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Liquid-liquid phase transition in supercooled water: Recent progress from simulations and experiments

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Liquid water exhibits a large number of unusual properties, many of which become pronounced in cold and supercooled water, such as the density maximum at 4 C. Based on computer simulations, it has been proposed that a liquid-liquid phase transition (LLPT) occurs in supercooled water, in which two phases of liquid water become distinct below a critical point currently estimated to occur at approximately 210 K and 100 MPa. Such a LLPT provides a unified and thermodynamically consistent explanation of many of water's anomalies, including the behavior of amorphous solid water. While it is now firmly established that a LLPT occurs in realistic (including quantum-based) water simulations, attempts to provide a definitive experimental demonstration are frustrated by rapid ice crystallization. After reviewing the status of the LLPT hypothesis, I will discuss recent simulations that seek to identify novel ways to detect the LLPT in real water, and recent experiments that attempt to do so.

Keyword-1

liquid-liquid phase transition

Keyword-2

supercooled water

Keyword-3

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