Collisional recombination in strongly coupled plasmas

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The goal of this works is to study the rate of collisional recombination in non-equilibrium nondegenerate nonideal plasmas. The results are obtained by molecular dynamics (MD) simulations including the simulation technique to distinguish electron-ion pairs corresponding to the quasiclassical bound states.

Rate of recombination in ideal plasma can describe ratio $K_e = C(Z)e^{10}m^{-1/2} n_e^2 n_i T^{-9/2}$ where $C(Z) \sim Z^3$ and coefficient C is independent from temperature and pressure of plasma. In strongly coupled plasmas this radio is not describe rate of recombination on plasma. But it can describe it if coefficient C consider how function of temperature and concentration of plasma.

Dependences of rate of recombination on various plasma parameters such as nonideality, ion charge and distribution of particle in plasma are obtained.
It is found that coefficient C decrease monotonous with growth of nonideality of plasma. Moreover coefficient C decrease fast than power of -9/2 in strong
nonideality plasma. As a result of this depend of rate collision recombination on nonideality is not monotonous. In small parameter of nonideality it increases according to the law of three body recombination on ideality plasma. But it has maximum on larger nonideality and rate of recombination decreases on strongly coupled plasmas. For plasma with charge of ion equal unity it locates on $\Gamma = 0.9$.

Rate of recombination depends from charge of ions much strong. For small nonideality this depends according to the law Z^3 as well as ideality plasma. But ratio of recombination rate in plasma with ion charge equal one end plasma with ion charge more then one fast decreases with growth of parameter of nonideality in strongly coupled plasmas. In result of this maximum of rate of recombination displaces to area of lesser nonideality and rate of recombination on plasma with ion's charge more then one is lesser then on plasma with charge of ion equal unity in strongly coupled plasmas.

Rate of recombination on strongly coupled plasmas depends on distribution of particle on plasma. In particular it is lesser on several times in plasma with ions fixed on centers of crystalline lattice. This effect is observed on parameter of nonideality less then ~1.4 for plasma with charge of ion equal unity and ~0.7 for plasma with charge of ion equal two. For plasma with more charge of ion this value of parameter of nonideality must displaces on area of lesser nonideality.

In order to investigate influence of the form of the electron-ion interaction potential we choose the Coulomb potential with a cut-off at short distances. Various properties of the bound states are obtained depending on the depth of this potential $U_{min} = -(5-15)kT$. In this parameter rate of recombination is independent from depth of potential.