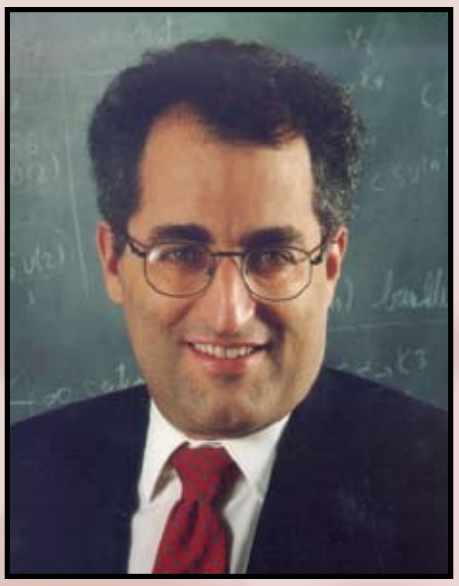
Center for Applied Mathematical Sciences
Distinguished Lecture, Spring 2012
Joint with the Mathematics Department Colloquium



Edward Witten

Khovanov Homology And Gauge Theory

Abstract: In this talk, I will sketch a new approach to Khovanov homology of knots and links based on counting the solutions of certain elliptic partial differential equations in four and five dimensions. The equations are formulated on four and five-dimensional manifolds with boundary, with a rather subtle boundary condition that encodes the knots and links. The construction is formally analogous to Floer and Donaldson theory in three and four dimensions. It was discovered using quantum field theory arguments but can be described and understood purely in terms of classical gauge theory.

Wednesday, March 28, 2012

Lecture: 3:30 – 4:30 pm
KAP 414

Reception: 3:00 – 3:30 pm
KAP 410

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Edward Witten is currently a professor of Mathematical Physics at the Institute for Advanced Study in Princeton. Witten has made many notable contributions to theoretical physics, in work that has spawned a large number of highly mathematical results.

As early as 1984, Witten worked on the important problem of the gravitational anomaly which contributed to what is known as the first string theory revolution. With Gary Horowitz, Philip Candelas and Andy Strominger, Witten showed how string theory can lead to realistic descriptions by compactifying the theory on higher dimensional manifolds known as CalabiYau manifolds. In the string theory conference at University of Southern California in the mid-'90s, Witten solved an outstanding problem of how five different versions of string theory were related to one another by dualities. Witten conjectured the existence of a unifying theory called M-theory whose complete structures has not been discovered yet. Non-technically this can be described as what might be the most fundamental physical theory of the universe.

Edward Witten's important contributions to physics include a relatively recent result of gauge gravity duality. In 1997, Juan Maldacena formulated a result establishing a relationship between gauge theories and a certain theory of gravity commonly known as AdS/CFT correspondence. This discovery has dominated theoretical physics for the past 15 years and Witten's work following Maldacena's insight has shed light on this relationship. His other contributions include a simplified proof of the positive energy theorem involving spinors in general relativity, his work relating supersymmetry and Morse theory, his introduction of topological quantum field theory and related work on mirror symmetry, knot theory, twistor theory and D-branes and their intersections.

Witten has been honored with numerous awards including a MacArthur Grant (1982), the Fields Medal (1990), the Nemmers Prize in Mathematics (2000), the National Medal of Science (2002), Pythagoras Award (2005), the Henri Poincaré Prize (2006), the Crafoord Prize (2008), the Lorentz Medal (2010) and the Isaac Newton Medal (2010). He is a member of the US National Academy of Sciences, the Royal Society, the French Academy of Sciences and the Pontifical Academy of Sciences.