INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Méthodes Formelles (LMF)
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Internship location: Building 650 of Université Paris-Saclay (= building PCRI)
—> https://maps.app.goo.gl/f1pPgYXN3vj1QGdz7

Thesis possibility after internship: YES
Funding: YES
If YES, which type of funding: to be determined

Title: **Feynman's classical-path argument in quantum walks**

Summary:
1. Objective:
The idea is to evaluate whether Feynman's argument (FA) for the classical path, within the path-integral formulation of quantum mechanics, applies to the discrete-spacetime systems that (discrete-time) quantum walks are.
2. Background:
For those who are not familiar with it, let me state the original FA: a quantum system behaves classically when the path integral is dominated by paths for which the action of the system is extremal.
3. Why the question we ask is not obvious:
Because the original FA is, first of all, (i) for continuous-spacetime systems, and second of all, (ii) rather for non-relativistic systems (since we will deal with a path integral of first quantization, not a functional integral of second quantization). Quantum walks break these two conditions (i) and (ii).
4. Methods of the study:
Developing analytical tools to treat this problem is probably something quite involved, and with my colleagues and former students we have concentrated our last efforts on doing a numerical study as a first step in this problem (with certain analytical arguments but which are currently not the main thing). You will have to work on a Python code that counts and analyzes the different paths of the path integral, and tries to see if we have evidence for Feynman's argument.
5. Requirements regarding the student:
The student must know how to code in Python.

Please indicate which specialities seem to be more adapted to the subject:
Condensed Matter Physics: NO Soft Matter and Biological Physics: NO
Quantum Physics: **YES** Theoretical Physics: **YES**