Ortho-to-*Para* Ratio of Water in the Orion Bar.

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The ortho-to-para ratio (OPR) of water has been measured in various astronomical objects, from the Interstellar Medium (ISM) [1,2] to cometary atmospheres [3]. Most of the results are close to 3, which is consistent with water at the thermal equilibrium in warm gas (>50K) [1,3]. However, a very low OPR of 0.1 – 0.4 was derived, based on $H_2{}^{18}O$ observations and Large Velocity Gradient (LVG) modelling, in the Orion Bar [4], a well-studied Photon Dominated Region (PDR). Such a low OPR is equivalent to a spin temperature close to 10K, which is well below the kinetic temperature of this UV-illuminated region [5].

The departure of the water spin temperature from the kinetic temperature of the gas is commonly assumed to be due to the photodesorption of water molecules from cold icy grains [6]. But recent laboratory studies using UV laser photodesorption from cold surfaces (typically 10K) did not produce water with a low OPR [7].

Reanalysis of water line emission ($H_2{}^{16}O$ and $H_2{}^{18}O$) from the Orion Bar using the Meudon PDR Code [8] will be presented. This model computes the radiative transfer in a stationary plane-parallel slab of gas and takes into account thermal balance and chemistry. It is worth noting that in this model water is formed with an OPR in thermal equilibrium at the local gas temperature. Preliminary results show a good agreement between observed water lines intensity and those predicted by the model, with an OPR always higher than 2.5. Best-fit model parameters (thermal pressure and UV field intensity) are also in agreement with those derived from the analysis of high-J CO lines in the Orion Bar [9].

We will also present the experimental attempts made at LERMA to prepare icy sample from water molecules with a controlled disequilibrium in the water *ortho* and *para* populations in the gas phase in order to study the impact of VUV photodesorption on the water OPR.

Références

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