

WELCOME @ 6th ARD-ST3 Annual Workshop

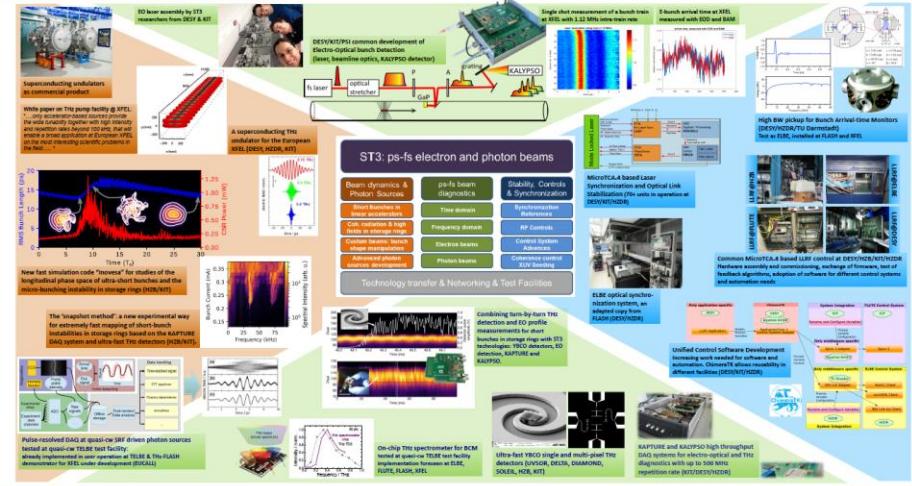
Programme Matter and Technologies

ARD-ST3: ps – fs electron and photon beams
between Helmholtz centers and beyond

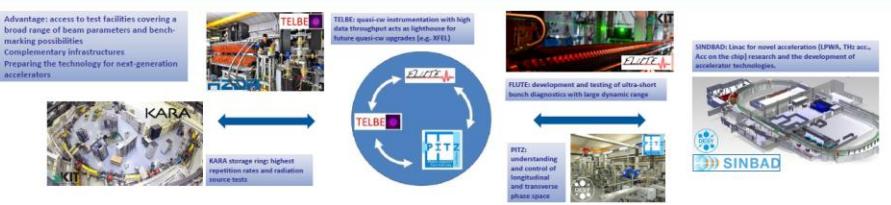


DESY, HZB, HZDR, KIT

Joint Technology Developments



Accelerator Test Facilities



Networking Activities & Know-how Transfer & Education

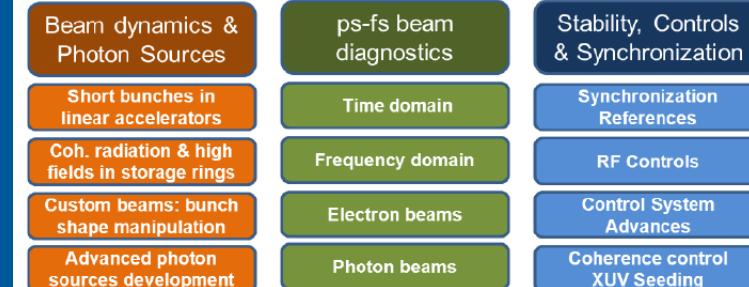
	Annual Meetings	Location	# P.	Topical Workshops within the Network	Close ties to other program topics and sub-topics
2012, Aug 21-22	1 st ARD-ST3 Annual Meeting	DESY/Hamburg	50	On Longitudinal Diagnostics for FELs (at DESY, HZB, KIT)	ST1: SRF Technologies
2014, Feb 26-27	2 nd ARD-ST3 Annual Meeting	HZDR	53	On Cherenkov (at DESY, HZB)	- CW instrumentation
2015, Jul 15-17	3 rd ARD-ST3 Annual Meeting	KIT	65	On Cherenkov (at DESY, HZB, KIT)	- SRF field regulation
Tutorials M. Dorho, CSDS & Radiation-Beam Interaction				F. Luther, Electromagnetic Compatibility (EMC), Distortion and Noise Reduction	- Beam dynamics & simulation
F. Luther, Electromagnetic Compatibility (EMC), Distortion and Noise Reduction					- Beam dynamics & control
2015, Jul 13-15	4 th ARD-ST3 Annual Meeting	DESY/Hamburg	58	On MoreSTFC-A (at DESY)	- Beam dynamics & automation/feedbacks
Tutorials J. Bahri, Inertial Devices - Beam Dynamics and Developments E. Gremillet, Beam Dynamics - PTHz laser and light sources using materials vs. relativistic electron				PND and Master Theses within the Network	
2017, Jul 19-21	5 th ARD-ST3 Annual Meeting	DESY/Dresden	75	Dr. Nicole Hiller 2013 at KIT with work at HZB	ST1: SRF Technologies
Tutorials J. Rossbach, Introduction to FEL Physics				Nicolas Gauthier 2013 at KIT with work at HZB	- CW instrumentation
J. Rossbach, Beam dynamics in bunch shape reconstruction from spectroscopic data				Dr. Michael Gauthier 2013 at Uni Dresden with work at HZB and DESY	- SRF field regulation
M. Krasznahorkay, Beam dynamics in the PTHz injector				Dr. Igor Rudnitskiy 2013 at Uni Warsaw with work at DESY and HZB	- Beam dynamics & simulation
2018, Sep 20-28	6 th ARD-ST3 Annual Meeting	HZDR	58	Maciej Grzechnik 2013 at Uni Warsaw with work at DESY and HZB	- Beam dynamics & control
Tutorials U. Schramm, High Power Lasers S. Lederer, Vacuum Systems				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & automation/feedbacks
Dr. Adrin Borysyanov 2018 at KIT with work at DESY				ST2: Beam Dynamics & Diagnostics	
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & simulation
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & control
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & automation/feedbacks
				ST3: ps and fs photon and electron beams	
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & simulation
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & control
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & automation/feedbacks
				ST4: Novel Accelerator Concepts	
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & simulation
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & control
				Dr. Maciej Grzechnik 2013 at KIT with work at HZB	- Beam dynamics & automation/feedbacks

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

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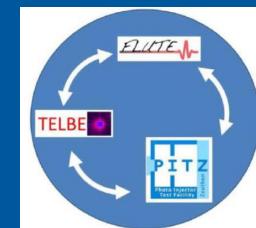
3 pillars

