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PHOTONICS - EUROPHOTONICS MASTER COURSE

MASTER THESIS PROPOSAL

Course 2014 –2015

Laboratory : Optics Group. Universitat Autònoma de Barcelona

City, Country : Bellaterra, Spain

Title of the master thesis: Bright matter-wave solitons in curved geometries

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Summary of the subject (maximum 1 page):

Bright matter-wave solitons (MWS), corresponding to non-spreading wavepackets with constant phase, can be generated in quasi one dimensional attractive Bose Einstein condensates (BECs) as a tuned equilibrium between dispersive effects and nonlinear interactions [1]. Bright MWS have potential applications in energy and information transport in nonlinear systems and provide an exceptional testbed for studying quantum mechanics above the single-atom level. Nevertheless, in 2D and 3D, the Gross Pitaevskii equation (GPE) describing the zero temperature dynamics of BECs does not admit stable solitons. In this work we will investigate the stability of these solitons when we load them in a curved geometry, like a ring. We will start by engineering the ring potential in such a way that the dynamics is effectively 1D and we will investigate the stability of the soliton by means of variational methods. Then, we will consider 2D and 3D ring potentials and we will investigate different methods to stabilize MWS. Also, the transfer of momentum required to set them into motion and the subsequent propagation along the ring will be investigated. The study will be performed numerically by integrating the Gross-Pitaevskii equation describing the system.

[1] L. Khaykovich et al., Science **296**, 1290 (2002); K. E. Strecker et al., Nature **417**, 150 (2002); S. L. Cornish, S. T. Thompson, and C. E. Wieman, Phys. Rev. Lett. **96**, 170401 (2006).

Keywords : matter-wave solitons, matter-wave transport

Additional information :

* Required skills: Basics of Quantum and Atom Optics and programming skills