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Quantum-Based Pascal and The End of Mercury Manometers

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New methods of pressure and vacuum realization that are based on quantum calculations are currently under development. This is exciting in that it fits with the current SI-redefinition paradigm, that if a new technique relies upon a quantum property, measurement, calculation, or invariant of nature, then this technique can have served as a primary standard. Standards built this way are then directly tractable to the SI and will not itself require re-calibration. For the Pascal, a Fixed Length Optical Cavity (FLOC) and methods that enable the FLOC to be primary, including a Variable Length Optical Cavity (VLOC) will be discussed. These new methods operate by measuring the gas pressure through the interaction of light with the atomic or molecular properties of the gas and have enabled a new quantum-based pressure standard. Development of these new standards will enable the elimination of mercury manometers, a standard that has been in use for four centuries. The talk will cover the current status of the effort by National Metrology Institutes to re-define standards through the use of quantum based measurements, and will connect current NIST efforts to the coming SI-Redefinition. The talk will also briefly update activities to develop a Cold Atom Vacuum Standard (CAVS) which will enable a quantum-based vacuum standard capable of measuring extreme vacuum (XHV). Evangelista Torricelli invented the mercury in 1643, and while he did not realize it at the time, started a new field of vacuum technology which led to the explosion of technology that led to the modern national vacuum societies of today!

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