9th International Symposium on Radiative Transfer, RAD-19
June 3-7, 2019, Athens, Greece

Keynote lecture

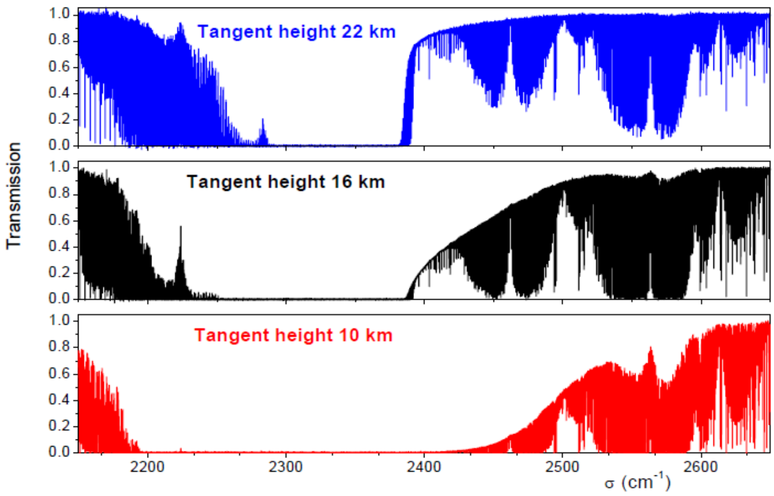
ABSORPTION SHAPE ISSUES IN ATMOSPHERIC RADIATIVE TRANSFER AND REMOTE SENSING

Jean-Michel Hartmann

Laboratoire de Météorologie Dynamique/CNRS, Ecole polytechnique, Palaiseau, France.
jean-michel.hartmann@lmd.polytechnique.fr

A review of the effects of intermolecular collisions (*i.e.* of pressure) on the shape of gas phase molecular spectra as they manifest in atmospheres and laboratory experiments will be presented. This will be largely done on the basis of the content of Ref. [1] and it update in Ref. {2].

I will start by a brief introduction to the various observation geometry for recordings of atmospheric absorption and emission spectra and examples of the different types of features that can appear in these spectra. I will then discuss these structures one by one. This will be done starting from spectrally isolated lines, before considering clusters of tightly-spaced and overlapping absorption transitions affected by collisional line-mixing, the far wings of lines and bands and the associated atmospheric transparency windows, and collision-induced absorption processes (*e.g.* figure below). Illustrative comparisons between laboratory measurements and available models will be first presented in order to point out the main characteristics of the mechanisms involved and their spectral manifestations. The consequences for radiative transfer in planetary atmospheres and remote sensing will then be discussed. Example will be given of the influence of proper/improper modeling of collisional effects on retrievals of volume mixing ratios, temperature, or pressure from atmospheric spectra. Finally, some remaining problems will be discussed, in order to open perspectives for future researches.



Transmission spectra recorded in solar occultation mode by the satellite-borne Atmospheric Chemistry Experiment around the 4.3 µm CO_2 band looking down to various tangent heights *h*. The increase, with decreasing *h*, of the absorptions by the wings of the CO_2 lines wings and, on the high frequency side, by the N_2 collision-induced band, is obvious.

[1] J.-M. Hartmann, C. Boulet, D. Robert. *Collisional effects on molecular spectra. Laboratory experiments and models, consequences for applications*. Elsevier, Amsterdam (2008)

[2] J.-M. Hartmann, H. Tran, R. Armante, C. Boulet, A. Campargue, F. Forget, L. Gianfrani, I. Gordon, S. Guerlet, M. Gustafsson, J. Hodges, S. Kassi, D. Lisak, F. Thibault, G. Toon. Recent advances in collisional effects on spectra of molecular gases and their practical consequences. Journal of Quantitative Spectroscocpy and Radiative Transfer **213**, 178-227 (2018).