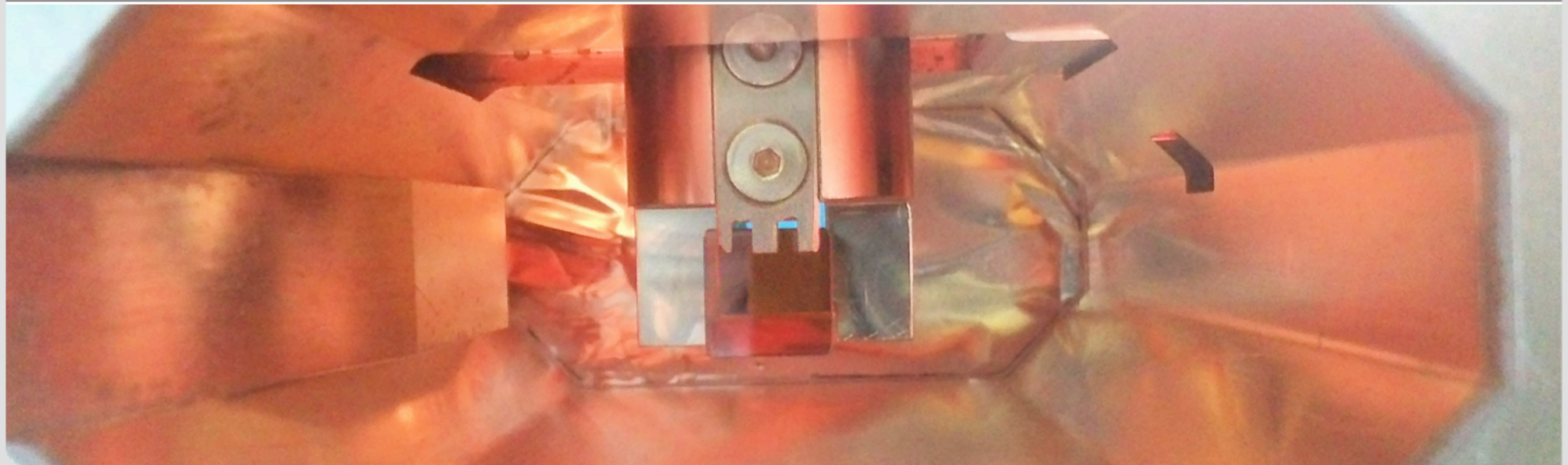


Electro-Optic Electron Bunch Diagnostic @ ANKA

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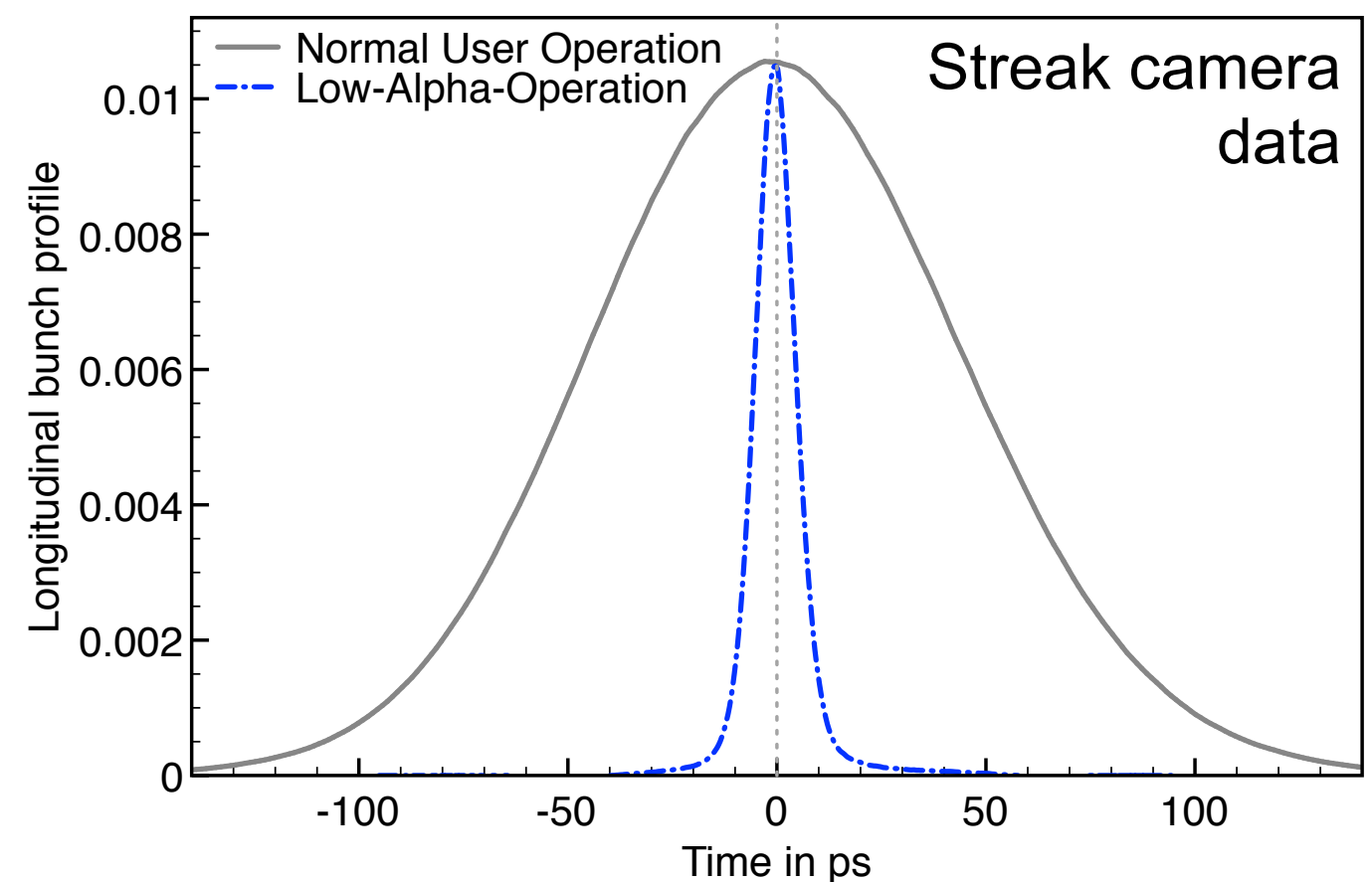
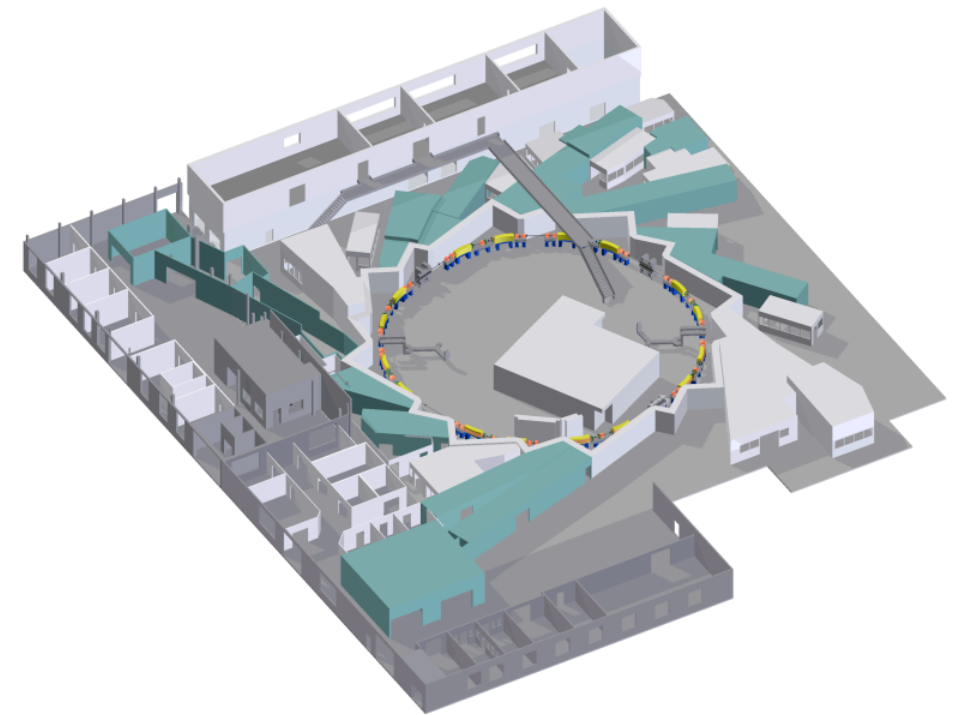


