

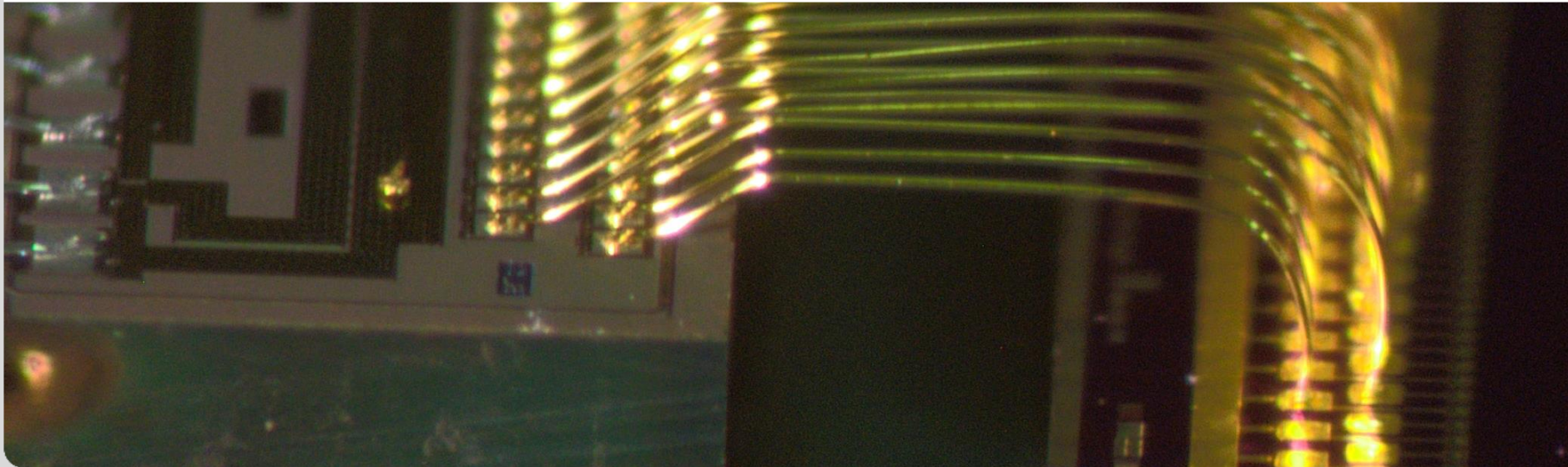


KALYPSO: an ultra-fast linear array detector for MHz repetition rate spectroscopy

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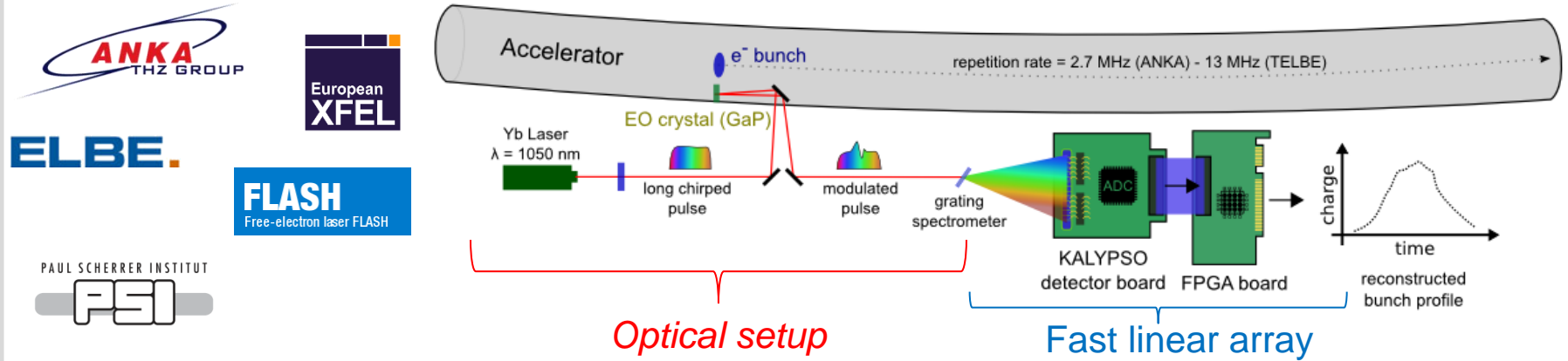
M. Caselle, L. Rota (*lorenzo.rota@kit.edu*), M. Balzer, S. Kudella, M. Weber, A. Mozzanica, N. Hiller, M.J. Nasse, G. Niehues, P. Schonfeldt, C. Gerth, B. Steffen, S. Walther, D. Makowski, A. Mielczarek

