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Researchers realize coherent storage of light over one hour

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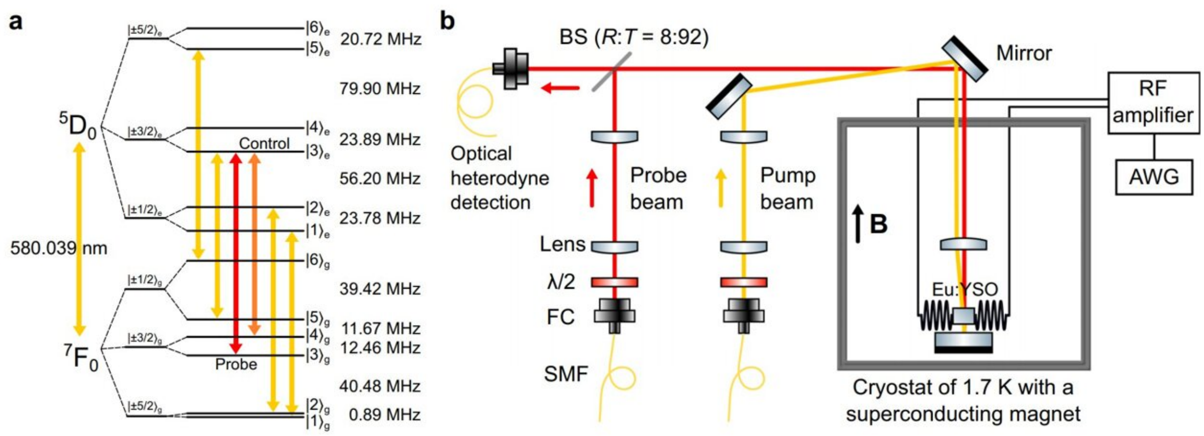

Energy level diagram and experimental setup. Credit: MA Yu et al.

Remote quantum distribution on the ground is limited because of the loss of photons in optical fibers. One solution for remote quantum communication lies in quantum memories: photons are stored in long-lived quantum memory (quantum flash drive) and then quantum information is transmitted by the transportation of the quantum memory. Given the speed of aircraft and high-speed trains, it is critical to increase the storage time of quantum memories to the order of hours.

In a new study published in *Nature Communications*, a research team led by Prof. Li Chuanfeng and Prof. Zhou Zongquan from University of

Science and Technology of China (USTC) extended the storage time of optical memories to over one hour. It broke the record of one minute achieved by German researchers in 2013, and made a great stride towards the application of quantum memories.

In the attempt to achieve optical storage in a zero-first-order-Zeeman (ZEFOZ) magnetic field, the complicated and unknown energy level structures in both the ground and excited states have long challenged researchers. Recently, researchers used spin Hamiltonians to predict level structures. However, an error may occur in the theoretical prediction.

To overcome the problem, researchers from USTC adopted the spin wave atomic frequency comb (AFC) protocol in a ZEFOZ field, namely ZEFOZ-AFC method, successfully implementing long-lived storage of light signals.

Dynamical decoupling (DD) was used to protect spin coherence and extend storage time. The coherent nature of this device is verified by implementing a time-bin-like interference experiment after 1h storage with a fidelity of 96.4%. The result showed the great storage capacity of coherent light and its potential in quantum memories.

This study expands the optical storage time from the order of minutes to the order of hours. It meets the basic requirements of the optical storage lifetime for quantum memories. Through optimizing storage efficiency and signal-to-noise ratios (SNR), researchers are expected to transmit quantum information by classical carriers in a new quantum channel.

More information: Yu Ma et al, One-hour coherent optical storage in an atomic frequency comb memory, *Nature Communications* (2021). DOI: 10.1038/s41467-021-22706-y

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