What if quantum physics worked on a macroscopic level?

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Quantum physics concerns a world of infinitely small things. But for years, researchers from the University of Geneva (UNIGE), Switzerland, have been attempting to observe the properties of quantum physics on a larger scale, even macroscopic. In January 2011, they managed to entangle crystals, therefore surpassing the atomic dimension. Now, Professor Nicolas Gisin's team has successfully entangled two optic fibers, populated by 500 photons. Unlike previous experiments which were carried out with the fiber optics of one photon, this new feat (which has been published in *Nature Physics*) begins to answer a fundamental question: can quantum properties survive on a macroscopic level?

For thirty years, physicists have been able to entangle photon pairs (particles of light). Thus, an action on the first particle will have an instant impact on the second, regardless of the distance and the obstacles between them. It occurs as if it were one single photon present at two different places. With this feat in mind, one question remains: can larger elements be entangled on a macroscopic level?

It would seem intuitive to think that the rules of physics that apply at the atomic level would be transferable to the macroscopic world. However, attempts to prove this have not been easy. In fact, when the size of a quantum system increases, it interacts more and more with its surrounding environment, which rapidly destroys its quantum properties. This phenomenon, known as quantum decoherence, is one of the limitations on the capability of macroscopic systems to retain their quantum properties.

From micro to macroscopic

Despite these limitations, and due to technological advances, scientists from UNIGE's Faculty of Science were able to entangle two fiber optics populated by 500 photons, unlike those that were previously entangled to only one photon.

To do this, the team led by Nicolas Gisin, professor in the Physics Section, created an entanglement between two fiber optics on a microscopic level before moving it to the macroscopic level. The entangled state survived the transition to a larger-scale world and the phenomenon could even be observed with the traditional means of detection, i.e. practically with the naked eye.

In order to verify that the entanglement survived in the macroscopic world, the physicists reconverted the phenomenon at the microscopic level.

"This first large-scale experiment paves the way for many applications that quantum physics offers. The entanglement at the macroscopic level is one of the main research areas in the field, and we hope to entangle increasingly large objects in the years to come," said Professor Gisin.

Provided by University of Geneva