

EO Speed posters

- > Serge Bielawski
Signal-to-noise optimization in Electro-Optic Sampling:
balanced detection, near-extinction operation, or both?
- > Boris Sawadzki
Preparation for Electro-Optical Measurements at DELTA
- > Bernd Steffen
Electro-Optical bunch length Detection at the E-XFEL

Signal-to-noise optimization in Electro-Optic Sampling: balanced detection, near-extinction operation, or both?

Serge Bielawski

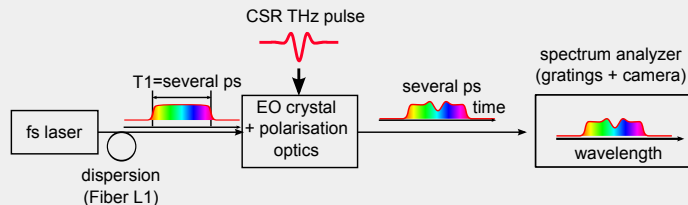
on behalf of the collaborations between **PhLAM (Université Lille 1, France)**, **KIT**, and **SOLEIL**

7th Workshop on Longitudinal Diagnostics for Free Electron Lasers, 2017

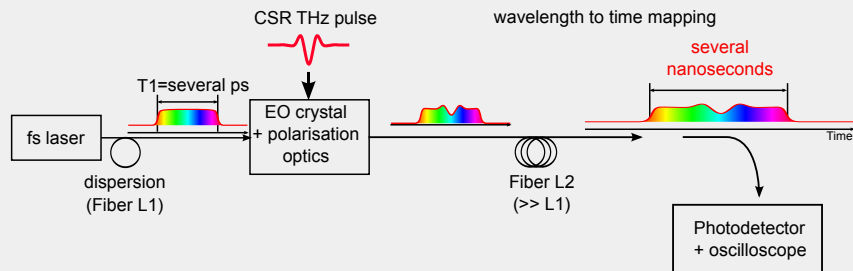


Single-shot EO sampling

Time \rightarrow spectrum conversion

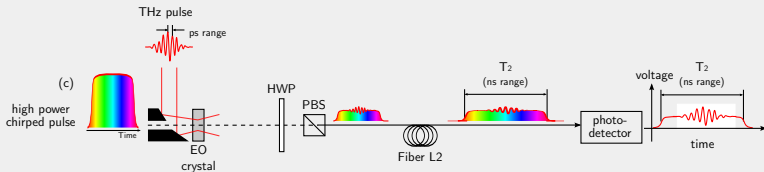


Time \rightarrow spectrum \rightarrow time conversion

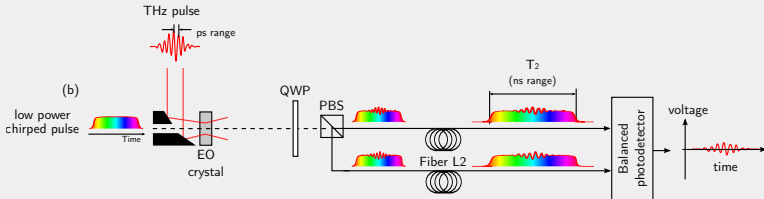


Single-shot EOS: how to optimize signal-to-noise ratio?

EO crystal between polarizers "close to extinction": **High responsivity**

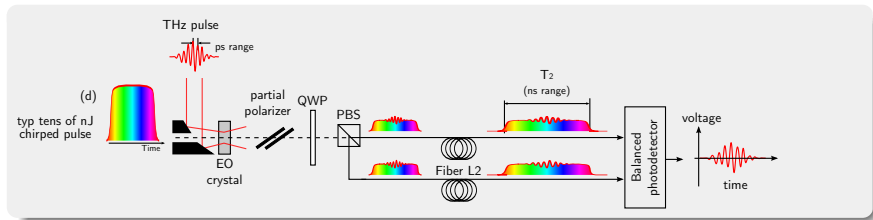


Balanced detection between the two polarizer ports: **Laser noise cancellation**

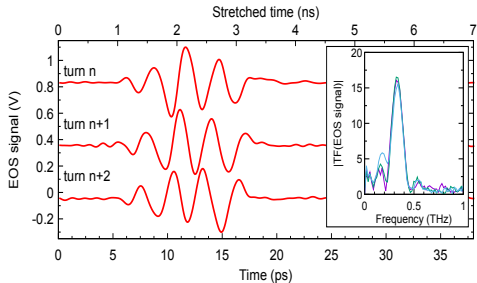


- Incompatible strategies?

