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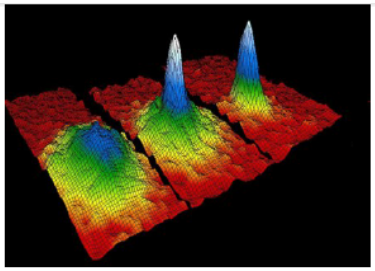
ボーズ・アインシュタイン凝縮を用いた新型の量子コンピュータ

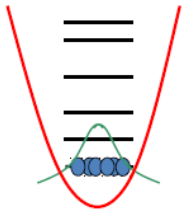
Quantum Information with Bose-Einstein Condensates

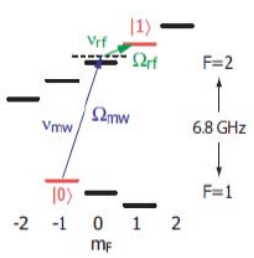
SCIENCE PLAZA 2014

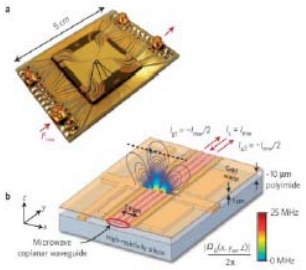
Motivation

Quantum computers offer the promise of very fast computation of certain types of computational problems. This includes problems such as factoring numbers, simulating quantum many-body problems, and database search. Here we describe what physical systems are being considered for building a quantum computer today, and our research about using Bose-Einstein condensates for the use in quantum information.





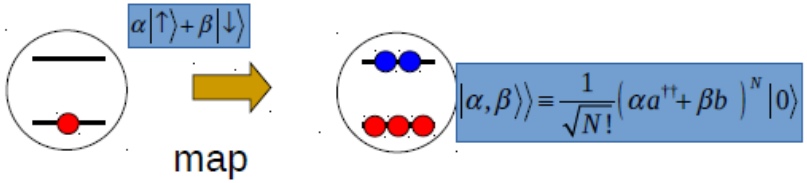




Recent advances in atom chip BEC technology has allowed for the coherent control of BECs between hyperfine states, which may be used as qubits tates. Strong coupling between an optical cavity has also been achieved

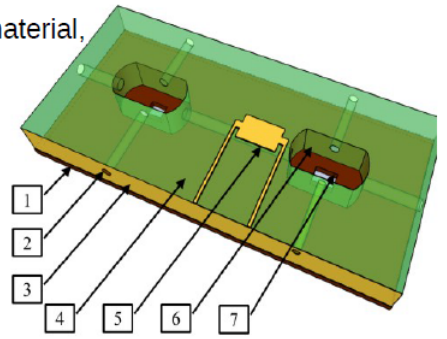
Originality and Impact

Our research focuses on using Bose-Einstein condensates (BECs) as a way of storing quantum information. Using two different types of bosons in the BEC it is possible to store and manipulate them such that quantum algorithms can be executed in the same way as standard qubits. We illustrate this by a simulation of Grover's algorithm on BECs which shows the same quadratic speedup as standard qubits.



The qubit states here are not simple a two level system, but macroscopic collective states which have the form. *Byrnes Phys. Rev A* ***85*** *040306(R) (2012)*

①Permanent magnetic material,
②Silica-waveguide,
③Reflective coating,
④Fused silica,
⑤Thermal phase-shifter,
⑥Optical micro-cavity,
⑦Magnetic trap.



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Our approach for atomchip: Magnetic Traps within cavities QED

Abdelrahman Opt. Exp. 22, 3501 (2014); Ilo-Okeke Phys. Rev. Lett. 112, 233602 (2014); Byrnes Phys. Rev A 88, 023609 (2013); Pyrkov New J. Phys. 15, 093019 (2013); Hussain Phys. Rev. A 89 053607 (2014).

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