Outline

- **Introduction:** Low- α_c -Operation at ANKA
- **Motivation** for Single-Shot Bunch Profile Measurements
- **Method:**
 - Electro-Optic Sampling (EOS)
 - Electro-Optic Spectral Decoding (EOSD)
- **Measurement results:**
 - EOS: Long-Ranged Wake Field Studies
 - EOSD: Single-Shot Measurements

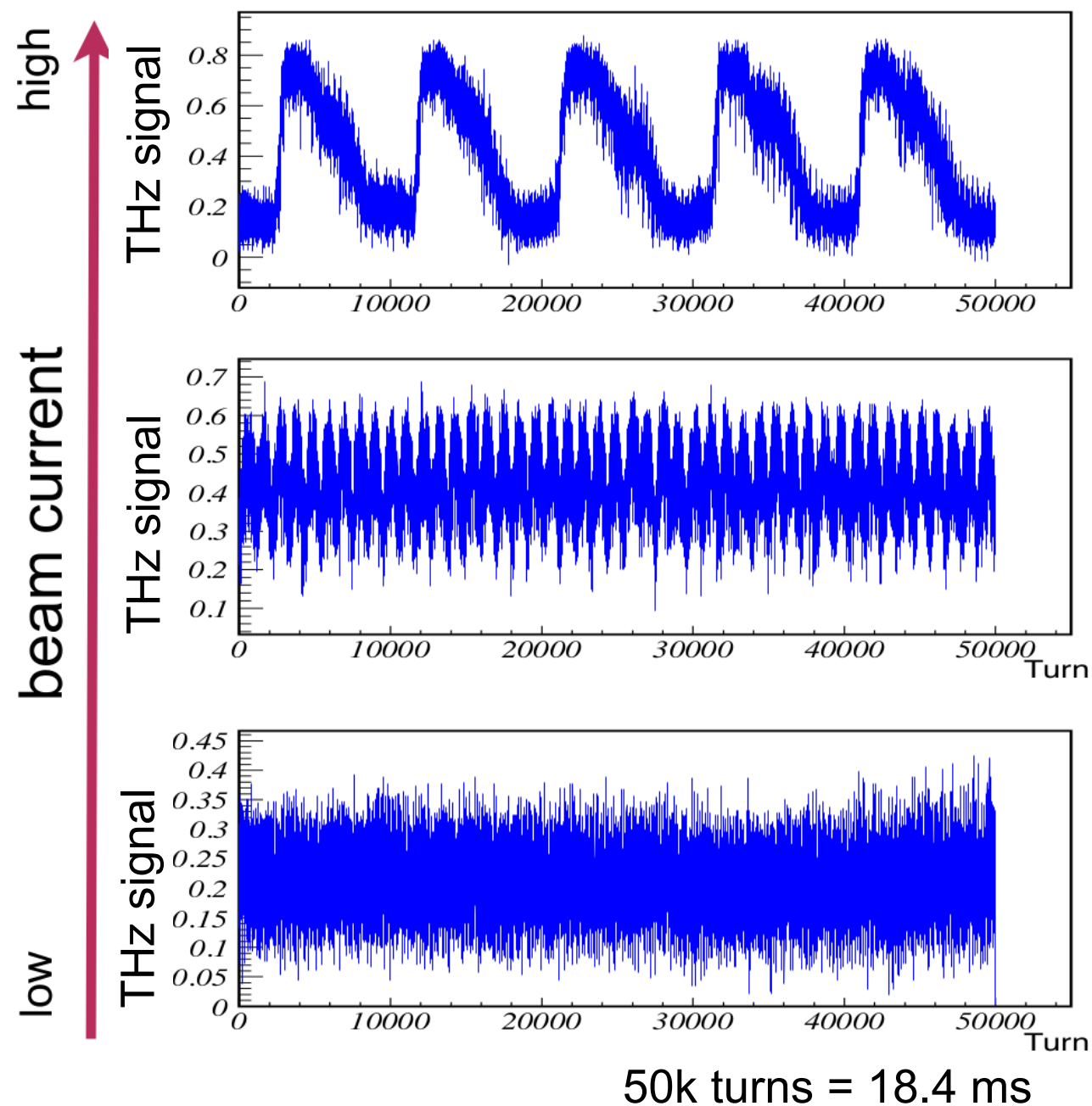
Introduction: Low- α_c -Operation at ANKA

- Generation of coherent synchrotron radiation (CSR)
- Circumference 110.4 m
- $f_{\text{rev}} = 2.715 \text{ MHz}$
- $f_{\text{RF}} = 499.69 \text{ MHz}$
- Energy 0.5 - 2.5 GeV (0.8 - 1.6 GeV during low- α_c -mode)
- RMS bunch length 45 ps (for 2.5 GeV), **10 ps down to 1-2 ps (for 1.3 GeV)**
- Filling pattern: **single- or multi-bunch** (min. bunch spacing 2 ns)

