

## Atom Oscillators and Other Atom-Based Circuits

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It is a delightfully unintuitive fact that one can cultivate a faithful analog of electronics using ultracold neutral atoms by substituting chemical potential for electric potential and atom flux for electric current. The term “atomtronics” is meant to invoke a metaphor that brings to mind circuits and circuit elements in which atoms are doing what electrons do in the familiar realm of electronics. One thus pictures atom-based resistors, capacitors, inductors, and even diodes and transistors somehow all mimicking their electronic counterparts. Assuming little familiarity with ultracold matter this talk will introduce the notion of atomtronics, cover recent theoretical and experimental work and discuss the potential impact of atomtronics for sensor applications. Our current work centers on the atom analog of the transistor oscillator. When appropriately coupled to a waveguide or antenna, a transistor oscillator emits an electromagnetic wave, the energy of which is carried by photons. In an analogous fashion, the atom oscillator emits a matter wave, the energy of which is carried by atoms. To the extent that it can be made a viable technology atomtronics can have considerable impact on atom based sensors. For example, inertial sensors for navigation and guidance as well as magnetic field sensors can be made substantially more sensitive for a fixed size than existing atom interferometric systems. More generally we have an interest in developing a paradigm for problem solving in *quantum* signal processing that parallels the power of electronics in solving classical signal processing problems.