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Femtosecond Electron Sources and Attosecond Electron Foci

SHAWN HILBERT, AMANDA FRICKE, CORNELIS UITERWAAL, HERMAN BATELAAN, University of Nebraska–Lincoln — We report progress on a nanometer-sized femtosecond electron source. The source consists of an 80-MHz repetition rate femtosecond laser with a tungsten field emission tip. Our autocorrelation spectra support the claim¹ that the emission process is dependent on the electric field of the laser pulse. This field dependence suggests sub-cycle ($T_{\text{cycle}} = 2\pi/\omega = 2.7$ fs) electron emission.^{1,2} Consistently, we found that the duration of the emission process has an upper bound of 100 fs.³ However, we now deduce a lower bound for the emission process duration of about 10 fs. Nevertheless, this electron source may be combined with a temporal lens to focus the electron pulses to subcycle temporal widths.⁴ ¹P. Hommelhoff, *et al*, Phys. Rev. Lett. 96, 077401 (2006) ²P. Hommelhoff, *et al*, Phys. Rev. Lett. 97, 247402 (2006) ³B. Barwick, *et al*, New J. Phys. 9, 142 (2007) ⁴P. Baum, A. H. Zewail, Proc. Natl. Acad. Sci. USA. 104, 18409 (2007) * This material is based upon the work supported by the National Science Foundation under Grant Nos. PHY-0355235 and PHY-0653182.

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