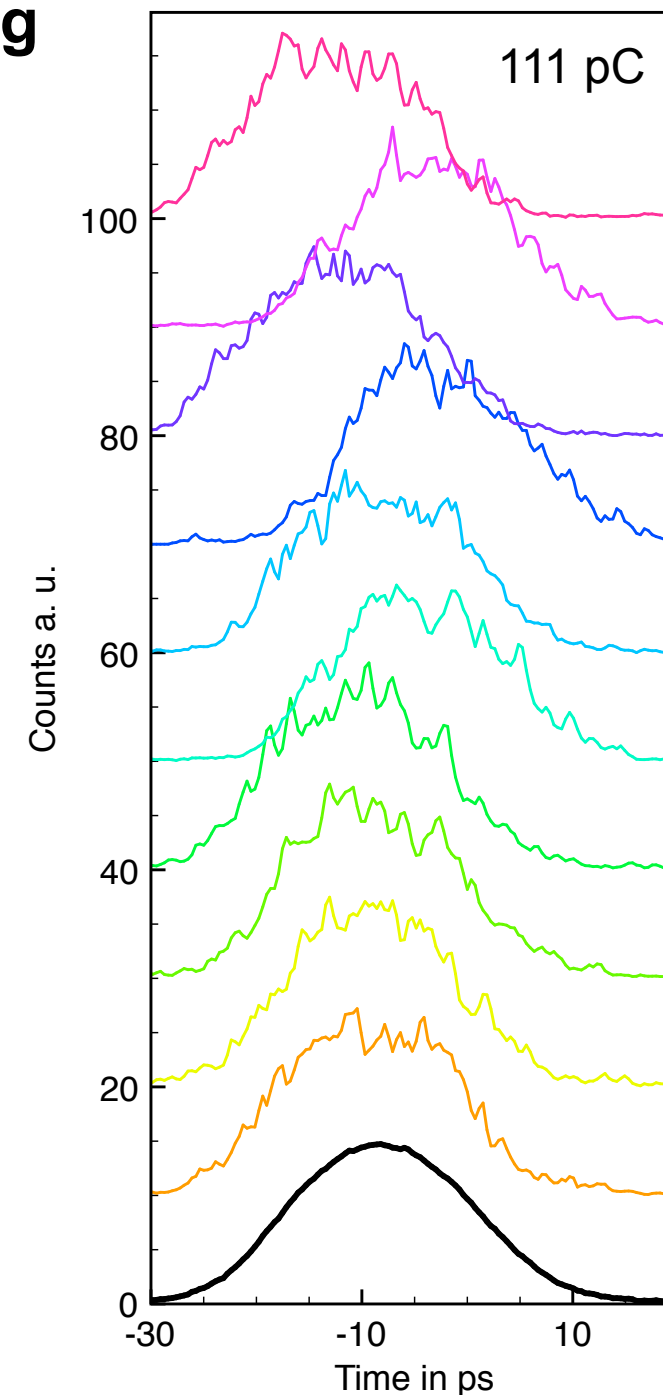


Motivation for single-shot EO measurements at ANKA

Bursting behavior of CSR → microbunching



Streak Camera single-shot capabilities limited



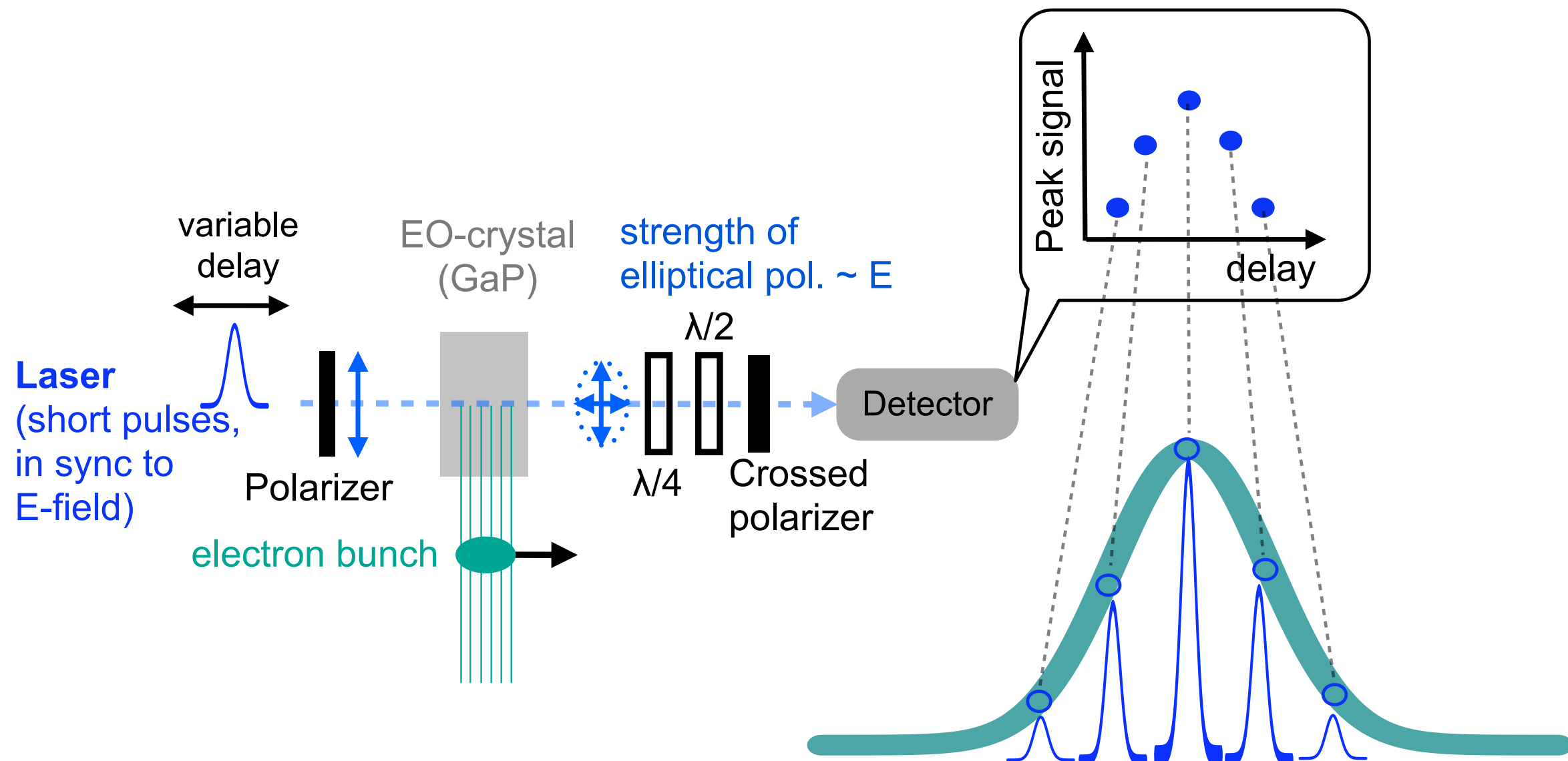
Dominated by shot-noise

We want:
Single-shot measurements to study bursting behavior!

Without filters;
v-slit fully opened

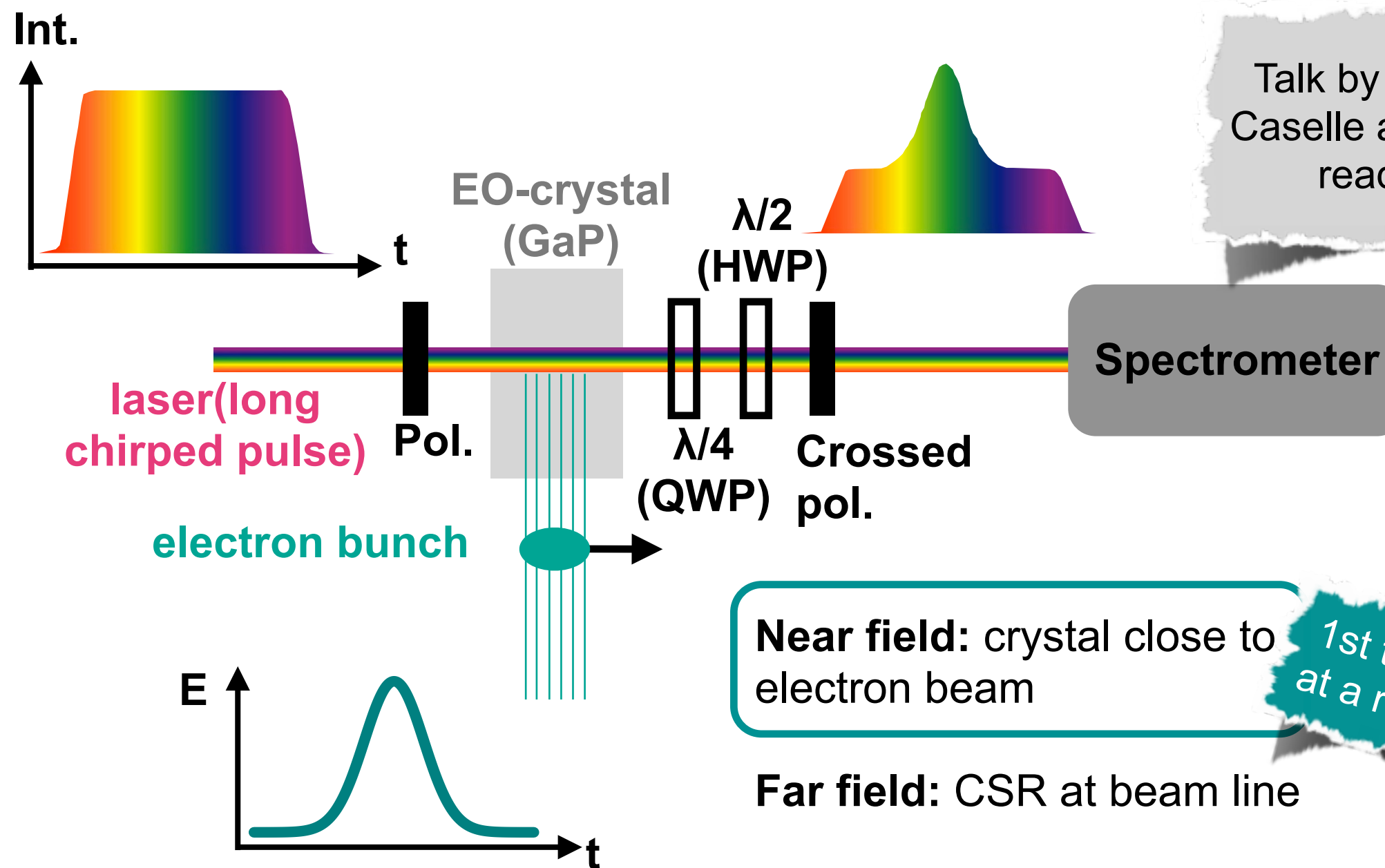
Electro-optical sampling (EOS)

