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'Exploring the deep interior of giant planets with atomistic simulations'

Mon, 4th July 2022 @ 14h

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The interior of the ice giant planet Neptune is dominated by a mixture of water, ammonia, and methane at temperatures between 1000 K and 20000 K[1]. Many observable properties of the planet, such as luminosity, gravitational moments and magnetic fields, are thought to be determined by the physical and chemical properties of matter within this ice layer. In particular, the superionic phases of water and ammonia, characterized by highly mobile hydrogen ions diffusing through a lattice of oxygen and nitrogen ions, respectively, have gained much attention[2-4], because they are suggested to be related to the complex magnetic field structure of Neptune. Determining the stability domain of such phases, and especially their melting curves, is therefore crucial to constrain the location and extent of the dynamo region in the planets' mantles.
This presentation provides an overview of the recent advances made in the study of metallic and superionic phases of water and ammonia[5-7] by combining atomistic simulations based on density functional theory with insights from high-pressure experiments. This approach provides accurate equation of state data, phase diagrams, and transport properties such as electrical conductivity, which can provide useful insights for planetary modeling.

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