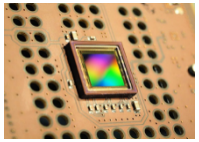
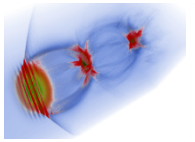
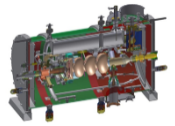
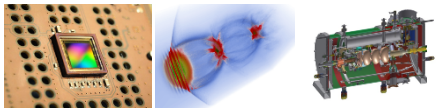




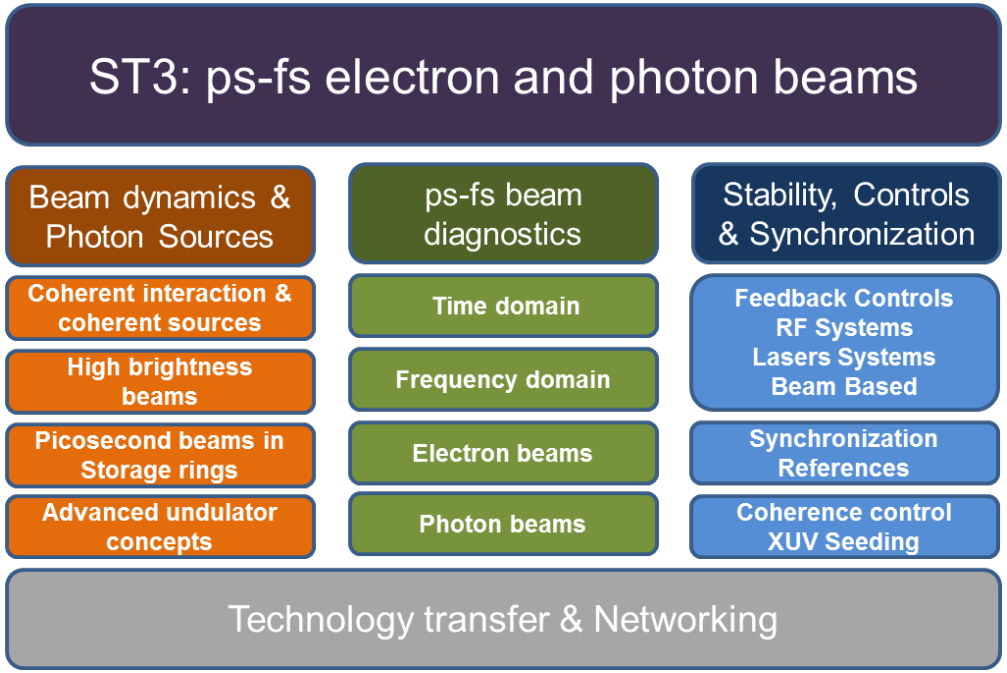
ST3:
ps and fs electron and photon beams

A.-S. Müller and E. Bründermann for the sub-topic 3 participants DESY, FZJ, HZB, HZDR, KIT

ST3: Structure & topics

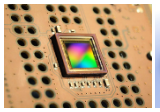
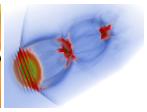
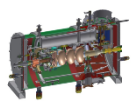


- Activities structured into three major research areas
  - **Beam dynamics & Photon Sources**
  - **ps-fs beam diagnostics**
  - **Stability, Controls & Synchronization**



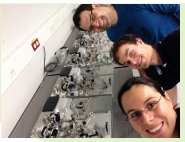
… wide range of topics and different technologies involved

ST3: Joint Technology Developments

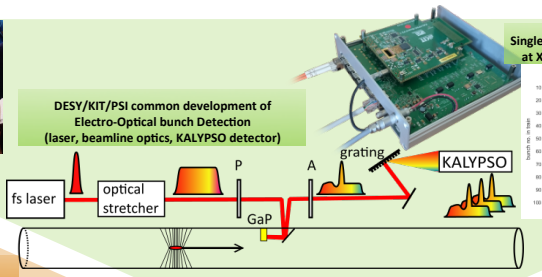




Superconducting undulators as commercial product

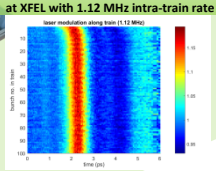
EO laser assembly by ST3 researchers from DESY & KIT



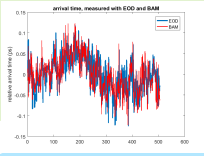
DESY/KIT/PSI common development of Electro-Optical bunch Detection (laser, beamline optics, KALYPSO detector)

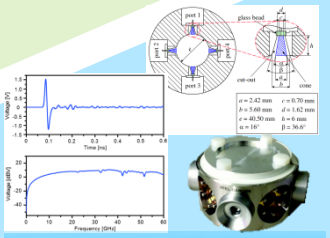


Single shot measurement of a bunch train at XFEL with 1.12 MHz intra-train rate



E-bunch arrival time at XFEL measured with EOD and BAM

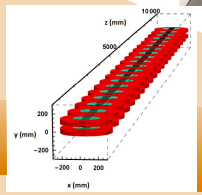




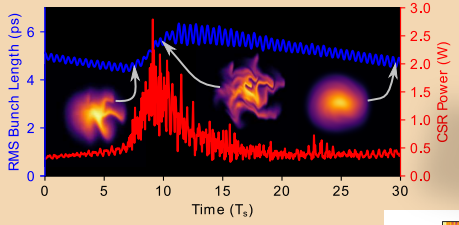
High BW pickup for Bunch Arrival-time Monitors (DESY/HZDR/TU Darmstadt)
Test as ELBE, installed at FLASH and XFEL

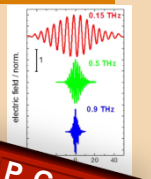
White paper: THz pump facility @ XFEL

"…..any accelerator-based sources provide the wide tunability together with high intensity and repetition rates beyond 100 kHz, that will enable a broad application at European XFEL on the most interesting scientific problems in the field……"

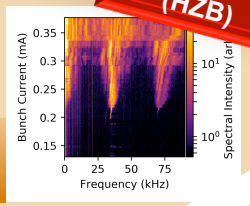


A superconducting THz undulator for the European XFEL (DESY, HZDR, KIT)
Ref.: xfel.tind.io/record/1563





New fast simulation code "Inovesa" for studies of the longitudinal phase space of ultra-short bunches and the micro-bunching instability in storage rings (HZB/KIT)



The 'snapshot method': a new experimental way for extremely fast mapping of short-bunch instabilities in storage rings based on the KAPTURE DAQ system and ultra-fast THz detectors (HZB/KIT).

ST3: ps-fs electron and photon beams

Beam dynamics & Photon Sources	ps-fs beam diagnostics	Stability, Controls & Synchronization
Short bunches in linear accelerators	Time domain	Synchronization References
Coh. radiation & high fields in storage rings	Frequency domain	RF Controls
Custom beams: bunch shape manipulation	Electron beams	Control System Advances
Advanced photon sources development	Photon beams	Coherence control XUV Seeding

Technology transfer & Networking & T…

P. Goslawski (HZB)

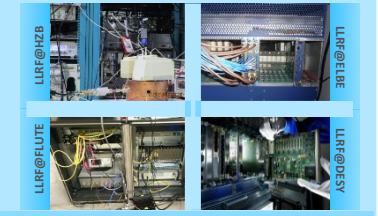
C. Lechner (DESY)

L. Rota (KIT)

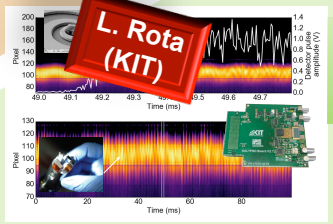
M. Hierholzer (DESY)

MicroTCA.4 based Laser Synchronization and Optical Link Stabilization (70+ units in operation at DESY/KIT/HZDR)

ELBE optical synchronization system, an adapted copy from FLASH (DESY/HZDR)

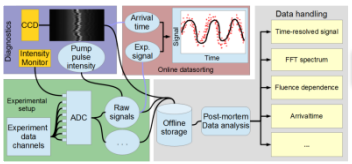


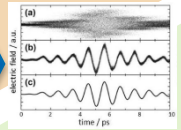
Common MicroTCA.4 based LLRF control at DESY/HZB/KIT/HZDR
Hardware assembly and commissioning, exchange of firmware, test of feedback algorithms, adoption of software for different control systems and automation needs



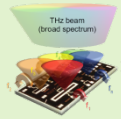
Combining turn-by-turn THz detection and EO profile measurements for short bunches in storage rings with ST3 technologies: YBCO detectors, EO detection, KAPTURE and KALYPSO.

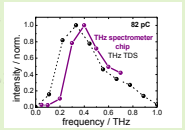
Unified Control Software Development
Increasing work needed for software and automation. ChimeraTK allows reusability in different facilities (DESY/KIT/HZDR)



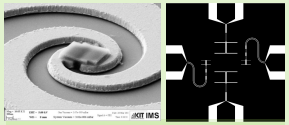


Pulse-resolved DAQ at quasi-cw SRF driven photon sources tested at quasi-cw TELBE test facility:
already implemented in user operation at TELBE & THz-FLASH
demonstrator for XFEL under development (EUCALL)





On-chip THz spectrometer for BCM
tested at quasi-cw TELBE test facility
implementation foreseen at ELBE, FLUTE, FLASH, XFEL



Ultra-fast YBCO single and multi-pixel THz detectors (UVSOR, DELTA, DIAMOND, SOLEIL, HZB, KIT)

KAPTURE and KALYPSO high throughput DAQ systems for electro-optical and THz diagnostics with up to 500 MHz repetition rate (KIT/DESY/HZDR)

→ **See MT-ARD-ST3 poster: E. Bründermann for DESY, HZB, HZDR, KIT**

Highlight-Talks

"ChimeraTK: …"/DESY; "XUV seeding …"/DESY
"Beam diagnostics …"/ KIT; "Two beam operation …",/HZB

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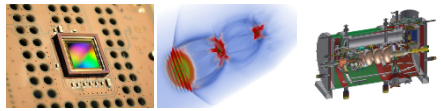
MT ARD

ST3: Close ties to other program topics and sub-topics



ST1: SRF Technologies

- CW instrumentation
- SRF field regulation
- High rep. detectors & control
- Beam dynamics
- Automation/Feedbacks

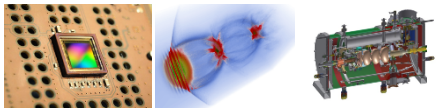
ST3: ps and fs photon and electron beams

- 1D detector
- Ultra fast readout
- Ultra broadband
- High speed DMA
- Data acquisition
- Data analysis

- Ultra short pulse diagnostics
- Beam dynamics & simulation
- Synchronization
- NRF field regulation
- Fast Feedbacks

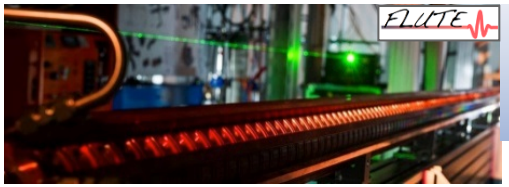
ST4: Novel Accelerator Concepts

ST3: Accelerator Test Facilities



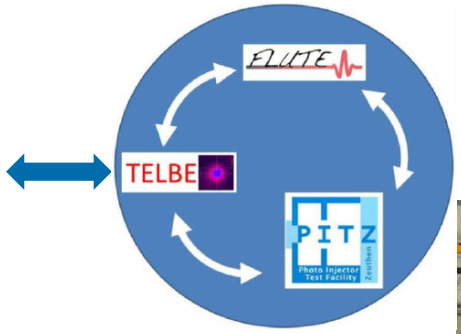
- Advantage: access to test facilities covering a broad range of beam parameters and bench-marking possibilities
- Complementary infrastructures
- Preparing the technology for next-generation accelerators

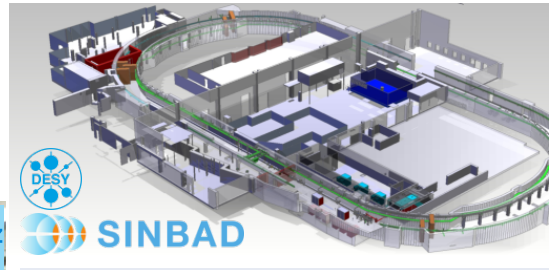
TELBE: quasi-cw instrumentation with high data throughput acts as lighthouse for future quasi-cw upgrades (e.g. XFEL)



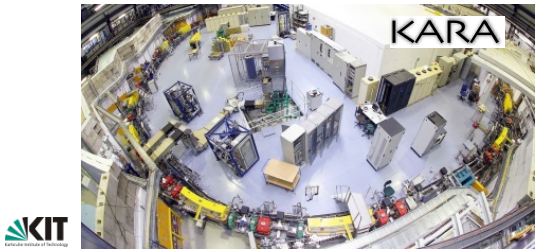
FLUTE: development and testing of ultra-short bunch diagnostics with large dynamic range

KIT

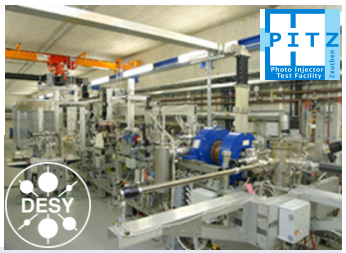




SINBAD: Linac for novel acceleration research (LPWA, THz acceleration, Accelerator on a chip) & accelerator technologies development .



