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Experiment Timing at High Repetition Rate Free Electron Lasers

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Ever since the first pump-probe experiment at LCLS in 2009, it has been clear that determining X-ray/optical relative arrival times is critical to performing precision measurements. In the decade of ensuing developments at LCLS, we have pioneered many of the XFEL timing measurement schemes used across the world. Currently, to measure timing at the soft x-ray end stations, an incident optical laser is split into two time delayed pulses, crossed at an angle with respect to the x-rays at a target, and the arrival time of the x-rays is geometrically encoded on the reflected light. The pulses are then recombined and the spatial position of the onset of phase and amplitude changes provides the arrival time. The x-ray targets are designed utilizing thin film interference effects to produce a large x-ray induced reflectivity change. We have used these methods at LCLS for x-ray pulse energies as low as few a microjoules and the results will be presented. Further, we will show some future arrival time measurement schemes that will overcome the drift between the optical pump and arrival time measurements, which is quickly becoming one of the main limitations in experiment time resolution.

Footnotes

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