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**Deep strong coupling in a circuit QED system - huge Lamb shift**
-[1] TOMOKO FUSE, FUMIKI YOSHIHARA, National Institute of Information and Communications Technology, SAHEL ASHHAB, Qatar Environment and Energy Research Institute, Hamad Bin Khalifa University, KOUICHI SEMBA, National Institute of Information and Communications Technology — Among a variety of cavity/circuit-QED systems, circuits employing superconducting flux qubits as artificial atoms can achieve large coupling strengths because of the flux qubit's huge magnetic moment [1-3]. Using a flux qubit and a compact superconducting LC oscillator, we have realized so-called deep strong coupling between the qubit and the oscillator, where $g/\omega_o/2\pi = 1.3$ ($g$: coupling strength, $\omega_o/2\pi$: bare oscillator frequency) [1]. The measured spectra of the coupled system are well described with the Hamiltonian of Rabi model. The bare qubit frequency $\Delta/2\pi$ is found to be 3.8 GHz, and the theoretical model predicts that the frequency of the qubit, $\omega_{01}$, will be suppressed to 0.5 GHz, indicating an extraordinary large Lamb shift of about $0.85\Delta$. Recently, we have measured the spectrum of $\omega_{01}/2\pi$, by driving $\omega_{01}/2\pi$ and probing $\omega_{03}/2\pi$. In this presentation, the measured spectroscopy data will be shown.
[1] F. Yoshihara, T. Fuse, et al., Nature Physics (2016) doi:10.1038/nphys3906. [2] P. Forn-Diaz, et al., Nature Physics (2016) doi:10.1038/nphys3905. [3] S. Ashhab and F. Nori, PRA 81, 042311 (2010).

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