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Energy Approach to Atoms, Ions and Nuclei in a Super Strong Laser Field ALEXANDER GLUSHKOV, Odessa University and Troitsk ISAN, Russian Acad. Sci. — A consistent relativistic energy approach is applied to studying the interaction of the atoms and ions of plasma with an super intense electromagnetic (laser) field. Method bases on description of atom in a field by the k-photon emission and absorption lines. The lines are described by the QED moments of different orders, which can be calculated with the use of the Gell-Mann and Low S-matrix adiabatic formalism. In relativistic version the Gell-Mann and Low formulae expresses an imaginary part of the energy shift ImE through the QED scattering matrix, including interaction of atom with electromagnetic field and field of the photon vacuum. We present QED S-matrix energy formalism for calculation of the spectral lines shape in dense plasma. For any atomic level we calculate Im E as function of the laser pulse central frequency and further the moments of lines. Numerical modelling carried out for H, Cs, Ar, Yb, Tm atoms and H-, Li- and Ne-like ions. Especial interest attracts new relativistic treating of the drastic broadening effect of widths for the autoionization resonances in lanthanides. The direct interaction of super intense laser fields in the optical frequency domain with nuclei is studied and the AC Stark effect for nuclei is described within the operator perturbation theory and the relativistic mean-field model for the ground-state calculation of the nuclei 49Sc, 171Yb and compared with other available data.

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