TRANSPORT OF TRAPPED ATOMS AND CONDENSATES

V.O. Nesterenko[1], **A.N. Novikov**[1], **A.Yu. Cherny**[1], **and E. Suraud**[2]

[1]*Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Moscow region, 141980, Russia*
[2]*Laboratoire de Physique Quantique, Universitй Paul Sabatier, 31062 cedex, Toulouse, France*

An irreversible transport of individual atoms and Bose-Einstein condensates (BEC) in multi-well traps is analyzed within the mean field approximation. The transport is driven by time-dependent monitoring the coupling between the wells (barrier penetrabilities) and their relative depth detuning. The particular transfer protocols (Stimulated Rapid Adiabatic Passage, Landau-Zener, mixed Landa-Rozen-Zener) are scrutinized with the accent to most promising adiabatic scenarios [1-3]. It is shown that, while the transfer of individual atoms can be performed quite easily, the transport of BEC meets serious troubles due to the nonlinear effects caused by the interaction between BEC atoms.

In this connection, we propose some effective protocols which overcome this trouble and allow a robust and complete BEC transport in a wide range of both repulsive and attractive interaction [2,3]. Moreover, the non-linearity is turned from detrimental to a favorable transport factor. This opens interesting prospects for manipulating BEC location and creating new dynamical regimes. Besides, since BEC is a coherent system, its transport can be used for generation and investigation of various geometric phases which are now considered as promising information carriers in quantum computing.

References

[1] V.O. Nesterenko, A.N. Novikov, F.F. de Souza Cruz, and E.L. Lapolli, Laser Phys. **19**, n.4, 616 (2009).
[2] V.O. Nesterenko, A.N. Novikov, A.Yu. Cherny, F.F. de Souza Cruz, and E. Suraud, J. Phys. B. **42**, 235303 (2009).
[3] V.O. Nesterenko, A.N. Novikov, and E. Suraud, to be published in Laser Phys., **20**, n.15, (2010); arXiv:0912.0828[cond-mat.quantum gases].