KARA storage ring: highest repetition rates and radiation source tests



PITZ: understanding and control of longitudinal and transverse phase space

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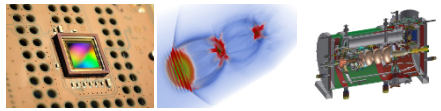


News from the test facilities and Photon Sources

SINBAD-ARES linac – Status

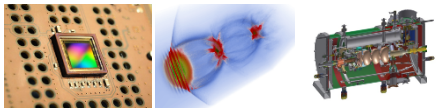


Photo-injector goals:

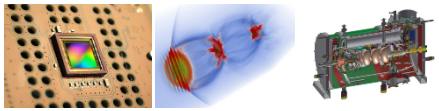
- Study of **limitations in e-bunch compression** to **fs duration** using conventional RF technology.
- Production of high brightness fs long e-bunches for **injection into novel compact high gradient accelerators** (LWFA, DLA, THz driven accelerators etc.).

- RF-gun cavity tuning performed
- Ongoing installations RF gun region
- Start of Conditioning: September 2018

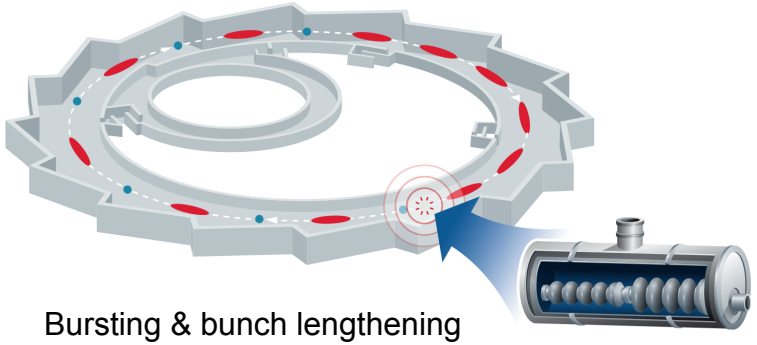
References:

- U. Dorda et al., "Status and objectives of the dedicated accelerator R&D facility SINBAD at DESY", NIM A (2018).
- B. Marchetti et al. "Conceptual and technical design aspects of accelerators for external injection in LWFA", Applied Sciences, 8(5), 2018.
- B. Marchetti et al., "Status of the ARES RF gun at SINBAD: from its characterization and installation towards commissioning", Proc. IPAC18.

BESSY VSR – fully funded

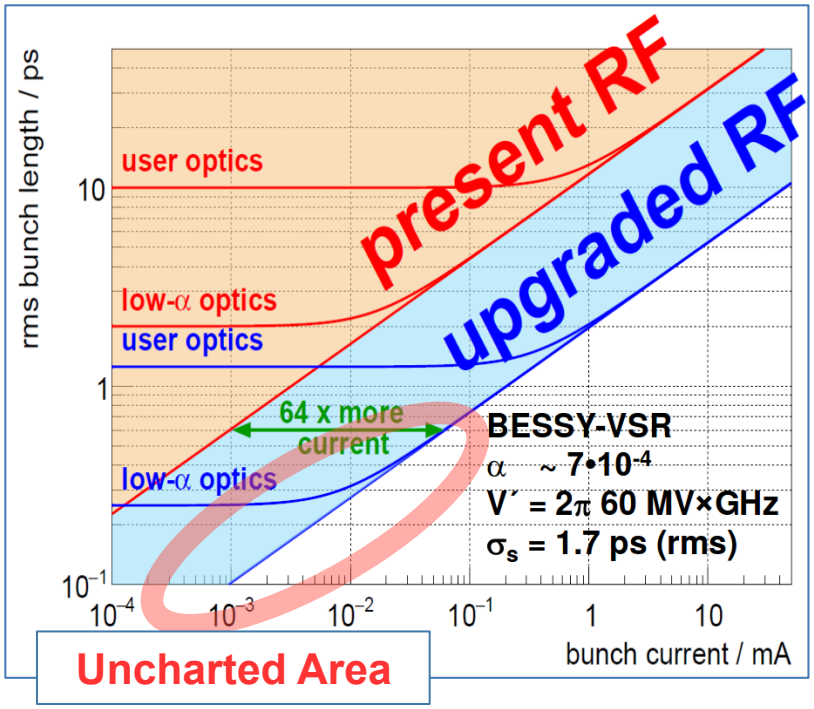


long & short intense bunches. simultaneously in one storage ring



- Increase longitudinal focusing gradient by factor 64 with high voltage (20 MV/m) sc cw multi cell cavities
- Bunch shortening by a factor of 8
- 64 times more current in short bunches than with low alpha => extend bursting threshold
- Two RF frequencies to generate short and long buckets via a beating

Bursting & bunch lengthening



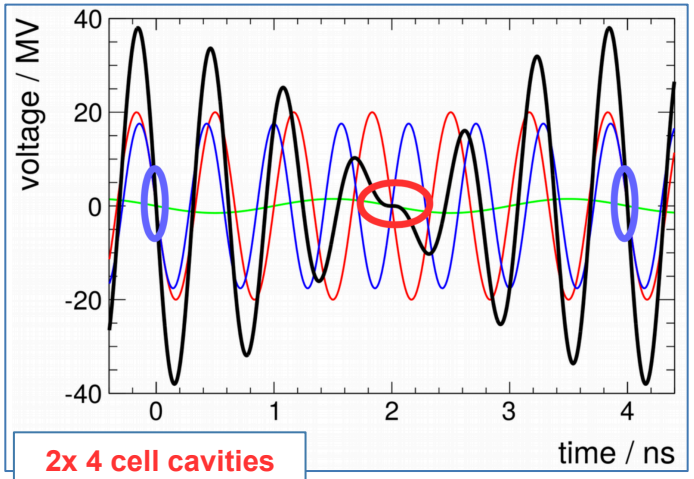
$$\sigma_0 \sim \sqrt{\frac{\alpha_c}{V'_{\mathrm{rf}}}}$$

$$I_{\mathrm{th.}} \sim \alpha_c$$

$$I_{\mathrm{th.}} \sim V'_{\mathrm{rf}}$$

In low alpha mode
400 fs with
0.04 mA/bunch

Voltage beating pattern:



2x 4 cell cavities
16 MV @ 1.50 GHz
2x 4 cell cavities
14 MV @ 1.75 GHz

Reference: A. Jankowiak et al, TDS BESSY VSR, doi:10.5442/R0001

Courtesy: VSR project team

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BESSY VSR – Status

P. Goslawski (HZB)
ARD-ST3 Highlight Talk

Project realization phase

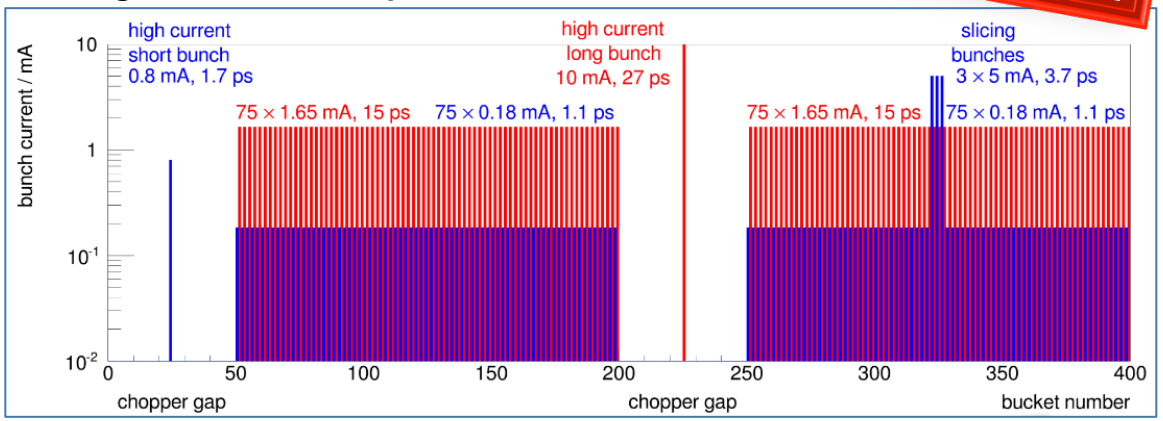
- 2022 preparatory phase (2 x 1.5 GHz cavities)
- 2023 full BESSY VSR

Beam Dynamics

- Intra-beam scattering: 25% bunch length increase for 0.8 mA @ 1.7 ps

Reference: T. Mertens et al, IPAC18, WEXGBE3, invited

Envisaged multi user fill pattern:



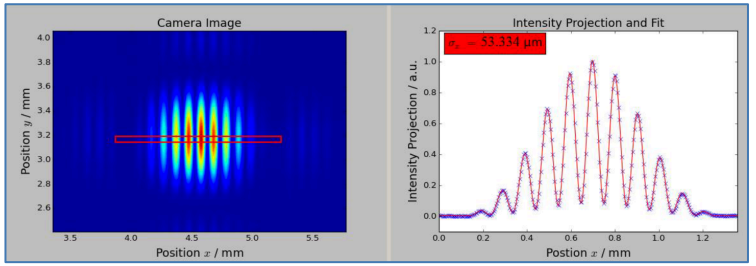
- **Two Orbit Test Week Feb2018** – new bunch separation scheme using non-linear beam dynamics

  Future option under study, no VSR baseline

Beam Diagnostics

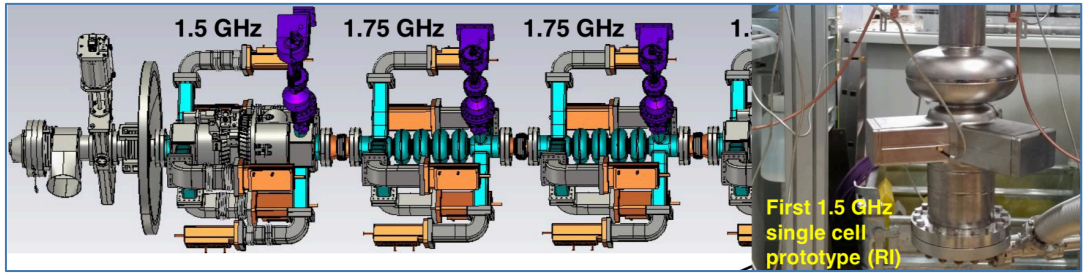
- Bunch resolved diagnostics, BPMs, Streak Camera
- Interferometric Beam Size Monitor

Reference: M. Koopmans, Master Thesis, HU Berlin & HZB, 2018



Hardware

- 4-cell 1.5-GHz design ready, procurement, tests with 1-cell cavity
- Finalization of couplers, HOM absorbers and full coldstring
- First tests at HZB campus



Courtesy: VSR project team

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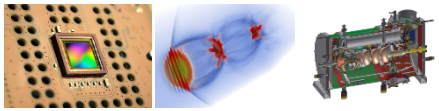
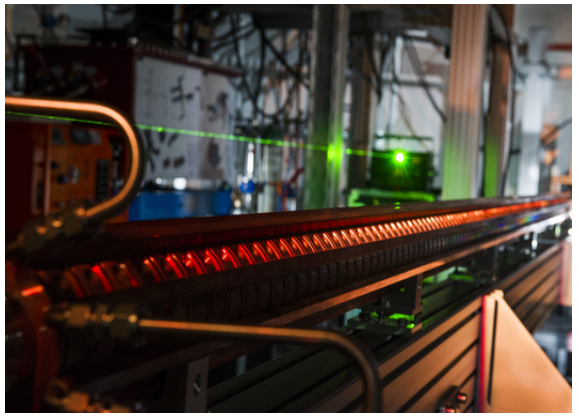
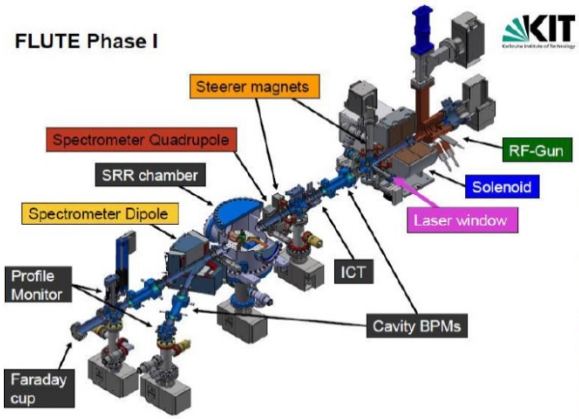
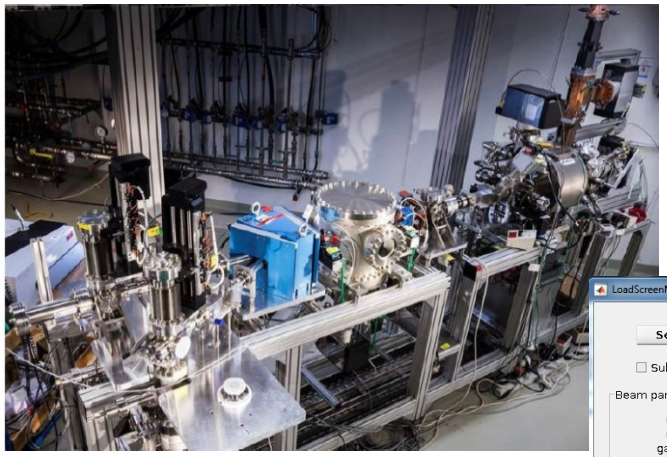
FLUTE Inauguration