Intensity distribution of electron bunch is modulated onto laser pulse which is then analyzed.



best S/N ratio for nearly crossed polarizer and analyzer angles

Spectral decoding (single shot) - EOSD

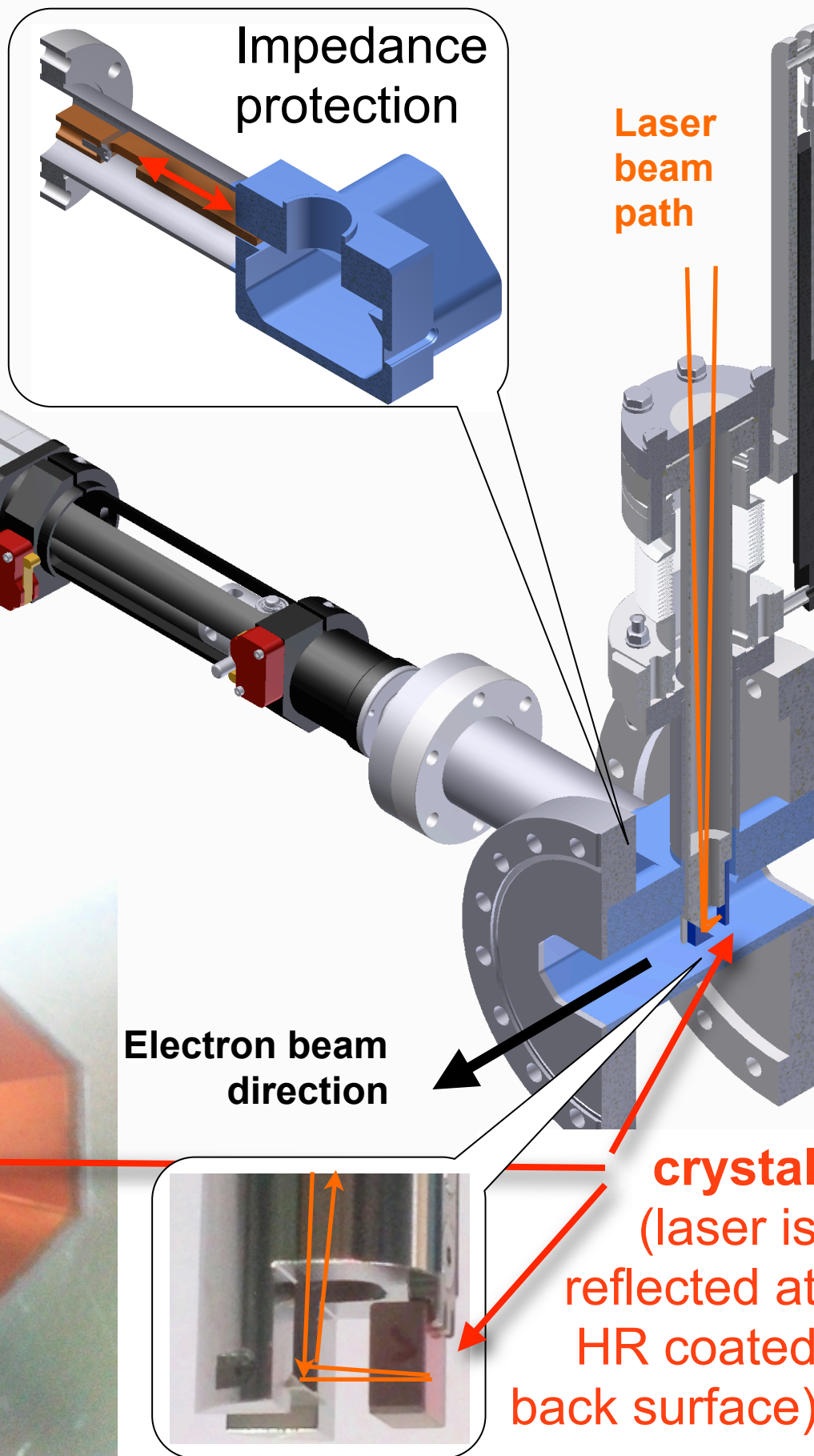


$\lambda/4$: compensate intrinsic birefringence of crystal
 $\lambda/2$: control transmission through crossed polarizer

