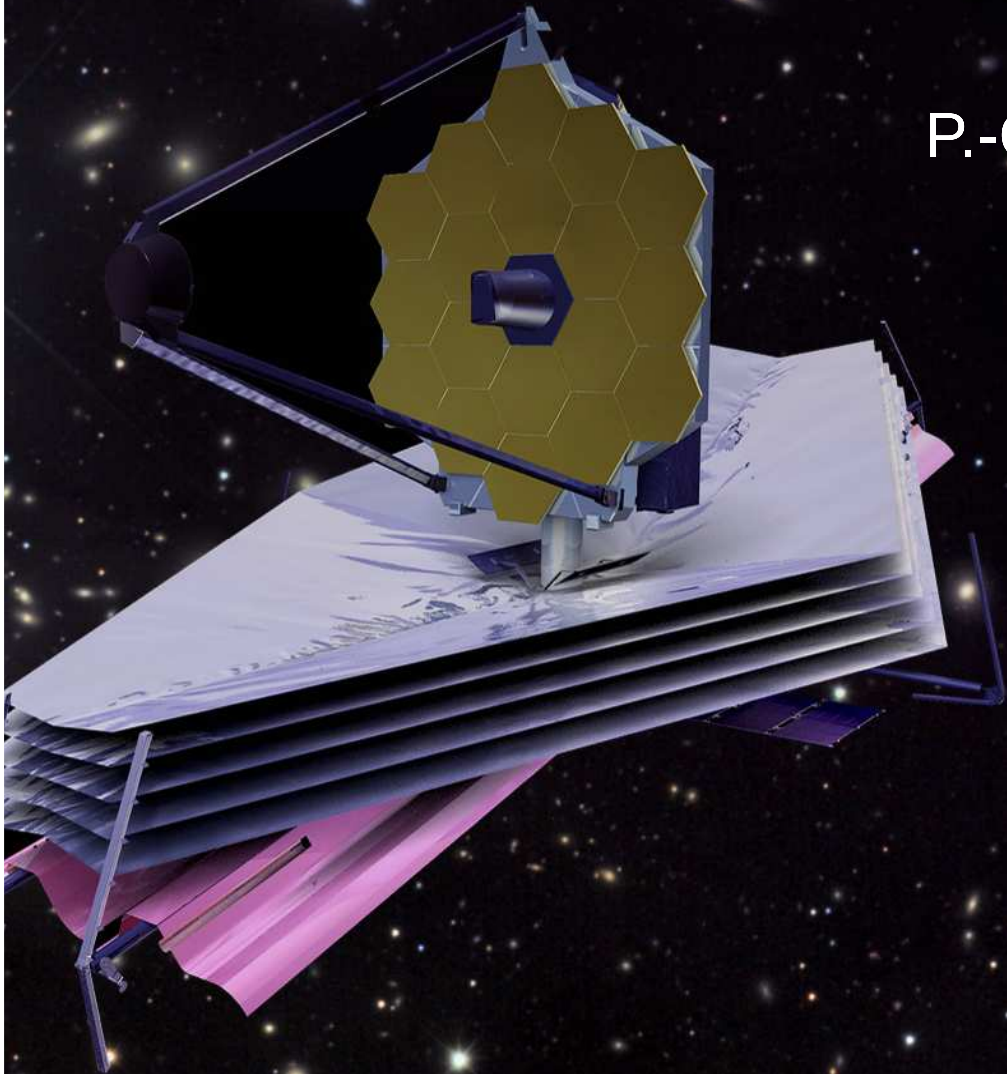
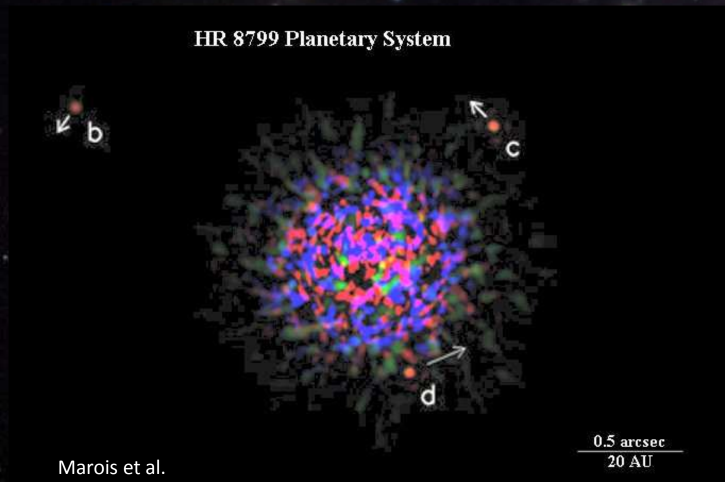
Exoplanets atmospheres

P.-O. Lagage, P. Tremblin, S. Fromang

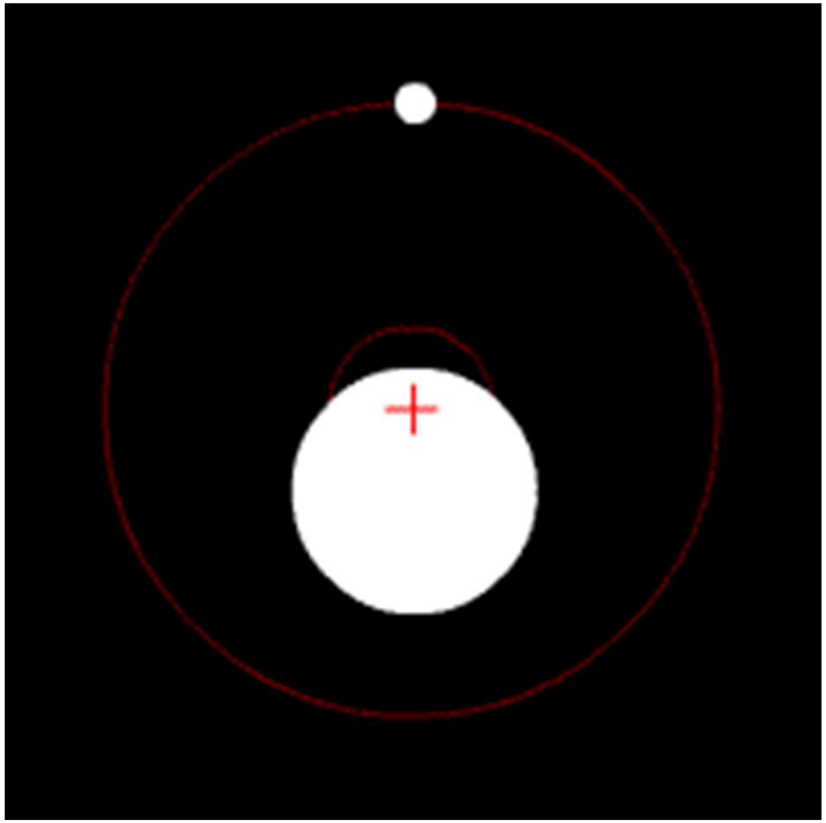




To start with:
A bit of « history »

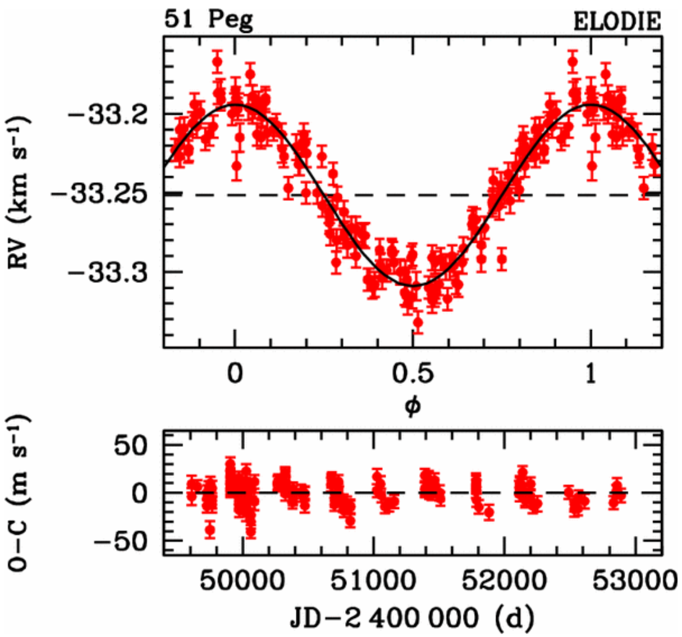
Not long!

1995 : Detection of the first extrasolar planet!



Radial velocity method

High resolution ultra stable spectrometer

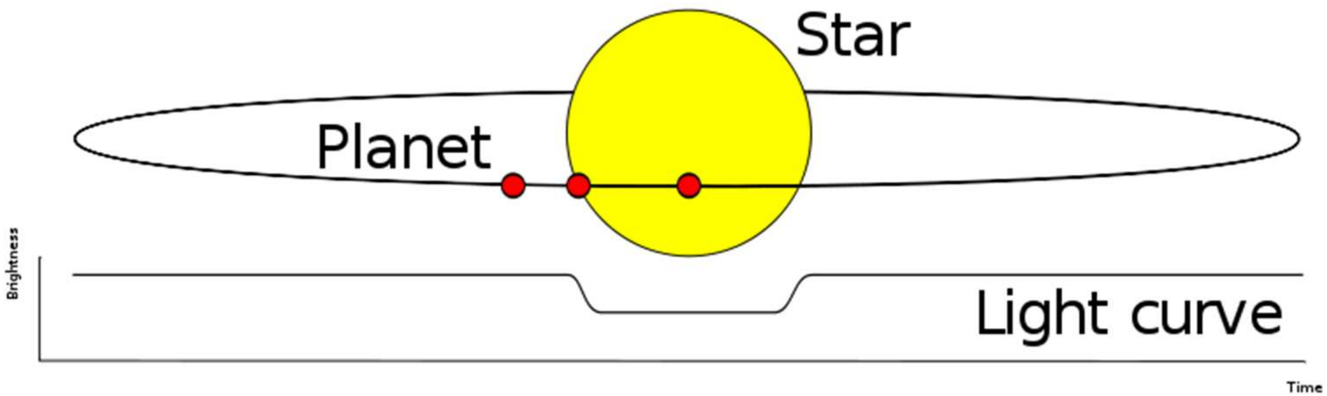


M. Mayor et D. Queloz, 1995

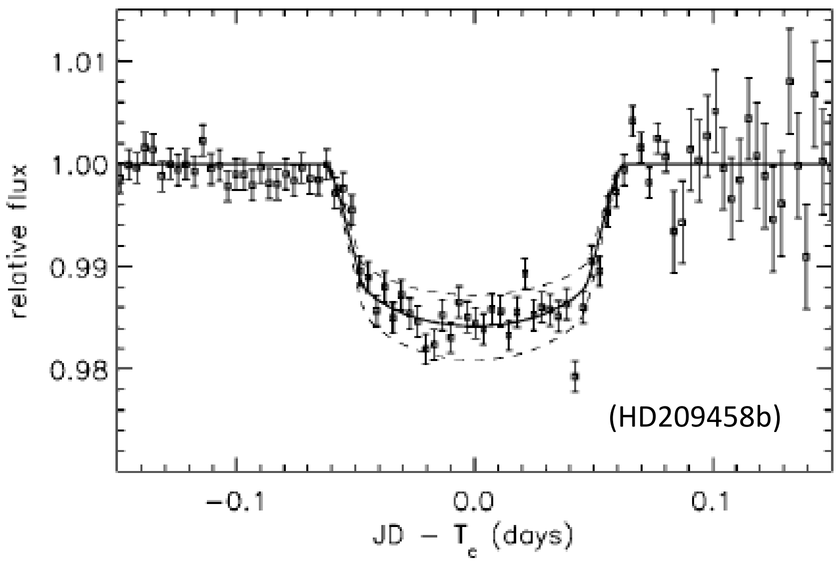
→ Mass sin(i)

→ First surprise: « hot Jupiter »

1999-2000 : Detection of the first transit of an exoplanet!



Exoplanet on the
star-observer line of sight



Charbonneau et al. 2000

FIG. 2.—Shown are the data from Fig. 1 binned into 5 m averages, phased according to our best-fit orbit, plotted as a function of time from T_c. The rms variation at the beginning of the time series is roughly 1.5 mmag, and this precision is maintained throughout the duration of the transit. The increased scatter at the end of the time series is due to increasing air mass which occurred at roughly the same time for both transits, since the two occurred very nearly 1 week apart. The solid line is the transit shape that would occur for our best-

Definite « Proof » of exoplanets!

→ r_{planet}/R_{star}

→ Surprise: inflated Jupiter

→ Explication récente:
P. Tremblin et al. To be submitted

2004 : Detection of the first light from an exoplanet!

Direct imaging technique in use

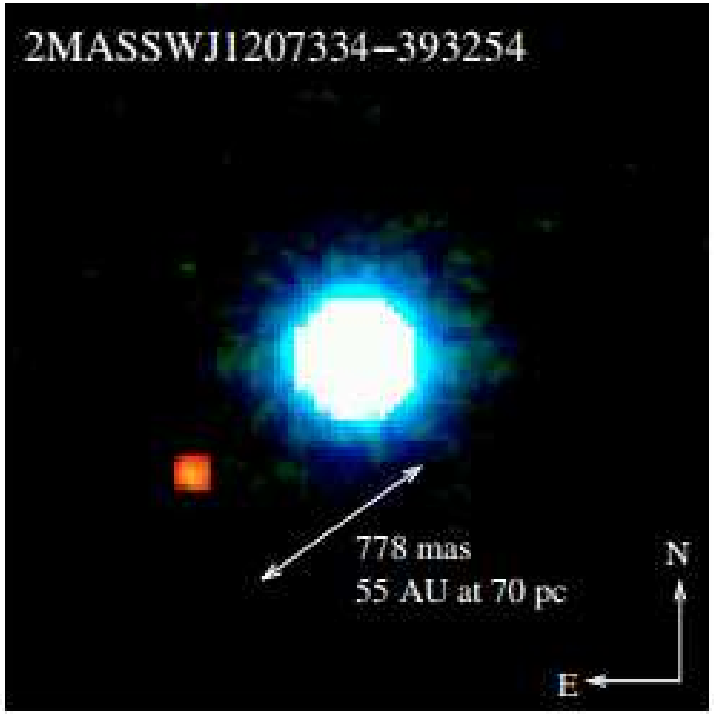


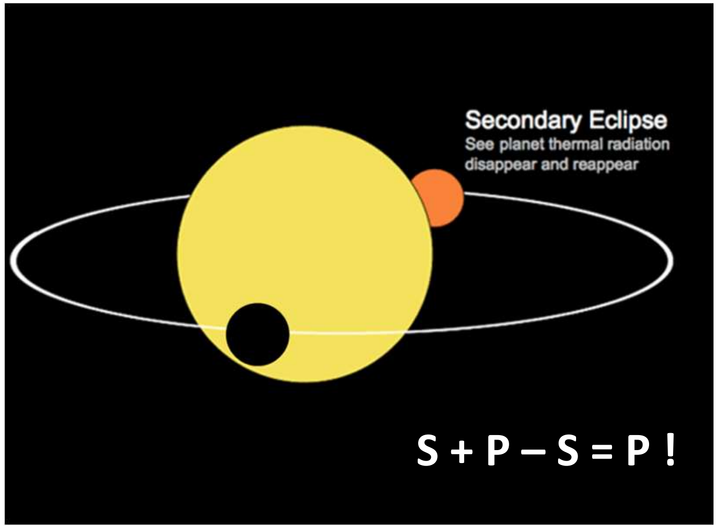
Fig. 1. Composite image of brown dwarf 2M1207 and its GPCC in *H* (*blue*), K_s (*green*) and L' (*red*). The companion appears clearly distinguishable in comparison to the color of the brown dwarf 2M1207.

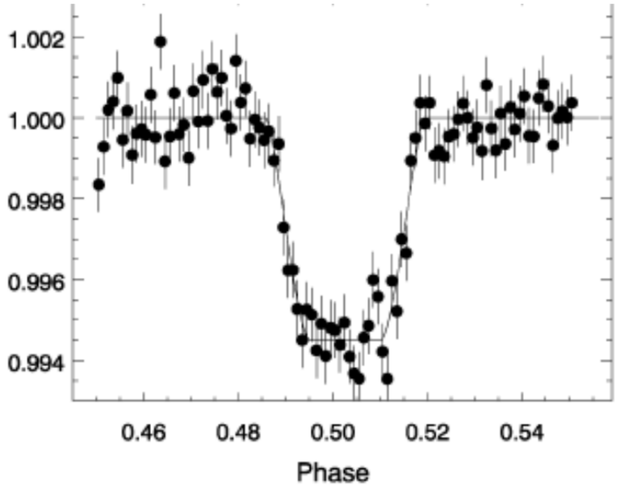
VLT NACO

Chauvin et al. 2004

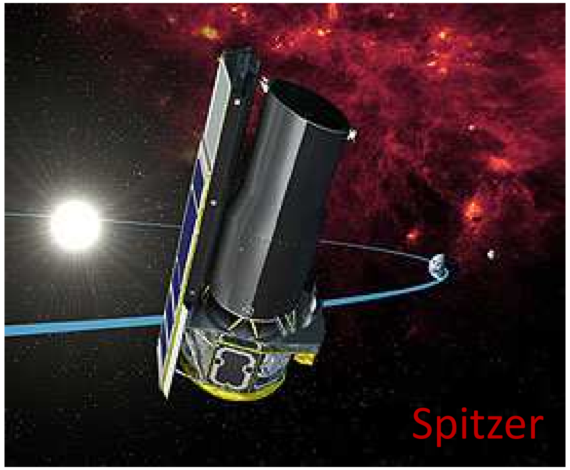
« Substellar » object
2 Jupiter mass
Around a brown dwarf

Détection aussi de la lumière émise par les exoplanètes en transit : lors du transit secondaire





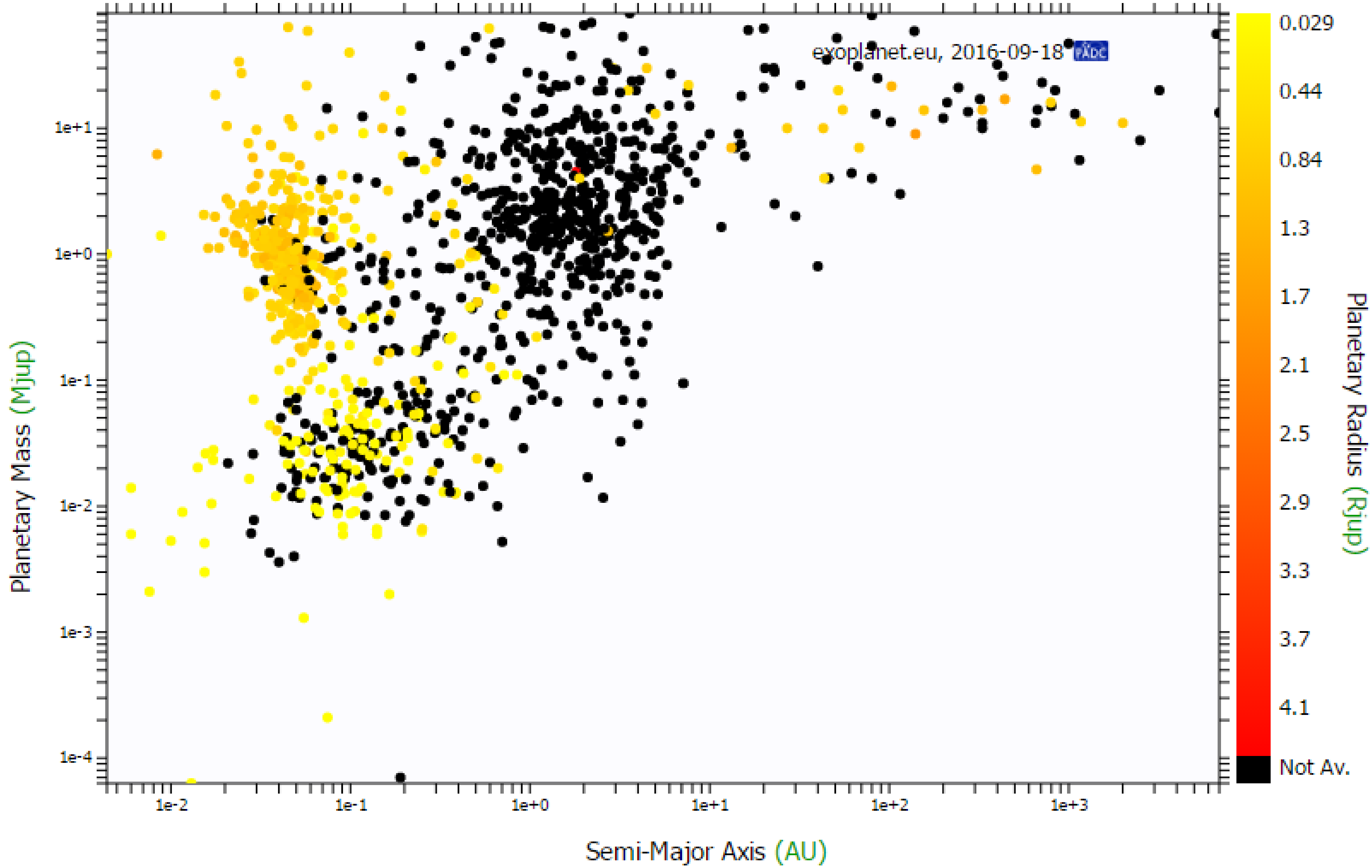
Deming 2006



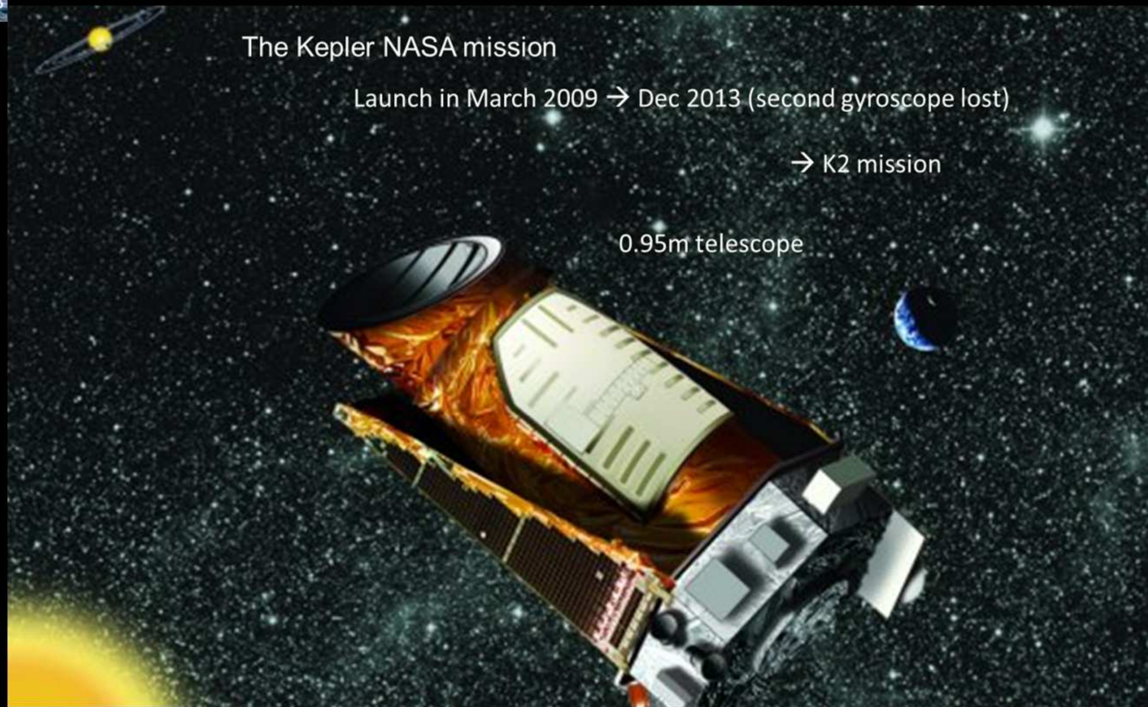
Where are we today?

