

Project Title:

**Quantum electrodynamics in microwave regime
in superconducting electrical circuits**

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I would like to continue to use the RICC cluster for quantum dynamics calculations and for calculating properties of cavity-QED and transmission-line-QED systems based on superconducting circuits with Josephson junctions. Such systems are recently receiving increasing attention for their potential to implement quantum optics like experiments in controlled and engineered electrical circuits. In particular, I would like to calculate the spectral properties of single-artificial-atom lasers and parametrically driven cavity-QED systems that recently have been implemented experimentally by other groups in Japan and abroad.

This is a continuation of the project from the previous fiscal year. Only a limited amount numerical calculations has yet been made using the RICC for this project. This is due to an incompatibility with our existing code with the RICC system. However, I have recently manage to port our code for simulation of quantum systems in superconducting electrical circuit to the RICC system, and expect to be able to do more calculations on this topic during the next fiscal year.

Fiscal Year 2010 List of Publications Resulting from the Use of RICC

[Publication]

J.R. Johansson, G. Johansson, C.M. Wilson, and Franco Nori, Dynamical Casimir effect in superconducting microwave circuits, Phys. Rev. A 82, 052509 (2010).

The paper is mainly theoretical, however supporting calculations were done on RICC to verify some of the theoretical results, but these numerical calculations was not included in the final version of the manuscript and thus no acknowledgement. We expected to be able to continue work on this topic and including more numerically oriented work that would benefit greatly from the RICC system during the next year.

[Proceedings, etc.]

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[Oral presentation at an international symposium]

The above-mentioned work was featured in poster and oral presentations in a number of international conferences in Japan (at RIKEN, at NII in Tokyo, and at NTT BRL in Hon atsugi) as well as abroad at the US March meeting as well as in Europe.