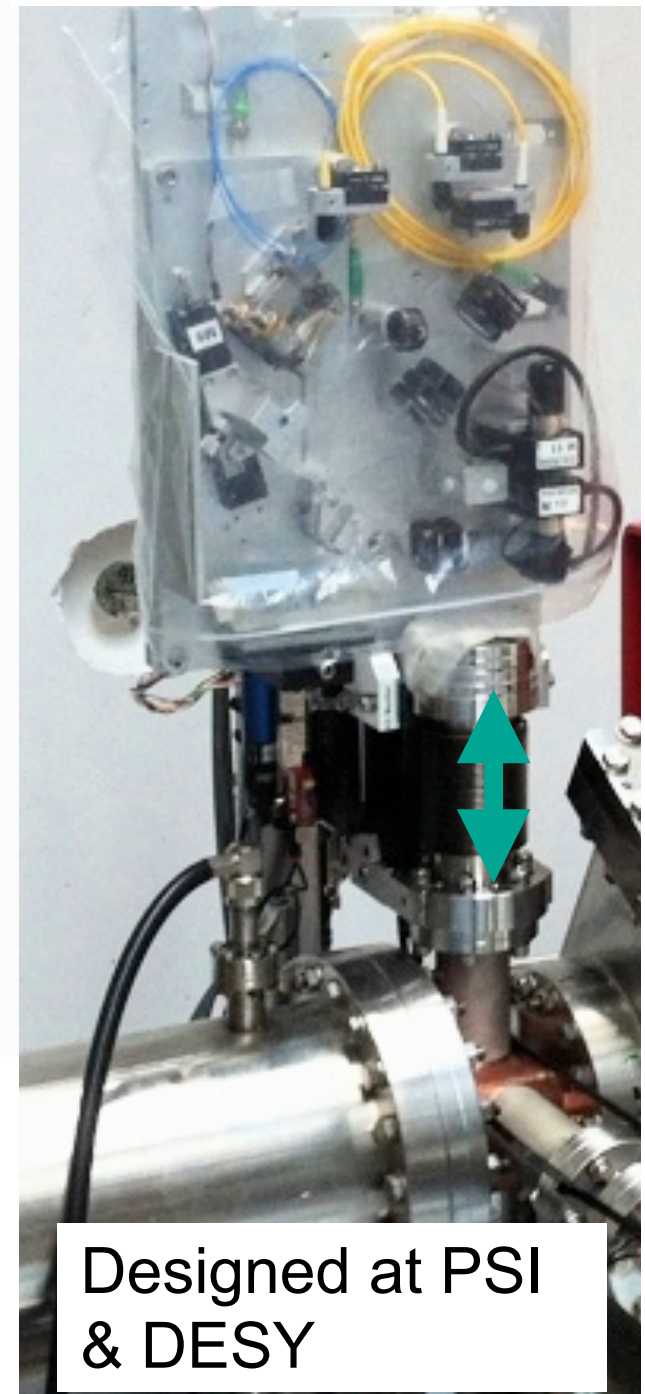
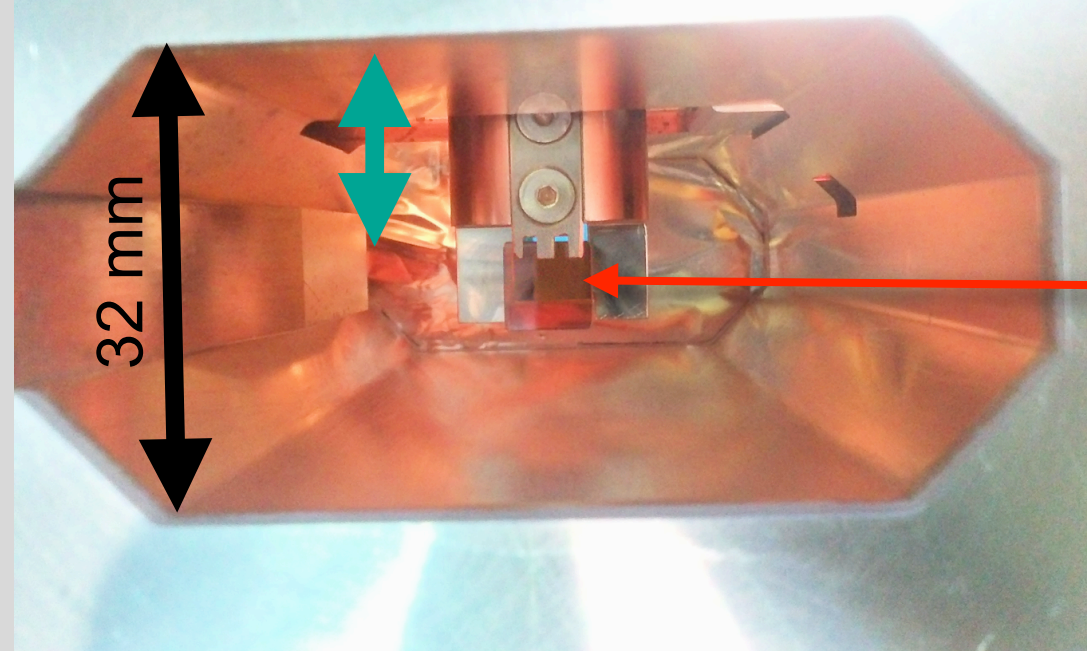
Near-Field setup at ANKA: EO-Monitor

