HZB Facility Talk

Thorsten Kamps

Humboldt Universität zu Berlin / Helmholtz-Zentrum Berlin

HGF MT ARD ST3

ST3 Meeting, Hamburg/Online, 29.09. to 01.10.2021

ATHENA

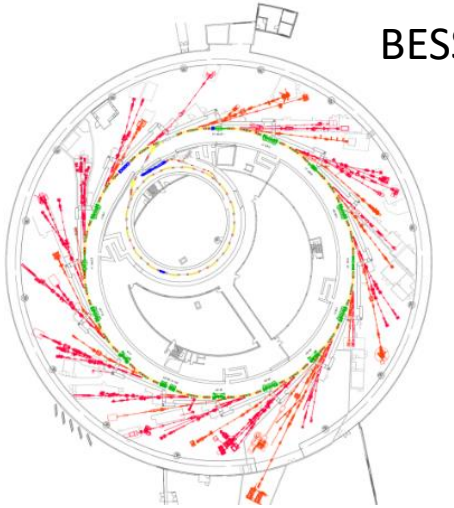
HZB Helmholtz Zentrum Berlin

HUMBOLDT-UNIVERSITÄT ZU BERLIN

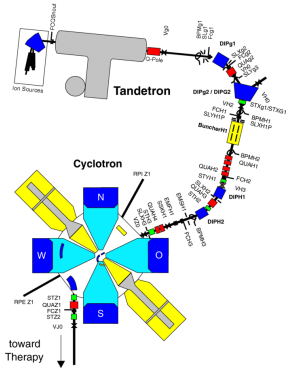
Today

- Our facilites for proton therapy, Bessy II, its upgrade path and Bessy III
- Accelerator R&D for SRF topics with QPR and VSR Demo
- Status and plans of the test accelerator Sealab/bERLinPro

One center, two campuses and many accelerators



BESSY II



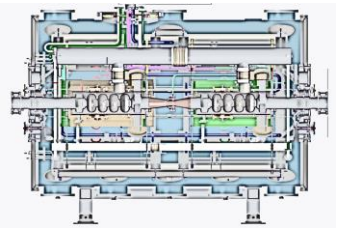
Cyclotron and proton therapy complex

BESSY III & MLS2

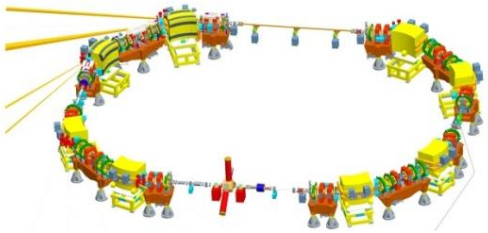
PTB

SupraLab@HZB

VSR DEMO



Metrology Light Source



PTB

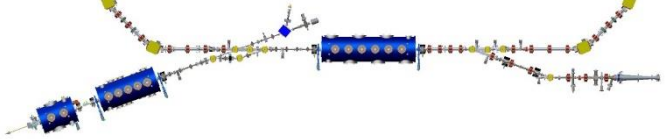
LEAPS League of European Accelerator-based Photon Sources

Digital LEAPS – ML, AI, Data
PerMaLic – permanent magnets

MT ARD

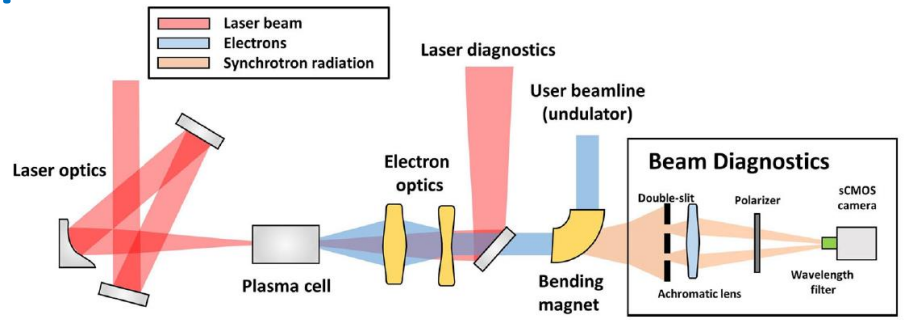
ATHENA Accelerator Technology Helmholtz Infrastructure

