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48 - Building a Portable, Cold-Atom Pressure Standard

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Vacuum measurement plays a central role in a wide range of scientific and industrial applications including residual gas analysis, semi-conductor device manufacture, and atmospheric modeling. Remarkably, no primary pressure standard existed for the high (HV) and ultra-high vacuum (UHV) regime (below 10^{-7} Pa) until recently. In 2018, a UBC and BCIT collaboration succeeded in producing the first primary pressure standard for HV and UHV. Based on a cold-atom sensor, this new technique for particle detection requires no calibration and relies on immutable laws of nature - specifically, the interaction potentials between atoms and molecules. The existing cold-atom standard is immobile and the size of several refrigerators; to see wide use and to promote worldwide adoption, an apparatus must be shippable, and usable in non-ideal conditions by non-experts. To realize this, we are assembling a miniaturized version of the apparatus, that will be robust to vibrations, mechanical shock, and temperature changes. We will also investigate methods of automatically operating and re-calibrating the apparatus. This device will allow us to disseminate the cold-atom pressure standard worldwide starting with a plan to compare the cold atom primary standard with an existing secondary pressure standard (based on orifice-flow) at the National Institute of Standards and Technology. This work will also lay the groundwork for the construction of commercial absolute pressure standards.

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