EO monitor with
grating compressor
and wave plates

Laser system (Yb-doped
fiber laser @ 1030 nm):
see talk by P. Peier

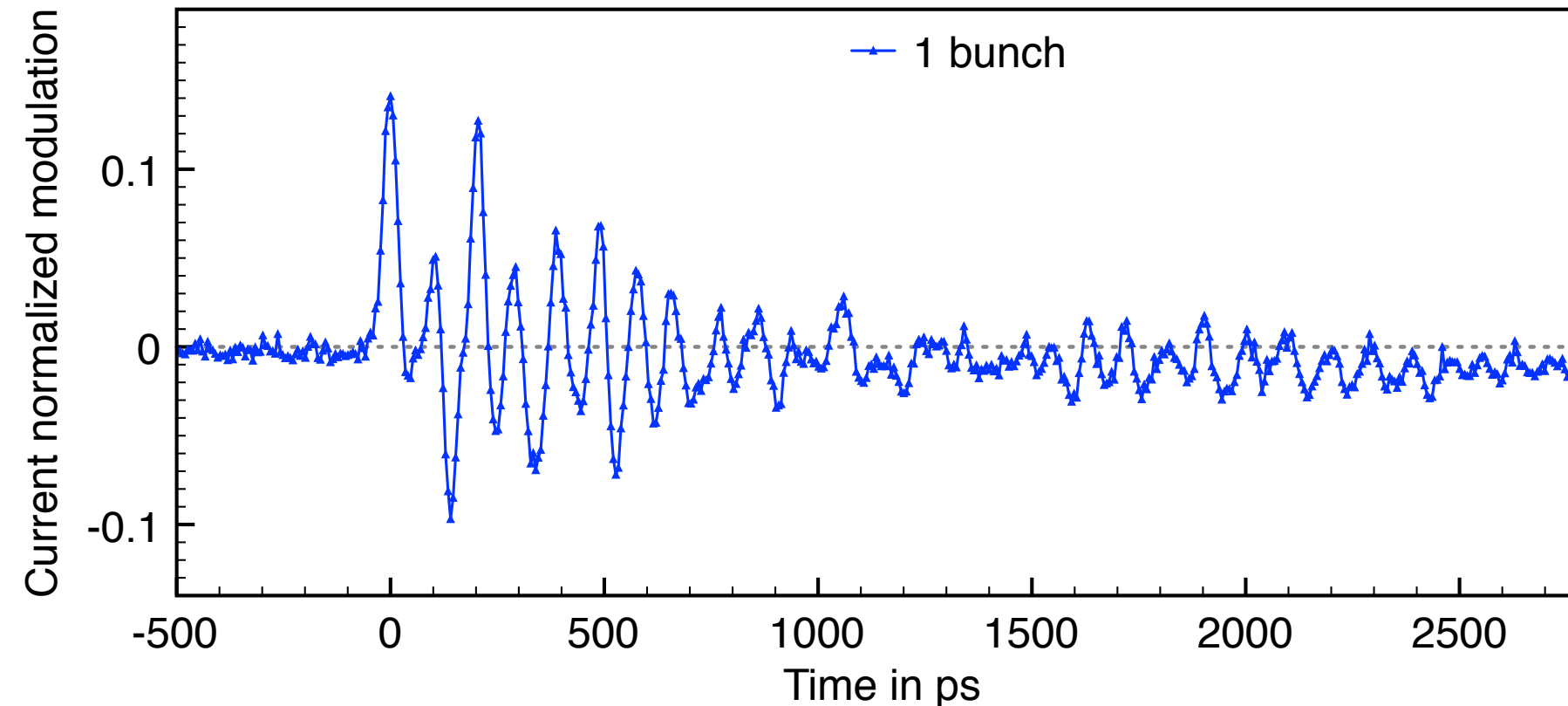


Electrons flying into plane
of view

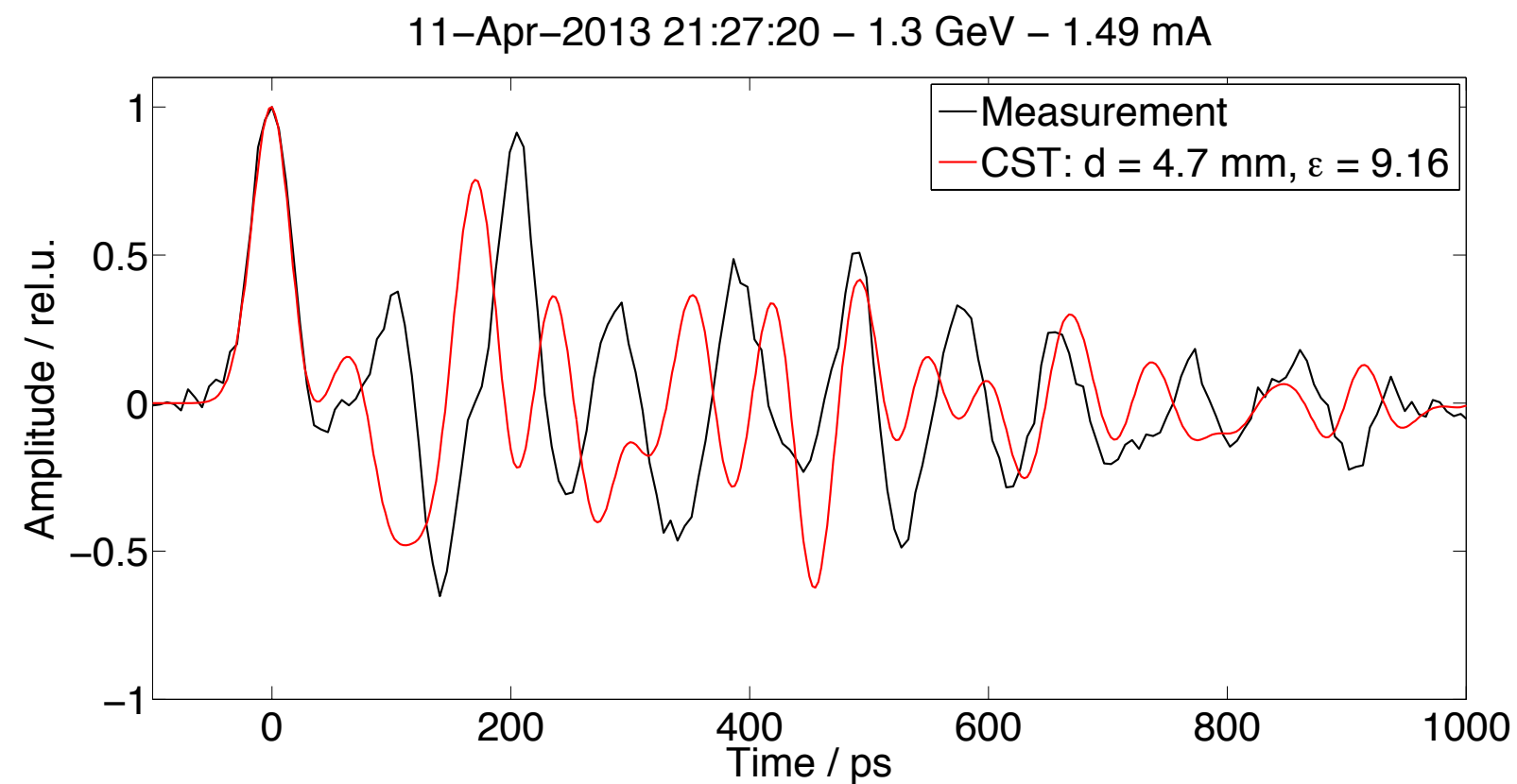


Designed at PSI
& DESY

EOS: Long-Range Wake-Fields



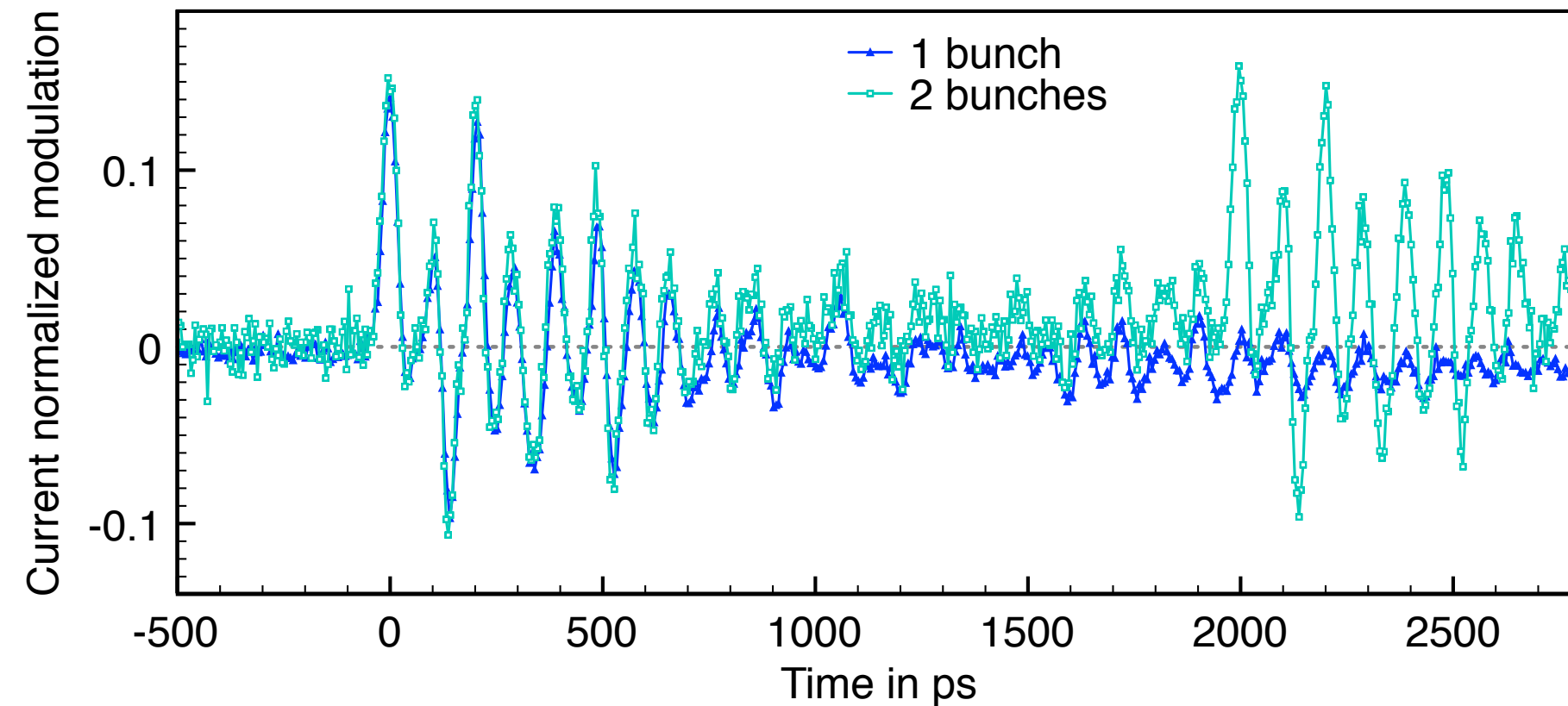
Bunch spacing 2 ns



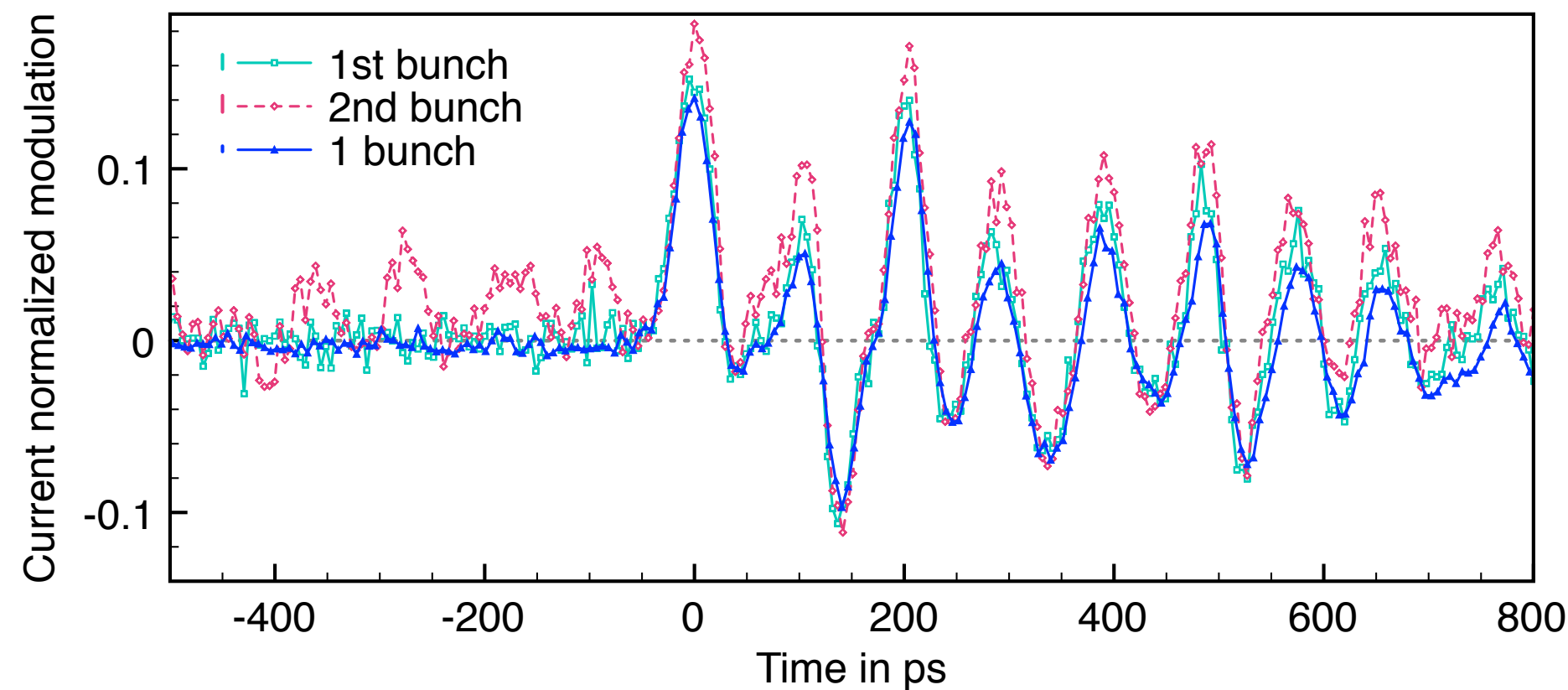
CST Simulations

B. Kehrer et al.
