INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

INTERNSHIP SUBJECT FORM

Name of the Host Laboratory	Center for Theoretical Physics (CPHT)
Website of the Host Laboratory	http://www.uquantmat.fr/
Research Group	Quantum Matter Theory
Internship Supervisor	Laurent Sanchez-Palencia
Internship Subject	Propagation of quantum information in correlated quantum systems
Student's level	☐ Advanced Undergraduate Students (3rd or 4th year) ☒ Master's students (1st or 2nd year) ☐ PhD students
Proposed Duration	☐ 3 months ☒ 4 months ☐ 5 months ☐ 6 months
Prerequisites	Advanced quantum physics courses
Internship description (max. 15 lines)	Understanding how a strongly-correlated quantum system evolves when driven out of equilibrium is presently a pivotal challenge to quantum physics. It would deeply impact our fundamental understanding of quantum matter and promise fascinating applications to quantum communications. In this context, ultracold atoms are particularly interesting for it is now possible to investigate a variety of far-from-equilibrium properties of these systems thanks to accurate time-dependent control of the physical parameters. Whether the system will evolve towards thermal equilibrium or a more complicated stationary state remains largely an open question. One-dimensional systems are particularly fascinating when they are integrable and are thus unable to reach thermal equilibrium. Fortunately, the peculiarities of one-dimensional (1D) systems make them amenable to a variety of powerful analytical and numerical techniques. The aim of this project will be to theoretically investigate the propagation of information in 1D quantum systems. We will study the behavior of quantum correlations and entanglement in the limit of strong interactions. We will focus on novel situations where known theorems break down, for instance in the presence of long-range interactions. These fundamental issues will be addressed from a theoretical point of view, using the most modern N-body approaches, both analytical and numerical, for instance using Matrix Product States approaches.

The boxes marked with cross implies eligible