ST3: ps-fs electron and photon beams



Technology transfer & Networking & Test Facilities

test facilities



h**ZDR**



HELMHOLTZ
ZENTRUM DRESDEN
ROSSENDORF

Mitglied der Helmholtz-Gemeinschaft

ARD-ST3 testfacility TELBE: Status and Outlook

„test facility for diagnostic on quasi-cw electron and photon beams“

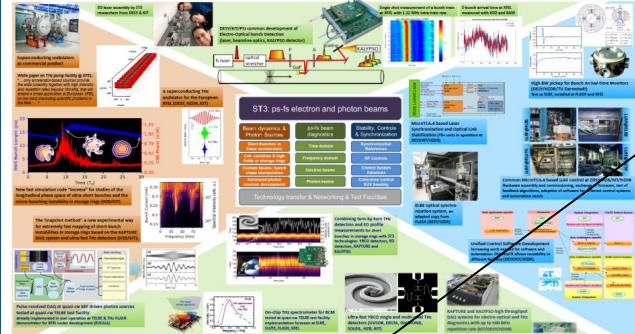
Programme Matter and Technologies

ARD-ST3: ps – fs electron and photon beams
between Helmholtz centers and beyond

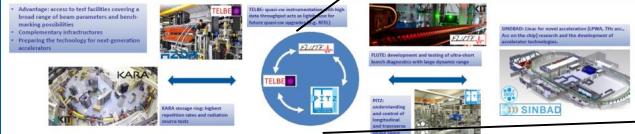
DESY, HZB, HZDR, KIT



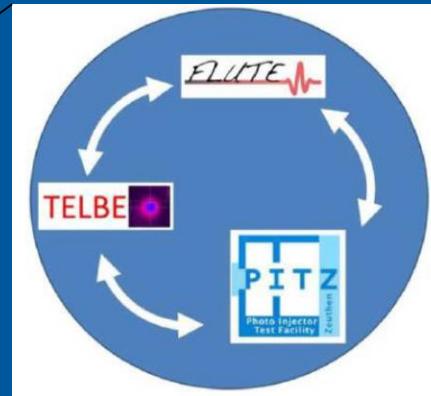
Joint Technology Developments



Accelerator Test Facilities



Networking Activities & Know-how Transfer & Education



M. Gensch



ARD-ST3 testfacility TELBE: Status and Outlook

„test facility for diagnostic on quasi-cw electron and photon beams“

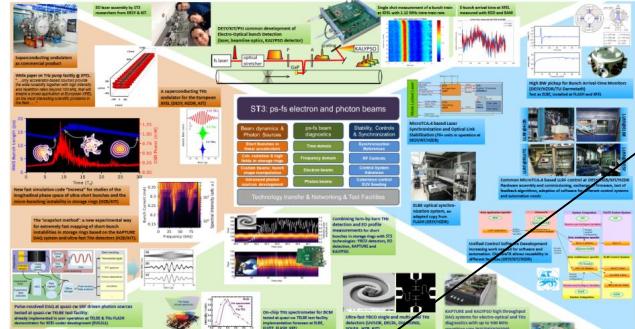
Programme Matter and Technologies

ARD-ST3: ps – fs electron and photon beams
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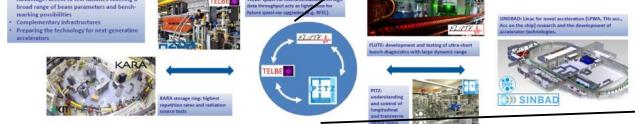
DESY, HZB, HZDR, KIT



Joint Technology Developments



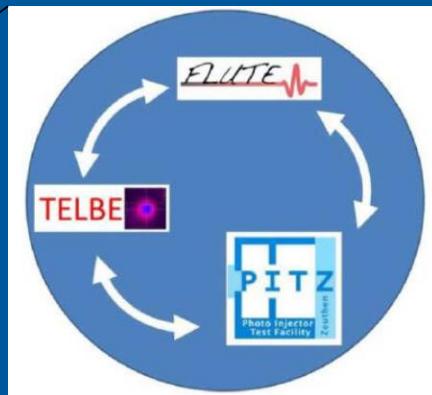
Accelerator Test Facilities



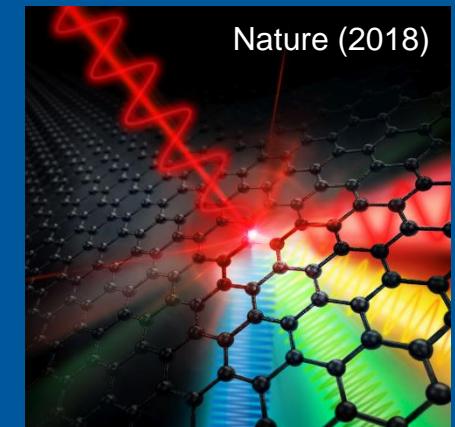
Networking Activities & Know-how Transfer & Education



diagnostic
developments

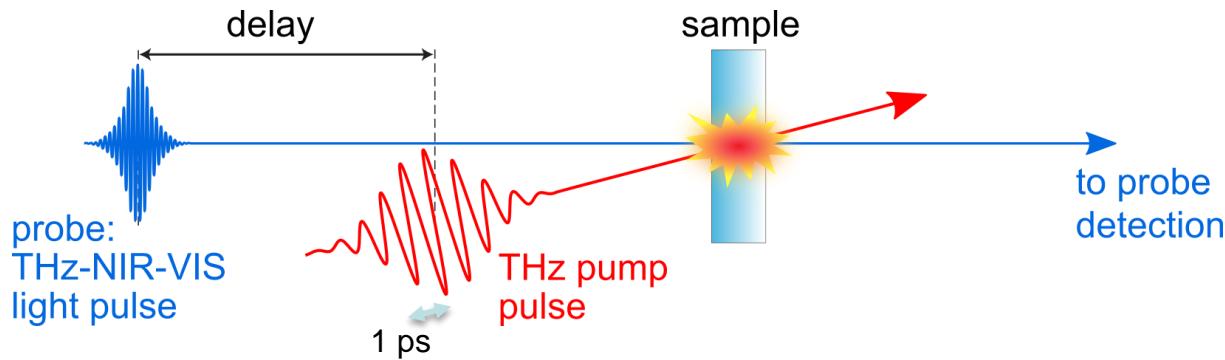


photon
science
breakthrough



M. Gensch





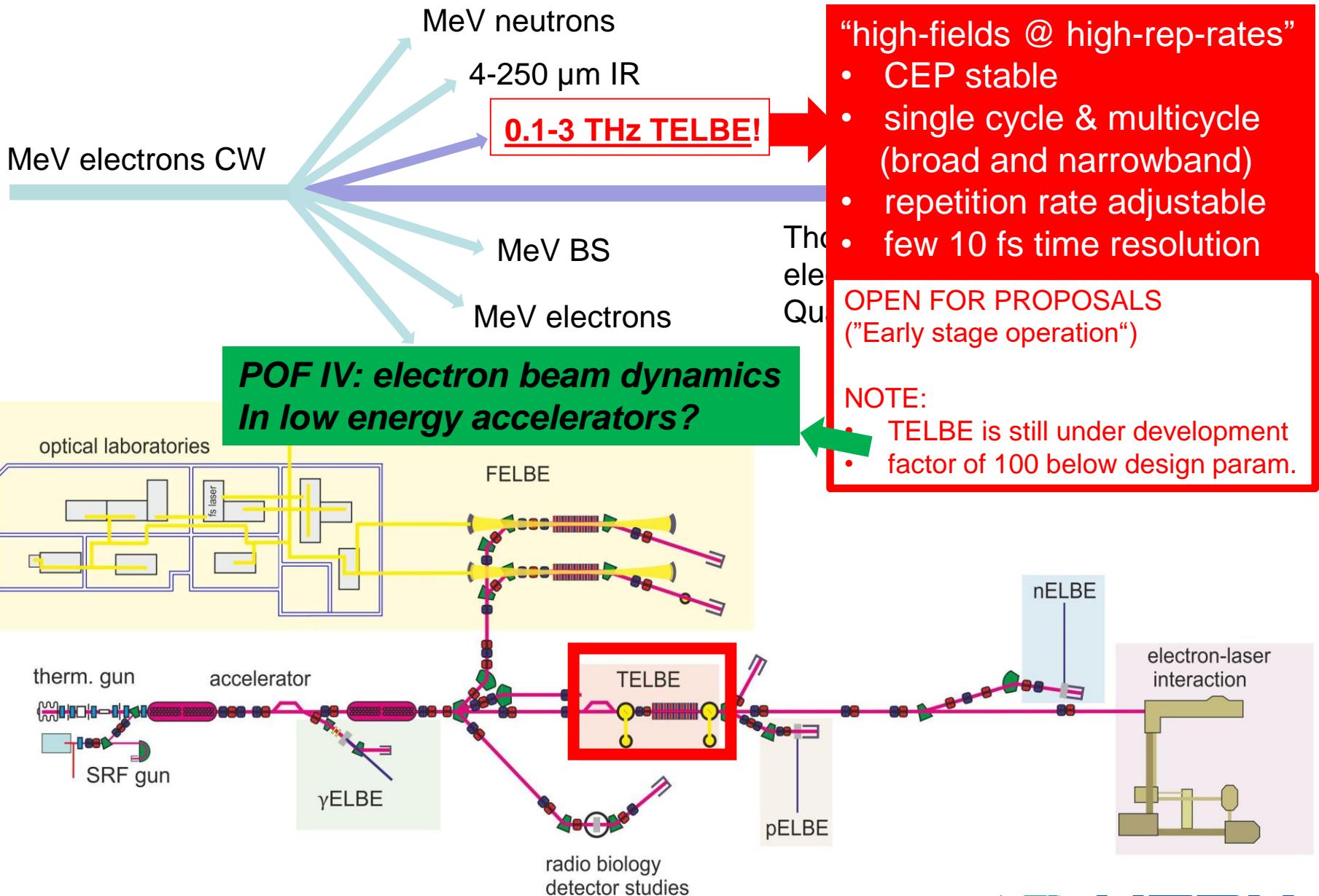
typical experimental scheme:

1. THz pump induces non-equilibrium state in sample
2. delayed fs laser pulse probes transient state

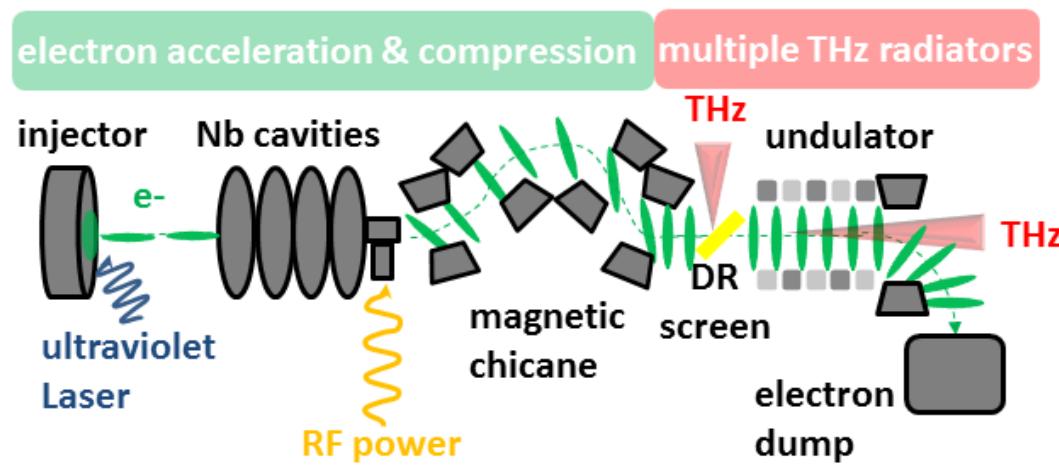
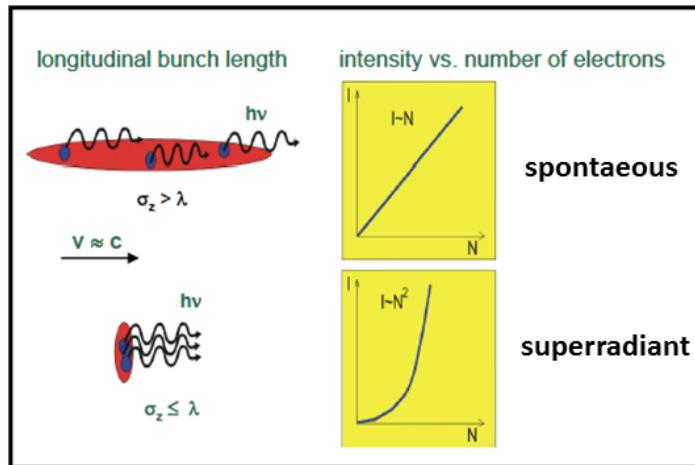
GOAL: observe phenomena on sub-cycle timescales → femtoseconds

POF IV: attoseconds!

ELBE accelerator and TELBE



Working principle: superradiance

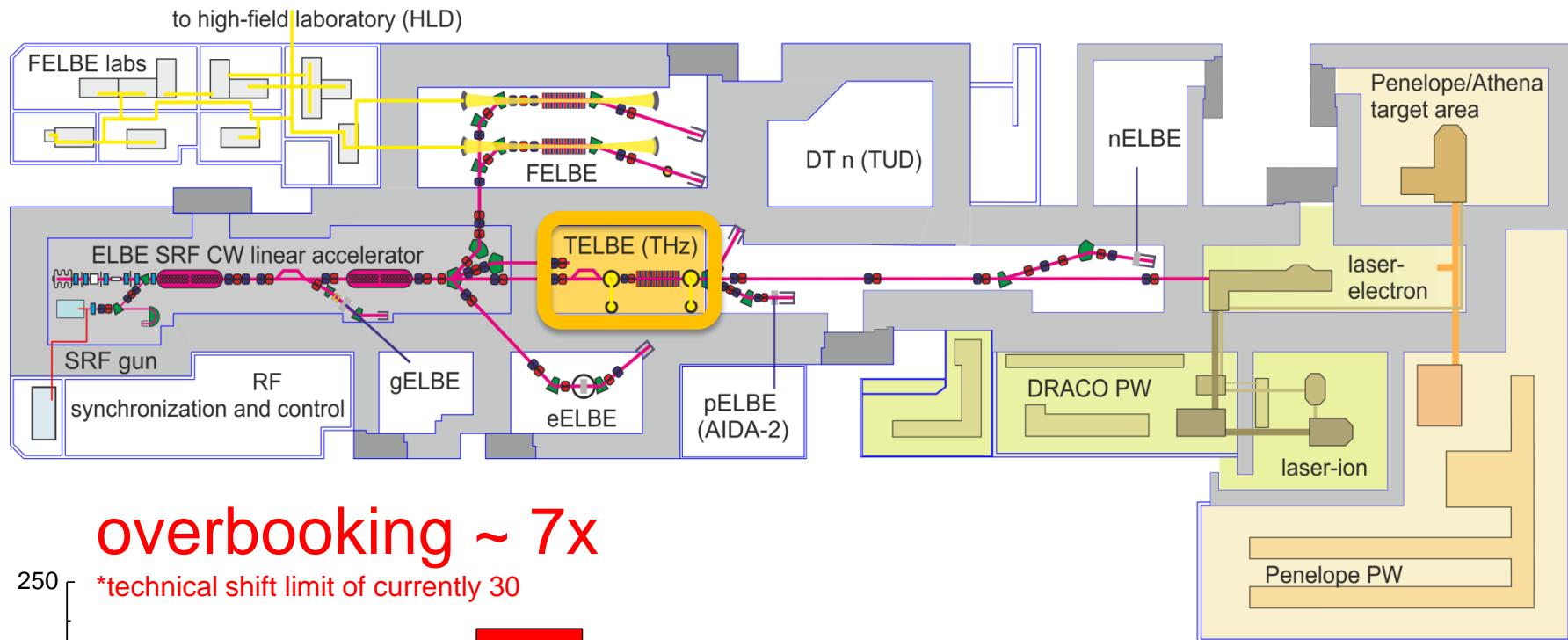


Principle:

- high charge in very short electron bunch
- Emission from multiple (synchrotron) radiators (THz waveform is flexible)
- Repetition rate variable

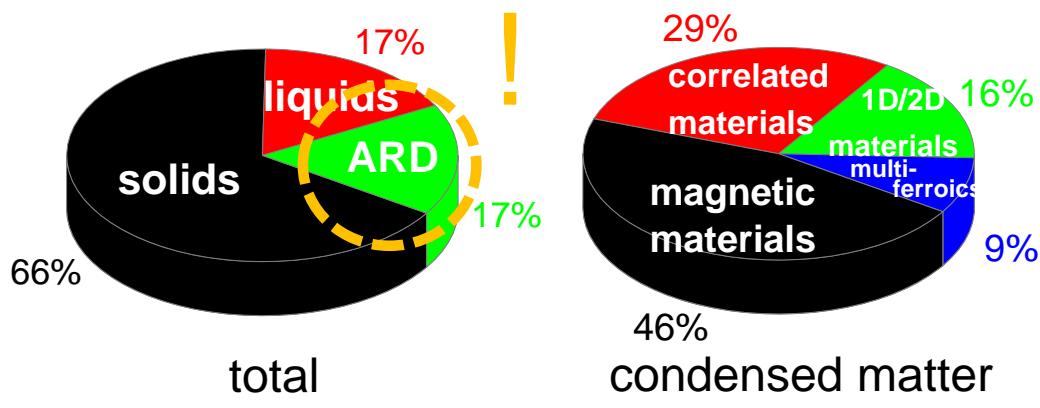
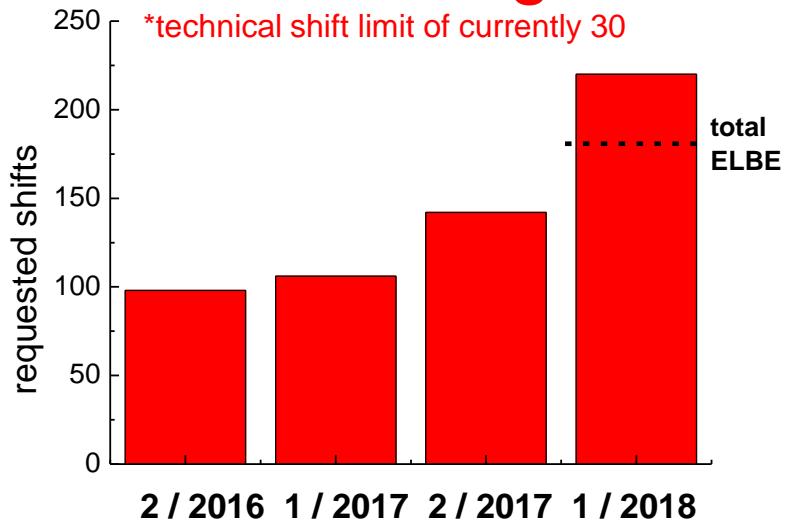
B. Green et al, *High-Field High-Repetition-Rate Sources for the Coherent THz Control of Matter*, Sci. Rep. **6** (2016), 22256.

TELBE the high -field THz user facility



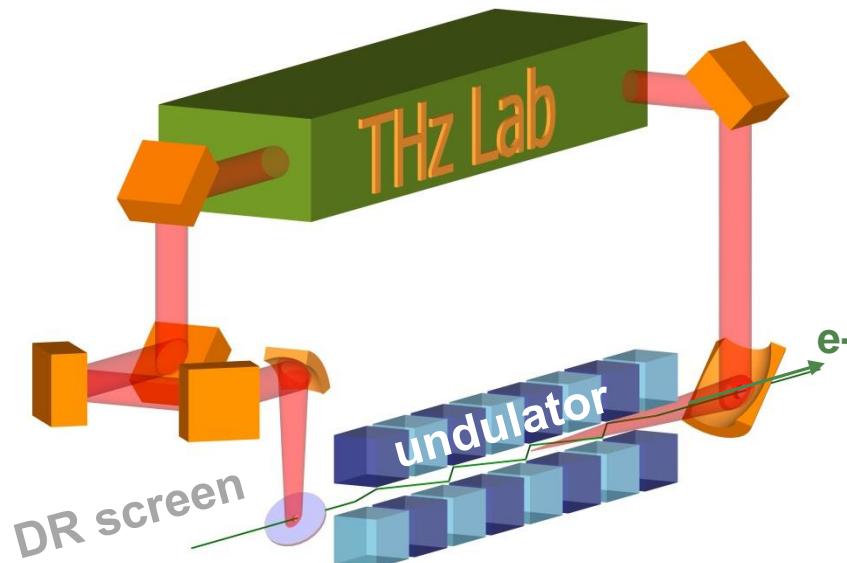
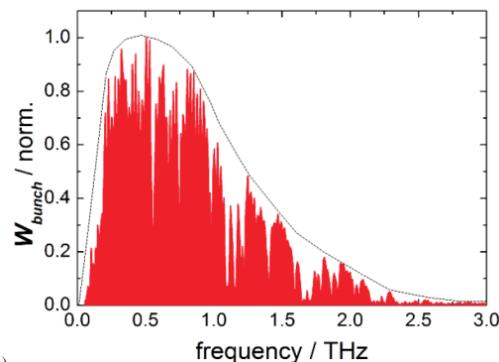
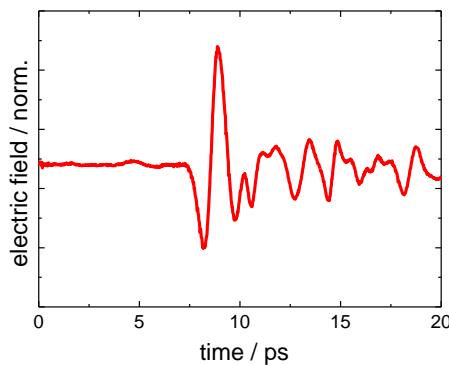
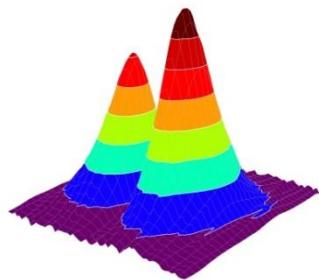
overbooking ~ 7x

*technical shift limit of currently 30

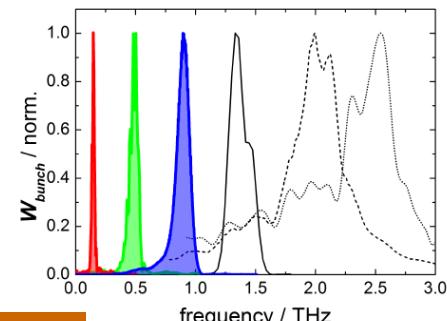
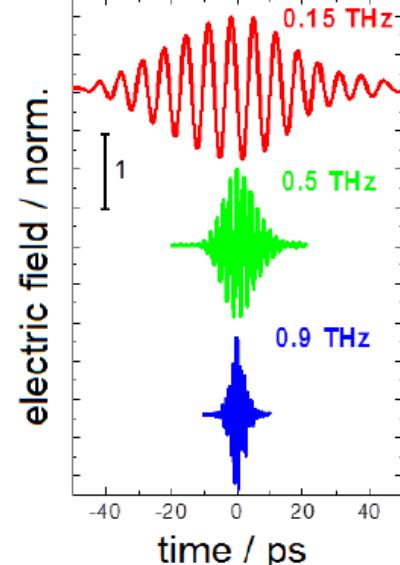
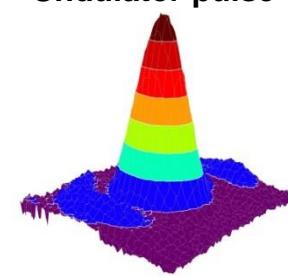


