Mohammad Hamed Mohammady

Institute of Physics SAS

Project number
IM-2023-79

Project duration
1.9.2024-31.8.2029

" The MPULZ programme will give me the opportunity to build a competetive research group operating at the cutting edge of quantum thermodynamics, and will help lay the groundwork for obtaining European research grants such as ERC."

BIOGRAPHY

Mohammad Hamed Mohammady obtained his Ph.D. in Theoretical Physics from University College London in 2013. Subsequently, he has held several postdoctoral positions across Europe. This includes a Marie Curie IEF fellowship at Instituto de Telecomunicações, Lisbon between 2014 and 2016, where he studied how Landauer's erasure principle manifests itself in the quantum regime, and an IF@ULB Marie Curie co-fund fellowship at Université Libre de Bruxelles between 2021 and 2023, where he determined how the laws of thermodynamics limit the class of quantum observables that admit accurate or non-disturbing measurements. Dr. Mohammady was awarded an IMPULZ fellowship at the Institute of Physics of the Slovak Academy of Sciences in Bratislava, where he has been building a research group specialising in operational quantum thermodynamics—within the Research Center for Quantum Information—since September 2024.

Operational Quantum Thermodynamics

This is a proposal for the applicant to build a research group in the Institute of Physics of the Slovak Academy of Sciences, in order to establish a resource theoretic framework for operational quantum thermodynamics. To date, the resource theory of quantum thermodynamics has been founded on the operationally unjustified assumption of unitarity of the global dynamics, and has only addressed the thermodynamic costs of transforming one quantum state to another state. In this project, the applicant will provide the resource theory of quantum thermodynamics with a fully operational foundation that does not rely on unitarity, and will investigate the thermodynamic costs of other tasks in operational quantum physics such as: performing quantum measurements, implementing incompatible quantum processes, and the higher-order task of transforming one quantum process to another quantum process.

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PUBLICATIONS

1. M. Hamed Mohammady, Takayuki Miyadera, Leon Loveridge – "Measurement disturbance and conservation laws in quantum mechanics" – Quantum 7, 1033 (2023) https://doi.org/10.22331/q-2023-06-05-1033
2. M. Hamed Mohammady and Takayuki Miyadera – "Quantum measurements constrained by the third law of thermodynamics" – Phys. Rev. A 107, 022406 (2023) https://doi.org/10.1103/PhysRevA.107.022406
3. M. Hamed Mohammady – "Thermodynamically free quantum measurements" – J. Phys. A 55 505304 (2022) https://iopscience.iop.org/article/10.1088/1751-8121/acad4a
4. Harry J. D. Miller, M. Hamed Mohammady, Marti Perarnau-Llobet, Giacomo Guarnieri – "Thermodynamic uncertainty relation in slowly driven quantum heat engines"– Phys. Rev. Lett. 126, 210603 (2021) https://doi.org/10.1103/PhysRevLett.126.210603
5. M. Hamed Mohammady and Alessandro Romito – "Conditional work statistics of quantum measurements" – Quantum 3, 175 (2019) https://quantum-journal.org/papers/q-2019-08-19-175