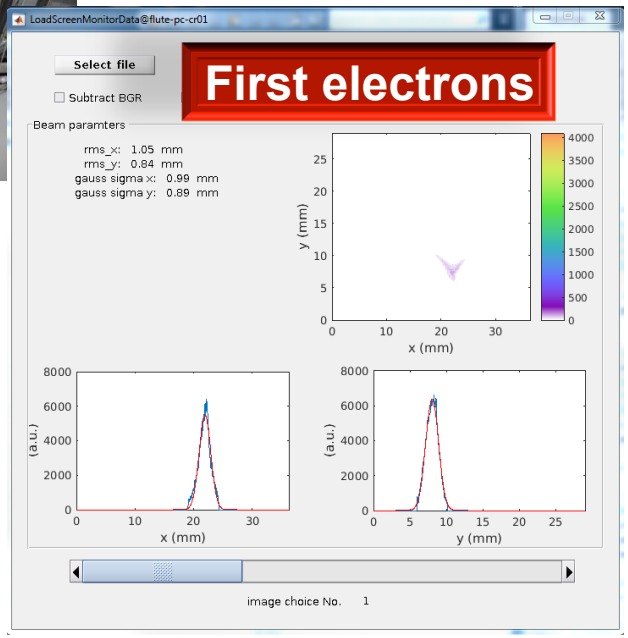




Successful Diagnostics Integration







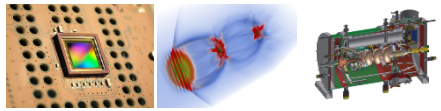
References:

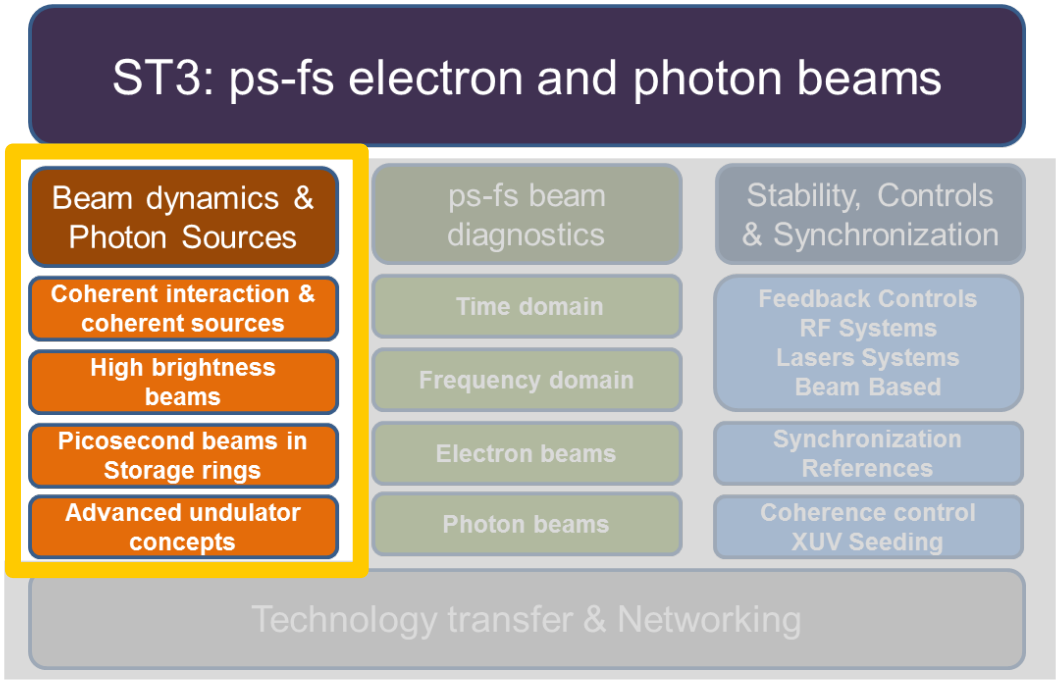
- M. Yan, A. Bernhard, E. Bründermann, S. Funkner, I. Kriznar, A. Malygin, S. Marsching, W. Mexner, A. Mochihashi, M. J. Nasse, G. Niehues, R. Ruprecht, T. Schmelzer, M. Schuh, N. Smale, S. Wüstling, A.-S. Müller, „FLUTE Diagnostics Integration“, Proc. IPAC2018, WEPAL029
- A. Malygin, A. Bernhard, A. Böhm, E. Bründermann, S. Funkner, I. Kriznar, S. Marsching, W. Mexner, A. Mochihashi, M. J. Nasse, G. Niehues, R. Ruprecht, T. Schmelzer, M. Schuh, N. Smale, P. Wesolowski, M. Yan, A.-S. Müller, M. Schwarz, „Commissioning status of FLUTE“, Proc. IPAC2018, THPMF068

→ **See Poster by M. J. Nasse, KIT for the FLUTE collaboration**

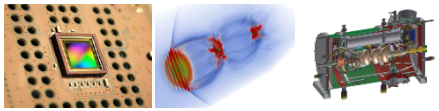
PAUL SCHERRER INSTITUT DESY KIT Karlsruher Institut für Technologie ATP KIT Accelerator Technology Platform HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

Beam dynamics and photon sources

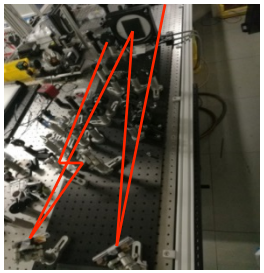




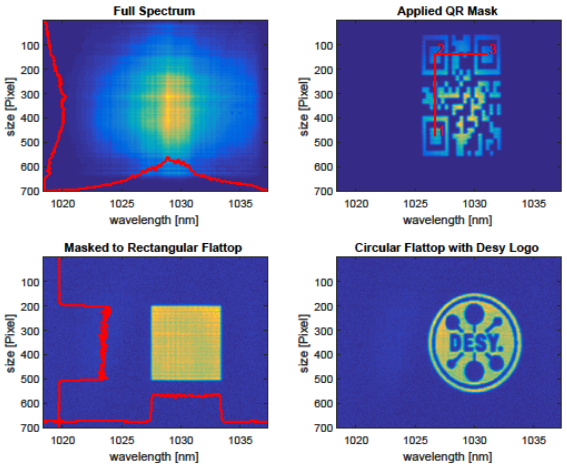
Ellipsoidal bunch generation at PITZ developments towards ELLA 2.0



1: Spatial Light Modulator Shaper

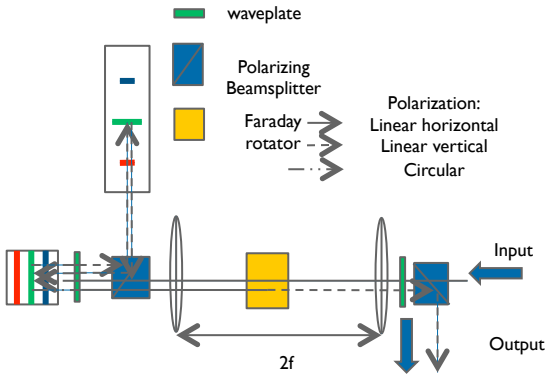


- First shaping unit finished
- Shaping with feedback from spectrograph has been demonstrated
- Second unit under construction (full 3D)
- temporal measurements with cross correlation coming up

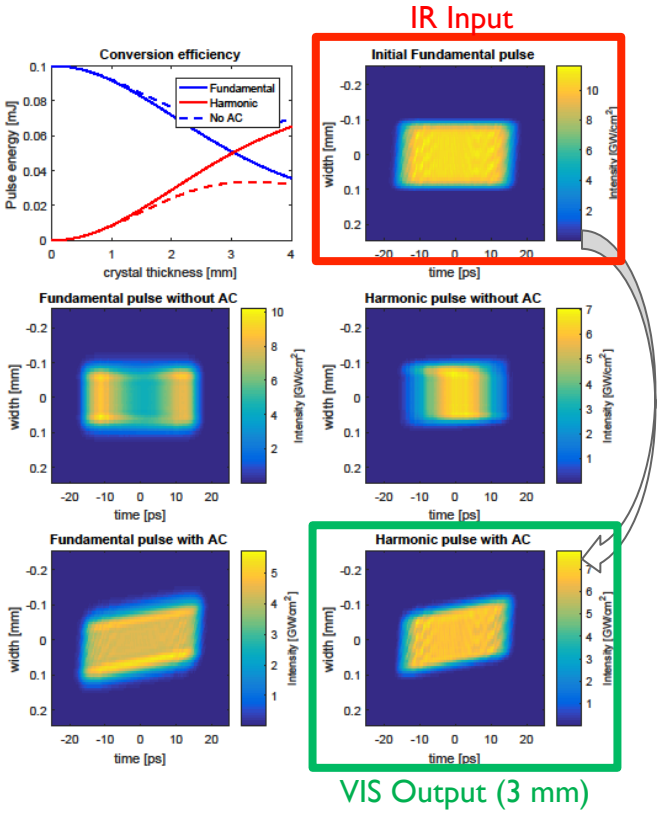


2: Volume Bragg Grating Shaper

- Gratings ordered and delivered
- Setup for matched dispersive imaging distance will be tested
- Extraction with polarizing beamsplitters



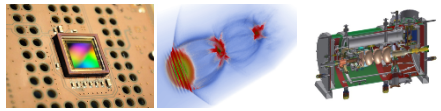
3: Design of shape preserving UV-Conversion



Simulations (Chi23d) show feasibility of shape preserving conversion with angular chirp (AC)

Courtesy: C. Koschitzki, PITZ

Simulations of THz SASE FEL based on the PITZ accelerator and the LCLS-I Undulator



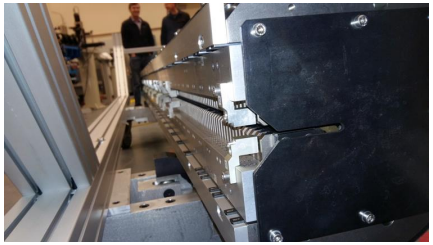
- PITZ plans long term loan of 2 LCLS-I undulator modules from SLAC
- Simulations have been done to investigate, if undulators are suitable

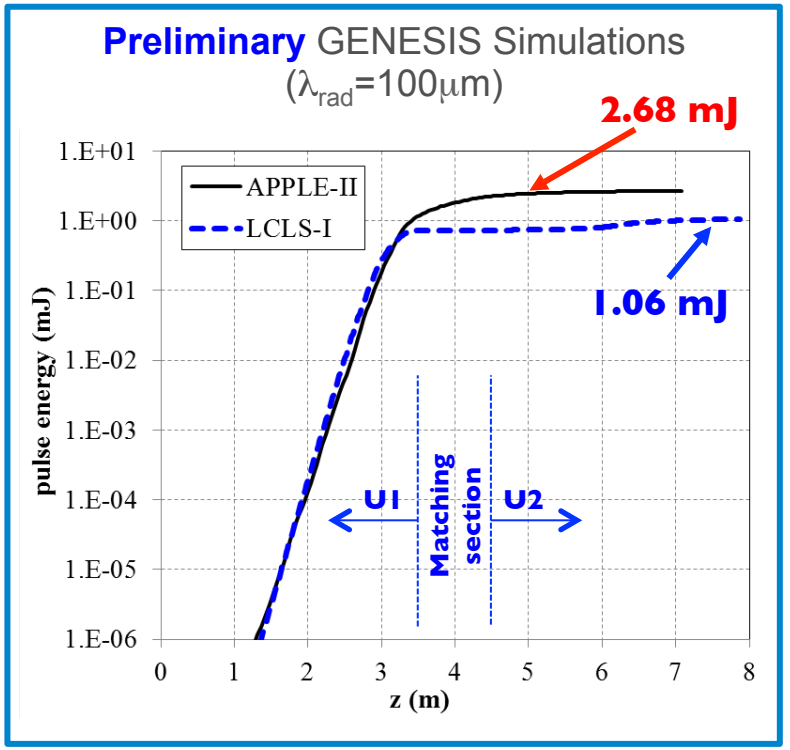
→ **See Poster by P. Boonpornprasert**

Some Properties of LCLS-I undulator

Properties	Details
Type	**planar hybrid** (NdFeB)
K-value	3.49
Support diameter / length	30 cm / 3.4 m
Vacuum chamber size	11 mm x **5 mm**
Period length	30 mm
Periods / a module	113 periods

