Contribution ID: **52** Type: **Poster, reserve for contributed talk**

An Efficient Quantum Phase-Space Method for Simulating Feedback Control of Interacting Many-Body Quantum Systems

Thursday 5 September 2024 12:00 (20 minutes)

Accurately modelling measurement and control of ultracold Bose gases has so far proved unfeasible due the prohibitively large size of the numeric simulations, and problems with under-sampling. We present a new field-theoretic technique based on existing phase-space methods, and use it model feedback cooling of a Bose gas subject to measurements via phase-contrast imaging.

is developed for scalable numerical simulations of controlled quantum systems, and used to model feedback cooling of a Bose gas subject to periodic, non-destructive measurements via phase-contrast imaging. We check the validity of our approach in a two-mode system, which permits an exact solution due to its low-dimensional nature, and observe exceptional agreement across various moments of pseudospin operators. In addition, we benchmark our approach with existing techniques such as the Number-Phase Wigner particle filter, which has been the leading choice for existing simulations of controlled quantum systems.

Finally, we present preliminary results demonstrating successful cooling of a thermal state with low condensate fraction to condensate formation in both quasi-1D and 2D geometries, correctly accounting for measurement induced backaction and spontaneous emission effects. It is shown that the final achievable condensate fraction is dependent upon experimental parameters such as the measurement strength, rate, and detector resolution, and a simple model is constructed to derive optimal values for the parameters above.

References

Short bio (50 words) or link to website

- Completed PhD at the Australian National University
- Moved to University of Queensland where I undertook ARC APD and DECRA fellowships
- Moved to University of Sussex UK for a Marie Curie fellowship
- Currently at ANU on an ARC Future Fellowship

Relevant publications (optional)

Career stage

Postdoc

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Track Classification: FINESS