

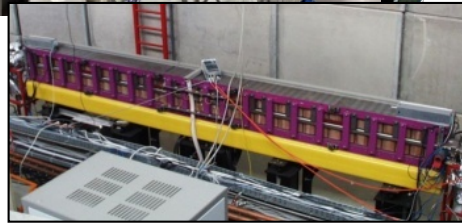
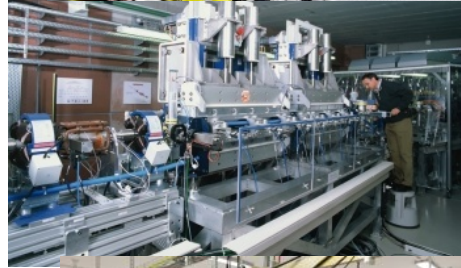
Status of DELTA

Shaukat Khan, Zentrum für Synchrotronstrahlung

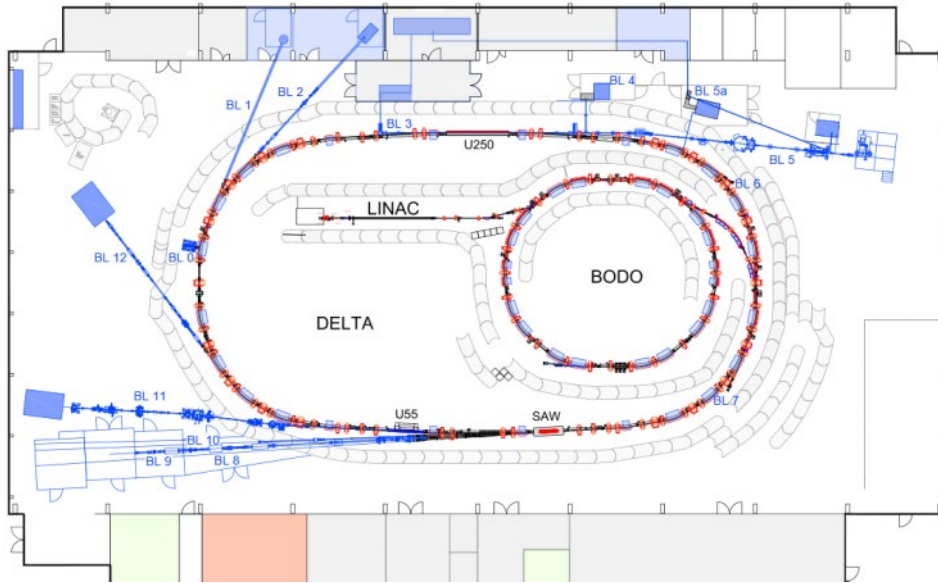
Online, Dec 17, 2020



Accelerator-based photon sources in Germany

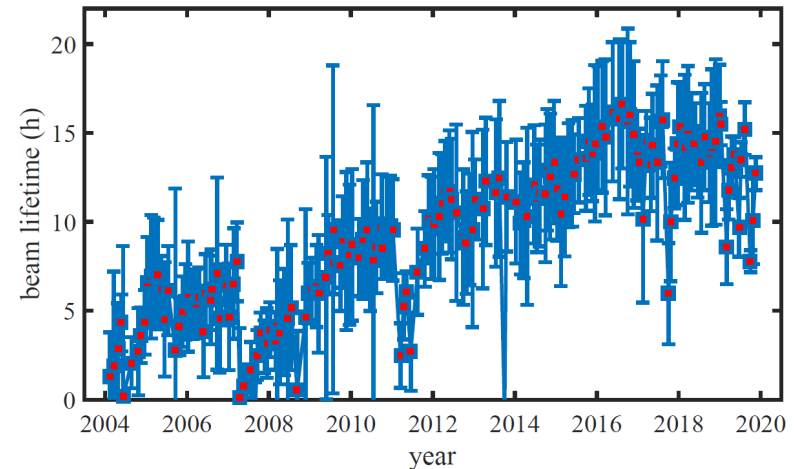
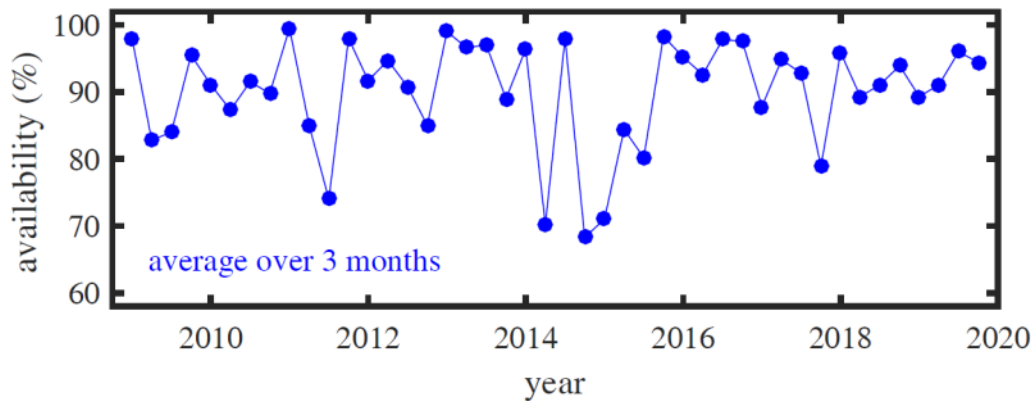


