

**Report on a short visit to Dr C. Henkel's group at Postdam University
(K.Mallick)**

I have visited the group of Dr. Carsten Henkel in Postdam University from the 13th to the 17th November 2006.

Our collaboration deals with the problem of the decoherence of a Bose-Einstein condensate in a disordered potential. Our interest in this subject has been triggered by recent experimental results of the group of Alain Aspect in Orsay. Their experiment studies the expansion of a condensate in a random potential after the magnetic trap has been released. The dynamics of the condensate in presence of disorder is radically different from a free expansion. More precisely, two salient features appear (i) in the central part of the condensate where the interaction effects (that cause the non-linear behaviour) are important, the expansion saturates and stops; this region is dominated by large scale disorder. (ii) The wings of the condensate, which are essentially a non-interacting system, are highly populated by fast particles and contain a relatively important fraction of the condensate; scattering from small-scale disorder present in the central region may provide an explanation for the population enhancement of the wings.

We study this system by using the Gross-Pitaevski equation with a noisy potential. With Dr Henkel, we have developed two different approximations valid respectively for the central region and for the wings. The central region can be analyzed by scaling arguments (in the spirit of the Castin-Dum technique). For the wings, we have to analyze the linear Schrödinger equation with disorder, i.e., the Anderson problem. The main issue, which we are working on now, is to match the external part with the inner part. We are planning to perform numerical simulations similar to those in Henkel and Gardiner (Phys. Rev. A, 69, 043602, 2004). Another method would be to use path integral techniques that are well suited to the linear problem and to perform a variational approximation to match the interacting zone.

Finally, we realized that the effect of disorder could be mimicked at least qualitatively by adding a small cosine potential to the magnetic trap. This potential could help us to understand the scattering effects that also occur in the disordered case. Experiments in the group of W. D. Philips have been carried with such a potential and they provide a challenging problem, (even in the absence of disorder) for theorists.

My visit to Dr. Carsten Henkel has been very fruitful. We have been able to circumvent precisely the experimental results relevant to our mathematical study. We have made progress towards the understanding of the relevant physical mechanisms that must be taken account in our approximation schemes. We plan to pursue this work in the forthcoming months. Carsten Henkel will be visiting France and we shall continue to communicate with each other on this subject.