Programmable quantum interference between two superconducting cavities

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Date: 3 July 2020, Friday
Time: 4:00 PM
Venue: Remote via Zoom Join (Meeting ID: 893 1651 7823, Password: 722275)
https://us02web.zoom.us/j/89316517823?pwd=TXBOc2M5bIFrYVI1MFVGTk12T1pqZz09
Host: Associate Professor David Wilkowski

Abstract

Interference between particles is one of the simplest and yet most elegant demonstrations of quantum mechanics. It provides insights into fundamental scientific problems and enables technological applications such as quantum computing and cryptography. Pioneering experiments often used optical photons, which interfere readily through simple beam splitters. However, studying more complex interference phenomena requires the ability to create, manipulate, and measure arbitrary quantum states. While these tasks are challenging for photons flying along an optical fiber, high-quality experiments can be performed on trapped particles. We show that it is possible to combine the best of both worlds in a single system where we have the ability to prepare and control exotic quantum states, as well as the capability to switch on a robust and tunable coupling between them.

We engineered a time-dependent bilinear coupling that can be tuned to implement a robust beam splitter between two superconducting cavities and realize a high quality Hong-Ou-Mandal interferometer between them. We also efficiently probe the quantum state overlap between two multiphoton states. Lastly, we combine our beam splitter with on-demand differential phase shifters to create a programmable Mach-Zehnder interferometer that is capable of manipulating two-photon interference on the fly. Our results pave the way towards scalable boson sampling, linear optical quantum computing in the microwave domain, and quantum algorithms between long-lived bosonic memories.

Short Biography

Yvonne is a Principal Investigator in the Centre for Quantum Technologies and a Presidential Young Professor in the Department of Physics, National University of Singapore. Her team works on building robust quantum hardware using superconducting microwave circuits. Their devices provide useful new avenues to develop novel techniques for quantum information processing as well as to explore interesting effects in quantum physics. Yvonne received her B.A in Physics from the University of Oxford and Ph.D from Yale University. She is also a recipient of the Singapore National Research Foundation (NRF) Fellowship (Class 2020) and MIT Tech Review’s Innovator’s Under 35 (Asia-Pacific) award.

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