Numerical Wakefield Calculations
for Electro-optical Measurements,
MOPME015, IPAC'13

EOS: Long-Range Wake-Fields

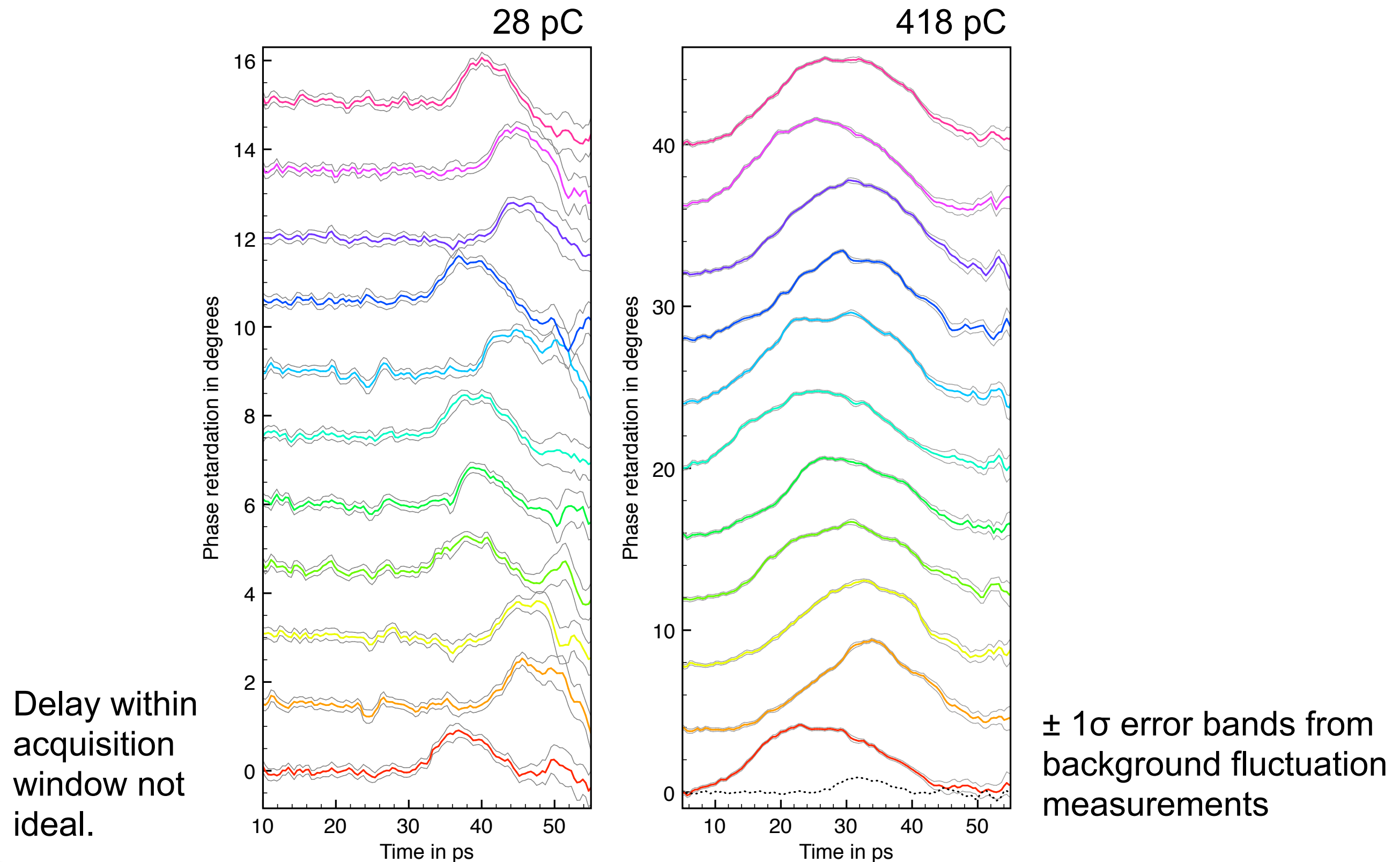


Bunch spacing 2 ns

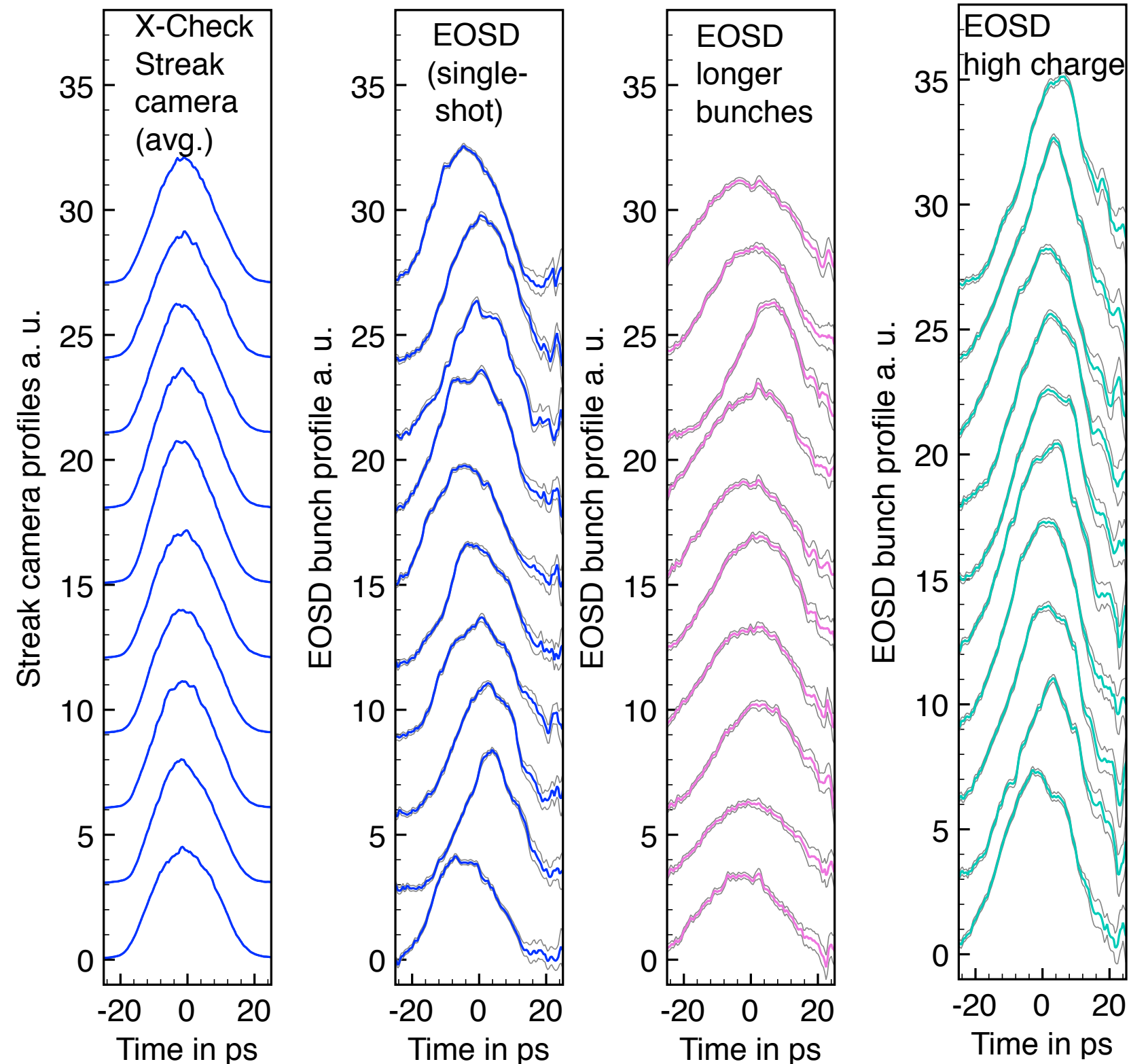


Signal of 2nd
bunch higher due
to wake-fields!

EOSD: Single-Shots - Sensitivity



EOSD: Single-shot bunch profiles for different electron beam parameters



Thank you for your attention/support!

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V. Schlott, B. Steffen,
