Quantum fluctuation-dissipation relations

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Lecture 1. Linear response theory.

1.1. Linear response and susceptibilities.
1.2. Hamiltonian systems close to equilibrium.
1.3. Fourier transform and Green functions.
1.4. The response of a classical harmonic oscillator.
1.5. Kramers-Kornig relations.

Lecture 2. Markovian dynamics.

2.1. Classical Markov chains.
2.2. Quantum maps.

Lecture 3. Fluctuation-disspation theorems.

3.1. Generalized classical FDT.
3.2. Generalized quantum FDT.
3.3. Practical implementation.

References

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2. Prost, J., Joanny, J. F., & Parrondo, J. M. R. (2009). Generalized Fluctuation-Dissipation Theorem for Steady-State Systems. *Physical Review Letters*, **103**, 090601.
3. Mehboudi, M., Sanpera, A., & Parrondo, J. M. R. (2018). Fluctuation-dissipation theorem for non-equilibrium quantum systems. *Quantum* **2**, 66.
4. D. des Cloizeaux, *Linear response, generalized susceptibility and dispersion theory* (International Atomic Energy Agency, 1968) pp. 325–354.
5. J. Jensen and A. R. Mackintosh, *Rare earth magnetism structures and excitations* (Clarendon Press, 1991).
6. V. Balakrishnan, *Elements of Nonequilibrium Statistical Mechanics*, Ane Books, Delhi & CRC Press, 2008. See also the online course on *Nonequilibrium Statistical Mechanics*: https://nptel.ac.in/courses/115106091/