Fermilab Quantum Institute
Science Seminar

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"Efficient Circuit Decompositions using Intermediate Qudits"

Typical quantum computation is expressed in terms of qubits, or binary systems. In common quantum hardware, there is an infinite spectrum of discrete energy levels and the qubit abstraction is artificial: a quantum computer can be configured to operate on any number of d levels. Multivalued computation typically confers only constant advantage over binary when the entire computation is reencoded. When used temporarily, use of higher level states can confer asymptotic advantages. In this talk, I will introduce the basics of multivalued quantum computation and a few key examples of its application. In particular, I will examine some cases for temporary access to higher level states. First, I will present a generalized Toffoli decomposition which replaces ancilla with temporary access to the Ternary state. Second, I will present a method which allows us to generate ancilla using qubit-qudit compression, where the state of many qubits is stored in a smaller number of qudits resulting in clean ancilla. This generalizes the methods used in the Toffoli decomposition and extends to many arithmetic applications like adders.

Friday, April 24, 2020 @ 2:00pm

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