

Seminar

Star-to-Chain transformations and their use – from numerics to analogue quantum simulation

Robert H Jonsson

Malmö University, Sweden

Quantum systems coupled to an environment or bath are ubiquitous in physics. Often, this interaction has a star-like structure, where the system couples to many bath modes, which is hard to treat directly.

In many cases of interest, however, a basis transformation on the bath reshapes the star structure into a chain with nearest-neighbour couplings only. This star-to-chain mapping (also known as chain-mapping, TEDOPA, the Lanczos or Cholesky transformation, or reaction-coordinate mapping) is exact, not an approximation, and it opens the door to numerical methods like matrix product states and DMRG.

In this talk I give an accessible introduction to this transformation, and then illustrate its use through three different examples from my own research. These include the numerically exact treatment of strong coupling in giant atoms^[1], Unruh radiation from relativistically accelerated emitters^[2], and the design of analogue quantum simulation setups in integrated photonics^[3].

References:

- [1] D. D. Noachtar, J. Knörzer, R. H. Jonsson, Non-perturbative treatment of giant atoms using chain transformations, Phys. Rev. A 106, 013702 (2022), arXiv:2201.11544
- [2] R. H. Jonsson, J. Knörzer, Chain-mapping methods for relativistic light-matter interactions, Quantum 8, 1237 (2024), arXiv:2306.11136
- [3] F. H. Huber et al, Non-Exponential Decay in Finite Photonic Waveguide Arrays, arXiv:2509.06443

Monday, Oct 12th 2026

11:30 Hrs (Tea / Coffee 11:15 Hrs)

Auditorium, TIFRH