CEA - Saclay 91191 Gif-sur-yvette Cedex

Service de Physique de l'Etat Condensé

SÉMINAIRE

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Mercredi 16 novembre 11h15

Orme des Merisiers SPEC Salle Itzykson, Bât.774

Solid Helium: Supersolidity or Quantum Plasticity?

John Beamish

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Helium is a quantum material. Its zero point motion prevents it from freezing and liquid helium becomes a superfluid at temperatures below 2 K. It can be frozen by applying pressure but it is a very quantum mechanical solid. Over 40 years ago, it was predicted that helium could become a supersolid at low temperature a solid in which crystalline order coexists with superflow. In 2004, experiments by Kim and Chan showed evidence that solid helium decouples from a torsional oscillator below 200 mK, the non-classical rotational inertia expected for a supersolid. However, searches for DC superflow and other superfluid behavior were unsuccessful. We have studied another property which distinguishes solids from liquids shear rigidity. The shear modulus of solid helium increases dramatically below 200 mK, with the same dependence on temperature, amplitude and 3He impurity concentration as the torsional oscillator frequency - the two phenomena are clearly related. However, the shear modulus changes are naturally explained in terms of dislocations moving in response to stress. The behavior of defects in solid helium is quite different from that in classical solids. We describe what we have learned about quantum plasticity in solid helium and how it may be related to the supersolid behavior seen in torsional oscillators.

A coffee break will be served at 11h00. The seminar will be given in English.

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