Numerical simulation of electron-ion collisions in UHI plasmas

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The electron –ion collision operator in plasmas with strong laser fields is analyzed. It is shown that the conception of "strong fields" in the collision problem in plasmas is defined by a single parameter, the ratio of the oscillatory electron radius to the distance from the ion at which Coulomb field of the ion is equal to the laser field amplitude. It is found that the phase space structure is strongly modified when the value of this parameter is large: stochastical attractor appears, previous analytical approaches became unjustified.

In the frame of numerical and analytical estimations the boundary of attraction region is found, energy exchange processes are investigated, effective frequencies and cross sections are defined. It is shown that the efficiencies of all main energy exchange channels defined by collisions (Joule heating, harmonics generation, bremstrahlung radiation, fast electron generation) increase strongly with the increasing of the laser field intensity independently from the field polarization.

The general expression of pair collision operator in strong fields is proposed and analyzed. The collision operator, with along the usual diffusion part, includes an effective "friction force", determined by coherent effects at collisions. The dynamical aspects of coherent effects and problems of invariant measure determination are discussed.