Research finds that large(ish) objects can follow the rules of the microscopic world

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Miles Blencowe, a quantum theorist with the physics and astronomy department at Dartmouth, is part of a team working to connect the macroscopic and the microscopic worlds by seeing if they can make larger objects obey the laws of quantum mechanics, where things can be in two places at once.

In the Sept. 14 issue of the journal *Nature*, the researchers report that they are much closer to making this classical-quantum connection with an experiment to determine the position of a vibrating beam measuring one-thousandth of a millimeter in width. While still tiny, the beam comprises about ten billion atoms, and it represents a much larger system than has been considered to date.

Blencowe explains that this field of research attempts to reconcile the inherent contradiction between the quantum world of microscopic or atomic-sized systems and the classical or macroscopic world of well-localized trees, buildings and cars that we live in. At some point, the quantum becomes the classical as objects get larger and larger, and scientists want to know how that crossover occurs.

"Quantum mechanics predicts that if you try to measure the position of an object accurately, you will disturb its position, so you can never precisely know where the object is," says Blencowe. "That disturbance was exactly what we saw in the larger system."

The study in *Nature* describes how a "single electron transistor" was employed as an extremely sensitive motion detector. It was used to measure the position of a vibrating beam made of silicon.

"The transistor carries a tiny current, one electron at a time, that is very sensitive to the beam's location," says Blencowe. "These detector electrons acted back on the beam, disturbing its motion, called the 'back action' effect. And we also saw that the back action sucked energy out of the beam and cooled it down, which brings the beam closer to behaving quantum mechanically."

Blencowe collaborated with colleagues at the University of Maryland, the University of Nottingham (UK), and McGill University (Canada) on this study. Future research will work with increasingly larger-scale systems.

Source: Dartmouth College

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