Time-dilation enhanced gated optical imager with 5 ps resolution

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A 5 ps gated framing camera has been demonstrated using the time dilation of a drifting electron signal. The time dilation is achieved by accelerating a photoelectron derived information pulse with a time varying potential[1]. The temporal dependence of the accelerating potential causes a birth time dependent axial velocity dispersion that spreads the pulse as it transits a drift region. The expanded pulse is then imaged with a conventional gated micro-channel plate based framing camera and the effective gating time of the combined instrument is reduced over that of the framing camera alone. In the drift region, electron image defocusing in the transverse or image plane is prevented with a large axial magnetic field. Details of the unique issues associated with rf excited photocathodes were investigated numerically and a prototype instrument based on this principle was recently constructed. Temporal resolution of the instrument was measured using a Mach-Zender interferometer coupled to a frequency tripled femtosecond laser operating at 266 nm. The system demonstrated 20X temporal magnification and the results are presented here. X-ray image formation strategies and photometric calculations for ICF implosion experiments are also examined. This work supported by General Atomics internal funding and Kentech Instruments Ltd. internal funding. Lawrence Livermore National Laboratory is operated by Lawrence Livermore National Security, LLC, for the U.S. Department of Energy, National Nuclear Security Administration under Contract DE-AC52-07NA27344.

[1] R. D. Prosser, J. Phys. E **9** (57) 1976.