Project 6 - Atmospheres

Part 1.

Let's explore exoplanet atmospheres! In the provided notebook you can find code that downloads the required data and spectrum of the WASP-39 b exoplanet using the NIRSpec/PRISM mode on JWST. We will use the python package petitRADTRANS that models 1d atmospheres using radiative transfer (the documentation can be found here https://petitradtrans.readthedocs.io/). Unfortunately, the JupyterHub kernel crashes regularly when loading the required opacity files that are used as input for our radiative transfer calculations. Therefore, you will not use the JupyterHub for this exercise, but a google Colab Notebook. Here is the link, where you find the code and notes to guide you through the exercise: `https://colab.research.google.com/drive/1VlGClE6VGnM4GG2DxBoSeRMDff4oeoLR?usp=sharing`. Please, make your own copy of this Colab Notebook! Additionally, you will need the 'input_data' folder containing all required opacities. You have access to this folder here: `https://polybox.ethz.ch/index.php/s/EiKEx7RbFrBPgsy`. Please, either upload this folder to your copy of the Colab Notebook or add this folder to your google drive and link the Colab notebook with your personal google drive. I left notes on this in the notebook.

1. Make a copy of the Colab Notebook to your google drive and edit your own copy, not the original.
2. Run the first lines in the notebook and visualise the spectrum of WASP-39 b.
3. Run cells to install and setup up petitRADTRANS.
4. Now you can use the planet parameters of WASP-39b fetched from the NASA Exoplanet Archive by petitRADTRANS (see notebook). Calculate the model spectrum using these parameters and the default radtrans object and visualise it together with the data.
5. Remove all line species from the atmosphere except H2O. Plot the spectrum of a planet containing only water. One by one, switch the molecules on/off to understand at which wavelengths they affect the planet. Can you visually identify the major molecules in the spectrum?
6. Use a more realistic "Guillot" PT-profile (pressure-temperature) to model the atmosphere. How does the profile look like? How does it compare to the one used before?

Note *To receive feedback on your project work please upload it as a PDF-file to the moodle-course. In case you have any questions, please contact Komal Bali (kobali@phys.ethz.ch), Janina Hansen (jahansen@ethz.ch), and Sean Jordan (jordans@ethz.ch).*