

At the low end of the pressure scale: Atom traps as primary standards

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Most take it for granted that if they need to measure something, they can just buy a device fit to do the job. As metrologists we know that underneath this apparent simplicity is a complicated system of definitions and comparisons involving multiple interconnected and interdependent measurements and realizations. The more complex this web becomes, the more effort and expense is required to produce a calibrated gauge, with inevitable growth in uncertainty. Ultra-high vacuum (UHV) is subject to this issue, requiring a series of comparisons to reach the lowest end of the pressure scale. But there is another way; it is possible to measure UHV pressures directly and intrinsically using cold trapped atoms. Since the earliest days of neutral atom trapping it has been known that the background gas in the vacuum limits the lifetime of atoms in the trap. We have inverted this problem to create a Cold Atom Vacuum Standard (CAVS). Because the measured loss-rate of ultra-cold atoms from the trap depends on a fundamental atomic property (the loss-rate coefficient or thermalized cross section) such atoms can be used as an absolute sensor and primary vacuum standard. We will present an overview of the CAVS design and operation, and report on its prospects for deployment as an absolute sensor.