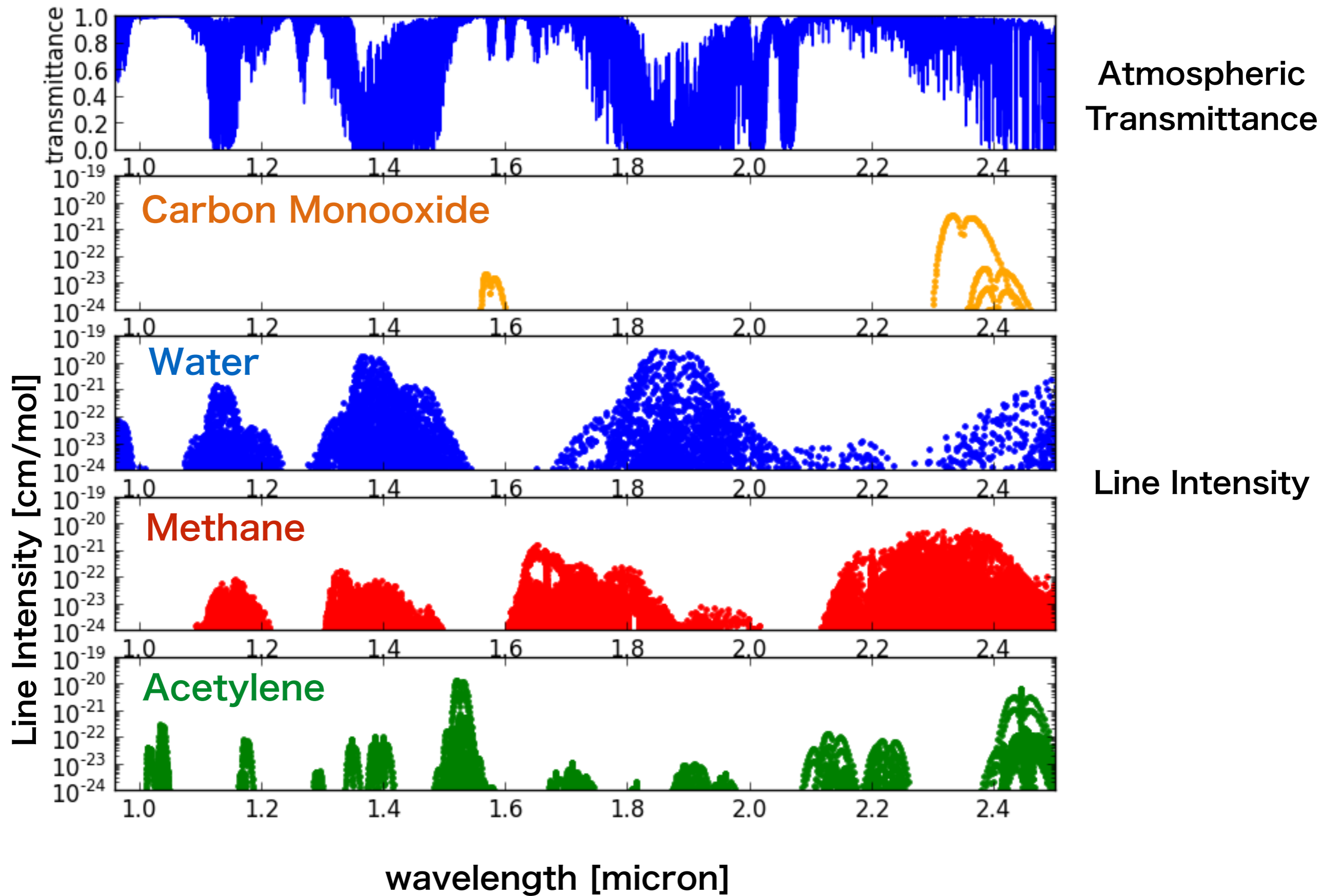
Brogi+2012, Nature

planet	molecules (band)	instruments	refs
tau Boo b	CO (K)	CRIRES/VLT	Brogi+12, Rodler+12
	H	NIRSPEC/Keck	Lockwood+14
HD 189733 b	CO (K)	CRIRES/VLT	Rodler+13, de Kok+13
	H	CRIRES/VLT	Birkby+13
51 Peg b	CO (K)	CRIRES/VLT	de Kok+13
HD 179949b	CO, H (K)	CRIRES/VLT	Brogi+ in prep

