Mathematics Department Colloquium

Organizer: Maciej Zworski

Thursdays, 4:10–5:00pm, Evans 60

March 9 **Steve Zelditch**, The Johns Hopkins University

Complex geometry and vacua: Counting universes in string theory

According to string theory, the vacuum state of the universe is 10 dimensional: the usual 4 dimensional vacuum spacetime times a small Calabi-Yau 3 fold. A notorious problem in string theory is that there are many candidates for the CY 3-fold (the vacua) and no known selection principle to pick a unique one. This has given rise to the controversial 'landscape' problem of string theory, and the statement (Bousso-Polchinski, Susskind, ...) that there are 10^{500} possible vacua. This huge number seems to spell the end of dreams of an 'elegant' unique universe determined by string theory.

My talk describes joint work with the string theorist M. R. Douglas and with B. Shiffman giving rigorous counting results on the number of possible vacua. Mathematically, vacua are critical points of special holomorphic sections of a line bundle over the moduli space of CY metrics on a fixed manifold X. Counting the number of critical points involves a lattice point problem and statistics of critical points of Gaussian random polynomial-like functions. The talk assumes no prior knowledge of string theory, Calabi-Yau manifolds, or of random polynomials.