Towards a spin exchange collision-based optical quantum memory in noble gas spins

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In recent years, significant progress has been made in the field of hot vapor quantum memories. A critical constraint on current systems is the maximally achievable storage time. Extending this storage time is necessary for a variety of quantum communication applications, e.g. unforgeable quantum tokens for authentication. We present our first steps towards a long-lived quantum memory based on a mixture of the noble gas ^{129}Xe and the alkali metal vapor ^{133}Cs confined in a temperature-controlled vapor cell. The required optical interface is based on electromagnetically induced transparency (EIT), which is implemented using a lambda scheme in the Zeeman sublevels of the long-lived hyperfine ground states of ^{133}Cs connected to an excited state via the D_1-line at 895 nm [1]. Spin-exchange collisions are envisioned to transfer the stored information from the alkali vapor to the noble gas [2]. The hours-long coherence time of ^{129}Xe [3] may enable the long-term storage of information as a collective atomic excitation.

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[2] O. Katz et al., Phys. Rev. A **105**, 042606 (2022)
[3] C. Gemmel et al., Eur. Phys. J. D **57**, 303–320 (2010)