

## Quantum information processing, quantum hybrid circuits, superconducting qubits

### Objective

Achieving a better understanding of quantum information processing, quantum hybrid circuits, superconducting qubits, quantum simulators, opto-mechanics, and related systems.

### Summary of Research Activities

- We have performed research on various aspects of quantum information processing, quantum hybrid circuits, superconducting qubits, quantum simulators, opto-mechanics, and related systems.
- These interdisciplinary studies often involve hybrid structures; e.g., superconductors and semiconductors, photons and electrons, or various (electromagnetic and/or mechanical) resonators coupled to other quantum systems and exchanging energy with them.
- Electronics, photonics, hybrid systems, and quantum information processing are overarching themes in our research.

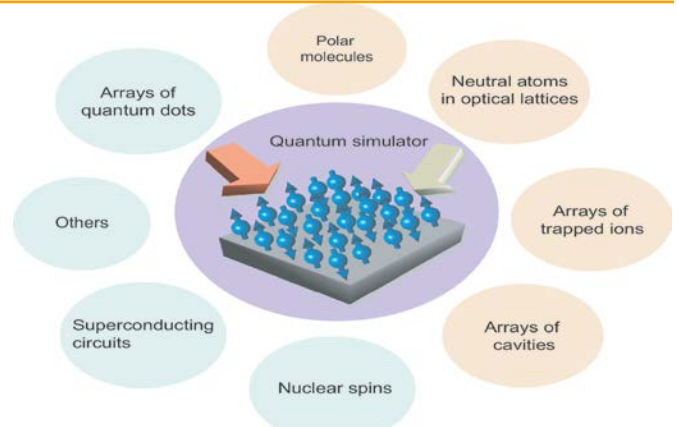


Fig. 1: Quantum Simulator (from the Jan 2014 cover of RMP)

### Publications

- I. Georgescu, S. Ashhab, F. Nori, *Quantum Simulation*, Rev. Mod. Phys., in press (2014). [[arXiv](#)] Cover story of the Jan-March 2014 issue of RMP. Listed here: <http://rmp.aps.org/#tabcontent-accepted> and available online here: <http://arxiv.org/abs/1308.6253>.
- C. Emary, N. Lambert, F. Nori, *Leggett-Garg Inequalities*, Reports on Progress in Physics **77**, 016001 (2014). [[PDF](#)][[Link](#)][[arXiv](#)]
- W. Cui, F. Nori, *Feedback Control of Rabi Oscillations in Circuit QED*, Phys. Rev. A **88**, 063823 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- C.P. Yang, Q.P. Su, F. Nori, *Entanglement generation and quantum information transfer between spatially-separated qubits in different cavities*, New J. Phys. **15**, 115003 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- N. Lambert, C. Flindt, F. Nori, *Photon-mediated electron transport in hybrid circuit-QED*, EPL **103**, 17005 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- Y. Ota, K. Kobayashi, M. Machida, T. Koyama, F. Nori, *Full Numerical Simulations of Dynamical Response in Superconducting Single-Photon Detectors*, IEEE Transactions on Applied Superconductivity **23**, 2201105 (2013). [[PDF](#)][[Link](#)]
- A. Shvetsov, A.M. Satanin, F. Nori, S. Savel'ev, A.M. Zagoskin, *Quantum metamaterial without local control*, Phys. Rev. B **87**, 235410 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- Z.-L. Xiang, S. Ashhab, J.Q. You, F. Nori, *Hybrid quantum circuits: Superconducting circuits interacting with other quantum systems*, Rev. Mod. Phys. **85**, 623 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- X.-Y. Lu, Z.-L. Xiang, W. Cui, J.Q. You, F. Nori, *Quantum memory using a hybrid circuit with flux qubits and NV centers*, Phys. Rev. A **88**, 012329 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- Z.-L. Xiang, X.-Y. Lu, T.-F. Li, J.Q. You, F. Nori, *Hybrid quantum circuit consisting of a superconducting flux qubit coupled to a spin ensemble and a transmission-line resonator*, Phys. Rev. B **87**, 144516 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- J.R. Johansson, G. Johansson, C.M. Wilson, P. Delsing, F. Nori, *Nonclassical microwave radiation from the dynamical Casimir effect*, Phys. Rev. A **87**, 043804 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- J.R. Johansson, P.D. Nation, F. Nori, *QuTiP 2: A Python framework for the dynamics of open quantum systems*, Comp. Phys. Comm. **184**, 1234 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- J.Q. Liao, F. Nori, *Single-photon emission and scattering in quadratically-coupled optomechanical models*, (2013). [[arXiv](#)]
- J.Q. Liao, F. Nori, *Photon blockade in quadratically coupled optomechanical systems*, Phys. Rev. A **88**, 023853 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]
- J.-Q. Liao, Q.-Q. Wu, F. Nori, *Entangling two macroscopic mechanical mirrors in a two-cavity optomechanical system*, Phys. Rev. A **89**, 014302 (2014). [[PDF](#)][[Link](#)][[arXiv](#)]
- X.Y. Lü, W.M. Zhang, S. Ashhab, Y. Wu, F. Nori, *Quantum-criticality-induced strong Kerr nonlinearities in optomechanical systems*, Scientific Reports **3**, 2943 (2013). [[PDF](#)][[Link](#)][[arXiv](#)]