more than 3500 exoplanets detected

(686 radial velocity; 2691 transit; 72 imaging; …)



IAS exoplanet, sismo;
AIM: sismo



Kepler mission: Super-Earths are ubiquitous

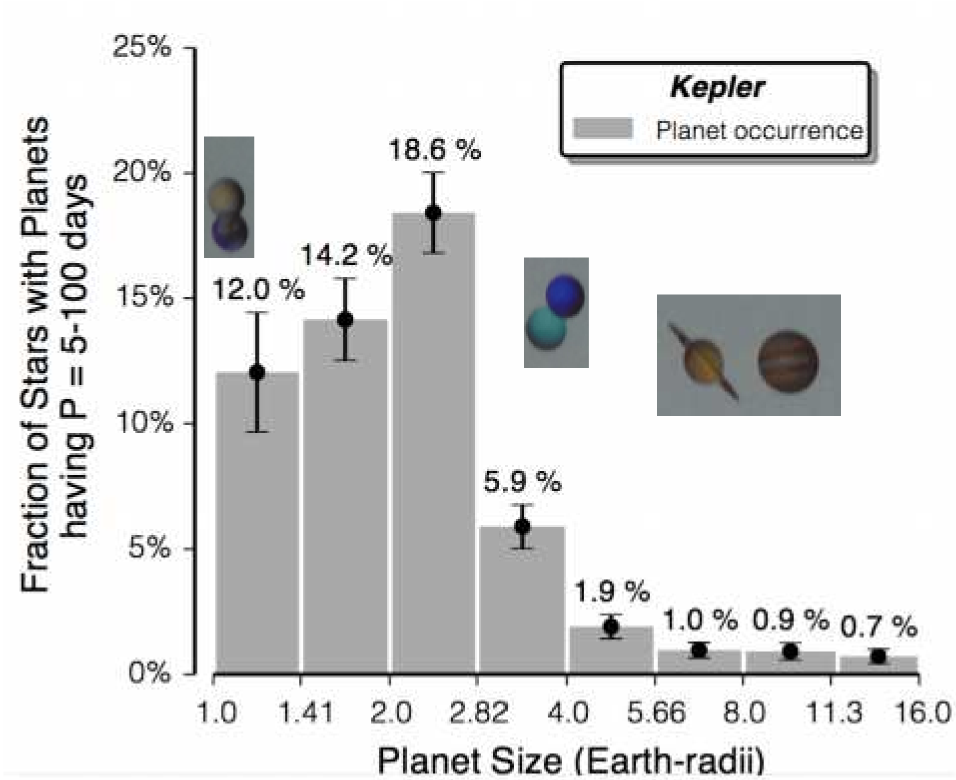
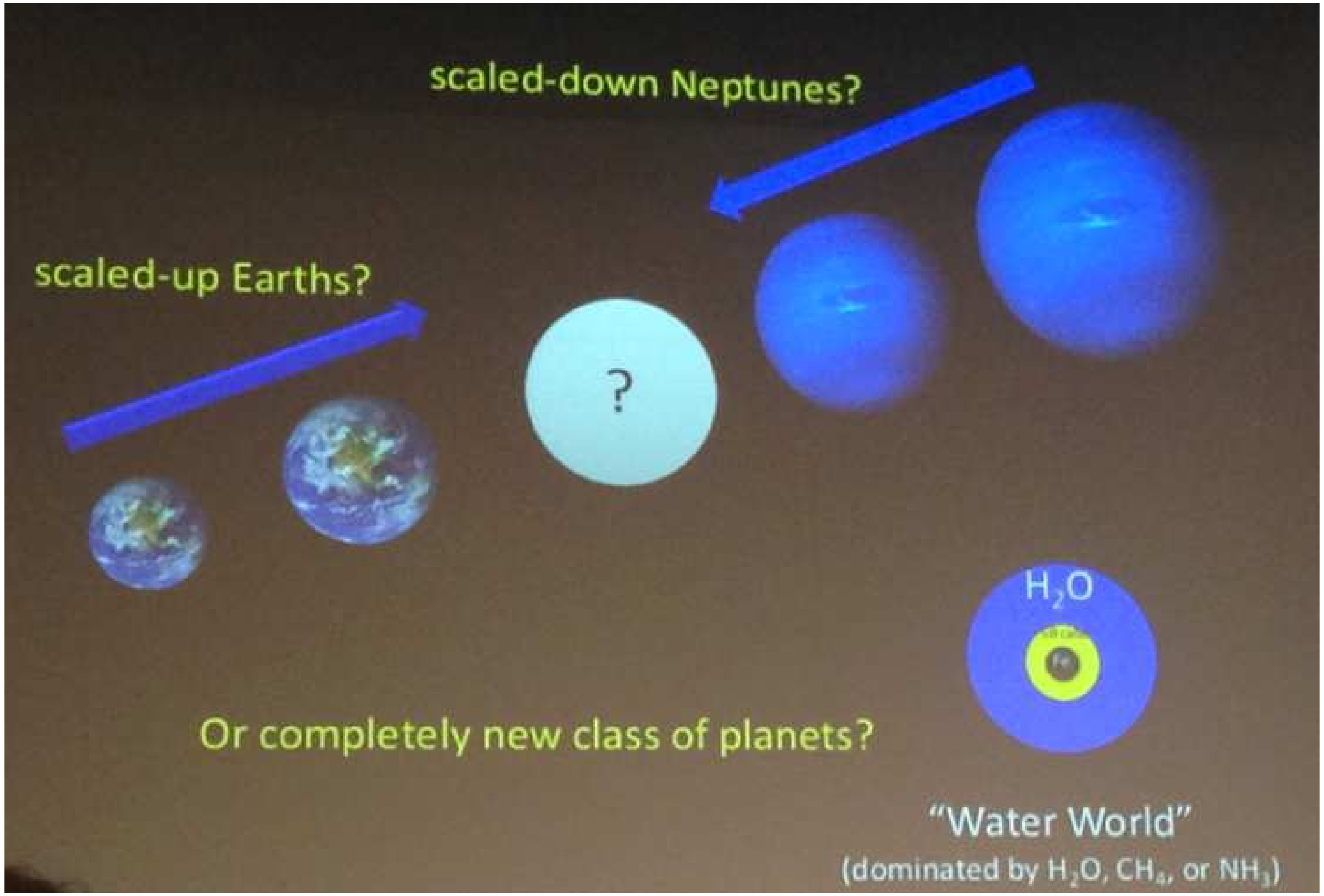


Fig. 1 The size distribution for planets around Sun-like stars. The fraction of Sun-like stars (G- and K-type) hosting planets of a given planet radius are tallied in equal logarithmic bins. Only planets with orbital periods of 5–100 days (corresponding to orbital distances of 0.05–0.42 AU) are included. Together, the lowest two bins show that 26% of Sun-like stars have planets of 1–2 $R_\oplus$ orbiting within ~0.4 AU. The occurrences of Neptune-size planets (2.8–4 $R_\oplus$) and gas-giant planets (8–11 $R_\oplus$) are 5.9% and 0.9%, respectively, more rare than Earth-size planets [19].

Marcy et al. 2014

Nouvelle surprise : grand nombre d'exo-planètes de masse intermédiaire entre la masse de la terre et la masse des planètes géantes du système solaire

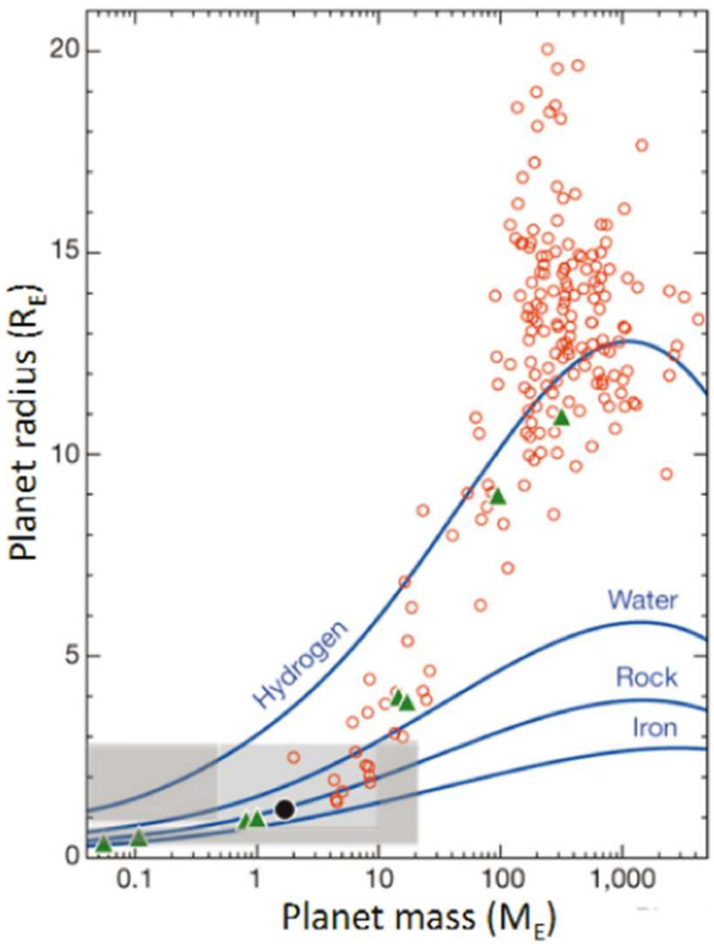
De quoi sont faits les Super-Terres?

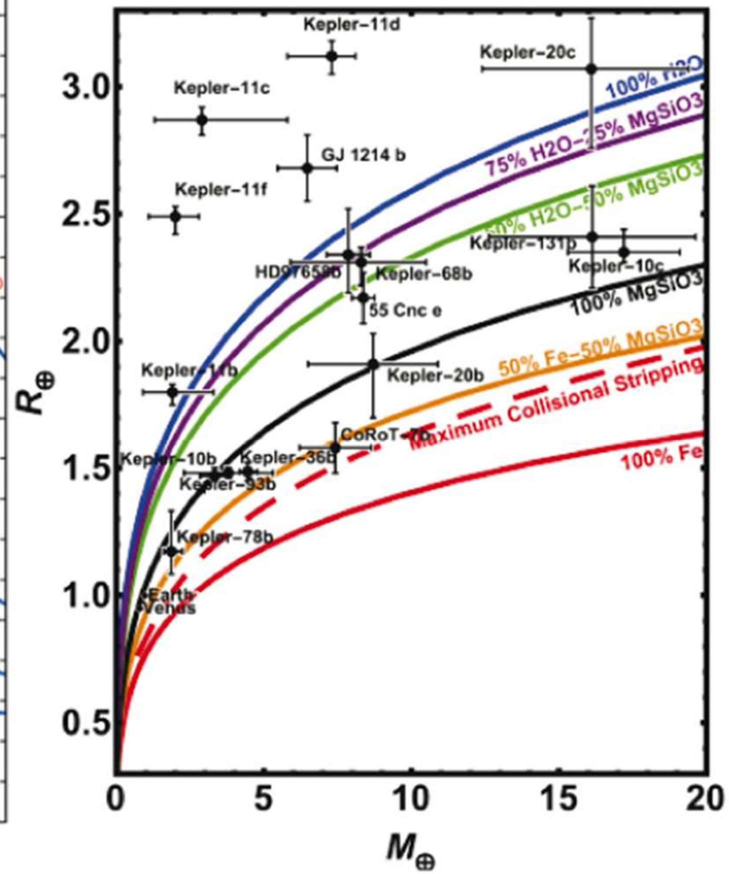


Vitesse radiale (Msin(i)) + transit (r/R + i)

→ densité moyenne

→ gazeuse ou rocheuse





Mass and radius are not the final words!

For example degenerency of the enveloppes of superEarths

THE ASTROPHYSICAL JOURNAL, 775:10 (12pp), 2013 September 20 VALENCIA ET AL.

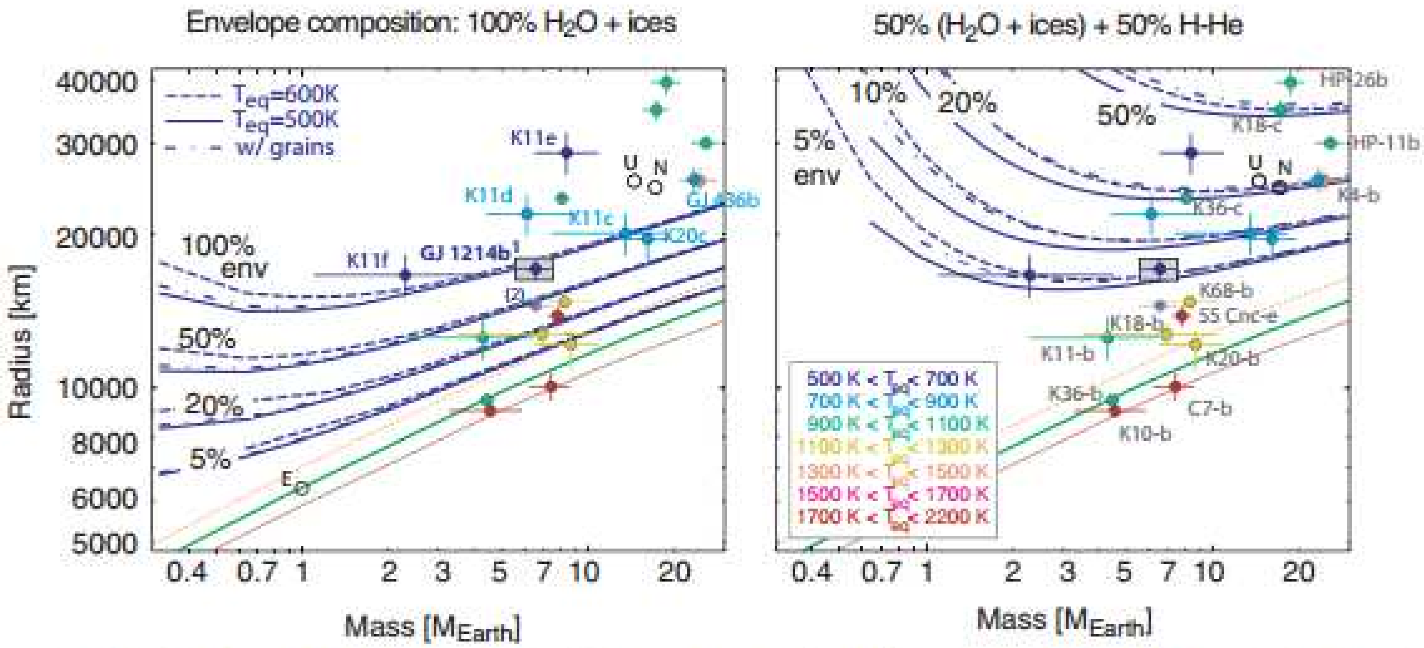


Figure 7. Mass–radius relationships for sub-Neptunes. The relationships between mass and radius for planets with an Earth-like nucleus below envelopes of varying mass fraction (100%, 50%, 20%, 10%, and 5%) are shown for a grain-free atmosphere at $T_{eq} = 500$ K (solid blue), and $T_{eq} = 600$ K (dashed blue), and a grainy atmosphere at $T_{eq} = 500$ K (dash-dotted blue). Two envelope compositions are shown: 100% H_2O/ices (left) and with 50% (H_2O/ices)+50% H/He (right). These MR relationships apply only to the planets GJ 1214b, Kepler-11e, Kepler-11f, Kepler-30b, and GJ 3470b as their equilibrium temperatures are ~560 K, ~650 K, ~575 K, ~600 K, and almost 700 K, respectively. The MR relationships shown correspond to an age of 4.6 Gyr. Planets are color coded by their equilibrium temperatures (calculated for an albedo of zero and an atmospheric redistribution factor of 1/4). Uranus and Neptune are shown for reference. The mass–radius relationships for three rocky compositions are shown: an Earth-like composition (green), a Mercury-like—enriched in iron with respect to Earth with an iron to silicate ratio six times that of Earth—(brown), and one voided of iron completely (pure magnesium-silicate oxides, orange). The latter shows the limit above which a planet has to have volatiles and cannot be completely rocky.