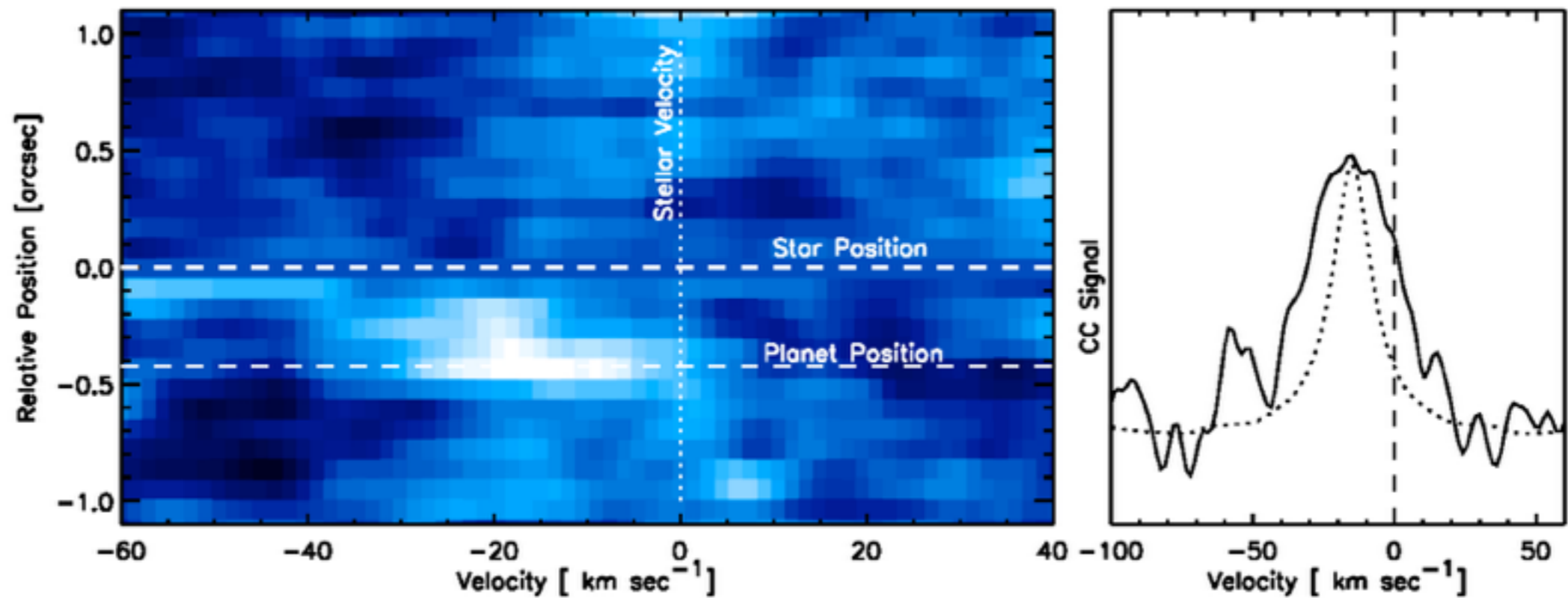
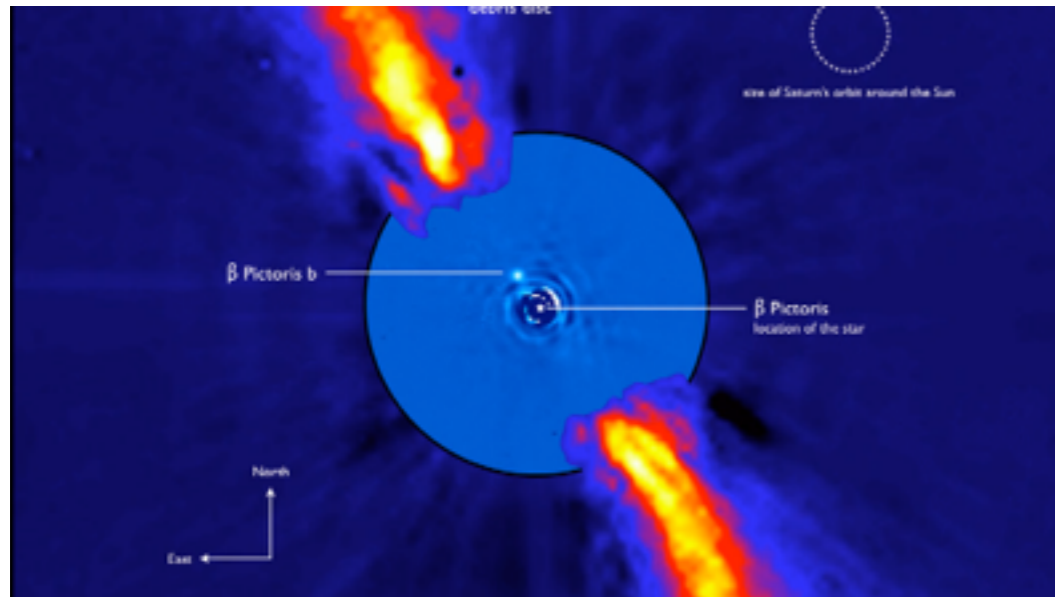
Cross-correlation analysis of spectra and molecular line template

