Unravelling water’s mysterious properties

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The intricate interaction between water and various molecular components often results in complex molecular dynamics; however, a comprehensive mechanistic description of these solutions is lacking. For instance, it remains unsolved how nanometer-scale transient structural heterogeneity, which arises from weak intermolecular interactions, relates to the overall structural dynamics of biomolecules in solution. Are water's anomalous properties directly involved in life processes? We investigate the interplay of supercooled water's peculiar thermodynamic and dynamic properties with solutes. Here, I will give an overview of our recent activity, highlighting studies on dynamics of supercooled water and protein spatiotemporal fluctuations. Finally, I will present recent results on rapidly supercooled microdroplets of aqueous mixtures that provide new insights into water's anomalies and its interplay with solvation.