Masters project

Stationary States of the Gross-Pitaevskii Equation

The simplest theoretical model describing Bose-Einstein condensates is the Gross-Pitaevskii equation (GPE), which is a non-linear Schrödinger equation, the non-linearity coming from the particle-particle interaction. While the equation can be spatially discretized to transform it to a matrix problem, the fact that the problem is non-linear makes it such that usual solution methods cannot be applied. We have developed a new approach, based on a continuation method starting from the equivalent linear problem. While this method works for low values of the non-linearity, there are convergence issues for the strongly non-linear case. The goal of this project is to modify the current approach in order to achieve a robust algorithm that works for all values of the non-linearity. Additional subproblems may also be investigated, such as the possible existence of stationary states that do not have a non-linear counterpart.

This project requires good computational skills and an understanding of numerical methods applied to matrix problems. Knowledge of Matlab and/or C++ is required.

For more information, contact Claude Dion at the Department of Physics
claude.dion@umu.se