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Dynamic quantum Kerr effect in circuit quantum electrodynamics YI YIN, HAOHUA WANG, MATTEO MARIANTONI, RAMI BARENDS, RADOSLAW C. BIALCZAK, YU CHEN, MIKE LENANDER, JULIAN KELLY, ERIK LUCERO, ANTHONY MEGRANT, PETER O'MALLEY, DANIEL SANK, JIM WENNER, TED WHITE, ANDREW CLELAND, JOHN MARTINIS, University of California, Santa Barbara — In the dispersive regime of circuit quantum electrodynamics (QED), where the qubit and resonator frequencies differ slightly, photons in the resonator exhibit induced frequency and phase shifts. The qubit-state dependent phase shift is usually measured by monitoring the resonator transmission spectrum at fixed qubit-resonator detuning. In this static scheme, the phase shift can only be monitored in the far-detuned, linear dispersion regime, in order to avoid measurement-induced demolition of the quantum state. By using a dynamic procedure to adiabatically drive the qubit frequency, here we are able to explore the dispersive interaction over a much broader range, and we further monitor the interaction using resonator Wigner tomography. Exotic non-linear effects on different photon states, e.g., Fock states, coherent states and Schrodinger cat states, are thereby directly revealed. Correspondingly, we demonstrate a quantum Kerr effect in the dynamic framework in circuit QED.

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