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Studies on the transport of relativistic electron beams in dense plasma

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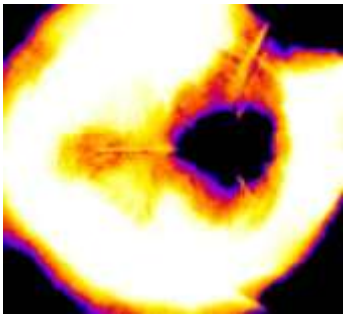
Dr. Sheng is a Changjiang Professor of Shanghai Jiao Tong University. He received the degree of doctor of science from Shanghai Institute of Optics and Fine Mechanics, CAS, in October 1993. Then he worked in the Max-Planck-Institute for Quantum Optics and the Institute of Laser Engineering, Osaka University as a research fellow. Since 2001 he has worked in the Institute of Physics, CAS, as a senior research fellow and he has become the distinguished professor of Shanghai Jiao Tong University since 2007. He has coauthored over 150 papers in refereed journals. He has been awarded the Fund for Distinguished Young Researchers from NSFC, the National Award for Natural Science (the Second Class), the Prize for Distinguished Achievement in Science and Technology, the Rao Yutai Prize of the Chinese Physical Society.

Abstract



The transport of relativistic electron beams in plasma is a classical problem in plasma physics, which has been studied over half a century. Recently this topic has attracted renewed interest because it is closely relevant with the fast ignition scheme, a new concept of inertial confined fusion, in which a pre-compressed fusion core is heated to enough temperature for ignition by a large flux of hot electrons produced by relativistic intense laser pulses. It is also relevant with the ion acceleration driven by intense lasers, where a strong sheath field is built up at the rear side of a solid target by fast electrons produced at the target front by the lasers. In some studies, it is supposed that the beam-plasma instabilities may be relevant with gamma-ray bursts in astronomical observations. In this talk, I shall present our recent theoretical and numerical studies on the transport of relativistic electron beams through cold dense plasma. In this case, it is shown that inter-particle collisions play significant role for the linear and nonlinear development of the beam-plasma instabilities. The dispersion relation for kinetic beam-plasma instabilities is solved in full k-space. It is shown that the electrostatic components of the general oblique mode are suppressed while the electromagnetic components are enhanced by collisions. As a special case of the electromagnetic instabilities, the current-filamentation instability has the largest growth rate, which becomes dominant in the nonlinear stage as shown in our two-dimensional particle-in-cell simulations. It is also shown that, even though a beam appears divergent during the transport in dense plasma in the collisionless case, it becomes collimated in the collisional case due to stabilization of the electrostatic instabilities and magnetic collimation. Comparison with some recent laser-plasma experimental results will also be made.

All are welcome! Tea, coffee, biscuits will be served at 1:15 P.M.