European Program Overview

Basic Physics for Inertial Fusion Energy in High Energy Density Physics with Intense Heavy Ion and Laser Beams

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By definition there is no European program on Inertial Fusion and definitely no HIIF program. There are, however, basic science issues which are studied at universities and research centers throughout Europe that contribute to improve the understanding of fundamental inertial fusion issues, like:

- Beam Plasma Interaction Processes
- Interaction of intense Laser fields with matter
- Accelerator physics
- Beam transport and focusing

In this talk, emphasis will be given to the development of the understanding of beam plasma interaction phenomena relevant to inertial fusion physics.
Intense beams of ions and photons interacting with matter transform the interacting zone into transient plasma. The system, then generally consists of a mixture of electrically charged ions, electrons and neutral particles as well. In this situation collective effects, determine the statistical properties of the sample. Atoms and ions immersed in a plasma environment experience perturbations from the plasma. As a result the atomic and ionic states turn out to be mixed, and strongly different from pure, unperturbed atomic states and they are different as well from the situation of a cold matter environment. Consequently not only the spectral characteristics of radiation emission and absorption by the atoms and ions in plasma are substantially different from spectra of the unperturbed species, but also bulk matter properties. These can be expressed in terms of an equation-of-state, relating pressure and temperature to the matter density of the sample, by the electrical, and thermal conductivity, and radiation transport properties. In general these properties turn out to be vastly different from those of matter under ordinary conditions. The physics of such dense, and strongly coupled plasmas is closely related to those states of matter with a high energy density and high pressure above 1 megabar. Examples are the interior of planets, giant planets and stars or even compact astrophysical objects or the converter of an inertial fusion target. The knowledge of the behaviour of matter under extreme conditions, especially at ultrahigh pressures in the megabar region, is of fundamental importance for inertial fusion energy research as well as improved models for the planetary and stellar structure. Future perspective of intense ion and laser beams for inertial fusion physics will be discussed from a European perspective