# Advanced radiation and remote sensing

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# Exercise No. 2 – Vibration

You can reuse the controlfiles from the first exercise to answer the questions on vibrational spectra. First, copy the controlfile into this directory:

$ cd ~/arts-lectures/exercises/02-vibrational\_spectra/

$ cp ../01-rotational\_spectra/absorption.arts vibration.arts

Next, you have to adjust the controlfile to perform simulations at higher frequencies. The catalogue storing the information on line absorption used in the first exercise is limited to frequencies below 3 THz. You have to replace it with HitranSplit/, which covers a wider range of frequencies. The frequency range has to be extended when reading the line catalogue (abs\_linesReadFromSplitArtscat) and when setting the frequency grid (f\_grid) for the simulation.

Afterwards, you can create a directory for the results and start the ARTS simulation:

$ mkdir results

$ arts vibration.arts

Plot the calculated absorption cross sections as a function of wavenumber. For this purpose, you can copy and adapt the plotting script from the exercise on rotational bands. Remember to create a plots/ directory before running the scripts.

1. Find the fundamental band of CO and plot its spectrum.
   * Determine the band center frequency from your plot.
   * There is some “pollution” in the P-branch that comes from lines of 13CO. Recalculate the spectrum for only the main isotopologue.
2. Explore the spectrum of either H2O or CO2. Can you find the different vibration bands?