Nécessité de mesurer la composition de l'atmosphère

Various reasons to study the atmosphere of exoplanets

1) To learn about the nature of exoplanets and their diversity

2) To understand planetary physics and chemistry

3) To constrain planetary formation

4) Ultimately to search for bio-signatures (long term goal)

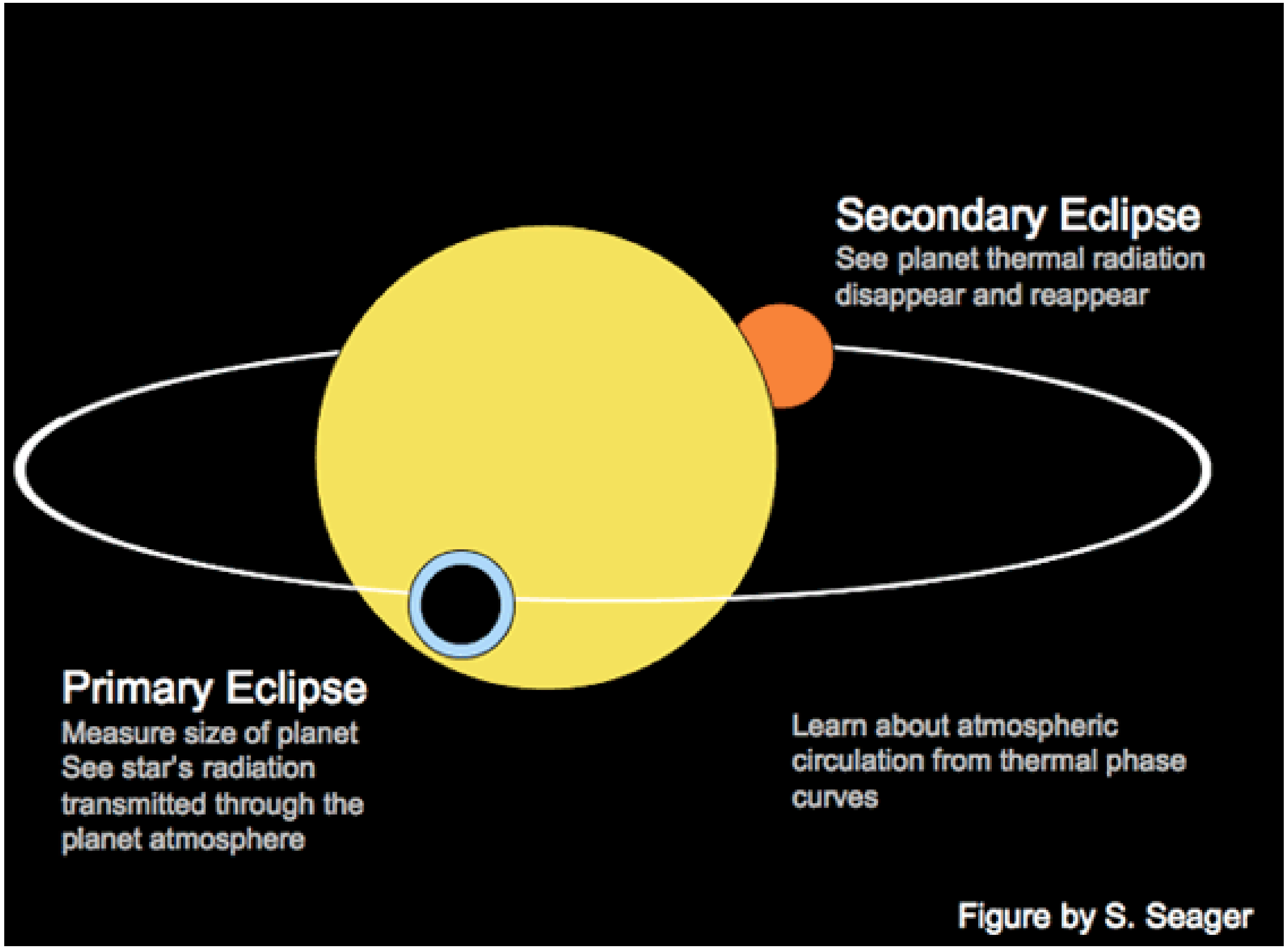
How to study the atmosphere ?

by spectroscopic observations in the IR

Molecule	$\Delta\nu = 2B_0$ cm^{-1}	λ (S_{max}) 2–5 µm	S_{max} cm^{-2} am^{-1}	R 2–5 µm	λ (S_{max}) 5–16 µm	S_{max} cm^{-2} am^{-1}	R 5–16 µm
H_2O	29.0	2.69 (ν_1, ν_3)	200	130	6.27 (ν_2)	250	55
HDO	18.2	3.67 ($\nu_1, 2\nu_2$)	270	150	7.13 (ν_2)		77
CH_4	10.0	3.31 (ν_3)	300	300	7.66 (ν_4)	140	130
CH_3D	7.8	4.54 (ν_2)	25	280	8.66 (ν_6)	119	150
NH_3	20.0	2.90 (ν_3)	13	170	10.33	600	50
		3.00 (ν_1)	20		10.72 (ν_2)		
PH_3	8.9	4.30 (ν_1, ν_3)	520	260	8.94 (ν_4)	102	126
					10.08 (ν_2)	82	110
CO	3.8	4.67 (1-0)	241	565			
CO_2	1.6	4.25 (ν_1)	4100	1470	14.99 (ν_2)	220	420
HCN	3.0	3.02 (ν_3)	240	1100	14.04 (ν_2)	204	240
C_2H_2	2.3	3.03 (ν_3)	105	1435	13.7 (ν_5)	582	320
C_2H_6	1.3	3.35 (ν_7)	538	2300	12.16 (ν_{12})	36	635
O_3	0.9				9.60 (ν_3)	348	1160

Table 5 Main molecular signatures and constraints on the spectral resolving power. $\Delta\nu$ is the spectral interval between two adjacent J-components of a band. S_{max} is the intensity of the strongest band available in the spectral interval. R is the spectral resolving power required to separate two adjacent J-components

From G. Tinetti et al. AAR 2013

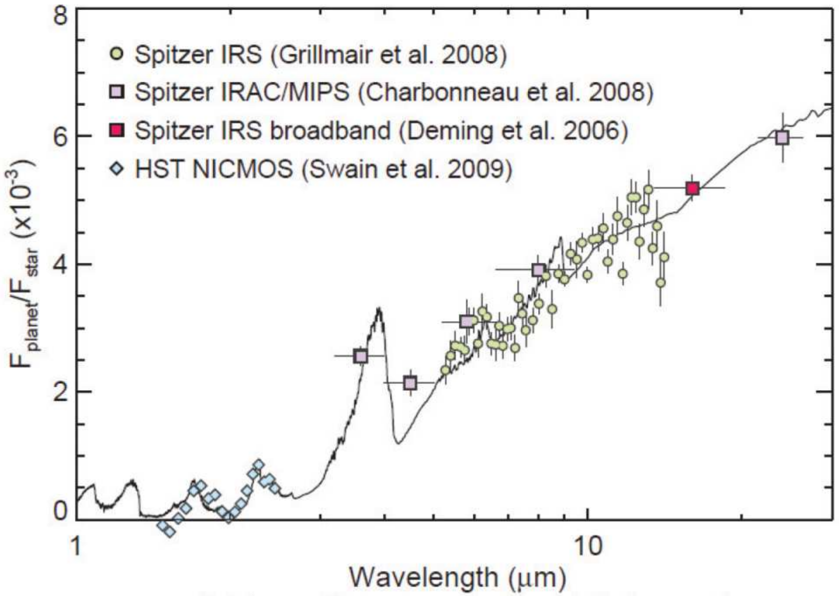


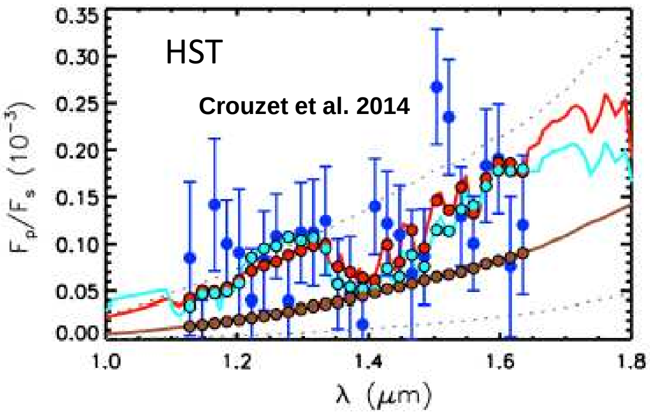
Star light passing through the exoplanet atmosphere
and being more or less absorbed
according to the atmosphere elemental and molecular composition

Tiny effect; difficult observation ; relative photometry needed can be as low as a few tens of ppm

Spectra of HD 189733 b

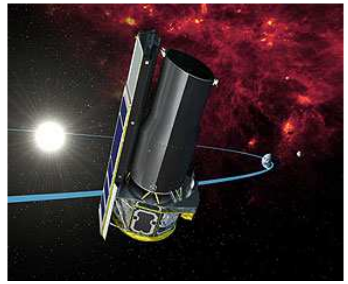
Day side emission spectrum of HD 189733b





Combining data from two facilities:

HST and Spitzer



Several dozens with only HST or warm Spitzer (photometry 3.6, 4.5 microns) observations

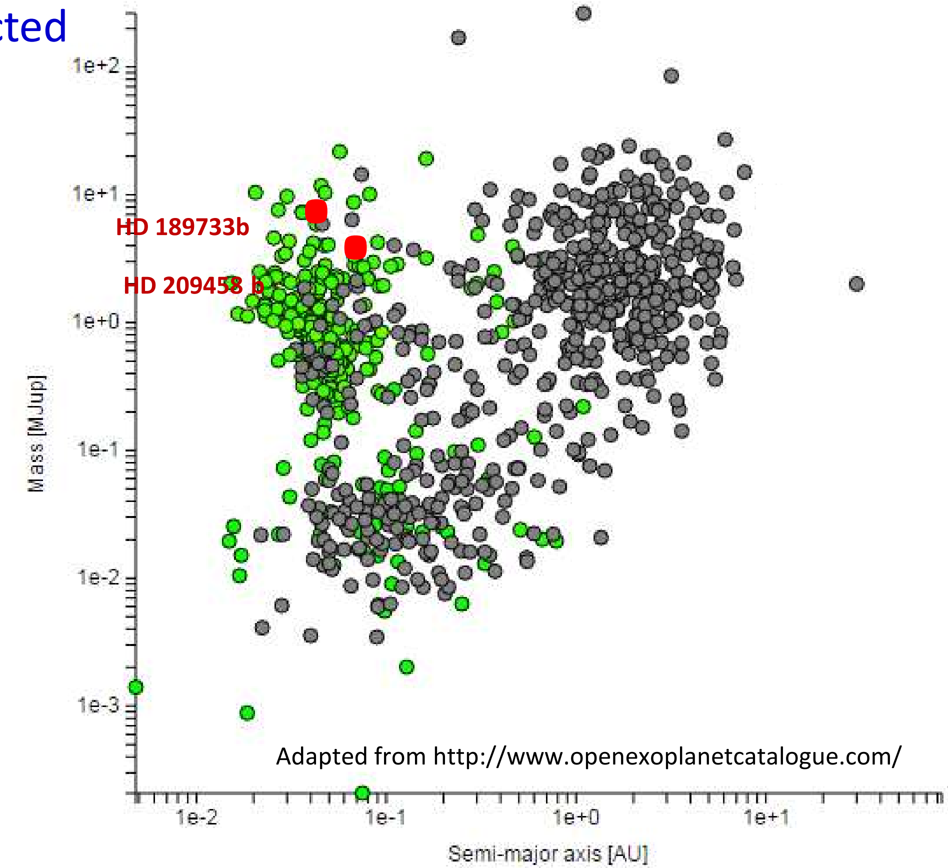
How many planets with « complete » spectroscopic spectral coverage?

Out of the 3500 exoplanets detected

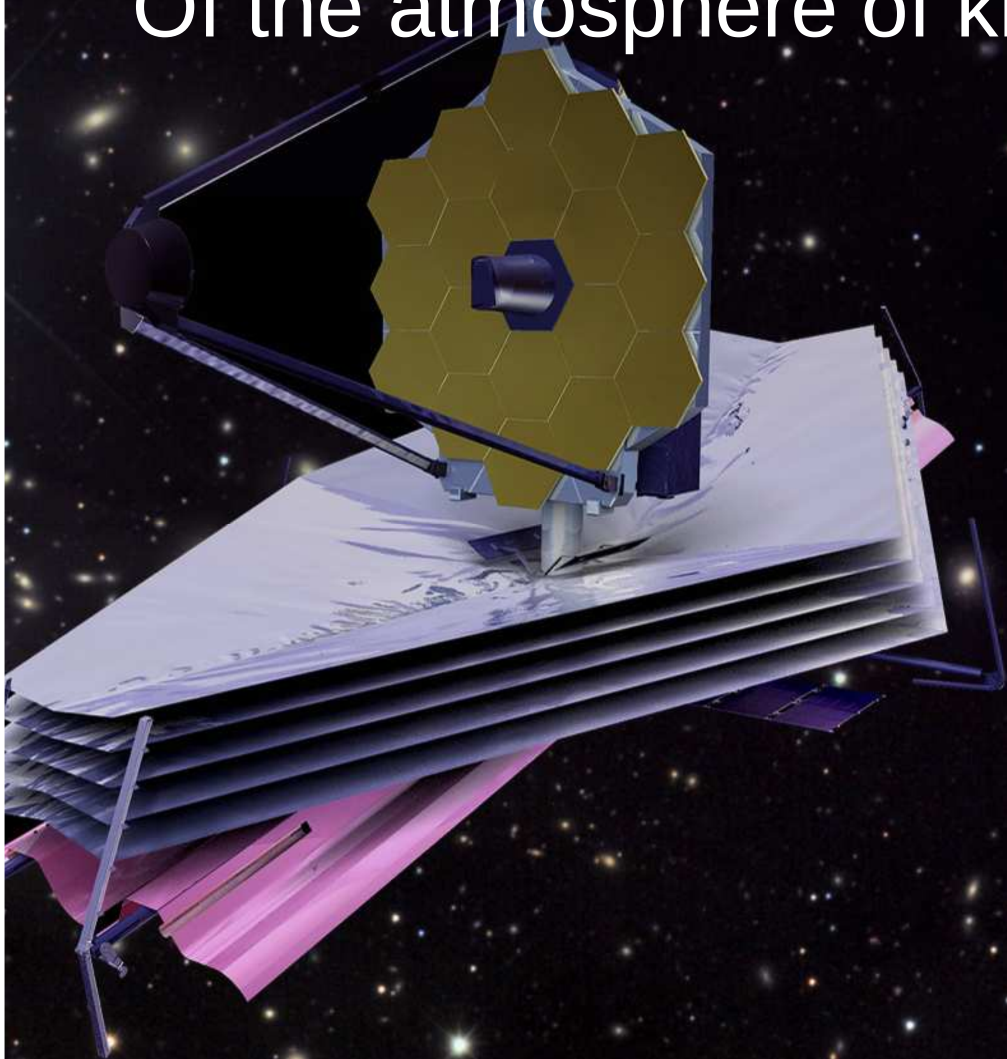
Only 2 !

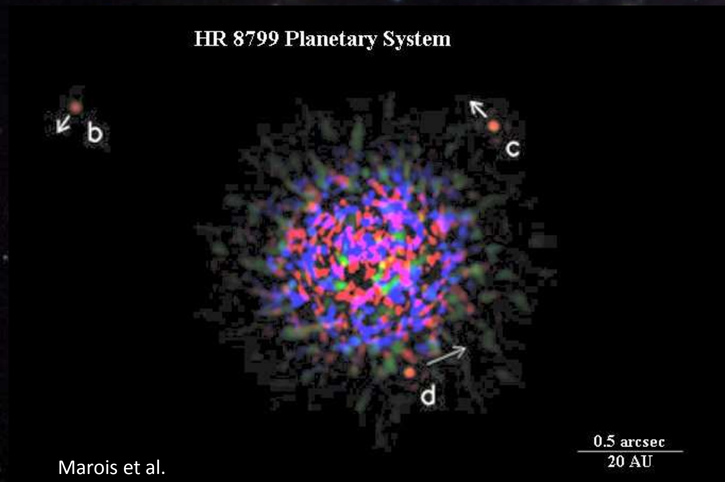
Hot Jupiter

Very bright

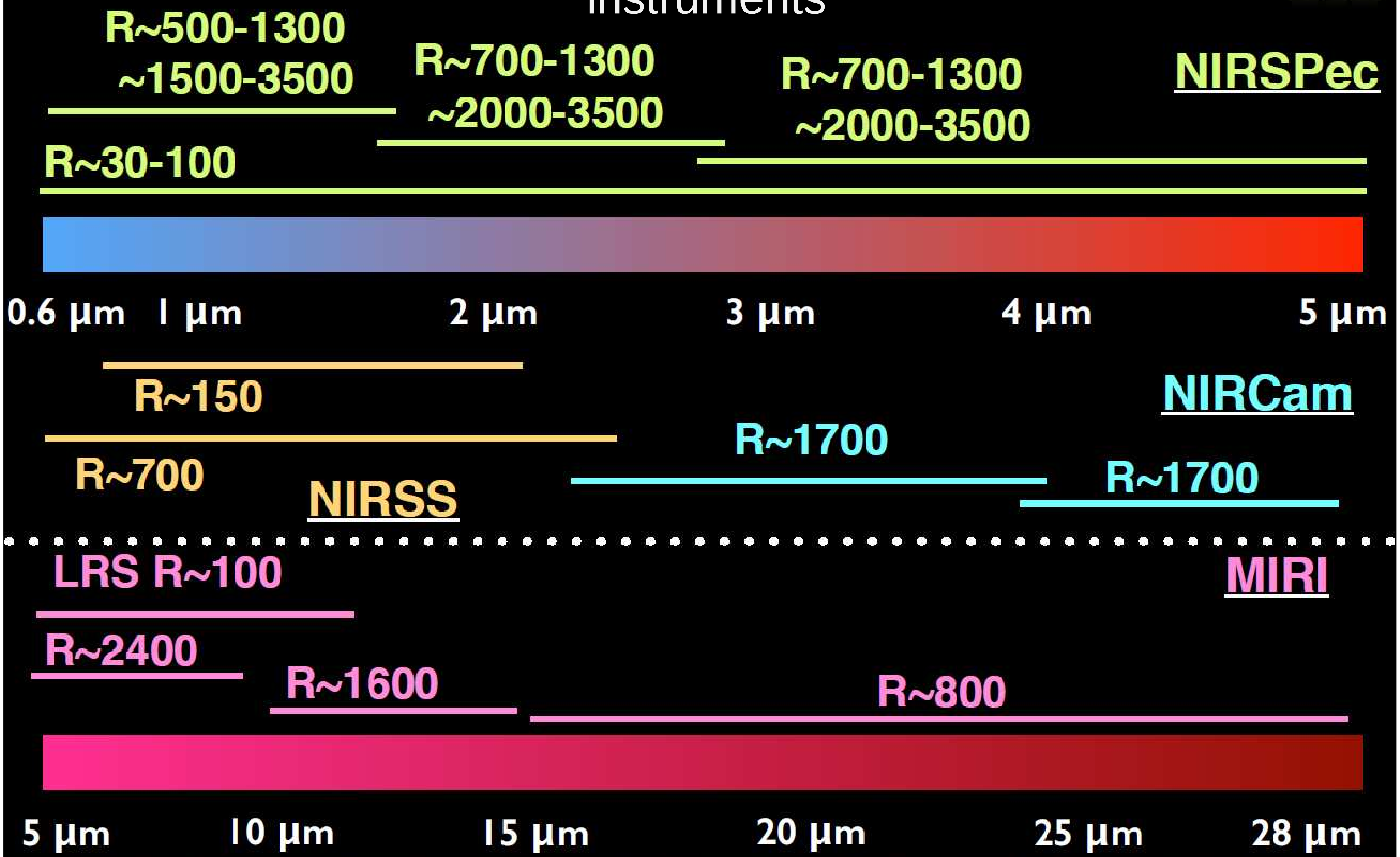


The JWST will have a major impact in the study Of the atmosphere of known exoplanets





Large wavelength coverage
The various spectroscopic modes of the 4 JWST instruments



Les observations avec le JWST dans le cadre du projet P2IO

Coordinating the MIRI GTO exoplanet program (105 h)

40 hours direct imaging exoplanets

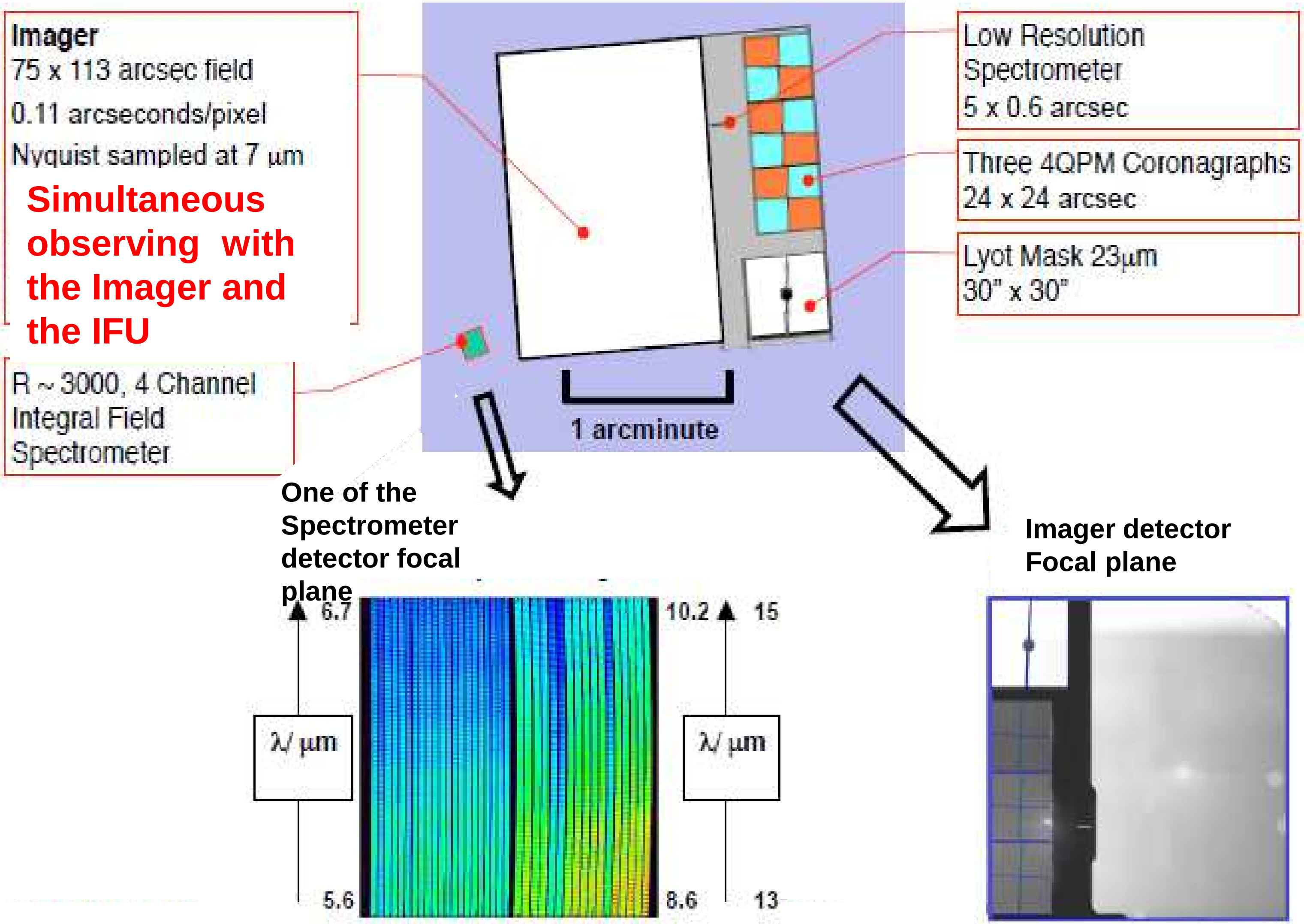
60 hours transiting

On va avoir plein de spectres !