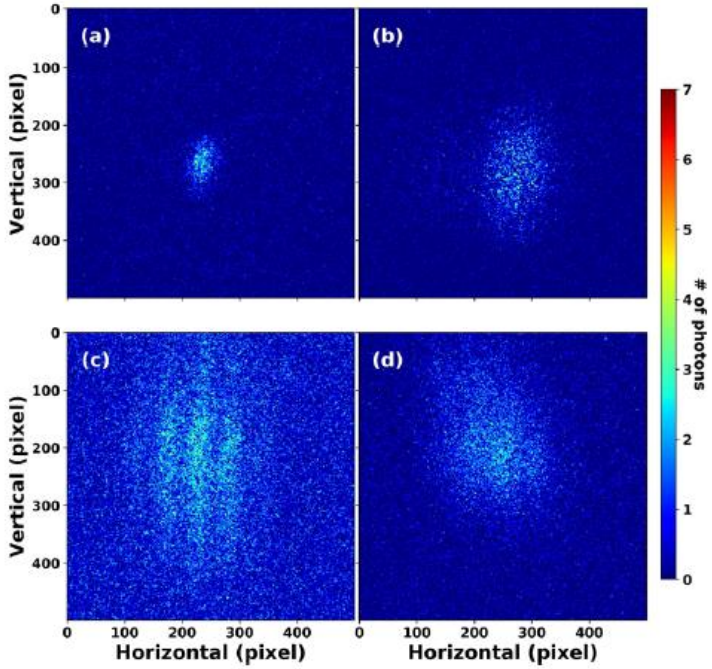
SEALAB/ bERLinPro

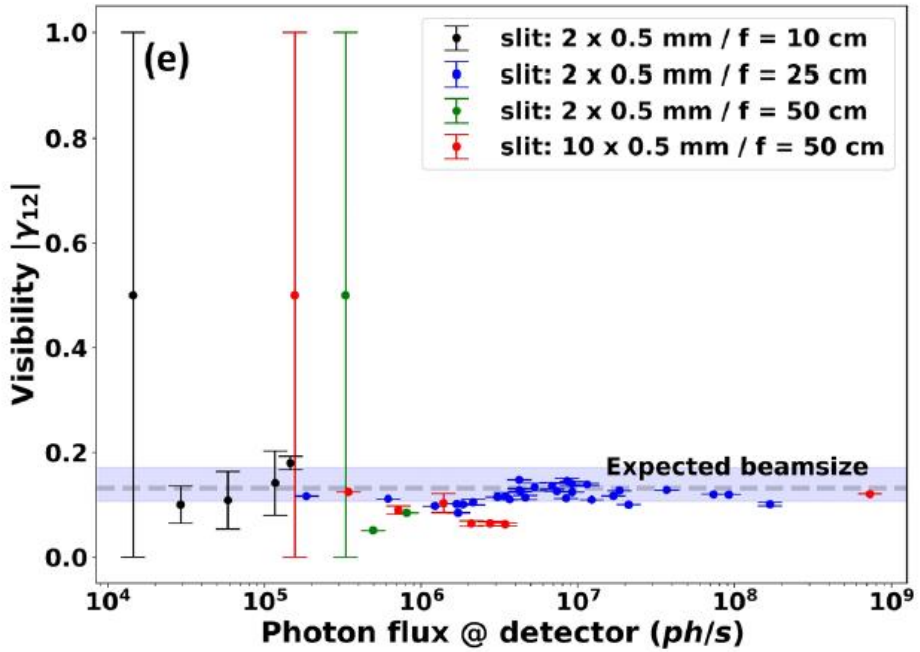


We develop, operate, maintain and modernize our accelerators to provide unique research opportunities

How this all works together



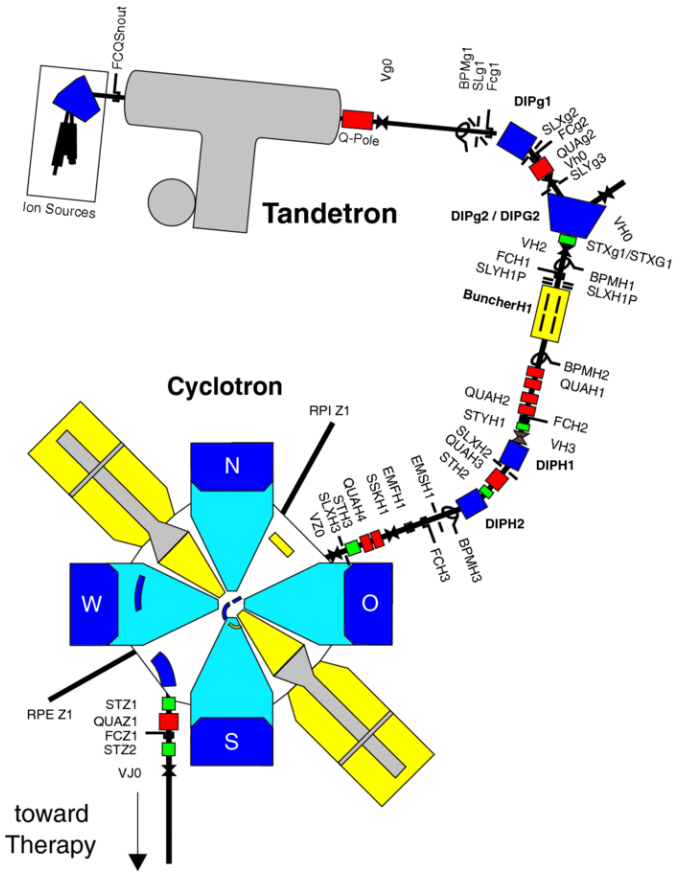




J.-G. Hwang, et al., Communications Physics, 2021, doi.org/10.1038/s42005-021-00717-x

