LABORATOIRE DE PHYSIQUE STATISTIQUE
DE L'ECOLE NORMALE SUPERIEURE
(LABORATOIRE ASSOCIE AU CNRS, A L'ENS ET AUX UNIVERSITES PARIS 6 ET 7)
24 RUE LHOMOND 75231 PARIS CEDEX 05, FRANCE

Post-doctoral position
Supersolidity : experiments on helium crystals

The research group of Sebastien Balibar is looking for candidates to fill a postdoctoral position starting in 2010. The candidate will work on supersolidity in solid helium.

Several research groups have shown that the rotational inertia and elasticity of solid helium 4 exhibit anomalies at low temperature. There is some consensus that these anomalies are due to a phase transition to a supersolid state. However, "supersolidity continues to defy agreed theoretical explanation", as Tony Leggett recently said.

It has been shown experimentally that supersolidity in solid ^{4}He is highly sensitive to the presence of disorder. In most experiments the amount of disorder is not known, but our group has a long experience of crystal growth in helium, and thanks to an optical control of the experimental cell down to 20 mK we are capable of controllably growing polycrystals, disordered single crystals, or very high quality oriented single crystals.

Supersolidity has also been found to be very sensitive to the presence of ^{3}He impurities, and in 2009, we discovered how to eliminate all ^{3}He impurities (X. Rojas et al., Proc. of QFS 2009, to appear in J. Low Temp. Phys. 2009). In such ultrapure ^{4}He crystals, we found that the shear modulus increases below 40 mK, an elastic anomaly which cannot be interpreted as previously thought (pinning of dislocations by impurities). Our group is thus ready for crucial tests of supersolidity in ideal crystals which are free of defects *and* free of impurities.

Of particular interest will be to examine whether supersolidity is an intrinsic property of ideal crystals which is only enhanced by disorder or if disorder is necessary for the existence of supersolidity. This will be a test of competing interpretations of the observed anomalies, namely in terms of dislocation networks (Kuklov, Pollet, Boninsegni, Prokof'ev, Svistunov et al.) or in terms of a vortex liquid (PW Anderson).

The group has already acquired the necessary competence in acoustic techniques for the measurement of the shear modulus, a subject on which an established collaboration with H.J. Maris (Brown University, USA) exists. For torsional oscillators experiments, a collaboration has been started with the group of M.H.W. Chan. The project is generously supported by several research grants. Further experiments are planned on dc-mass transport and ion mobility. Our group would be open to other suggestions.

The ideal candidate will have a recent Ph.D and a definite experience in the experimental study of quantum fluids and solids, or at least in low temperature techniques. He or she would be free to join our group sometime between January and October 2010. The work will be in direct collaboration with two graduate students and S. Balibar.

Our laboratory is located in the center of Paris. For more information about our activity, see http://www.lps.ens.fr/~balibar/.

Interested candidates should send a CV with a publication list by e-mail to Sébastien Balibar (balibar@lps.ens.fr).

Sébastien Balibar, Directeur de recherches, ENS Paris (France)