Parameters and availability



Parameters

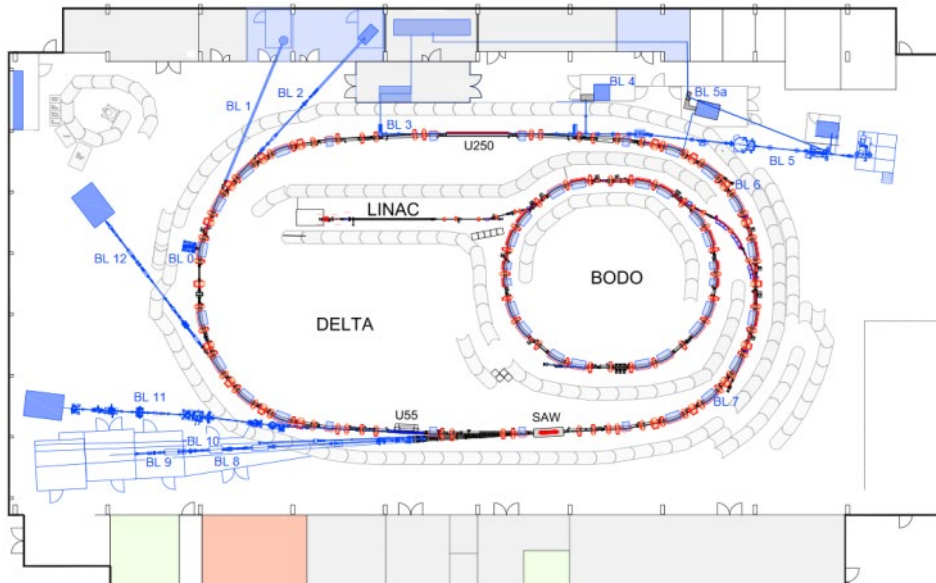
circumference	115.2 m
beam energy	1.5 GeV
beam current	130 mA multi-bunch
beam current	20 mA single bunch
beam lifetime	~13 h at 100 mA
hor. emittance	~16 nm rad
bunch length	40 ps rms
user operation	2000 h/y (20 weeks/y)
machine studies	1000 h/y (10 weeks/y)



(J. Friedl, G. Schmidt)



Parameters and availability

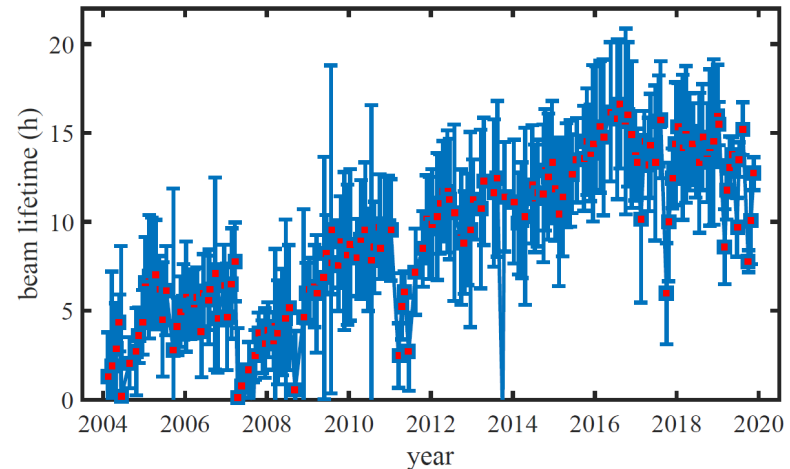
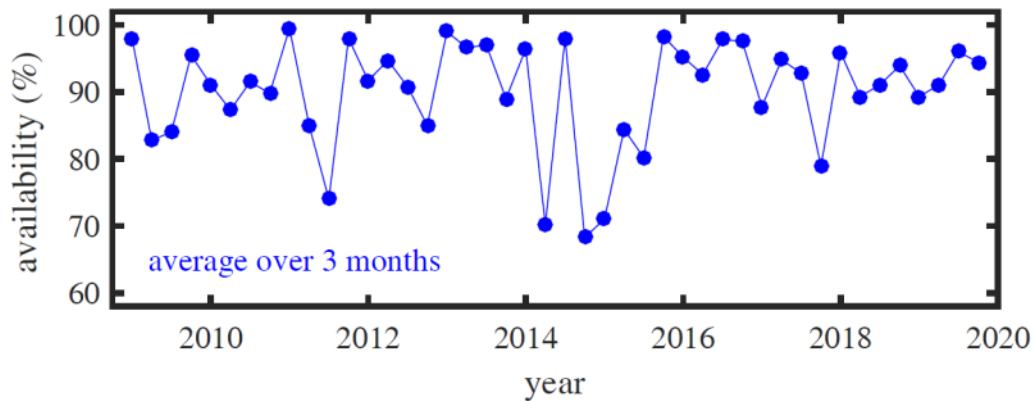


Parameters

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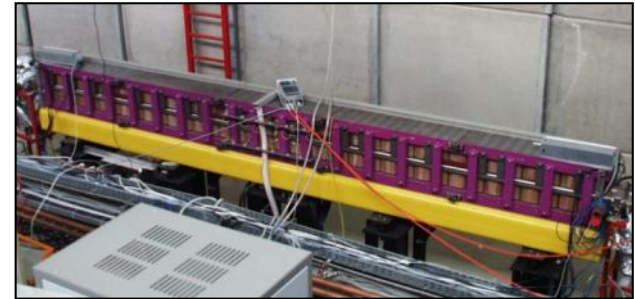
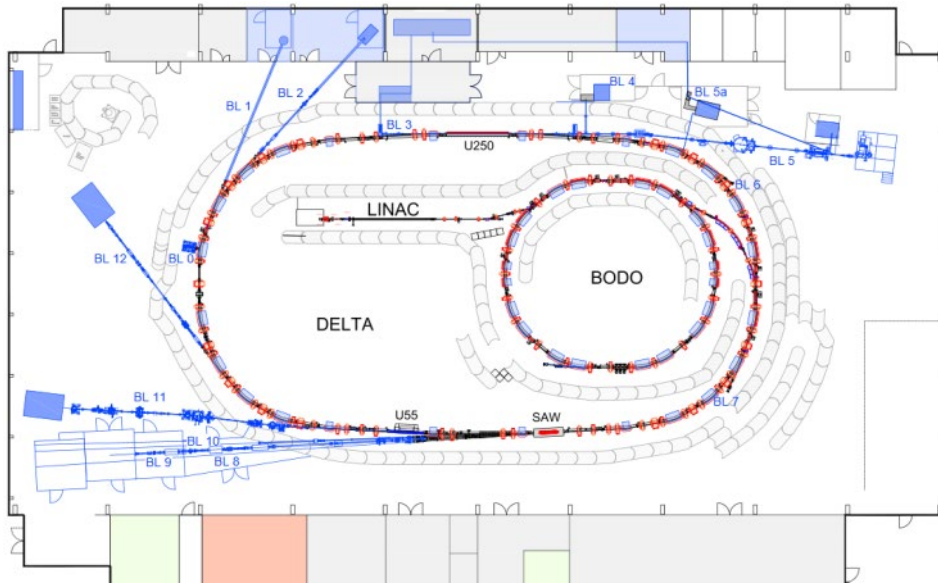
user operation 9 weeks in 2020

