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**Amplitude Bistability in the Multimode Regime of Circuit-QED**
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In theory of dynamical systems, bistability refers to a situation where the system has two possible stable equilibrium states. For certain optical devices, it is possible to have two resonant transmission states that only differ in amplitude and is referred as "optical amplitude bistability." This phenomenon occurs due to nonlinear nature of light-matter interaction where the light absorption or blockade by the absorber strongly depends on the drive strength. The transition between these two bistable solutions happens when the absorber is saturated and no longer capable of blocking light. In this talk, we study the dynamics of a transmon qubit coupled to a large number of modes of a long superconducting resonator and driven by an external microwave drive. We introduce a generalized theory of multimode amplitude bistability first discussed by C.M. Savage and H.J. Carmichael [1] for a resonant single mode cavity. We will demonstrate that bistability is a characteristic of the entire system including the qubit and all modes of the resonator and can be characterized analytically by the knowledge of two collective cooperativity parameters.

[1] IEEE JOURNAL OF QUANTUM ELECTRONICS, VOL. 24, NO. 8, AUGUST 1988

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