Setup for single-shot recording of radiated THz pulses (tested at SOLEIL)



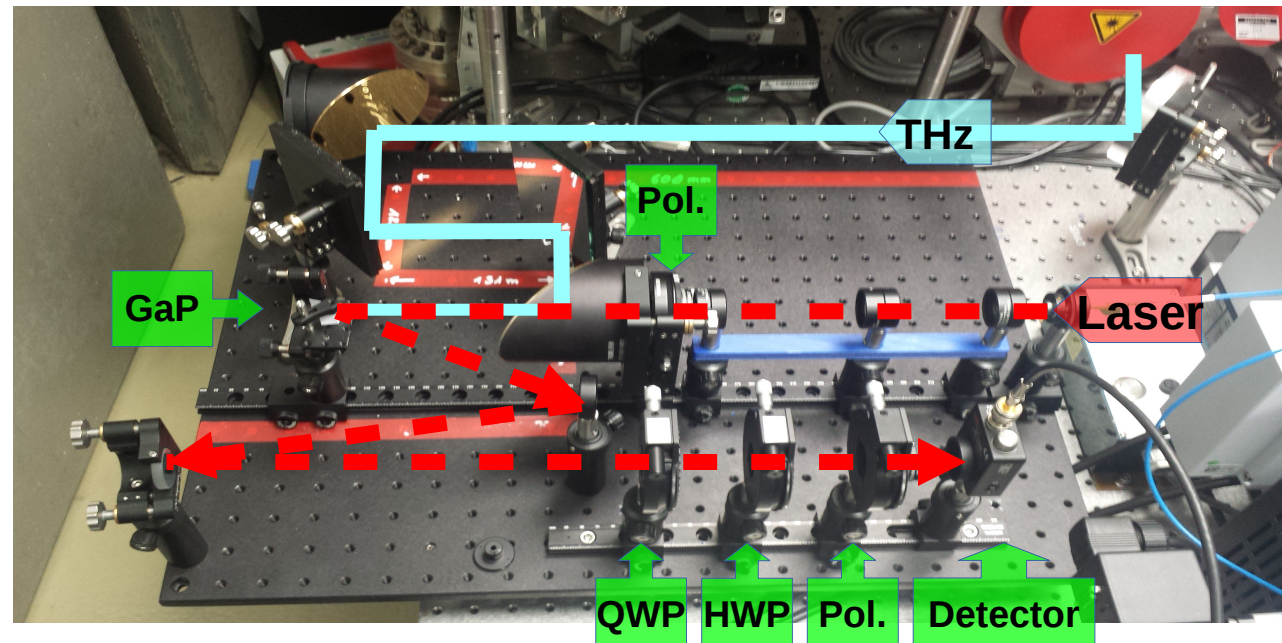
- Balanced detection for **noise cancellation** (laser and ASE)
- Introduction of Brewster plates (with transmission T) allows the **sensitivity to be increased** by an arbitrary factor $1/\sqrt{T}$. [Ahmed *et al.*, Rev. Sci. Instr. 85, 013114 (2015)].



PREPARATION FOR ELECTRO- OPTICAL MEASUREMENT AT DELTA

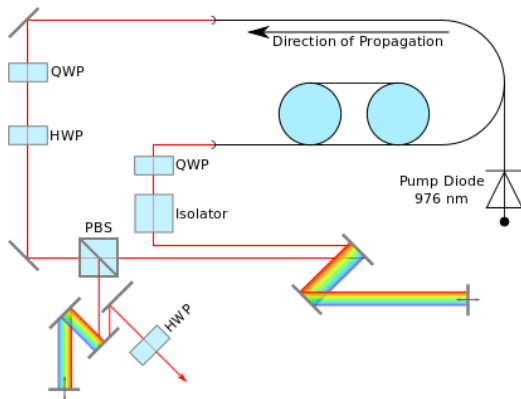
Boris Sawadski
DELTA, TU Dortmund

- Far Field EO-Measurement
- Motivation:
Measure the sub-millimeter slicing of the electron bunch
- Setup for EO Sampling:

