Are we ready to characterise exoplanet atmospheres with the James Webb Space Telescope observations ?

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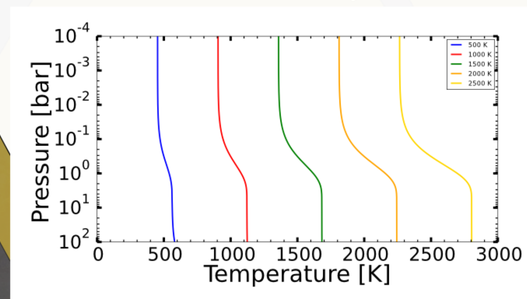
Coming soon:
Test of Nemesis Baudino et al. (in prep.)
Test of an other forward model Lee et al. (in prep)

JWST:
In May 2020 the JWST will be launched with four instruments on board;
three instruments, will be operating in the 0.6-5 microns range: NIRISS, NIRCam, NIRSpec,
and one in the 5-28 microns range: MIRI.

Goals: To Identify differences between atmospheric models in the literature and to converge iteratively in minimal conditions. To use similar chemistry and radiative transfert.
Process: 7 tragets with same input temperature profiles between 500-2500K and 4 targets computed without assumption on profiles for forward models.

Impose TP profiles
test of the radiative transfert+ chemistry



A minimal core:

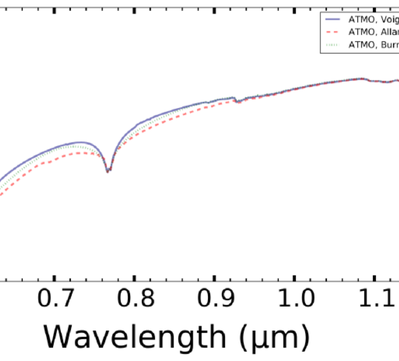
- a restrain number of molecules in absorption: NH_3, CH_4, CO, CO_2, H_2O, PH_3, Na, K
- H2–H2 and H2–He CIA
- Voigt profile for Na and K
- no cloud

4 exoplanets
test of the radiative-convective equilibrium+chemistry+ radiative transfert

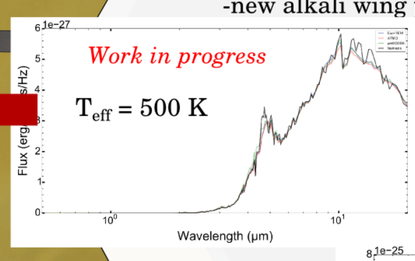
2 DI
VHS 1256-1257 b, GJ504 b
2 transiting
Wasp 12 b, GJ 436 b

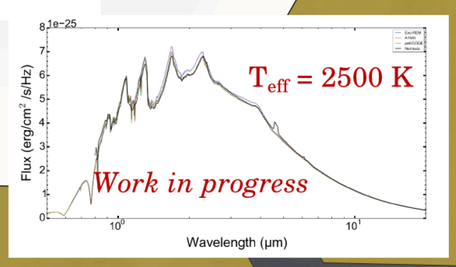
About Nemesis :
- update of the H_2-H_2 and H_2-He CIA
- PH_3 Exomol line-list
-new alkali wing profile

forward

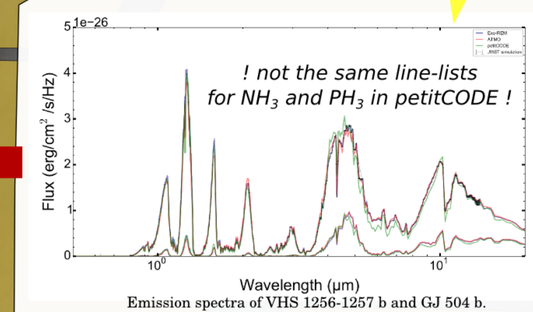


retrieval





forward

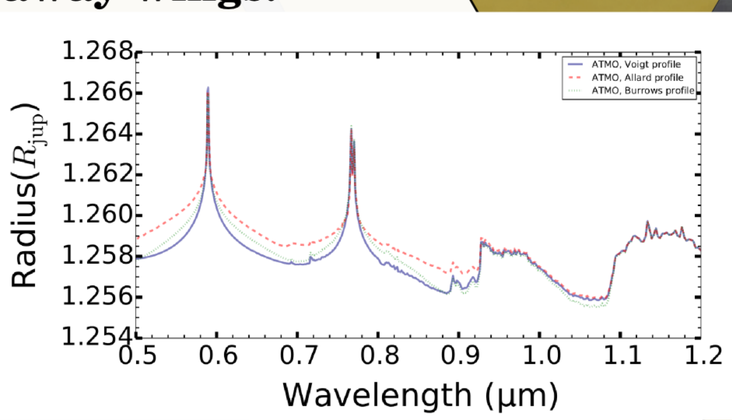


Emission spectra of VHS 1256-1257 b and GJ 504 b.
In black simulation of the JWST NIRSpec/Prism and MIRI/LRS in 0.5h

Examples from the benchmark between: ATMO, Exo-REM and petitCODE

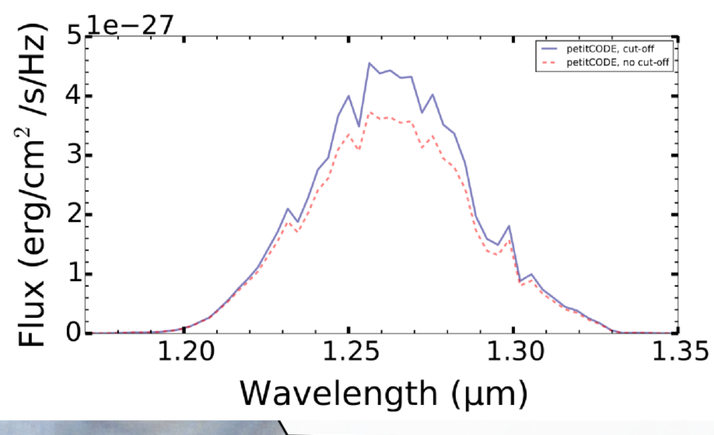
Key situations:

- Alkalies faraway wings:



at least 2 profiles in the literature fitting alternatively better the observations, for the benchmark we simplify the shape to help the comparison

- molecular far-wing lineshape



using or not sub-Lorentzian profile on the molecular lines can put extra differences between models

Conclusions:

- Feel free to participate to this benchmark process: full sources and complete definition available in Baudino et al. 2017: (2017ApJ...850..150B)

- Alkali wing profile and completeness of the line-lists are critical problems to model "hot" atmosphere, especially if observations of JWST are really with S/N>100, PH_3 need to be taken into account

- Other spotted differences include: ion effect > 2000 K, isotopes, radius definition for transmission spectrum, MMW, cold trap, molecular diffusion

- ATMO, Exo-REM, Petit-CODE and NEMESIS updated, test in progress for the retrieval part of NEMESIS

-The paper include also a comparison of Venot 2012 and Zahnle & Marley 2014: no visible difference for DI planets but Zahnle & Marley 2014 not adapted to irradiated object

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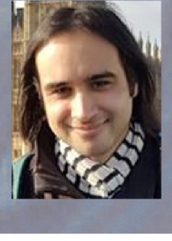

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