Propagation of Adiabatic Pulses: Adiabatic Passages with Single and Vacuum Photons

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We study the excitation and manipulation of the quantum coherence in a Λ-type molecular media and its influence on chirped pulse propagation. The coherent population trapping (CPT) of the ground states in the Λ-system results in fascinating new dynamics of pulse propagation through it [1]. We have considered the three-level molecules. The dressed state basis approach is employed, which provides deep physical insights showing interaction of "bright" and "dark" states with radiation.

Refractive index of a system is typically considered as the bulk response of a medium to an incoming electromagnetic field. However, the incoming light would experience the same dispersion even with a single atom at the target. We consider propagation of single photon interacting with a single two-level atom to determine the dispersion behavior and also calculate the phase and group velocity of the single photon wave packet to further analyze the dispersion experienced the single photon. Even more, the adiabatic passages with single and vacuum photons turned out to be possible. The results are important for long-distance quantum communications as well as to manipulation of quantum states for molecular detection in engineering, chemical, and biological applications.

References

[1] M Fleischhauer, A Imamoglu and Jonathan P Marangos, Rev. Mod. Phys. **77**, 633 (2005)