Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 22/10/2012

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Adresse / *address:* 4, place Jussieu

Lieu du stage / *internship place*: Campus Jussieu

Titre du stage / *internship title*: **Sound velocity in polariton quantum fluids**

Polaritons are quasi-particules arising from strong coupling between exciton and photons in semiconductor microcavities. They have been extensively studied in the past twenty years and are currently on the focus of the fundamental and applied research at the interface between quantum optics and condensed matter fields.

Especially, due to their bosonic character, polaritons are considered as an ideal system for the study of fundamental properties of a new kind of quantum fluid with specific properties coming from their intrinsic out-of-equilibrium nature.

Recently, it has been shown that polaritons can exhibit superfluidity [1]. After this first observation, other typical superfluid properties such as quantized vortices [2] and dark solitons [3] have been the focus of recent researches, showing similarities with atomic BEC.

The concept of superfluidity and the nature of its quantum properties such as frictionless flow or quantized circulation of currents are strongly linked to the shape of the spectrum of the Bogoliubov excitations. Nevertheless, up to now, only few studies have been devoted to the investigation of the different regimes expected for the Bogoliubov spectra in the case of polariton fluids. In particular, in the linear regime, the theory predicts a square root dependence of the speed of sound with the fluid density, but differently from the atomic case [4] this has never been experimentally verified in polariton quantum fluids.

The speed of sound can be determined exploiting the relation between the angle formed, in the supersonic regime, by the Cerenkov's waves generated by a fluid moving against an obstacle and the Mach number (i.e. the ratio between the speed of sound and the speed of the fluid). The aim of the stage is to verify, through real space imaging, this relation that allows extracting the value of the polariton-polariton interaction constant.

References

[1] A. Amo et al., Superfluidity of polaritons in semiconductor microcavities, Nature Physics, 5, 805 (2009).
[2] K. G. Lagoudakis et al., Quantized vortices in an exciton-polariton condensate, Nature Physics, 4, 706 (2008).
[3] A.Amo et al., Polariton Superfluids reveal Quantum Hydrodynamic Solitons, Science, 332, 1167 (2011).
[4] K. B. Davis et al., Bose-Einstein Condensation in a Gas of Sodium Atoms. Phys. Rev. Lett., 75, 3969 (1995).

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Si oui, financement de thèse envisagé/ *financial support for the PhD***:NO**

Lasers et matière	**X**	Lumière, Matière : Mesures Extrêmes	**X**
Optique de la science à la technologie	**X**	Plasmas : de l'espace au laboratoire	

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