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Instability of Charge Qubit Outfitted in a Double Quantum Dot

I. Filikhin[1], **A. Karoui**[1], **V. Mitic**[2], **T. Zatezalo**[1], **and B. Vlahovic**[1]

[1] CREST/Mathematics and Physics Department, North Carolina Central University, Durham, NC 27707 USA

[2] University of Nis, Faculty of Electronic Engineering, Nis, Serbia, and University of Belgrade, Institute of Technical Sciences, Serbian Academy of Sciences and Arts, Belgrade, Serbia

e-mail: ifilikhin@nccu.edu

Abstract. We study electron tunneling in binary quantum systems as double quantum dot (DQD) and double quantum well (DQW), considered as two-level systems. The Schrödinger equation for this system is reduced using single band ***kp***-effective Hamiltonian, and is solved numerically. We calculate full electron spectrum E_n, $n = 1, 2 \ldots$ in the bi-confinement potential. The tunneling in DQD is studied in relation to two factors, a coupling coefficient W_n and an asymmetry factor Δ_n of the potential. The ratio W_n/Δ_n defines the electron localization in DQD. The cases of ideal and almost ideal DQD are examined and compared. We are modeling the effects of environmental influence and fluctuations of electrical pulse on the coherence of DQD based charge qubit. In particular, we show that the coupling in the ideal DQD ($\Delta_n = 0$) is unstable for any small fluctuations of Δ_n.

Keywords: Electron tunneling, Electron localization, Quantum wells, Semiconductors, Electric field, Charge qubit

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