Abstract Submitted
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Giant photon gain in large-scale quantum circuit-QED systems: Diagrammatic non-equilibrium Green's function approach BIJAY AGARWALLA, Department of Chemistry, University of Toronto, Canada, MANAS KULKARNI, International Center for Theoretical Sciences, Tata Institute of Fundamental Research, Bangalore, India, SHAUL MUKAMEL, Department of Chemistry, University of California, Irvine, USA, DVIRA SEGAL, Department of Chemistry, University of Toronto, Canada — Motivated by recent experiments on the generation of coherent light in engineered hybrid quantum systems, we investigate gain in a microwave photonic cavity coupled to quantum dot structures and develop concrete directions for achieving a giant amplification in photon transmission by employing the Keldysh NEGF technique [1]. We propose two architectures for scaling up the electronic gain medium: (i) N double-quantum-dot systems and (ii) M quantum dots arranged in series akin to a quantum cascade laser setup. In both setups, the fermionic reservoirs are voltage biased, and the quantum dots are coupled to a single-mode cavity. Optical amplification is explained based on a sum rule for the transmission function, and it is determined by an intricate competition between two different processes: charge-density response in the gain medium and cavity losses to input and output ports [2]. The same design principle is also responsible for the corresponding giant amplification in other photonic observables, mean photon number, and emission spectrum, thereby realizing a quantum device that behaves as a giant microwave amplifier.

Agarwalla et al, Phys. Rev. B 94, 035434 (2016)

Agarwalla et al, Phys. Rev. B 94, 121305(R) (2016).

Bijay Agarwalla
Department of Chemistry, University of Toronto

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