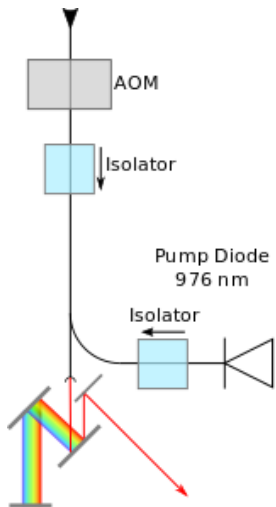


Laser System

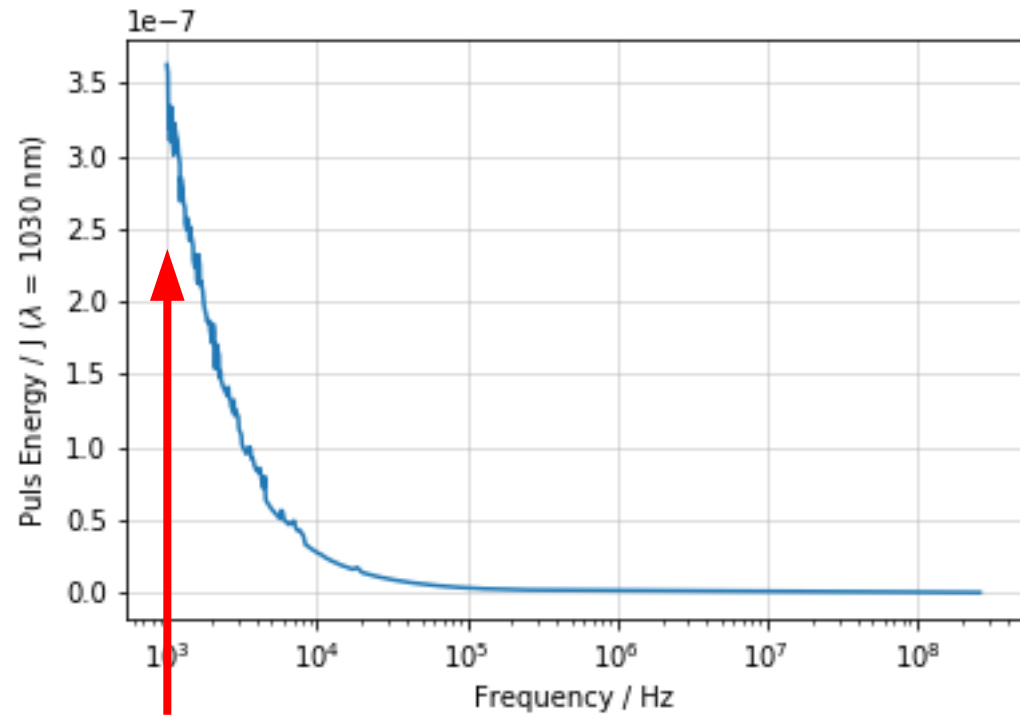
OSC



AMP

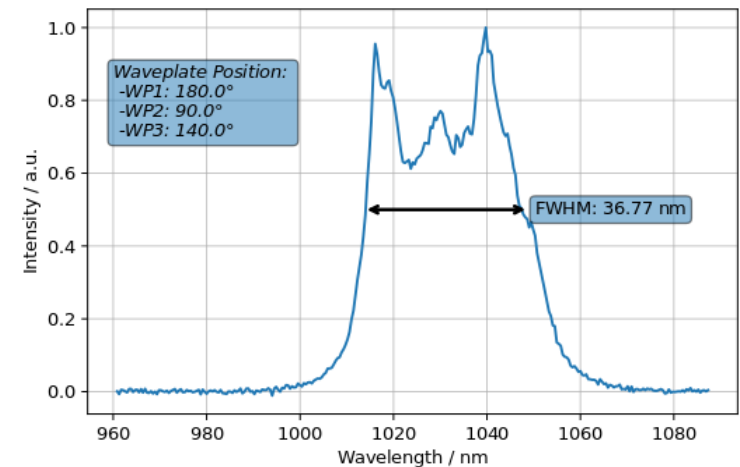
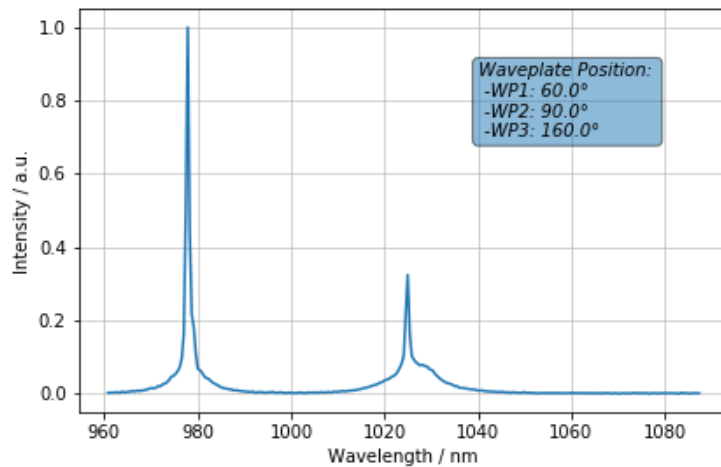
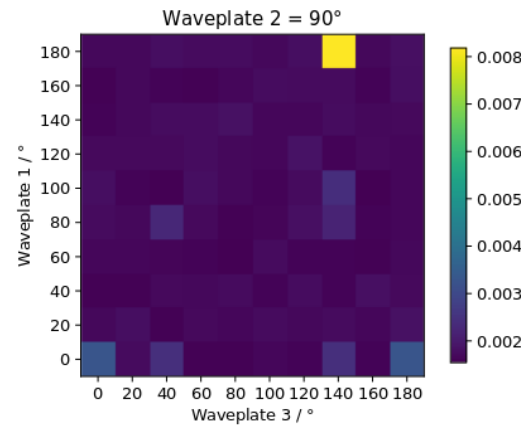


