

# Matter wave interferometry with clusters in the time-domain

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Interferometry with matter waves is a versatile tool for testing the foundations of quantum physics as well as for new precision measurements on clusters of molecules. We present our new instrument (OTIMA) [1, 2], a pulsed all-optical ionizing Talbot-Lau interferometer [3] in the time domain [4,5]. The apparatus consists of three pulsed UV/VUV lasers ( $\lambda = 157$  nm) which are all retro-reflected on a single mirror to generate three standing light waves. Interferometry in the time-domain with optical gratings eliminates most of all dispersive effects. We successfully performed interference experiments with various organic clusters and are preparing new experiments for deflectometry, spectroscopy and photo dissociation studies. The setup can be adapted for testing quantum superposition on an increasingly large mass scale in search for new effects such as continuous spontaneous localization [6,7].

## References:

- [1] Haslinger, P., Dörre, N., Geyer, P., Rodewald, J., Nimmrichter, S. & Arndt, M. A universal matter-wave interferometer with optical ionization gratings in the time domain. *Nature Physics*, advance online publication, 10.1038/NPHYS2542 (2013).
- [2] K. Hornberger, S. Gerlich, P. Haslinger, S. Nimmrichter and M. Arndt, *Rev. Mod. Phys.* **84**, 157 (2012).
- [3] E. Reiger, L. Hackermüller, M. Berninger, and M. Arndt Exploration of gold nanoparticle beams for matter wave interferometry, *Opt. Comm.* 264, 326-332 (2006).
- [4] Nimmrichter, S., et al., Concept of a time-domain ionizing matter wave interferometer. arXiv:1102.3644v1 2011.
- [5] S. B. Cahn, A. Kumarakrishnan, U. Shim, T. Sleator, P. R. Berman and B. Dubetsky, *Phys. Rev. Lett.* **79**, 784 (1997)
- [6] S. L. Adler and A. Bassi, *Science* 325, 275 (2009).
- [7] S. Nimmrichter, K. Hornberger, P. Haslinger and M. Arndt, *Phys. Rev. A* 83, 043621 (2011).