QSUN Quantum Research Group of Stellenbosch University

SA QuTI South African Quantum Technology Initiative

NITheCS National Institute for Theoretical and Computational Sciences

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SEMINAR

Approach to equilibrium of an optical quantum field mode scattering from a non-equilibrium quantum reservoir

Prof Marco Merkli (Memorial University of Newfoundland, Canada)

Friday, 22 March 2024 @ 14h00-15h00 SAST

Venue: Physics Seminar Room, Stellenbosch University, and online

ABSTRACT

Rigorous derivations of the approach of individual elements of large isolated systems to a state of thermal equilibrium, starting from arbitrary initial states, are exceedingly rare. This is particularly true for quantum mechanical systems. We demonstrate how, through a mechanism of repeated scattering, an approach to equilibrium of this type actually occurs in a specific quantum system. We consider an optical mode passing through a reservoir composed of a large number of sequentially-encountered modes of the same frequency, each of which it interacts with through a beam splitter. We then analyze the dependence of the asymptotic state of this mode on the assumed stationary common initial state of the reservoir modes and on the transmittance of the beam splitters. These results allow us to establish that at small large transmittance, such a mode will, starting from an arbitrary initial system state, approach a state of thermal equilibrium even when the reservoir modes are not themselves initially thermalized.

This talk is intended for an audience which is not necessarily specialized in the topic of open quantum systems or thermalization. It is based on a recent collaboration with S. De Bièvre and P. Parris, available on the arXiv at https://arxiv.org/pdf/2312.14290.pdf.

BIOGRAPHY

Marco Merkli is a faculty member of the Department of Mathematics and Statistics at Memorial University in St. John's, Canada. As a mathematical physicist, his research primarily revolves around elucidating the dynamics of open quantum systems. His expertise lies in developing mathematical tools tailored for analyzing the evolution of systems under external influences. This endeavour aims to establish a robust mathematical framework for the theory of open quantum systems, ensuring the precision of physical predictions and reducing uncertainties in the field. Merkli's mathematical inquiries have also uncovered novel physical phenomena, particularly concerning the impact of quantum correlations (entanglement) on the dynamics of open systems. He endeavours to foster dialogue between the mathematical and physical communities interested in quantum sciences.

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