

A parallel computation of the stationary states of rotating Bose-Einstein condensates using an iterative pseudo-spectral method

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We present a parallel method for computing the stationary states of rotating Bose–Einstein condensates (BEC) modeled by the Gross–Pitaevskii equation (GPE). The computation takes the form of a constrained minimization problem solved using a preconditioned non-linear conjugate gradient method. This numerical method has been proven to be particularly effective and can be implemented by leveraging existing HPC libraries. The method is indeed based on a pseudo-spectral discretization and allows the use of parallel Fast Fourier Transform to build a fully distributed solver. We discuss in detail the implementation of the method and provide parallel results for both two- and three-dimensional problems with fast rotation and large nonlinearities.

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