

An artificial atom in a transmission line as a quantum sensor

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Superconducting quantum systems in an open space allow one to reproduce textbook phenomena of quantum optics on a new basis of fully controllable artificial quantum systems (artificial atoms). Such systems, differently from natural atoms, can be easily coupled to the environment and other circuit elements and therefore new quantum optical phenomena can be demonstrated with the single quantum systems. Particularly, the artificial atoms can be strongly coupled to an open 1D space of transmission lines. We demonstrate the strong coupling regime of the two-level artificial atom. This implies that the atom relaxes with the photon emission into the line and non-radiative relaxation as well as dephasing are negligible. With the strong coupling we were able to experimentally realise a series of phenomena, useful for applications, using the artificial atom as a quantum source and sensor of specific properties of light. Some of those phenomena are a tuneable on-demand single-photon source, an absolute power sensor, a quantum wave mixer, etc. All these effects either can not be demonstrated with natural atoms or extremely difficult.