Status, Highlights and Outlook

Accelerator Research and Development

Andreas Jankowiak, HZB
Jens Osterhoff, DESY

February 1st, 2021
7th Annual MT Meeting
Online
AGENDA

• Accelerator Research and Development in PoF IV

• Strategic Investment, Helmholtz Association
  ATHENA = Accelerator Technology HEImholtz iNfrAstructure
  VSR DEMO = Technology Demonstrator for Variable Pulse Length Storage Ring

• Innovation Pool projects with ARD relation “old” & “new”

• Highlights ARD research in ST1, ST2, ST3 and ST4

• Miscellaneous
  German Committee for Accelerator Physics
  Working Group on Accelerator Physics, DPG
ARD VISION & MISSION
Advancing the state of the art in accelerator science and technology

Our research aims for high-impact progress and catalyzes science and technology revolutions. We provide the tools for the scientific breakthroughs of the future.

Expanding the capabilities of accelerator based research facilities

Development of novel technologies and disruptive concepts

ca. 30% of Nobel prizes in physics are influenced by accelerator science
(A. Chao, E. Haussecker, ICFA BD newsletter #53)

PETRA III. + IV.
BESSY II + III
ELBE + DALI

Engines of Discovery
A Century of Particle Accelerators
Andrew Seckel, Edmund Wilson
ARD PoF IV

2021 – 2027 PoF IV

ST1: Advanced CW SRF-Systems

ST2: New Concepts and Prototypes for Maximizing the Performance of Hadron & Electron Accelerators

ST3: Advanced Beam Control, Diagnostics and Dynamics

ST4: Ultra Compact, Novel Accelerators and their Applications
ARD PoF IV – MANAGEMENT BOARD

- steering, controlling and reporting of OUR research program (together with you!)
- dissemination of information and initiating applications & research proposals
- program board MT days
- listening to your input! fostering collaborations
## OUR MILESTONES

<table>
<thead>
<tr>
<th>Mst</th>
<th>Year</th>
<th>Milestone + Partners</th>
<th>ST</th>
<th>Centers</th>
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</thead>
<tbody>
<tr>
<td>ARD.01</td>
<td>2023</td>
<td>Review the usage and impact of Machine Learning on the ARD research program.</td>
<td>common</td>
<td>All</td>
</tr>
<tr>
<td>ARD.02</td>
<td>2024</td>
<td>Update evaluation of the user needs for guidance of the research program.</td>
<td>common</td>
<td>All</td>
</tr>
<tr>
<td>ARD.03</td>
<td>2024</td>
<td>Review of SRF CW materials performance and re-alignment of studies.</td>
<td>ST1</td>
<td>DESY, HZB</td>
</tr>
<tr>
<td>ARD.04</td>
<td>2025</td>
<td>Demonstration of high-brilliance SRF-based electron sources.</td>
<td>ST1</td>
<td>HZDR, HZB, DESY</td>
</tr>
<tr>
<td>ARD.05</td>
<td>2025</td>
<td>Demonstration of CW SRF high-current heavy ion beam acceleration.</td>
<td>ST1</td>
<td>GSI, HIM</td>
</tr>
<tr>
<td>ARD.06</td>
<td>2026</td>
<td>Compilation of recipes for CW SRF accelerating systems design and operation.</td>
<td>ST1</td>
<td>DESY, HZB, HZDR, HIM, GSI</td>
</tr>
<tr>
<td>ARD.07</td>
<td>2024</td>
<td>Design review for high field and fast ramped superconducting magnets with an assessment and selection on the most promising concepts.</td>
<td>ST2</td>
<td>GSI, KIT</td>
</tr>
<tr>
<td>ARD.08</td>
<td>2024</td>
<td>Assessment on the main intensity limitations of large circular accelerators and options to shift them to higher values.</td>
<td>ST2</td>
<td>GSI</td>
</tr>
<tr>
<td>ARD.09</td>
<td>2026</td>
<td>Summary and evaluation of progress in conservation and generation of reliable operation with high beam quality by means of advanced beam controls and cooling concepts.</td>
<td>ST2</td>
<td>GSI, GSI-Jülich, HI-Jena, HZB, KIT</td>
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<tr>
<td>ARD.10</td>
<td>2024</td>
<td>First stage demonstration of experimental and theoretical methods for tailored</td>
<td>ST3</td>
<td>All</td>
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<tr>
<td></td>
<td></td>
<td>longitudinal phase space generation</td>
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<tr>
<td>ARD.11</td>
<td>2025</td>
<td>Establish routine femtosecond precision operation at short-pulse accelerator</td>
<td>ST3</td>
<td>DESY, HZDR, KIT</td>
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<td></td>
<td></td>
<td>facilities</td>
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<tr>
<td>ARD.12</td>
<td>2027</td>
<td>Demonstration of experimental and theoretical methods for tailored 6D phase space</td>
<td>ST3</td>
<td>All</td>
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<tr>
<td></td>
<td></td>
<td>generation</td>
<td></td>
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<tr>
<td>ARD.13</td>
<td>2022</td>
<td>First availability of jointly developed infrastructure ATHENA</td>
<td>ST4</td>
<td>All</td>
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<tr>
<td>ARD.14</td>
<td>2024</td>
<td>Understanding of scaling of proton energies and assessment of applications of</td>
<td>ST4</td>
<td>GSI/HI-Jena, HZDR</td>
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<td></td>
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<td>societal relevance (e.g. tumor therapy)</td>
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<tr>
<td>ARD.15</td>
<td>2025</td>
<td>Measurement and control of electron beam parameters suitable for FEL pilot user</td>
<td>ST4</td>
<td>DESY, KIT, HI-Jena, HZB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>facility</td>
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<tr>
<td>ARD.16</td>
<td>2027</td>
<td>Substantial increase in average power of plasma accelerators for high throughput</td>
<td>ST4</td>
<td>DESY, HI-Jena, HZDR</td>
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<tr>
<td></td>
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<td>applications</td>
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**Definition of work programme, follow up and annual reporting on the ST level!**
“COMMON ARD” MILESTONES

