Major physics breakthrough in understanding supersolidity

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Physicists at the University of Alberta, in Edmonton, Alberta, Canada, have made a major advance in the understanding of what appears to be a new state of matter.

Working in the highly specialized field of quantum fluids and solids, Prof. John Beamish, chair of the Department of Physics, and PhD student James Day, report their findings in a paper to be published in the science journal *Nature* on Wednesday, Dec. 6, 2007. Beamish and Day are the only researchers in Canada conducting experimental research in this area of fundamental physics.

At very low temperatures, helium gas turns into a liquid. Put under extreme pressure the liquid turns into a solid. Physicists have been manipulating solid helium so they can study its unusual behaviour.

In 2004, a research team at Penn State university in the United States, led by Dr. Moses Chan, electrified the physics world when it announced that it may have discovered an entirely new state of matter – supersolidity. The team made the discovery by cooling solid helium to an extremely low temperature and oscillating the material at different speeds. They found that the particles behaved in a way not seen before, which suggested it might show the “perpetual flow” seen in superfluids like liquid helium.

Day and Dr. Beamish have taken this research a different direction. In an experiment not done before, they cooled the solid helium and

manipulated the material another way – by shearing it elastically. In doing so, they found that the solid behaved in an entirely new and unexpected way – it became much stiffer at the lowest temperatures.

“The experimental results from the University of Alberta are remarkable,” Dr. Chan said. “Namely, Professor Beamish and his student James Day found that the shear modulus of solid helium increases by 20% when it is cooled below 0.25K.

“Furthermore, the temperature dependence of the shear modulus seems to track the period change seen in torsional oscillator. It seems the two phenomena are related and probably have the same mechanical origin.

“This is an important breakthrough since the original discovery,” Chan said.

Other physicists around the world are also studying the implications. Through this discovery, Beamish and Day have significantly added to the body of knowledge about the fundamental states of matter allowed by nature.

Source: University of Alberta