J Astrophys Aerospace Technol 2017, 5:2 (Suppl)
DOI: 10.4172/2329-6542-C1-009

Quantum simulation of interaction between atom and light

Masao Hirokawa
Hiroshima University, Japan

At the dawn of the 21st century, the solid-state analogue of the interaction between atom and light in a superconducting system was theoretically proposed by Yu. Makhilin, G. Schön, and A. Shnirman and by F. Marquardt and C. Bruder It has been experimentally demonstrated by I. Chiorescu, *et al.* and by A. Wallraff, *et al.* In that solid-state analogue, an artificial atom and a microwave are used respectively for the atom and the light. The interaction is made near a microwave resonator on a superconducting circuit. Here, the artificial atom is made by using a superconducting LC circuit. The harmonic oscillator atom is obtained in the case without any Josephson junction, and the 2-level atom is based on the anharmonicity coming from Josephson junctions. Their current cutting-edge technology is beginning to show us the ultra-strong coupling regime or the deep-strong coupling regime of the atom-light interaction beyond its standard regime of quantum electrodynamics, which is even equal to that of quantum chromodynamics. For instance, more than 10% atom-light interaction has been demonstrated in the experiment by F. Yoshihara, *et al.* I would like to introduce the following subjects on quantum simulation using the artificial atom on the superconducting circuit. I chiefly talk about 1) the duality between a dark state and a quasi-dark state for an artificial atom coupled to both the photon and phonon fields in an optomechanical system. In addition to this, if we have time, I will also talk about; 2) the dressed photon and the Schrödinger-cat-like entangled ground state of the general quantum rabi model; and 3) the possibility of the conversion from virtual photon to real photon in a ground state of that model.

mhirokaw@hiroshima-u.ac.jp