machine studies 7 weeks in 2020



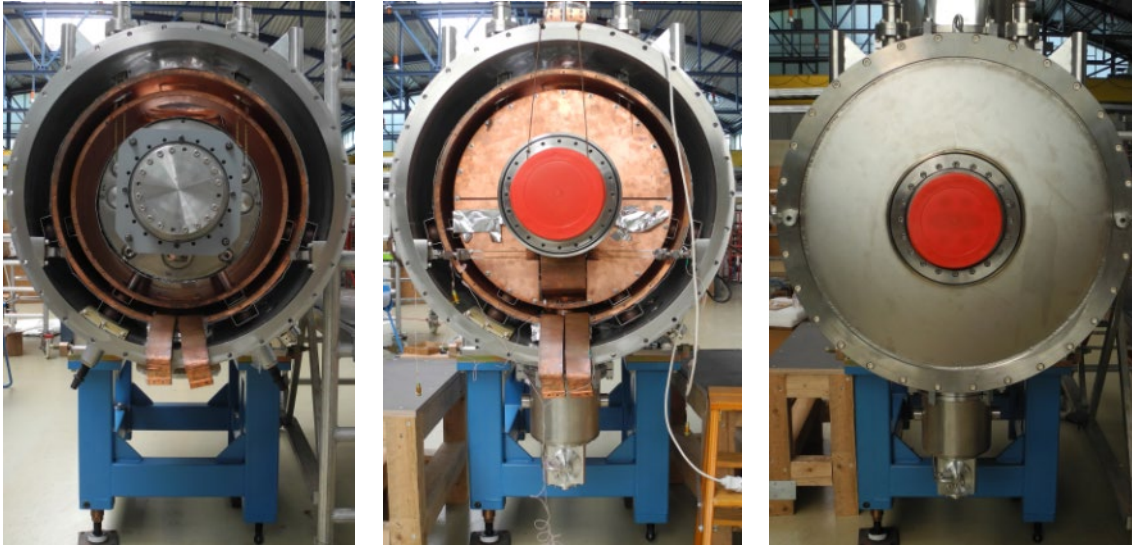
(J. Friedl, G. Schmidt)

Insertion devices



New superconducting wiggler installed

(A. Althaus, B. Beyer, B. Büsing, G. Dahlmann, S. Khan, V. Kniss, M. Paulus, B. Sawadski, D. Schirmer, G. Schmidt, T. Schulte-Eickhoff, C. Sternemann, T. Dybiona, M. Tolan + BINP team)



New superconducting wiggler delivered in July 2018

configuration: asymmetric \rightarrow symmetric

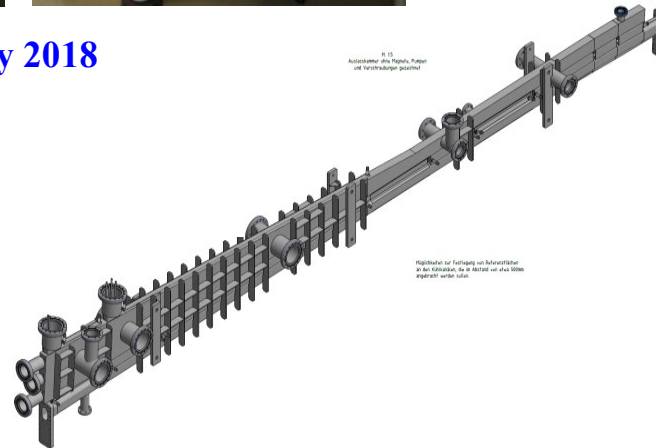
magnetic field: 5.3 T \rightarrow 7 T

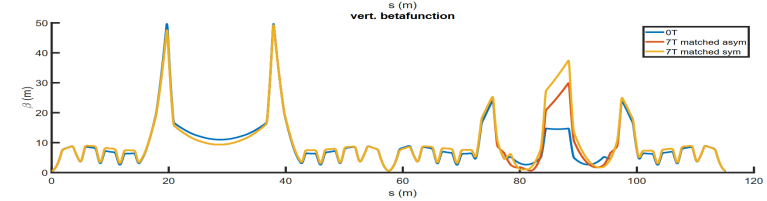
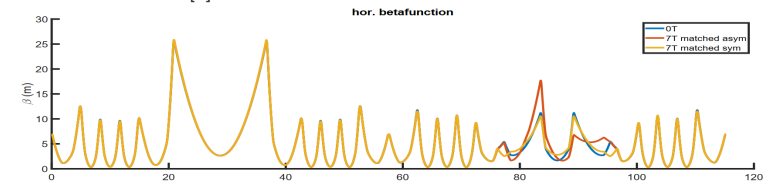
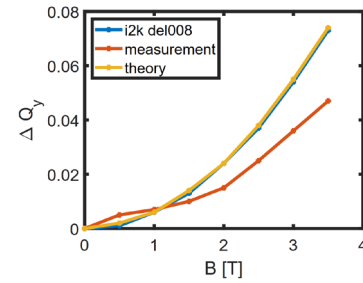
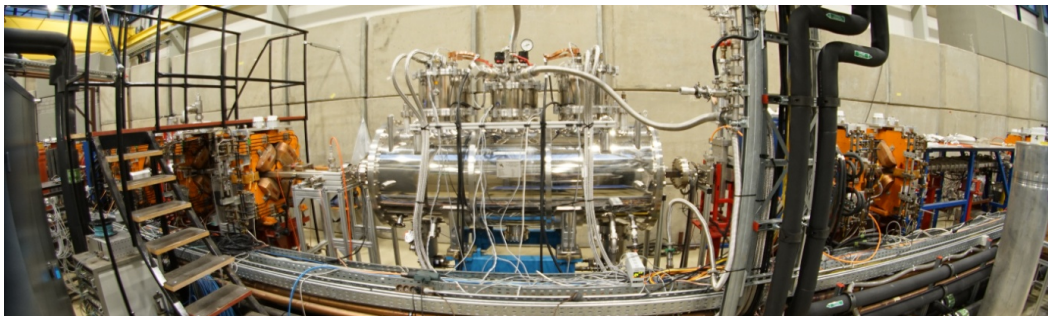
number of periods: 5 \rightarrow 9

