



## INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

### INTERNSHIP SUBJECT FORM



Name of the Host Laboratory	Center for Theoretical Physics (CPHT)
Website of the Host Laboratory	<a href="http://www.uquantmat.fr/">http://www.uquantmat.fr/</a>
Research Group	Quantum Matter Theory
Internship Supervisor	Laurent Sanchez-Palencia
Internship Subject	Quantum simulation of quasicrystals with ultracold atoms
Student's level	<input type="checkbox"/> Advanced Undergraduate Students (3 <sup>rd</sup> or 4 <sup>th</sup> year) <input checked="" type="checkbox"/> Master's students (1 <sup>st</sup> or 2 <sup>nd</sup> year) <input type="checkbox"/> PhD students
Proposed Duration	<input type="checkbox"/> 3 months <input checked="" type="checkbox"/> 4 months <input type="checkbox"/> 5 months <input type="checkbox"/> 6 months
Prerequisites	Advanced quantum physics courses
Internship description (max. 15 lines)	<p>Quasicrystals are a fascinating state of matter, characterized by long-range but non-periodic order, hence lying at the frontier of order and disorder. They are characterized by anomalous thermodynamic and transport properties, including localization transitions in low dimensions, critical spectra, and fractal properties. Quasicrystals have been discovered by chance in some solid-state alloys and remain difficult to synthesize in condensed matter. In contrast, they can be emulated in ultracold-atom quantum simulators using atom-light interaction in dedicated laser configurations. Quantum gases loaded in such structures inherit their quasiperiodic order. This was demonstrated recently. These works open a new area and a number of fundamental questions, which we propose to address: What are the physical signatures of the fractal structure of the spectrum? How does it impact the thermodynamic properties of a quantum gas? What quantum phases can be stabilized as a result of the interplay of many-body interactions and quasiperiodicity? How does it impact the out-of-equilibrium dynamics of the system? Is it possible to stabilize a quasicrystal of ultracold atoms without imposing the quasiperiodic order from external laser fields? The aim of the internship, to be followed by a PhD thesis, is to address these questions using a combination of analytical and numerical work. A part of the project may be developed in collaboration with experiments on ultracold-atom systems.</p>

The boxes marked with cross implies eligible