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ARD.01 – Impact of Machine Learning (till 2023)
Naming of team of responsible persons
- organisation of workshops on ST level
- interaction with DMA
- followed by general ARD workshop & presentation of results (2023)

ARD.02 – User needs / guidance for ARD research (till 2024/2025)
Naming of organisation team
- workshops with MU/MML (starting 2023)
- presentation of results in 2024/2025?
NEW “MILESTONE ENERGY EFFICIENT R&D” – HOW?

first ideas

ARD.00 – MT-ARD roadmap to energy efficient accelerators (till 2027)

Investigate, develop & demonstrate new concepts from components to systemic solutions, e.g.
- New modes for stable facility operations, e.g., based on renewable energy solutions
- New magnets, materials and current leads
- New superconducting and cryogenics approaches
- Energy management and design

Activities
- Innovation Pool projects – ACCLAIM is forerunner
- pilot projects (also cross RF)
- topical workshops (on ST level, on ARD level, on MT level)

more details: next MT days
OUR NETWORK OF INFRASTRUCTURES
Cutting-edge test facilities for research and education

Energy recovery, high current bERLinPro HZB

SCRF Gun Development

Versatile & Precision LLRF Systems

Extreme Beams

Novel accelerator R&D ATHENA flagships DESY, FZJ, GSI, HIJ, HZDR, HZB, KIT

Beam dynamics, timing, plasmas FLASH DESY

Diagnostics, Synchronization, Plasma Sources

Highest acceptance cSTART KIT

CW beams, radiation ELBE HZDR

Beam Laser Interaction

Plasma Injector & Storage Ring R&D
NEW IN 2020: THE ARES ACCELERATOR @ DESY
A new tool for accelerator R&D across subtopics in operation

Normal conducting S-band electron linac @ DESY in operation
Facility for **Accelerator R&D** (ST2, ST3, ST4) & **novel acceleration techniques** testbed (DLA)
**First user beam time** (ACHIP collaboration) end of 2020. **ARES is open for access.**
Installation of bunch compressor and PolariX Xband TDS foreseen Q1/2021 – needed for the production and characterization of **ultra-short pulses** (part of ATHENAe).
Relative **energy stability measured**: 5e-05 at 155 MeV