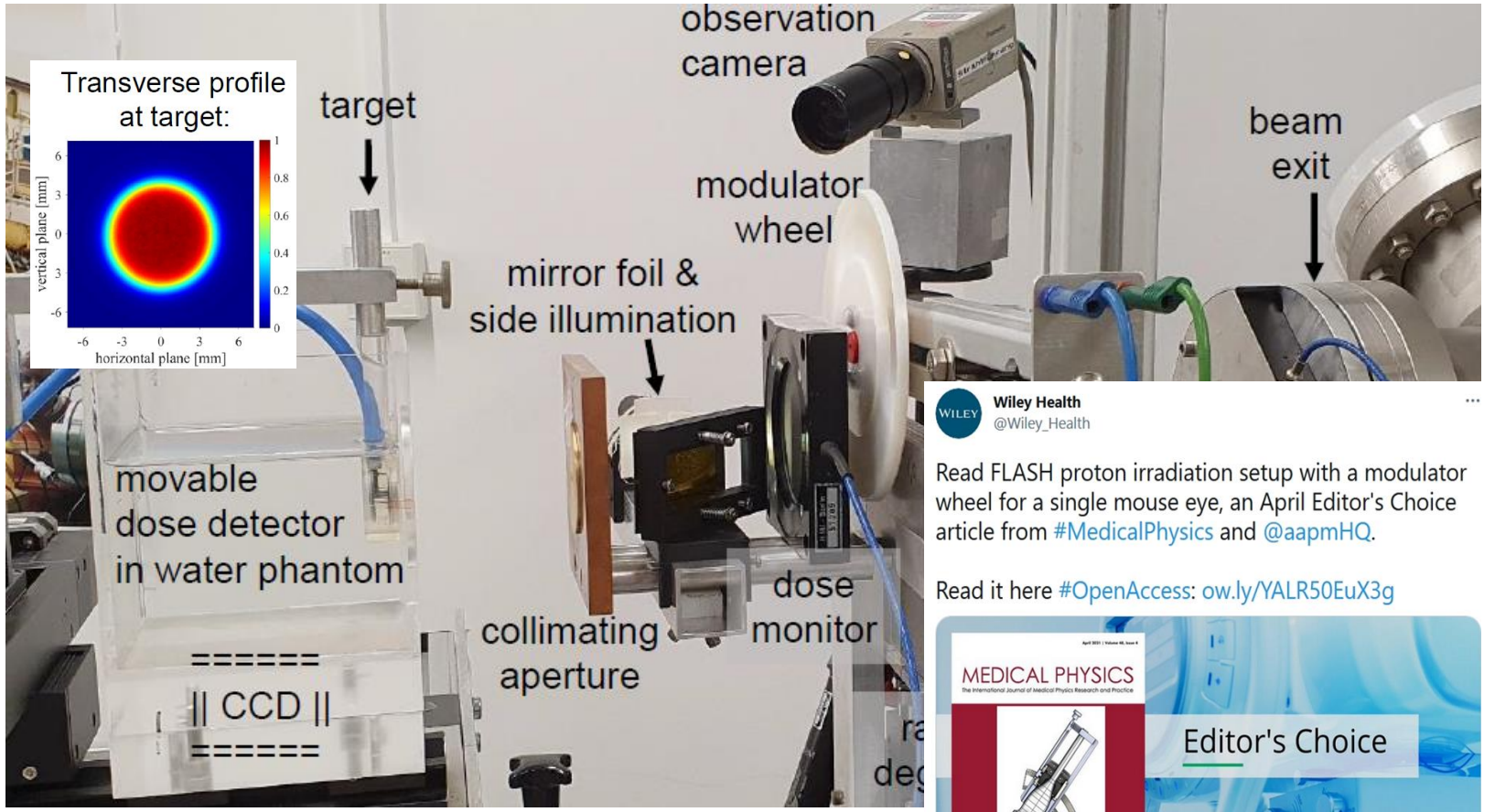
Treatment, FLASH research and instrumentation tests

Proton irradiation of intraocular tumors with 68 MeV isochron cyclotron



A. Denker, G. Kourkafas

G. Kourkafas, et al., Med. Phys. 48 (4), 2021



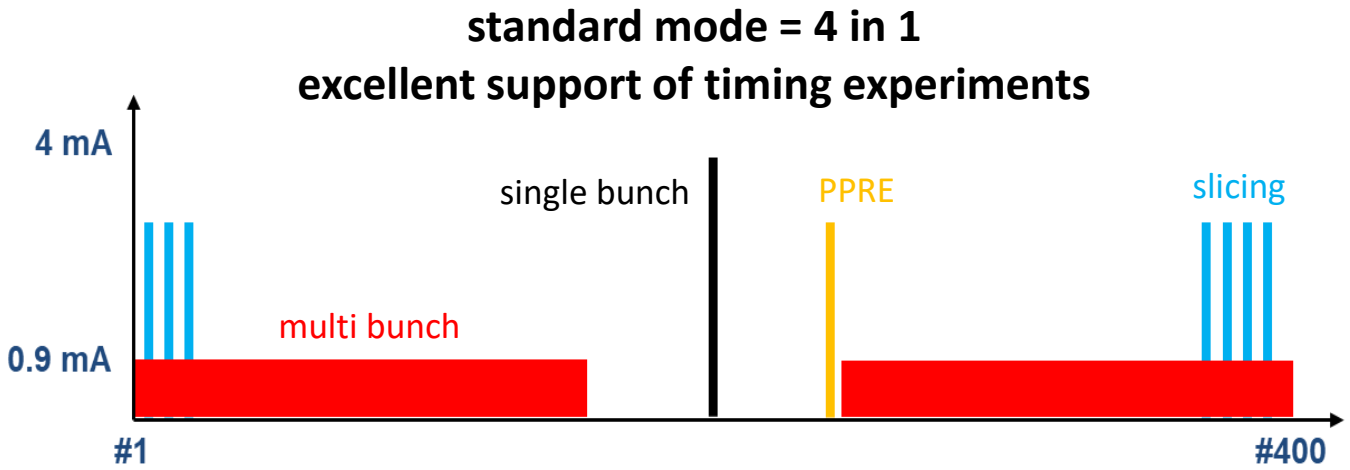
FLASH therapy at HZB: development of irradiation nozzle and irradiation tests with single mouse eyes

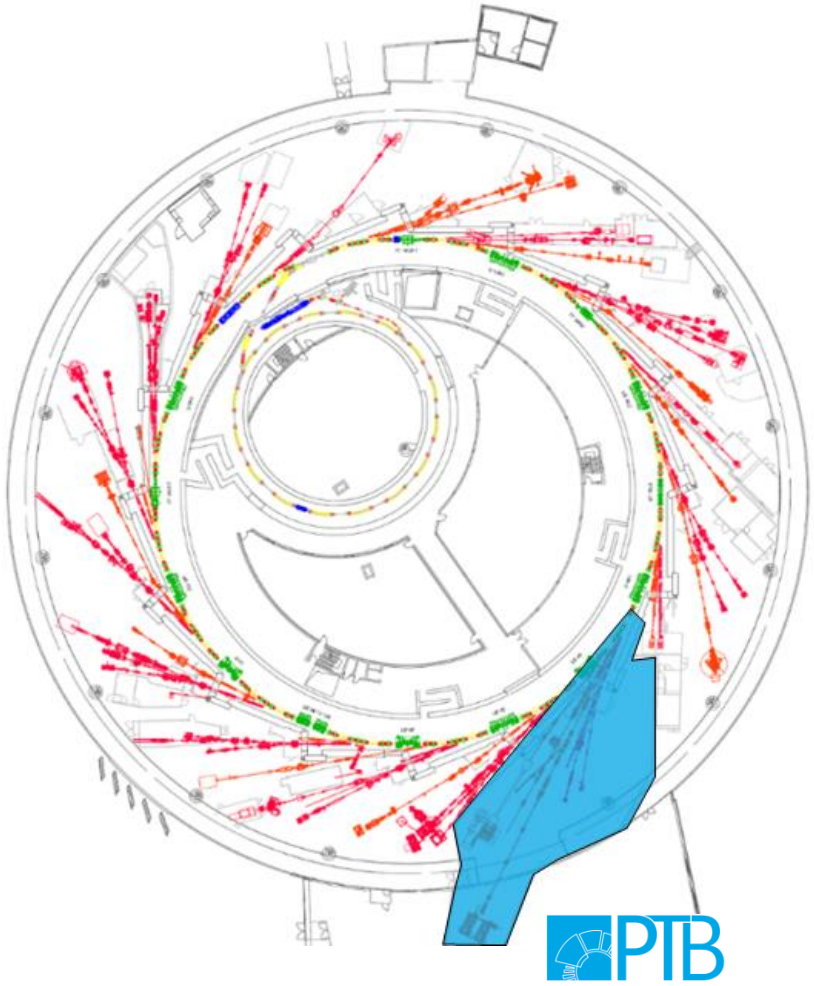
Our synchrotron radiation source Bessy II

