

Master in Photonics – "PHOTONICS BCN" ERASMUS+ "EUROPHOTONICS"

MASTER THESIS PROPOSAL

Dates: April - September 2020

Laboratory: Dpt. Quantum Physics and Astrophysics Institution: U. Barcelona City, Country: Barcelona, Spain

Title of the master thesis: Dynamics and quantum correlations in one-dimensional Bose Systems

Name of the master thesis supervisor: Artur Polls / Bruno Julia Diaz Email address: <u>bruno@fqa.ub.edu</u> Phone number: 934037179 Mail address: Marti i Franques 1, 08028 Barcelona

Keywords: 1D quantum many-body, exact diagonalisation, montecarlo methods

Summary of the subject (maximum 1 page):

The great current experimental control on the interactions, the geometry and the number of atoms in cold atomic gases experiments has motivated many theoretical investigations. In particular, ultracold atomic gases are nowadays considered a test-laboratory to simulate quantum many-body systems [1]. In particular there is a lot of interest in one-dimensional mixtures where quantum effects are enhanced [2], for a review see for instance [3].

In this project, we propose to study the structure of uniform and trapped Bose mixtures using different many-body techniques, i.e. variational Montecarlo methods, exact diagonalization, paying special attention to the dynamics of the system and the evolution of their properties when the number of particles changes from few to many.

 M. Lewenstein, A. Sanpera, V. Ahufinger, Ultracold Atoms in Optical Lattices: Simulating quantum many-body system, Oxford (2012)
M. A. García-March, B. Juliá-Díaz, G. E. Astrakharchik, J. Boronat, A. Polls, Phys. Rev. A 90, 063605 (2014).
T. Sowiński, M. A. García-March, Rep. Prog. Phys. 82, 104401 (2019).











Additional information:

* Required skills: Programming skills (python or fortran), Knowledge of quantum many-body (preferable)

* Miscellaneous: