QuanTalks

IISc Quantum Technologies Initiative (IQTI) Seminar Series

Title: Engineering symmetry-selective couplings of a superconducting artificial molecule to microwave waveguides

Speaker: Dr. Aamir Ali

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Biography: Aamir Ali obtained his BSc. degree in Physics (Honours) from St. Xavier's College, Kolkata in 2009. He carried on to the Integrated PhD program in Physics in Indian Institute of Science, Bangalore. Under the supervision of Prof. Arindam Ghosh, he carried out his PhD work in condensed matter physics in semiconductor heterostructures and bilayer graphene. After obtaining his PhD. in 2017, he moved for postdoctoral research with Prof. Dmitri Efetov in Institute of Photonic Sciences, Spain. There, he learned techniques based on microwave electronics techniques and developed a proof-of-principle calorimeter that performed the first ever measurement of the electronic heat capacity of graphene. Next, he switched his research field to superconducting quantum circuits after moving to the group of Prof. Simone Gasparinetti in the recently formed Wallenburg Centre for Quantum Technology (WACQT) in Chalmers University of Technology, Sweden. The Centre is dedicated to a 12-year, ~100 million Euros Swedish program to build a quantum computer and increase industrial awareness of the opportunities offered by quantum technology. His focus here is in the development of an emerging field of quantum thermodynamics based on superconducting quantum circuits. It addresses the fundamental physics of how quantum-mechanical effects on thermodynamics; as well as applications such as energy management in quantum technology.

Date & time

Thursday, 2nd June 2022, 4 PM IST

Abstract: Tailoring the decay rate of structured quantum emitters into their environment opens new avenues for nonlinear quantum optics, collective phenomena, and quantum communications. Here we demonstrate a novel coupling scheme between an artificial molecule comprising two identical, strongly coupled transmon qubits, and two microwave waveguides. In our scheme, the coupling is engineered so that transitions between states of the same (opposite) symmetry, with respect to the permutation operator, are predominantly coupled to one (the other) waveguide. The symmetry-based coupling selectivity, as quantified by the ratio of the coupling strengths, exceeds a factor of 30 for both the waveguides in our device. In addition, we implement a two-photon Raman process activated by simultaneously driving both waveguides and show that it can be used to coherently couple states of different symmetry in the single-excitation manifold of the molecule. Using that process, we implement frequency conversion across the waveguides, mediated by the molecule, with efficiency of about 95%. Finally, we show that this coupling arrangement makes it possible to straightforwardly generate spatially-separated Bell states propagating across the waveguides. We envisage further applications to quantum thermodynamics, microwave photodetection, and photon-photon gates.

Meeting Link: Click here to join the Webinar

Venue: **Physics Department Auditorium, IISc.** Tea/Coffee at 3: 45 PM

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