Electromagnetically Induced Transparency from Spin Coherences in Semiconductors

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Electromagnetically induced transparency (EIT) uses quantum interference induced by nonradiative quantum coherence such as a spin coherence to render an otherwise opaque medium transparent. Optical manipulation of spin coherence in the form of EIT in atomic systems has led to remarkable phenomena such as lasing without inversion, slow and stored light, and very recently entangled photon pairs. The realization of EIT in semiconductors, however, has been difficult. Two main obstacles are the complex manybody Coulomb interactions inherent in an excitonic system and the short decoherence time of typical quantum coherences in semiconductors.

In this paper, we report recent progresses on the experimental demonstration of EIT from exciton spin coherence and EIT from electron spin coherence in GaAs quantum wells. The successful demonstration of EIT from the exciton spin coherence illustrates that manybody Coulomb interactions, which are often detrimental to quantum coherences, can also be harnessed for the manipulation of these coherences. The use of the robust electron spin coherence overcomes the short decoherence time typical of other forms of quantum coherences in semiconductors.

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