Exploring the quantum with trapped photons

Michel Brune

Laboratoire Kastler Brossel, Departement de Physique de l'E.N.S., Paris

We present experiments where photons are trapped in a nearly ideal “photon box” as introduced by Einstein and Bohr in one of the gedanken experiments they introduced for discussing the unbelievable strangeness of quantum theory. Our photon box consists in a high Q cavity trapping microwave photons between superconducting mirrors.

In the experiments, we probe and manipulate the trapped microwave field with single Rydberg atoms, which act as extremely sensitive and even non-destructive probes of the cavity field. We will show how this system is used for exploring the most fundamental aspects of quantum theory of measurement such as state collapse or the occurrence of quantum jumps in a quantum dynamic. The problem of the transition between the quantumess of small isolated quantum systems as opposed to the classical behaviour of the measurement apparatus will also be addressed by preparing a“Schrödinger kitten” state of the field an by observing its decoherence.