UQ Physics boosts the signal

May 10 2010

(PhysOrg.com) -- University of Queensland physicists have demonstrated a novel solution to the problem of information degradation when amplifying signals at the quantum information level.

Researchers from UQ School of Mathematics and Physics and Griffith University have published their results in Nature Photonics.

Traditionally amplifiers take an input and multiply its size by a set amount, for example, music at a live gig might be doubled in volume through a PA system.

In current applications using optical fibres, light carrying information can be amplified many times without serious degradation.

In contrast, when we get down to the level of fundamental particles such as atoms or photons, the rules of quantum mechanics that govern the behavior of such particles, prohibit ideal amplification.

Professor Tim Ralph's team has found that it is possible to make a device that performs ideal amplification at this level, as long as it does not always work.

No one had previously noticed that quantum systems could be amplified in this way, so this discovery increases our knowledge of how quantum systems work.

“The important thing is that an indicator on the device tells you when it

has worked properly," said Professor Ralph from UQ's ARC Centre for Quantum Computer Technology.

"It turns out that having a device that works reliably sometimes is sufficient to counteract the detrimental effects of losses in applications like quantum cryptography."

Using this device, the team has now demonstrated this noiseless quantum amplifier in a set of experiments in which light beams at the quantum level were amplified without degradation.

The team were also able to show that their noiseless amplifier could increase the mysterious quantum property "entanglement".

"Entanglement is a special sort correlation between parties. When we amplify the light we increase the strength of the correlation," Professor Ralph said.

"For many quantum technologies, like quantum teleportation, the starting point is to share entanglement - our amplifier makes it easier to share.

"We expect that practical techniques for improving security of communications will be one thing to emerge from this work."

Provided by University of Queensland