TELBE sources

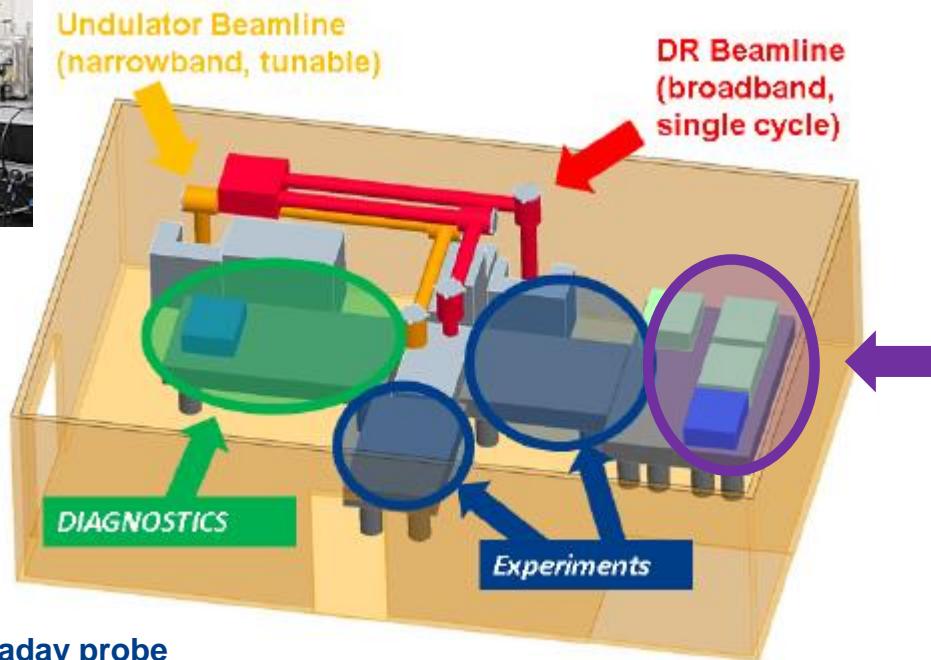
Diffraction Radiator (DR) pulse



Undulator pulse



B. Green et al, *High-Field High-Repetition-Rate Sources for the Coherent THz control of Matter*,
Sci. Rep. 6 (2016), 22256.



2 fs lasersystems

- commercial
- few μJ @ 200 kHz
- few mJ @ 1 kHz
- commercial lock (synchrolock)

THz sources

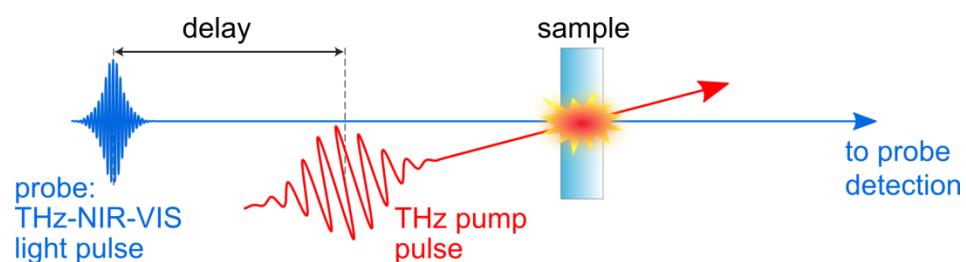
- TELBE
- +
- 2 x titled pulse front LiNbO
- 3 x ZnTe (optical rect.)

Experimental endstations:

- THz/NIR pump TR MOKE/Faraday probe
- THz/NIR pump THz emission probe
- THz/NIR pump coherent phonon spectroscopy probe
- THz time-domain spectroscopy
- FTIR (step scan) spectroscopy

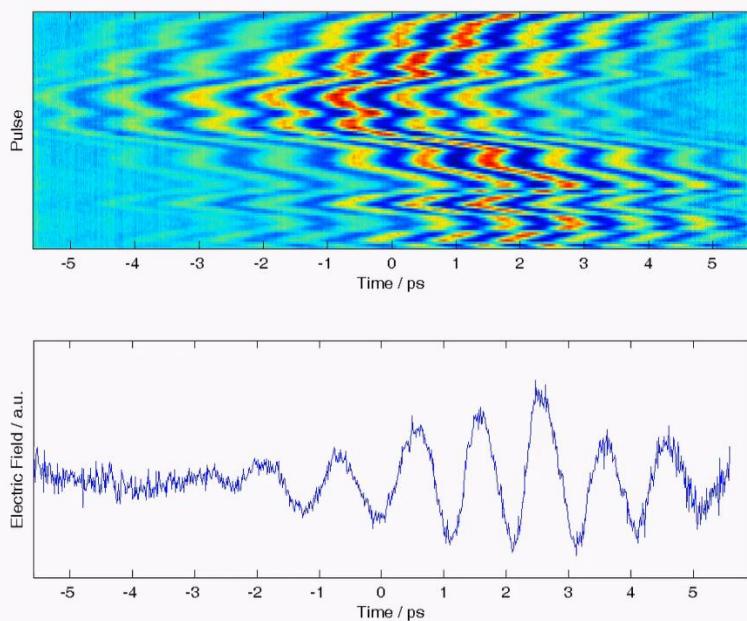
sample environments:

- temperature: 2.7 to 500 K
- magnetic field: up to 10T
- liquid jet



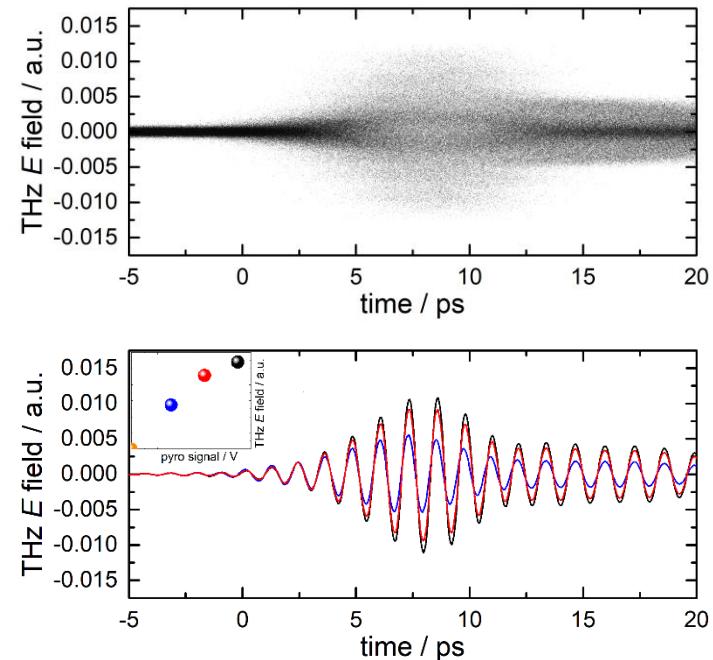
TELBE fluctuations:

- arrival time
- intensity
-



pulse-resolved DAQ at 100 kHz

EOS of 800 GHz undulator tune



- fluctuations on ps timescale
- How do we reach fs time resolution?

Demonstrator for the European XFEL!



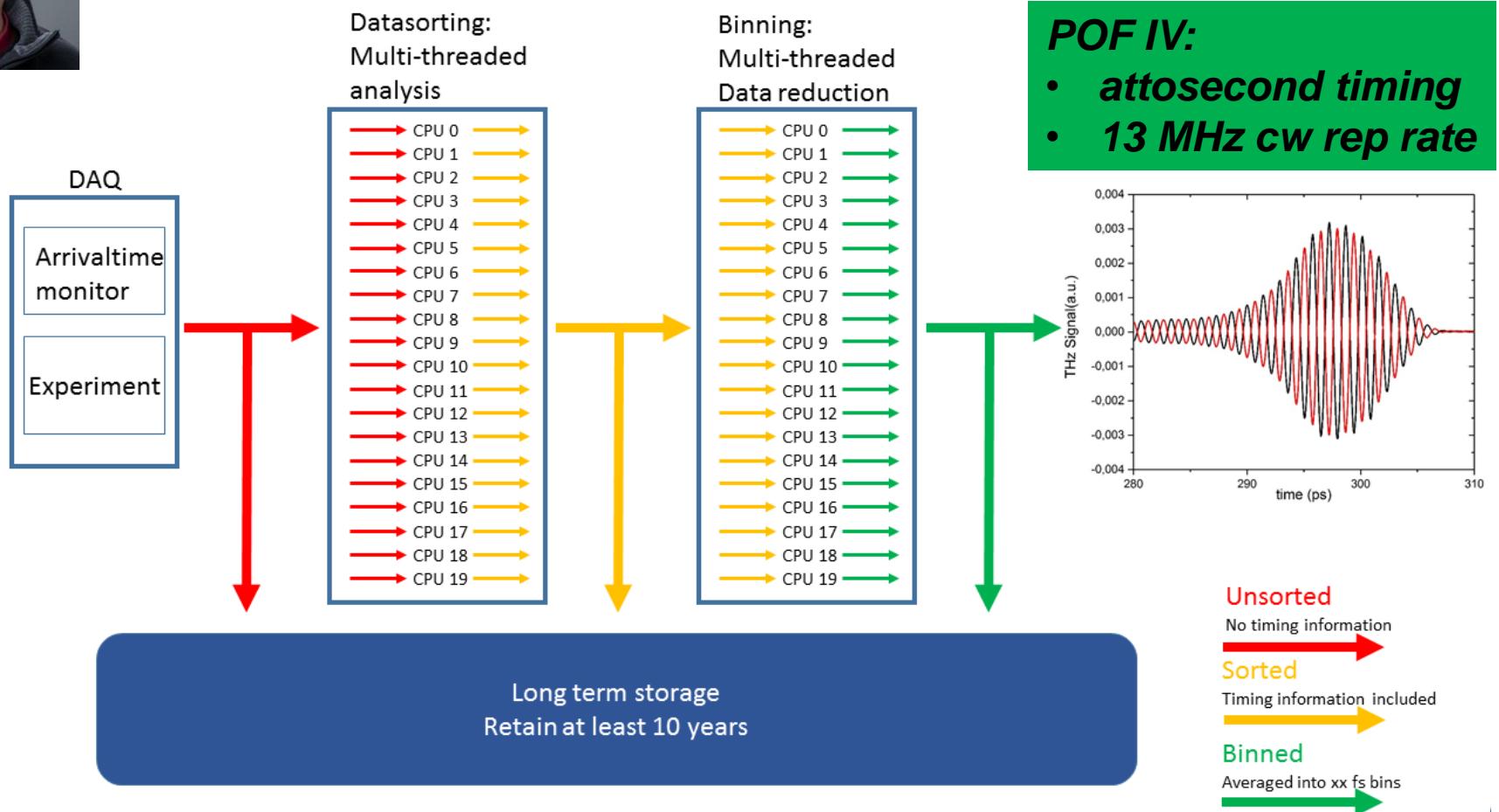
Bertram Green
see talk

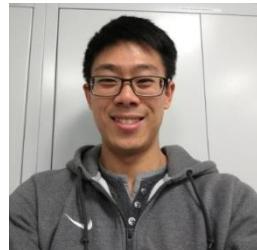
STRUCTURAL DYNAMICS 4, 024301 (2017)



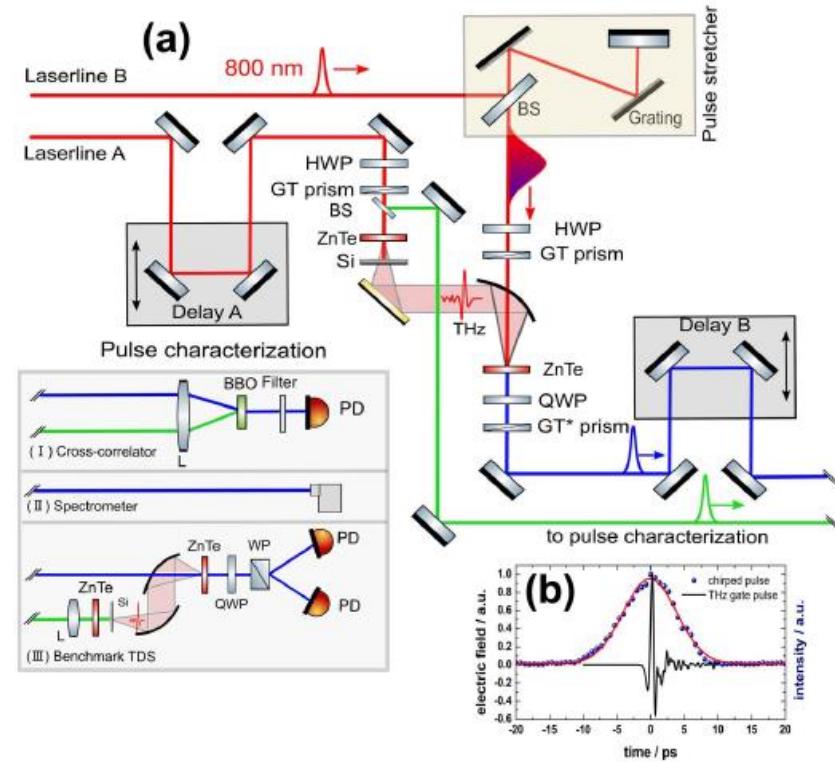
Probing ultra-fast processes with high dynamic range at 4th-generation light sources: Arrival time and intensity binning at unprecedented repetition rates

S. Kovalev,^{1,a)} B. Green,¹ T. Golz,² S. Maehrlein,³ N. Stojanovic,²
A. S. Fisher,⁴ T. Kampfrath,³ and M. Gensch^{1,a)}





Min Chen
see poster



IDEA:

- based on THz slicing
- make the laser follow the accelerator instability

POF IV: amplify sliced laser pulses?

