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Realization of a universal quantum pressure standard[1] PINRUI SHEN, KIRK MADISON, University of British Columbia, JAMES BOOTH, British columbia institute of technology — We have reported the realization of the first cold atom primary pressure standard for the high- and ultra-high vacuum (UHV) regimes. This standard is a fundamentally different approach to vacuum metrology as it is based on a universal law governing quantum diffractive collisions between particles. We show that a measurement of the collision-induced loss rate of trapped atoms versus trap depth provides the velocity averaged total collision cross section - the only parameter required to quantify the pressure or flux of particles impinging on the trapped atoms. Using a sensor ensemble of ^{87}Rb atoms we demonstrated that this new quantum pressure standard can be applied to gases of both atomic species (He, Ar, and Xe) and molecular species (N_2, CO_2, and H_2), surpassing the scope of existing orifice flow pressure standards. The accuracy of this new standard was verified against an N_2 calibrated ionization gauge traced back to an orifice flow standard. Moreover, using this standard we were able to observe and quantify the performance limits of the ionization gauge. We also demonstrated the use of a magneto-optical trap (MOT) as a transfer standard to extend the operational range of the cold atom pressure standard by a factor of 100.

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