Clay Research Conference
28 September 2022
L1

Abstracts of Talks

Bhargav Bhatt (IAS/Princeton University and University of Michigan)

Title: Vanishing theorems in algebraic geometry

Abstract: Vanishing theorems in complex geometry, such as the Kodaira vanishing theorem, play an important role in understanding the structure of complex algebraic varieties. Ultimately, they rely on critical input from Hodge theory. After recalling this story, I will survey some recent and ongoing work giving analogous results in mixed characteristic as well as applications to birational geometry; the key input now comes from p-adic Hodge theory.

Kevin Costello (Perimeter Institute)

Title: Scattering amplitudes and vertex algebras

Abstract: Scattering amplitudes are fundamental quantities in quantum field theory. Vertex algebras are well-developed algebraic objects which encode the structure of two-dimensional conformal field theories. I will describe a surprising relationship between these two topics, which goes by the name "celestial holography". This relationship gives new techniques for computing scattering amplitudes of Yang-Mills theory. No prior knowledge of quantum field theory will be required for this talk.

Jacob Tsimerman (University of Toronto)

Title: The André—Grothendieck Period conjecture over function fields

Abstract: (Joint with B.Bakker) Periods are integrals of differential forms, and their study spans many branches of mathematics, including diophantine geometry, differential algebra, and algebraic geometry. If one restricts their attention to periods arising over $\overline{\mathbb{Q}}$, then the Grothendieck Period Conjecture is a precise way of saying that these are as transcendental as is allowed by the underlying geometry. While this is a remarkably general statement (and very open), it does not include another major (also open!) conjecture in transcendence theory - the Schanuel conjecture. In particular, e is not a period, even though it can `described through periods via the relation $\int_1^e \frac{dx}{x} = 1$. We shall present a generalization due to André which unifies the two conjectures in a satisfactory manner.

In the (complex) function field case, a lot more is known. The Grothendieck Period Conjecture has been formulated and proved by Ayoub and Nori. We shall explain the geometric analogue of the André- Grothendieck Period Conjecture and present its proof. It turns out that this conjecture is (almost) equivalent to a version of the Ax-Schanuel conjecture, which has been the subject of a lot of study over the past decade in connection with unlikely intersection problems. The version relevant to us is a comparison between the algebraic and flat coordinates of geometric local systems. We will sketch two proofs of this conjecture and explain how it implies the relevant period conjecture.