Monitored Quantum Many-Body Systems

Unitarity is a fundamental property of quantum mechanics which underlies the dynamics of closed quantum many-body systems, the concept of thermalisation and the emergence of statistical mechanics. A different paradigm for quantum dynamics arises in presence of an external environment, which can represent for example dissipation due to a bath or an external monitoring apparatus[1,2]. Other sources of non-unitarity can arise for example in presence of non-Hermiticity due to post-selection of measurement outcomes [3].

The goal of this project is to explore the consequences of non-unitarity on the dynamics of quantum many-body systems, in particular for what concerns the dynamics of quantum information. Examples include: the study of entanglement dynamics in presence of quantum measurements or continuous monitoring, the use of measurements and active feedback to steer and prepare quantum many-body states.

During this theoretical internship, the Master's student will acquire, develop, and apply state- of-the-art techniques for open quantum many-body physics to solve paradigmatic models for non-unitary quantum systems. This internship can naturally evolve into a PhD Thesis at the interface between nonequilibrium quantum dynamics, open quantum systems, statistical physics and quantum information.

[1] R. Fazio, J. Keeling, L. Mazza, M. Schiro, arXiv:2409.10300

[2] X Turkeshi, A Biella, R Fazio, M Dalmonte, M Schiró, Physical Review B 103 (22), 224210 (2021)

[3] Y. Le Gal, X Turkeshi, M Schiró, SciPost Physics 14 (5), 138 (2023)

[4] Y. Le Gal, X Turkeshi, M Schiró, PRX Quantum 5, 030329 (2024)

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