Ref.: LCLS conceptual design report, SLAC-0593 (2002)





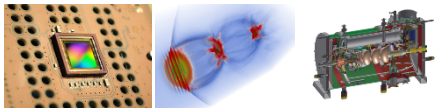
Preliminary conclusions on LCLS-I undulators at PITZ

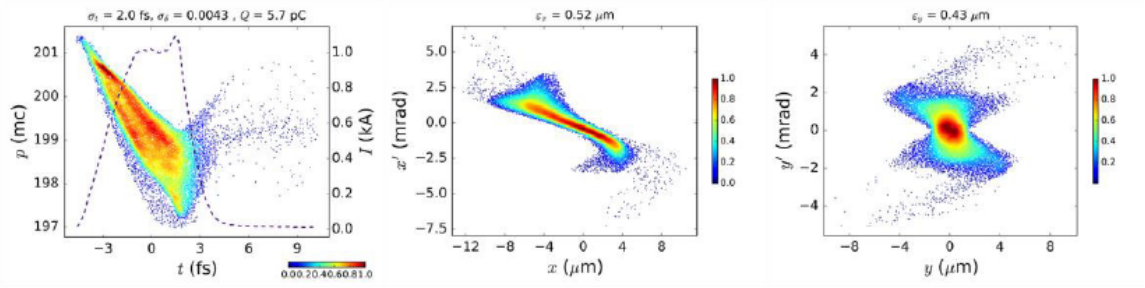
- Not such extremely high performance as for APPLE-II
- Clearly proper for **proof-of-principle experiment.**
- 4 nC electron beam transport through vacuum chamber needs efforts, but seems feasible

PITZ Photo Injector Test Facility Zeuthen

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

SINBAD-ARES linac – Working Points

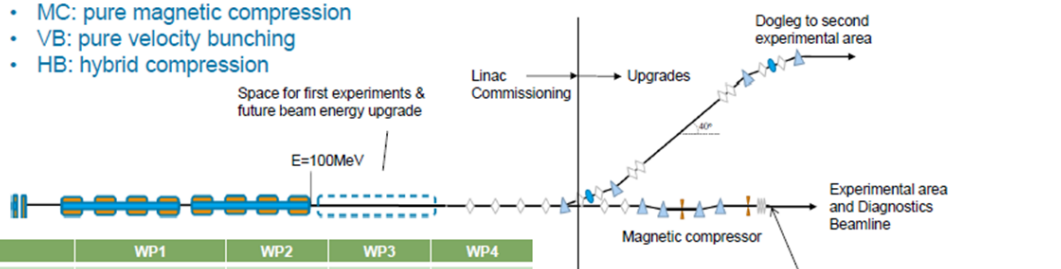




Plasma entrance (the tail containing 2% of the particles were removed)

e-Bunch Compression and Focusing

3 Compression Techniques:
- MC: pure magnetic compression
- VB: pure velocity bunching
- HB: hybrid compression



	WP1	WP2	WP3	WP4
Q (pC)	0.8	5.7	30	17.3
σ_t (fs)	0.5	2.0	29.6	12.2
I (kA)	0.6	1.1	1.6	1.5
$\varepsilon_x/\varepsilon_y$ (μm)	0.10 / 0.10	0.52 / 0.43	0.84 / 0.84	0.52 / 0.94
Brightness (A/m²)	$4.6*10^{16}$	$3.6*10^{15}$	$4.1*10^{14}$	$8.2*10^{14}$
Compression method	MC	MC	VB	HB
σ_x / σ_y (μm)	13 / 17	52 / 25	\	48 / 29

Courtesy: B. Marchetti

Design Study for Generating Sub-femtosecond to Femtosecond Electron Bunches for Advanced Accelerator Development at SINBAD

Dissertation
zur Erlangung des Doktorgrades
an der Fakultät für Mathematik, Informatik und Naturwissenschaften
Fachbereich Physik
der Universität Hamburg

vorgelegt von

Dipl.-Phys. Jun Zhu
aus Jingdezhen

Hamburg
2017

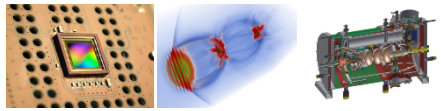
Jun Zhu, PhD thesis
Detailed conceptual design summarized

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

DESY

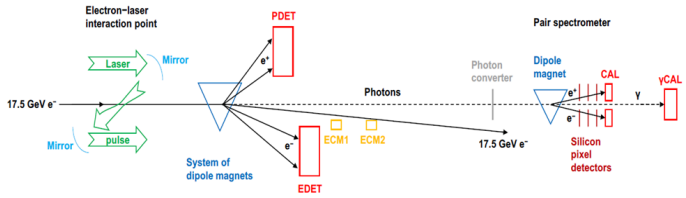
HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

Tests of QED in strong-field regime with electron-photon interactions (LUXE)

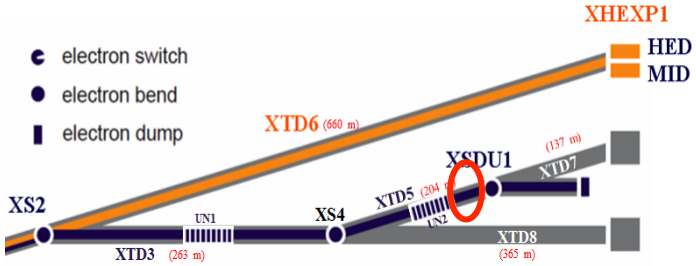


Design study for an experiment LUXE @ XFEL

- measure QED in the presence of strong fields at and above the Schwinger critical field
- measure multi-photon absorption in Compton scattering and e+e- pair production in electron--photon interactions



Layout sketch of the experiment.



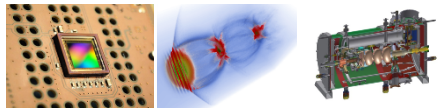
Possible location of the experiment at the XFEL.

International workshop at DESY.

Reference: A. Hartin, "New Strong field QED Review paper, electron/ laser and collider IP", accepted for publication (arXiv:1804.02934)

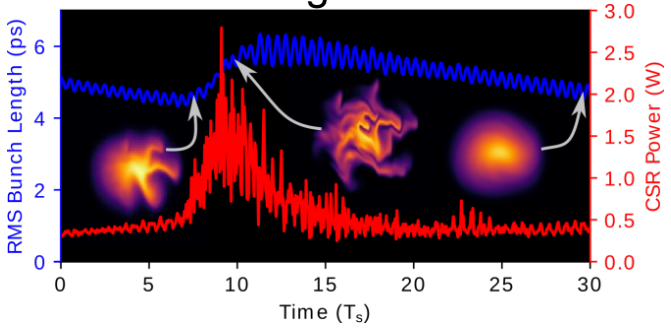
Courtesy: B. Heinemann, E. Negodin

Update: CSR, simulation, experiments, damping times, …

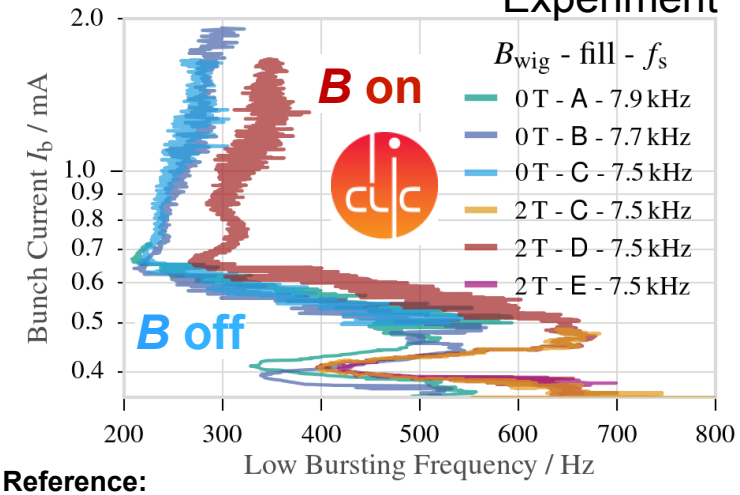


Inovesa: Numerical Optimized Vlasov Equation Solver Application

THz bursting: simulation

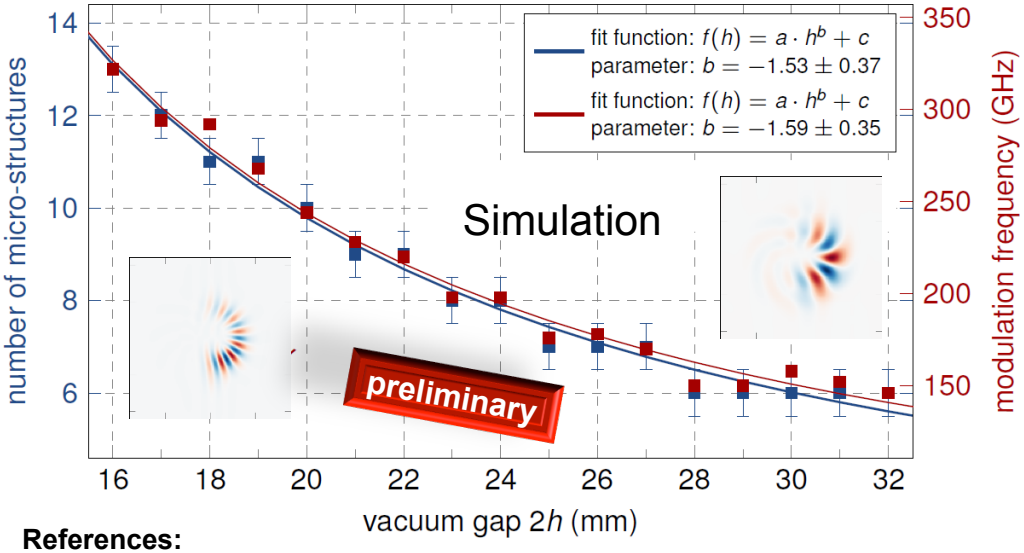


Experiment



Machine Learning for Data Analysis

Studies using the Application of k-means



References:

- T. Boltz, M. Brosi, E. Bründermann, P. Schönfeldt, M. Schwarz, M. Yan, A.-S. Müller, „Studies of Longitudinal Dynamics in the Micro-Bunching Instability Using Machine Learning“, Proc. IPAC2018, THPAK030 (2018)
- Ibid., „Machine Learning Application on the Investigation of the Micro-Bunching Instability at Storage Rings“ ICFA Beam Dynamics Mini-Workshop, Machine Learning Applications for Particle Accelerators, Feb 2018

Reference:

M. Brosi, J. Gethmann, A. Bernhard, B. Kehrer, A.I. Papash, P. Schönfeldt, P. Schreiber, J.L. Steinmann, A.-S. Müller, “Studies of the Micro-Bunching Instability in the Presence of a Damping Wiggler”, Proc. IPAC 2018, THPAK029 (2018)

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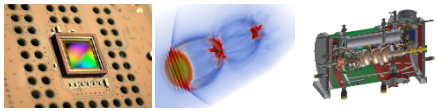
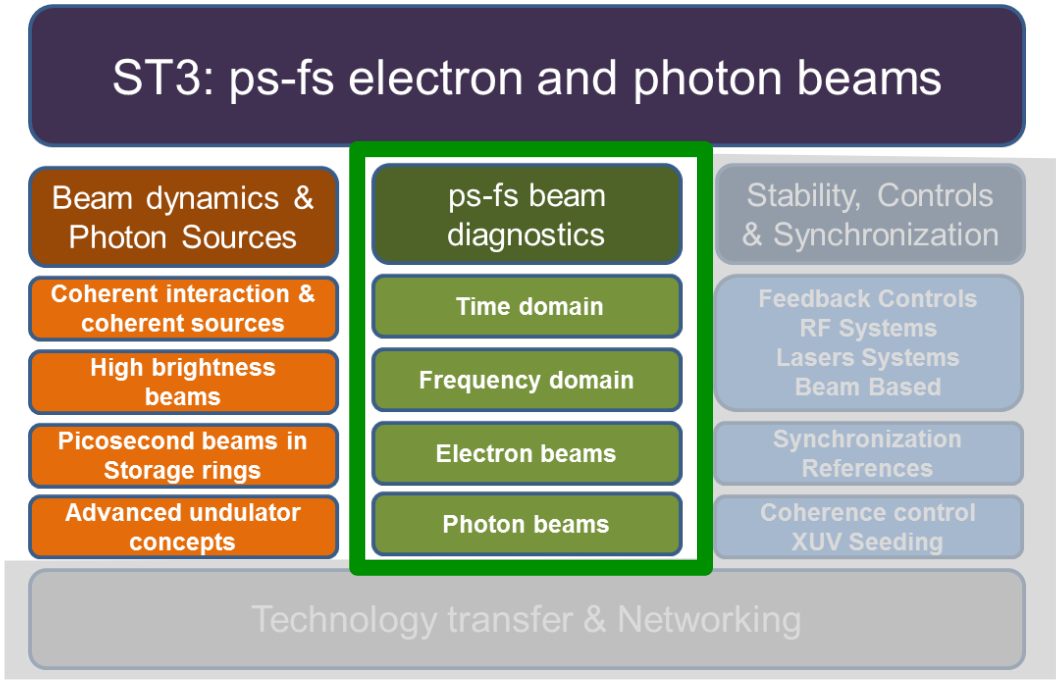
MT ARD

