Breakthrough in particle control creates special half-vortex rotation

March 3 2015

A breakthrough in the control of a type of particle known as the polariton has created a highly specialised form of rotation.

Researchers at the Universities of Strathclyde and Pittsburgh, and Princeton University, conducted a test in which they were able to arrange the particles into a 'ring geometry' form in a solid-state environment. The result was a half-vortex in a 'quantised rotation' form.

This experiment had previously been possible only with the use of ultra-cold atoms, a fraction of a degree above absolute zero, but new techniques enabled the researchers to perform the test at higher temperatures. This made for a simpler, more efficient system which could feed into research for new technologies.

Professor Andrew Daley, of Strathclyde's Department of Physics, was part of the research team and worked on the underlying model of the experiment, which was performed in Pittsburgh.

He said: "This type of controlled experiment is fundamental science but also has applications in quantum technology; much of our research revolves around controlling and understanding these quantum systems. This type of research led in the past to the understanding of building a transistor or a laser.

"Fringes were seen across the entire image of the ring we created, showing that we were controlling the polaritons in a coherent way and that they were displaying collective behaviour, as opposed to behaving as individuals. We were then able to demonstrate unusual states where the particles rotated in the ring at rates that were quantised. The phenomena we observed, known as half-vortices, are peculiar to situations where two different kinds of particles rotate in a superfluid – that is, the particles also must flow with no resistance.

"In this experiment, the polaritons had a much longer lifetime than in previous experiments, which made this collective behaviour possible. The ring made in our work can be created relatively easily in solid-state systems that can operate up to room temperature; this opens the door to all kinds of other superfluid light effects, which could have applications in optical communications."

More information: Gangqiang Liu, David W. Snoke, Andrew Daley, Loren N. Pfeiffer, and Ken West, "A new type of half-quantum circulation in a macroscopic polariton spinor ring condensate," *PNAS*, DOI: 10.1073/pnas.1424549112

Provided by University of Strathclyde, Glasgow

Citation: Breakthrough in particle control creates special half-vortex rotation (2015, March 3) retrieved 15 June 2024 from https://phys.org/news/2015-03-breakthrough-particle-special-half-vortex-rotation.html