Tunneling Control of Optical Properties of a Quantum Well from Adjacent Quantum Well by Coherent Population Trapping Effect

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Now the coherent population trapping (CPT) effect attracts a big researcher's interest. The essence of this effect is the appearing of specific superposition of long-lived states in multilevel quantum system interacting with two-frequency coherent (usually laser) field. This superposition state (dark state) is not interacts with the field. The dark resonances were investigated theoretically [1, 2] as well as experimentally in semiconductor quantum wells in the basis of InGaAs/AlInAs and GaAs [3]. The dark resonances are of particular interest for the development of devices for recording and storing of quantum information and also for quantum logic elements. So the methods of recording and reading of qubits with a high degree of fidelity were realized on the basis of the EIT resonance in the atoms inside an optical lattice.

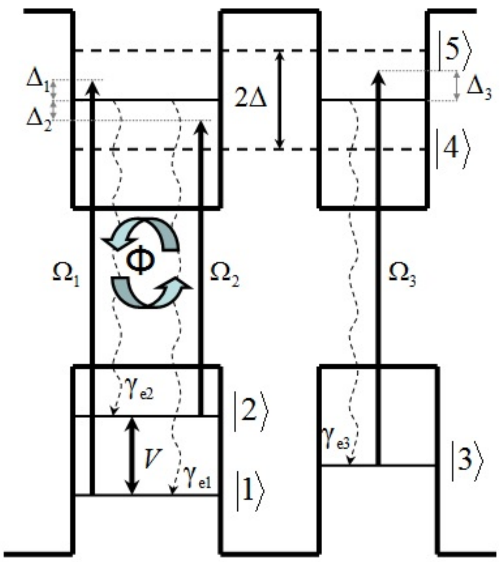

Fig.1 *Structure consisting of double tunneling-coupled quantum wells. Here* Δ_1, Δ_2 *are laser detunings of optical fields,* Ω_1, Ω_2, Ω_3 *are Rabi frequencies of optical fields and V is Rabi frequency of low-frequency field, 2Δ is tunneling splitting.*

In this work we investigate the CPT effect in the double tunnel-coupled quantum wells interacting with laser radiation $\Omega_{1,2,3}$ (Fig.1). The microwave field V closes the contour of excitation (Δ-system). We found that it is possible to create the specific collapse of population (dark resonance), which takes place for the excited level of simple Λ-system, for the ground level $|3\rangle$ of additional excitation canal. Moreover, destruction and restoration of CPT by variation of the total phase Φ (Fig.1) of exciting fields in the Δ-system gives us the possibility to control population of the ground level $|3\rangle$.

We investigate the cases of constant and pulsed optical radiation. In the case of pulsed radiation we found that only edges of signal pulse are absorbed. Middle of the pulse does not interact with the quantum wells due to dark state of the level $|3\rangle$. It can be useful for reducing of the pulse duration and generation of the higher harmonics.

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