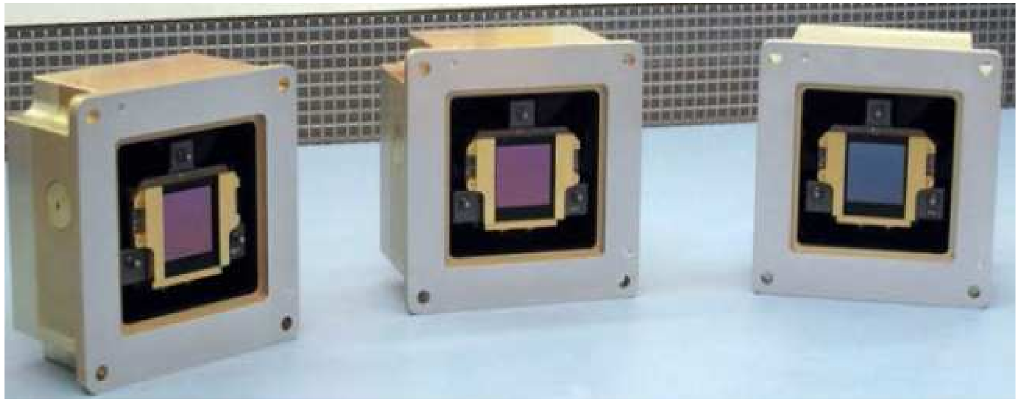
The exoplanets detected by direct imaging are most often younger than those transiting their host star. They are **still in the cooling phase** and it is important to determine their luminosity to constrain their formation (hot versus cold start). Observations in the Mid-IR are particularly important to determine the luminosity of those exoplanets with a temperature below 1000K. No observation in the MIRI wavelength range has been possible so far. Of special interest in the MIRI wavelength range are the **NH_3 lines** at 10.65 microns, which are a good probe of the temperature **below 1000K**. Note also that non equilibrium chemistry can be at work at these temperatures. Only giant planets have been detected by direct imaging so far.

The exoplanets transiting their host star are closer to the star than those observed by direct imaging; in addition they are older, so that the temperature is mostly determined by the star irradiation. The range of masses of detected transiting exoplanets is broader; of particular interest are the super-Earths, whose atmosphere could be very diverse.

MIRI Focal Planes (Entrance and Detector)



DETECTORS



Parameter	baseline array	contingency array
format	1024 x 1024	1024 x 1024
pixel size	25 μm	25 μm
IR-active layer thickness	35 μm	30 μm
IR layer As doping	7×10^{17} cm^{-3}	5×10^{17} cm^{-3}
read noise*	14 e$^-$	14 e$^-$
dark current	0.2 e$^-$/s	0.07 e$^-$/s
quantum efficiency**	$\geq$ 60%	$\geq$ 50%
nominal detector bias***	2.2V	2.2V
well capacity	$\sim$ 250,000 e$^-$	$\sim$ 250,000 e$^-$

Run at JPL end of August beginning september partially devoted to exoplanet TSO detector tests to be conducted at JPL soon

(G. Rieke, M. Ressler, D. Dicken, P. Bouchet et al.)

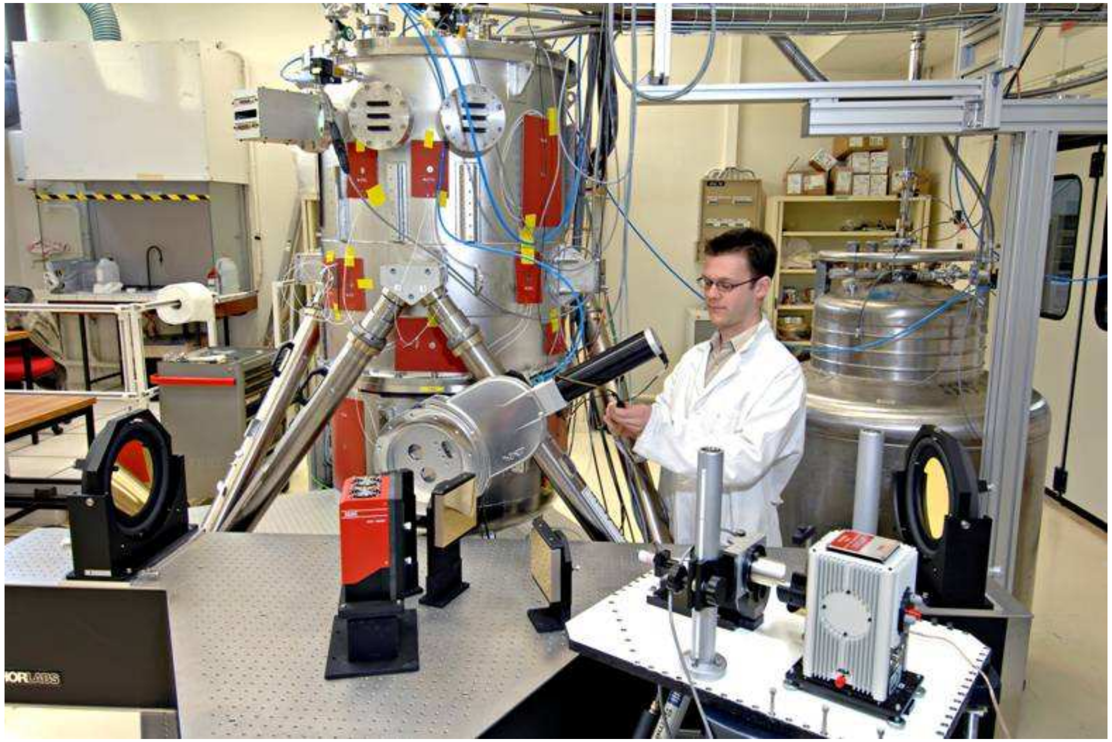
Vis-à-vis du programme exoplanet

(hors tout! Contrat consortium, centre d'expertise, projet P2IO):

Tests supplémentaires en laboratoire at Saclay:

principalement le mode 'spectroscopie sans fente'

(si autorisé à utiliser backup double prism)



Participants:

Salima Mouzali (responsable station)

Philippe Galdemard

Dan Dicken (responsable tests stabilité)

POL (responsable tests slitless)

+ opticien

→ Pourrais etre inclus dans projet P2IO

Source selection: *Transiting exoplanets*:

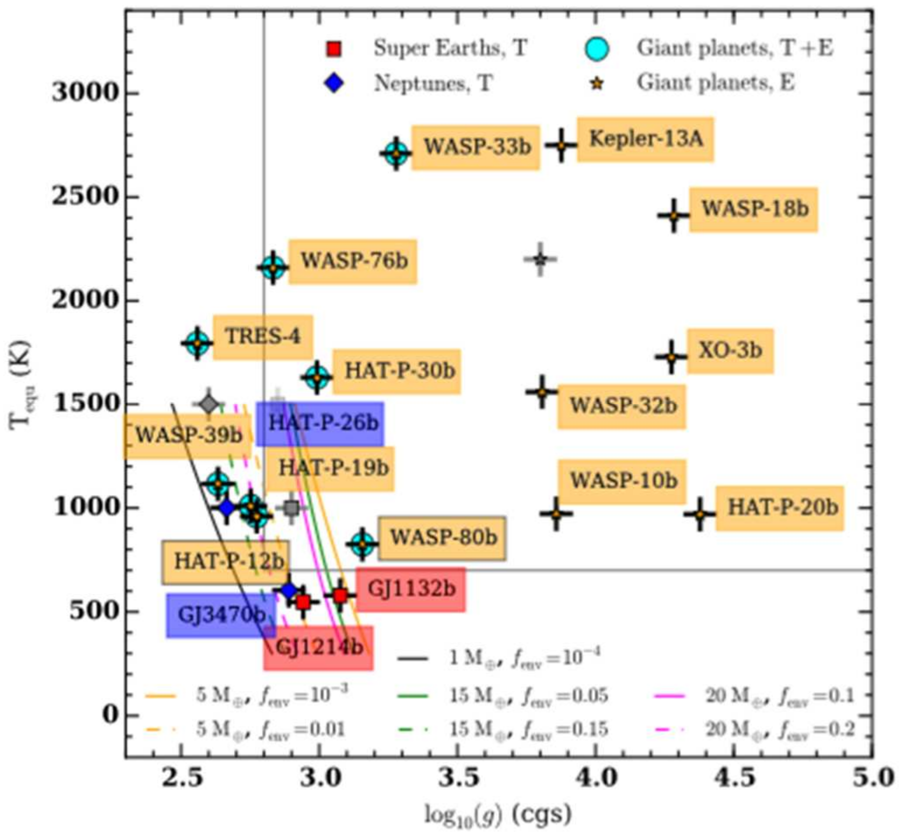
Three criteria:

- detected by SPITZER,
- brightness of the star fainter than a K magnitude of 7 (for saturation issues); in fact at the end, all the selected sources have K magnitude greater than 8 which is safer,
- high Signal over Noise ratio (>5 for LRS) during one transit or eclipse.

Fifty sources met the criteria when observed **in emission**
Among these, a dozen have also a >5 S/N transmission spectra in one transit.

Name; green OK for transmission and emission; yellow OK for transmission; violet OK for emission	Obs mode	Spectral type Star	K mag star (mag)	Teff (K)	Radius star (Rsun)	Stellar Variability	Orbital period (d)	Eccentricity	Semi mjr axis (au)	transit duration (hours)	Mass Planet (Mjup)	Mass Planet (Mearth)	Radius Planet (Rjup)	Radius Planet (Rearth)	Equilibrium Temp Planet (K)	surface gravity g (m/s^2)	Flux Star (Jy @ 7 µm)	Star N/S with a noise floor at 50 ppm (@ 7 µm)	Amplitude Transit in ppm (@ 7 µm)	S/N Transit (LRS @ 7 µm)	Contrast Eclipse in ppm (@ 7 µm)	SNR Eclipse LRS @ 7 µ
Super-Earths; mini Neptunes																						
GJ1132 b	LRS transmission? Risky. At best (H) 4,3 sigma.	M3.5	8,322	3270	0,207		1,629	0,00000	0,01530	0,7820	0,0051	1,6	0,103	1,13	579	12,02	0,066	131	237	1,8	68	0,4
K2-3 b	photometry?	M0.0V	8,561	3896	0,553		10,054	0,00000	0,07750	2,5630	0,0264	8,4	0,185	2,03	501	19,28	0,045	102	32	0,3	14	0,1
(K2-3 c)		"	8,561	3896	0,553		24,640		0,14050			0,0	0,146	1,60	372		0,045				2	
(K2-3 d)		"	8,561	3896	0,553		44,560		0,20860			0,0	0,136	1,49	305		0,045				1	
GJ 1214 b	LRS transmission. LRS emission adding resolution elements?	M	8,782	3026	0,216		1,580	0,00000	0,01411	0,8760	0,02	6,4	0,238	2,61	547	8,83	0,047	142	646	4,5	298	1,7
55 Cnc e	photometry?	K0IV-V	4,015	5196	0,953		0,737	0,05700	0,01544	1,5840	0,0254	8,1	0,1713	1,88	1958	21,64	2,477	72	35	0,5	89	1,0
HD 219134 b	photometry?	K3V	3,26	4699	0,778		3,093	0,02000	0.0382	0,9600	0,0136	4,3	0,1433	1,57	1022	16,56	5,264	72	30	0,4	30	0,3
HD 97659 b	photometry?	K1V	5,735	5170	0,741		9,490	0,07800	0,08000	2,8490	0,0238	7,6	0,2005	2,20	757	14,80	0,509	74	38	0,5	27	0,3
Trappist 1b		M8	10,3	2550	0,114		1,511	0,00000	0,01111	0,6020	0,003	1,0	0,0993	1,09	400	7,61	0,014	200	246	1,2	59	0,2
Trappist 1c		M8	10,3	2550	0,114		2,422	0,00000	0,01522	0,6960	0,003	1,0	0,0936	1,03	342	8,56	0,014	200	176	0,9	22	0,1
Neptune like																						
	LRS transmission LRS emission																					

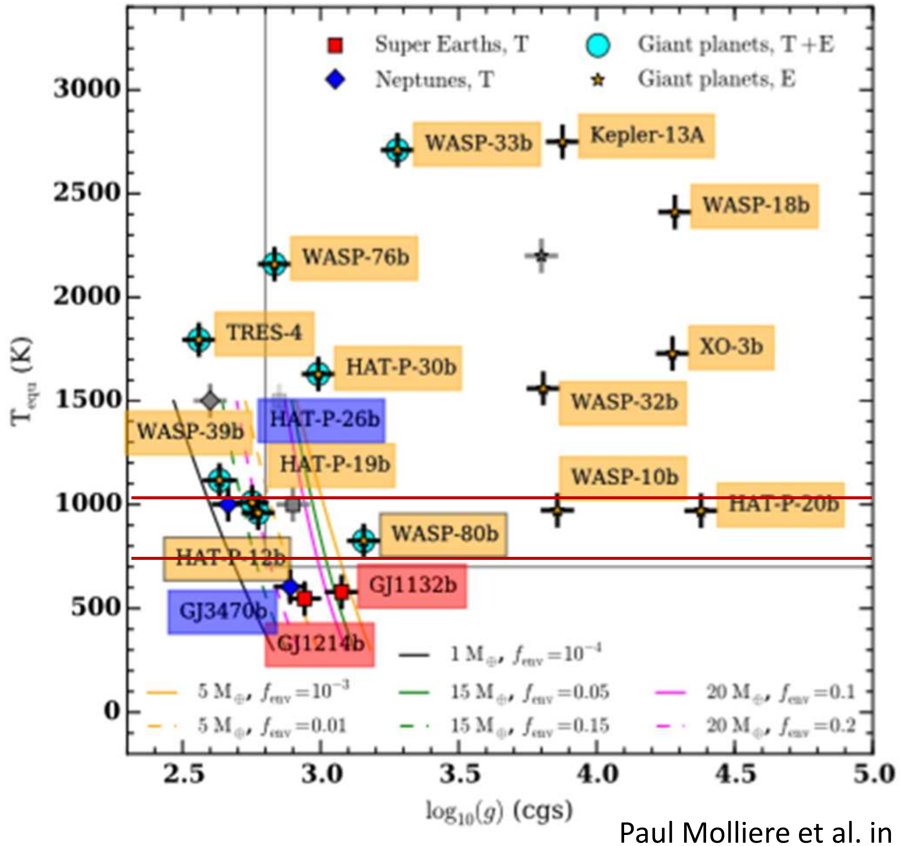
Ideally we would like to cover the T – log (g) parameter range



Paul Molliere et al. in preparation

But selection has to be done !

First priority :



Paul Molliere et al. in preparation

Then we selected, as first priority for MIRI source at a temperature lower than 1000 K ("MIRI target" : NH3 lines, non equilibrium chemistry), we ended up with 5 targets* :

HAT-P-12 b, HAT-P-19 b, WASP-80 b, WASP-10 b, HAT-P-20 b

with masses ranging from 0.21 to 3.1 Jupiter mass and a log g from 2.6 to 4.4, to be observed with the LRS in emission and when possible in transmission

→ could fill up the whole GTO!

(*WASP-39b at the limit in terms of temperature)

Direct Imaging:

Not so many targets

Selection criteria :

- angular distance to the stars
- mass (<11 Mjup)
- S/N

A group of 8 targets has been obtained with temperature < 1000K (NH3 lines out of Equilibrium) :

VHS 1256-1257 b (LRS), GU Psc b (LRS), WD 0806-661B b (LRS), PSO J318.5338−22.8603 (LRS), HR 8799 b, c, d (Corono), GJ504 b (Corono), HD 95086 b (Corono), 2M1207 b (Corono)

We added up 3 targets at higher temperature (1700-1900 K):

β-Pic b (Corono), Rox42B b (Corono), HD 106906 b (MRS)

In addition, we will observed a few **brown dwarfs**

Discussions of the source list
tomorrow in Leiden !

To interpret the observation :
Models of exoplanet atmosphere are needed

In the framework of the P2IO project :

	Description	Date	People in charge	De
1	Benchmarking of atmospheric exoplanet models	2016	P. Tremblin . P-O. Lagage + MIRI consortium exoplanet modeling group	1 paper (ApJ)
2	Simulate the expected effects of composition variations (e.g., C/O ratio) for different scenarii of planet formation in disks, for direct imaging and for the exoplanets transiting	2016-2017	P. Tremblin, P.-O. Lagage + student at UCL	At least 2 pape
3	Implement of clouds in the ATMO model	2017-2018	P. Tremblin, postdoc	1 paper (ApJ o
4	Development of 3 D models from the dynamico code: Post-processing of 3D models with ATMO to produce 2D maps of the atmosphere transmission spectra, study of simple clouds prescriptions.	2016-2018	S. Fromang, P. Tremblin + postdoc	1 paper (ApJ o
5	Analysis of the first JWST exoplanet observations in ERS and in GTO	2019	P.O. Lagage, PhD (of WP2), S. Fromang, M. Ollivier, P. Tremblin and international collaborators	At least 1 pape

Benchmarking activity

benchmarking activity
of the 3 exoplanet atmosphere 1D codes
available in the European MIRI consortium Institutes

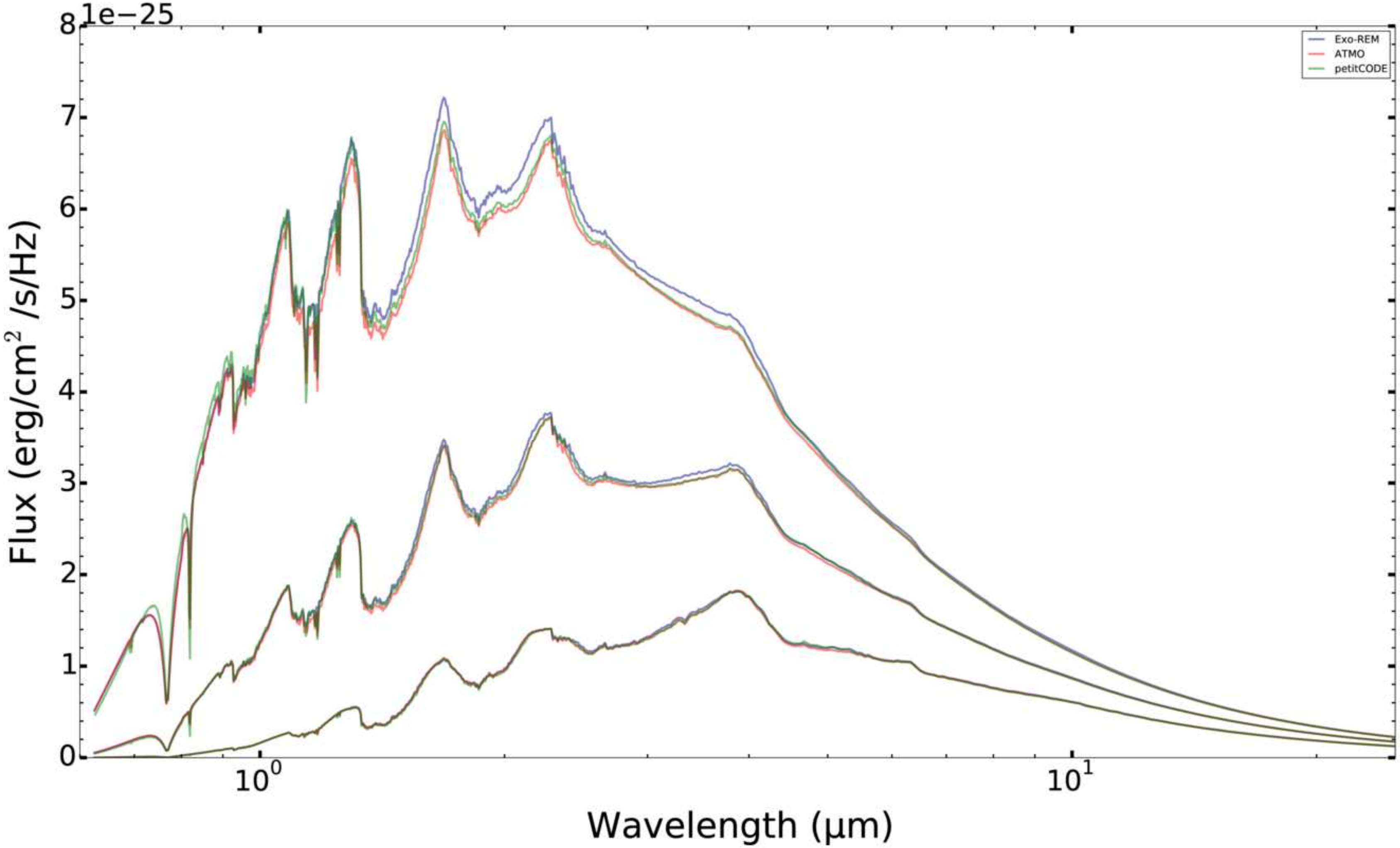
The 3 codes are :

the Petit code, developed from scratch at Heidelberg
(by P. Mollière, PhD student supervized by T. Henning)

the ExoREM code developed from scratch at Meudon
(by J.-L. Baudino, former PhD student of B. Bézard
(specialist of planetary atmosphere);
J-L Baudino has now a one year postdoctoral position at Saclay)

the ATMO code developed at Exeter partly by P. Tremblin as a Post-doc, and updated

