Master in Photonics – “PHOTONICS BCN”
ERASMUS+ “EUROPHOTONICS”

MASTER THESIS PROPOSAL

Dates: April - September 2020

Laboratory : FAN (UB)+ MonteCarlo Group (UPC)
Institution: U. Barcelona and U. Politecnica de Catalunya
City, Country : Spain

Title of the master thesis: Dynamical symmetry in quantum and classical systems"

Name of the master thesis supervisor: Bruno JuliaDiaz, Grigori Astrakharchik
Email address : brunojulia@ub.edu
Phone number :+934039179
Mail address : Marti I Franques 1, Diagonal 647, Barcelona

Keywords : Many-body quantum systems, Dynamical symmetry

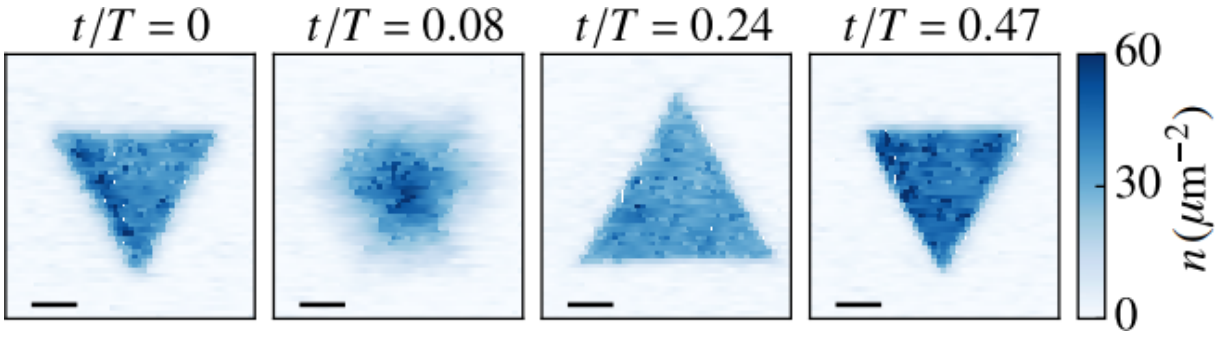
Summary of the subject (maximum 1 page) :

Very recently [1] it has been experimentally observed that a two-dimensional Bose gas confined to a harmonic trap, has a special dynamical symmetry for certain initial shapes of the cloud. In particular, it was found that an initial triangular shape resulted in a periodic time evolution in which the triangle was reappearing rotated in the opposite direction. Although this phenomenon is not yet entirely explained, a hint to its explanation lies in the same scaling with the distance between quantum contact interaction and the kinetic energy (both scale as inverse square of the distance). Similarly, a classical gas consisting of a larger number of particles interacting with inverse square potential indeed possess the same dynamical symmetry.
The goal of the project is to carry out molecular dynamics simulations of a three-dimensional classical gas confined to a harmonic trap. It will be important to verify if there exists a figure (cube, pyramid, etc) which possesses a dynamical symmetry and during time evolution regenerates the self-similar shape.

Bibliography:

[1] R. Saint-Jalm, P. C. M. Castilho, É. Le Cerf, B. Bakkali-Hassani, J.-L. Ville, S. Nascimbene, J. Beugnon, and J. Dalibard

"Dynamical Symmetry and Breathers in a Two-Dimensional Bose Gas"
Phys. Rev. X 9, 021035 (2019)



Additional information :
* Required skills : Computational physics, Quantum physics, Many-body Quantum physics (prefereable)
* Miscellaneous :