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M3Or3C-02 [Invited]: Engineering nonlinear dissipation across two superconducting cavity modes

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Dissipation engineering has emerged in recently years as a promising way to allow efficient control of complex quantum systems. The key ingredient for such dissipative quantum control is to synthesize non-trivial dissipation operators (jump operators), such as linear superposition of photon loss in two oscillators or (nonlinear) two-photon loss in one oscillator. In this talk we present experiments towards synthesizing various nonlinear jump operators across two oscillator modes. Our system employs a 3D cQED device architecture that has two quantum memory modes and one reservoir mode (potentially two) that are coupled via transom qubit(s). The system has shown the capability to couple two highly-coherent oscillator modes to a reservoir (readout) mode and to implement four-wave mixing. We leverage these coherent multi-body interactions to engineer cross-cavity two-photon driven dissipation, with further extension to arbitrary 2nd order polynomial of creation/annihilation operators of two cavities.

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