Abstract

In this report, we present results that demonstrate orders of magnitude improvement in signal sensitivity for x-ray optical cross correlation as used for relative delay identification. For both so called “warm” accelerator based x-ray Free Electron Lasers (xFELs) and the new superconducting quasi-continous high repetition rate xFELs, there still is a need for shot-by-shot arrival time measurement and sorting.

Time-shear interference for x-ray/optical cross-correlation timing at high repetition rate free-electron lasers.

Markus Ilchen , Timur Y Osipov , more...

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1 Introduction

1.1 Jitter

State the existing problem

1.1.1 History

State the old way of fixing it

1.1.2 Stochastic sampling paradigm

1.1.3 Expectations at EuXFEL and LCLS-II

1.2 Diamond

1.2.1 Thermal Load

But with the higher repetition rate xFELs, the average power load on x-ray optics is so high that we need extremely highly conducing cross correlation medium.

1.2.2 Absorption

sensitivity

1.2.3 Historical trials

1.3 Time-shear interference

State the new interference

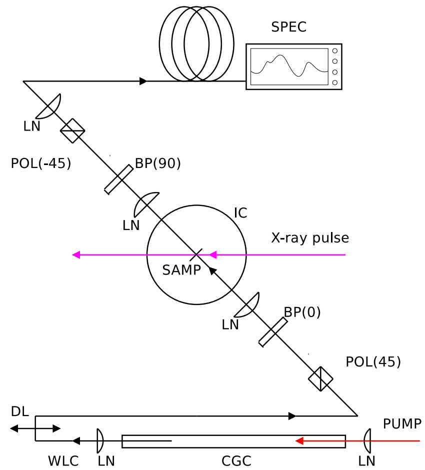

Figure 1: Schmatic of the experimental design. PUMP – 800 nm 50 fs pump laser pulse, LN – lens, CGC – Continuum Gas Cell, WLC – White Light Continuum, DL – Delay Line, POL(x) – Polarizer (angle), BP(x) – Birefringent Plate (fast-axis alignment angle), SAMP – Sample, X-ray pulse, IC – interaction Chamber, SPEC – Optical Spectrometer.

2 Method

2.1 Whitelight Generation

150 μJ in 50 fs pulse to pump a cell of 200 PSI of Argon.

2.2 Birefringent delay

2.3 Substrates

Diamond Crossed polarization analysis

3 Results

3.1 Phase not Absorption

Signals in water and diamond

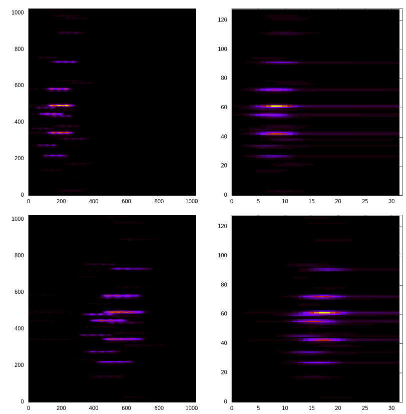

Figure 2: Use a non-2D version of this figure.

3.2 X-ray Photon energy dependence

3.3 Optical wavelength dependence

4 Discussion

4.1 Material index change

review a bit of the carrier dynamics that causes the index change

4.2 algorithm

4.3 Signal versus ev/atom (XPP/AMO)

4.4 Temporal Resolution (XPP)

4.5 Using the etalon (AMO)

5 Conclusion