Niels Neumann / TUD
see poster



short communications

On-chip THz spectrometer for bunch compression fingerprinting at fourth-generation light sources

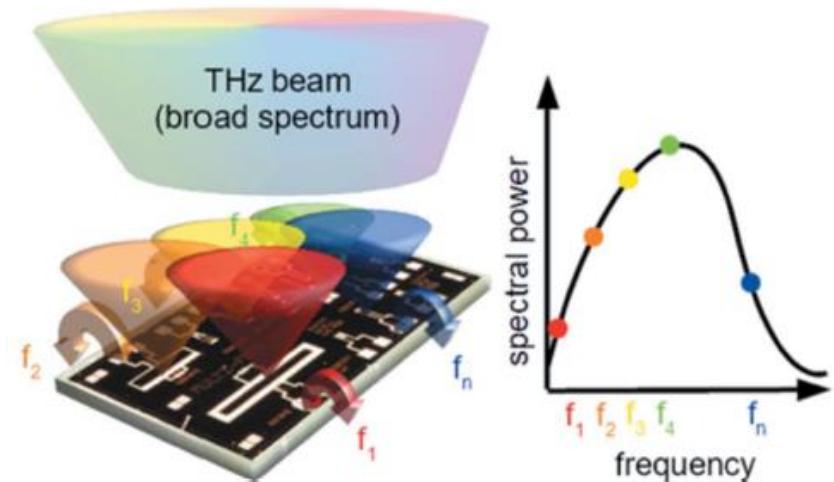
M. Laabs,^a N. Neumann,^{a*} B. Green,^b N. Awari,^b J. Deinert,^b S. Kovalev,^b D. Plettemeier^a and M. Gensch^{b*}

Synchrotron JSR JOURNAL OF SYNCHROTRON RADIATION ISSN 1600-5775

IDEA:

- replace single element pyrodetector in BCMs
- pulse/bunch-resolved (up to 13 MHz)
- currently 7 THz frequencies

POF IV: pulse-resolved spectro imager





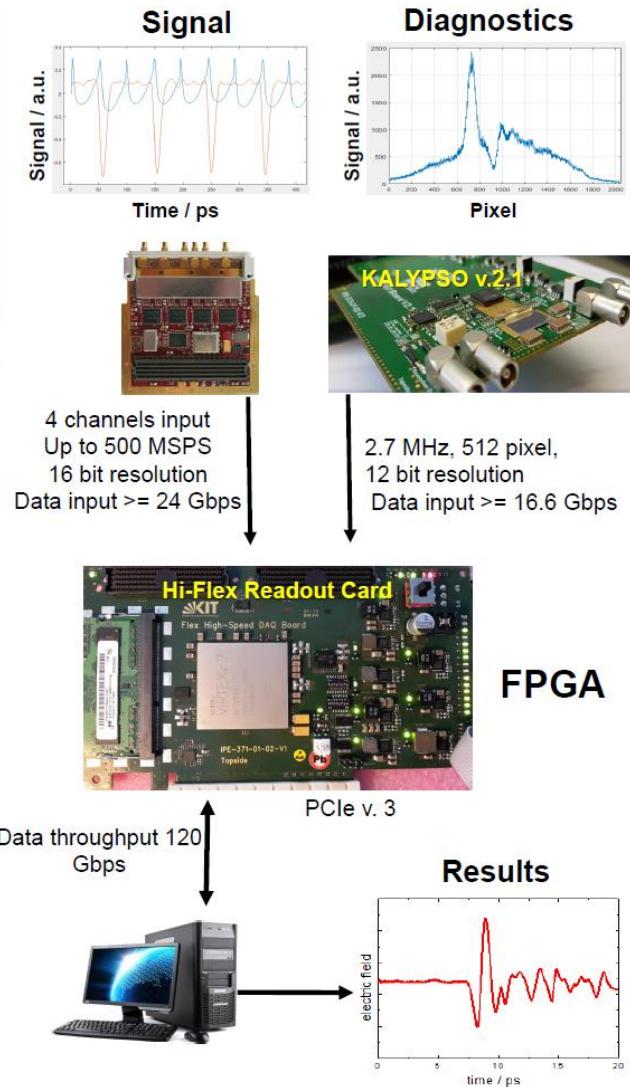
Mohammed Bawatna
see poster

IDEA:

- Move into FPGA based realtime data aquisition & analysis

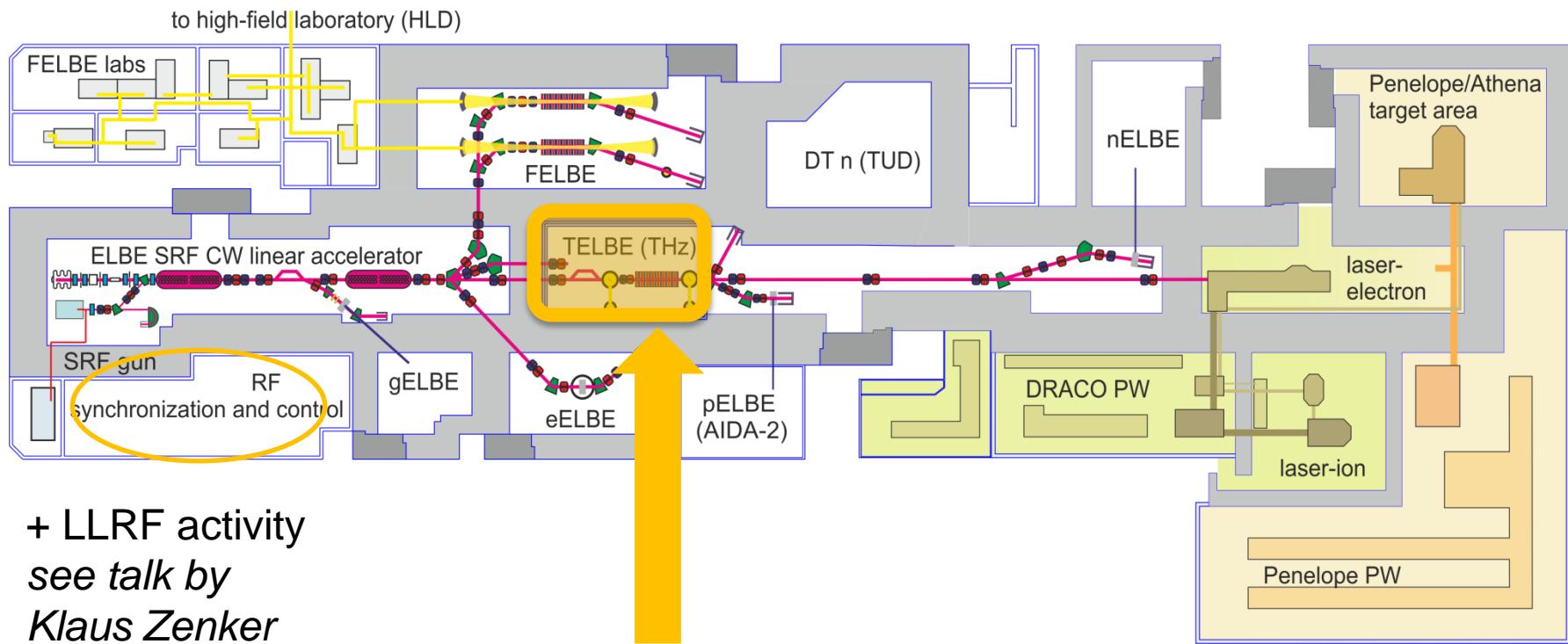
POF IV:

- operate DAQ at 13 MHz cw
- develope data management procedures



ARD test facility TELBE: 2012 - 2018

HZDR



- (pulse/bunch-resolved) THz based diagnostic
- detector tests
- timing schemes
- synchronisation schemes
-

