News: Nobel Prize in Physics 2012

honours

Serge Heroche and David J Wineland

Abstract

Nobel Prize for 2012 celebrates the "ground-breaking experimental methods that enable measurement and manipulation of individual quantum systems" and goes to **Serge Haroche**, Collège de France, Paris, France, École Normale Supérieure, Paris, France and **David J. Wineland**, National Institute of Standards and Technology, Boulder, CO, USA, University of Colorado, Boulder, CO, USA.

This year's Nobel Prize in Physics celebrates the triumph of experimental methods in isolating and manipulating individual quantum systems. A quantum system is described by a wavefunction and the measurement outcome is always statistical. Measurement process often alters the state, so much so that the state is destroyed by trying to measure it.

Serge Haroche and David Wineland succeeded in making direct observation of individual quantum systems, such as a single atom and a single photon trapped in a suitable cavity long enough to observe *directly* the quantum attributes without destroying the state.

Both Laureates worked in the field of Quantum Optics with complementary techniques: David Wineland trapped electrically charged ions in a cavity made with with electric field configurations and studied their interaction with light (photon) and Serge Haroche did the opposite. He trapped photons with a set of mirrors and let them interact by sending (Rydburg) atoms through the trap.

In Heroche's lab the microwave photons are trapped in a cavity made up of superconducting mirrors so that a single photon bounces about for as long as a second. This is long enough to prepare the photon in an entangled state (a superposed state of photon) of its polarisation. This state is viewed with the help of Rydburg atoms (specially prepared atomic states that are nearly 1000 times the size of usual atoms) sent individually into the cavity. The phase of the exiting Rydburg atoms signals the presence of entangled photon in the cavity without being destroyed by the measurement.

In Wineland's experiment the atomic state of the trapped ion could be manipulated to be in a superposed state, say of two different energy eigenstates, achieved by gently nudging by a photon of intermediate frequency - a clear demonstration of Quantum Mechanics in action.

While on the one hand these experiments confirm the corner stone of Quantum Mechanics, they also pave way to their application in many scenes, such as making ultra precise clocks, getting to the next step in achieving a Quantum Computer etc.

R Ramachandran
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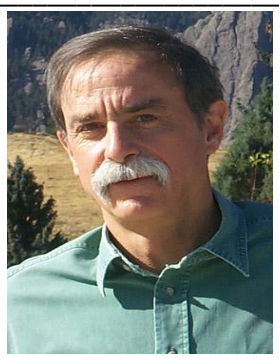
Serge Heroche



David J Wineland