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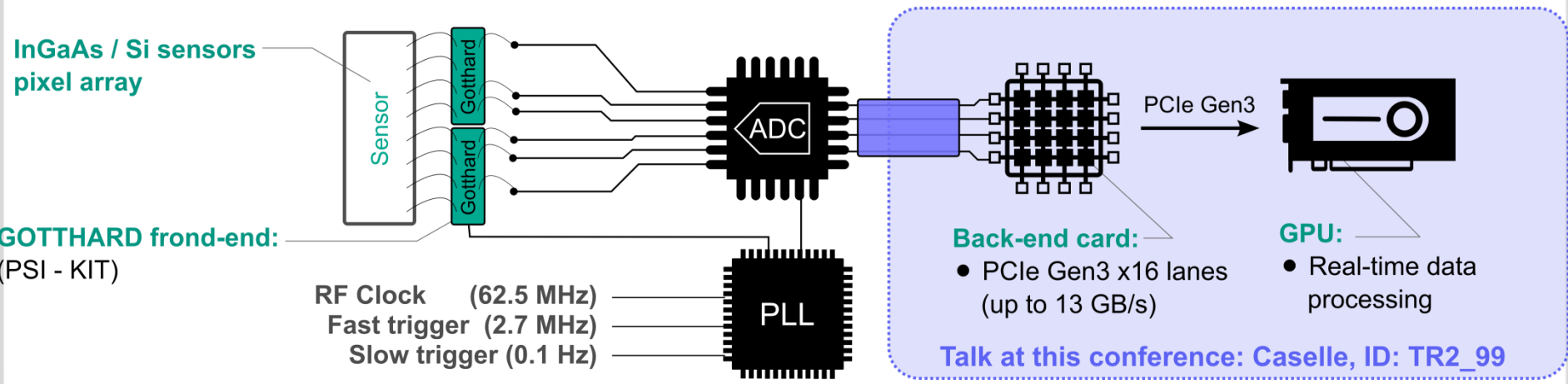


KALYPSO: a 2.7 Mfps linear-array detector

Motivation: *femtosecond sampling system* → to resolve the longitudinal “micro-bunch” substructure.



➔ **Fast linear array: high-speed front & back-end electronics with GPU for fast on-line data processing**



KALYPSO: an ultra-fast linear array detector for MHz repetition rate spectroscopy

L. Rota* (lorenzo.rota@kit.edu), M. Caselle, M. Balzer, S. Kudella, M. Weber, A. Mozzanica, N. Hiller, M.J. Nasse, G. Niehues, P. Schonfeldt, C. Gerth, B. Steffen, S. Walther, D. Makowski, A. Mielczarek

Motivation

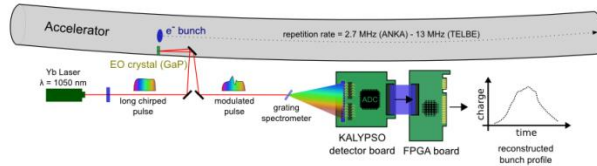
Scientific goal:
study the e^- bunch dynamics at linear accelerators (XFEL, TELBE) and synchrotrons (ANKA, DELTA)

"Ideal" linear array detector:

- Visible / Near-Infrared wavelengths
- High frame-rate: MHz range
- Continuous acquisition

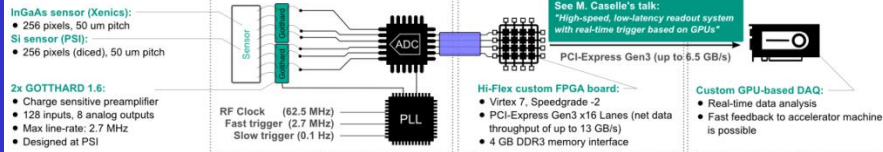
Commercial detectors are not suitable:

- Limited frame-rate (92)
- Synchronization with accelerator machine and other detectors not easily implemented



Electro-Optical (EO) techniques allow to reconstruct the longitudinal bunch profile by measuring the spectrum of a laser pulse, which has been modulated inside an EO crystal by the Coulomb field of the charged beam.

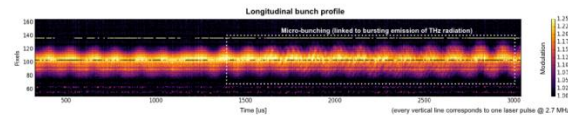
KALYPSO 2.1 architecture: 2.7 MHz line-rate



Preliminary results

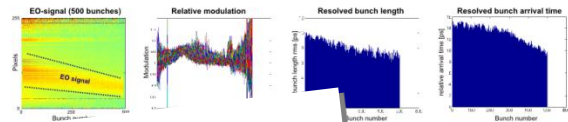
KALYPSO at ANKA:

- Single-shot measurement at a line-rate of 2.71 MHz
- Continuous acquisitions over long observation times (> 10⁵ shots)
- Bunch substructures can now be resolved



KALYPSO at XFEL:

- Bunch length measurements with 1.13 MHz rate over the XFEL bunch train
- Full system mounted in rack underneath the beamline
- Bunch shape, length & arrival time diagnostics



Contacts with:
HL-LHC, CLIC and FLASH



Very promising system for longitudinal beam diagnostic.....

Scientific motivation

Architecture & technological challenges

KALYPSO installed



Results & future work