Quantum Rabi Oscillation: A Direct Test of Field Quantization in a Cavity

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We have observed the Rabi oscillation of circular Rydberg atoms in the vacuum and in small coherent fields stored in a high Q cavity. The signal exhibits discrete Fourier components at frequencies proportional to the square root of successive integers. This provides direct evidence of field quantization in the cavity. The weights of the Fourier components yield the photon number distribution in the field. This investigation of the excited levels of the atom-cavity system reveals nonlinear quantum features at extremely low field strengths.