EuroSciCon Joint Event on
Laser Optics & Photonics and Atomic & Plasma Science

July 16-17, 2018
Prague, Czech Republic

Am J Compt Sci Inform Technol 2018, Volume 6
DOI: 10.21767/2349-3917-C1-003

QUANTUM DYNAMICS OF A HYDROGEN-LIKE ATOM IN A TIME-DEPENDENT BOX: NON-ADIABATIC REGIME

S Rakhmanov[1], D Matrasulov[2], V I Matveev[3, 4, 5]
[1]National University of Uzbekistan, Uzbekistan
[2]Turin Polytechnic University in Tashkent, Uzbekistan
[3]Federal Center for Integrated Arctic Research, Ural Branch, Russia
[4]Russian Academy of Sciences, Russia
[5]Northern (Arctic) Federal University, Russia

Atoms and molecules confined to nanoscale domains have physical properties which are completely different than those of free atoms. Such difference is caused by modification of the boundary conditions imposed for quantum mechanical wave equations, as well as by high pressure induced by the domain boundaries. For free atoms, the boundary conditions are imposed in whole space, while for confined atoms one should solve the wave equations with the boundary conditions imposed on a finite domain. Due to such modification, properties of the atoms, molecules and matter depend on the shape and size of a confining domain. Experimentally, atom-in-box system can be realized in co-called atom optic billiards which represents a rapidly scanning and tightly focused laser beam creating time averaged quasi-static potential for atoms. Recent technological developments make possible trapping and manipulating of atoms and molecules in time-dependent potentials. Manipulation of the atomic Hamiltonians with both discrete and continuum spectra is of practical importance in such field as metrology and quantum information processing. In this work we study quantum dynamics of hydrogen-like atom confined in spherical box with time dependent radius by focusing on the response of atomic electron to the effect of moving walls of the box. The time-dependence of the wall's position is considered as non-adiabatic, i.e. we consider the cases of rapidly shrinking, expanding and harmonically breathing boxes. The expectation values of the total and kinetic energy, average force, pressure, coordinate are analyzed as a function of time. It is shown that linearly extending box leads to de-excitation of the atom, while the rapidly contracting box causes the creation of very high pressure on the atom and transition of the atomic electron into the unbound state. In harmonically breathing box diffusive excitation of atomic electron may occur in analogy with that for atom in a microwave field.

saparboy92@gmail.com