



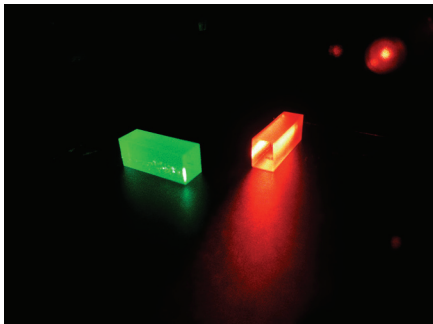
UNIVERSITÉ
DE GENÈVE

PRESS RELEASE

Geneva | 5 March 2012

TWO CRYSTALS LINKED BY QUANTUM PHYSICS

Researchers at the UNIGE have succeeded in entangling two macroscopic crystals, a step towards the development of quantum memory.



The two entangled crystals (Gisin/GAP)

Physicists take a perverse pleasure in playing with the strangeness of the quantum world. For years that's how they have managed to entangle miniscule objects such as photons, particles of light. In other words, after specific manipulations, they persuade two photons to act as a single entity, even though they might be separated by as much as several kilometres. A breakthrough has just been made in this endeavour since a team from the Group of Applied Physics at the University of Geneva (UNIGE) has succeeded in entangling not miniscule objects, but instead, macroscopic crystals visible to the naked eye. This exploit earned the researchers a publication in the journal *Nature Photonics*.

For almost fifteen years Professor Nicolas Gisin and his physicist collaborators have been entangling photons. If this exercise seems to them perhaps henceforth trivial, it continues to elude us ordinary humans. The laws that govern the quantum world are so strange that they completely escape us human beings confronted with the laws of the macroscopic world. This apparent difference in nature between the infinitesimally small and our world poses the question of what link exists between the two.

However these two worlds do interact. To realise this, one must follow the latest experiment of the Group of Applied Physics (GAP). Nicolas Gisin, researcher Mikael Afzelius and their team have actually produced the entanglement of two macroscopic crystals, visible to the naked eye, thanks to a quantum particle, a photon, otherwise known as a particle of light.

To achieve this exploit, the physicists developed a complex device to which they hold the key. After a first system that allows them to verify that they've actually managed to release one, and only one, photon, a condition essential to the success of the experiment, a second device "slices" this particle in two. This splitting allows the researchers to obtain two entangled photon halves. In other words, even though they are not in the same location, the two halves continue to behave as if they were one.

Wait for the photons to exit

The two halves are then each sent through a separate crystal where they will interact with the neodymium atoms present in its atomic structure. At that moment, because they are excited by these entangled photons, the neodymium lattices in each crystal likewise become entangled. But how can we be certain that they've actually reacted to

the two photon halves?

That's simple ... or nearly! They just have to wait for the two particles to exit the crystals - since they exit after a rather brief period of about 33 nanoseconds - and to verify that it really is the entangled pair. "That's exactly what we found since the two photons that we captured exiting the crystals showed all the properties of two quantum particles behaving as one, characterised by their simultaneity in spite of their separation", Félix Bussi res rejoices, one of the authors of the article.

In addition to its fundamental aspect, this experiment carries with it potential applications. Actually, for the specialists in quantum entanglement, this phenomenon has the unpleasant habit of fading when the two entangled quantum objects are too far from one another. This is problematic when one envisions impregnable quantum cryptography networks which could link two distant speakers separated by several hundreds or even thousands of kilometres.

"Thanks to the entanglement of crystals, we can now imagine inventing quantum repeaters", Nicolas Gisin explains, "in other words, the sorts of terminals that would allow us to relay entanglement over large distances. We could then also create memory for quantum computers."

Entanglement still has many surprises in store for us.

contact

Nicolas Gisin

022 379 05 02
nicolas.gisin@unige.ch

Mikael Afzelius

022 379 05 07
mikael.afzelius@unige.ch

Felix Bussi res

022 379 05 27
felix.bussieres@unige.ch

UNIVERSIT  DE GEN VE
Service de communication

24 rue du G n ral-Dufour
CH-1211 Gen ve 4

T l. 022 379 77 17
media@unige.ch
www.unige.ch