HZB BESSY II Light Source

Bessy II, a soft X-ray light source with 36 beamlines (13 undulators, 2 wave length shifters), setup from 1992 to 1998, in user operation since 1999. Constantly evolving.

Complex fill pattern supporting imaging, spectroscopy and timing experiments: low-α mode for ps beams serving CSR and THz, femto slicing for 100 fs beams for pump probe applications



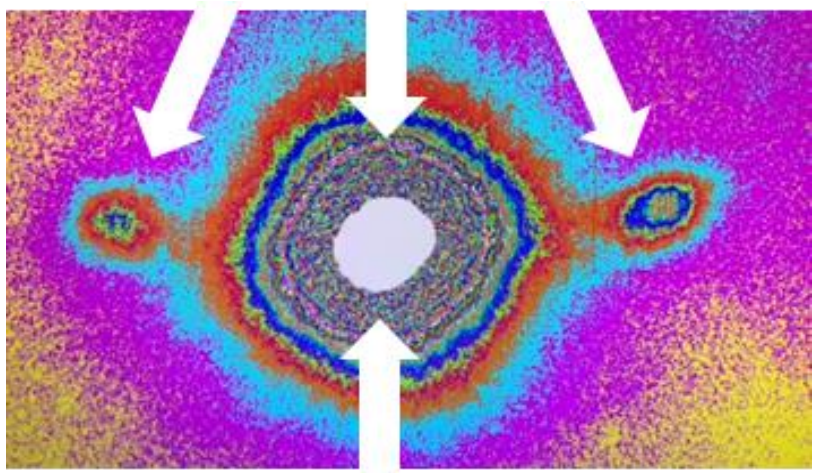


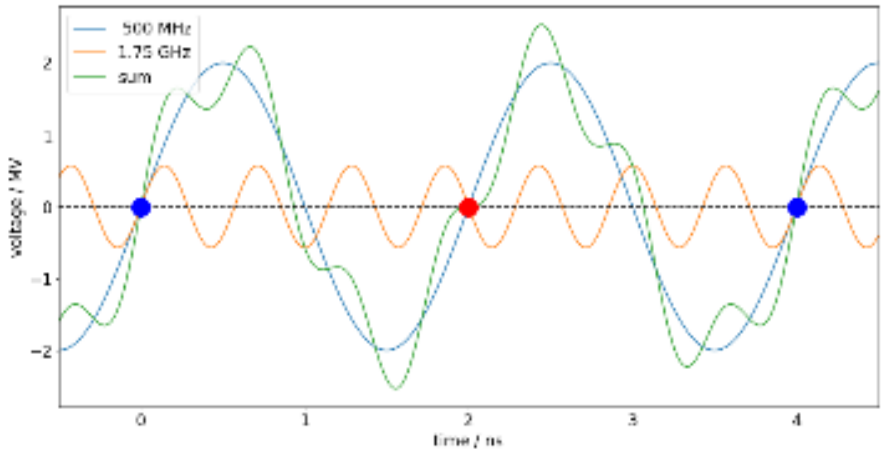
A. Jankowiak, M. Ries, A. Schälicke

New opportunities at our synchrotron radiation source Bessy II

TRIBs

Higher harmonic cavities





A. Jankowiak, M. Ries, A. Schälicke

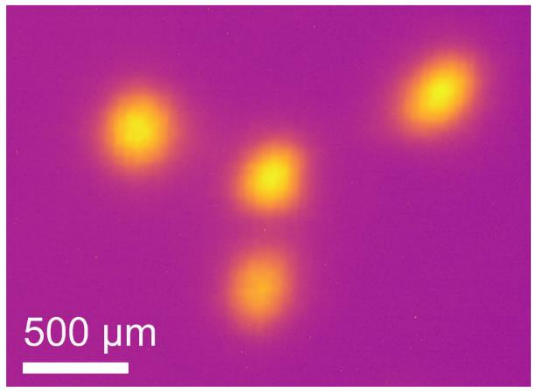
New opportunities for our synchrotron radiation source Bessy II

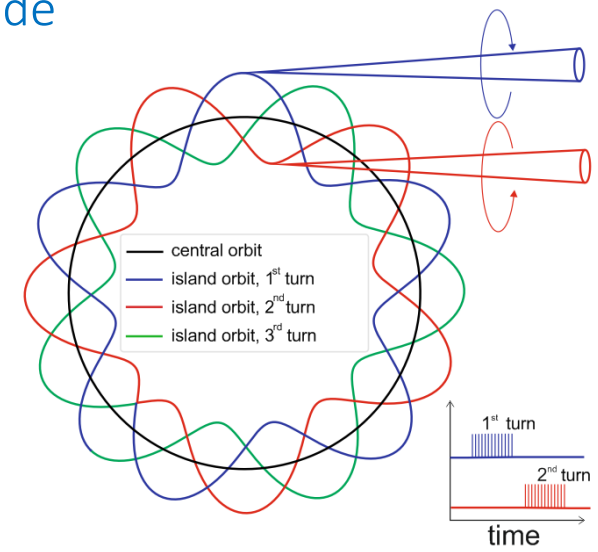
MHz fast switching of radiation properties through multi-orbit operation mode

