

Abstract Submitted  
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**Design of multimode parametric devices for quantum-limited directional amplification** LEONARDO RANZANI, Raytheon BBN Technologies, FLORENT LECOCQ, GABE PETERSON, KATARINA CIOK, RAYMOND SIMMONDS, JOHN TEUFEL, JOE AUMENTADO, National Institute of Standards and Technology — Parametric interactions provide near quantum-limited amplification of weak microwave signals, which results in enhanced measurement fidelity of quantum information circuits. While conventional Josephson parametric amplifiers consist of a resonator driven by a single strong microwave pump, it was recently realized that multiple parametric interactions can be combined to provide novel functionalities, such as nonreciprocal propagation and directional amplification. Such operations can be implemented in a single device by simultaneously turning on a set of parametric processes between multiple resonant modes. In this talk we are going to discuss the design of multi-mode parametric devices and their signal and noise properties. We will begin with the basic building modules consisting of either two or three mutually coupled modes and connect them in a modular fashion to build more complex coupling topologies. The resulting devices provide programmable routing and quantum-limited amplification of microwave signals with low backaction on the device under test.

Leonardo Ranzani  
Raytheon BBN Technologies

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