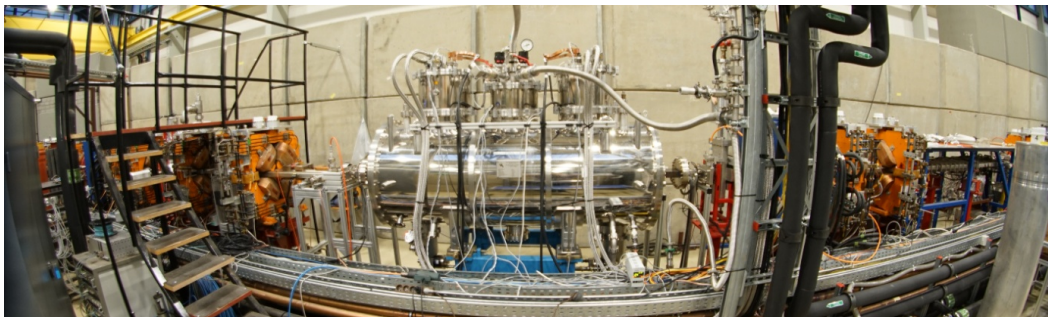
He consumption: 130 l/week \rightarrow none

New vacuum chamber still missing

installation and operation with reduced field
(3.5 to 5 T)







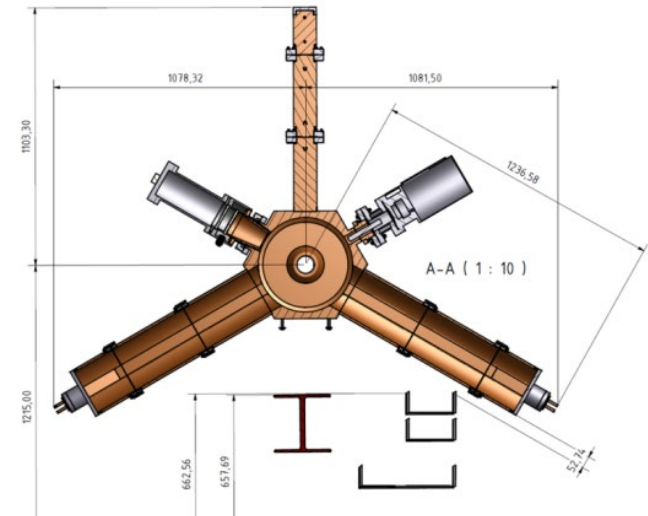
RF upgrade in 2019

(W. Brembt, P. Hartmann, A. Leinweber, V. Kniss, T. Weis)

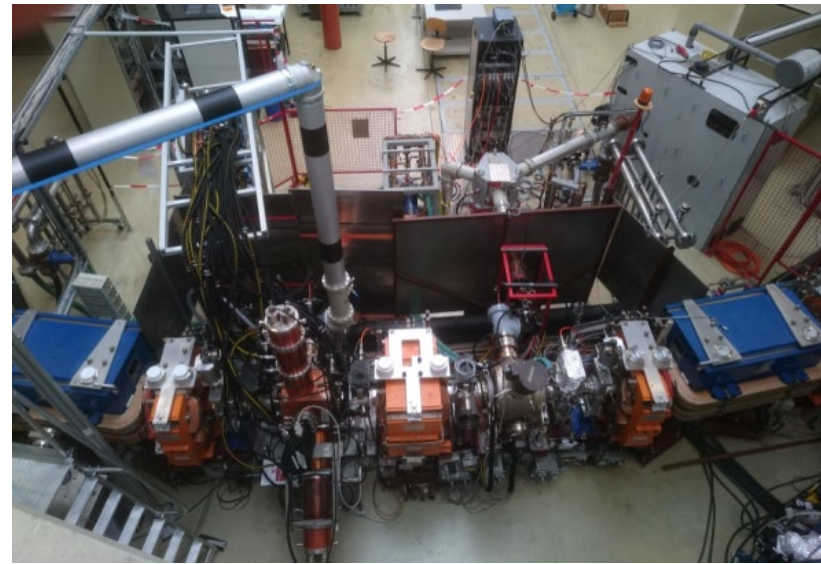
500 MHz European HOM-damped cavity
delivered and conditioned in 2018, problem with coupler
installed in April 2019
operated since August 2019 after problem with probe window

500 MHz solid-state amplifiers
installed in 2017
- 75 kW for the storage ring
- 20 kW for the booster

Digital low-level RF system
operated since August 2019



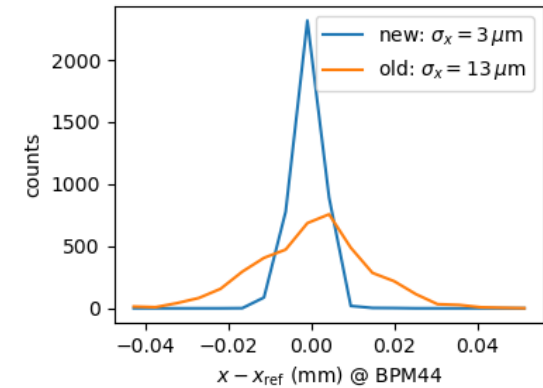
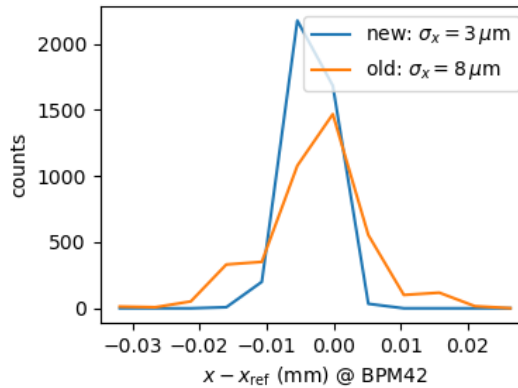
(Courtesy Research Instruments GmbH)



