Living out Einstein's dreams - French researchers make quantum breakthrough

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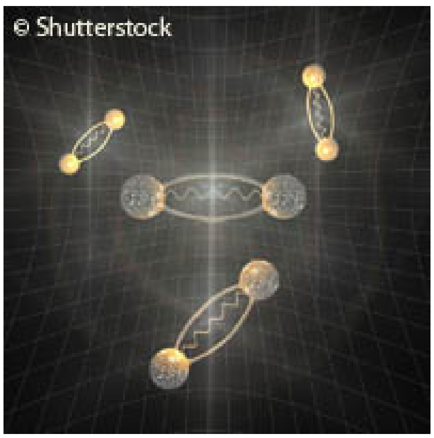

A team of EU-funded researchers has, for the first time, successfully carried out a constant stabilisation experiment of a quantum state - something Albert Einstein himself once dreamt of.

Einstein famously stated he wanted to trap a photon in a box for around a second, and now a team of French scientists has managed to go one step further by maintaining a constant number of photons in a high-quality microwave cavity in a permanent manner, as they outline in a new study published in the journal *Nature*.

The study was led by scientists from the Laboratoire Kastler Brossel in Paris.

Building on a breakthrough they made four years ago, where they observed a single and same microwave photon trapped in a box hundreds of times over, in this new study the team stabilised a given number of photons in a 'photon box', a cavity formed of two superconducting mirrors. It is the first time a complete experiment of quantum stabilisation has occurred.

Usually the photon, the basic unit of light, can only be observed when it disappears. The eye absorbs photons, destroying them and translating the information they carry as it is recorded.

Stabilisations play a major role in our everyday lives as they ensure the operation of many systems that surround us, such as in an oven where its heating temperature is dependent on a set value. As long as the ideal temperature has not been reached, the oven continues to heat up then maintains its state according to the thermostat readings.

The main aim of the DECLIC project is to understand the transition from quantum to classical devices. Quantum information thrives to build large quantum systems for tasks in communication or computing beyond the reach of classical devices; but questions remain surrounding whether another mechanism responsible for the disappearance of state super-positions at the macroscopic scale could exist, in addition to environment-induced decoherence.

The DECLIC project, which runs until 2015, was set up to explore the dynamics of fields trapped in cavities and to study their decoherence under various perspectives. It will implement novel ways to generate non-classical states with large photon numbers stored in one cavity or non-locally split between two.

The AQUTE project's main aims are to develop quantum technologies based on atomic, molecular and optical (AMO) systems for scalable quantum computation and entanglement-enabled technologies like metrology and sensing.

More information: Sayrin, C., et al. (2011) 'Real-time quantum feedback prepares and stabilizes photon number states', *Nature*, 477, 73-77. doi:10.1038/nature10376

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