Laboratoire de Physique et Modélisation des Milieux Condensés



Theoretical physics laboratory



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LPMMC – Theoretical physics laboratory



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Heat transfer in nano-circuits as a bosonic scattering problem – Denis Basko

Measurement and control of the Hamiltonians of quantum computers – Benoît Vermersch

Theory of quantum reservoir computing with light in random media – Sergey Skipetrov

Anderson localization of elastic waves – Bart van Tiggelen and Sergey Skipetrov

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Heat transfer in nano-circuits as a bosonic scattering problem

Supervisor: Denis Basko



Experiment on heat transfer via photons in a superconducting resonator Meschke, Guichard, Pekola, *Nature* **444**, 187 (2006)



Effective circuit:

Resistors = baths of harmonic oscillators Superconducting resonator = *LC*

Internship goals:

- 1. Construct the scattering matrix for the bath excitations
- 2. Express the heat current and its noise in terms of the scattering matrix

Necessary background: quantum mechanics, scattering theory, second quantization



Measurement and control of the Hamiltonians of quantum computers

Supervisor: Benoît Vermersch



- Experiments on IBM quantum computers
- Generate a tunable Hamiltonian
- Use randomized measurement toolbox



Theory of quantum reservoir computing with light in random media

Supervisor: Sergey Skipetrov **Optical quantum** (b) Reservoir processor (a) Neural network reservoir processor Fixed (random) links Adjustable links Nodes Adjustable links Nodes pump Inout Output Input Output laver laver layer laver

- Build a theoretical model
- Simulate task 1: Detect entangled states
- Simulate task 2: Measure entanglement



Anderson localization of elastic waves

Supervisors: Bart van Tiggelen end Sergey Skipetrov

Random arrangement of aluminum beads



Weak disorder: diffusion Strong disorder: localization

- Account for vectorial nature of elastic waves
- Adapt the analytic theory of localization
- Compare with numerical simulations