New orbit correction and related studies

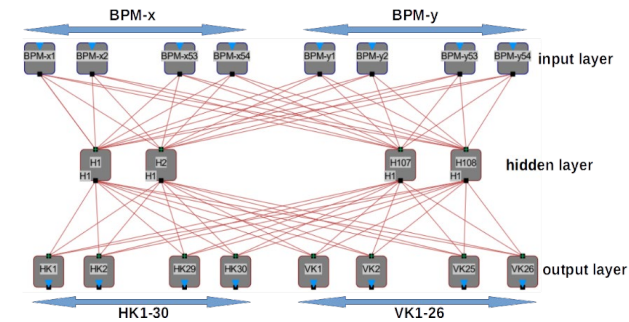
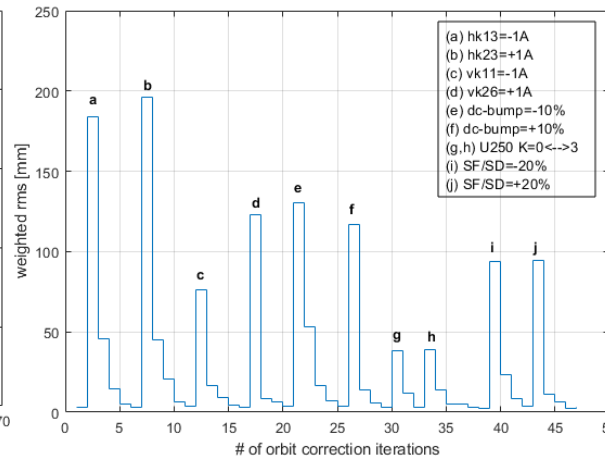
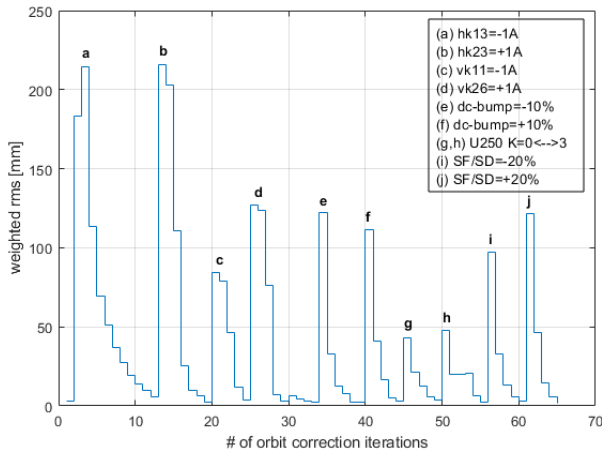
(S. Kötter, B. Riemann**, T. Weis; **now at SLS)

Cone-base optimization
 - improved performance
 - in routine user operation



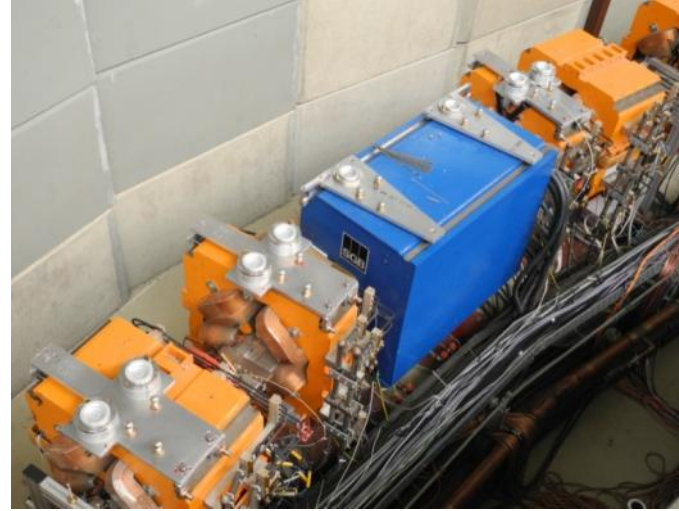
Orbit correction and tune control with neural networks

(D. Schirmer)



Alignment of the storage ring

(U. Berges, B. Büsing, G. Dahlmann, T. Dybiona, B. Sawadski, G. Schmidt, T. Schulte-Eickhoff)



