Coulomb explosions in plasma

Seksembayev Zh.B., Bayakhmetov O.S., and Sakhiyev S.K.

Gumilyov Eurasian National University, Astana, Kazakhstan, [enu@enu.kz](mailto:enu@enu.kz)

Coulomb explosion of target occurs due to interaction of the ultra powerful laser impulse with the material of target. In such interaction relatively light electrons due to super strong electromagnetic fields, caused by ultra short laser pulses, almost immediately removed from the laser target and form relativistic beam, directed mainly along the laser impulse direction vector. Due to the huge energy transfer of laser and because of the electronic component removal the fully ionized plasma state is created. Therefore non-compensated Coulomb charge in plasma is obtained. These conditions allow accelerating target ions up to MeV energies in the explosion, which create a beam of high-energy particle beam moving in the same direction. Some of such occasions to appear and use of the effect is described in [1, 2]. Obtained energies in the Coulomb explosion reach high values. It was obtained, that energy values in the explosion, and explosion times depends on the target parameters, such as particles charge, density, size. Experimental works, shown in [2], prove the dependence.

Calculations using mechanical approach were made for different configurations: particle-particle, series of particles, particles in cylindrical and spherical volumes. In particle-particle configuration, the energy obtained in Coulomb repulsion of same sign charged ions can be calculated taking the action of the Coulomb force every moment during flight away time. Also one can use the energy difference of the two states. Obtained results have only slight difference in coefficients. We have tried to do calculations for other configurations using the same way and applying some approximations. Numerical calculations were made for twice change of the system sizes.

References

1. Voronchev V.T., Kukulin V.I., Yadernaya fizika, 2010, Vol.73, №1, pp.41-61.
2. Zweiback J., *et al.*, Physical Review Letters, 2000, Vol. 84, №12, pp.2634-2637