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Many-particle effects in the propagation of slow light through atomic gases IYAD MAHMOUD, KARL-PETER MARZLIN, BARRY SANDERS, University of Calgary — The optical properties of an atomic gas, including the dramatic reduction of the group velocity of light in electromagnetically induced transparency, usually grow with the density of atoms in the medium. However, in atomic gases of high density the resonant dipole-dipole interaction (DDI) will generate atom-atom correlations that can significantly alter the optical response of the medium. We present a theoretical analysis of the influence of DDI on the optical properties of a gas of three-level atoms in Λ configuration in which electromagnetically induced transparency is possible. Our novel method combines dressed states of quantum optics with the Keldysh diagram technique of non-equilibrium many-body theory and is particularly suited to describe atom-atom correlations in systems exhibiting coherent population trapping. We derive the susceptibility of the atomic gas from the properties of the many-body Green's function and analyze its dependence on the temperature and density of the gas. The diagram technique also allows us to develop an intuitive picture of the physics of the propagation of light through a dense gas.

Iyad Mahmoud
University of Calgary

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