Sub-second optical storage in an atomic frequency comb memory using dynamical decoupling

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The developement of devices like quantum memories is nowadays very active, as their existence opens prospects as well for the implementation of a quantum network as for the possibility to synchronize quantum resources [1]. However, the information stored in those memories always suffers from limited lifetime due to inevitable interactions with the environment.

Rare-earth ion doped crystals are very good candidates to implement these quantum memories, as the information can be stored in very protected degrees of freedom, limiting the aforementioned loss mechanisms. Even further, it has been recently shown that coherence times of up to 6 hours could be reached in europium doped YSO [2], by using dynamical decoupling sequences under specific magnetic field configurations called 'ZEFOS' points.

Following these observations, we have investigated the effect of dynamical decoupling sequences on an optical storage sequence using the atomic frequency comb protocol [3] under weak magnetic field configurations, and have shown that the storage time can be pushed from 1 ms up to 400 ms. These observations open new prospects in the possibility to use rare-earth ion doped crystals for long-term quantum information manipulation.

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