TRIBs: two orbits serving two fill patterns, a bunch seperation scheme

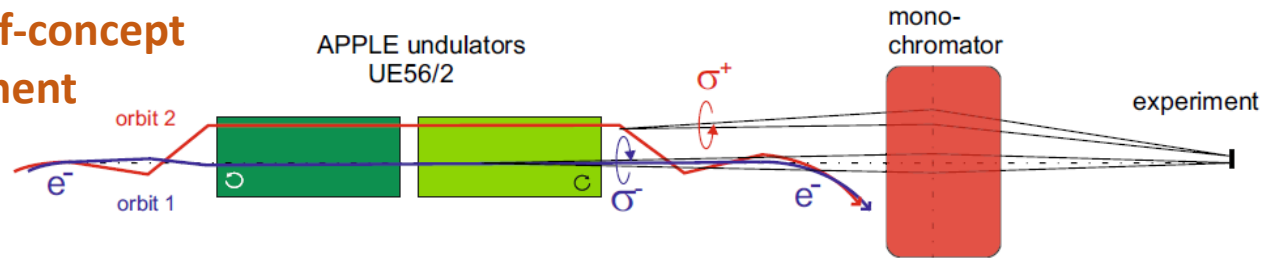
Now a way to generate qualitative new radiation properties: MHz fast helicity switching from a TRIBs-ready undulator

Towards ultimate sensitivity for soft/tender X-ray spectroscopy

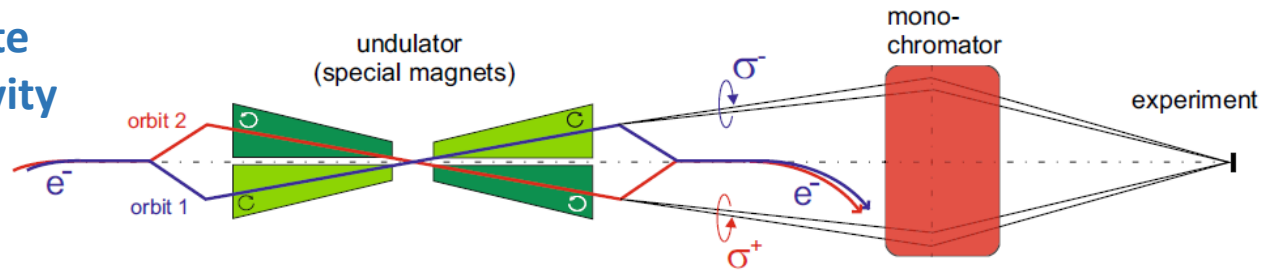




Proof-of-concept experiment



Ultimate sensitivity



K. Holldack, et al., Communications Physics, 2021, doi.org/10.1038/s42005-020-0331-5

New opportunities for our synchrotron radiation source Bessy II

A knob for bunch length control independent of the beam current

ALBA

HZB Helmholtz Zentrum Berlin

DESY.

EUROPEAN UNION
European Regional Development Fund

SUPRALAB@HZB

BESSY II

LEAPS

PTB
Physikalisch-Technische Bundesanstalt Braunschweig und Berlin

MLS II
MLS
BESSY II
BESSY III

HZB Helmholtz Zentrum Berlin

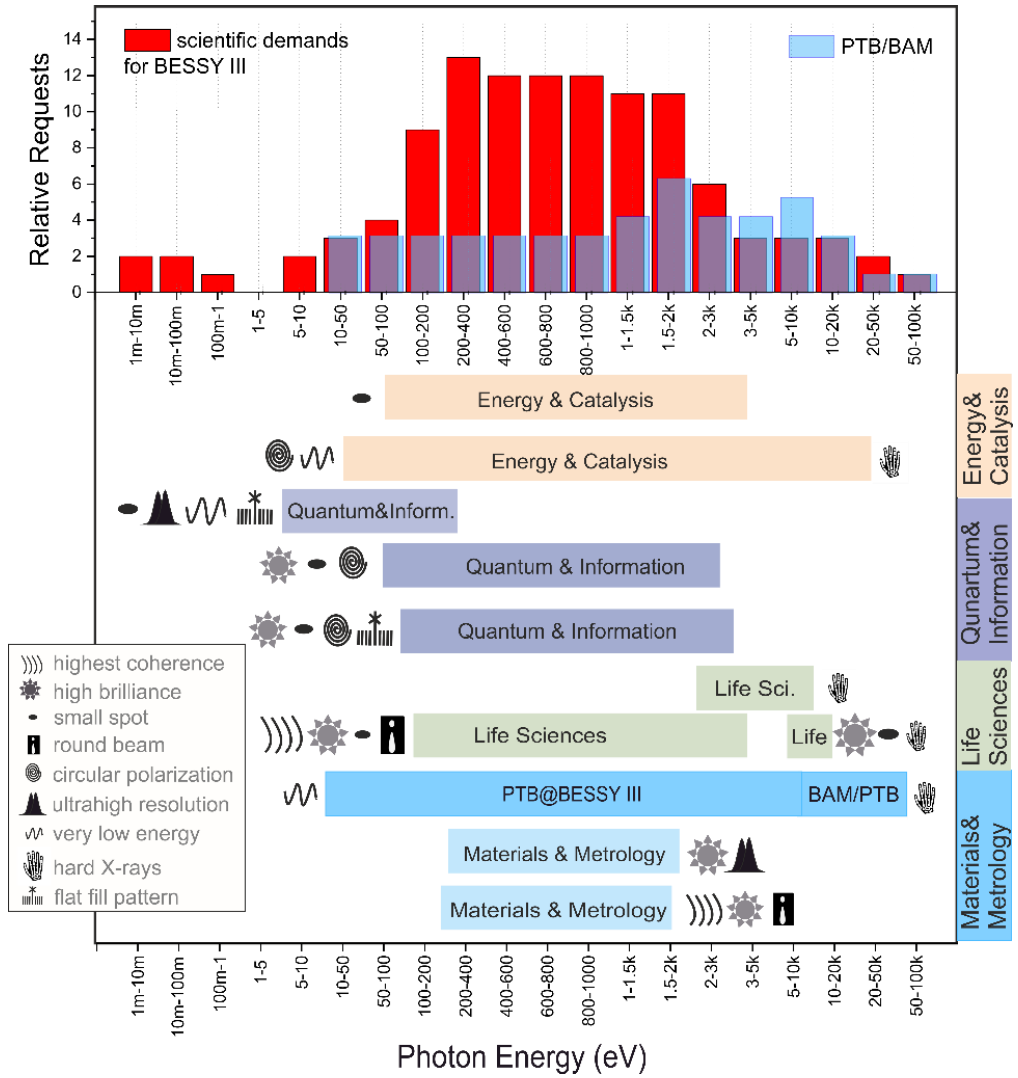
Joint project to develop an active normal-conducting 1.5 GHz harmonic cavity

