OBSERVING MOLECULES IN THE INTERSTELLAR MEDIA: THEORETICAL AND EXPERIMENTAL STUDIES OF ENERGY TRANSFER.

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In order to retrieve actual molecular abundances from molecular spectral lines astrophysical observations, knowledge of the molecular rotational levels excitation schemes is essential. Actual excitation results of a trade-off between photon excitation and collisional excitation by the main constituents of the interstellar gas, molecular hydrogen, and, to a lesser extent, atomic hydrogen and helium. These rates are almost always obtained from theoretical investigations, by computing classical or quantum dynamics of the interaction of the observed molecule with electrons, He, H or H2.

Our laboratories have recently calculated a set of collision coefficients characterizing the efficiency of energy transfer between helium and/or hydrogen and a large variety of interstellar molecules. We have been dealing with molecules ranging from light hydrides, observed by the Herschel Space Telescope in the sub-mm (THz) range, to medium size molecules, observed at wavelengths in the mm range (80-400 GHz) to heavy complex organic molecules, observed also in the cm range.

We shall present a review of recent theoretical results obtained in our laboratories, for various kind of commonly observed molecules.

In order to validate the theoretical computations, comparison with experimental measures is essential. We present here such comparisons mainly for water, on total and differential cross section.