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Nanodevice sensors measured with rf- and microwave reflectometry[1]

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Nanodevices can be extremely sensitive sensors, but they typically operate at low temperatures and have high impedances. This makes it hard to measure these devices at high frequencies, however this problem can be overcome by impedance matching these devices with resonant circuits using rf and microwave techniques. We will review a number of nanodevices probed with rf and microwave methods, both dissipative and non dissipative nanodevices can be measured in this way. Typical examples of dissipative devices are single electron transistors, quantum point contacts and scanning tunneling probes. The change in dissipation of the device will translate into a magnitude change of the reflected signal. Non-dissipative devices like parametric capacitances or inductances of superconducting circuits give rise to a shift in the resonance frequency of the resonant circuits which results in a phase shift of the reflected signal. Using these methods drastically increases the operation frequency and often also the sensitivity of the measured quantity. The non dissipative devices also have very low back-action and can potentially approach the limits set by quantum mechanics.

[1]Work in collaboration with Christopher Wilson, Timothy Duty, Jonas Bylander, Sergey Kafanov, Martin Sandberg, Fredrik Persson, Martin Gustavsson, and Simon Abay