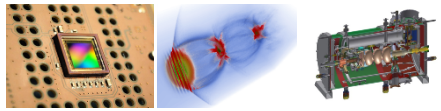
ps-fs Beam Diagnostics





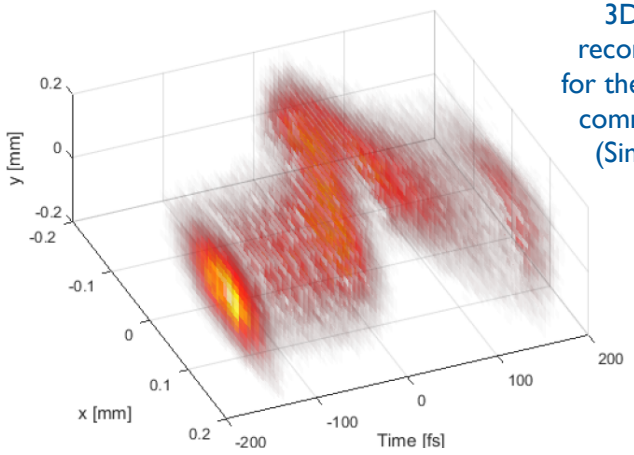
PolariX TDS Project

(Polarizable X-band Transverse Deflection Structure)

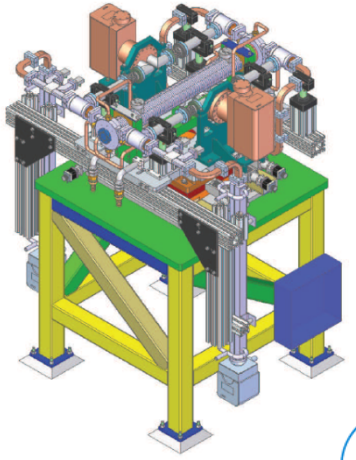


Collaboration between DESY-CERN-PSI

- Development and realization of advanced modular X-band TDS system with **new feature** of providing **variable polarization of the deflecting force**
- Common Mechanical Design (**FLASHForward, FLASHII, SINBAD** at DESY, **ATHOS** beamline at SwissFEL)
- First Review Meeting (October 2017) about **Tolerances** Evaluation gave **positive feedback**
- **Procurement of the prototype ongoing (PSI)**
- Prototype **planned to be tested** next year with beam **at DESY** (FLASHForward beamline). Then, 6 cavities will be produced



3D charge reconstruction for the prototype commissioning (Simulation)



Assembly of the PolariX TDS Prototype at DESY.

PAUL SCHERRER INSTITUT

DESY

CERN

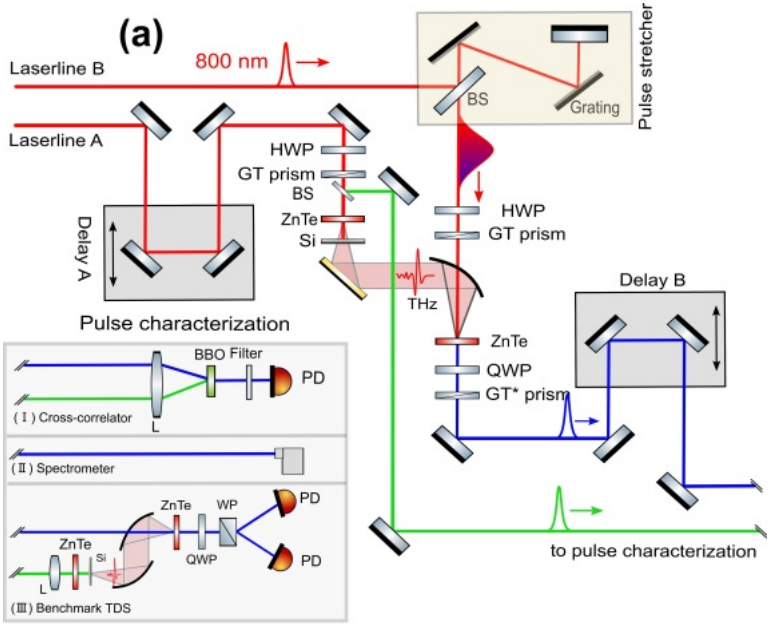
References:

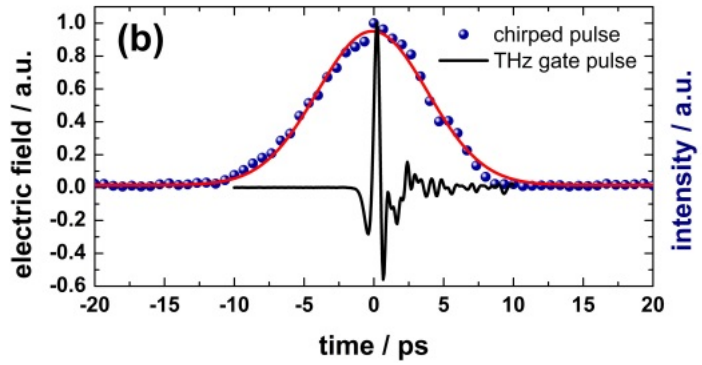
- P. Craievich et al. "Status of the PolariX TDS Project", Proceed. IPAC18, THPAL068.
- D. Marx et al. "Simulations of 3D Charge Density Measurements for Commissioning of the PolariX-TDS", Proceed. IPAC18, WEPAF050.

Courtesy: B. Marchetti

Towards intrinsic laser-accelerator synchronisation by THz slicing

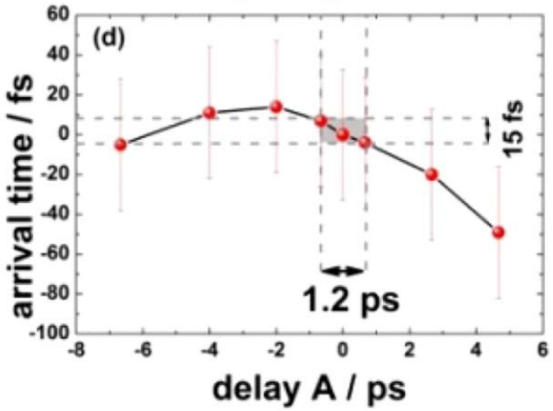
See also ARD status report





Courtesy: M. Gensch, HZDR

- Proof of principle for laser-accelerator synchronisation based on THz slicing
- Arrival time jitter is compensated by almost 2 orders of magnitude
- Applicable at any light source based on ultra-short electron bunches
- Next generation is under development



Reference: M. Chen et al, "Towards femtosecond-level intrinsic Laser Synchronization at 4th Generation Lightsources", Opt. Lett. 43, 2213 (2018)

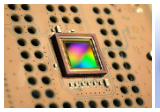
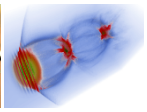
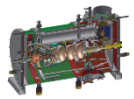
HZDR HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

