Contribution ID: **70** Type: **Oral contribution**

Modified Nuclear Lifetime in Hot Dense Plasmas

Thursday 29 June 2006 09:50 (20 minutes)

In hot dense plasmas, the electronic environment in the immediate vicinity of the nucleus is modified, and thus, the plasma conditions influence key processes driving the lifetime of a nuclear level [1]. A correct lifetime prediction requires every deexcitation process to be evaluated jointly with its corresponding excitation process. For heavy nuclei, the nuclear lifetime of discrete levels is often strongly dependent on internal conversion which involves bound electrons. In plasma, many of these electrons are no longer in a bound state and the internal conversion rate can be significantly reduced. Its coupling with its inverse process, Nuclear Excitation by Electron Capture (NEEC), can lead to greatly increased nuclear lifetimes.
In some cases, an atomic transition can be coupled with a nuclear transition in a process called Nuclear Excitation by Electron Transition (NEET) if their energies are closely matched [2]. This can accelerate the deexcitation of the excited nuclear level, and reduce its lifetime.
We developped a model able to deal with these processes in plasma under thermodynamic equilibrium. It evaluates internal conversion, NEEC and NEET rates in plasma. Depending on the particular situation, we use either an average atom description or a Multi Configuration Dirac Fock (MCDF) approach to describe the electronic environment of the atom. Large variations of several excited nuclear level lifetimes have been predicted.
A complete description of the nuclear lifetime must also include some other nuclear levels through which indirect nuclear excitation or deexcitation may occur. This particular situation may provide a fast method to populate or depopulate nuclear isomers [3].

[1] M. R. Harston and J. F. Chemin, Phys. Rev. C59, 2462 (1999)
[2] P. Morel, V. Meot, G. Gosselin, D. Gogny and W. Younes, Phys. Rev. A69, 063414 (2004)
[3] G. Gosselin and P. Morel, Phys. Rev. C70, 064603 (2004)

Author: GOSSELIN, Gilbert (Comissariat a l'energie atomique (CEA))

Co-authors: Dr MOREL, Pascal (Comissariat a l'energie atomique (CEA)); Dr MEOT, Vincent (Comissariat a l'energie atomique (CEA))

Presenter: GOSSELIN, Gilbert (Comissariat a l'energie atomique (CEA))

Session Classification: 11 Nuclear theory in astrophysics

Track Classification: Nuclear theory in astrophysics