CFEL SCIENCE

SEMINAR

04th December 2013 - 2:00 p.m.

CFEL-bldg. 99, seminar room I

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A generalized model of atomic processes in plasmas

A generalized model of atomic processes in plasmas, FLYCHK, has been developed over a decade to provide experimentalists fast and simple but reasonable predictions of atomic properties of plasmas. For a given plasma condition, it provides charge state distributions and spectroscopic properties, which have been extensively used for experimental design and data analysis. It has been applied to a wide range of plasma conditions relevant to long or short-pulse laser-produced plasmas, tokamak plasmas, or astrophysical plasmas. The FLYCHK code is currently available through NIST web site (http://nlte.nist.gov/FLY) for more than 600 users.

In recent years, a novel state of matter of highly transient and non-equilibrium plasmas has been created with X-ray free electron lasers (XFEL). As high intensity x-rays interact with matter, the inner-shell electrons are ionized and Auger electrons and photo electrons are generated. The relatively high energy electrons participate in the ionization processes as well as x-ray photons. For high density matter, collisional ionization by these electrons dominates photoionization as electron density increases.

The atomic kinetics model SCFLY, an extended version of FLYCHK code, using super-configurations has been developed and applied to study XFEL generated high density plasmas. The code accepts the time-dependent history of x-ray energy and intensity to compute population distribution and ionization distribution self-consistently with electron temperature and density assuming an instantaneous equilibration. The methods and assumptions in the atomic kinetics model and its applications to various experiments including XFEL experiments will be presented as well as limitations of the model.

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