P. Peier, C. Gerth, P.
Pollet & all the
technical staff at
ANKA, PSI & DESY
who helped to make
this project work!

SPONSORED BY THE



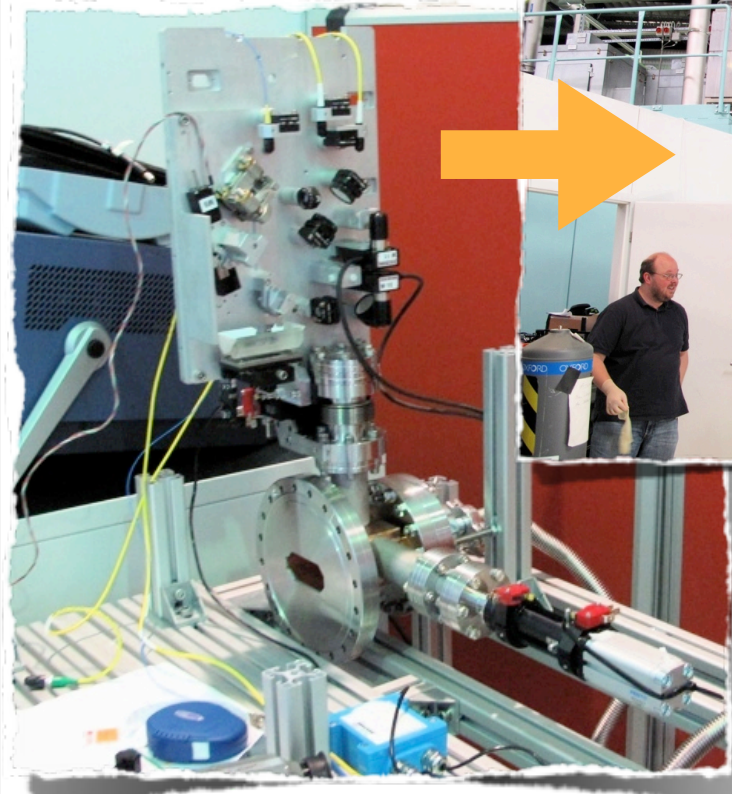
Federal Ministry
of Education
and Research



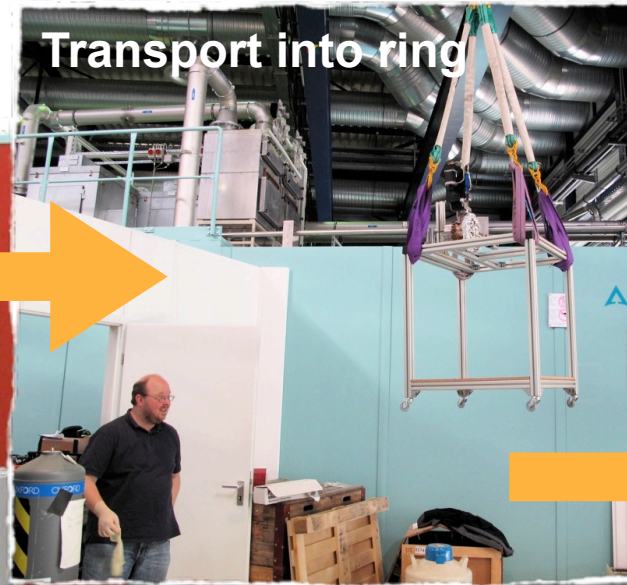
PAUL SCHERRER INSTITUT



Alignment before
installation



Transport into ring



Hole in the ring!
Oops...



Measuring



First results!

Making it fit

