Recent Works on Atomic and PMI Data for Controlled Fusion Research in Russia

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An overview of the works carried out in Russia during the past two years on atomic and plasma-material interaction (PMI) data will be presented. Activities and newest results obtained at Ioffe Institute in St. Petersburg, P.N. Lebedev Physical Institute, NRC Kurchatov Institute, TRINITI, Moscow Institute of Physics and Technology, Moscow Engineering Physics Institute, Novosibirsk State University, and G.I. Budker Institute of Nuclear Physics, concerning the generation and the use of atomic and PMI data, will be described. A special emphasis will be made on the works in support of ITER diagnostics to be delivered by the Russian Federation, as well as domestic fusion projects.

The subjects include:

- an overview of experimental data and theoretical methods for charge-changing processes of ion beams passing through gaseous, solid and plasma targets, including electron capture and electron loss processes with heavy many-electron ions, stopping power, isotopic effects;
- measurements of absolute total cross sections of one- and two- electron capture by He2+ ions from argon atoms and the studies of the applicability of various particle interaction potentials;
- calculations of interatomic potentials and reflection coefficients for scattering of particles at various surfaces (H, D – W, D–C, H, D – Be and others);
- simulations of heavy ions quasi-continuum (in the 4-8 nm spectral range), using the statistical model of atoms for elementary processes with many-electron atoms and ions in plasmas, including the new channels of radiative losses for heavy ions and the comparison with observations in magnetically confined fusion plasmas;
- development of a method for simulating the transition probabilities in ions for the problems of interaction of ultra-short electromagnetic pulses with hot dense plasmas and diagnostics of matter, including the inertially confined fusion plasmas, with free-electron lasers;
- development and verification of theoretical models of spectral line shapes (SLS) in plasmas, including the SLS models for high energy density plasmas of inertially confined fusion plasmas and the outline of the newest trends in the SLS community;
- progress in ITER Main Chamber H-alpha (and Visible) Spectroscopy, including the Zeeman spectroscopy of beryllium and the test of interpretation algorithms on JET;
- passive signal simulation for ITER charge-exchange recombination spectroscopy (CXRS) of the core and edge plasmas, including the CX data needs for Be at low collision energies in SOL;
- the use of data for fine structure of atomic levels in radiative-collisional kinetics and radiation losses simulation for edge plasmas in fusion facilities, including the radiation losses during massive gas injection for discharge quenching in ITER;
- progress on laser-induced fluorescence in ITER divertor, including the simulation of photon emission coefficients (PEC) under laser fluorescence;
- overview and highlights of the most recent Russian conferences on PMI;
- the work on Russian atomic spectroscopy information system in Novosibirsk and a number of other subjects.