Supersolidity or Quantum Metallurgy?

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Colorado State University
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Refreshments at 3:45PM
Location: 120 Engineering (Hammond Auditorium)

Abstract

Theory has predicted that a superfluid-like state could exist in solid helium, where mass-less transport can occur within a crystalline lattice. It was suggested by Anthony Leggett in 1970 that an experimental sign of such a quantum state could be the measurement of a nonclassical rotational inertia (NCRI). 34 years later, in 2004, experiments performed by Eunseong Kim and Moses Chan reported an exciting result of an apparent mass decoupling in very sensitive torsion oscillator measurements. Further experiments by several groups around the world confirmed this result stimulating many new theories trying to explain this behavior, many of which proposed a collective role of defects in the crystalline lattice or the coexistence with a glassy or amorphous state. New experiments, including some neutron and X-ray scattering studies performed by our group, have successively ruled-out these explanations, and it has been shown that the observed anomalies can be explained through novel elastic behavior or a stiffening of solid helium at low temperatures. Supersolidity may not exist, but a new field of quantum metallurgy has been uncovered.

Biographical Sketch

Alan Braslau is an experimental condensed-matter physicist who received his PhD from Harvard University studying smectic ordering induced at the free surface of liquid crystals in the isotropic and nematic phases. He went on to a post-doctoral position at Orsay in France studying anchoring properties in liquid crystal devices before being hired as a tenured staff-scientist in fundamental research at the French national laboratory of the CEA at Saclay. There he studied the elastic properties of fluid interfaces at molecular length-scales, moving then to the study of the physical-chemistry of nucleic acids in heterogeneous environments. With the announced discovery of supersolidity, he turned to structural studies of solid helium at very low temperatures, later contributing to studies of turbulence at very high Reynolds number in superfluid helium in the SHREK experiment in Grenoble, France.