Abstract:

**Bhaswar Bhattacharya**: Large Deviation Variational Problems in Random Combinatorial Structures

The upper tail problem in the Erdos-Renyi random graph $G \sim \mathcal{G}_{n,p}$, where every edge is included independently with probability $p$, is to estimate the probability that the number of copies of a graph $H$ in $G$ exceeds its expectation by a factor of $1 + \delta$. The arithmetic analog of this problem counts the number of $k$-term arithmetic progressions in a random subset of $\{1, 2, \ldots, N\}$, where every element is included independently with probability $p$. The recently developed framework of non-linear large deviations (Chatterjee and Dembo (2016) and Eldan (2017)) shows that the logarithm of these tail probabilities can be reduced to a natural variational problem on the space of weighted graphs/functions. In this talk we will discuss methods for solving these variational problems in the sparse regime ($p \rightarrow 0$), and show how the solutions are often related to extremal problems in combinatorics. (This is based on joint work with Shirshendu Ganguly, Eyal Lubetzky, Xuancheng Shao, and Yufei Zhao.)

**Elliot Paquette**: Random matrix point processes via stochastic processes

In 2007, Virag and Valko introduced the Brownian carousel, a dynamical system that describes the eigenvalues of a canonical class of random matrices. This dynamical system can be reduced to a diffusion, the stochastic sine equation, a beautiful probabilistic object requiring no random matrix theory to understand. Many features of the limiting eigenvalue point process, the Sine-$\beta$ process, can then be studied via this stochastic process. We will sketch how this stochastic process is connected to eigenvalues of a random matrix and sketch an approach to two questions about the stochastic sine equation: deviations for the counting Sine-$\beta$ counting function and a functional central limit theorem.