Atomic processes in dense plasmas

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In recent years, new regimes of matter have been created with large plasma generation devices, such as NIF (National Ignition Facility), high power short pulse lasers, X-ray free electron lasers (XFEL) and Z machines. New states of matter have been created over a wide range of plasma conditions: hotter and denser, highly transient, warm dense, or astronomically high x-ray photoionized plasmas. The new state of matter requires new theories and modelling capabilities. In terms of diagnostics, plasma spectroscopy has been applied to understand the new states of matter.

To address the issues in plasma spectroscopy of the new state of 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.

An overview of new machines used by high energy density physics will be given, and the FLYCHK code descriptions and applications are presented.