INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

INTERNSHIP SUBJECT FORM

Name of the Host Laboratory	LULI
Website of the Host Laboratory	https://portail.polytechnique.edu/luli/fr
Research Group	Atomic Physics in Dense Plasmas PAPD
Internship Supervisor	Prof. Dr. Frank Rosmej (LULI), Prof. Dr. V.S. Lisitsa (MIPT, MEPhI)
Internship Subject	Quantum effects in atomic populations in dense plasmas
Student's level	☐ Advanced Undergraduate Students (3rd or 4th year) X Master's students (1st or 2nd year) ☐ PhD students
Proposed Duration	☐ 3 months ☐ 4 months X 5 months X 6 months
Prerequisites	Knowledge in radiation theory, laser produced plasmas, atomic physics, skills in Fortran
Internship description (max. 15 lines)	The atomic populations are the fundamental quantities for various different disciplines in science and applications. For complex systems of atoms, immersed in correlated plasma environment, where collisions, radiation relaxation and charged particle microfields are encountered, current quantum mechanical and quantum optical approaches could provide only exaggeratedly complicated untreatable solutions. Contrary to that the new Quantum-F-Matrix Method (QFMM) developed at LULI-PAPD allows an innovative representation of atomic kinetics, accounting for quantum interference effects of populations in the electric microfields. The objective of the internship is to study the correct thermodynamic limit that cannot be achieved in standard quantum mechanical perturbation theory. The student will develop a simple but exact quantum mechanical test case based on the density matrix approach to benchmark limits of current classical methods and to validate QFMM in dense plasmas. Attention will be paid to autoionizing states and hollow ion X-ray emission that is of great interest for the characterization of unexplored phenomena of matter under extreme conditions. A further objective is to proceed towards analysis of recent experimental data obtained at XFEL and optical laser systems that are challenging currently employed models in atomic kinetics that are almost entirely based on the classical population approach (collisional-radiative models).