1. high dispersion observation ($R \sim 10^5$) @NIR

2. a lot of molecular lines ($N > 50$)



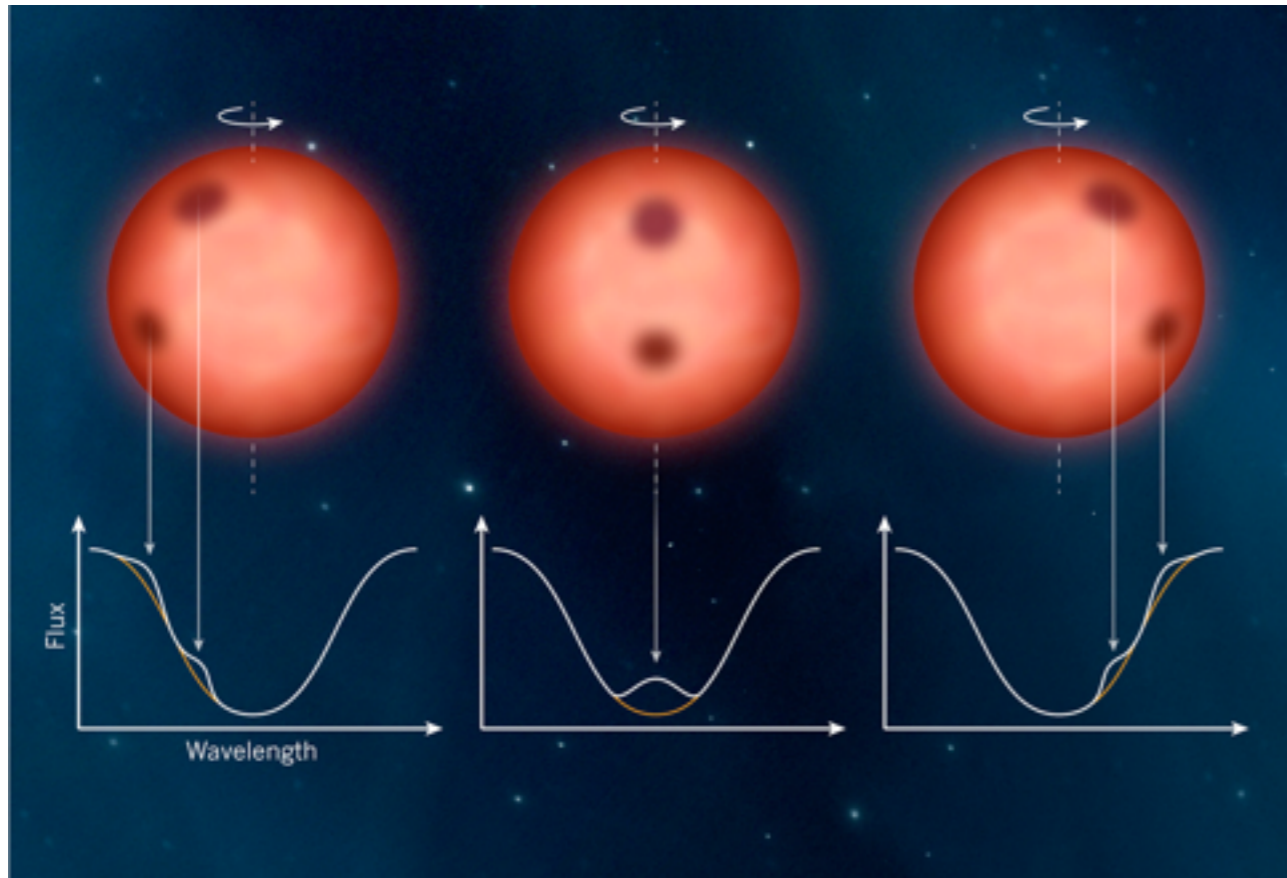
High Contrast + High Dispersion : 直接撮像された場所を高分散分光



