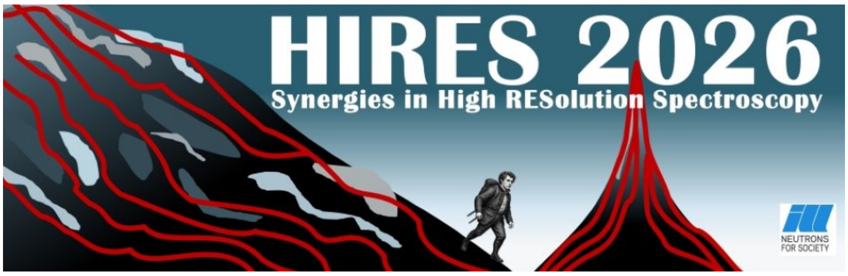

Contribution ID: **54** Type: **Oral**

High-pressure QENS: identifying plastic phases in planetary ices

Simple molecular systems such as hydrogen, water, ammonia, and methane are the main constituents of the Ice and Gas Giants (Uranus and Neptune), many icy moons, and numerous Neptune-like exoplanets. Space missions have also revealed dissolved salts (e.g., NaCl, KCl) in several icy-moon plumes. Although chemically simple, these systems display rich and sometimes unexpected physical behavior under extreme conditions. Water is especially intriguing due to its anomalous properties, largely driven by its ability to form strong directional hydrogen bonds. In liquid water these bonds form and break on picosecond timescales, coupling translational, rotational, and vibrational motions. Understanding its fast dynamics is key to describing intermolecular interactions. Changing H-bond strength — by adding ammonia, salts, or other bonding species — significantly modifies water's behavior. High pressure compresses molecular environments, accessing regions of the interaction potentials otherwise unreachable, while high temperature alters H-bond lifetimes and can induce exotic diffusive regimes. In this talk, I show how high-pressure quasi-elastic neutron scattering (HP-QENS) is a unique tool to directly observe the plastic phases of planetary-relevant ices. These mesophases retain crystalline order while allowing rapid molecular rotation. I will summarize results for Ice VII [1], ammonia hydrates at different compositions (AMM [2], AHH [3]), and LiCl hydrates [4].

[1] Rescigno et al., Nature (2025), DOI:10.1038/s41586-025-08750-4
[2] Zhang et al., JPC Lett. (2023), DOI:10.1021/acs.jpclett.3c00092
[3] Ninet et al., ILL (2023), https://doi.ill.fr/10.5291/ILL-DATA.7-02-215
[4] Nicholls et al., ILL (2025), https://doi.ill.fr/10.5291/ILL-DATA.7-04-202

Session

Hard Condensed Matter

Primary author: RESCIGNO, Maria

Co-authors: BOVE, Livia Eleonora (CNRS Paris & Università La Sapienza Roma); KOZA, Michael (Institut Laue Langevin)

Presenter: RESCIGNO, Maria

Session Classification: Hard Condensed Matter