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Quantum 1/f Noise in Precision Measurements[1] PETER H. HANDEL, Univ. of Missouri St. Louis, Physics & Astronomy + Center for Nanoscience — An investigation of electronic 1/f noise in ultrasmall devices and systems is presented, focused on nanoscale engineering of electronic devices for low phase noise. The investigation is based on the quantum 1/f formulas and raises new questions of electronic noise, since fluctuations are more important in smaller devices. Based on the quantum 1/f noise theory, we find that in a certain transition range of sizes this general law is suspended, but reappears for 1/f noise in the nanometer domain, where the transition from coherent to conventional quantum 1/f effect is complete. The coherent and conventional quantum 1/f effects and their connection are briefly derived. The resulting quantum 1/f formulas are used to derive the 1/f noise of GaN/AlGaN MODFETs, RTDs, BAW and SAW quartz resonators, MEMS resonators, and spin valves. They are also used to calculate phase noise in these devices and in oscillators based on them, from first principles along with some classical noise sources. Device optimization is thus facilitated for ultra-small devices.

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