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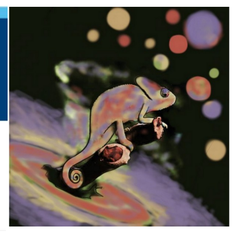

Transmission Spectra of Exoplanets

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Exoplanetary atmospheres' physical and chemical structure are influenced by the irradiation from the host star. The physical and chemical properties can be determined through the transmission spectrum, i.e. the spectrum observed during the transit of the planet in front of its host star. This project aims at modelling the transmission spectrum starting from a physical and chemical model. We start from 1D atmosphere models of an irradiated atmosphere (day side and night side) and combine them to obtain a 2D atmosphere model. Then we propagate the light of the host star in the atmosphere in order to calculate the spectrum. The complete model will be able to compute transmission spectra of different types of exoplanets.

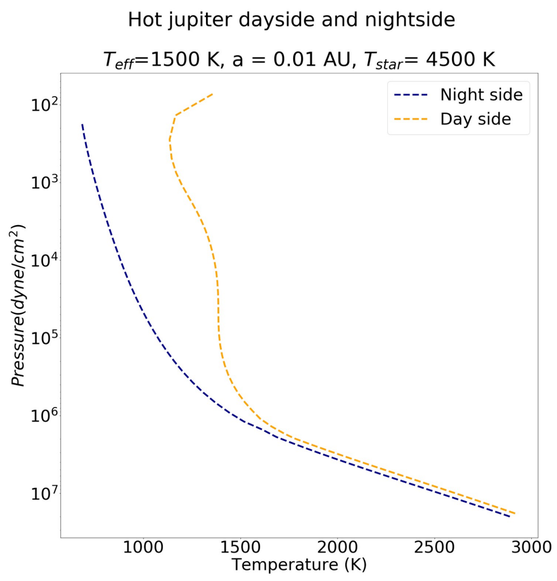

Fig. 1: Temperature-pressure profile of a hot jupiter with an effective temperature of 1500K, orbiting an M dwarf. The yellow line is the day side (irradiated) and the blue line the night side.

The models

The atmospheric 1D models are computed with the following programs:
→ MARCS code (Gustaffson et al, 2008), a fast, self-consistent 1D radiative transfer code
→ GGchem (Woitke et al, 2017), a fast thermo-chemical equilibrium code

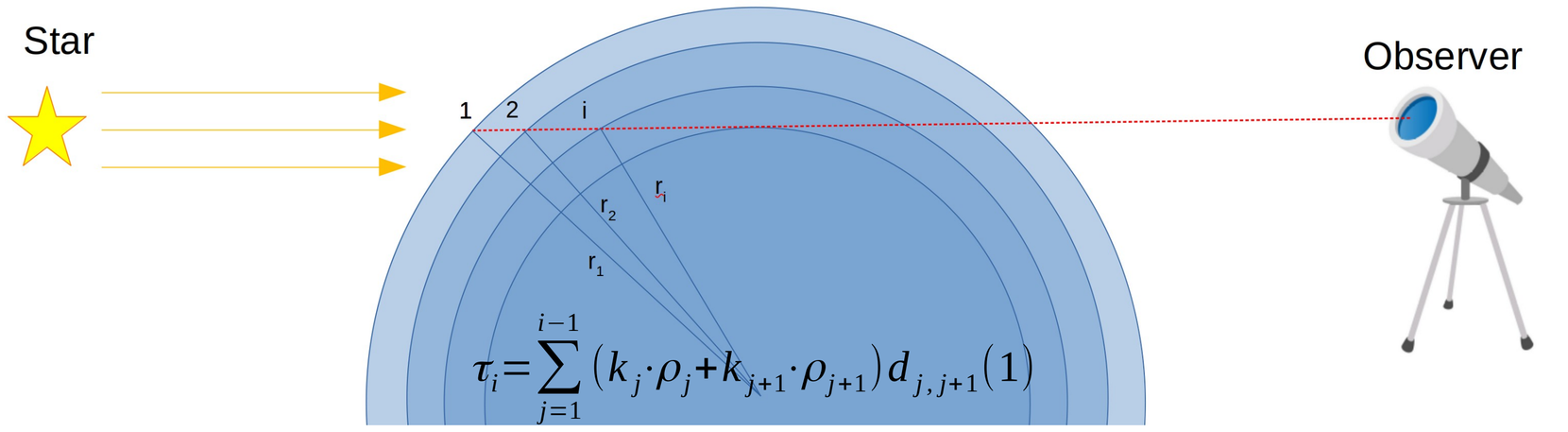

Fig. 2: Visual description of the transmission geometry. The optical depth along the red line is computed using eq. 1, where k is the absorption coefficient, ρ the mass density and d the distance between two grid points along the line

2D grid

The combination of N 1D models gives a 2D grid through which we solve the radiative transfer equation and get the spectrum as seen by the observer – see fig. 2.

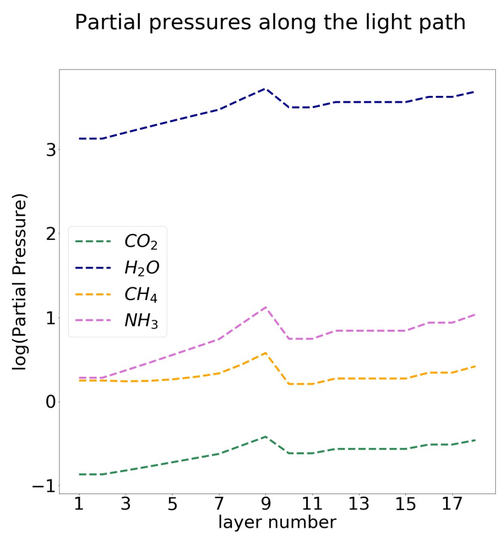

Fig. 3 Preliminary results. Partial pressures profiles of some selected molecules along the path of the transmitted light (red dotted line in fig.2.)

Future work

This is still a work in progress.

→ Finish debugging
→ Study different distribution of the irradiated energy on the day side
→ Study the effect of winds on the energy distribution

References:

B. Gustaffson et al (2008), '*A grid of MARCS model atmospheres for late-type stars*', A&A, vol 486, 3, 951-970

P. Woitke et al (2018), '*Equilibrium chemistry down to 100 K Impact of silicates and phyllosilicates on carbon/oxygen ratio*', A&A, vol 614