INTERNSHIP PROPOSAL

Title of the internship :

Trajectory-based quantum tunneling using Bohmian mechanics

Level (L3, M1, M2)	L3/M1
For M2, can be followed with PhD? (indicate the title of the PhD)	
Period / length of the internship (indicate the year)	2021, 2-3 months
Supervisor	Thomas CZUBA / Denis LACROIX
Team/Service	PhyNet
Pole	Nucléaire
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Description of the internship

The concept of particle trajectory is defective in the standard formulation of Quantum Mechanics (namely, the Copenhagen interpretation), as one cannot define both position and momentum at the same time with precision. An alternative formulation of quantum mechanics was promoted by De Broglie and David Bohm in the 30s – 50s, where the concept of trajectory was introduced at its core. It appears that these trajectories follow a set of classical like equations of motion where a new non-linear potential is added that accounts for quantum effects during the evolution. This is the so-called 'Bohmian Mechanics' that has been expanded over and used in a variety of problems in the last decades.

The objective of this internship is to study quantum tunneling in the Bohmian Mechanics. More precisely, this approach will be applied to simple potential that are meaningful to describe spontaneous fission and more generally particle decay from nuclei. The workload will be divided between the formal aspects (i.e. analytical derivations) and the numerical aspects (i.e. solving the equations of motions). The goal of the internship will be to understand how basic quantities like particle flow and/or tunneling time arise naturally from the Bohm interpretation of quantum mechanics.

Description of the team/service

The PhyNet team (nuclear and theoretical physics in French) is the nuclear theory team of the new Laboratoire de physique des 2 Infinis: Irène-Joliot Curie (IJClab) located on the Paris- Saclay campus. Our team is working on state-of-the-art theoretical methods in nuclear structure and reactions, nuclear astrophysics and dynamics. Our group specializes in many-body theories (from nuclear density functional to ab initio methods coupled to effective field theory), related numerical and formal techniques, including interdisciplinary connections and emerging technologies, e.g. ultra-cold gases of bosonic or fermionic atoms, machine learning technologies and quantum computing. At the same time, we work in close connection with IJClab experimentalists, particularly on the microscopic interpretation and prediction of nuclear physics data.