

**Clay Research Conference**  
**27 September 2023**  
**University of Oxford**  
**Andrew Wiles Building**  
**L1**

**Abstracts**

**Valentin Blomer** (University of Bonn)

Title: Density theorems and applications

Abstract: The generalized Ramanujan conjecture predicts that all cuspidal automorphic representations for  $GL(n)$  are tempered. A density theorem is a certain quantitative approximation towards the Ramanujan conjecture that in many cases serves as a good substitute. In this talk I will survey results, methods, and applications.

**John Pardon** (Stony Brook University)

Title: Derived moduli spaces of pseudo-holomorphic curves

Abstract: Moduli spaces of solutions to nonlinear elliptic pdes (anti-self-dual connections, monopoles, pseudo-holomorphic curves, etc.) are a fundamental tool in low-dimensional and symplectic topology. I will discuss foundational aspects of moduli spaces of pseudo-holomorphic curves, in particular how to construct their derived structure using moduli functors, as conjectured by Joyce. Key tools include derived manifolds, log smoothness, and stacks.

**Laure Saint Raymond** (IHES)

Title: What does entropy measure?

Abstract: Entropy is a key concept in many fields of physics and mathematics (statistical physics, information theory, dynamical systems): although it is always linked to a notion of complexity, it has a variety of definitions. The aim of this presentation is to understand what it can measure, close to equilibrium, in the process of relaxation towards equilibrium and far from equilibrium. A major issue is to know whether it can measure mixing properties.

**Chenyang Xu** (Princeton University)

Title: Kähler-Einstein metric, K-stability and moduli spaces

Abstract: A complex variety with a positive first Chern class is called a Fano variety. The question of whether a Fano variety has a Kähler-Einstein metric has been a major topic in complex geometry since the 1980s. In the last decade, algebraic geometry, or more specifically higher dimensional geometry has played a surprising role in advancing our understanding of this problem. In fact, the algebraic part of this question is one step of a larger project, namely constructing projective moduli spaces that parametrize Fano varieties satisfying the K-stability condition. The latter is exactly the algebraic characterization of the existence of a Kähler-Einstein metric. In the lecture, I will explain the main ideas behind the recent progress of the field.