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Lilienfeld Prize Talk: New Results on Water in Bulk, Nanoconfined, and Biological Environments

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This talk will introduce some of the 63 unsolved mysteries of water, and will demonstrate some recent progress in solving them combining information provided by water in bulk, nanoconfined, and biological environments. In particular, we will present evidence from experiments designed to test the hypothesis that water displays "polymorphism" in that it can exist in two liquid different phases and display a novel liquid-liquid critical point. The concept of liquid polymorphism is also proving useful in understanding some of the anomalies of other liquids with local tetrahedral symmetry, such as silicon, silica, and carbon. In particular, the talk will discuss changes in dynamic transport properties [1], and water in biological environments, including a possible physical explanation for the phenomenon known as the protein glass transition [2].

[1] P. Kumar, S. V. Buldyrev, S. L. Becker, P. H. Poole, F. W. Starr, and H. E. Stanley, "Relation between the Widom line and the Breakdown of the Stokes–Einstein Relation in Supercooled Water," Proc. Natl. Acad. Sci. USA 104, 9575-9579 (2007).

[2] P. Kumar, Z. Yan, L. Xu, M. G. Mazza, S. V. Buldyrev, S.-H. Chen. S. Sastry, and H. E. Stanley, "Glass Transition in Biomolecules and the Liquid-Liquid Critical Point of Water," Phys. Rev. Lett. 97, 177802 (2006).