Selected Abstracts from Other Physical Review Journals

Abstracts of papers that are published in other Physical Review journals and may be of interest to Physical Review A readers are printed below.

Chaos and flights in the atom-photon interaction in cavity QED. S. V. Prants, *Laboratory of Nonlinear Dynamical Systems, Viktor Il'ichev Pacific Oceanological Institute of the Russian Academy of Sciences, 2690041 Vladivostok, Russia;* M. Edelman, *Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012;* G. M. Zaslavsky, *Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012, and Department of Physics, New York University, 2-4 Washington Place, New York, New York 10003.* (Received 11 December 2001; revised manuscript received 6 June 2002; published 30 October 2002)

We study dynamics of the atom-photon interaction in cavity quantum electrodynamics, considering a cold two-level atom in a single-mode high-finesse standing-wave cavity as a nonlinear Hamiltonian system with three coupled degrees of freedom: translational, internal atomic, and the field. The system proves to have different types of motion including Lévy flights and chaotic walkings of an atom in a cavity. The corresponding equations of motion for expectation values of the atom and field variables have two characteristic time scales: fast Rabi oscillations of the internal atomic and field quantities and slow translational oscillations of the center of the atom mass. It is shown that the translational motion, related to the atom recoils, is governed by an equation of a parametric nonlinear pendulum with a frequency modulated by the Rabi oscillations. This type of dynamics is chaotic with some width of the stochastic layer that is estimated analytically. The width is fairly small for realistic values of the control parameters, the normalized detuning δ and atomic recoil frequency α. We consider the Poincaré sections of the dynamics, compute the Lyapunov exponents, and find a range of the detuning, $|\delta| \lesssim 3$, where chaos is prominent. It is demonstrated how the atom-photon dynamics with a given value of α depends on the values of δ and initial conditions. Two types of Lévy flights, one corresponding to the ballistic motion of the atom and the other corresponding to small oscillations in a potential well, are found. These flights influence statistical properties of the atom-photon interaction such as distribution of Poincaré recurrences and moments of the atom position x. The simulation shows different regimes of motion, from slightly abnormal diffusion with $\langle x^2 \rangle \sim \tau^{1.13}$ at $\delta = 1.2$ to a superdiffusion with $\langle x^2 \rangle \sim \tau^{2.2}$ at $\delta = 1.92$ that corresponds to a superballistic motion of the atom with an acceleration. The obtained results can be used to find new ways to manipulate atoms, to cool and trap them by adjusting the detuning δ. [Phys. Rev. E **66**, 046222 (2002)]

Method for direct observation of coherent quantum oscillations in a superconducting phase qubit. Ya. S. Greenberg,[1] A. Izmalkov,[1] M. Grajcar,[2] E. Il'ichev,[1] W. Krech,[2] and H.-G. Meyer[1]
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Time-domain observations of coherent oscillations between quantum states in mesoscopic superconducting systems have so far been restricted to restoring the time-dependent probability distribution from the readout statistics. We propose a method for *direct* observation of Rabi oscillations in a phase qubit. The external source, typically in GHz range, induces transitions between the qubit levels. The resulting Rabi oscillations of supercurrent in the qubit loop induce the voltage oscillations across the coil of a high quality resonant tank circuit, inductively coupled to the phase qubit. It is the presence of these voltage oscillations in the detected signal which reveals the existence of Rabi oscillations in the qubit. A detailed calculation for zero and nonzero temperatures are made for the case of persistent current qubit. According to the estimates for decoherence and relaxation times, the effect can be detected using conventional rf circuitry, with Rabi frequency in the MHz range. [Phys. Rev. B **66**, 224511 (2002)]

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