Supersolidity and plasticity of solid helium at low temperatures

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Supersolidity, the appearance of viscousless flow in solids, was first indicated in $^4$He torsional oscillator (TO) experiments [1]. Despite many efforts to uncover the mechanism of supersolidity since the first observation of non-classical rotational inertia (NCRI), the microscopic origin and physical interpretation of the observed phenomena has been under considerable debate. Recently, the TO response was considerably suppressed when the effect of shear modulus on TO was removed, suggesting alternative non-superfluid explanations responsible for the TO response [2]. On the other hand, quantum statistics dependence of the TO response [3], heat capacity signatures [4], and rotation effects on the TO response [5] are conflicting with non-supersolid explanations. In this talk, I will present simultaneous measurement of the TO response and shear modulus to understand the fundamental connection between two phenomena.