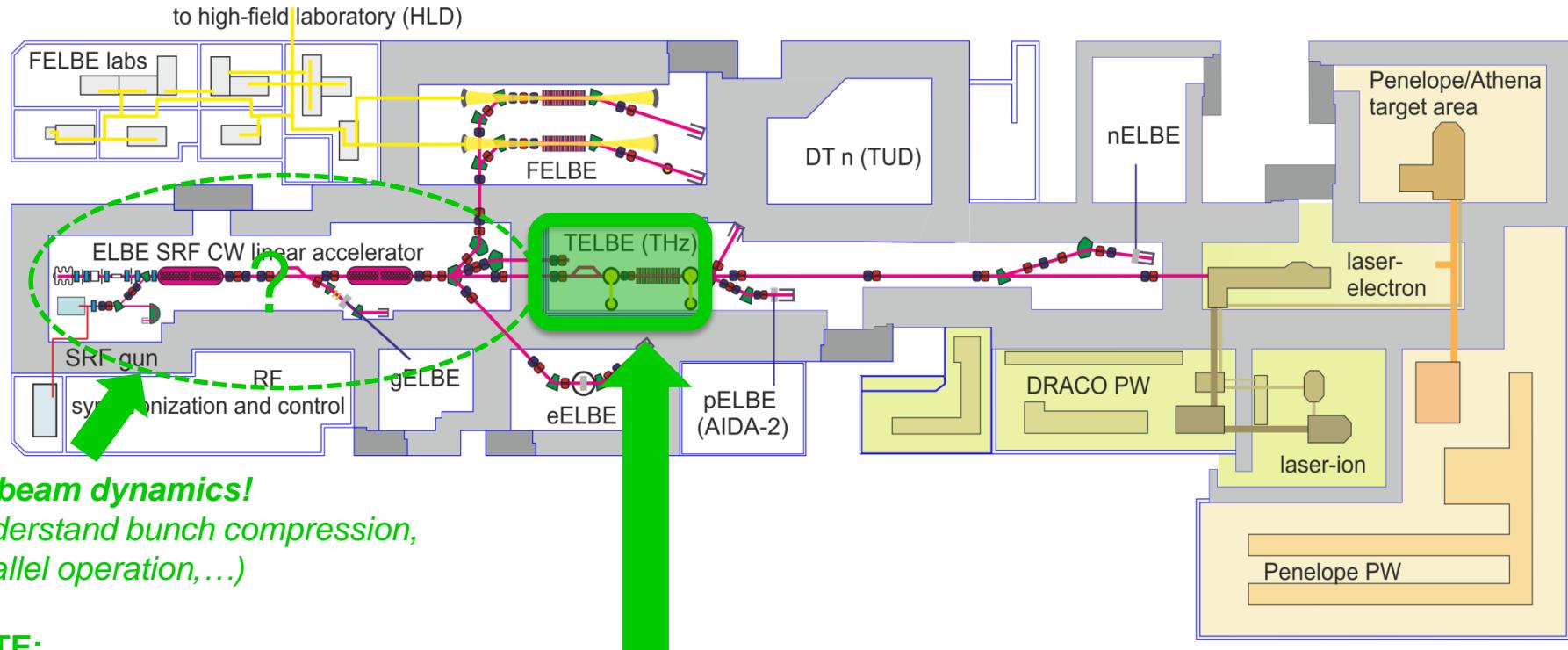
DRESDEN
concept

HZDR

ARD test facility ELBE in POFIV?

hZDR

from discussions at the FLASH/TELBE joint user meeting 20.07.2018



- **beam dynamics!**
(understand bunch compression, parallel operation,...)

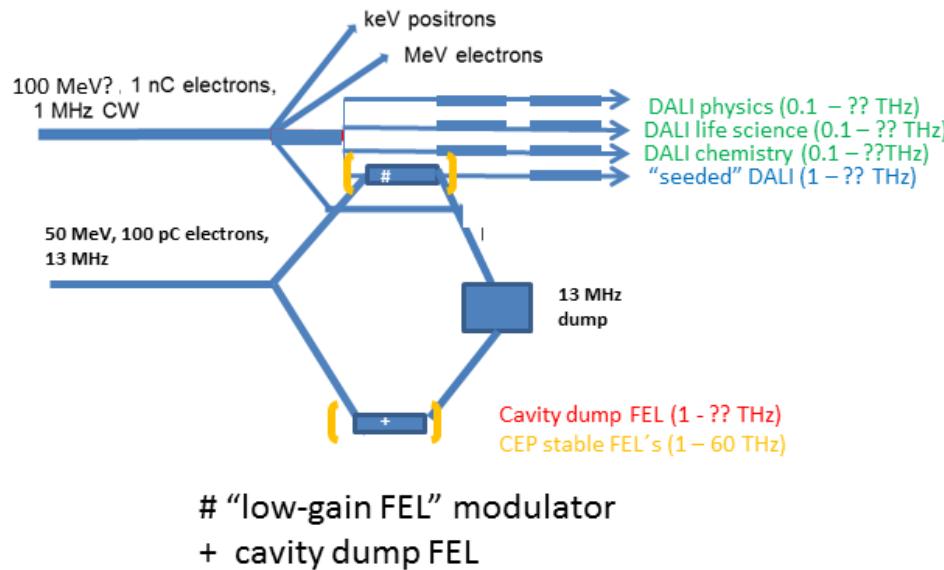
NOTE:

- interest in peak pulse energy
- NO interest in stability!

POF IV:

- **attosecond timing**
- **13 MHz rep rate**
- **Combine with ARPES/SNOM/...**
-**spectro imager....**

ELBE upgrade: DALI?



3 building blocks



Status 25.04.18 Tom Cowan

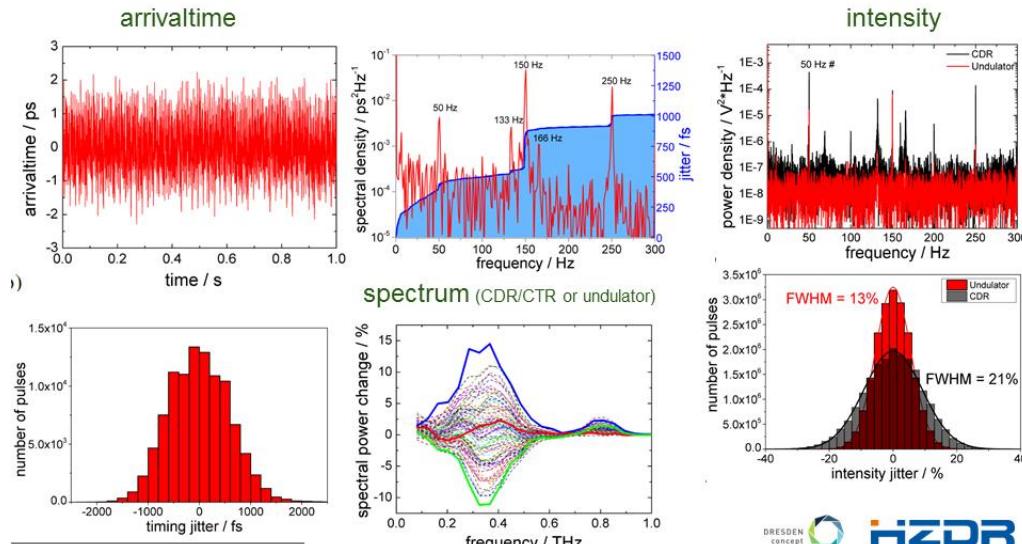
POF IV:

- *advanced photondiagnostics*
- *beam dynamics in low energy accelerators*
-

THANK YOU!

ARD-ST3 test facility TELBE

available pulse-resolved diagnostic and ONLINE analysis



ARD-test facility TELBE