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Atom-interferomtery measurements of dispersive phase shifts for matter waves due to nano-structures VINCENT P.A. LONIJ, ALEXANDER D. CRONIN, University of Arizona, Department of Physics, STEVEN LEPOUTRE, HAIKEL JELASSI, GÉRARD TRÉNEC, MATTHIAS BÜCHNER, JACQUES VIGUÉ, University of Toulouse-UPS, IRSAMC, Toulouse, France — Atom interferometers are renowned for their ability to measure phase shifts with great precision. We have improved an atom interferometer experiment to measure phase shifts due to Van der Waals atom-surface interactions with enough precision to detect an unusual velocity dependence. We used standing waves of light, as beam splitters, and a nano-fabricated structure as a phase shifter. One arm of the Mach-Zehnder atom interferometer was transmitted through a nano-structure with 50 nm wide openings. This nano-structure exhibits a refractive index for matter-waves with a dispersion relation that is different from other, previously known, dispersive elements in atom-optics, such as electric fields or dilute gasses. The phase shifts for lithium atoms in the velocity range 700 to 2000 m/s depends on velocity to the power -0.47 (whereas for electric fields the phase shift depends on velocity to the power -1, and a dilute gas causes phase shifts that undulate as a function of velocity). We discuss the origin of this newly observed velocity dependence, and the utility of this experiment to measure Van der Waals C_3 coefficients.

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