Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: LPTMS
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Thesis possibility after internship: YES
Funding already obtained for a PhD: NO

Quantum fluctuations in non-linear analog systems

Several system with a strong quantum behavior host nonlinear effects: solitons, vortices, shock-waves and domain walls have been observed in ultracold atomic vapors, in cavity exciton-polaritons, in superfluid helium, in super-conductors... This double, quantal and nonlinear feature makes these systems excellent models (so called "analogs") for studying quantum effects such as Hawking radiation or dynamical Casimir effect. In such studies, the quantum fluctuations of the ground state (the "vacuum" of the theory) are nontrivial thanks to the non-homogeneity of the vacuum, which is made possible by the nonlinearity of the wave describing the system.

The theoretical description of some analogue systems has recently made important progresses. One has now reached a point where a detailed comparison with recent experiments is possible.
After a period dedicated to getting acquaintance with the necessary theoretical tools, one of the goals of the work will be to study the back-reaction exerted by the analog Hawking radiation on a sonic horizon. The system under consideration will be the boundary between a subsonic and a supersonic region of a flow of an atomic Bose-Einstein condensate. This is a model of "acoustic horizon" which emits a sonic analogue of the gravitational Hawking radiation.

This is a theoretical internship/PhD, during which one will try to keep a close contact with experimental issues. The general theoretical framework is the one of nonlinear waves (for describing the semi-classical background flow) and quantum field theory (for the study of quantum fluctuations).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	YES