REPORT Short Visit Grant 995:

Large Effects of Small Randomnessin Dilute Atomic Gases

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From February 26 to March 15 2006, I visited the Professor Alain Aspect's group at *Institut d'Optique Théorique et appliquée* (IOTA) in Paris-Orly. At IOTA, classical simulations of the 2d XX-model with quenched disorder had been performed by Dr. Laurent Sanchez-Palencia. These simulations are essentially the classical counterpart of the quantum mechanical calculations done in Barcelona. The goal of my visit therefore was to put together the knowledge each of our two groups had gained in these simulations, to find intuitive interpretations and to start thinking of future experiments showing these effects.

At first, I gave a seminar on the work done in Barcelona which served as a starting point for intense discussions with local experimentalists on how to understand the physics of our theoretical models. We theoretically studied the mapping of a Bose-Bose mixture onto a spin system whose experimentally controllable parameters allow for a (exact) realization of a quantum XX-model with quenched disorder. On top of that, we were able to both gain a more thorough understanding of the simulations that were done by the other. Last but not least, Dr. Sanchez-Palencia and I intensely discussed intuition and generalization of the mathematical transformations and approximations of the above mapping that we made in the article written by Prof. Jan Wehr (Arizona), Prof. Maciej Lewenstein (Barcelona) and us and then submitted to PRL. In particular, we discussed the mapping process from Bose-Bose to spin system and found that the physical spins are nothing but a (quantum) superposition of the different Bose species with particular relative phases.

At present, our article is still being reviewed by Physical Review Letters. Our collaboration is continuing on possibilities of generating order using quenched disorder and, in particular, on estimating possibilities of experimental observation of this effect.

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