Quantum physics: Flavors of entanglement

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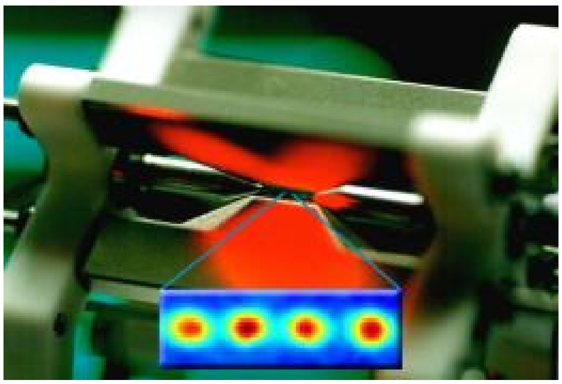

Innsbruck physicists exposed four entangled ions to a noisy environment. Credit: University of Innsbruck

The entanglement of quantum objects can take surprising forms. Quantum physicists at the University of Innsbruck have investigated several flavors of entanglement in four trapped ions and report their results in the journal *Nature Physics*. Their study promotes further developments towards quantum computing and a deeper understanding of the foundations of quantum mechanics.

Entanglement is a fascinating property connecting quantum systems. Albert Einstein called it the "spooky action at a distance". This bizarre coupling can link particles, even if they are located on opposite sides of the galaxy. The strength of their connections is behind the promising quantum computers, the dream machines capable of quick and efficient computations.

The team lead by Rainer Blatt at the Institute of Experimental Physics of the University of Innsbruck has been working very successfully towards the realization of a quantum computer. In their recent study, these physicists exposed four entangled ions to a noisy environment. "At the beginning the ions showed very strong connections," says Julio Barreiro. "When exposed to the disturbing environment, the ions started a journey to the classical world. In this journey, their entanglement showed a variety of flavors or properties."

Their results go far beyond what was previously investigated with two entangled particles since four particles can be connected in many more ways. This investigation forms an important basis for the understanding of entanglement under the presence of the disturbances of the environment and the boundary between the dissimilar quantum and classical worlds. The work has now been published in the journal Nature Physics.

As part of their study, the Innsbruck scientists have developed new theoretical tools for the description of entangled states and novel experimental techniques for the control of the particles and their environment.

More information: Experimental multiparticle entanglement dynamics induced by decoherence. J. T. Barreiro, P. Schindler, O. Gühne, T. Monz, M. Chwalla, C. F. Roos, M. Hennrich, R. Blatt. *Nature Physics*. 27 September 2010. DOI:10.1038/NPHYS1781

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