Image storage by EIT in a doped solid for up to one minute

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Electromagnetically induced transparency (EIT) is a well established technique to write optical data into atomic coherences. EIT enables slowing down [1] or even stopping [2,3] of light pulses. In our experiments, we use a rare-earth-ion doped crystal (Pr^{3+}:Y_2SiO_5) to store 2D images by EIT for ultra-long storage times up to one minute. The long storage times are possible by combination of powerful strategies to control the solid state quantum system. First, we apply appropriate 3D static magnetic fields to reduce decoherence, induced by interactions of the dopant ions with the environment of the host lattice. Second, we apply a self-learning (evolutionary) algorithm to automatically determine optimal pulses for preparation of the complex medium. Third, we use efficient radiofrequency sequences to dynamically decouple atomic coherences from perturbations. The unique combination of these techniques prolongs the EIT storage times by many orders of magnitude. The ultra-long storage times (of images) are of relevance for long-distance quantum networks based on quantum repeaters [4,5] or spatially multiplexed quantum memories [6,7].

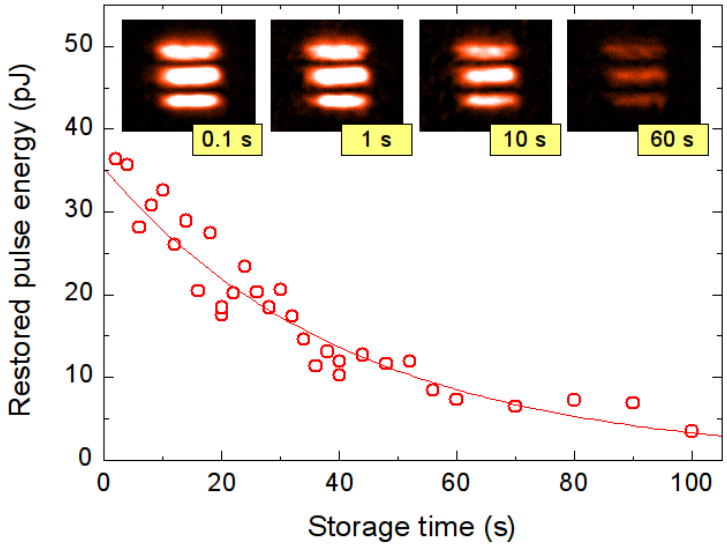

Figure 1: Storage of images by EIT in Pr^{3+}:Y_2SiO_5. The 1/e storage time reaches 42 s.

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