Benchmarking activity

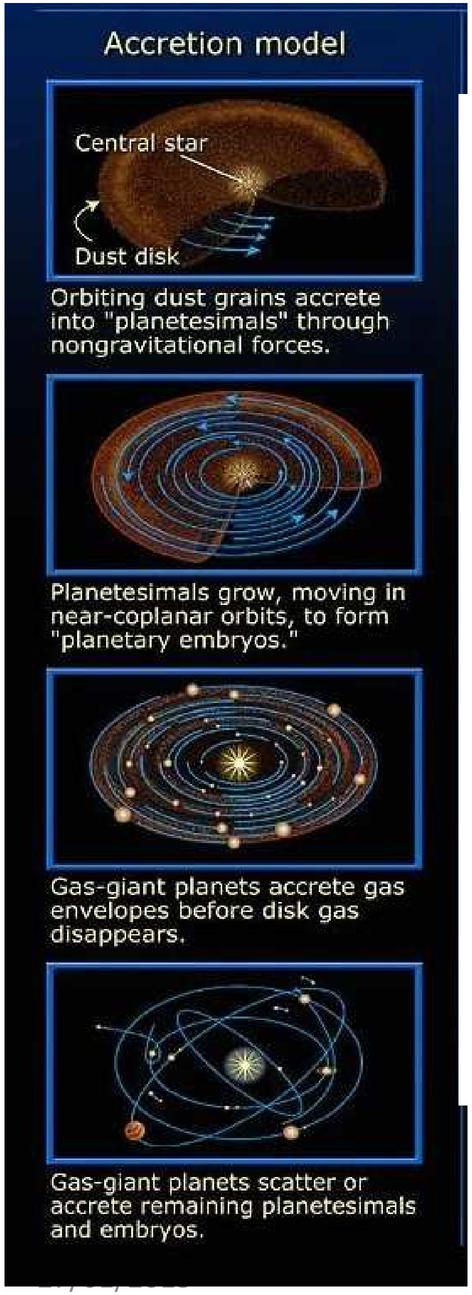


Emission spectra (down to up) for 1500, 2000, 2500 K

Baudino et al. in preparation, well advanced

	Description	Date	People in charge	De
1	Benchmarking of atmospheric exoplanet models	2016	P. Tremblin . P-O. Lagage + MIRI consortium exoplanet modeling group	1 paper (ApJ) Draft (Baudin
2	Simulate the expected effects of composition variations (e.g., C/O ratio) for different scenarii of planet formation in disks, for direct imaging and for the exoplanets transiting	2016-2017	P. Tremblin, P.-O. Lagage + student at UCL	At least 2 pape
3	Implement of clouds in the ATMO model	2017-2018	P. Tremblin, postdoc	1 paper (ApJ o
4	Development of 3 D models from the dynamico code: Post-processing of 3D models with ATMO to produce 2D maps of the atmosphere transmission spectra, study of simple clouds prescriptions.	2016-2018	S. Fromang, P. Tremblin + postdoc	1 paper (ApJ o
5	Analysis of the first JWST exoplanet observations in ERS and in GTO	2019	P.O. Lagage, PhD (of WP2), S. Fromang, M. Ollivier, P. Tremblin and international collaborators	At least 1 pape

Information on exoplanet formation from atmosphere composition?



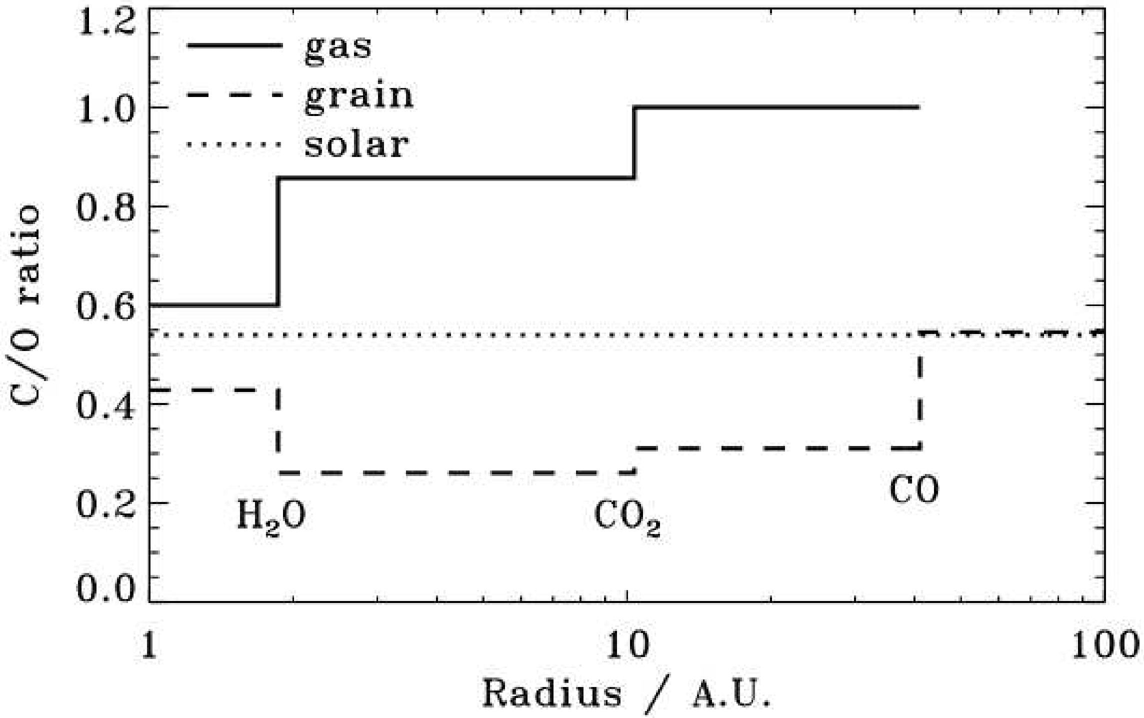


Fig. 1.— The C/O ratio in the gas and in grains, assuming the temperature structure of a 'typical' protoplanetary disk around a solar-type star (T_0 is 200 K, and $q = 0.62$). The H_2O, CO_2 and CO snow-lines are marked for reference.

Oberg 2011

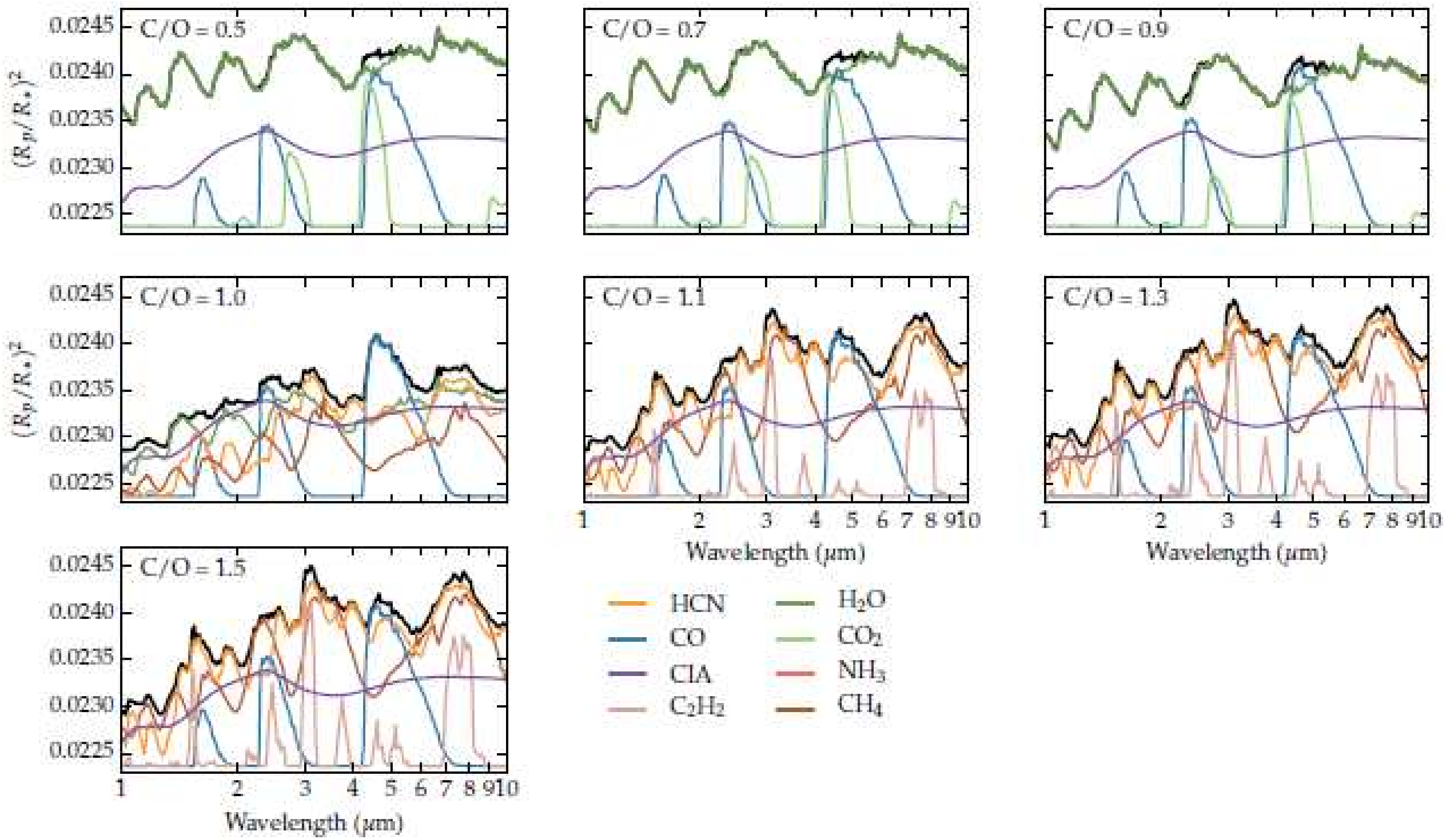
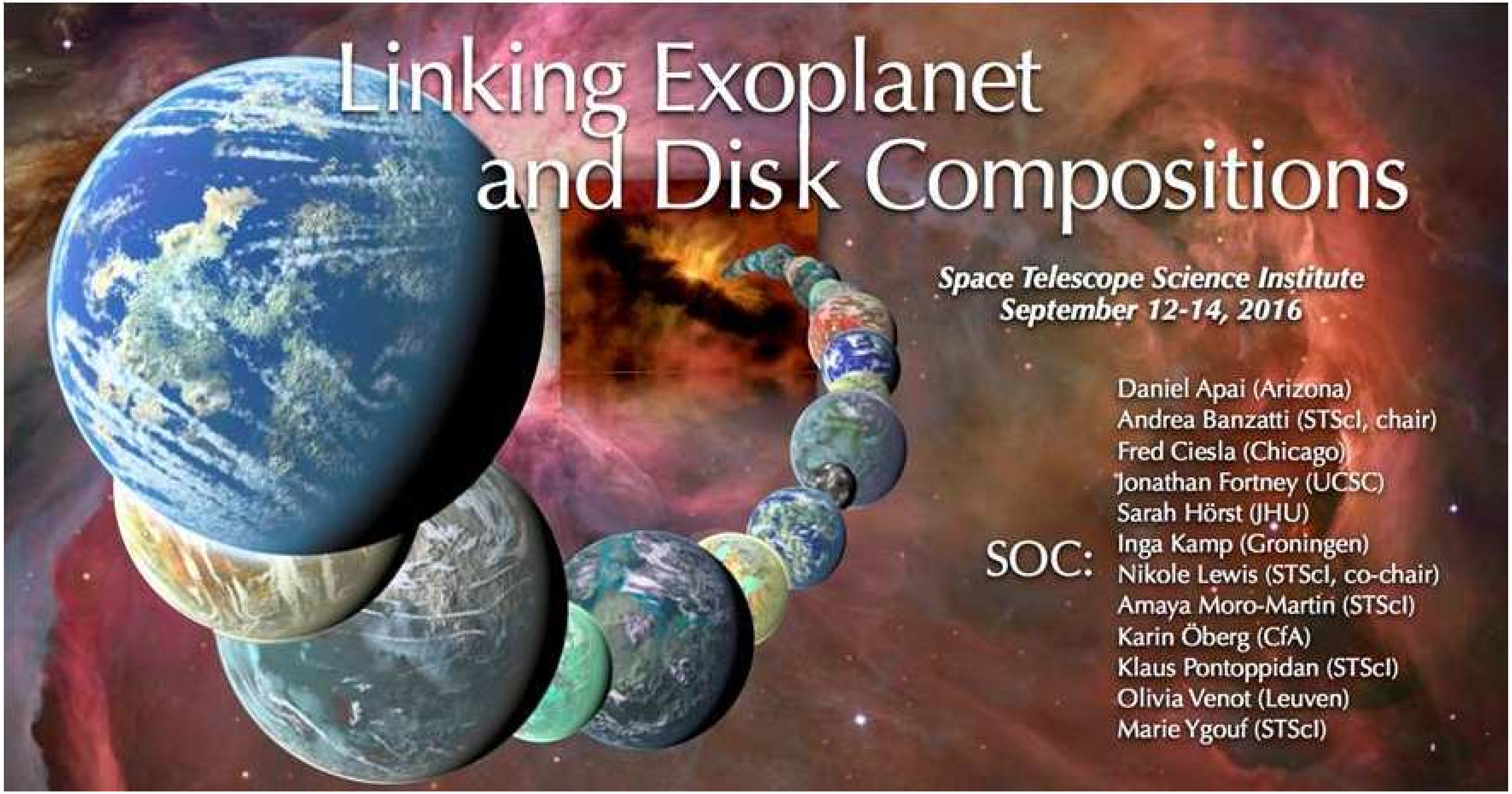


Figure 4. Synthetic transmission spectra (black lines) and contributions of the major opacity sources (colored lines, see legend) for the atmospheres whose chemistry is shown in Figure 3, for different C/O values. The opacity sources include the seven molecules considered in this study, and the collision induced absorption (CIA) from H_2–H_2 and H_2–He pairs. Note that for each plot we only show the major opacity contributors to the spectrum, and we hide the molecules that do not significantly contribute to the transmission spectrum features.

Rochetto et al. (almost accepted ApJ)

Plan : Do the same for emission

A dedicated workshop at STScI:



→ Not so easy !!!

Interesting subject for the P2IO project?

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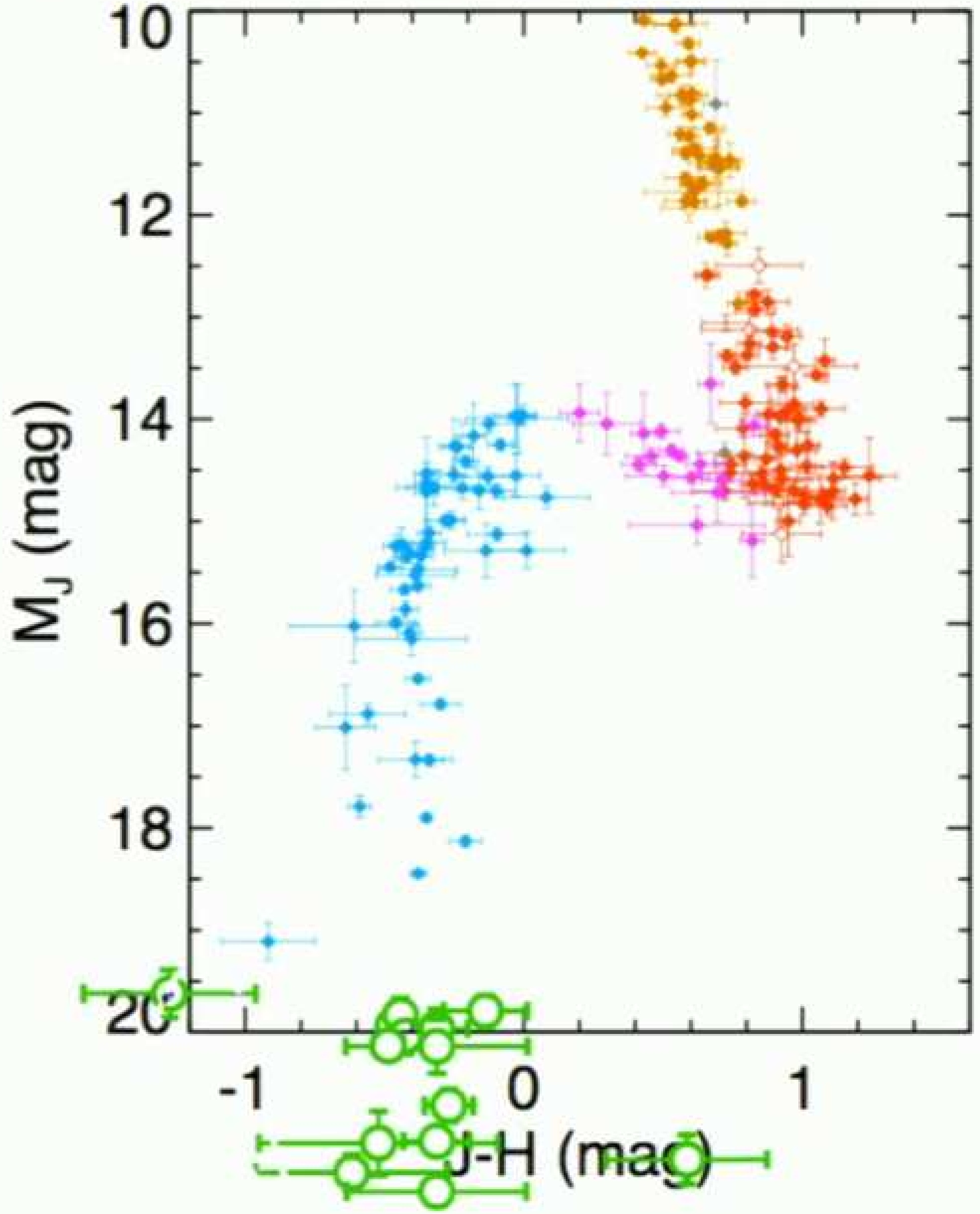
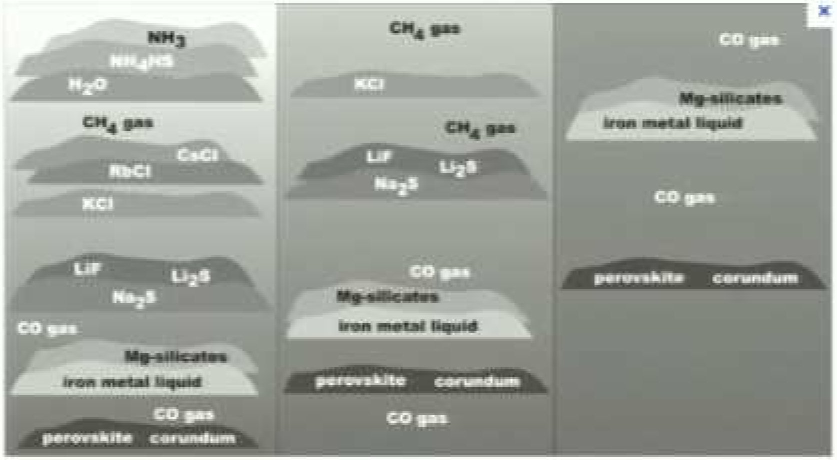
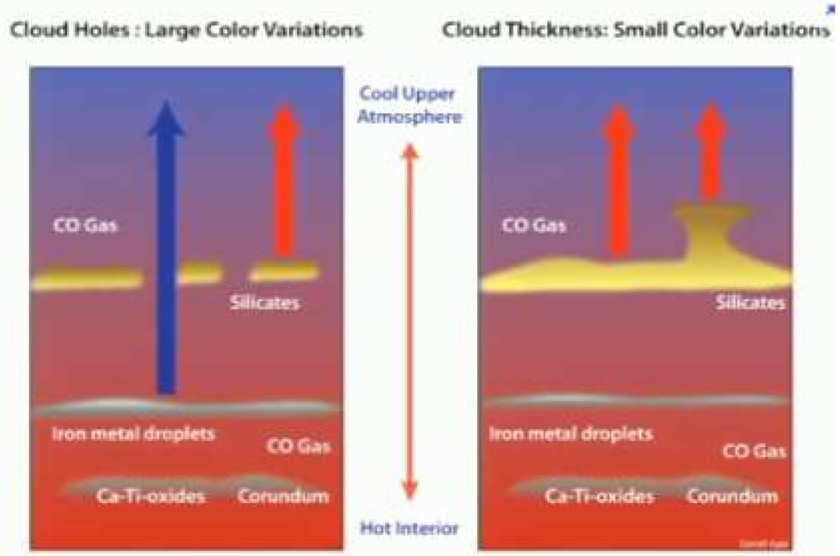
3	Implement of clouds in the ATMO model	2017-2018	P. Tremblin, postdoc	1 paper (ApJ o
4	Development of 3 D models from the dynamico code: Post-processing of 3D models with ATMO to produce 2D maps of the atmosphere transmission spectra, study of simple clouds prescriptions.	2016-2018	S. Fromang, P. Tremblin + postdoc	1 paper (ApJ o
5	Analysis of the first JWST exoplanet observations in ERS and in GTO	2019	P.O. Lagage, PhD (of WP2), S. Fromang, M. Ollivier, P. Tremblin and international collaborators	At least 1 pape

Naines brunes

Marley et al. (2010), Apai et al.