Acousto Optic Modulator (AOM)



Thz rep. rate

Laser System



→ Pulse shape?

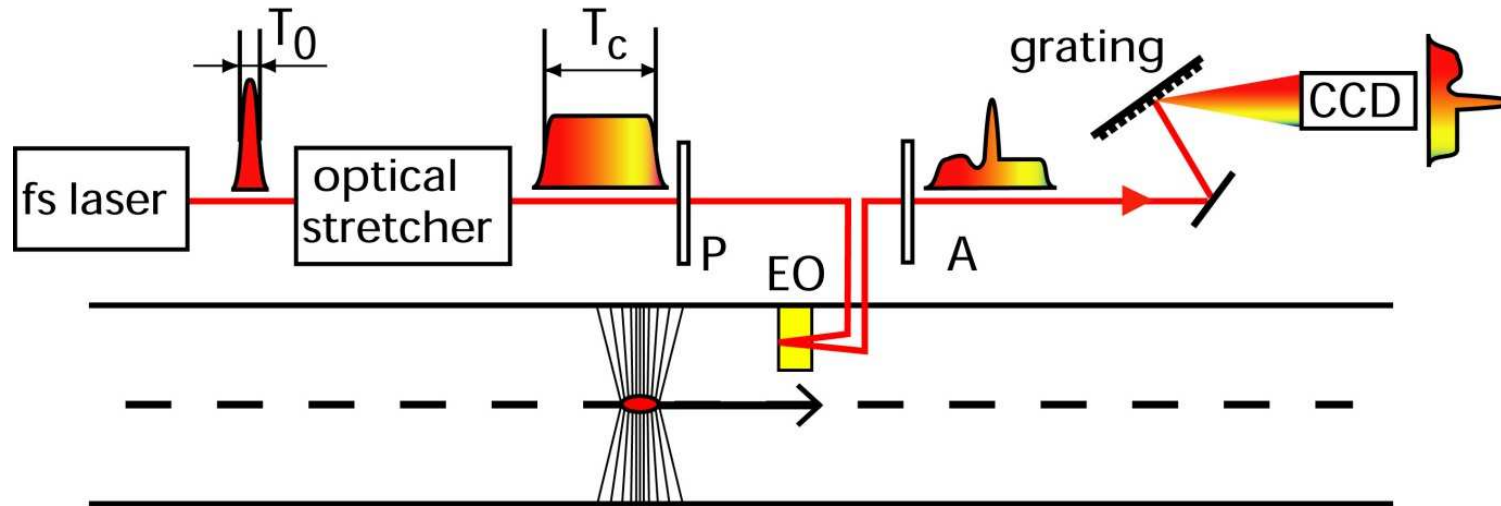
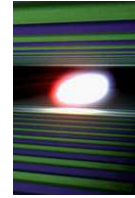


