Speaker: Gautham Umashankar, Dept. of Physics, Yale University, US

Time and venue: October 17, 2025; 4:00 PM; DCF, Dept. of Physics, HSB-226B

Title: Dynamically modulated oscillator-qubit interactions for error-resilient bosonic control

Abstract:
Strong light-matter interactions are key to quantum technologies. In superconducting circuits, a strong dispersive coupling between linear microwave oscillators (light) and nonlinear qubits (matter) is used to enable universal bosonic control and error correction. Bosonic modes like cavity resonators have a large Hilbert space and high coherence, which make them a powerful resource for quantum information. However, this always-on dispersive interaction propagates errors from ancillary qubits to the bosonic systems both while idling and performing operations. This talk will present a way to parametrically activate the interaction between the bosonic modes and the ancilla qubits, keeping both elements decoupled when not active [1]. This enables time-dependent dispersive interactions which can realize ancilla-fault-tolerant bosonic control. The talk will also introduce a new linear quantum coupler [2], and present data from an architecture that implements dynamic oscillator-qubit interactions using this coupler. The dispersive coupling can be modulated by four orders of magnitude within 100 ns in this architecture, from a value smaller than some of the smallest rates of decoherence in the system to a value large enough to implement high-fidelity bosonic control.

References:

1. APS Global Physics Summit 2025 - Talk C33.09
2. A Linear Quantum Coupler for Clean Bosonic Control - https://arxiv.org/pdf/2501.1802