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Phase shift in atom interferometry due to spacetime curvature¹ CHRIS OVERSTREET, PETER ASENBAUM, TIM KOVACHY, DANIEL BROWN, JASON HOGAN, MARK KASEVICH, Stanford University — In previous matter wave interferometers, the interferometer arm separation was small enough that gravitational tidal forces across the arms can be neglected. Gravitationally-induced phase shifts in such experiments arise from the acceleration of the interfering particles with respect to the interferometer beam splitters and mirrors. By increasing the interferometer arm separation, we enter a new regime in which the arms experience resolvably different gravitational forces. Using a single-source gravity gradiometer, we measure a phase shift associated with the tidal forces induced by a nearby test mass. This is the first observation of spacetime curvature across the spatial extent of a single quantum system.

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