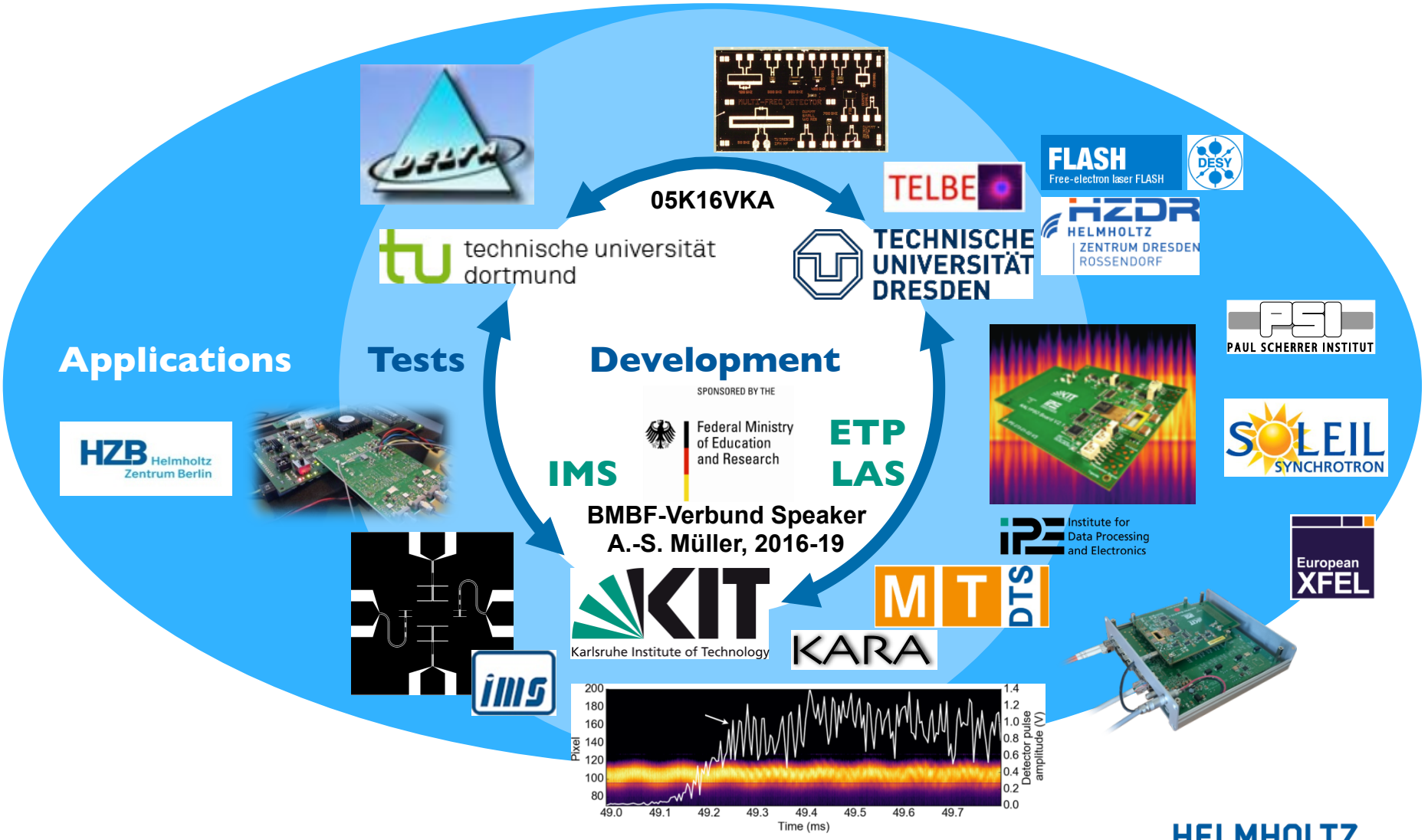
TELBE

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

MT ARD

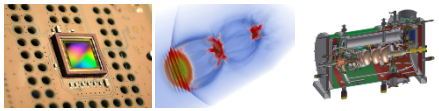
ST3: Collaboration with universities

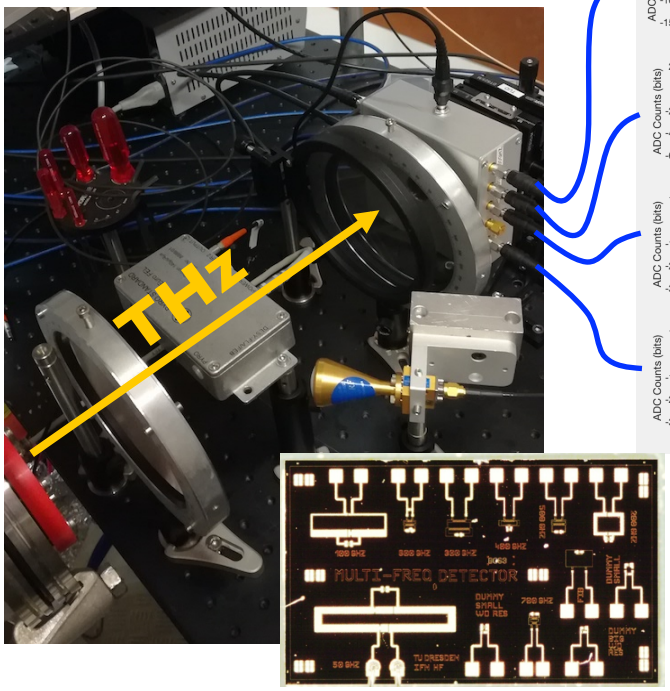


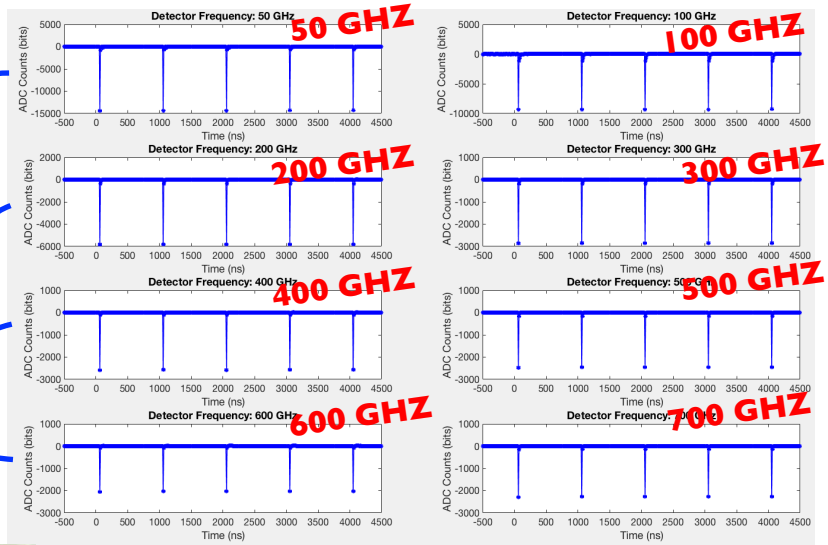
HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

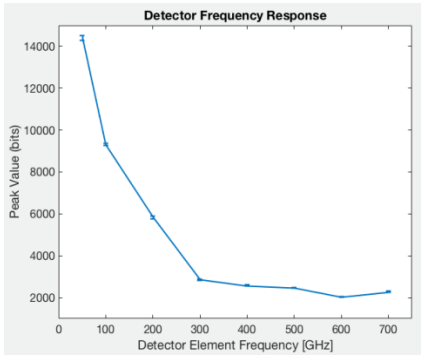
On-chip THz Spectrometer for electron bunch length diagnostics

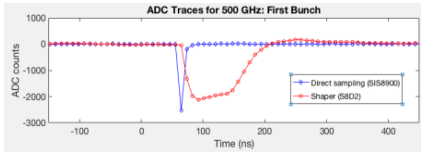


Example:
Measurement setup at the THz diffraction radiation beamline at FLASH









Measurements at TELBE, FLASH & DELTA with On-chip THz Spectrometer developed at TU Dresden

- Spectral fingerprint and polarization dependency
- Test of electronics for MTCA based readout

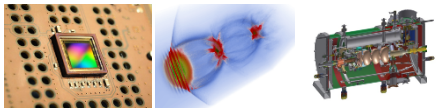
References:

- Schiselski, M., Laabs, M., Neumann, N., Gensch, M., & Plettemeier, D.: „Integrated Schottky diode detector for THz spectrometer“. In *Microwave Conference (GeMiC), 2015* (pp. 272-275). IEEE.
- M. Laabs,“On-chip THz spectrometer for Bunch Compression Fingerprinting”, submitted

Courtesy: N. Neumann & M. Laabs (TU Dresden), C. Mai (TU Dortmund), Ch. Gerth (DESY), M. Gensch (HZDR)

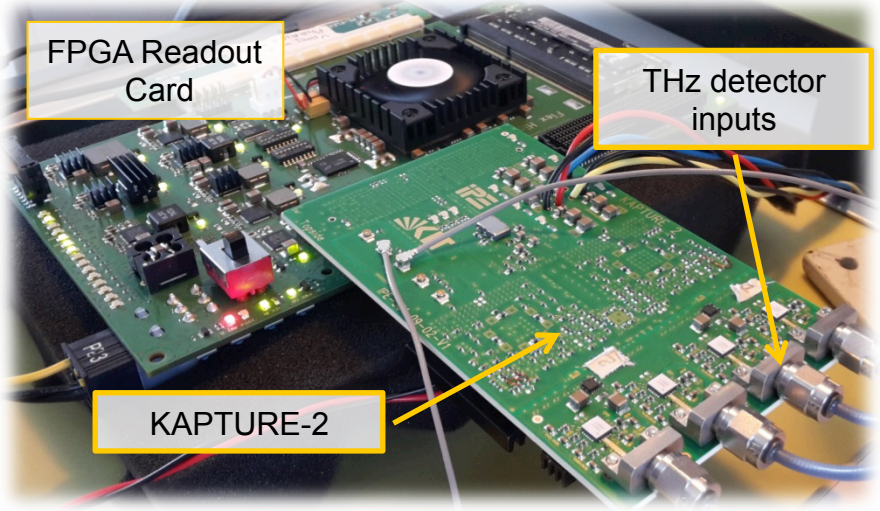
HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

KAPTURE – 2

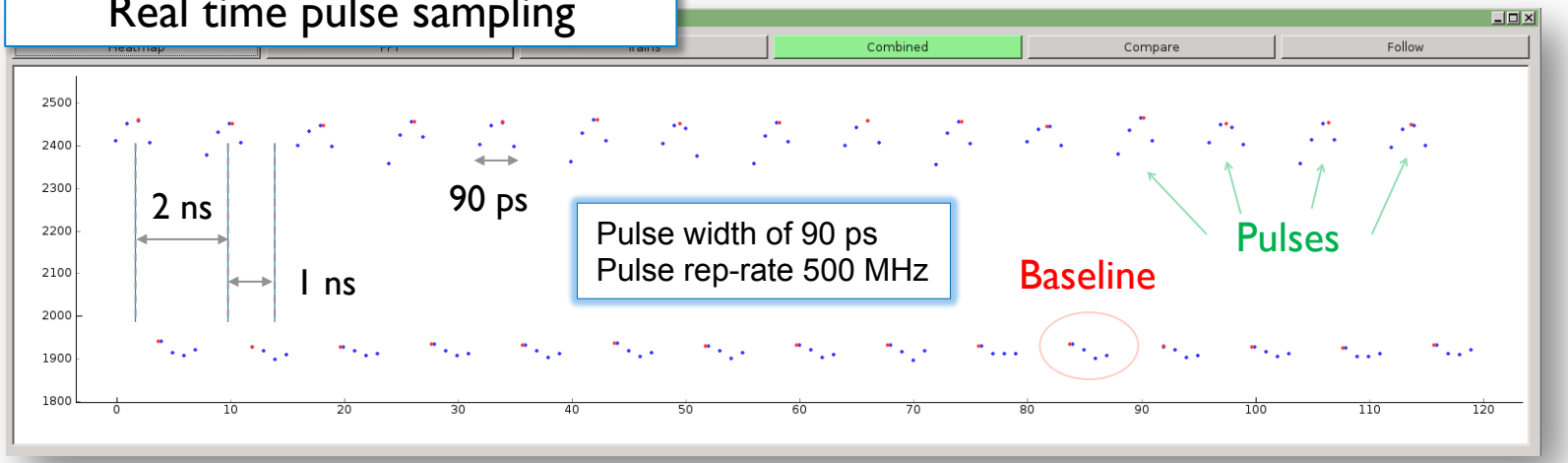


Readout electronics for Terahertz detectors

- System is operational @ KARA
- Local sampling frequency > 300 GS/s
- Up to 1 GHz trigger rate
- Pulse amplitude (mV) and arrival time (ps) accuracy



Real time pulse sampling



Courtesy: M. Caselle, KIT

KALYPSO: ultrafast 1D detector

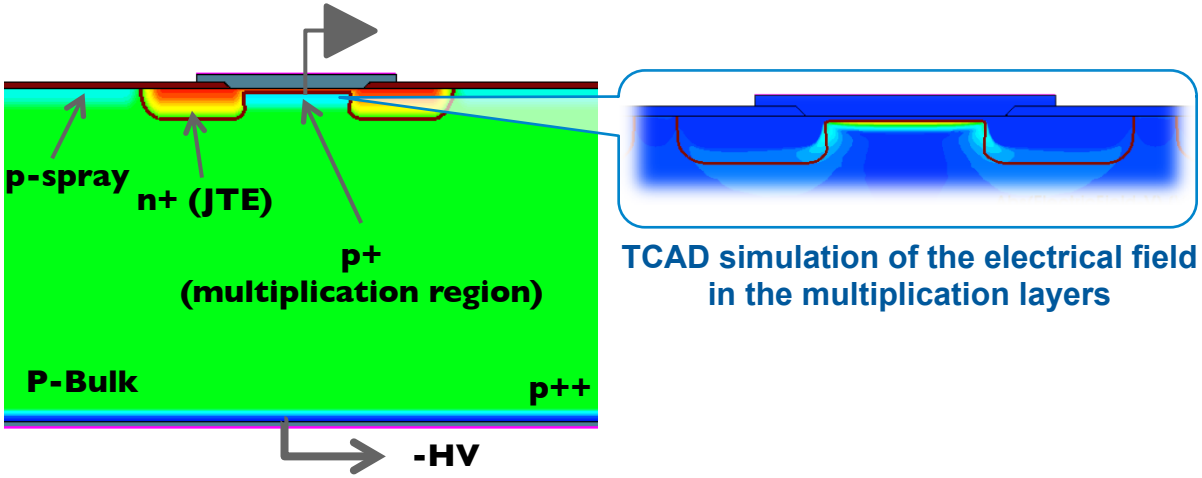
L. Rota (KIT)
ARD-ST3 Highlight Talk

KALYPSO II: production version

- 2.7 Mfps @ 2048/1024/512 Pixels, pixel pitch of 25 µm
- AR coating layers from 350 nm to1050 nm
- Developed for longitudinal (EOSD, near-IR)

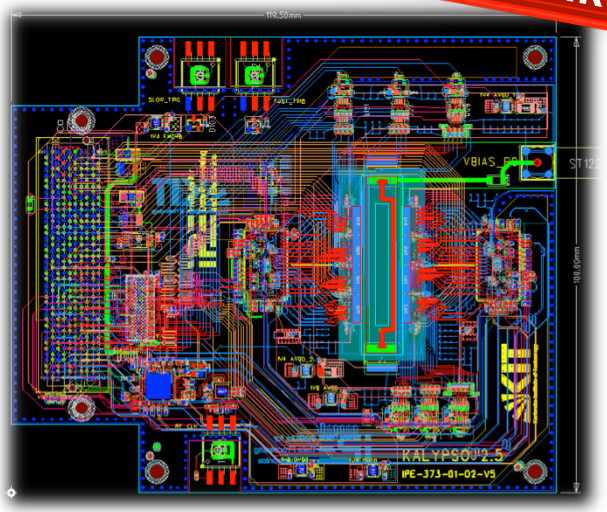
KALYPSO III: under development

- 10 Mfps @ 512 pixels
- ASIC on CMOS 110 nm will be submitted August 2018
- New sensor technology based on *low-gain avalanche PD* for transversal beam profile



TCAD simulation of the electrical field in the multiplication layers

Courtesy: M. Caselle, KIT



KALYPSO II: production version for:
KARA, FLASH, EuXFEL, ELBE, SOLEIL

MTDTS MTARD

Development & Tests

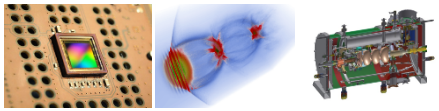
KIT Karlsruher Institut für Technologie
PSI PAUL SCHERRER INSTITUT
DESY