Vertical alignment

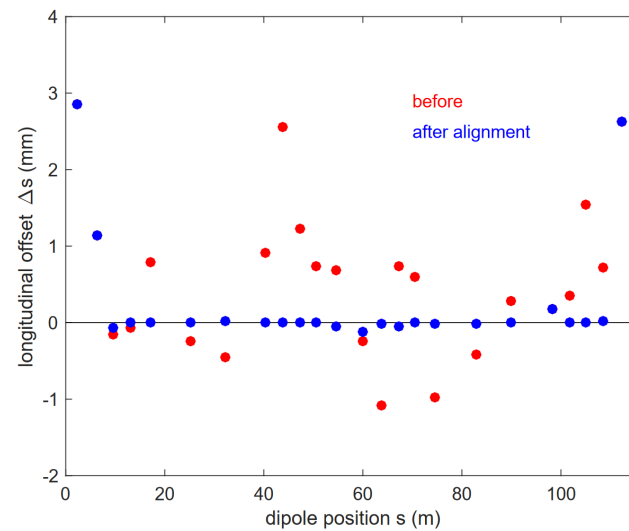
- completed in 2013

Horizontal alignment

- completed in 2018

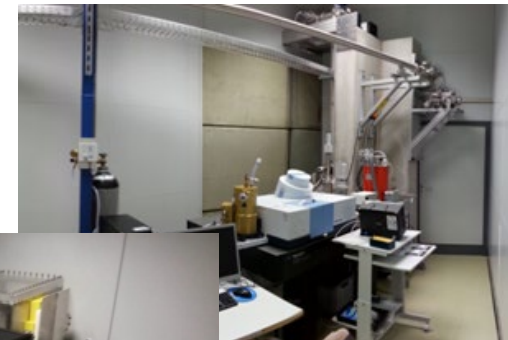
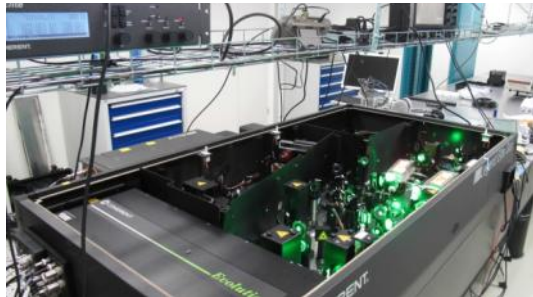
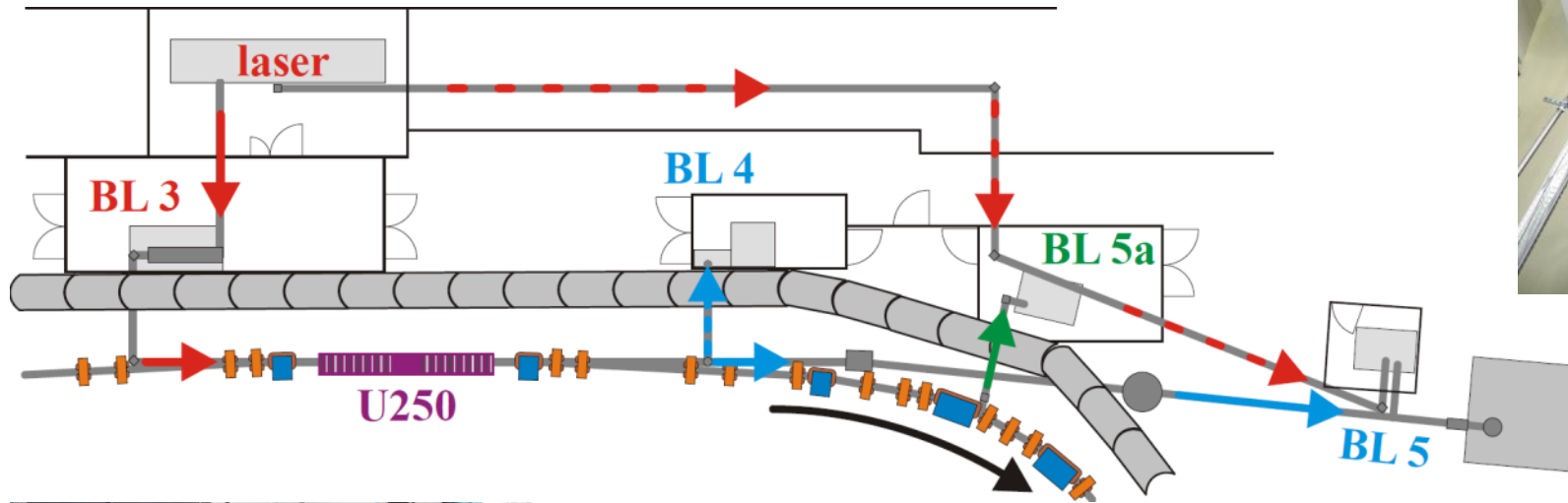
Longitudinal alignment of dipoles

- almost completed in 2020



Facility for ultrashort VUV and THz pulses

B. Büsing, H. Kaiser, S. Khan, S. Kötter, D. Krieg, A. Krishnan, C. Mai, A. Meyer auf der Heide, I. Mohammad, V. Vijayan



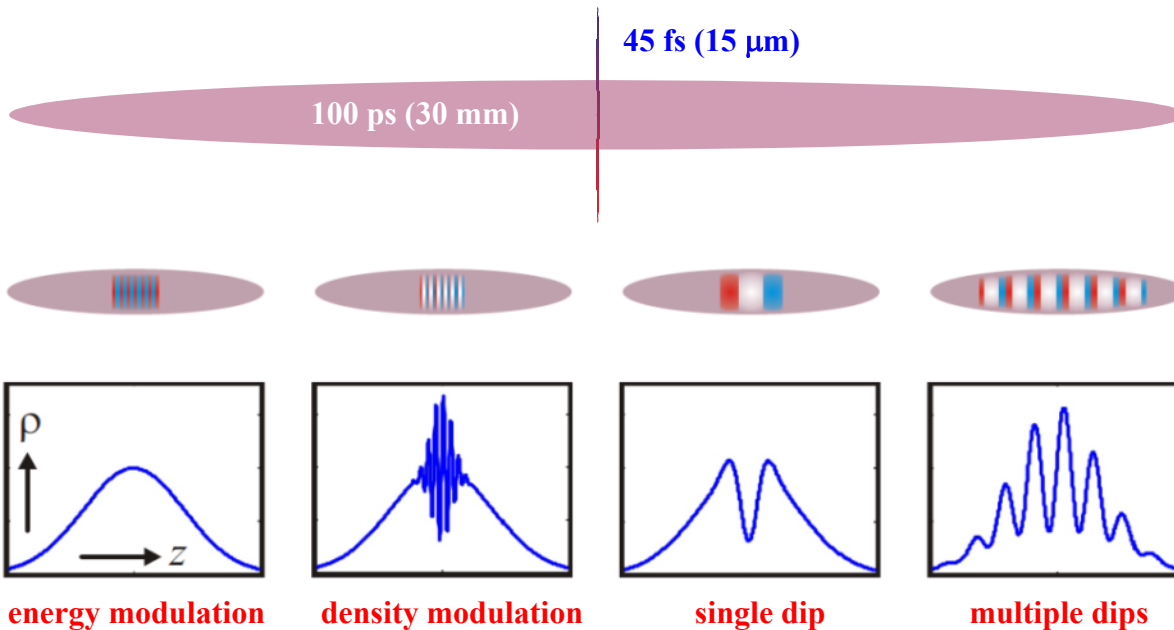
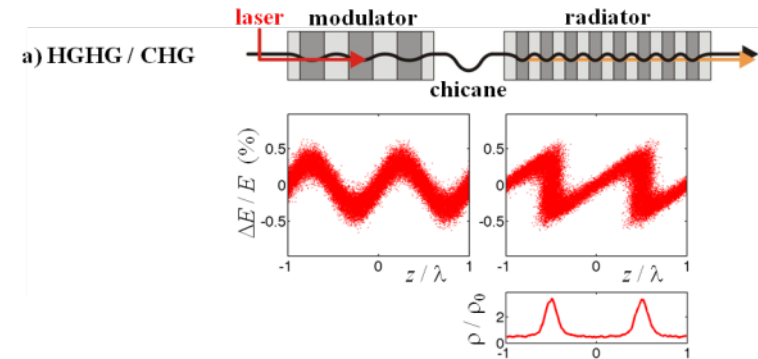
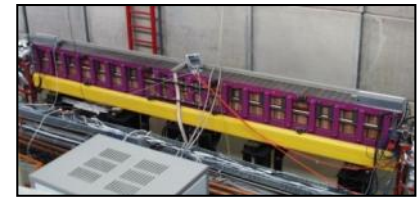
Facility for ultrashort VUV and THz pulses

