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ALUMNI SPOTLIGHT

Former Students Gather for Symposium in Memory of Richard Ferrell

In November, from November 16-17, 2007, a symposium entitled Strongly Interacting Systems: Past, Present and Future, was held in memory of Richard A. Ferrell at the Max Planck Institute, Dresden, Germany. Dr. Ferrell was a theorist with contributions in several areas, including statistical and condensed matter physics. He joined UMD Physics in 1953, and was an active member of the campus and the nearby community until his death in 2005.

Pictured below, are former students of Dr. Ferrell's (From left: John Quinn, Jay Bhattacharjee, Peter Fulde and Alan Luther). They are among the most distinguished PhD recipients of the UMD Physics Department.

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RESEARCH SPOTLIGHT

"Spooky action-at-a-distance" with individual atoms

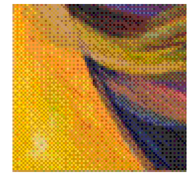
By: Christopher Monroe

Albert Einstein never liked Quantum Mechanics, with its fuzzy superpositions and confused states of reality. In 19 Podolsky and Nathan Rosen proposed a thought experiment that they believed would finally show cracks in th essentials of their famed proposal can be seen by cconsidering two "quantum coins," that are prepared in a st both heads-up and both tails-up at the same time. When such coins are brought far apart from each other a mechanics predicts that the only possible results can be HH and TT – the orientation of the coins always match when either individual coin is observed, its value is expected to be totally random (H or T). What's interesting h coin is in an indeterminate state until observed, the observer immediately knows that orientation of the oth happens faster than the speed of light can traverse the distance between the coins.

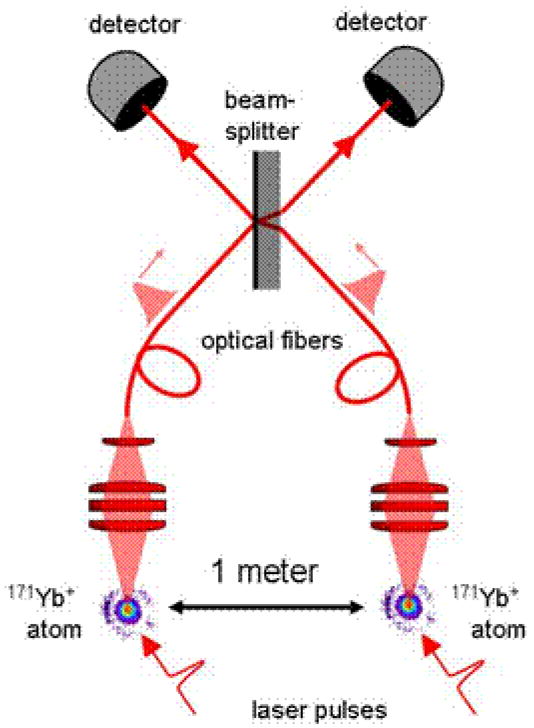
Einstein called this quantum behavior "spooky action-at-a-distance," and concluded that either quantum mechanics is incomplete, or it is just very weird. We now know, thanks to John Bell in 1964, that if quantum mechanics is indeed incomplete, than any more complete theory must be just as weird, so we might as well stick with quantum mechanics. Bell devised a measure of this weirdness: an inequality involving measured pair-correlations that is violated for situations like the one considered by Einstein, Podolsky and Rosen.

This weird type of quantum state the Einstein introduced is now known as an "entangled state," and the spooky action-at-a-distance that he bemoaned is now the central resource in the field

of Quantum Information Science. Replace the coins by quantum bits that can be in the state 0 and 1 simultaneously, and these qubits can be used for superfast computing applications, or fundamentally secure communication. Qubits are now being investigated in a variety of physical systems, from individual atoms and photons, to superconducting circuits and semiconductor quantum dots.



Depiction of atoms (yellow Prof. Boris Bl



Schematic of experiment to entangle two remote trapped atoms. Laser pulses simultaneously excite the two atoms, and their emitted photons are guided by fibers onto a beamsplitter. When the two photons emerge from the beamsplitter and are detected in coincidence, the trapped ions are entangled.

Recently, a team of researchers from the University of Maryland Department of Physics and Joint Quantum Institute have observed for the first time, quantum entanglement of individual atoms separated by a large dista **449**, 68, (2007)]. Two atoms, held in electromagnetic tr synchronized with a laser pulse, and the resulting emitte beamsplitter and detected. This detection produced an entai where qubits were stored in the magnetic orientation of eac (the correlations of the atomic-scale magnets and the individually) was directly verified by measuring the magneti laser, resulting in a clear violation of Bell inequalities. Tl between atomic qubits may ultimately lead to the fabricatio computer, where atomic memories will be able to store expor and be connected through optical interconnects as demon term, this is among the most promising roads to a "quantum be propagated over very large (or even geographic) distai fibers.

Christopher Monroe is the Bice Sechi-Zorn Professor of Physics and Fellow of the Joint Quantum Institute at the U more complete description of this research, please see http://www.newsdesk.umd.edu/scitech/release.cfm?Article

In 2006, Dr. Quinn, '58, was awarded the Physics Distinguished Alumni Award. He is the former Chancellor of the University of Tennessee. His thesis work, involving one of the first field theoretic evaluations of electron self-energy by expanding in the dynamically screened Coulomb interaction, is a classic which is still cited.

Dr. Bahattacharjee, '79, is currently a Professor at the Indian Institute of Technology (IIT) in Bangalore. He first worked with Dr. Ferrell as a graduate student, and continued that collaboration until Dr. Ferrell's final paper.

Dr. Fulde, '63, is currently the head of the Max Planck Institute for the Physics of Complex Systems in Dresden. His thesis addressed superconductors with a strong spin exchange field. The Ferrell-Fulde phase was recently observed in CeCoIn 5.

Dr. Luther, '67, Professor at the Nordic Institute for Theoretical Physics (Nordita) in Denmark, won the Buckley Prize in 2001 (with Vic Emery) for his "*fundamental contribution to the theory of interacting electrons in one dimension*."