Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

A flux-driven Josephson parametric amplifier for experiments with propagating quantum microwaves[1] E.P. MENZEL, A. BAUST, F. DEPPE, T. NIEMCZYK, E. HOFFMANN, M. HAEBERLEIN, A. MARX, R. GROSS, Walther-Meissner-Institut and TU Muenchen, Garching, Germany, E. SOLANO, Universidad del Pais Vasco and IKERBASQUE Foundation, Bilbao, Spain, K. INOMATA, RIKEN, Wako-shi, Japan, T. YAMAMOTO, Y. NAKAMURA, NEC, Tsukuba and RIKEN, Wako-shi, Japan — For the detection of propagating quantum microwaves in circuit QED linear amplifiers are key ingredients. Phase sensitive amplifiers [e.g., Josephson parametric amplifiers (JPA)] in principle allow for the amplification of one signal quadrature without adding noise. In practice, however, internal losses often introduce a finite amount of noise. We have recently shown that, despite such a residual noise, signals on the quantum level can be fully characterized using two amplification chains and suitable correlations [E.P. Menzel et al., PRL 105, 100401 (2010)]. In this work, we characterize a flux-driven JPA. At 5.64 GHz the maximum degenerate gain is 25.5 dB and the signal bandwidth is 1.8 MHz. Phase-insensitive measurements yield a noise temperature of 100 ± 20 mK, which is below the standard quantum limit of 135 mK.

[1]This work is supported by SFB 631, NIM, Basque Government IT4720-10, Spanish MICINN FIS2009-12773-C02-01, and EU project SOLID.

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Date submitted: 27 Dec 2010 Electronic form version 1.4