Abstract Submitted
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Collision Universality Based Quantum Pressure Standard[1] PINRUI SHEN, Department of Physics and Astronomy, University of British Columbia, JAMES BOOTH, , Department of Physics, British Columbia Institute of Technology, ROMAN KREMS, Department of Chemistry, University of British Columbia, KIRK MADISON, Department of Physics and Astronomy, University of British Columbia — Collisions between particles can change their momentum and internal states. We show that quantum diractive collisions, those at exceedingly large impact parameters, induce a position measurement and transfer exceedingly small energies that encode both the total collision cross section and the form of the interaction potential at long range. Specically, the transferred energy spectrum for an initially stationary sensor atom follows a universal scaling law that depends only on the sensor atom mass and the thermally-averaged, total collision cross section. The characteristic scale corresponds to the zero-point energy associated with the collision-induced quantum measurement, and the scaling law shape is characteristic of the interaction potential at long range. This universality is encoded in the loss rates of both neutral particles and ions from shallow traps induced by a thermal gas. Using laser-cooled 87Rb sensor atoms and the universal law for van der Waals collisions, we realize a self-dening pressure standard showing that the total cross section and background density can be simultaneously found from a measurement of trap loss as a function of trap depth.

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