THE UNIVERSITY OF CHICAGO

Computational and Applied Mathematics
Student Seminar

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Network Structure of Non-equilibrium Quantum Transport Models

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ABSTRACT

In the emerging field of quantum network science, a key challenge is understanding the relationships between network structure and underlying physical descriptions of many-body quantum systems. To explore these relationships, we construct networks representing the energy landscape of non-equilibrium transport through quantum antidots—an example of an open, many-body quantum system—corresponding to two distinct models of internal quantum states: a single-particle, non-interacting model and a mean-field model including interactions. We find that the cycle structure reflects common spin conservation rules, but the two models result in different minimum lengths of cycle basis elements, reflecting the (in)distinguishability of particles in the models. Furthermore, spin-conserving, internal energy relaxation produces topological discrepancies in the degree distribution and the length distribution of cycles in the cycle bases across the two models. Our approach motivates future efforts to use network science to understand the dynamics of quantum systems with potential applications to quantum information technologies.