Contribution ID: **21** Type: **Poster**

A nonequilibrium quantum Otto cycle in a one-dimensional Bose gas

Monday 2 September 2024 17:00 (2 hours)

Theoretical study of nonequilibrium quantum thermodynamics in many-body interacting systems is typically restricted by the complexity of dynamical simulation. Integrable systems, despite their exact solutions, are often no exception to this. However, the recently developed theory of generalized hydrodynamics (GHD) is capable of capturing the large-scale dynamics of integrable and near-integrable models in parameter regimes not accessible through alternative methods. We utilize this recently developed theory of GHD, applying it to the study of a nonequilibrium quantum thermodynamic device. In particular, we analyse a quantum Otto cycle driven by control over interparticle interactions in an experimentally realistic one-dimensional Bose gas, which can be described by the integrable Lieb-Liniger model in the uniform limit and is nearly integrable in the harmonically trapped configuration. We explore the performance of this Otto engine cycle across the model' s rich parameter space—from weak to strong interactions and at temperatures below and above quantum degeneracy. Further, we express the engine performance through a direct link with Glauber's second-order correlation function, which allows both net work and efficiency to be expressed analytically in various regions of the parameter space. Overall, the theory of GHD allows us to study a realistic finite-time operation of this quantum thermodynamic cycle and hence to understand the crossover between the previously studied idealised limits of instantaneous and quasistatic quenches.

References

Short bio (50 words) or link to website

I completed my Masters of Experimental Physics at the University of Western Australia under Associate Profeesor John McFerran, and am soon to complete my PhD under Professor Karen Kheruntsyan at the university of Queensland.

Relevant publications (optional)

Career stage

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Session Classification: Posters I

Track Classification: FINESS