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Exotic properties of water, ammonia, salty ices at extreme pressures: from quantum tunneling to superionicity

Prof. A. Marco Saitta

(Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie Université Pierre et Marie Curie – Sorbonne Paris, France)

The interiors of the icy giant planets (Uranus and Neptune) and their satellites are thought to contain very large amounts of molecular compounds, and in particular water and ammonia (Figure 1). At the extreme conditions of pressure and temperature estimated in those planetary interiors, the properties of these common systems are significantly different than at ambient conditions.

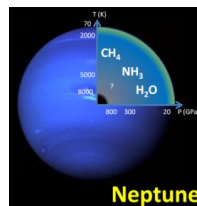


Figure 1: Chemical composition and P, T conditions in the mantle of Neptune

In this talk I will present an overview of theoretical and experimental work going on in our laboratory on these systems. I will show the high-pressure superionic transition in ammonia [1], and its subsequent full ionization at even higher pressures [2]. In parallel, I will present our recent work on the quantum behavior of protons in high-pressure pure [3] and salty ices [4-6]. Finally, the mixture of ammonia and water seems to combine both kinds of exotic properties, as our investigation of $\text{NH}_3 \cdot \text{H}_2\text{O}$ under high pressure indicates [7,8].

References:

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