Talks in theoretical sciences

Monday, 26 November 2018

ETH-ITS, seminar room, CLV B4

Speaker: Bernardo Zan (EPFL)

Time: 10:15 - 10:45

Title: Walking, weak first order phase transitions and complex CFTs

Abstract: Conformal field theories (CFTs) play a fundamental role in high energy physics, as well as statistical physics and condensed matter; they describe the physics of scale invariant systems, with second order phase transition being a famous example. There are instances, however, where a physical system shows approximate, rather than exact, scale invariance over some range of energies: examples are walking in gauge theories and weak first order phase transition in statistical models. These approximately scale invariant theories can still be understood in terms of CFTs, in terms of a renormalization group flow passing between two fixed points at complex coupling, i.e. complex CFTs. By using perturbation theory around these complex CFTs, one can make predictions about the approximately scale invariant theory.

Speaker: Miroslav Rapcak (University of Waterloo)

Time: 11:15 – 11:45

Title: Vertex Algebras and Spiked Instantons

Abstract: Over the past two decades, there have been a large interest in the connection between four-dimensional gauge theories and vertex algebras. The prototypical example is the famous AGT correspondence relating W_N algebras and gauge theories on $\mathbb{C}^2$. We extend the list of vertex algebras appearing in the connection to gauge theories by proposing a construction that associates a vertex algebra to any divisor in a Calabi-Yau three-fold. For divisors inside $\mathbb{C}^3$, we find a generalization of AGT that relates Nekrasov's spiked-instanton configuration with a three-parameter family of vertex algebras $Y_{L,M,N}$ generalizing W_N. The results have interesting implications in the theory of vertex algebras, gauge theories and geometric representation theory.

Speaker: Alba Grassi (Simons Center for Geometry and Physics)

Time: 14:15 – 14:45

Title: Mathematical and Physical aspects of String Dualities

Abstract: During the last decades string dualities have proven to be powerful tools to obtain new results in mathematics and in physics. In this talk I will present some aspects and applications of such dualities by focusing on the concrete example of topological string theory. This is a simplified, but nevertheless very rich string theory model that appears often in mathematical applications.

Speaker: Aleksander Doan (Stony Brooks University)

Time: 15:15 – 15:45

Title: Instantons and special geometries

Abstract: The Yang-Mills equations are one of the fundamental equations of particle physics, generalizing Maxwell's equations of electromagnetism. In the 1980's geometers realized that instantons--solutions of the Yang-Mills equations--capture subtle geometric properties of the spaces they inhabit. This discovery led to spectacular progress in the study of 3- and 4-dimensional geometries. I will briefly survey these developments and outline an intriguing program of using the Yang-Mills equations to study a class of higher-dimensional geometries, which are of interest to geometers and string theorists alike. I will then talk about my own work, which makes progress towards developing this program and has to do with degenerations of higher-dimensional instantons.

Speaker: Florian Naef (Massachusetts Institute of Technology)

Time: 16:30 – 17:00

Title: The Goldman-Turaev Lie bialgebra and the Kashiwara-Vergne problem

Abstract: Goldman and Turaev define a bracket and cobracket on the vector space spanned by free homotopy classes of loops on a surface, such that it forms an involutive Lie bialgebra. The Lie bialgebra structure is defined in terms of intersections and self-intersections of loops. There is an algebraic analog of this Lie bialgebra on the space of cyclic words defined by Schedler. It turns out that the topological and the algebraic versions are isomorphic. Moreover, in genus 0 finding an isomorphism is equivalent to the Kashiwara-Vergne problem which has its origins in Lie theory and is intimately linked with Drinfeld's theory of associators.