

Quantum information, quantum groups and operator algebras
4 November – 6 December 2024

Over the past century, quantum theory has had profound impact on the development of pure and applied mathematics. Quantum Information Theory has emerged as a framework for studying the processing of information using quantum mechanical devices. The mathematical areas of Operator Algebras and Quantum Groups arose out of, respectively, study of the foundations of quantum theory and quantum integrable systems. Our programme brought together researchers in these three areas to exchange and share ideas and techniques, with a focus being the rising prominence of the language of non-local games.

The programme started with a school, with lectures given by six experts in individual topics, with an aim to give participants from the different fields an introduction into the subject areas with which they were less familiar. An informal atmosphere, and problem sessions in the afternoons, lead to lively and interactive talks.

The following three weeks, being the core part of the programme, featured surveys of recent results and challenging open problems given by both participants, and external speakers. On most days there was a morning session, with several follow-on sessions in the afternoons. The relatively informal format of these activities meant they often naturally morphed into productive extended discussions. Scientific collaborations often arose spontaneously in the common areas of the Institute. Participants found the location to be a perfect work environment, aided by the architecture of the building, and the excellent support offered by the institute staff.

Our Open for Business Day attracted representatives of small and large companies active in solving the challenges of building, and programming, quantum computers, and explored some of the challenges posed by “quantum supremacy”, especially around cryptography. We held a related morning Careers panel discussion, where participants shared their experience and advice regarding professional paths, both in academia and in industry.

The organisers set up a light-touch mentoring scheme for junior participants, making sure that each of them had a chance to talk to a senior mathematician, and be involved in the programme's activities. We also had interactions with DPMMS and DAMPT in Cambridge, with various participants giving and attending seminar lectures there, and also further afield in the UK.

The programme culminated in a full-scale international conference in the fifth and final week, which brought together leading experts and junior researchers presenting the latest developments in the key areas of the programme. The recurring themes once again involved quantum graphs, graphical calculi and non-local games, but also applications of quantum group and quantum probability techniques to diverse questions ranging from quantum field theory to K-theory of operator algebras. Interactions in this area remain timely and will continue in the future, with the announcement of a major new annual conference series devoted specifically to Quantum Information Theory and Operator Algebras (meeting in 2025 in Waterloo, and in 2026 at the Mittag-Leffler institute), and various focused meetings in sub-areas, for example a Quantum Graphs workshop in Saarbrücken in February 2025.