Probabilistic Operator Algebra Seminar

Organizer: Dan-Virgil Voiculescu

December 11 **Maciej A. Nowak**, Mark Kac Center for Complex Systems Research, Jagellonian University Cracow

Title: *Towards applications of free random variables in cognitive science*

The study of neuronal interactions is currently at the center of several big collaborative neuroscience projects (including the Human Connectome Project, the Blue Brain Project, the Brainome, etc.). The scientific targets range from attempts to obtain a detailed map of the entire brain to the developments of new, biologically inspired architectures of artificial neural networks. I the talk I will give a few examples, how free random variables can make an impact on these targets. I will start from most conventional application of free random variables to the multivariate statistical inference in large sets of neuronal data. Then I will move to the modeling of real neuronal systems – in particular I will show how well-known Rajan Abbott model can be rephrased and extended in the language of free random variables. I will stress the role of non-normality of neuronal adjacency matrices and vital role of overlaps of right and left eigenvectors, which turn out to be the main source of entropy production in non-equilibrium systems and complex transient dynamic behavior. Finally, I conclude with a few remarks, how free random variables can help to understand the black-box magic of deep neural networks.