KINETICS OF ULTRARELATIVISTIC PLASMA

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The power of femtosecond laser pulses has exceeded the 10 petawatt level and continues to grow [1]. Intensities of more than 10^{23} W/cm^2 ($a_0 \sim 300$) at the laser focus have already been achieved. Several upcoming projects [2, 3] make it possible to achieve laser intensities exceeding 10^{24} W/cm^2, or $a_0 \sim 10^3$ soon. This will be a qualitative step forward in strong field physics, since the parameter ma_0/M, where M is the proton mass, becomes of the order of unity. Such powerful laser pulses can directly accelerate heavy particles to relativistic energies [4]. Moreover, the effect of relativistic transparency theoretically allows the propagation of a laser pulse even through a solid dense plasma. The latter, along with the generation of energetic particles, is of particular interest. Specific to the interaction of powerful laser pulses and ultra-dense plasma are relativistic effects in plasma. Among these effects, in addition to relativistic transparency, there are the radiation friction; super acceleration of electrons and ions, with the possibility of producing exotic particles such as muons; formation of super-strong electric and magnetic fields, providing a real test of such effects as, for example, the Unruh effect [5]. It is very important to evaluate the prospects of this direction for the formation of the vector of subsequent research. In the presentation, the kinetics and dynamics of such ultra-relativistic plasma will be investigated based on results of particle-in-cell simulations. All of these listed processes are considered.

References

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