Superconducting Quantum Circuits

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Abstract: The principles of quantum mechanics were introduced about a hundred years ago to explain the properties of microscopic systems like atoms and molecules. Recently, macroscopic systems in the form of electrical circuits containing billions of atoms have attained sufficient perfection that radiofrequency currents circulating in their wires can constitute single photons controllably exchanged with a measurement apparatus. These quantum circuits exploit both the dissipation-less character of superconductivity and the non-linearity of the Josephson effect. It is even now possible to design such macroscopic "artificial atoms" to perform functions unattainable with natural ones. Superconducting integrated circuits serving as quantum bits illustrate the problem of engineering a quantum electrodynamic system from top to bottom. A simple Lego-like set of three basic elements - linear capacitances, linear inductances and non-linear Josephson inductances - can be combined with almost no limitations. Can circuit architecture mitigate or even eliminate decoherence due to unavoidable defects of basic electrical components? This key question addressed to superconducting quantum bits will be discussed starting from the present entries of their "Mendeleev table".