Impact of nuclear spin conversion of H_2 on Amorphous Solid Water (ASW) on the chemistry of the interstellar medium

X. Michaut[1], J. Michoud[1], S. Cryan[1], D. Toulouse[1], M. Bertin[1], G. Féraud[1], J.-H. Fillion[1], P. Jeseck[1], F. LePetit[1], E. Roueff[1], E. Bron[1], A. Faure[2], P. Hily-Blant[2], and D. Lis[3]

[1] *LERMA, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Université, Paris, France*
[2] *IPAG, Université de Grenoble Alpes, CNRS, Grenoble, France*
[3] *Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA*

Email address of corresponding author: xavier.michaut@sorbonne-universite.fr

Hydrogenated molecules like H_2 and H_2O exist in several nuclear spin configurations due to the Pauli exclusion principle. These configurations are called *ortho* (parallel proton spins) and *para* (antiparallel proton spins). The *ortho* and *para* populations have been regularly determined by observations in different regions of space in far-UV absorption (Copernicus, FUSE) and in IR and sub-mm emission (ISO, Spitzer, Herschel). The *ortho/para ratio* (OPR) depends on physico-chemical processes in these environments, such as chemical formation, reactive collisions, adsorption and desorption effects of molecules on ice grains, and could be a tracer of molecular history. In order to interpret astronomical observations [1], it is important to compare them with the results of the more comprehensive astrochemical model [1-3]. H_2 is the most abundant molecule in the interstellar medium and is known to be the main reactant involved in the reaction chain to form hydrogenated molecules, so the *ortho/para ratio* of H_2 plays a role in the chemical evolution of molecules like water [1-3]. The *ortho/para ratio* of H_2 in the gas phase could be affected by the desorption processes of interstellar grains in cold regions [2].

It is therefore necessary to know the characteristic time of equilibration of the nuclear spin states of H_2 on solid water at low temperatures, and the relative abundances of the nuclear spin states during desorption [2]. Measurements reported in the literature on the characteristic time of H_2 nuclear spin conversion on amorphous solid water (ASW) around 10 K have shown wide discrepancies - ranging from a few minutes to tens of minutes [4,5]. To answer these questions, we developed a new laboratory experiment (COSPINU2) in an ultra-high vacuum chamber to perform *in situ* measurements using Fourier Transform InfraRed (FTIR) spectroscopy. We found that *ortho*-H_2 species completely transform into *para*-H_2 species after a few days. The temporal evolution follows a simple exponential decay with typical long characteristic times between 250 and 1200 minutes compatible with previous observations made with an alternative method[6].

In this talk, we will present the different methods used to address the question of *ortho-to-para* conversion of H_2 on ASW, the various measurements reported in the literature and their implications for the chemical evolution of the interstellar medium, particularly in the Photon-Dominated Region (PDR) known as the Orion Bar.

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