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Convex methods for sign problems

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Quantum mechanical theories have an underlying convex geometry defined by the fact that the Hilbert-space norm is positive definite. Positivity is a surprisingly strong constraint, which when combined with other information (such as lattice data, Schwinger-Dyson relations, or equations of motion), allows one to establish qualitatively tight bounds on the behavior of many quantum systems, including lattice quantum field theories. In this talk I show how these observations in combination with standard methods from convex optimization, allow us to perform simulations of regimes forbidden to quantum Monte Carlo methods, including finite density fermions and real-time dynamics.

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