Experimental investigations on nuclear spin-states equilibration of hydrogenated molecules at low temperature gas-solid interface

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We performed, within the GASOSPIN ANR project, experimental approaches and related calculations with the aim to investigate the dynamics of the nuclear spin states re-equilibration of hydrogenated molecules at very low temperatures. The motivation of this work is to understand the physical parameters that can play a role in the anomalies that are observed in the *Ortho-to-Para Ratios* (OPR) measured in comets and ISM. Different physical conditions ranging from very diluted matter to condensed phases were considered and discussed: molecules in the gas phase (H_2CO), molecules trapped in cryogenics matrices (H_2O, CH_4) or adsorbed on cold surfaces (H_2), molecules desorbing from cold surfaces (H_2) and finally solid-gas equilibrium at very low temperatures (CH_4, H_2O). In these different environments, we are now able to propose the dominant mechanism responsible for the nuclear spin conversion and estimate the characteristic time of conversion.

In this communication, we will focus on the recent progress we made concerning solid-gas interface and the observations we made in laboratory concerning OPR equilibration during deposition, residence and desorption from cold surfaces. Comparisons of the insight we can get from experiments dedicated to molecules like CH_4, H_2O and H_2 will be considered. Finally, perspectives about the influence of photodesorption will be given.