Water anomalies at -100 MPa

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Water is famous for its complexity, with more than 15 solid phases and numerous anomalies in the liquid phase. These anomalies become more pronounced when the liquid is supercooled. Several explanations have been proposed. One of them involves a first-order transition at low-temperature between two liquids with different structures. However, this transition seen on computers has remained elusive in the experiments. The only available reports are for very confined water, or for water-glycerol mixtures.

We study pure bulk water droplets in the 10 μm range, but at negative pressure. The droplets are included in a quartz crystal that provides a constant volume box, able to withstand the mechanical tension that develops in the liquid upon cooling. In this way, negative pressures in excess of -100 MPa can be reached before the liquid "tears" and a vapor bubble forms. Using Brillouin spectroscopy, we measure the sound velocity in the doubly metastable liquid, simultaneously supercooled and at negative pressure. I will describe our recent results and their interpretation, supported by molecular dynamics simulations.