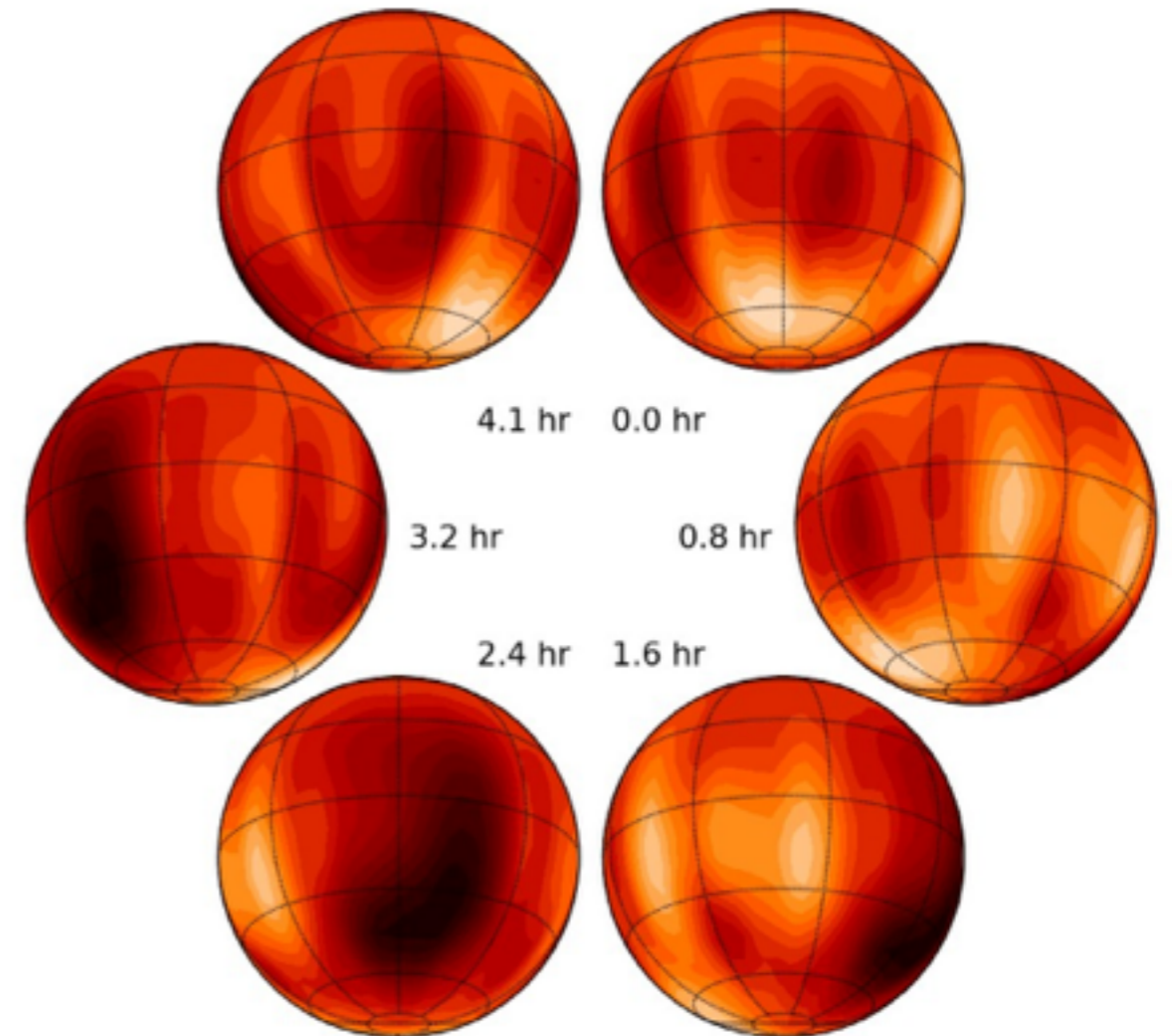
Snellen+2014, Nature

using **CRIRES/VLT**

Doppler Imaging of Brown Dwarf



Crossfield+2013, Nature

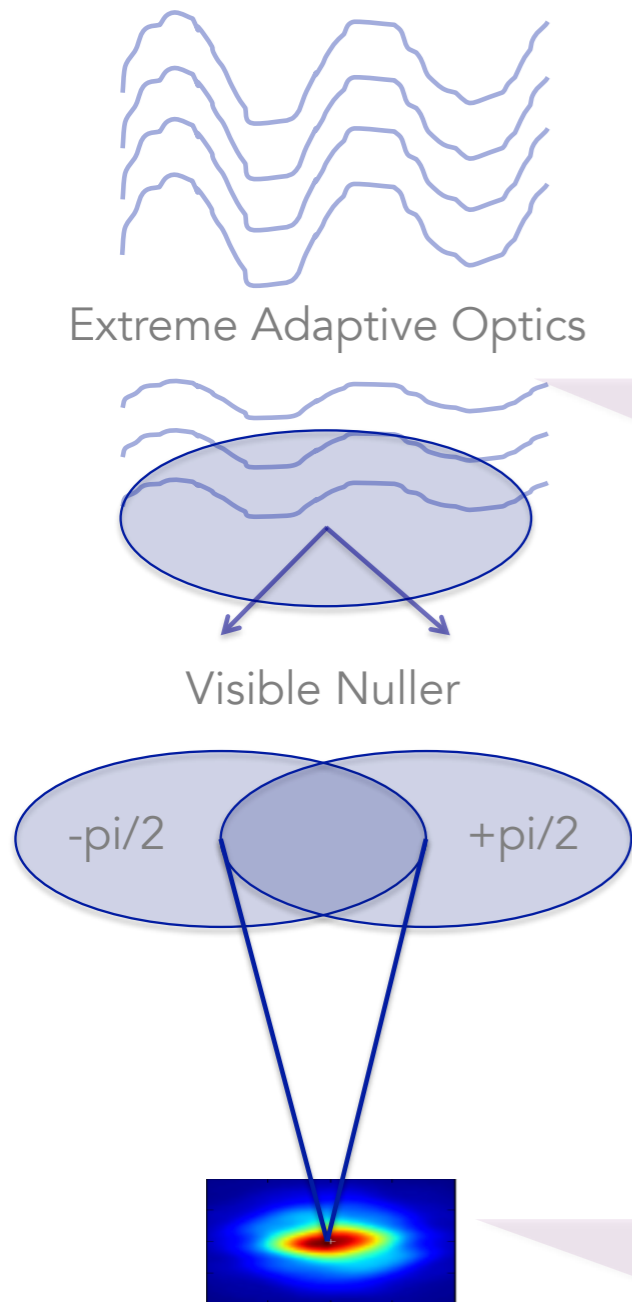


using CRIRES/VLT