Coherent harmonic generation (CHG)

- laser-induced energy modulation within a bunch "slice"
- density modulation in a magnetic chicane
- coherent radiation at harmonics of the laser wavelength (so far, 80 nm)

Coherent terahertz (THz) radiation

- short "dip" due to energy-dependent path length
- broadband coherent THz radiation
- narrowband coherent THz radiation from multiple dips



Echo-enabled harmonic generation at DELTA

Supported by Helmholtz ARD initiative (FZ Jülich)

- modulators: 2 short undulators
- radiator: present U250 undulator
- requires 20 m long straight section
- modified storage ring optics
- additional undulator for "femtosing"

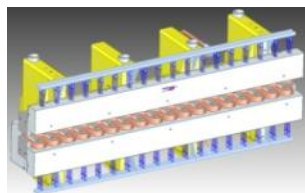
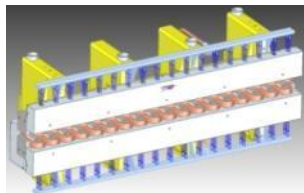
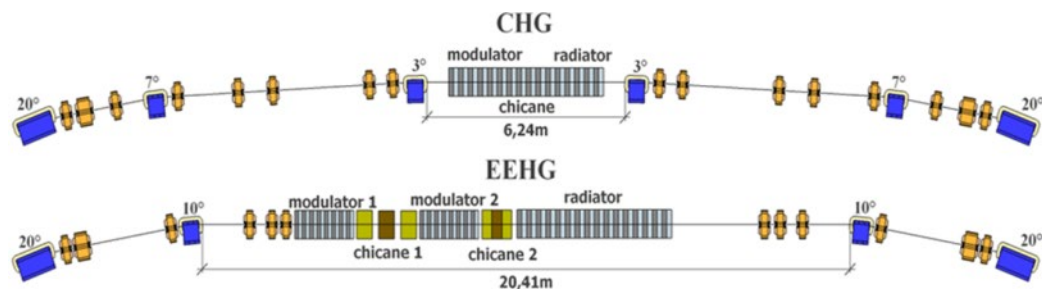
G. Stupakov, Phys. Rev. Lett. 102, 074801 (2009)

D. Xiang et al., Phys. Rev. Lett. 105, 114801 (2010)

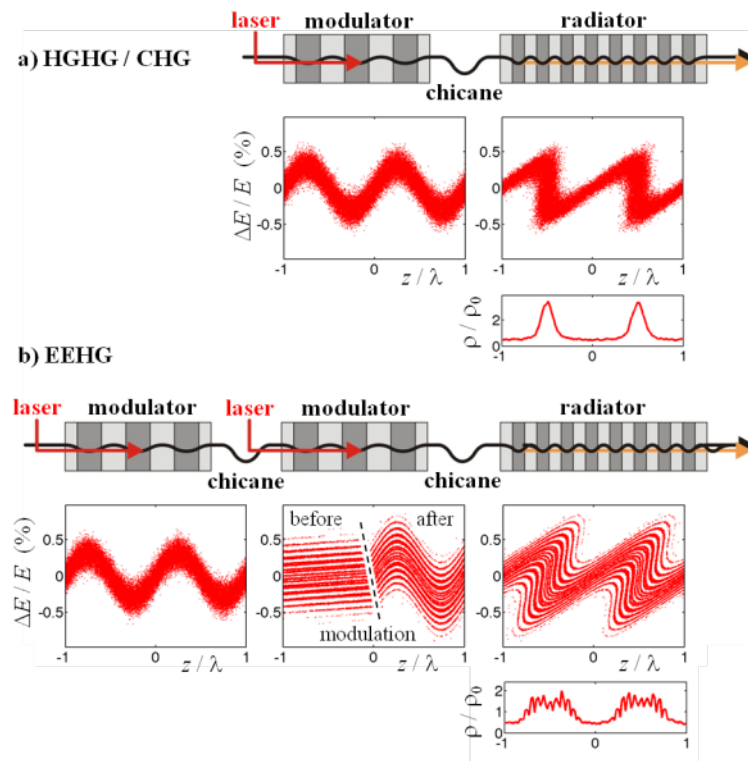
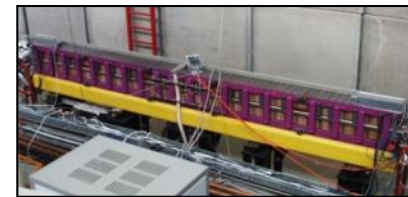
Z. T. Zhao et al., Nature Photonics 6, 360 (2012)

