

## Course Description

This course will focus on applications of  $C^*$ -algebras, operator systems, operator spaces, completely positive maps and completely bounded maps in quantum information theory.

We will begin with a review of special families of operators on Hilbert space, including the compact operators, the Schatten classes and the key duality theorems. We will then outline the key results in the theory of Von Neumann algebras and  $C^*$ -algebras, including Von Neumann's double commutant theorem, the GNS theory and Stinespring's dilation theorem. A particular focus will be given to the  $C^*$ -algebras and Von Neumann algebras that arise in quantum physics.

In the second part of the course we will study completely positive maps and operator systems and their applications to Knill-LaFlamme theory, private channels, PPT maps and to questions about quantum marginals. Then we will turn to operator spaces and completely bounded maps, which arise in capacity theory and in the study of maximal violations of Bell's inequalities.

We will assume that students are familiar with the basic results and concepts of functional analysis as presented in say the FAQI course.