Quantum cellular automata for quantum information processing

ROBERT RAUSSENDORF, Caltech, YIYANG GONG, Caltech — In this talk I discuss applications of simple quantum cellular automata in quantum information processing. A two-dimensional lattice of qubits is considered that has engineered defects (qubits missing) or a boundary of a suitable shape. The state of the system is updated by an alternation of simultaneous conditional phase gates between all pairs of next-neighboring qubits and simultaneous Hadamard transformations on all qubits. The system is “programmed” by the choice of the boundary shape. The following examples for applications are given: (1) transmission, (2) an encoding circuit, (3) encoded transmission through an error-detecting channel i.e., encoding, encoded transmission and decoding.