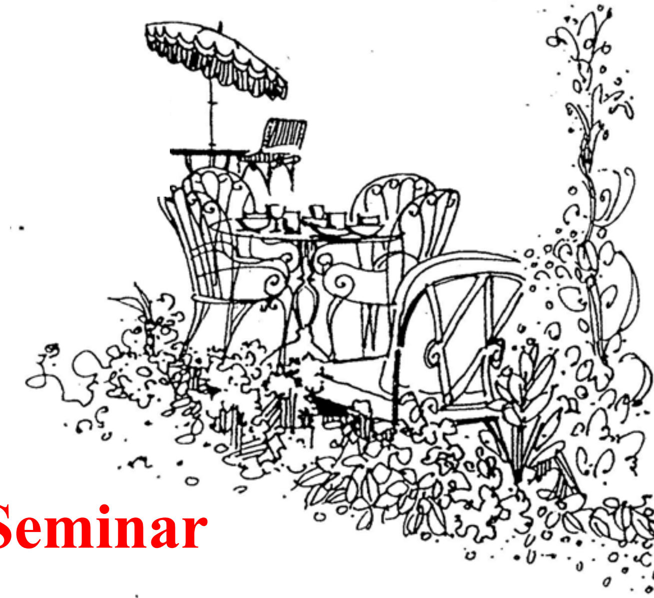
Chez Pierre

Presents ...

Monday, October 5, 2020

12:00pm Noon

Broadcast via Zoom



Chez Pierre Seminar

Soonwon Choi – Massachusetts Institute of Technology

"Symmetry and information flow in quantum circuits with measurements"

We will discuss novel quantum phases and phase transitions that emerge in the dynamics of quantum circuits and exhibit distinct modes of information flow. We consider a quantum system undergoing time evolution generated by random unitary gates which are occasionally interrupted by local measurements. It was previously found that such evolution leads to a phase transition in the entanglement of the wavefunction: at steady state it is characterized by volume law entanglement for small measurement rate, while it is an area law above a threshold rate. We investigate this phase transition by mapping the quantum dynamics into classical statistical mechanics models in equilibrium. Furthermore, we show that more phases are possible if we impose symmetries on the dynamics. To identify the phases, we develop a mapping between the dynamics in a broad class of quantum circuits to the ground states of effective spin Hamiltonians, which possess a higher symmetry than the original circuit. The different ground state phases admitted by the higher symmetry correspond to distinct patterns of information flow and scrambling in the circuit dynamics. We illustrate these ideas with two examples: (i) a quantum circuit with Z_2 symmetry resulting in non-abelian D_4 symmetry in an effective Hamiltonian and (ii) a quadratic fermionic circuit leading to U(1) symmetry. The latter exhibits Kosterlitz–Thouless transition in 1D between a critical phase with log(L) entanglement and "trivial" area law phases. Our work is a first step toward the classification of information flow in generic quantum circuits with symmetries.