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Nonlinear dynamics of atomic and molecular systems in an electromagnetic field: Deterministic chaos and strange attractors

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Abstract: We present an effective mathematical approach to studying a deterministic chaos and strange attractors in dynamics of nonlinear processes in the quantum (Rydberg atomic and molecular) systems interacting with a resonant electromagnetic field. We have elaborated an effective computational approach that includes new quantum-dynamic model for atomic and diatomic molecule in an electromagnetic field (based on the finite-difference solution of the Schrödinger equation, optimized operator perturbation theory and realistic model potential method) [1] and advanced chaos-geometric approach (e.g.[2,3]). The dynamical and topological invariants such as the correlation and embedding dimensions, the Kaplan-Yorke dimension, Lyapunov's exponents and Kolmogorov entropy etc for different parameters of a field are computed. It is shown that a low-dimensional chaos is realized in dynamics of diatomic molecules interacting with a resonant linearly polarized field. 1. Glushkov A.V., Advanced Relativistic Energy Approach to Radiative Decay Processes in Multielectron Atoms and Multicharged Ions. In: Nishikawa K., Maruani J., Brändas E., Delgado-Barrio G., Piecuch P. (eds) Quantum Systems in Chemistry and Physics. vol 26. Springer, Dordrecht. 2012. pp 231-252. 2. Glushkov A.V., Methods of a Chaos Theory. Odessa: Astroprint, 2012. 3. Glushkov A.V., Kuzakon V.M., Ternovsky V.B., Buyadzhi V.V., Dynamical Systems Theory Eds. J. Awrejcewicz, M. Kazmierczak, P. Olejnik, J, Mrozowski (Lodz). Vol.T1. P.461-466 (2013).

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