Probabilistic Operator Algebra Seminar

Organizer: Dan-Virgil Voiculescu

April 3 **Brian Hall**, University of Notre Dame

Title: *Heat flow, random matrices, and random polynomials.*

It is a classical result that if you apply the backward heat flow to a polynomial with all real roots, the new polynomial will still have all real roots. Recent results of Marcus-Spielman-Srivastava and Kabluchko, using "finite free convolutions" have shown how the behavior of the zeros connect to random matrix theory. Specifically, suppose X is a Hermitian random matrix with characteristic polynomial p and Y is a random matrix chosen from the Gaussian Unitary Ensemble. Then applying the backward heat flow to p gives a polynomial whose roots resemble the eigenvalues of $X+Y$. Things get more interesting if we apply the forward heat operator to a polynomial with real roots, or if we apply a heat operator (forward or backward) to a polynomial with complex roots. I will discuss a conjecture of mine with Ching Wei Ho in which applying the heat operator to the characteristic polynomial of one random matrix model gives a new polynomial whose zeros resemble the eigenvalues of a second random matrix model. Then I will describe a general conjecture about the evolution of zeros of polynomials under the heat flow. Finally I will describe some recent rigorous results in this direction, obtained with Ching Wei Ho, Jonas Jalowy, and Zachar Kabluchko. The talk will be self contained and have lots of pictures.