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December 16, 2024
Modeling Quantum Hardware: open dynamics and control
Universität Konstanz

Project Proposal

Since reading the noise modelling in a proposal for a gravitation wave observatory[1] I want make a similar analysis of a noise limited experiment. By examining a optomechanical resonance cavity with the numerical tools form this course, this can be achieved.
The proposal is in the spirit of the first paper a simplified gravitational wave observatory setup, with a resonant cavity and a room temperature mirror, modelled as a high Q oscillator. Then the noise sources from the temperature bath of the mirror mount, the radiation pressure noise and the shot (or phase) noise are introduced, as those are the main noise sources[2]. It should be possible to write this easily in the Lindblad framework of the course and solved using the common numerical tools.
As a extension of the project I would like to look into the squeezing, fitting with the theme of this project, as it was also done at LIGO[3].

[1] Rainer Weiss. "Electronically Coupled Broadband Gravitational Antenna". In: *Quarterly Progress Report, Research Laboratory of Electronics (MIT)* 105 (1972), p. 54. URL: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=bab68ee9e0a4f791e52141d7651524c4f41a699a (visited on 12/16/2024).

[2] Markus Aspelmeyer, Tobias J. Kippenberg, and Florian Marquardt, eds. *Cavity Optomechanics: Nano- and Micromechanical Resonators Interacting with Light*. en. Berlin, Heidelberg: Springer Berlin Heidelberg, 2014. ISBN: 978-3-642-55311-0 978-3-642-55312-7. DOI: 10.1007/978-3-642-55312-7. URL: https://link.springer.com/10.1007/978-3-642-55312-7 (visited on 12/16/2024).

[3] Haocun Yu et al. "Quantum correlations between light and the kilogram-mass mirrors of LIGO". en. In: *Nature* 583.7814 (July 2020), pp. 43–47. ISSN: 0028-0836, 1476-4687. DOI: 10.1038/s41586-020-2420-8. URL: https://www.nature.com/articles/s41586-020-2420-8 (visited on 12/16/2024).