Implementation and tests with beam at Bessy II (in 2022)

Technology base for bunch length control in 4th generation light sources

A. Jankowiak, M. Ries, A. Schälicke

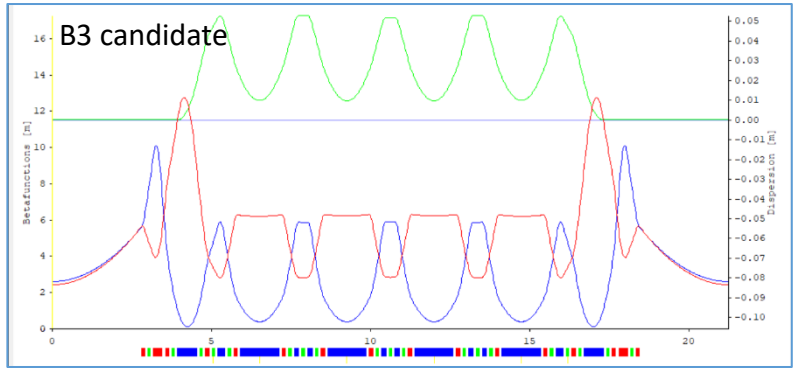
Bessy III – a science driven next generation light source



A. Jankowiak, M. Ries, P. Gaslowski

Sweet spot/ first undulator harmonic at 1 keV, (up to tender), with a range of 100 eV to 2.5 keV. Contingent requested by HZB, BAM and PTB. On site in Adlershof

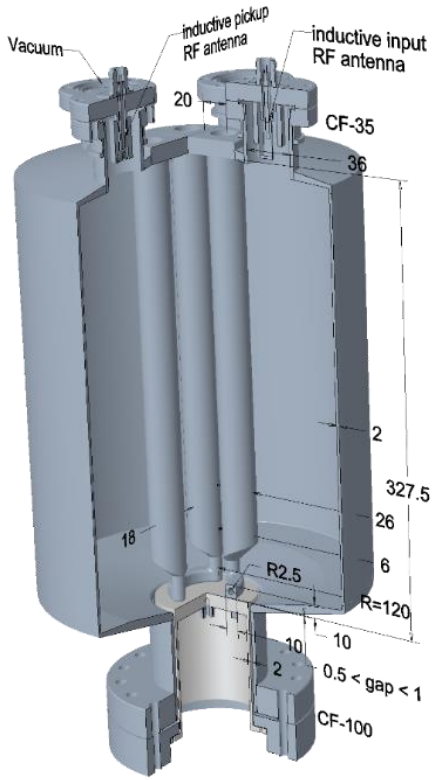
100 pm rad emittance at 2.5 GeV.
16 straights, up to 5 m free length for Ids
Dipole source for metrology (PTB).
320 m circumference to fit Adlershof site.



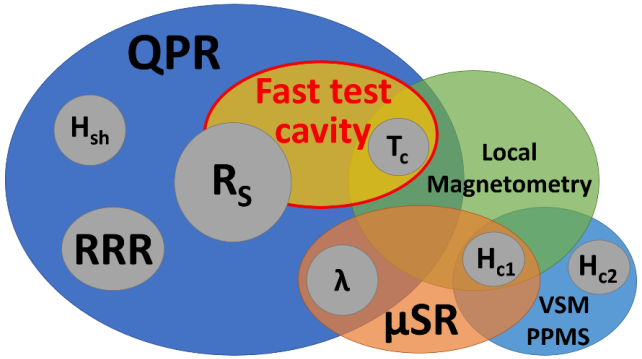
4th generation MBA lightsource with TRIBs and HHC for timing modes.

SRF driven research – from thin films to SRF accelerator modules

High Q / high T SRF materials



Development of a sample test cavity for fast turn-around RF testing of SRF materials.



