Numerical approximation of nonlinear Schrödinger equations by localized orthogonal decomposition

Christian Döding[1] Patrick Henning[2] Johan Wärnegard[3]

The Gross-Pitaevskii equation (GPE) is a nonlinear Schrödinger equation which is used in quantum physics to model the dynamics of Bose-Einstein condensates (BECs). It is well known that this equation has important time invariants such as the total energy of the system. Preserving the energy under numerical discretization can be of great significance in many practical situations. In this talk we consider numerical approximations of the GPE based on multiscale approaches. To be more precise, we choose a generalized finite element space which is based on the localized orthogonal decomposition method and which allows to capture the energy with high accuracy. Paired with energy-preserving time integrators we demonstrate how such an approach can lead to an efficient solver for the GPE and thus for the simulation of the dynamics of BECs on larger time scales.

[1]Ruhr-University Bochum, Department of Mathematics
christian.doeding@rub.de

[2]Ruhr-University Bochum, Department of Mathematics
patrick.henning@rub.de

[3]Columbia University, Department of Applied Physics and Applied Mathematics
jpw2176@columbia.edu