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I spent 4 weeks from 3 to 30 September 2006, in Institut de Ciencies Fotoniques in Castelldefels (Barcelona) as it was planned in the project. My host was Professor Maciej Lewenstein.

The title of my research proposal was 'Quantum phase transitions'. Following the discussion with Prof. Lewenstein and my supervisor Dr. Jacek Dziarmaga I got the task to examine the occurrence of random-field-induced order mechanism in quantum spin chains. Such mechanism and its realization using ultracold atoms trapped in optical lattices has been recently proposed by J. Wehr and M. Lewenstein in cond-mat/0604063. Specifically, I tried to examine how the symmetry breaking caused by random magnetic field in one direction changes magnetic properties of isotropic XY and Heisenberg spin 1/2 chains.

I started from browsing the literature concerning quantum spin chains. Then I made some exact numerical calculations for small systems using direct diagonalization method. I examined the XY model in zero temperature and the Heisenberg model in small nonzero temperature, both in ferromagnetic and antiferromagnetic cases. We added random magnetic field in x direction. The important result is that such random field with small amplitude increases the susceptibility in y direction for XY model in zero temperature, and antiferromagnetic Heisenberg model in small temperature. The susceptibility decreases in the ferromagnetic case. The susceptibility generally depends on the amplitude of magnetic field and changes by a factor of two.

I have also prepared the implementation of the Vidal's algorithm within DMRG in order to investigate infinite systems with periodic disorder.

The preliminary results which were obtained up to now are very promising. We plan, together with Dr Dziarmaga and Prof. Lewenstein, to carry on the collaboration in this field. The results will be published soon.

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