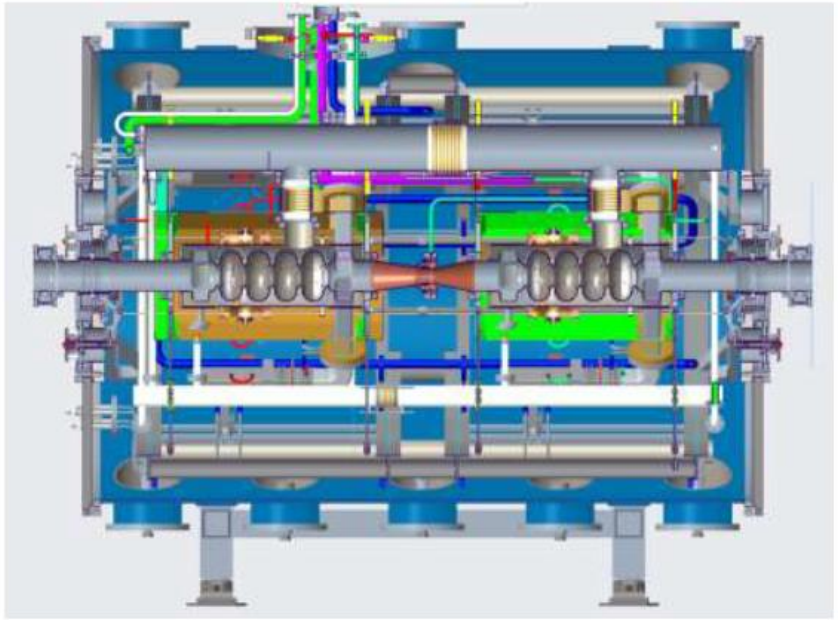
TECHNISCHE UNIVERSITÄT DARMSTADT

UNIVERSITÄT SIEGEN

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

InnoVEA

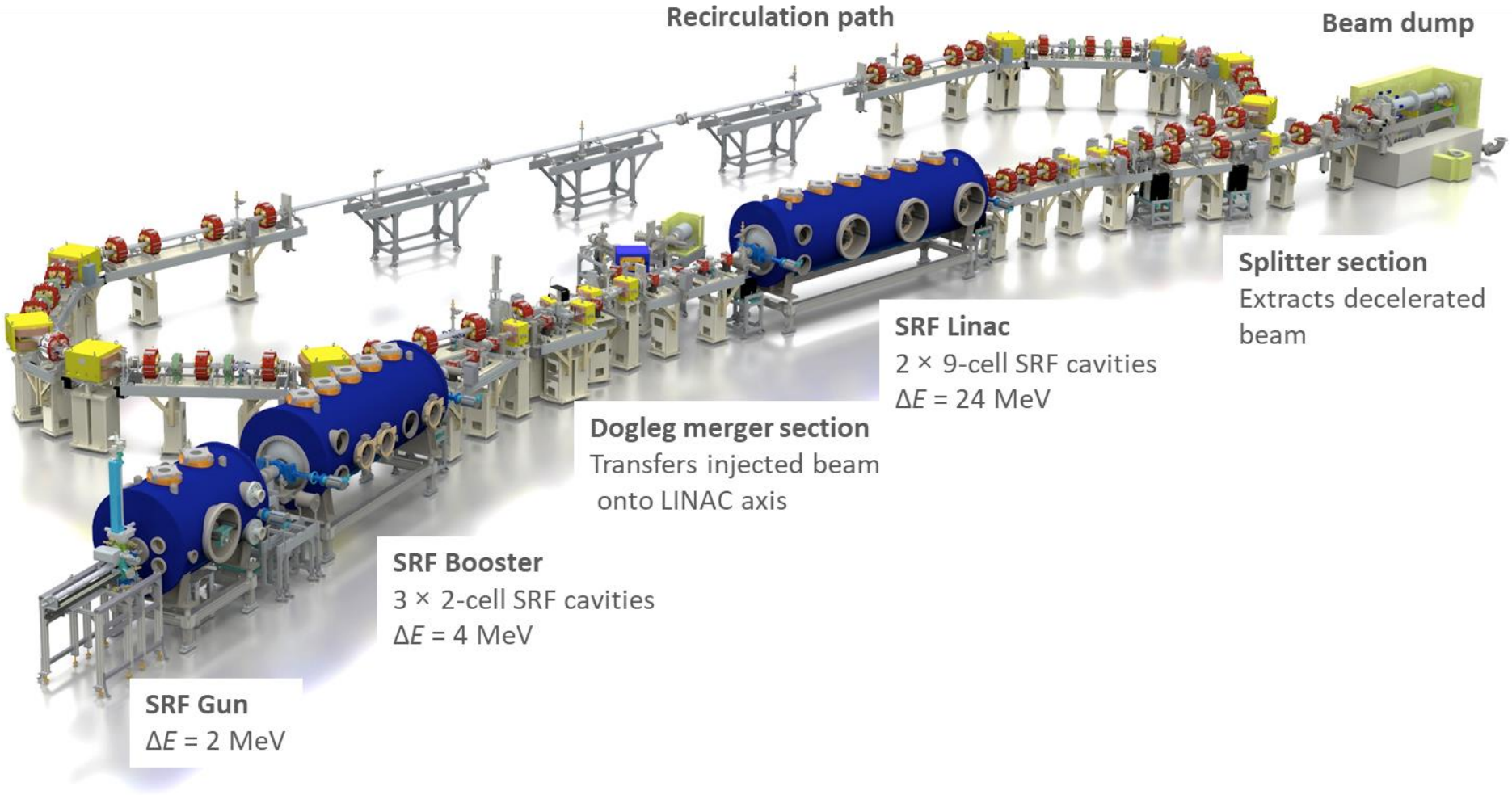
VSR Demo



Validate SRF technology for high current, high gradient CW operation.
Build and test a module with 2 x 1.5 GHz SRF HOM loaded cavities.

