MAR07-2006-020084

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Vacuum Rabi oscillations observed in a flux qubit LC-oscillator system[1]

KOUICHI SEMBA, NTT Basic Research Laboratories, NTT Corporation

Superconducting circuit containing Josephson junctions is one of the promising candidates as a quantum bit (qubit) which is an essential ingredient for quantum computation [1]. A three-junction flux qubit [2] is one of such candidates. On the basis of fundamental qubit operations [3,4], the cavity QED like experiments are possible on a superconductor chip by replacing an atom with a flux qubit, and a high-Q cavity with a superconducting LC-circuit. By measuring qubit state just after the resonant interaction with the LC harmonic oscillator, we have succeeded in time domain experiment of vacuum Rabi oscillations, exchange of a single energy quantum, in a superconducting flux qubit LC harmonic oscillator system [5]. The observed vacuum Rabi frequency 140 MHz is roughly 2800 times larger than that of Rydberg atom coupled to a single photon in a high-Q cavity [6]. This is a direct evidence that strong coupling condition can be rather easily established in the case of macroscopic superconducting quantum circuit. We are also considering this quantum LC oscillator as a quantum information bus by sharing it with many flux qubits, then spatially separated qubits can be controlled coherently by a set of microwave pulses. [1] F. Wilhelm and K. Semba, in Physical Realizations of Quantum Computing: Are the DiVincenzo Criteria Fulfilled in 2004?, (World Scientific; April, 2006) [2] J. E. Mooij *et al.*, Science **285**, 1036 (1999). [3] T. Kutsuzawa *et al.*, Appl. Phys. Lett. **87**, 073501 (2005). [4] S. Saito *et al.*, Phys. Rev. Lett. **96**, 107001 (2006). [5] J. Johansson *et al.*, Phys. Rev. Lett. **93**, 127006 (2006). [6] J. M. Raimond, M. Brune, and S. Haroche, Rev. Mod. Phys. **73**, 565 (2001).

[1]This work was partially supported by JSPS KAKENHI (18201018), MEXT KAKENHI (18001002) and JST-CREST.