UNIVERSITÄT DES SAARLANDES
Fakultät für Mathematik und Informatik
Fachrichtung Mathematik

Mathematisches Kolloquium

Am **Freitag**, dem 5. Dezember 2025, spricht um **14 Uhr c.t.** im Hörsal IV der Fachrichtung Mathematik, Gebäude E2.4, Teams-Link,

Prof. Dr. Igor Klep
University of Ljubljana

über das Thema:

Quantum Max Cut

Abstract:
The Quantum Max Cut (QMC) problem is a quantum analog of the classical Max-Cut problem and has emerged as a standard testbed for approximation algorithms for local Hamiltonians. In this talk I will describe how the algebraic structure of QMC leads naturally to representation theory of the symmetric group.
Our first main result is an extension of the noncommutative Sum-of-Squares techniques of Helton–McCullough, yielding a new family of relaxations for Quantum Max Cut based on polynomials in swap operators. To prove completeness of this hierarchy, we give a finite presentation of the algebra generated by these operators. Numerically, we find that level 2 of the hierarchy is already exact on all QMC instances on small graphs.
Our second main result is a polynomial-time algorithm that exactly computes the maximum eigenvalue of the QMC Hamiltonian for a class of graphs, namely those that can be decomposed as a signed combination of cliques. This includes, as a special case, complete bipartite graphs with uniform edge weights, recovering and extending results of Lieb and Mattis (1962).
The talk is based on joint works with Adam Bene Watts, Anirban Chowdhury, Aidan Epperly, and J. William Helton (Quantum, 2024), and Tea Štrekelj and Jurij Volčič (preprint, 2025).

Alle Interessenten und Interessentinnen sind zum Vortrag herzlich eingeladen. Der Vortrag findet im **hybriden Format** statt.

Die Dozenten der Mathematik