

## Notions of Positivity and Complexity in Quantum Information Theory

**Target Dates:** June 5 – August 4, 2023

**Time commitment:** 10-20 hours per week, compensated

**Background:** Completion of a course in proof-based linear algebra. Experience with Python, Sage, and/or Matlab is strongly preferred.

**Description:** We will let  $\mathbf{M}_k$  denote the algebra of  $k$ -by- $k$  complex matrices. A  $k$ -by- $k$  matrix is **positive semidefinite** if it is equal to its conjugate transpose and all eigenvalues are non-negative. Linear transformations from  $\mathbf{M}_n$  to  $\mathbf{M}_k$  which send positive semidefinite matrices to positive semidefinite matrices are central objects of study in quantum information theory. In this project we will study some related notions of positivity for linear transformations between matrix algebras and attempt to understand their complexity in terms of whether such linear transformations can be used to compute computationally hard problems.

**Application:** Please send a brief statement of purpose, one page or less, describing your interest in pursuing research in mathematics. A cv or resume addressing your qualifications is also required.

**Deliverables:** A poster or slide presentation. Published research is possible if significant results are obtained.