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Experimental quantum simulation of ultrafast-equivalent dynamics[1] TOSHIHIKO SHIMASAKI, RUWAN SENARATNE, SHANKARI V. RAJAGOPAL, PETER E. DOTTI, DAVID M. WELD, University of California Santa Barbara — We discuss the experimental realization of a physical quantum simulator of ultrafast phenomena, in which time-varying forces on neutral atoms in a tunable optical trap emulate the electric fields of a pulsed laser acting on electrons or nuclei in a binding potential [1]. The simulator operates in regimes equivalent to those of ultrafast and strong-field pulsed-laser experiments, opening up a hitherto unexplored application of quantum simulation techniques and a complementary path towards investigating open questions in ultrafast science. Counter-intuitively, this approach emulates some of the fastest processes in atomic physics with some of the slowest, giving rise to a temporal magnification factor of up to twelve orders of magnitude [2]. This allows straightforward access to temporal regimes that are difficult to reach in pulsed-laser experiments. The correspondence with ultrafast science is demonstrated by a sequence of experiments: we perform nonlinear spectroscopy of a many-body bound state, control the excitation spectrum by shaping the potential, observe sub-cycle unbinding dynamics during strong few-cycle pulses, and directly measure carrier-envelope phase dependence of the response to an ultrafast-equivalent pulse. We will also discuss future experimental directions for extending the capabilities of the quantum simulator and strengthening the ultracold/ultrafast correspondence. [1] R. Senaratne *et al.*, arXiv:1711.02654 (2017). [2] S. Sala *et al.*, Phys. Rev. A 95, 011403 (2017).

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