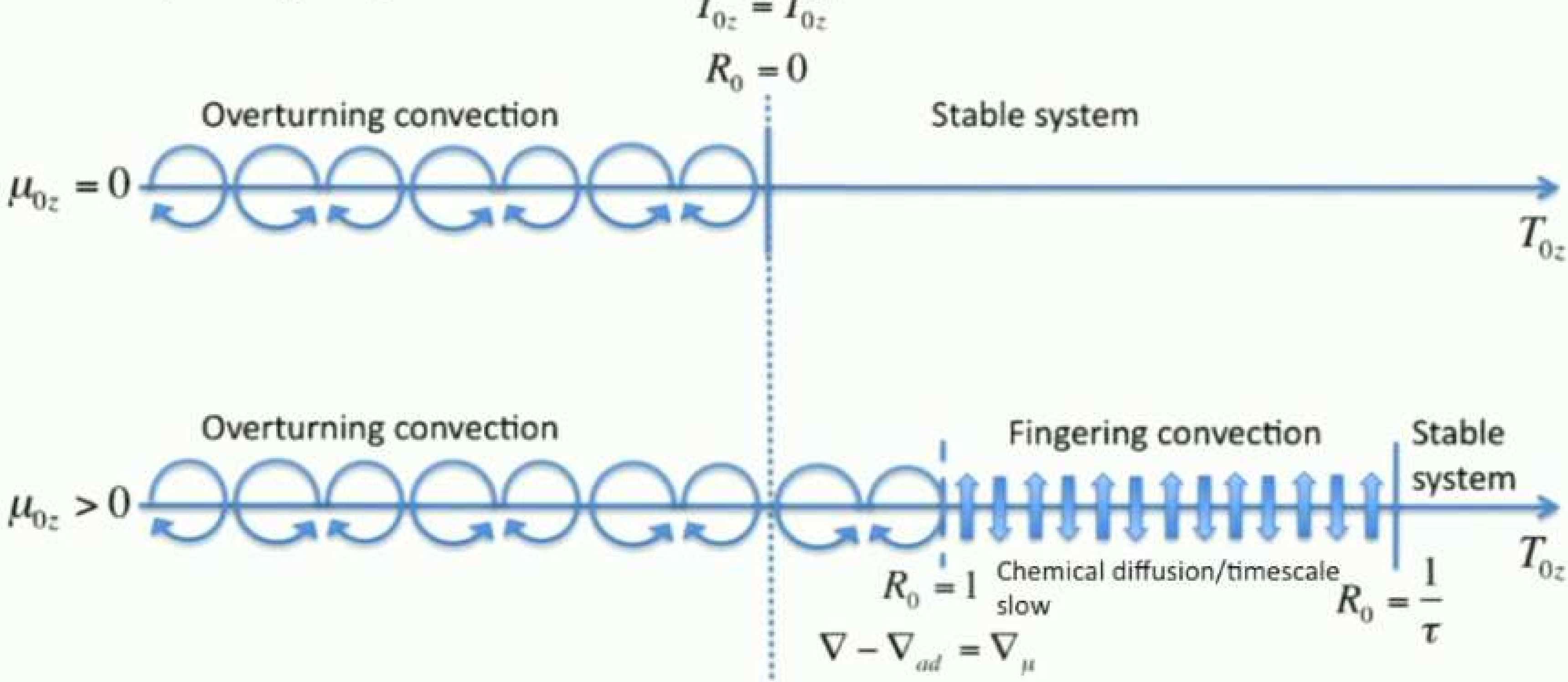
CLOUDLESS ATMOSPHERES FOR L/T DWARFS AND EXTRASOLAR GIANT PLANETS

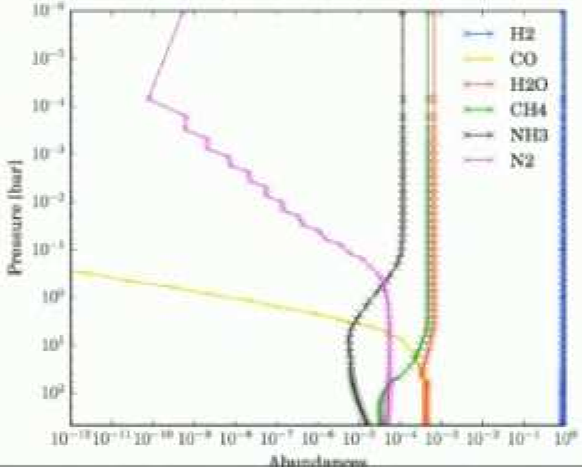
P. Tremblin
Maison de la Simulation (CEA Saclay) Université Paris-Saclay + University of Exeter

D.S. Amundsen, G. Chabrier, I. Baraffe, B. Drummond, S. Hinkley, P. Mourier, O. Venot

- Cooler deep layers + out-of-eq chemistry -> fingering convection ?

Tremblin et al. (2016) Rosenblum et al. (2011)



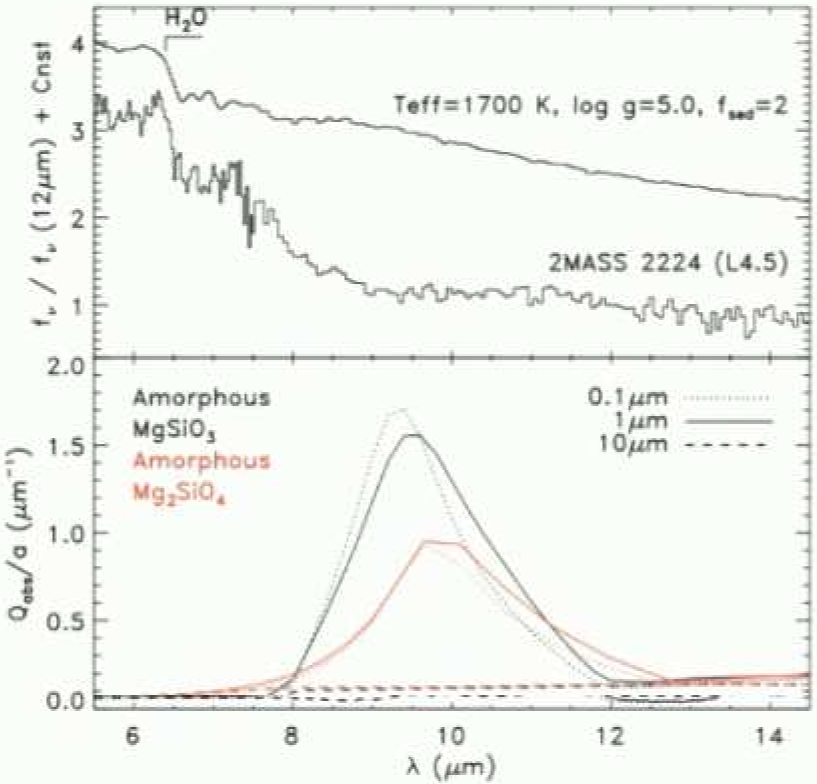


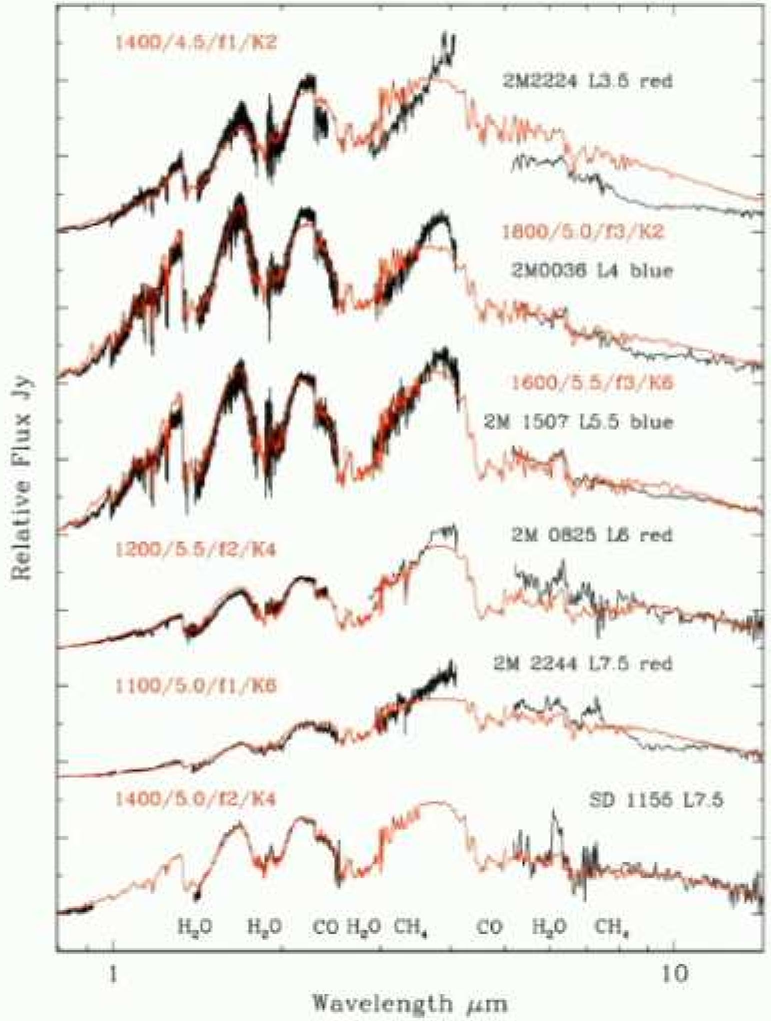
$$CO + 3H_2 \rightarrow CH_4 + H_2O$$
$$N_2 + 3H_2 \rightarrow 2NH_3$$

- No need for clouds for NIR spectra
  but there are clouds in L dwarfs !

Cushing et al. (2005) Stephens et al. (2009)

Page 16

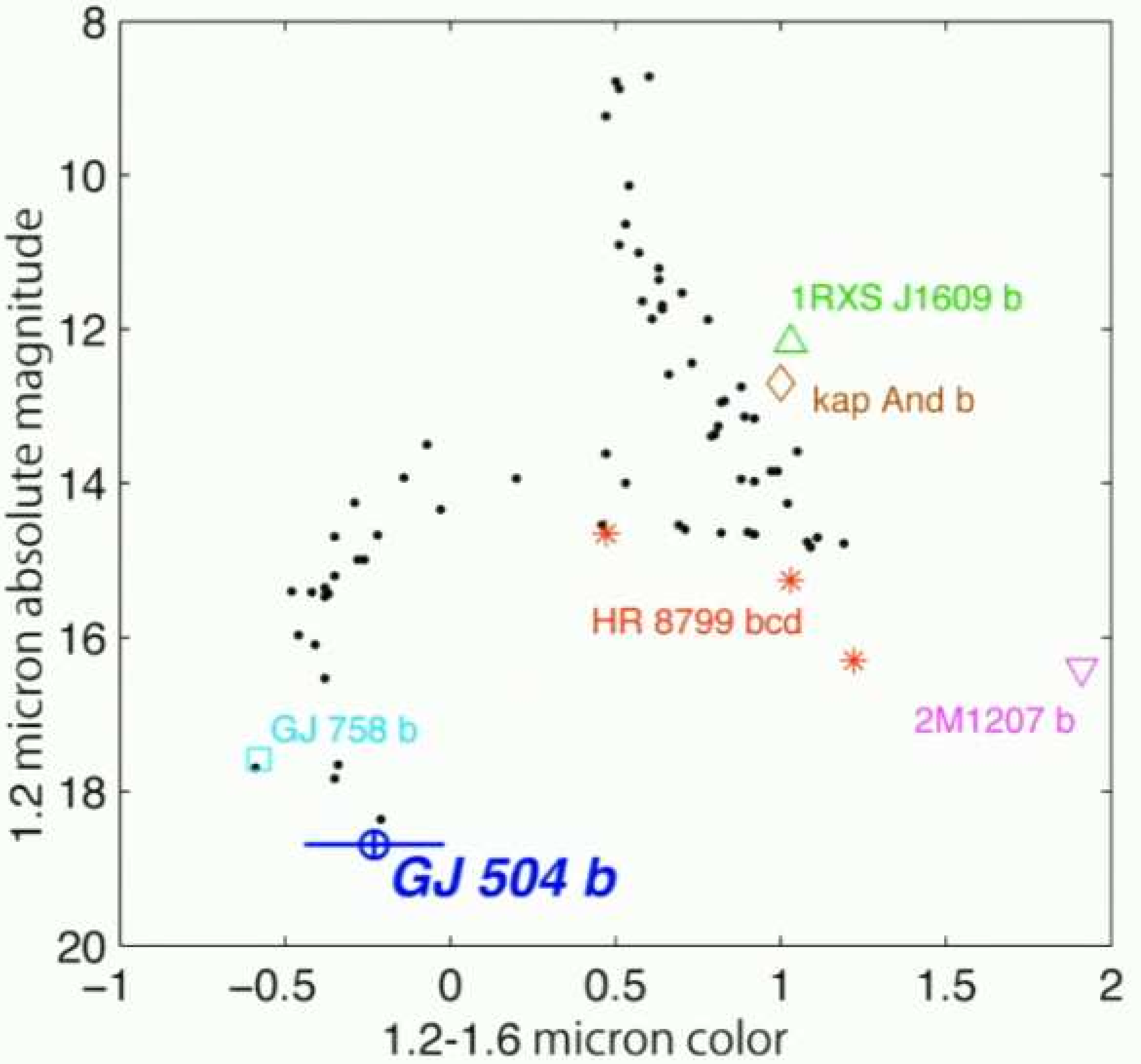




- Characterization for exoplanets thanks to JWST/MIRI, need a revision of current cloud models to reproduce this signature at long wavelength

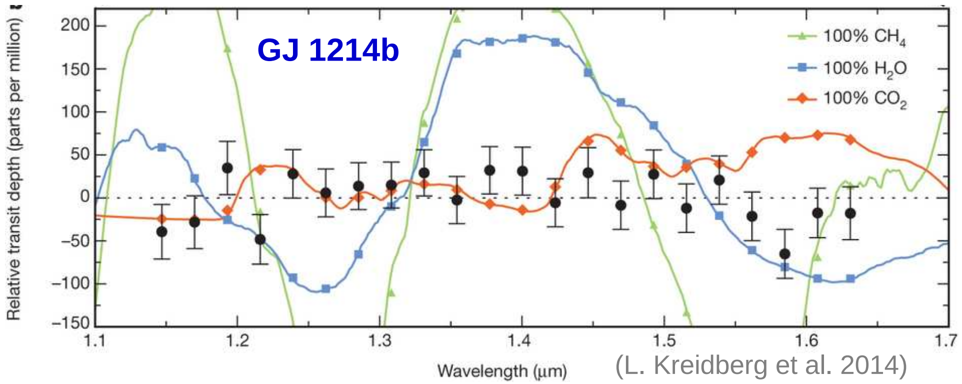
➢ Important for exoplanet? Yes !

Kuzuhara et. al. (2013)



Possible clouds also for exoplanets

To probe hazes, cloud (dust feature in the mid-IR, 10 μm)



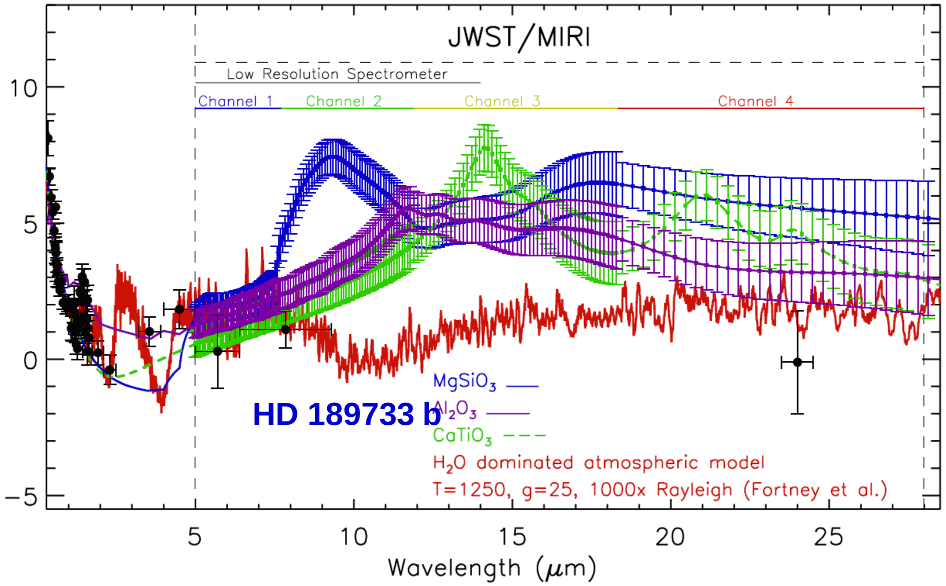
(L. Kreidberg et al. 2014)

Transmission spectrum : FLAT
→ clouds, Hazes

Possible clouds also for exoplanets

To probe hazes, cloud (dust feature in the mid-IR, 10 μm)

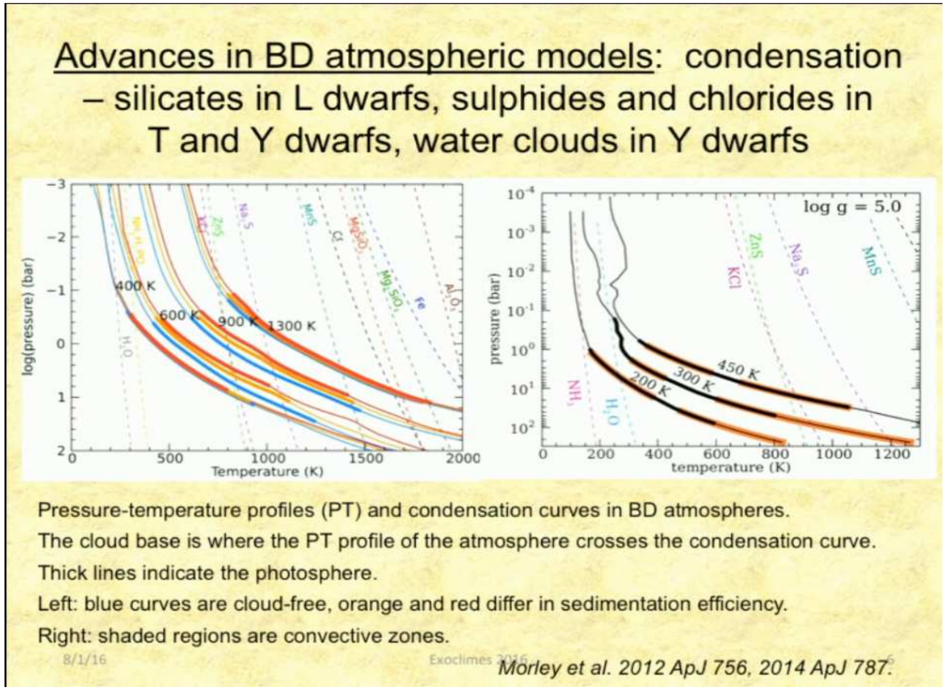
H. R. Wakeford and D. K. Sing: Transmission spectral properties of clouds for hot Jupiter exoplanets



Sujet en plein essor

Thème majeur à la dernière conf exoclime (2016)

Condensation de matériel dans les conditions particulières de l'atmosphere des exoplanetes



→ Donne lieu à de nouvelles expériences de laboratoire

→ Sujet qui peut probablement beaucoup bénéficier de la synergie Engendrée par le projet emblématique

