Energy Approach to Few-Body Finite Fermi-Systems in a Super Strong Laser Field

Alexander Glushkov[a],

[a] Odessa University - OSENU

We present new quantum approach for studying interaction of the finite Fermi systems (atoms, nuclei) with an super intense external fields (DC electric and laser fields). New quantum approach is the combined relativistic operator perturbation theory (PT) and relativistic energy formalism [1]. The relativistic energy approach is based on the Gell-Mann and Low adiabatic formalism and formalism of the relativistic Green function for the Dirac equation with nonsingular potential and complex energy [1]. The operator perturbation theory formalism includes a new quantization procedures of the Dirac (Schr?dinger) equation states of the finite Fermi-systems in a strong field. The essence of the operator PT is the inclusion of the well-known method of "distorted waves approximation" in the frame of the formally exact PT. The zeroth order Hamiltonian H0 of this PT possesses only stationary bound and scattering states. To overcome formal difficulties, the zeroth order Hamiltonian was defined by the set of the orthogonal eigen functions and eigen energies without specifying the explicit form of the corresponding zeroth order potential. In the case of the optimal zeroth order spectrum, the PT smallness parameter is of the order of G/E, where G and E are the field width and bound energy of the state level. It has been shown that G/E 1/n even in the vicinity of the "new continuum" boundary (n is the principal quantum number). Some results of the calculation for the DC, AC strong field Stark resonances, multi-photon resonances, broadening autoionization resonances, ionization profiles for several few-body atomic (H, He, Na, Mg) and nuclear (N,O) systems are presented and compared with some other known theories [2]. The AC Stark effect for nuclei is described within the operator PT and the relativistic mean-field (plus Dirac-Woods-Saxon) model for the ground-state calculation of the nuclei 16O, 171Yb and compared with other available data [2].

[1] A.V.Glushkov etal, Phys. Scr.T160, 95 (2008); , Int.J.Quant.Chem. 109, 1717 (2009); Progress in Theor. Chem. and Physics (Springer) 18, 504 (2008); 22, 51 (2009); 26, 231 (2013); J.of Phys.: CS 397, 012011 (2012).

[2] J.Rao, B.Li, Phys.Rev.A 51,4526 (1995); T.Burvenichm J.Evers, C.H.Keitel, Phys.Rev.C. 74, 044601 (2007).

E-mail: dirac13@mail.ru