Electro-Optical bunch length Detection at the E-XFEL

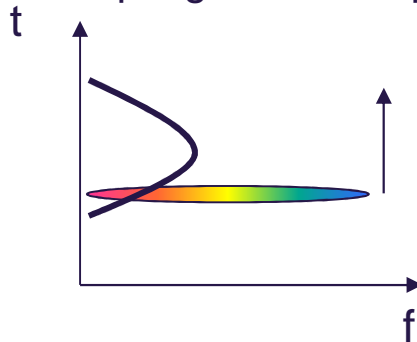
Bernd Steffen, Nov. 2017



Electro-Optical bunch Detection / Electro-optical Spectral Decoding

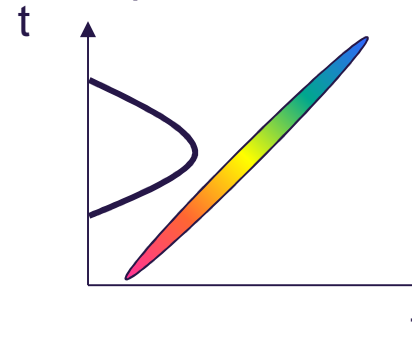


Sampling with laser pulse:



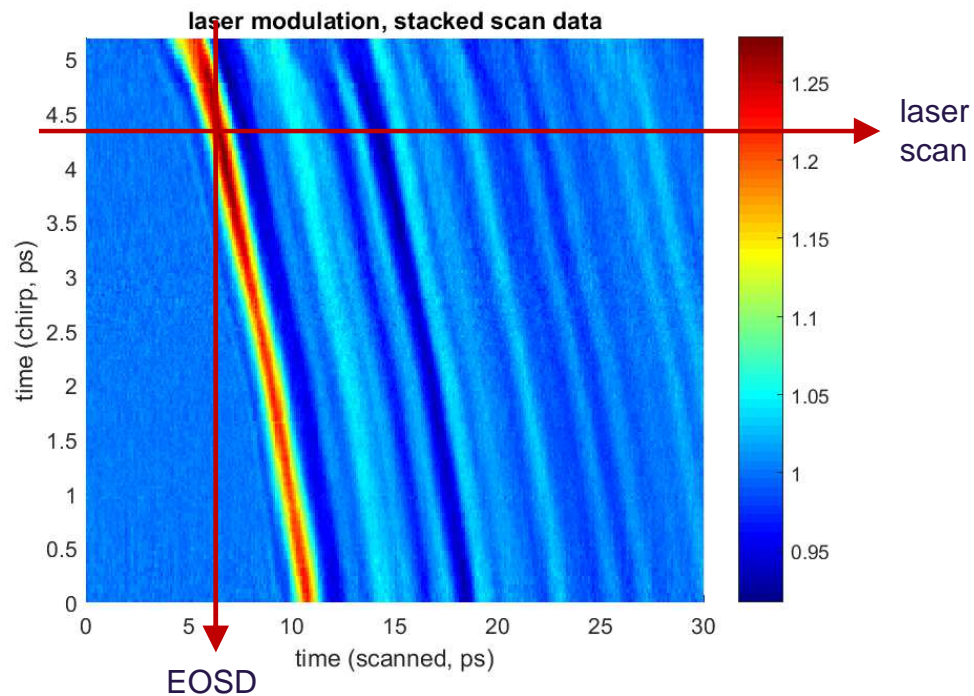
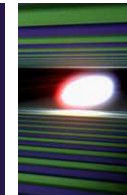
→ Sample electron bunch
with many laser pulses

Chirped laser pulse:

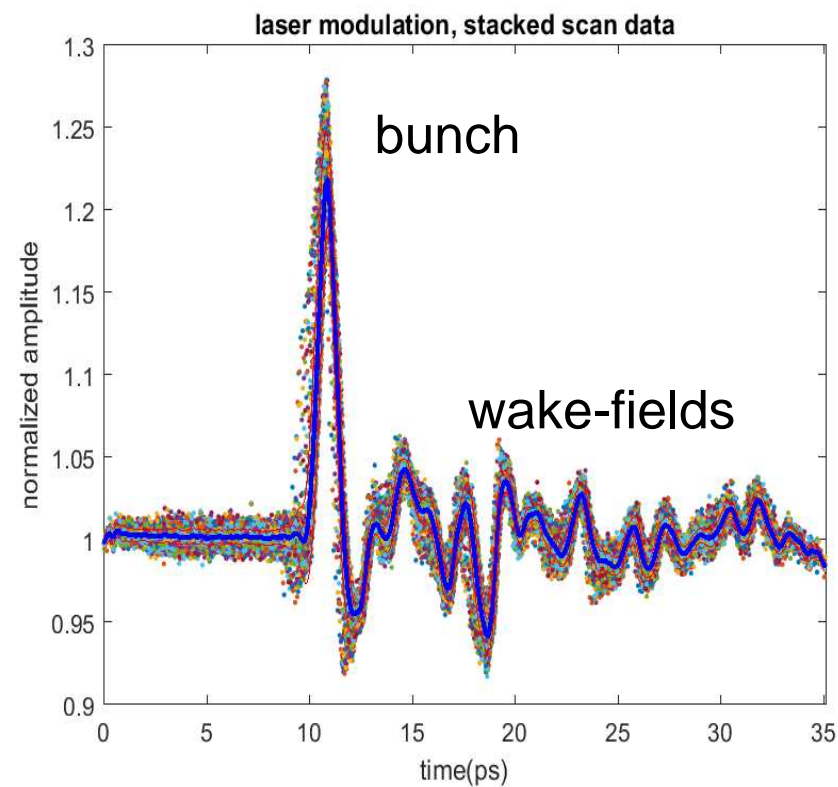
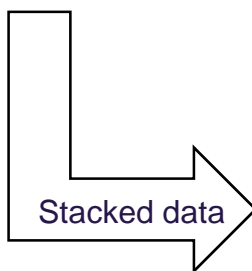


→ Defined relation between
time and frequency

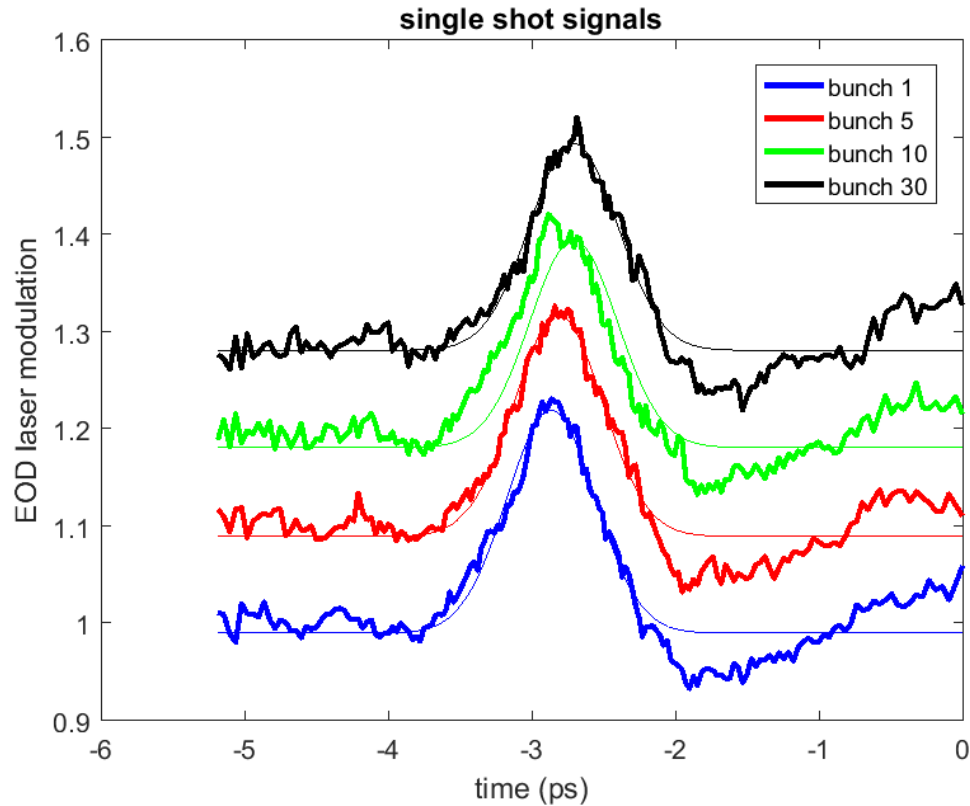
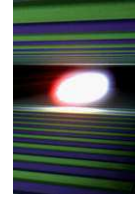
Measurements from XFEL-BC1 - Laser time scans



Raw signal from 5 bunches
each line averaged and
corrected with laser chirp



Measurements from XFEL-BC1 - Single shot EO Spectral Decoding



Single shot EOD traces and fitted Gaussians from the same bunch train

EOD traces of all 30 bunches of a bunch train with 1.13 MHz repetition rate

