Contribution ID: **50** Type: **Poster**

Tensor network methods for the Gross-Pitaevskii equation

Wednesday 4 September 2024 17:00 (2 hours)

Numerically simulating partial differential equations can be a challenging task. Often one requires huge simulation grids to be able to correctly resolve all physical length scales, leading to huge memory and CPU time requirements. Recently, there has been a focus in extending the applications of Tensor Networks (TNs) into simulations of challenging non-linear partial differential equations [1,2,3]. TNs have been widely successful, in the study of quantum many-body physics and strongly correlated systems [4], providing a framework to obtain physically motivated data compression. In this work, we extend the application of TNs to simulate quantum fluids and turbulence through the Gross-Pitaevskii Equation (GPE). We introduce a procedure to implement the split-step Fourier method for time evolution [5], and use this to demonstrate vortex formation in the GPE and dipolar condensates. We show that by encoding our problem in a TN format, one can perform simulations on large spatial grids in 2D and 3D, which would be unfeasible with standard direct numerical simulations.

References

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[5] - M.D Feit et.al, Journal of Computational Physics,Volume 47, Issue 3 (1982), https://doi.org/10.1016/0021-9991(82)90091-2

Short bio (50 words) or link to website

I am a second year PhD student at the University of Strathclyde, within a quantum many body physics group led by Prof Andrew Daley. Within this group, I am focused on quantum inspired methods and quantum algorithms for solving partial differential equations and strongly correlated systems.

Relevant publications (optional)

Career stage

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