John Adams Institute for Accelerator Science

John Adams Institute for Accelerator Science Lecture Series

Thursday 14th April 2016 at 4:15 pm
Fisher Room, Denys Wilkinson Building

Interaction of plasmas with intense laser pulses carrying orbital angular momentum

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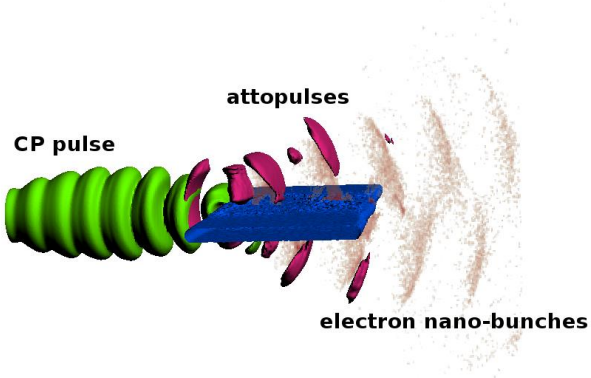
In the analytical or numerical investigation of Laser-Plasma interactions usually two degrees of freedom are included to describe the particle motion. One is in the longitudinal direction, along the laser propagation axis, where the electrons or ions are accelerated by the ponderomotive force or charge separation fields. The other is in the transversal, or radial, direction which allows us study the effects of non-uniform laser intensity profile in the focal spot (in ion acceleration) or the response of plasma channel (in electron acceleration). In our work the complexity of such phenomena is increased by adding a third degree of freedom: azimuthal direction. In this case the electromagnetic fields and particles has to be described by one more physical quantity, namely, orbital angular momentum. The interaction is studied with the help of three-dimensional particle-in-cell plasma simulation code (VSim). In the first part of this talk I will briefly discuss the generation of short wavelength radiation by using circularly polarized high intensity laser pulses. In the second part a new regime laser wake-field acceleration of electrons will be presented, where a screw-shaped laser pulse with azimuthally non-uniform intensity distribution is considered. Beside the standard wake-field and bubble generation, such laser beam induces the rotational motion of electrons, which generate strong axial magnetic field. The combined magnetic and electric fields form a compact source of both high frequency radiation, due to coherent synchrotron emission, and low emittance, high density relativistic electron bunches.



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