

量子情報処理

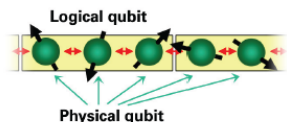
Quantum Information Processing

量子力学の特性を利用した革新的情報処理

Innovative Information Processing Using Quantum Dynamics

交換演算子だけを使った量子計算

Quantum Computation with Exchange Operations



量子回路設計

Designing Efficient Circuits for Quantum Algorithms

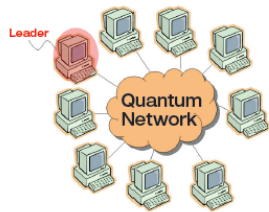


Small number of elementary operations

リーダー選挙問題

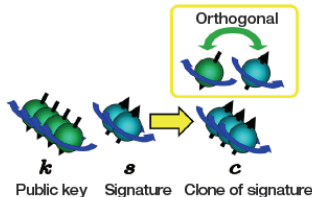
Quantum Leader Election

Computers collaborate to elect a unique leader from among them without fail.



量子ビットの性質

—量子通信の種となる性質の定量的評価—
Property of Qubits



$$\sum_{\eta=|s-k|/2}^{(s+k)/2} \frac{k!s!((2\eta+1)f(\eta)/16+g(\eta))}{c(\eta+1)\left(\frac{k+s}{2}-\eta\right)!\left(\frac{k+s}{2}+\eta+1\right)!}$$

$$f(\eta) = 4\eta + \eta(2\eta - 1) + \eta(\eta - 1)(2\eta - 1)(2\eta - 3) \\ g(\eta) = \eta + 1 + 2\eta - \eta(2\eta + 1) - \eta(2\eta - 1)\sqrt{\eta(\eta - 1)} + \eta(\eta - 1)\sqrt{\eta(\eta - 1)}$$

- 交換演算だけを用いて量子計算が実行できる事を証明
- 古典ネットワーク上では計算不能であることで有名な「一般化リーダー選挙問題」を計算する量子アルゴリズムを発見
- 超高速アルゴリズムを少ない計算資源で実行する量子回路を設計
- 量子通信に役立つ量子ビットの性質を定量的に評価

- Quantum computation is proven to be performed solely with exchange operations.
- Quantum algorithms for the celebrated generalized leader election problem, provably unsolvable on classical networks, are invented.
- Efficient circuits for quantum algorithms are designed with combinatorial
- Qubits' property useful for quantum communication is quantitatively evaluated.