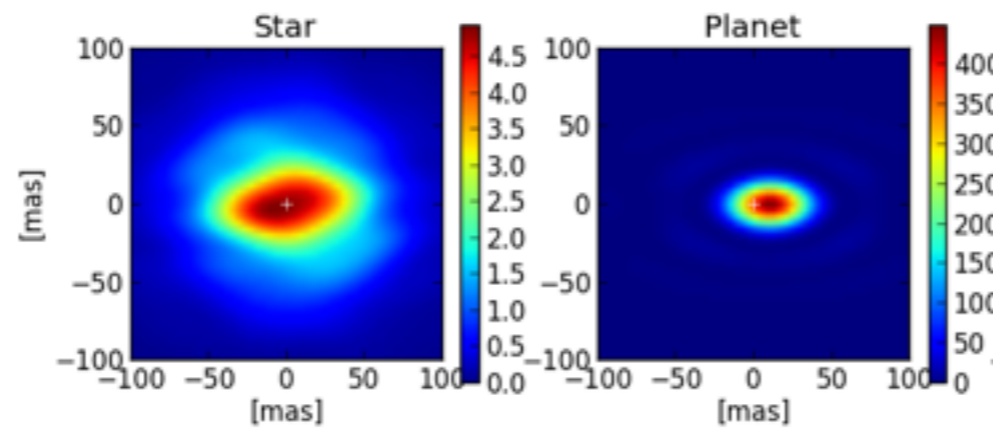
これを直接撮像した系外惑星でやることを狙っている！

High Contrast + High Dispersion : 分光コロナグラフ

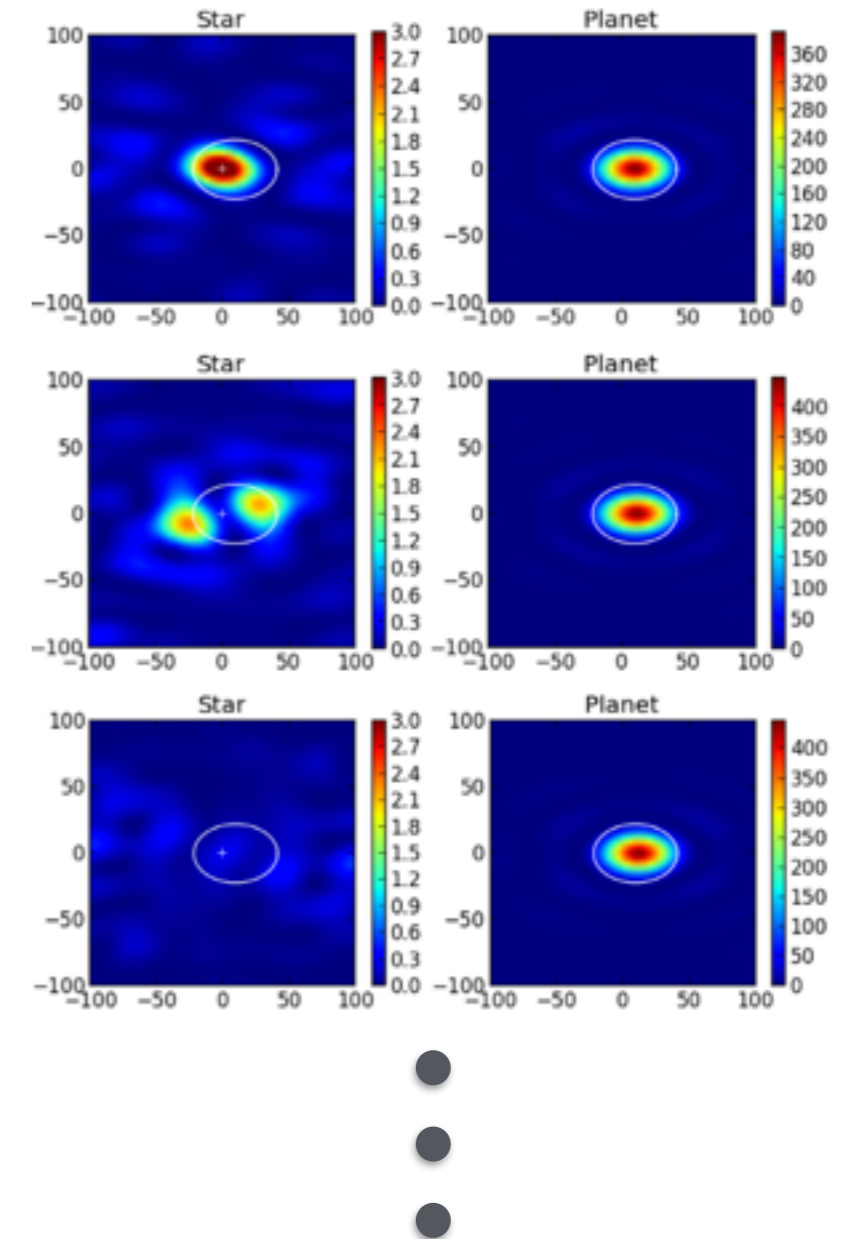
Kawahara+2014, accepted in ApJS, arXiv:1404.5712



積算焦点面イメージ



瞬間的な焦点面イメージ



空間的には分解できない惑星でも、恒星の光子ノイズを抑制できる

1. 系外惑星キャラクタリゼーションにおいて
高コントラスト＋高分散のできる装置の重要性
2. 岡山3.8m新望遠鏡に近赤外高分散分光装置
を置くメリットをさらに議論したい
(フレア星@晩期型や銀河、円盤では?)

高分散におけるExAOの装置的重要性→小谷講演