

# Convergence of a Riemannian gradient method for the Gross–Pitaevskii energy functional in a rotating frame

Mahima Yadav<sup>1</sup> Patrick Henning<sup>2</sup>

This talk focuses on the numerical approximation of ground states of rotating Bose-Einstein condensates. This requires the minimization of the Gross-Pitaevskii energy functional on a Riemannian manifold. As an iterative solver for finding such minimizers we propose a generalized Riemannian gradient method with Sobolev gradients and an adaptively changing metric. We prove that the scheme reduces the energy in each iteration and we further explore its global and local convergence properties. In particular, the local convergence rates can be explicitly quantified in terms of spectral gaps involving  $E''(u)$ , where  $E$  is the energy functional and  $u$  a ground state. The theoretical findings are supported by numerical experiments.

References:

[1] <https://arxiv.org/pdf/2406.03885>

---

<sup>1</sup>Ruhr University Bochum  
mahima.yadav@rub.de

<sup>2</sup>Ruhr University Bochum  
patrick.henning@rub.de