Exercises for Radiative Transfer in Astrophysics (WS2017)

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Exercise sheet 10

Planetary atmosphere using the PETIT-lite code

Paul Molliere has written a new exoplanet modelling code called PETIT. Here we are going to work with a scaled-down version of this code (which I call PETIT-*lite*). I will provide this to you on a memory stick. Please keep in mind that *this code is not yet open source!* So please kindly keep this code to yourself. Anybody who is interested to use it for research should contact Paul Molliere (molliere@mpia.de) and ask for permission to use it.

1. **Correlated k opacities**

   (a) Based on the Python script `source/opacities/test/get_opas.py` provided by Paul, write a Python script that plots the korrelated-k opacities for $p = 10^{-2}$ bar and $T = 400$ K for the various species (one color per species, as in Paul's example script.

   (b) Plot, for the two wavelength bins left/right of $\lambda = 3.0\,\mu$m, the cumulative opacity distribution $\kappa(s)$ between $s = 0$ and $s = 1$. Make the y-axis log, to ensure that one can see the full range in κ.

   (c) For these two bins (and for these two bins only!), compute the Planck mean and the Rosseland mean opacity. Explain the differences.

2. **The Na and K lines**

   (a) Find out, through experimentation, under which conditions (roughly) one can see strong Na and K lines in the opacity.

   (b) For which type of exoplanets do you expect to see such emission lines?

3. **Primary transit spectroscopy**

   (a) Run the Python script `source/radtrans/test/test_clouds_jwst.py`

   (b) Describe what you see: which features are which (roughly)?