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So far most models 1D

Need 3 D models

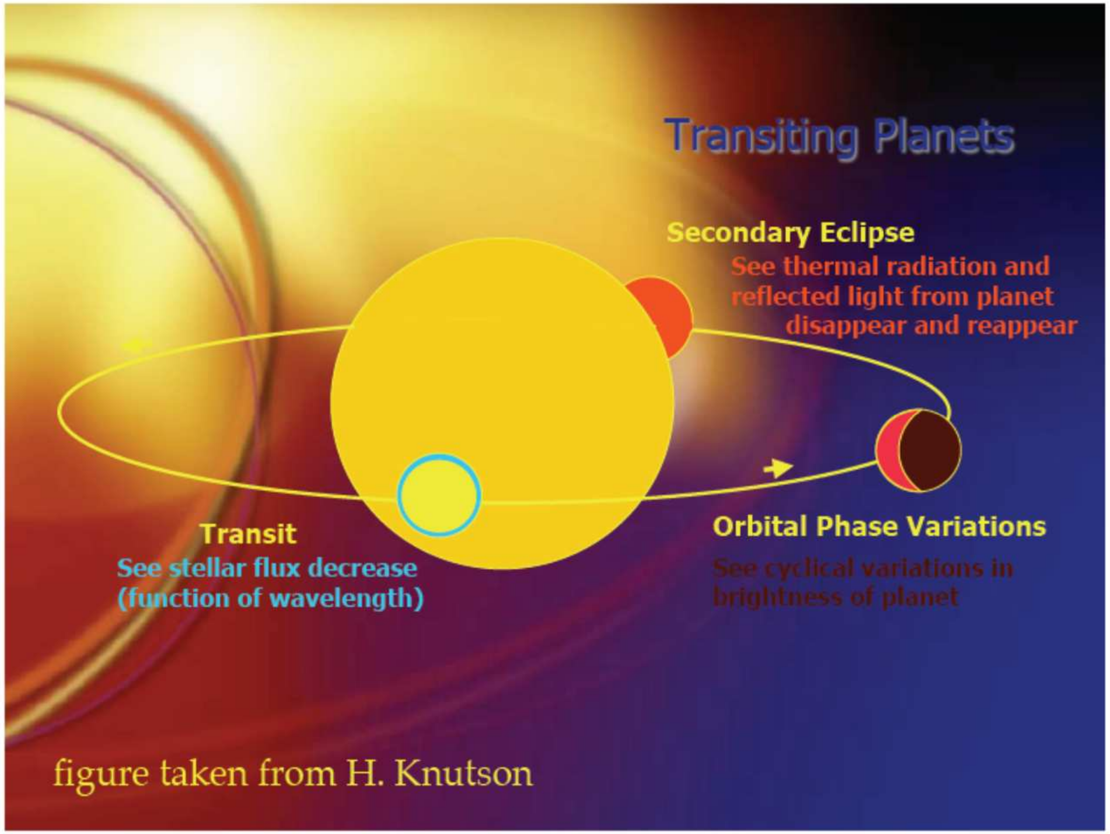
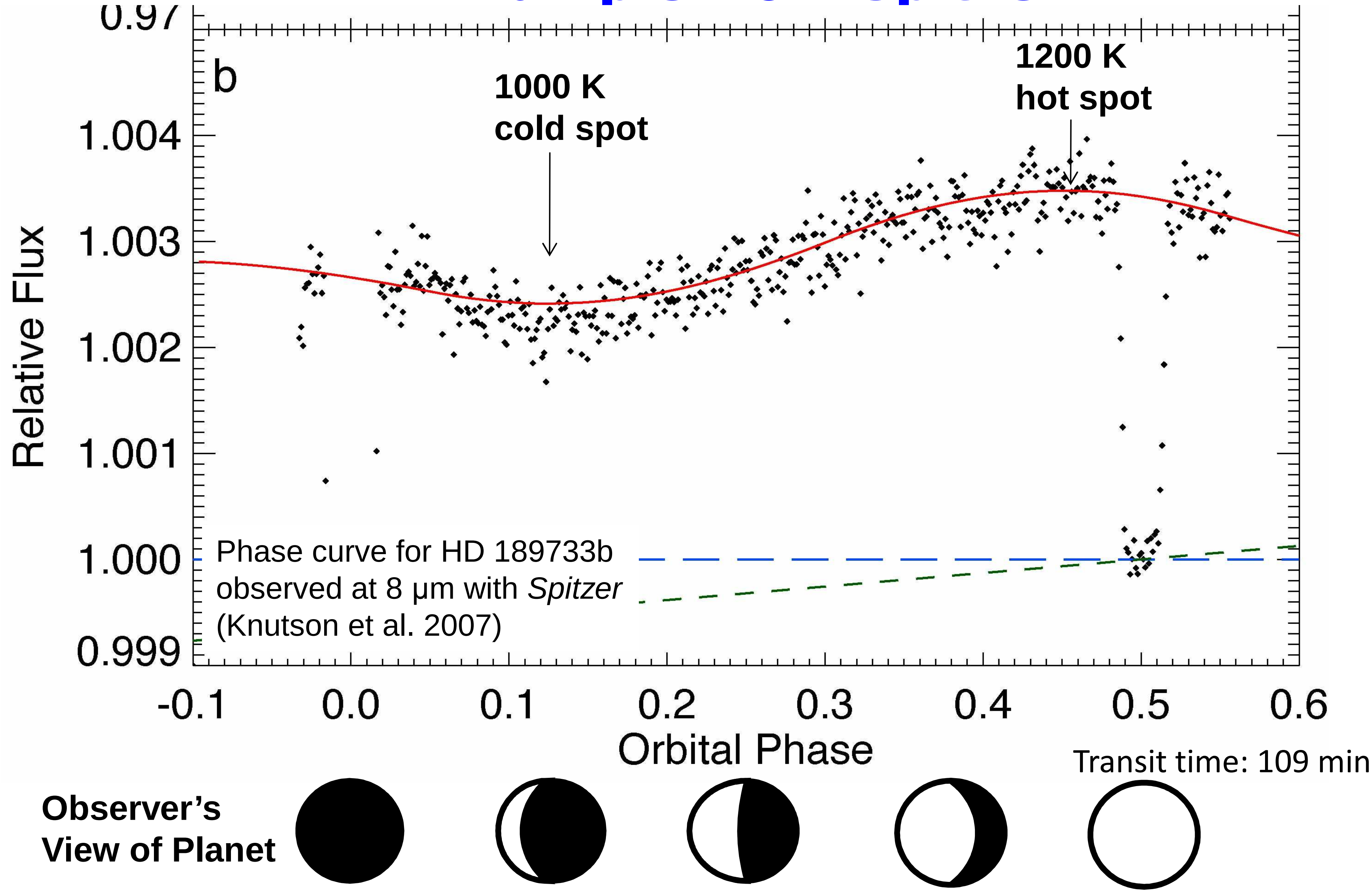
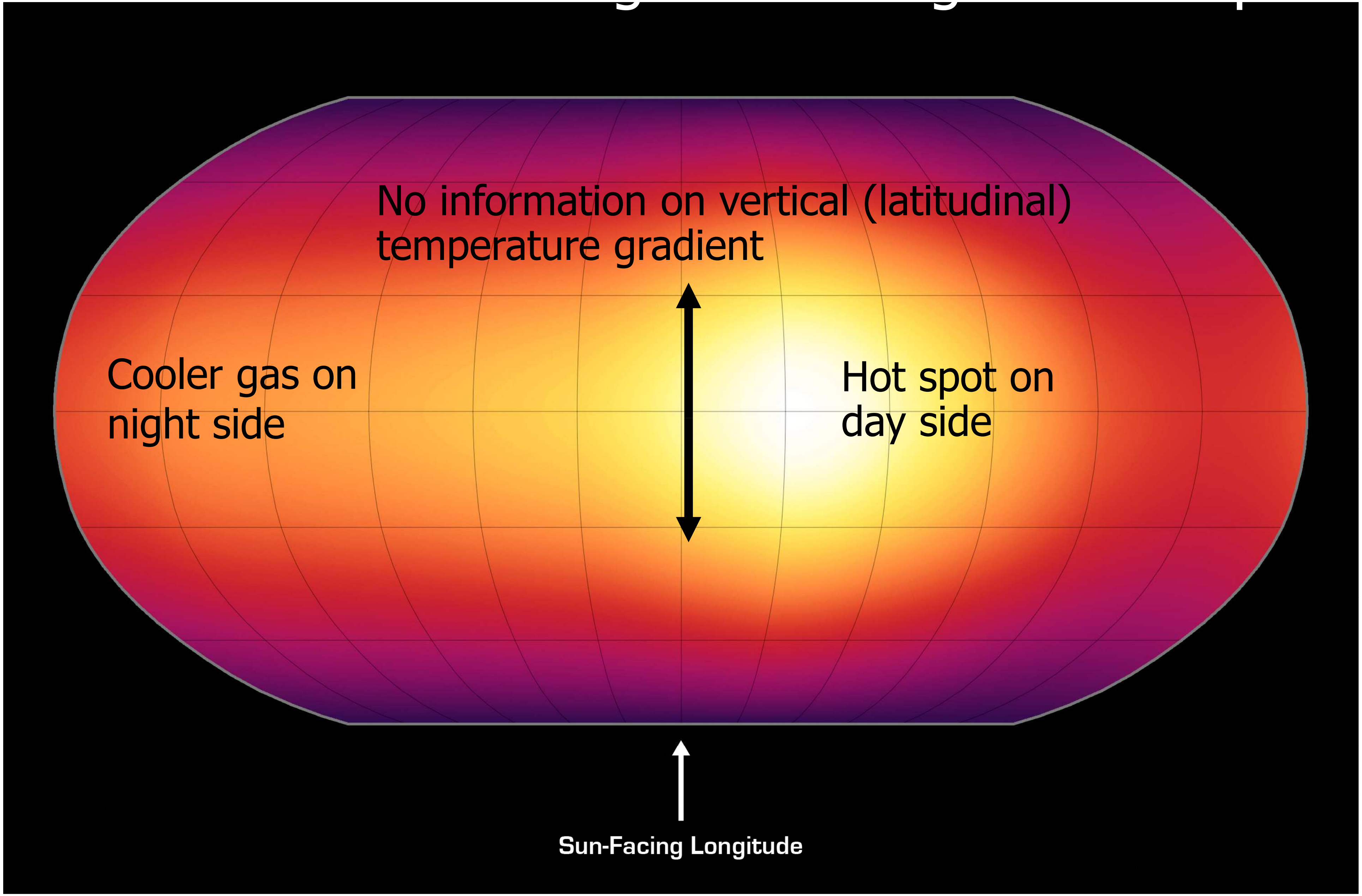


figure taken from H. Knutson

Phase Curves 101:
An Example from Spitzer



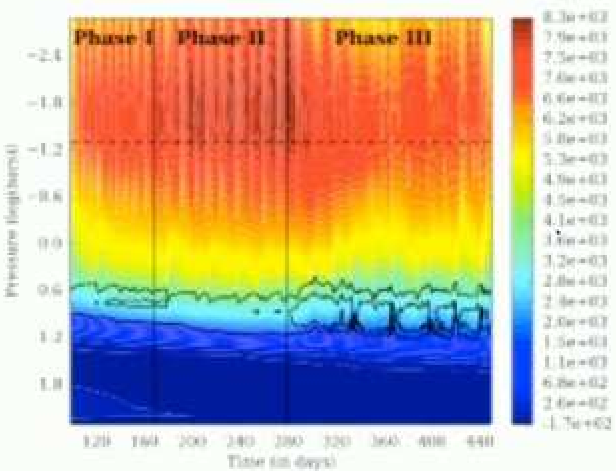


No information on vertical (latitudinal) temperature gradient
Cooler gas on night side
Hot spot on day side
Sun-Facing Longitude

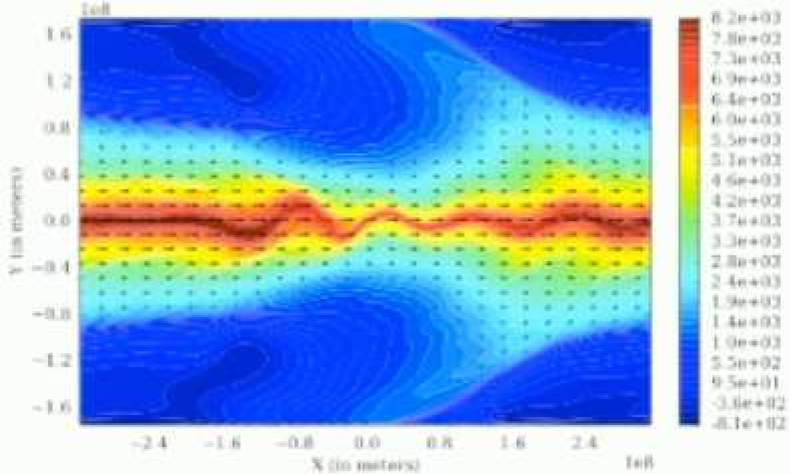
Shear instabilities & shocks in hot Jupiter atmospheres

Sébastien Fromang, Jérémy Leconte & Kevin Heng

Spacetime diagram of the equatorial zonal wind



Equatorial jet meanders in longitude-latitude plane at 10 mbar



- 3D, compressible and non-hydrostatic model of hot Jupiter model in the equatorial β-plane approximation
- Good agreement with published results (e.g. Heng et al 2011) at low resolution
- Important **time variability** at high resolution (1/4 degrees) due to **shear driven instabilities**
- **Weak shocks** (Ma≈1.5) at mbar levels only
- Potential consequences for drag mechanims & internal heating mechanisms

Activité 3 D

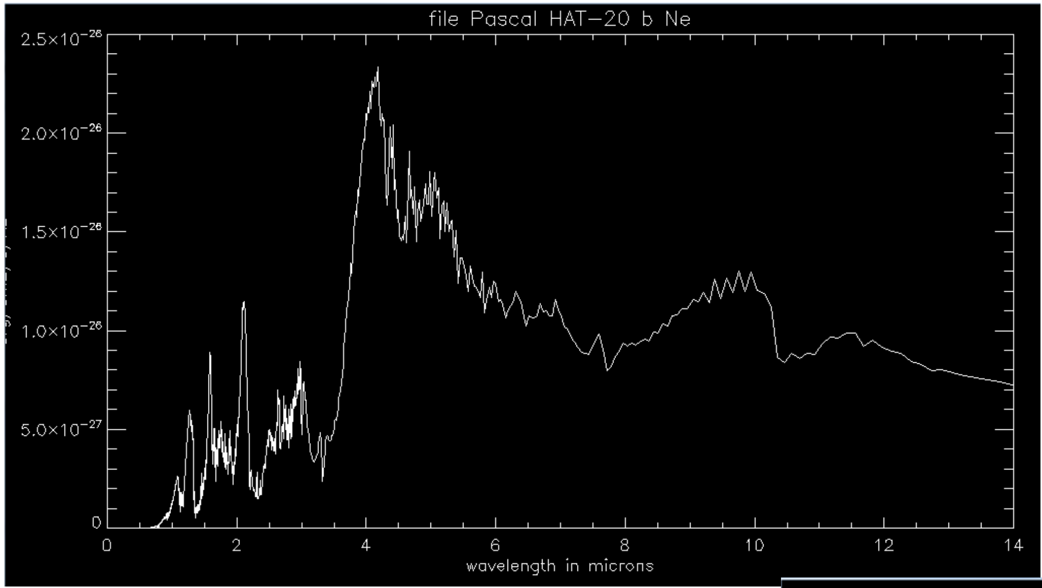
P. Tremblin et al.

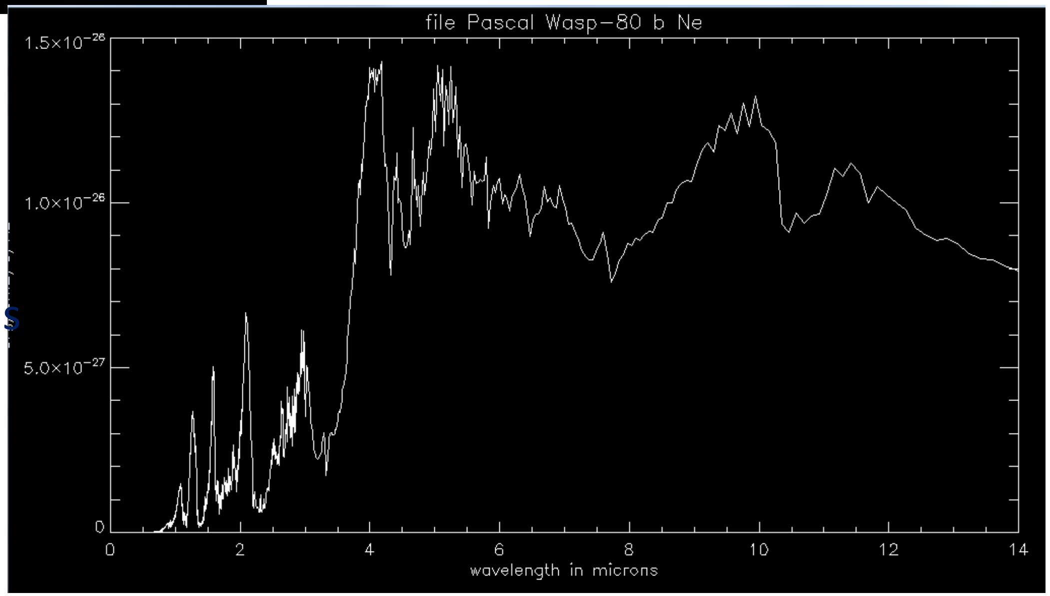
Model 2D prenant en compte le 3D!

Lien modelisation → observations

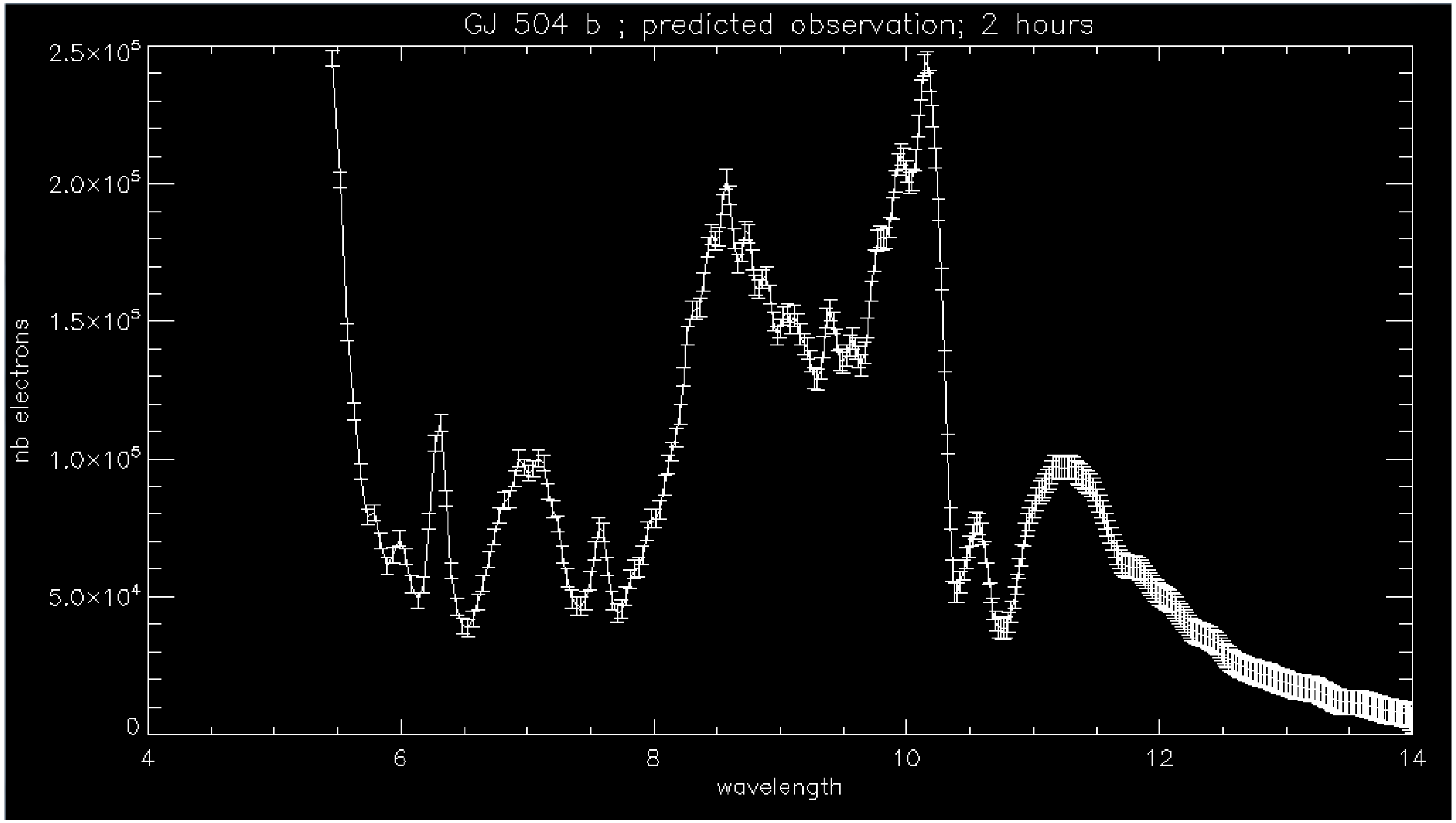
démarré

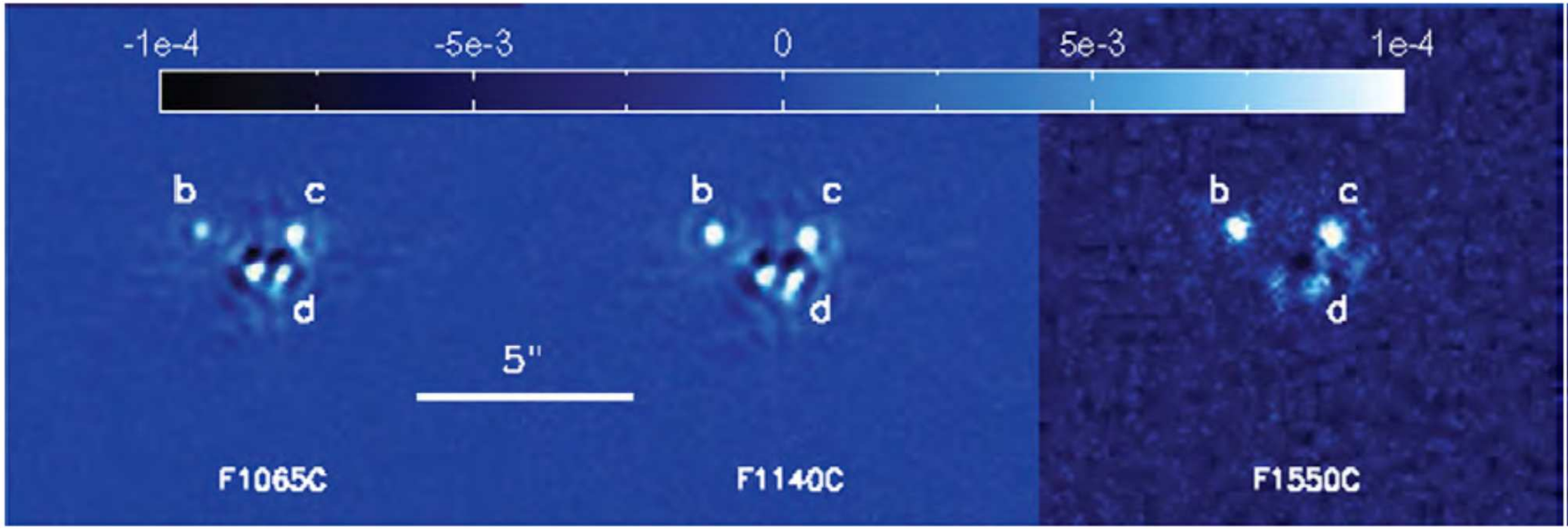
Now : modelling individual targets taking into account the observational constraints already available





Interesting to combine MIRI observations with shorter wavelengths observations; the 3-5 microns range (NIRCAM, NIRSPEC) is of particular interest


GJ 504 b ; predicted observation; 2 hours
nb electrons
wavelength
2.5×10^5
2.0×10^5
1.5×10^5
1.0×10^5
5.0×10^4
0
4
6
8
10
12
14


-1e-4
-5e-3
0
5e-3
1e-4
b
c
d
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c
d
b
c
d
5"
F1065C
F1140C
F1550C

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4	Development of 3 D models from the dynamico code: Post-processing of 3D models with ATMO to produce 2D maps of the atmosphere transmission spectra, study of simple clouds prescriptions	2016-2018	S. Fromang, P. Tremblin + postdoc	1 paper (ApJ or A
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Impatient d'être au WP5!

