Researchers putting a freeze on oscillator vibrations

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University of Oregon physicists have successfully landed a one-two punch on a tiny glass sphere, refrigerating it in liquid helium and then dosing its perimeter with a laser beam, to bring its naturally occurring mechanical vibrations to a near standstill.

The findings, published in *Nature Physics*, could boost advances in information processing that exploits special quantum properties and in precision-measurements for nanotechnology. The ability to freeze mechanical fluctuations, or vibrations, with a laser in so-called optomechanical oscillators, also opens a window on the little-explored transition between quantum and classical physics, said principal investigator Hailin Wang.

Wang, a member of the Oregon Center for Optics and a professor in the UO physics department, and his doctoral student Young-Shin Park performed the research under grants from the National Science Foundation and Army Research Laboratory through the Oregon Nanoscience and Microtechnologies Institute (ONAMI).

In nanotechnology, understanding phonons -- vibrations that carry energy -- is becoming increasingly important. For their project, Wang and Park purposely manufactured a deformed silica microsphere about 30 microns in diameter, about the size of a human hair.

A combination of cryogenic pre-cooling of the sphere to 1.4 Kelvin (minus 457.15 degrees Fahrenheit) and hitting the sphere's outer surface with a laser allowed researchers to extract energy from the mechanical oscillator and lower the level of phonon excitations to near 40 quanta. Ultimately, Wang said, the goal is to reduce that level, known as the average phonon occupation, to one quantum.

"Our goal is to get to and work with the quantum mechanical ground state in which there is very little excitation or displacement," Wang said. Reaching one quantum would require a temperature just a few thousandths of a degree from absolute zero (minus 459.67 degrees Fahrenheit).

Source: University of Oregon (news : web)

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