

PH.D. PROJECT 2021-2024

Non-equilibrium Entanglement

PROJECT SUPERVISOR: **Gabriele De Chiara**

CONTACTS: **g.dechiara@qub.ac.uk**

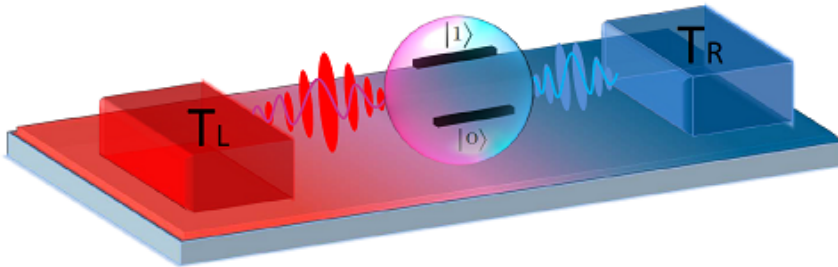
Webpage: <https://sites.google.com/site/gabrieledechiara/>

State of the art and motivations

Entanglement is one of the most characteristic traits of quantum theory. It gives rise to peculiar effects such as quantum non-locality and quantum teleportation but can also be used as a resource for quantum secure communications, i.e. quantum cryptography, precise measurements and quantum computing.

Entanglement can be found spontaneously in systems that are cold enough. These could be for example natural materials or artificial quantum materials simulated by a quantum computer. Entanglement of these systems is quite well understood.

A situation which is a bit elusive is what happens to the entanglement of systems that are brought out of equilibrium. This happens when a quantum system is coupled to two thermostats at different temperature (as in the picture below) or when a current is driven through the system.



from Sci Rep 5, 11787 (2015)

Objectives & Methodology

The objective of the project is to investigate entanglement, in its bipartite and multipartite setting, in non-equilibrium systems.

Methodology will range from analytical methods for simple systems made of a few qubits to numerical techniques, such as exact diagonalisation and tensor networks, for larger systems.

Collaborations

Collaborations are expected with theoretical groups led by:

- Maciej Lewenstein and Anna Sanpera (Barcelona)
- Gabriel Landi (São Paulo)

- Mauro Antezza (Montpellier)

as well as experimental groups:

- Jacob Sherson (Aarhus)
- Tobias Donner (Zürich)

and mutual visits can be envisaged.

Required skills

A good knowledge of quantum theory is necessary. The candidate should be familiar with at least a programming language. Ideally the candidate is familiar with quantum information concepts including the basic theory of entanglement.

Further information

For further information, please contact me, g.dechiara@qub.ac.uk.