Report on the INI Satellite Programme "Hypergraphs: Theory and applications" held at The Alan Turing Institute 22 July-16 August 2024.

The HTA Newton Institute Satellite Programme focused on key mathematical research questions on hypergraphs and higher-order networks. This is a very topical field with impact in different disciplines, ranging from theoretical physics and machine learning to brain research, which has become increasingly relevant as researchers seek to model higher-order relationships that cannot be captured by traditional graph theory. The Programme covered broad mathematical questions including spectral graph theory and combinatorics, to dynamical systems, applied topology, applied geometry and applications in machine learning and network science. Each of these areas is essential to understanding the structural and functional properties of hypergraphs that need further development.

Developing over 4 weeks, the programme kicked off with a very successful and intense Workshop (lectures recorded). The subsequent weeks were devoted to series of lectures and to collaborative discussions. The two panel sessions (on perspectives of the field and on early career advice, respectively) were among the highlights of the programme.

Because of its interdisciplinary nature, the programme fostered collaborations among scientists from various research areas, and the participants included senior as well as junior researchers, thereby stimulating discussions and the formulation of new mathematical ideas. We expect several scientific publications to come from these discussions.

Overall, the HTA Newton Institute Satellite Programme not only advanced research in hypergraph theory but also contributed to building a vibrant community of researchers dedicated to exploring both the theory and applications of this growing field.