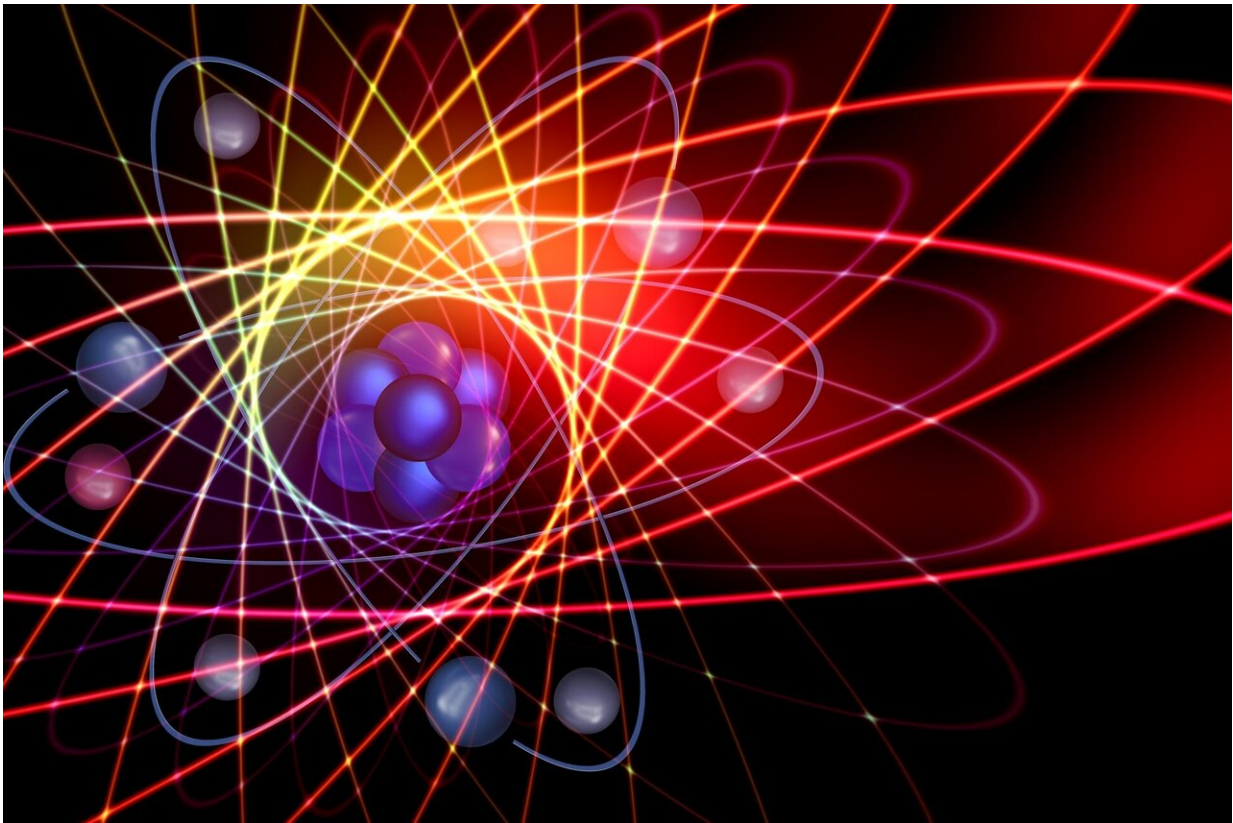


Scientists realize noiseless photon-echo protocol

August 16 2021



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Prof. LI Chuanfeng and Prof. Zhou Zongquan from University of Science and Technology of China (USTC) of the Chinese Academy of Sciences (CAS) innovatively raised and realized noiseless photon echo

(NLPE) protocol. The research of entire originality reduced the noise by 670 times compared with previous strategies and achieved solid quantum memory with high fidelity. The results were published in *Nature Communications*.

First observed by Erwin Hahn in 1950, photon echo is a fundamental physical interaction between light and matter as well as an essential tool for the manipulation of electromagnetic fields. However, the intense spontaneous noise emission generated has the same frequency as the signal, it is impossible to separate them in principle.

Previous protocols, such as atomic frequency comb and the revival of silenced echo, failed to eliminate the spontaneous noise emission as much as needed.

In this study, the researchers implemented NLPE protocol in $\text{Eu}^{3+}:\text{Y}_2\text{SiO}_5$ crystal to serve as an optical quantum memory and applied a four-level atomic system to suppress the noise.

By double rephasing the pulse in the four-level atomic system, they manipulated the spontaneous noise emission to have a different frequency from the signal. So it is much easier to separate the signal from the noise [emission](#). Though other noises were detected in practical experiment, they were all estimated to be trivial.

The results of the experiments showed that the [noise](#) was 0.0015 photons, 670 times less than previous results. Besides, the efficiency of NLPE was more than three times larger than that of previous protocols.

Furthermore, its [high efficiency](#), [high fidelity](#) and easy-to-achieve entitle NLPE with magnificent benefits as a noiseless quantum memory [protocol](#).

All of these advantages bring us one closer step to long-distance quantum communication.

More information: You-Zhi Ma et al, Elimination of noise in optically rephased photon echoes, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-24679-4](https://doi.org/10.1038/s41467-021-24679-4)

Provided by University of Science and Technology of China

Citation: Scientists realize noiseless photon-echo protocol (2021, August 16) retrieved 18 May 2024 from <https://phys.org/news/2021-08-scientists-noiseless-photon-echo-protocol.html>

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