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A “new” Quantum Mechanics?

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A team that involves FBK researchers has tested in an experiment a modified version of the theory, with promising results. The research paper received a special mention from "Physical Review Letters", the journal that published it

An important recognition for a group of researchers from the CNR **Institute of Photonics and Nanotechnology** (IFN-CNR), **FBK**, **TIFPA** and **University of Trieste**: their paper “Improved noninterferometric test of collapse models using ultracold cantilevers” published in “Physical Review Letters” (the most authoritative journal amongst those specializing in physics), has in fact been listed among the “Editor’s suggestions“of the journal.

It is a privilege for a few, if one considers that, on average, only one-sixth of the works published in the selective journal (about one out of four papers submitted to “Physical Review Letters” are accepted for publication) are recognized. The choice falls on the papers that stand out for their relevance, originality and general interest.

The research team consists of **Andrea Vinante** (IFN-CNR and FBK), first author and creator of the measurement method, **Paolo Falferi** (IFN-CNR, FBK and TIFPA), **Renato Mezzena** (University of Trento and TIFPA), Matteo Carlesso and Angelo Bassi (University of Trieste).

The research moves within the framework of **quantum mechanics**, the physical theory that describes the behavior of atomic or subatomic scale systems, and starts with a fascinating issue that is still open, that of “**measurement**“: while in the macroscopic world the physical properties of a system are always well defined, in the microscopic **quantum** world one can only define a state, known as a “wave function”, to which different physical properties may correspond (eg, an object can be simultaneously in two different positions). It is the experiment itself, namely the measurement, which forces the system to decide with some probability where to stand, i.e. to determine the so-called “**collapse of the wave function**“.

Very well known, to this regard, is the “**Schrodinger’s cat**” paradox: if we close in a box a hypothetical “quantum cat” together with a radioactive source capable of killing it, we cannot say with certainty whether the cat is alive or dead, but only that it is in an overlapping of two states, one of life and the other of death! Only by opening the box, that is, by performing a measurement, we will determine its **destiny**.

This interpretation of quantum mechanics, developed mainly by physicists **Niels Bohr** and **Wernel Karl Heisenberg** (and known as the “**Copenhagen interpretation**“), is largely accepted by the scientific community but remains a source of debate, as the theory does not define in a precise way how and when the wave function collapses. One of the possible solutions to the problem is to consider **modified versions** of the theory.

“In our experiment, we have experimentally tested an extensive version of quantum mechanics, which is obtained with a slight modification of its equations. This version predicts that the collapse of the wave function occurs **spontaneously**, thus eliminating the ambiguities of the theory, “Vinante points out. “In addition, the model predicts that any mechanical system is continuously perturbed by a very small ‘**noise force**‘, and this effect is in principle measurable. ”

The results of the experiment, conducted on mechanical **micro-sensors** at very low temperatures, are promising. “Our work sets the stringest limits ever applied to the parameters of these modified theories: this is a **remarkable result**, considering that the experiment is relatively simple and inexpensive. We also measured a very small noise force whose origin is compatible with the one predicted by the model, but which could be more reasonably explained by other less exotic causes. ” The next step will be to further refine the experiment to verify the exact origin of the signal.

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