Centre operational pour le JWST :

STScI (Baltimore)

Outils pour la préparation des observations

ETC : Estimator Time Calculator + simulateurs pour certains instruments

APT : Astronomer's Proposal Tool

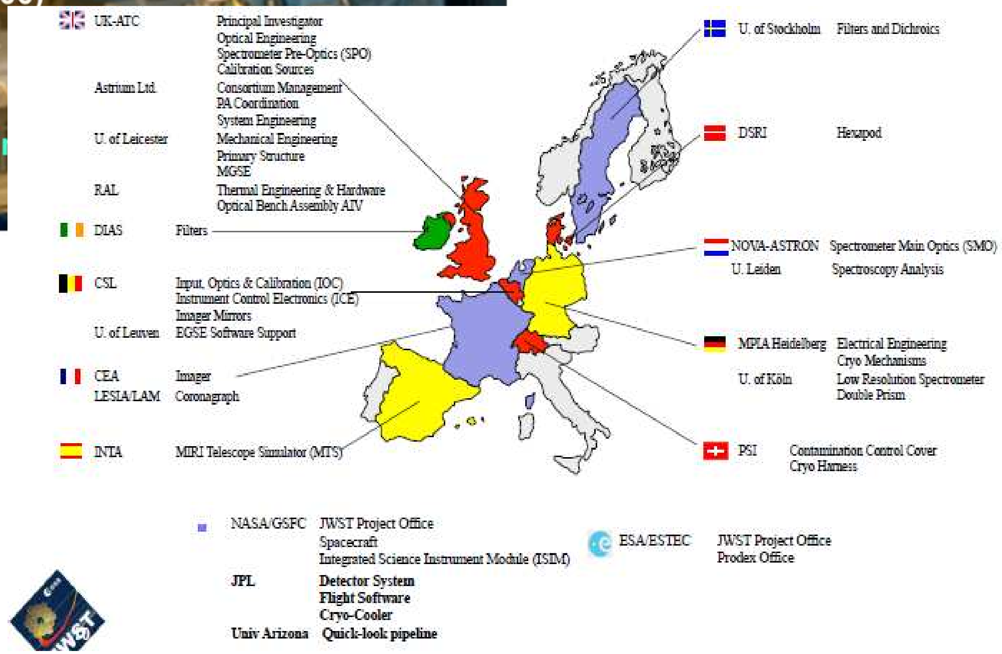
Disponibles début 2017

Outils pour la réduction des données

Première version un peu avant les premieres données.

- Etre dans un consortium qui fabrique un instrument →

On participe à l'élaboration des outils et on les teste et les utilise.



Activités vis-à-vis du consortium MIRI (→ ESA → NASA)
qui concernent le projet emblématique :

Activités liées à la préparation des observations en temps garanti

Participation à 2 des 3 larges programmes :

exoplanètes (105h) coordinateur POL

disques (105h) coordinateur T. Henning
participants : POL, EP

Programme PDR… Alain Abergel (5-10 h en collaboration international STsCI, NIRCAM)

Décision le 14 octobre lors de la réunion des Co-PI

Notes on APT (version 24.2)

The Astronomer's Proposal Tool (APT) is developed at STScI; it is used to write, validate and submit proposals for the HST, and it will be used for JWST as well.

These notes are a summary of the general APT 24.2 capabilities, the latest available version, and how we can use them to prepare GTO science. They also include some aspects of the timing model and overheads.

APT is still under development, so several capabilities in different templates are missing, dated or are being worked on.

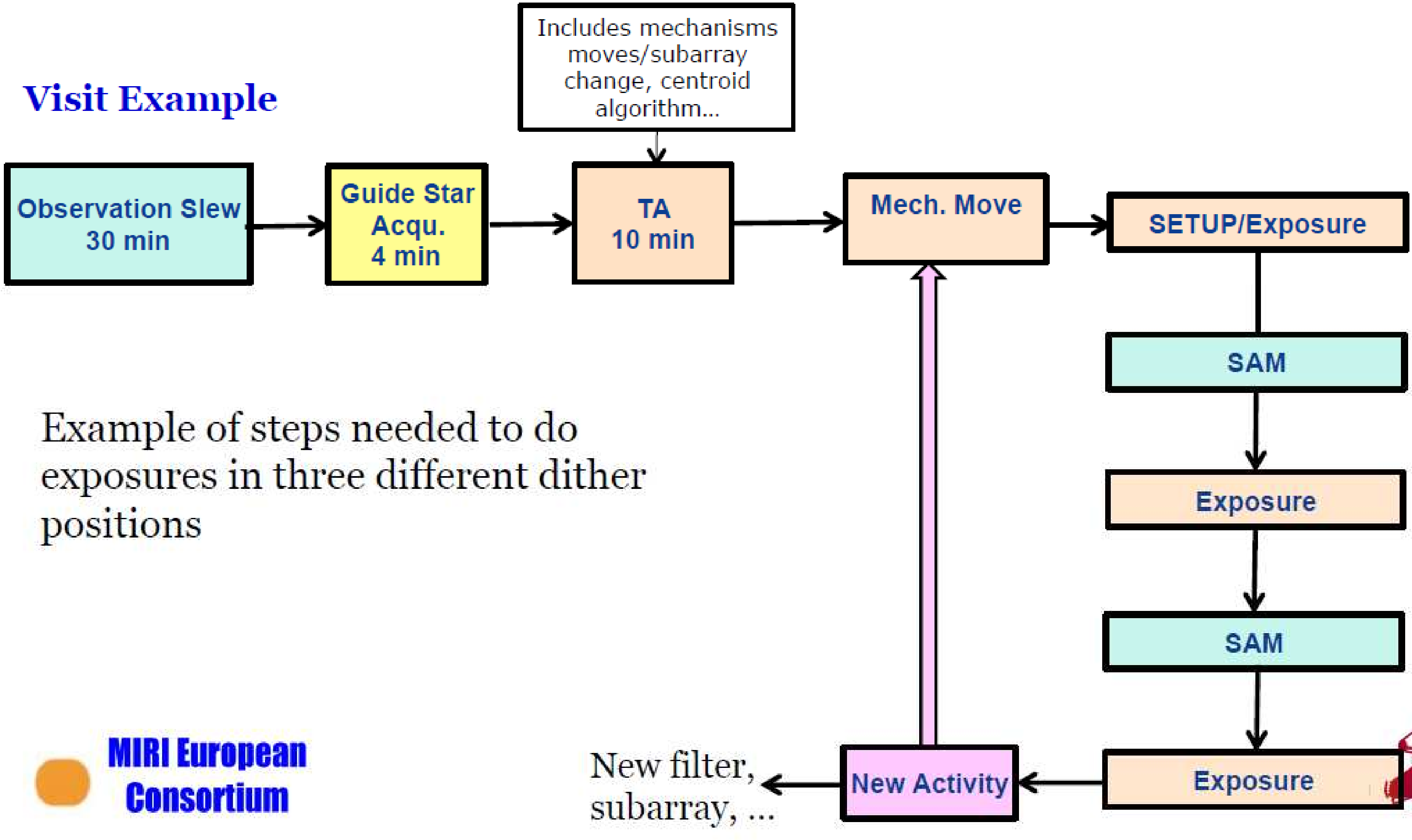
The overheads are still not accurate enough, and need rework.

Overheads in the APT are still in work but in general it can be used as a guideline. It is recommended to look at the results of the time estimates (science and overheads) with a critical eye and compare with your own rough estimation. The time reports generated by the APT (see slides 16 and 17) are a useful way to do this.

JWST/MIRI timing estimation overview

JWST/MIRI works in an **event-driven** fashion: before one activity starts the previous one has to end. There are several threads of activities as for instance the instruments are operated independently, but for a single instrument, two activities cannot be commanded simultaneously (e.g. move the FW and change detector readout mode cannot be done at the same time).

Visit Example

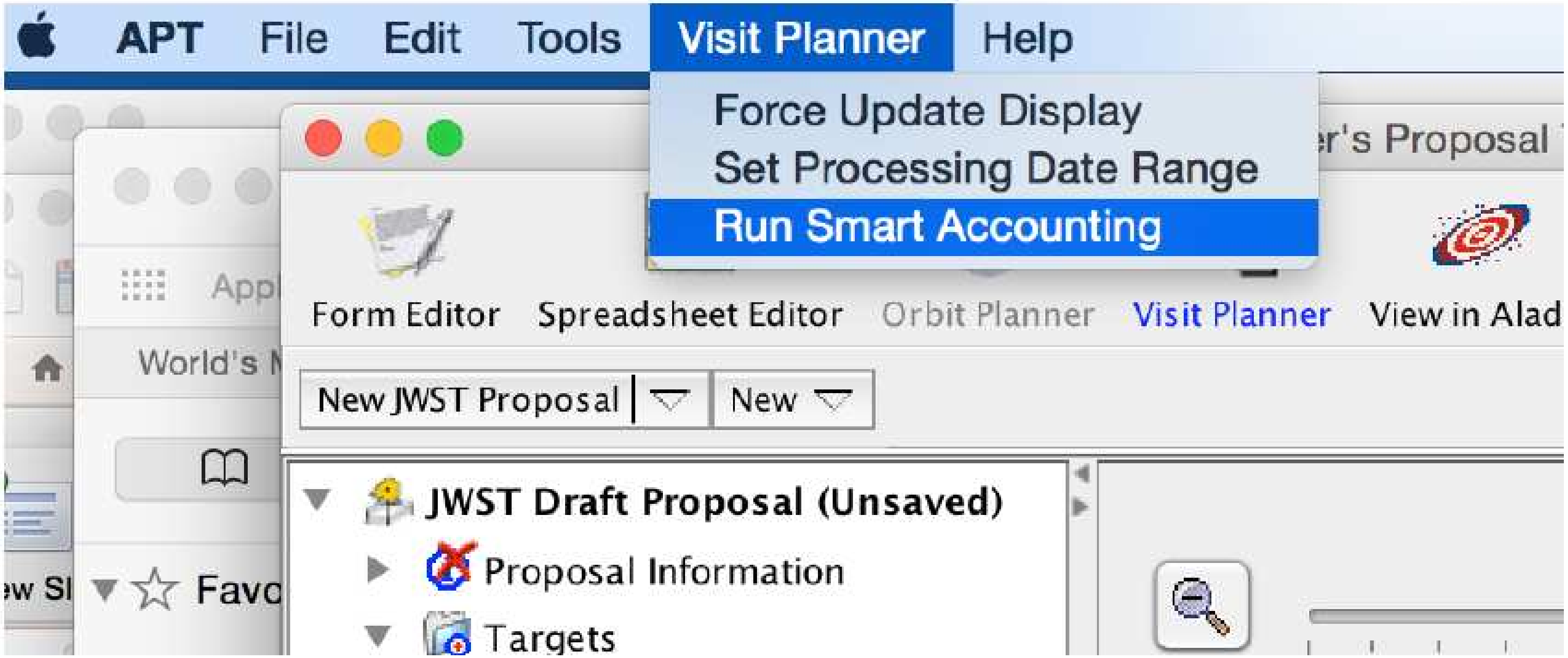


Example of steps needed to do exposures in three different dither positions

MIRI European Consortium

Some useful tips on APT

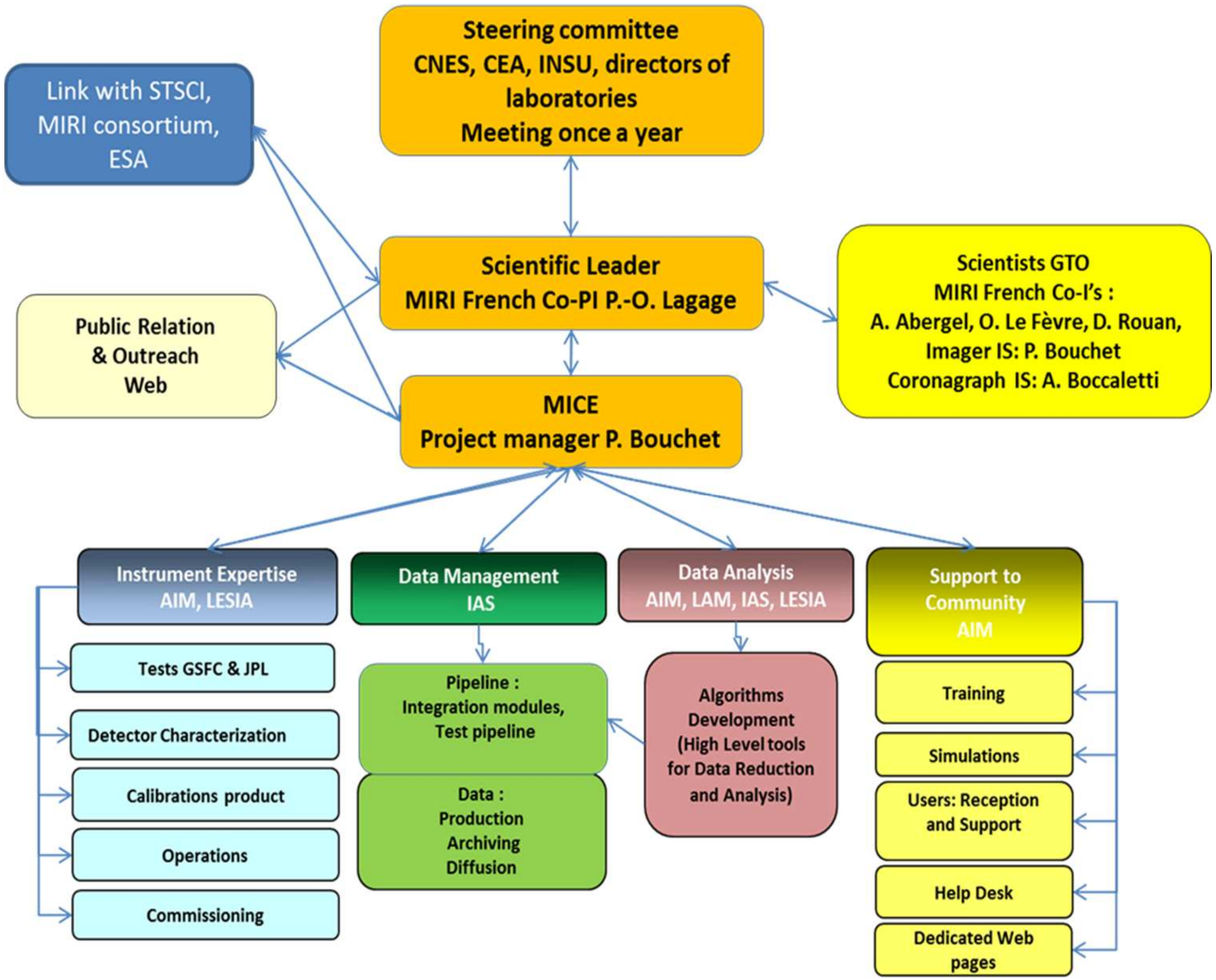
Run the smart accounting: This is specially important if you have a program with two instruments, many dithers, mosaics etc. It will reduc second slew time (if using two instruments) and have a better account dithers, movements to do mosaics etc. To run it go to the Visit Planner choose the option.



Activités vis-à-vis du centre d'expertise français (CNES)
pour le projet emblématique :

- ➔ To provide support to the French community to exploit scientifically MIRI
- ➔ To inform the community
- ➔ To provide added value compared to STScI

MICE MANAGEMENT



Les participants au projet emblématique sont

(des acteurs) et des 'clients' privilégiés du centre d'expertise français

	WP2 : Preparation of JWST observations	Date	People in charge	Deliveries
1	Improvement of the MIRI observation simulator: - add simulated disk observations with the coronagraph - other improvements necessary for our programs	2016 +	R. Gastaud, P. Bouchet, A. Coulais, P.-O. Lagage et al.	Software + upgrade of the user manual
2	Data reduction pipeline (imager): (- Providing data reduction algorithms to the STScI) - Implement/test the STScI standard pipeline at Paris-Saclay - High level pipelines not implemented by STScI	2016 2017-2019 2016-2017	P. Bouchet, K. Dassas A. Abergel, A. Coulais, D. Dicken, R. Gastaud, P.-O. Lagage, C. Cossou PhD et al.	Software, Documentation, Test reports Software & documentation
3	Exoplanet specifics: 1) MIRI Detector test campaings at JPL (one per year); Definition, participation, data reduction and interpretation. 2) Specific data pipeline • Member of the STScI WG to specify data pipeline for long observations (mainly exoplanet transit observations) 3) Data challenges: • data reduction, retrieval techniques benchmarking • pipeline Improvement following the data challenge results	2016-2018 2016-2017 2017-2018	D. Dicken, P. Bouchet, A. Coulais, R. Gastaud, P.-O. Lagage +collaboration with JPL and MPIA D. Dicken, P. Bouchet, A. Coulais, R. Gastaud, P.-O. Lagage. M. Ollivier +collab. (STScI and MPIA, SRON…) P.-O. Lagage P. Bouchet, A. Coulais, R. Gastaud, P. Tremblin, PhD + STScI, MPIA, SRON, …	Test report Technical note Document with results 1 paper probably in PASP Software and associated documentation

Ateliers JWST France les 8, 9 et 10 Novembre à l'IAP.

Dans quelques mois (début 2017), l'appel à observer avec le JWST dans le cadre 'Early Science Release' sera lancé ; puis ce sera au tour du premier appel 'temps ouvert' (Nov. 2017). Pour faire suite à l'atelier JWST France qui a eu lieu le 27 mai au CNES et pour continuer à préparer la communauté à répondre aux appels à observer avec le JWST, nous organisons 3 ateliers thématiques et un atelier « outils ».

Ces ateliers se dérouleront à l'IAP

les 8 et 9 novembre pour l'atelier consacré aux observations des disques et exoplanètes avec le JWST (point de contact : Pierre-Olivier.Lagage@cea.fr) le 9 novembre pour l'atelier sur la physique de H2 dans l'espace avec JWST (Point de contact Guillard@iap.fr)

le 9 novembre aussi pour l'atelier sur les grands relevés extragalactiques avec le JWST dans le cadre du Service d'observation SO4 (point de contact : Laurence.Tresse@univ-lyon1.fr)

le 10 novembre pour l'atelier sur « la familiarisation avec les outils du JWST » (point de contact : Patrice.bouchet@cea.fr).

Si vous êtes intéressés par ces ateliers, réservez dès à présent les dates. Des informations complémentaires sur le programme des journées seront diffusées d'ici peu.

(support financier projet emblématique?)