Nuclear quantum memory for hard X-ray phoNuclear Quantum Memory for Hard X-Ray Photonstons

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Quantum memories are essential elements in complex quantum computing and communication networks for reliably storing and retrieving quantum information. While several protocols of quantum memories have been developed for optical photons, storing X-ray photons has remained an open challenge. Here we report, for the first time, quantum memories of 14.4 keV (wavelength 0.86 Å) hard X-ray photons for 28 ns at the single photon level, with efficiency 8.5% and fidelity 67% (Fig. 1). The demonstrated protocol [1] is based on the formation of a comb-like structure in the nuclear resonant absorption spectrum due to the Doppler effect, by using a set of 3.2 μm-thick moving ^{57}Fe foils. Such tunable, robust, and highly flexible system offers a promising platform for compact solid state, room temperature quantum memory in the hard X-ray range, and paves the way for X-ray quantum information.

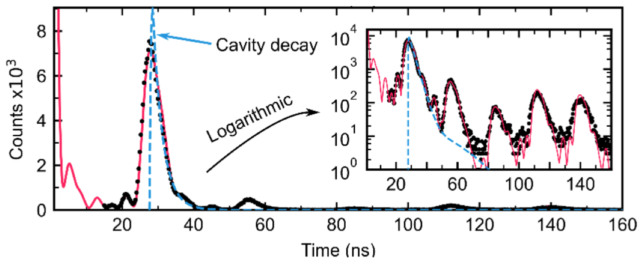

Figure 1: Experimental data (black) and numerical simulation (red) of storing 14.4 keV exponential cavity-decay single photons (blue) for 28 ns by moving 7 ^{57}Fe foils with velocity spacing 3.1 mm/s

References

[1] X Zhang, W-T Liao, A Kalachev, R Shakhmuratov, M Scully and O Kocharovskaya, Phys. Rev. Lett. **123**, 250504 (2019)