DAMOP09-2009-000084

Abstract for an Invited Paper
for the DAMOP09 Meeting of
the American Physical Society

Synthesizing arbitrary photon states in a superconducting resonator: The quantum digital to analog converter

JOHN MARTINIS, UC Santa Barbara

Two-level systems, or qubits, can be prepared in arbitrary quantum states with exquisite control, just using classical electrical signals. Achieving the same degree of control over harmonic resonators has remained elusive, due to their infinite number of equally spaced energy levels. Here we exploit the good control over a superconducting phase qubit by using it to pump photons into a high-Q coplanar wave guide resonator and, subsequently, to read out the resonator state. This scheme has previously allowed us to prepare and detect photon number states (Fock states) in the resonator and to measure their decay. Using a generalization of this scheme by Law and Eberly, we can now create arbitrary quantum states of the photon field with up to approximately 10 photons. We analyze the prepared states by directly mapping out the corresponding Wigner function, which is the phase-space equivalent to the density matrix and provides a complete description of the quantum state.