Applications

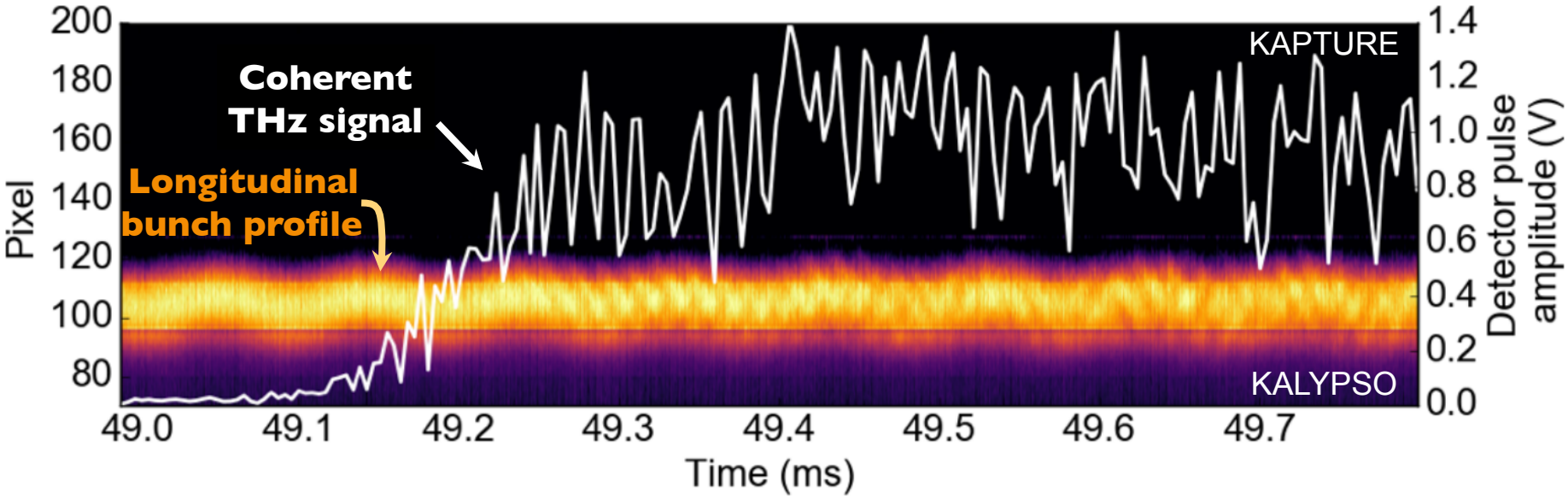
European XFEL
TELBE FLASH Free-electron laser FLASH
SOLEIL SYNCHROTRON

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

Synchronized beam diagnostics

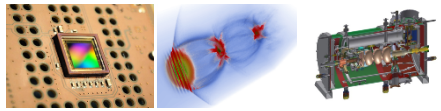


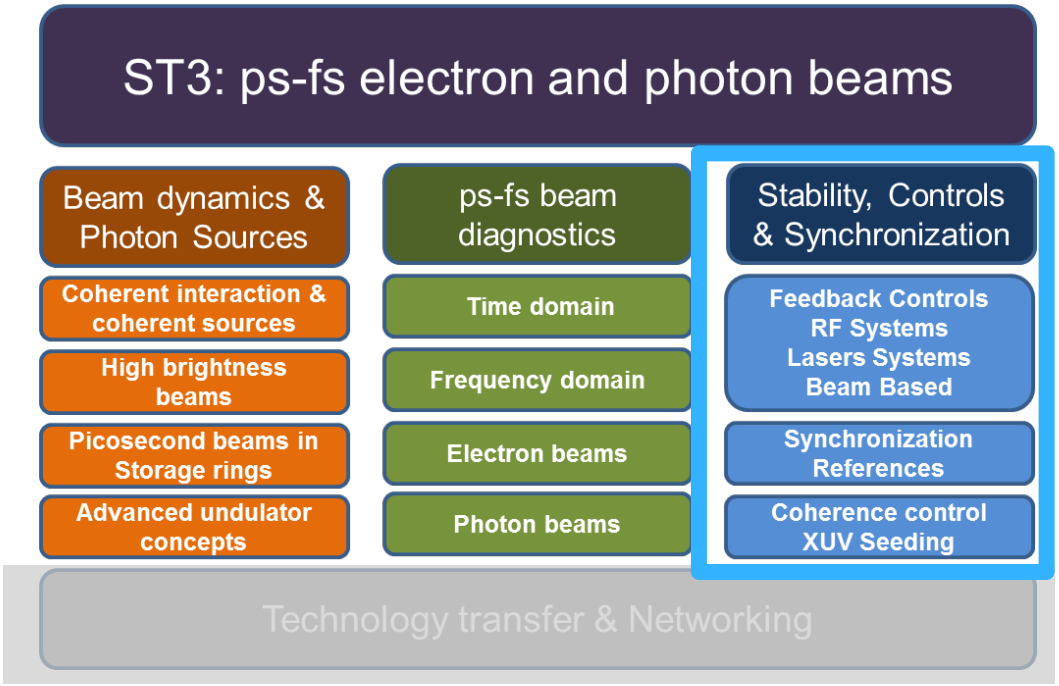
- Turn-by-turn synchronization of different detectors



Courtesy: B. Kehrer

Stability, Controls & Synchronization





Precision RF controls

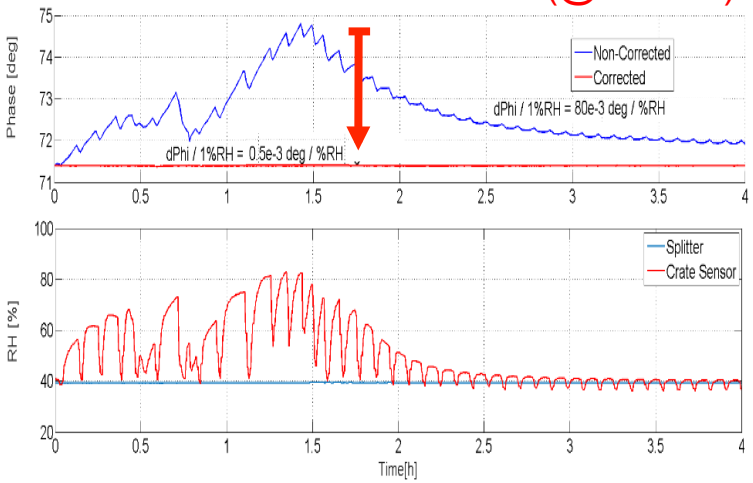
See also ARD status report

Drift Calibration Module

- Fighting humidity …

Humidity response:

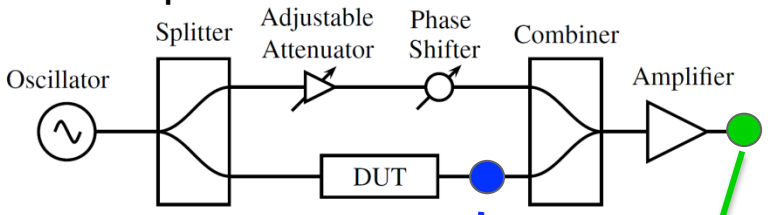
1/160 reduction (@1.3GHz)



Reference: PhD thesis, Jan Piekarski

Field detector with attosecond resolution

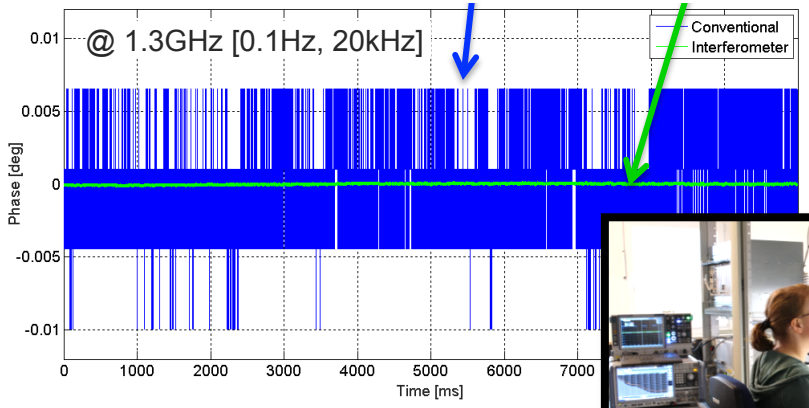
- Proof-of-concept using RF interferometer technique

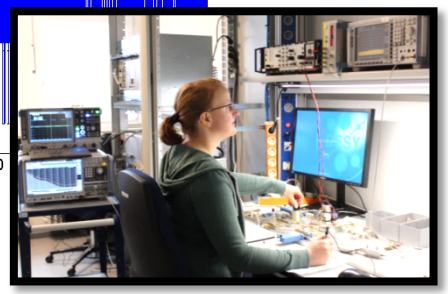


Reduction factor >50:

2.6 mdeg (rms), ≈ 5.5 fs

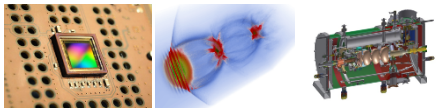
0.045 mdeg (rms), ≈ 96 as





Courtesy: L. Springer, DESY
→ See Poster session

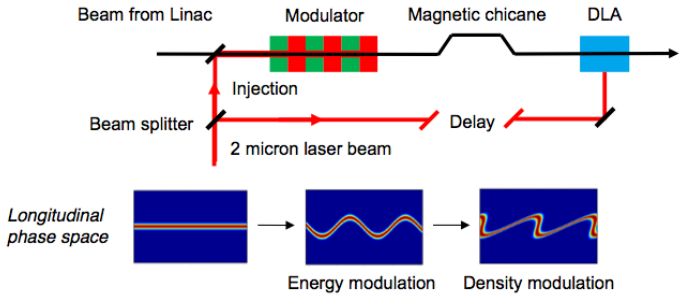
Acceleration of Phase-Synchronous Microbunch Trains in DLAs



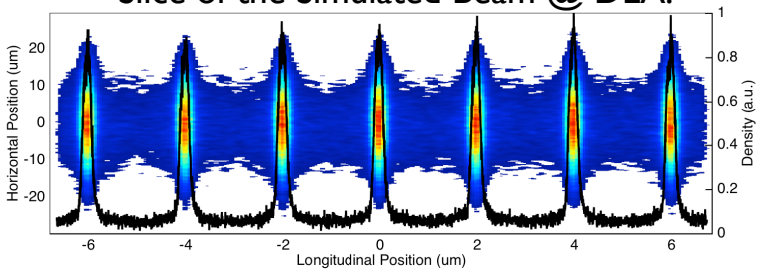
Experiments on Dielectric Laser Accelerators (DLA) @ SINBAD

- **Goal**: **Demonstration of clear net-acceleration** of externally injected bunches in micrometer scale accelerating fields of laser driven dielectric structures
- **Challenge**: Production and timing of the needed **sub-fs bunches**
- **Concept/Solution**: **Pre-modulation and DLA-acceleration with the same laser**
- **Benefit**: Sub-fs microbunches, **phase-locked to acc. field**

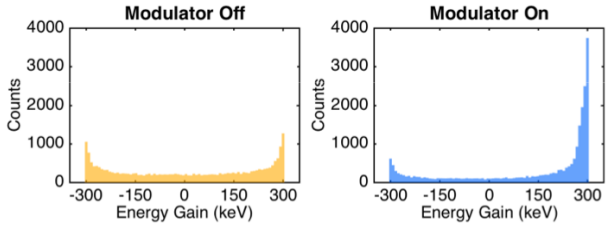
Basic Scheme:



Slice of the Simulated Beam @ DLA:



Simulation of the DLA interaction shows net-acceleration using the modulator:

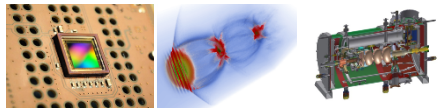


Reference: F. Mayet et al., "Simulations and plans for possible DLA experiments at SINBAD", NIM-A, 2018

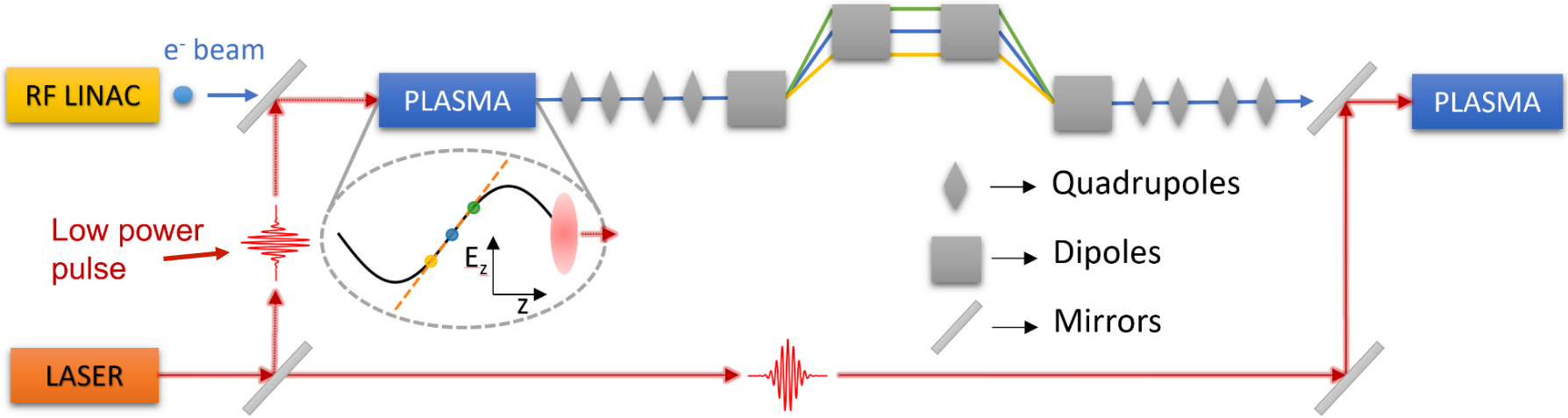
Courtesy: F. Mayet

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

Sub-fs timing jitter for injection into a laser-driven plasma accelerator



- First plasma stage (energy modulator) + magnetic chicane correct incoming jitter between laser pulse and electron beam.
- Simulations achieve sub-fs synchronization.



Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

DESY.

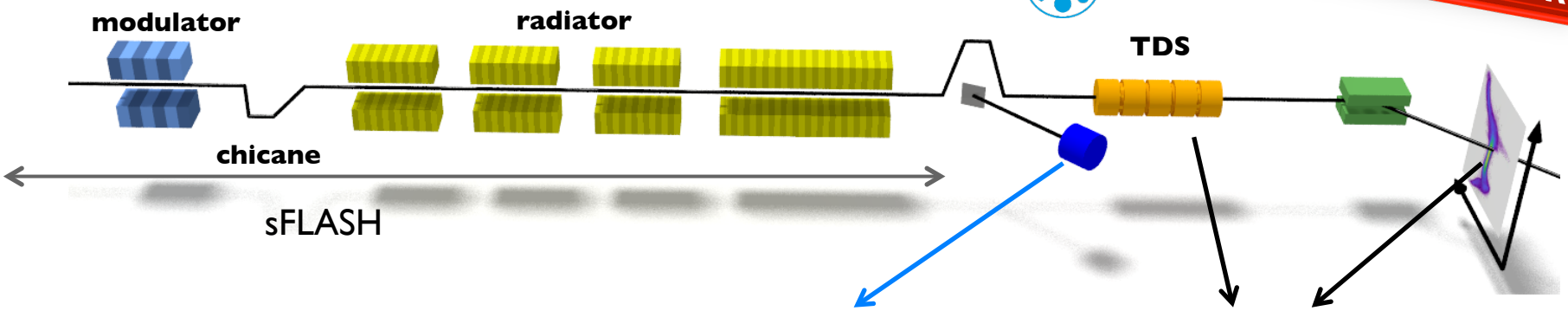
Reference:
A. Ferran Pousa, R. Assmann, R. Brinkmann, A. Martinez de la Ossa, "External Injection into a laser-driven plasma accelerator with Sub-Femtosecond Timing Jitter", J. Phys.: Conf. Ser. 874 012032.

Courtesy: Ángel Ferran Pousa, DESY

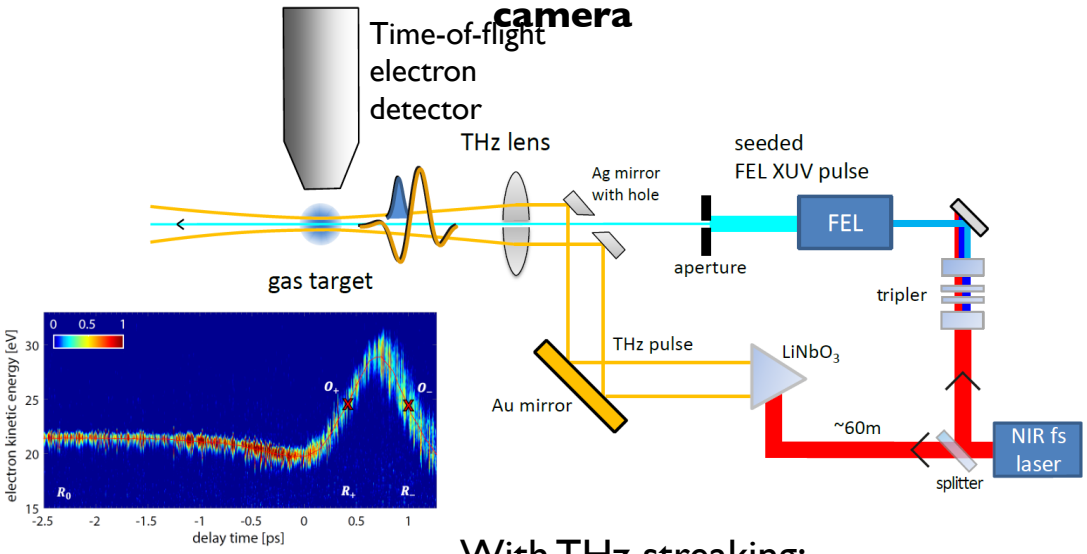
HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

XUV Seeding at FLASH

C. Lechner (DESY)
ARD-ST3 Highlight Talk



First XUV Chirp measurement using THz Streak camera



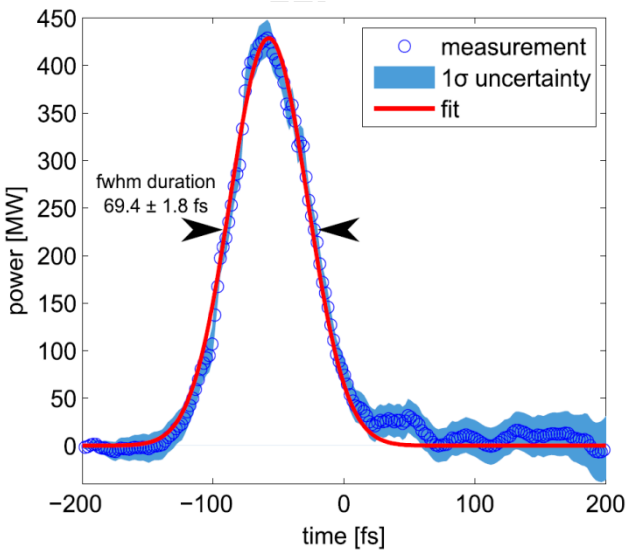
Reference:
A. Azima, et al., New J. Phys. 20, 013010 (2018)

With THz streaking:

- Access optical phase of FEL pulses
- Chirp of seeded FEL pulses

$$c = (-1940 \pm 800)\ \mathrm{THz/ps}$$

First TDS measurement at seeded



Reference:
T. Plath, et al., Sci. Rep. 7, 2431 (2017)

ChimeraTK: a control system independent software framework

ControlSystemAdapter

Support multiple control systems without changing source code!

DOOCS EPICS OPC UA

ApplicationCore

- Modular framework for control applications
- Unifies ControlSystemAdapter and DeviceAccess
- Helps writing applications which integrate well in different control systems

DeviceAccess

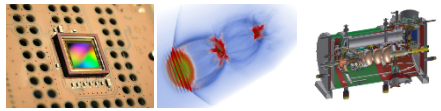
Access to hardware and other control system applications

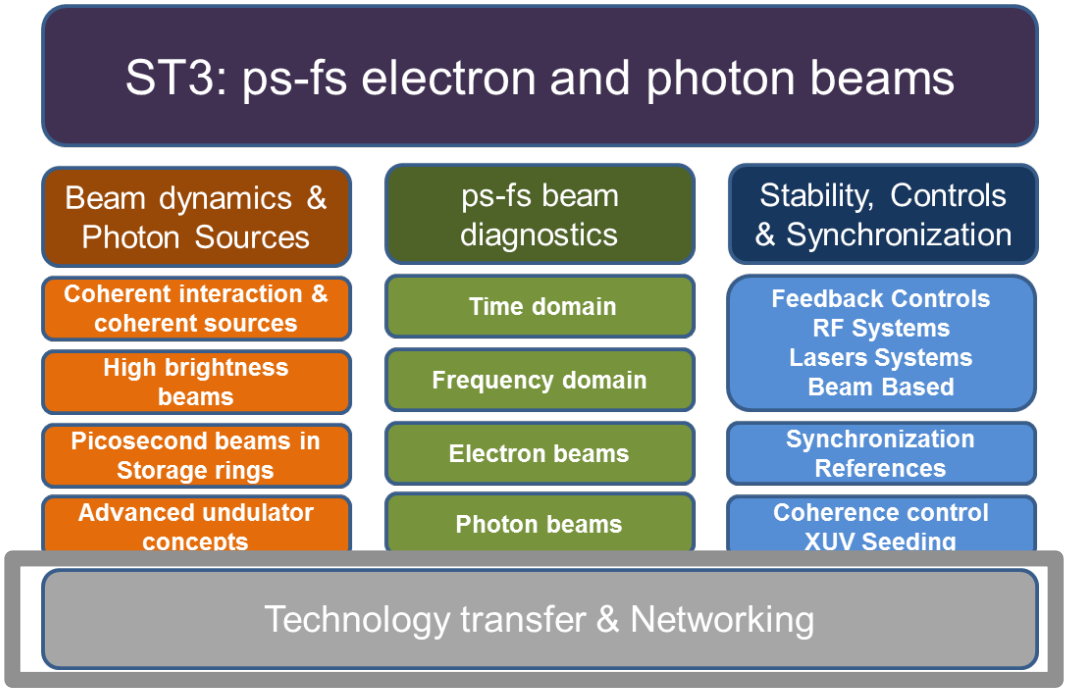
PCI EXPRESS Ethernet DOOCS

Already in use at: DESY REGAE Electron source REGAE, ELBE, FLUTE, DOOCS, OPC UA, EPICS

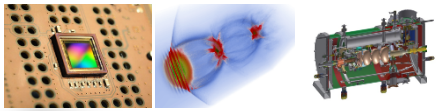
Courtesy: M. Hierholzer

Technology Transfer / Networking





ST3: Technology Transfer
Superconducting undulators

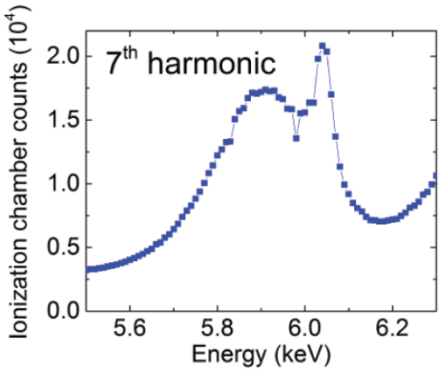


From Development towards a Commercial Product

SCU20 installed and in operation at KIT

- Reliable operation, first SCU "**in-series**" production
- Higher magnetic field than CPMUs with the same geometry

Cover of SRN published online 24 May 2018



SCU20's 7th harmonic at NANO beamline through 30 μrad × 30 μrad with an ionization chamber (2.5 GeV)

Reference: DOI: 10.1080/08940886.2018.1460171
S. Casalbuoni, N. Glamann, A. Grau, T. Holubek, D. Saez de Jauregui, S. Bauer, C. Boffo, T. Gerhard, M. Turenne, W. Walter, "Superconducting Undulators: From Development towards a Commercial Product", Synchrotron Radiation News, 31:3, 24-28 (2018)

Courtesy: S. Casalbuoni, KIT

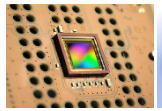
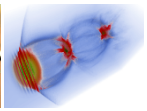
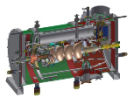
BILFINGER NOELL GMBH

KIT Karlsruher Institut für Technologie

ATP KIT Accelerator Technology Platform

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

ST3: synergies/collaboration/education


- strong emphasis on
  - education and exchange of technology & people
  - sharing of test facilities (free access for students/young researchers)
  - information exchange / decision taking in topical workshops

2.5 day annual ST3-meeting

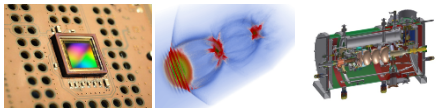
Up to **75 particants**, 3 tutorals / speed posters:

- 1st DESY-HH: 2012
- 2nd HZDR: 2014
- 3rd KIT: 2015
- 4th HZB: 2016
- 5th DESY-Zeuthen 2017

- **6th HZDR 26-28.09.2018**

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

Summary



- Overall excellent progress in many fields within ST3 “ps and fs electron and photon beams”
- Cooperation has been further intensified

For material, many thanks to …

E. Bründermann, H. Schlarb, M. Gensch, P. Goslawski, B. Steffen, C. Lechner, M. Hierholzer, M. Caselle, L. Rota, U. Dorda, B. Marchetti, P. Craievich, D. Marx, J. Zhu, T. Plath, P. Boonpornprasert, M. Krasilnikov, S. Casalbuoni, N. Glamann, A. Grau, D. Saez de Jauregui, FLUTE collaboration, R. Ruprecht, M. Schuh, M.J. Nasse, M. Yan, A. Malygin, N. Smale, T. Schmelzer, E. Blomley, M. Brosi, J. Gethmann, A. Bernhard, J.L. Steinmann, P. Schönfeldt, B. Kehrer, T. Boltz, C. Koschitzki, Y. Chen,B. Heinemann, E. Negodin, A. Hartin, M. Stanitzki, L. Springer, J. Piekarski, F. Mayet, Á.F. Pousa, S. Casalbuoni, N. Neumann, M. Laabs, C. Mai, Ch. Gerth, VSR project team, **… and more …**

Thank you for your attention!