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Fourth order dispersive regime of circuit QED with a transmon and a CJBA MAXIME BOISSONNEAULT, ALEXANDRE BLAIS, Universite de Sherbrooke, F. ONG, A. PALACIOS-LALOY, F. MALLET, P. BERTET, D. VION, D. ESTEVE, CEA Saclay — In most of the recent circuit QED experiments [1,2], a transmon qubit [3] is fabricated inside a transmission-line resonator. While the transmon qubit has the advantage of providing both better coupling and longer dephasing time than the Cooper-pair box, its anharmonicity is also reduced. Higher levels must therefore be taken into account. We study a transmon coupled to a cavity bifurcation amplifier (CJBA) in the dispersive regime, where the qubit-resonator detuning is larger than the coupling strength. Building on previous work [4], we use perturbation theory to fourth order and obtain analytical solutions for the system. We compare these to numerical simulations and experimental data and analyze how the non-linearity of the CJBA and higher transmon levels affect the physics of the system. We finally show how the many-level structure of this system can be used to help for the measurement. [1] DiCarlo et al, Nature, 2009, 460, 240, [2] Mallet et al, Nat. Phys, 2009, 5, 791, [3] Koch et al, PRA, 2007, 76, 042319, [4] Boissonneault et al, PRA, 2008, 77, 060305(R)

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