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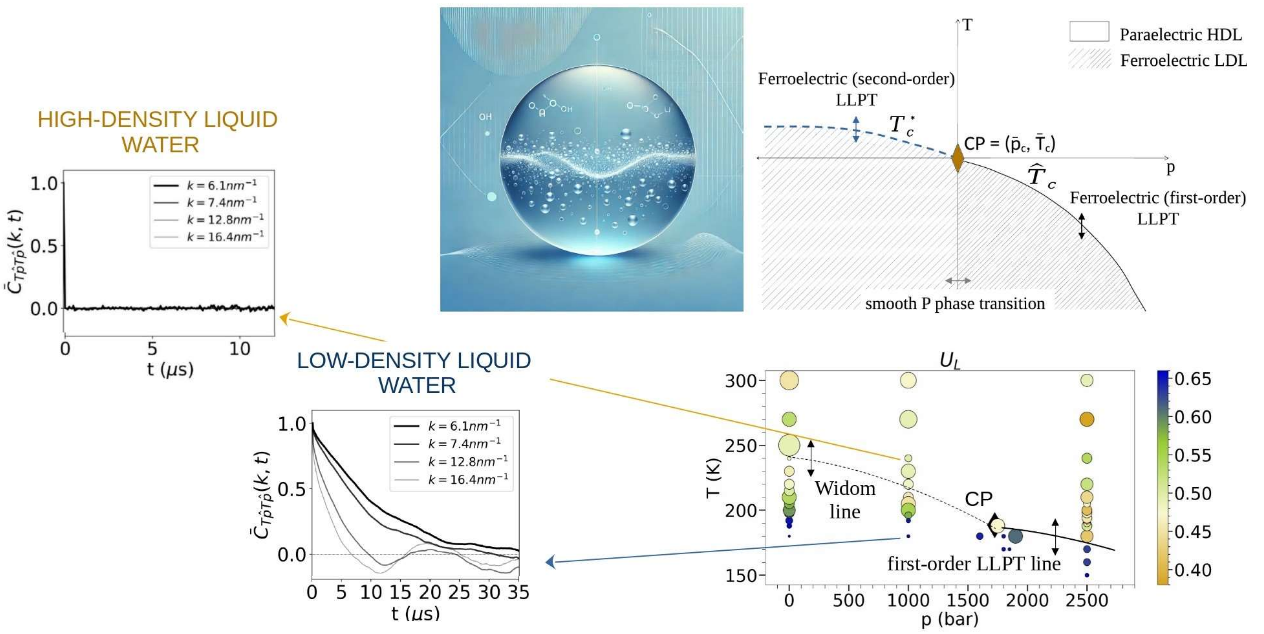
A ferroelectric phase transition underlying the liquid-liquid phase transition in supercooled water

A liquid-liquid phase transition (LLPT) between a High-Density Liquid (HDL) and a Low-Density Liquid (LDL) below water's freezing point, in the so-called supercooled regime, has emerged as a compelling hypothesis for explaining its equilibrium thermodynamic anomalies, which sets it apart from other liquids. Its origin has been so-far not clarified. On the other hand, water is a polar liquid and, as such, can, in principle, undergo a ferroelectric phase transition.

This research [1] introduces an original and far-reaching proposal: The LLPT can be driven by a ferroelectric phase transition. These results grounds on both analysis of extensive molecular dynamics simulations and a classical density functional theory in mean-field approximation valid for polar liquids. The theory reveals how the functional form of the dipolar interaction potential, which underpins density-polarization coupling, and the positional disorder in the liquid are essential for establishing this scenario. This study not only characterizes but shed light on the origin of the LLPT and thermodynamic anomalies in water.

Understanding the origin of water's peculiar behavior holds the key to uncovering fundamental mechanisms driving life and Earth's processes. Explaining the peculiarities of water while treating it as a generic polar liquid, this study raises significant questions: Could the ferroelectric properties of water influence the natural selection of organisms and Earth's geological evolution? Is water 'merely' a polar liquid with the microscopic characteristics suitable to allow a ferroelectric phase transition close to Earth's environmental conditions? And what contribute to shaping its microscopic characteristics?



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