E. Hemsing et al., Nature Photonics 10, 512 (2016)

P. R. Ribič et al., Nature Photonics 13, 555 (2019)



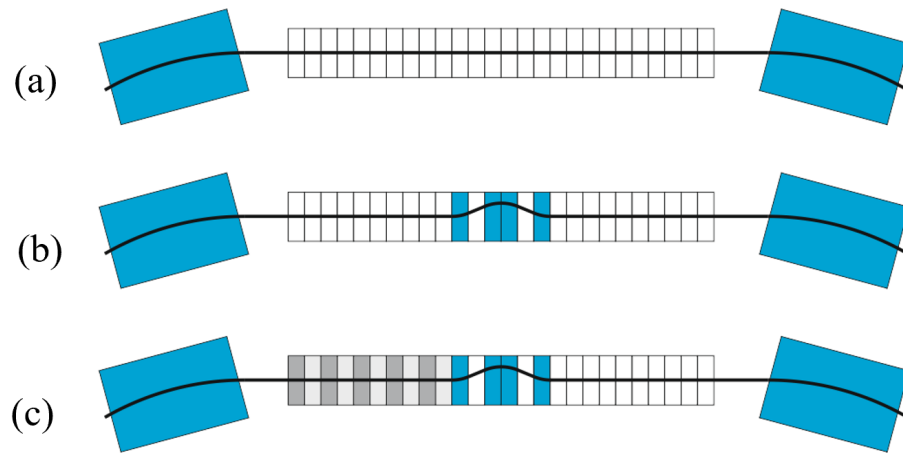
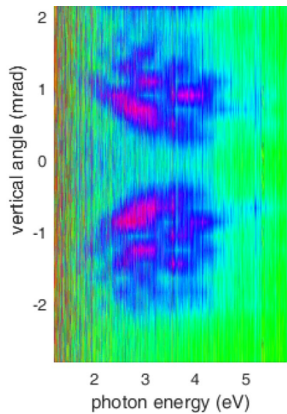
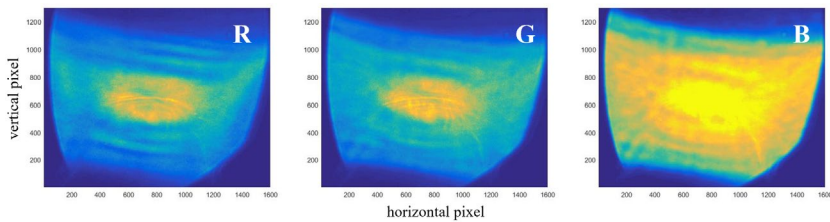
Courtesy Scanditronix AB



Edge radiation

Apparent longitudinal acceleration/deceleration

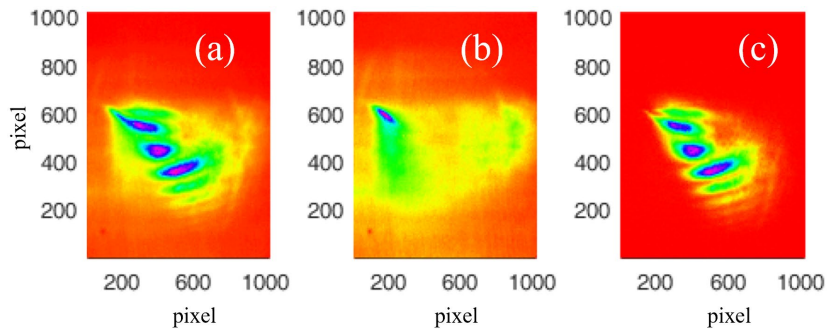
- circular off-axis fringes
- radial polarization
- photon energy depends on angle



Coherently emitted edge radiation (ChEER)

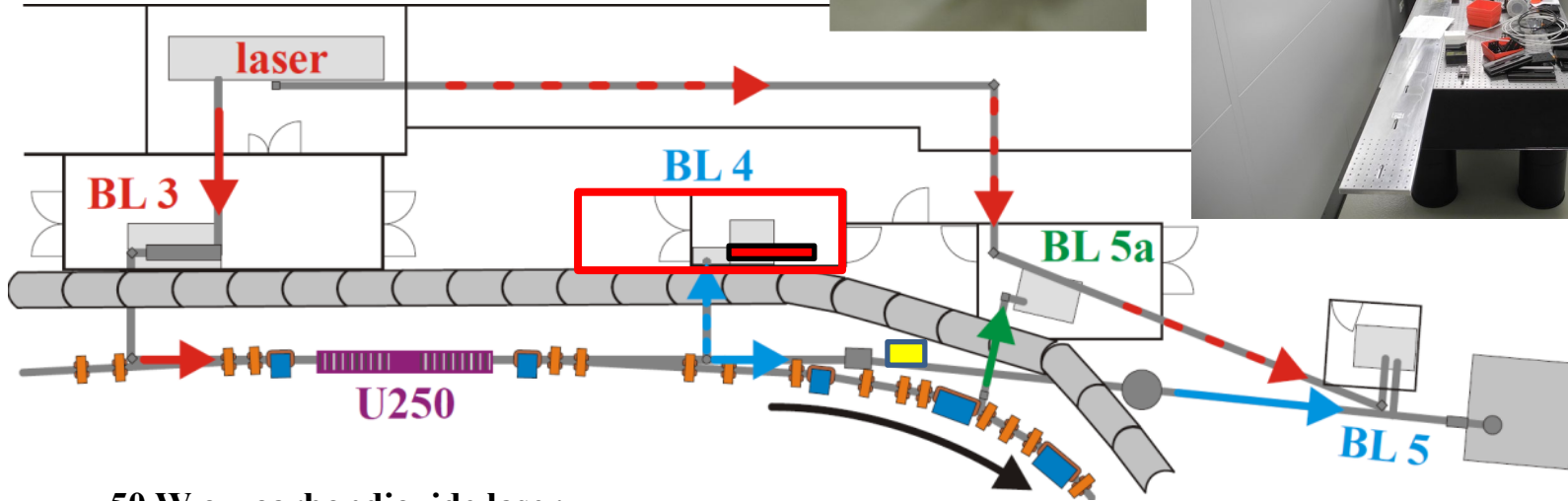
Laser-electron interaction

- edge radiation from density-modulated bunch



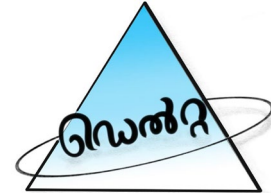
Compton backscattering

Energy measurement with high precision



- 50 W cw carbon dioxide laser
- high-purity germanium detector





Thank you for your attention

Ministerium für Innovation,
Wissenschaft und Forschung
des Landes Nordrhein-Westfalen



DFG Deutsche
Forschungsgemeinschaft



Mercator Research Center Ruhr
Eine Initiative der Stiftung Mercator
und der Universitätsallianz Ruhr



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