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(G*) Storage lifetimes in a field-deployable quantum memory system

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A robust, reliable and field-deployable quantum memory device will be necessary for long-distance quantum communication and the future quantum internet [1]. An attractive implementation to meet these requirements is a warm vapour system operating under the conditions of Electromagnetically Induced Transparency. This technique is capable of storing and receiving quantum optical light states [2]. Our study investigates the temperature dependence of the storage lifetime for the D1 transition in Rb87 vapour. Rubidium is chosen for its favorable operational temperature and resonant wavelengths that are readily attainable from commercial light sources.

We employ a rack-mountable optical memory setup containing isotopically pure Rb87 vapour cells. Using spectroscopic techniques for temperature calibration [3], we explore a range of operating temperatures. Employing optical pulses of ˜500 ns duration, we achieved storage decay lifetimes as long as 175 µs, which is a promising benchmark for this type of system. The measured storage lifetimes provide insight into the decoherence mechanisms that can affect optical memory performance. Lower operating temperatures can exhibit an increased coherence time due to reduced atomic motion but tend to also lead to a subsequent decrease in memory efficiency due to lower atomic depths.

These lifetimes demonstrate the potential for field-deployable systems in long-distance quantum communication schemes. Our results also underscore the importance of temperature control in quantum memory systems and offer practical insights for utilizing quantum architecture in both classical and quantum regimes in new and exciting applications.

[1] Mehdi Namazi et al., Phys. Rev. Appl. 18, 044058 (2022)
[2] Mehdi Namazi et al., Phys. Rev. Appl. 8, 034023 (2017)
[3] Li-Chung Ha et al., Phys. Rev. A 103, 022826 (2021)

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Keyword-2

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