J. Knobloch, O. Kugeler, S. Keckert, A. Velez

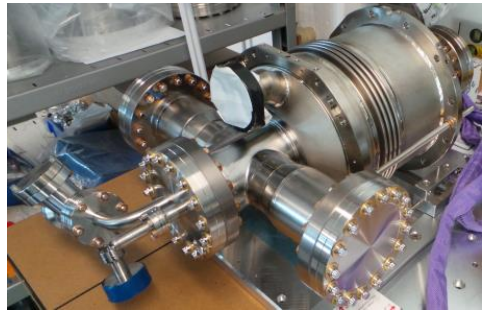
The ERL test facility at HZB – transition from bERLinPro to Sealab

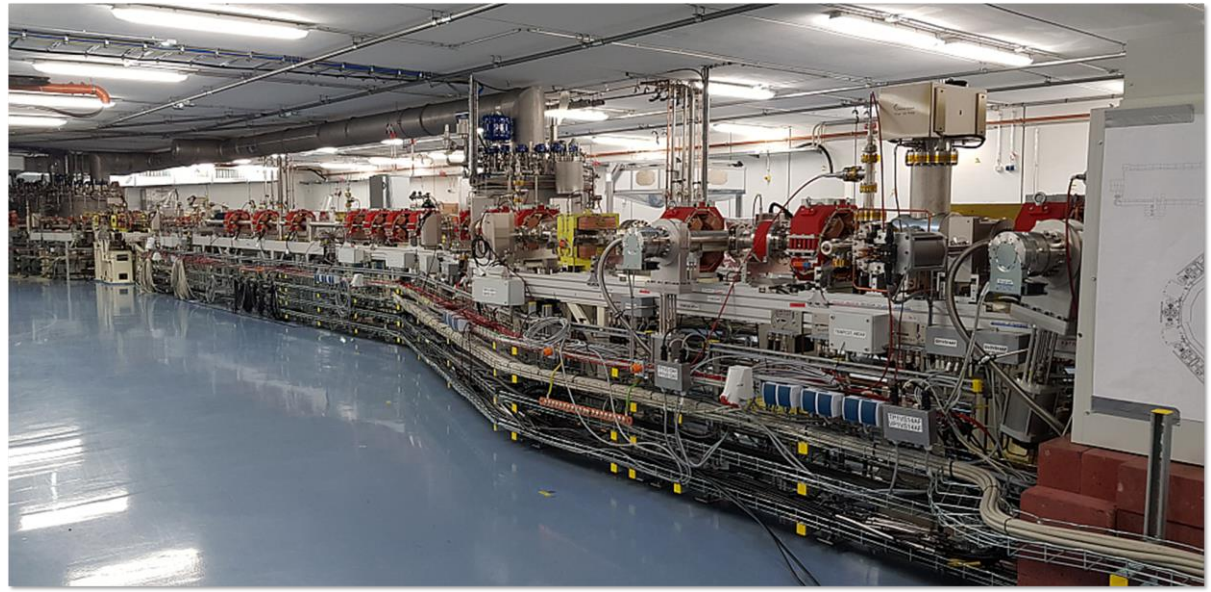


A. Jankowiak, et al., Proc. of ERL 2019
A. Neumann, et al., Proc. of SRF 2021

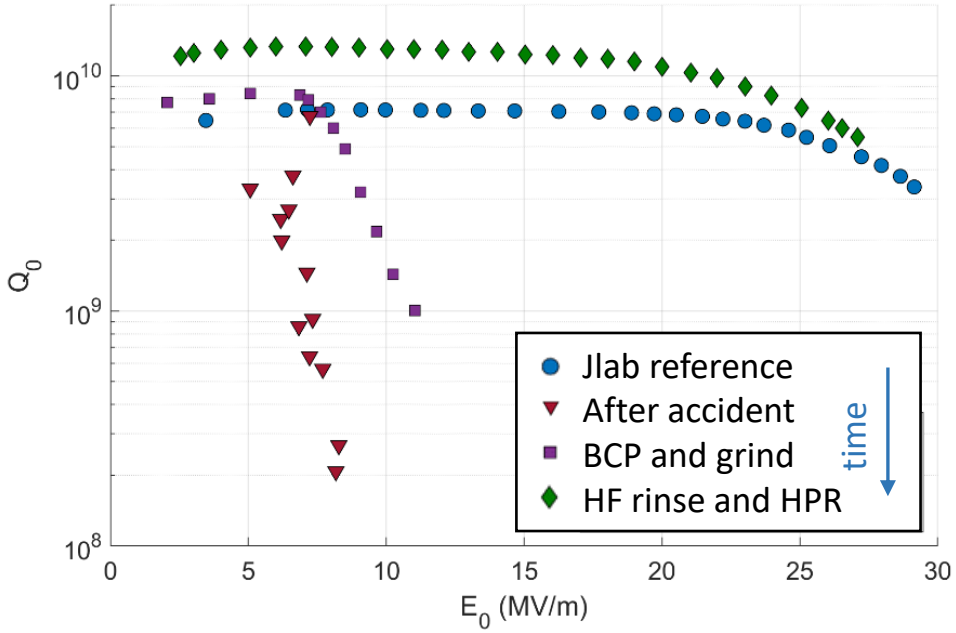
The ERL test facility at HZB – transition from bERLinPro to Sealab

On track for first beam in March 2022





Y. Tamashevich, Prof. of SRF 2021



Sealab – an accelerator science and technology test facility

Sealab is a accelerator science and technology test facility with a broad range of beam parameters: Hz to GHz, fC to nC, fs to ps, up to 6.5 MeV (50 MeV with linac)

Study full parameter space and performance, especially at high average current (5 mA) of the SRF photoinjector for ERL, FEL, ultra-fast scattering applications.

Beam tests of diagnostics concepts and new acceleration methods. Connects to ATHENA. Relevant for light sources (XFEL osc, CW FEL, compact THz/FEL) and HEP (collider, cooler).

→ See speed talk by Benat Alberdi Esuain tomorrow on running Sealab for UED applications

Summary

HZB operates and develops large scale user **facilities - synchrotron radiation sources, proton therapy -** and accelerator **R&D Infrastructures - QPR, VSR Demo module, Sealab/bERLinPro**.

We advance **fundamental and applied accelerator science and forefront technologies** for the continuous improvement of these facilities and to develop state-of the-art accelerator concepts and novel disruptive methods and paradigms to provide perfect experimental opportunities for HZB´s present and future users/partners.

Our strategy is to **maintain Bessy II at the forefront by an ambitious R&D program** (TRIBs, HHC), which is strongly **linked to our new facility Bessy III**.

ARD ist crucial to our success, especially here in ST3 where we look at timing modes/TRIBs for storage rings as well as ultra-short pulse generation and diagnostics with SRF photoinjectors.