



**Approaching the quantum limit of amplification  
with Josephson microwave circuits**

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Quantum Mechanics puts a limit on how small the degradation of information passing through an amplifier can be. It is known theoretically that the minimum noise added by an "op-amp"-like amplifier to the signal amounts at least to half a photon at the signal frequency.

Can we develop a practical amplifier working at microwave frequencies that would approach this quantum limit? We will present a new type of amplifier which is based on a ring of four Josephson tunnel junctions. Unlike the SQUID, which is powered by a DC source, our amplifier is powered by an RF source, and its backaction noise is minimal.

Our results [1] can immediately be applied to the readout of solid state qubits, and, on a longer time scale, to the measurement of very weak signals in various areas of science.

[1] Bergeal et al., Nature 465, 64 (2010)