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A time domain matter-wave interferometer for testing the mass limits of quantum mechanics JONAS RODEWALD, NADINE DOERRE, PHILIPP GEYER, PHILIPP HASLINGER, MARKUS ARNDT, University of Vienna — We demonstrate a matter-wave interferometer in the time domain (OTIMA) as a powerful tool for testing the validity of quantum theory for large particles [1,2]. The interferometer operates in the near-field regime and utilizes three pulsed standing laser wave gratings. These periodically deplete the particle beam and imprint a periodic phase pattern on to the traversing matter waves. Depending on the particle's ionization or fragmentation cross section and optical polarizability the gratings act as absorptive masks and phase gratings with a grating period of just 80nm. The pulsed scheme of the experiment facilitates interference measurements in the time domain offering high count rate, visibility and measuring precision. Since the action of optical gratings is non-dispersive the OTIMA is well suited for interference studies on an increasingly large mass scale in the quest for novel decoherence effects, such as continuous spontaneous localization. Experiments with various organic clusters and monomers have demonstrated the functionality of the interferometer and serve as a motivation for investigating the wave-particle character of particles with masses up to 10^5 amu and beyond.

[1] P. Haslinger, N. Dörre, P. Geyer, J. Rodewald, S. Nimmrichter, and M. Arndt, Nat. Phys. **9**, 144 (2013).
[2] N. Dörre, J. Rodewald, P. Geyer, B. von Issendorff, P. Haslinger, and M. Arndt, Phys. Rev. Lett. **113**, 233001 (2014).

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