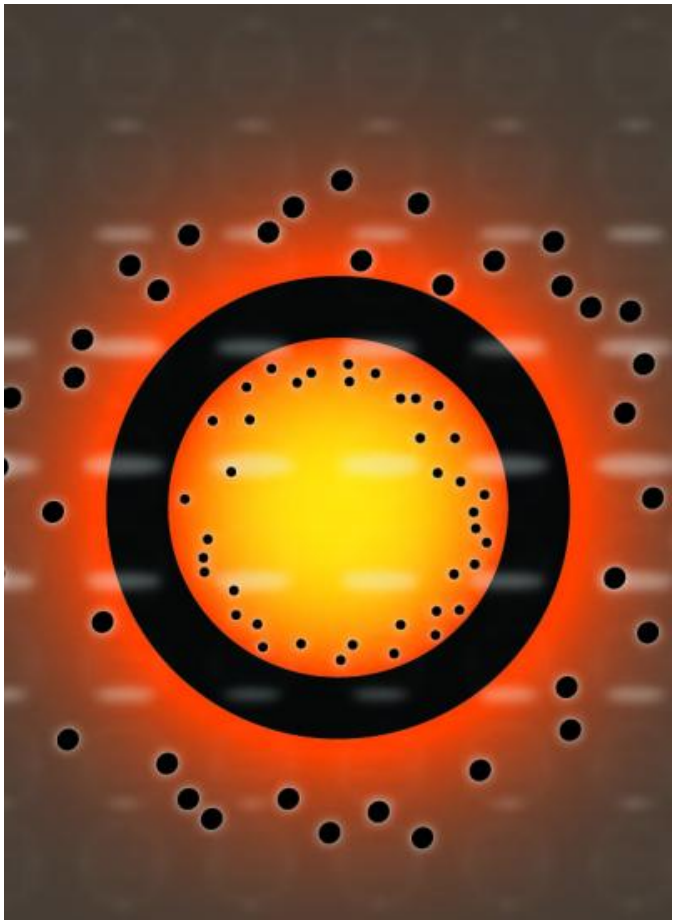
# New Insights Into The Remote Control of Quantum Systems

A fundamental characteristic of quantum physics is the fact that two or more particles can exhibit correlations stronger than classically allowed. This unique characteristic applies particularly to quantum entanglement: as soon as the quantum state of a particle is measured the state of its entangled partner changes accordingly, regardless of how far apart the two entangled particles might be. This feature allows for the remote quantum state preparation, which is an essential ingredient for applications in quantum communication, quantum cryptography, and quantum computation.



*This is a graphic representation of remotely prepared quantum states. In their experiment, the researchers demonstrated that it is possible to prepare quantum states remotely by means of quantum discord (outside the circle) which might not always be possible to achieve by means of entanglement (inside the circle).*

The degree of entanglement is often used as a figure of merit for determining its usefulness for quantum technologies. Strongly entangled systems, however, are very sensitive to extrinsic influence and difficult to prepare and to control. A team of

researchers headed by the physicists Caslav Brukner (theory) and Philip Walther (experiment) at the University of Vienna have been able to show that in order to achieve successful remote state preparation entanglement is not the only way forward. Under certain circumstances, non-entangled states can outperform their entangled counterparts for such tasks - as long as they have a significant amount of so-called "quantum discord". This novel and not yet fully understood measure of quantum correlations quantifies the disturbance of correlated particles when being measured.

In their experiments, the researchers used a variety of two-photon states with different polarization correlations. "By measuring the polarization state of a certain photon we prepare the state of the respective partner photon remotely", explains Philip Walther. "In the experiment we observe how the quality of our remotely prepared quantum state is affected by changes in the quantum discord." This work provides an important and significant step towards future quantum information processing schemes that would rely on less demanding resources.

University of Vienna [1]

August 09, 2012

**Source URL (retrieved on *03/12/2014 - 5:08pm*):**
http://www.wirelessdesignmag.com/news/2012/08/new-insights-remote-control-quantum-systems?qt-most_popular=0

**Links:**
[1] http://www.univie.ac.at/en/