**Target parameters / actual commissioning parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target</th>
<th>Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 – 155 MeV</td>
<td>50 – 156 MeV</td>
<td></td>
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<tr>
<td>0.5 – 200 pC</td>
<td>0.1 – 100 pC</td>
<td></td>
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<tr>
<td>Single pulse @ 50 Hz</td>
<td>10 Hz</td>
<td></td>
</tr>
<tr>
<td>few fs / sub-fs pulse length</td>
<td>500 – 800 fs (w/o bunch compression)</td>
<td></td>
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<tr>
<td>norm. emittance: &lt; 0.8 mm*mrad</td>
<td>&gt; 1 mm*mrad</td>
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Contact: Florian Burkart, florian.burkart@desy.de
ATHENA Accelerator Technology HEImholtz iNfrAstructure

- providing infrastructure for bringing compact plasma accelerators to user readiness
- complementing laser plasma accelerators with „large scale“ technologies

ATHENAe flagship (DESY) refocused and on track

ARES linac in SINBAD facility operational
KALDERA laser preparing for unprecedented average power
Plasma accelerator activities synchronized

ATHENAh flagship (HZDR) progressing well

Variable pulse contrast front-ends in commissioning at partner sites
Penelope laser power amplifier installation ongoing
Athena target area under construction
CONSTRUCTION OF AN SRF MODULE TO DEMONSTRATE THE TECHNOLOGY TO ACHIEVE HIGH CURRENT & HIGH GRADIENT OPERATION IN SYNCHROTRON MACHINES

- 2 x 1.5 GHz SRF cavities with waveguide HOM absorbers (high HOM power damping rates required → CBIs in storage ring)
- 2 x 16 KW high power couplers
- Complex cryo-module design
- Development of new accelerator components (Collimating shielded bellow)
- Integration and commissioning with high power RF in SUPRALAB @ HZB
STRATEGIC INVESTMENT PROJECTS – VSR DEMO

2020
Contract cavities & Couplers & start procurement cryomodule parts

2021

2022
Testing of components

2023

2024
Cold-string and cryo-module assembly
Integration in bERLinPro bunker

…

2027
Module commisioning
PLASMED X all-optical X-ray source for XFI

Successful demonstration of tunable photon source for medical imaging

- **Goal:** Proof-of-principle demonstration of an all-optical X-Ray source for X-Ray fluorescence imaging (XFI) on a mouse phantom
  - *BMBF InnovationPool 2019 - 2020*
  - *Project continuation foreseen by 3rd party technology-transfer funding*
- Robust laser plasma accelerator electron source commissioned
- Successfully detected fluorescence from medically-used nanoparticles
- First demonstration of bandwidth narrowing and tunability by an APL
- Custom-designed X-ray detectors from KIT to be tested Q2 2021
- Imaging of mouse phantom to be carried out Q1 2021

Successful demonstration of tunable photon source for medical imaging
AMALEA – ACCELERATING MACHINE LEARNING FOR PHYSICS

Innovation Pool Project - 2019/2020
- MT-ARD, MT-DTS and MT-DMA
- DESY, HZB, HZDR, KIT

MT-ARD related activities:
Development of fast diagnostics and control systems for optimizing beam parameters at current and future accelerators (KARA, BESSY, PETRA IV) with Machine Learning

Very nice results achieved in AMALEA – will partly continued and extended in ACCLAIM

Not shown here: ongoing work at BESSY - reinforcement learning for
- Injection efficiency
- Booster current optimization
- Mitigation of harmonic orbit perturbation

Physics-based deep neural networks for beam dynamics in charged particle accelerators, A.Ivanov, I.Agapov
Phys. Rev. Accel. Beams 23, 074601 – Published 7 July 2020

Feedback Design for Control of the Micro-Bunching Instability based on Reinforcement Learning Boltz, T.; Brosi, M.; Bründermann, et al
Proceedings of the10th International Particle Accelerator Conference (IPAC 2019)

Initialized NN accurately represents the parametric dependency of dynamics on magnet strength, such as the appearance of a third-integer resonance

Schematic representation of a FODO structure with eight magnets and a corresponding TM-PNN

see talk today plenary session
NEW INNOVATION POOL PROJECTS

project duration: 01.01.2021 – 31.12.2023 (3a)

ACCLAIM – ACCeLerating science with AI and ML
spokespersons: Frank Gaede (DESY) & Matt Zepf (HIJ)
DESY, GSI, HIJ, HZB, HZDR, KIT
AI for real time optimisation of PWA + Laser, AI for tuning and controls, ML for anomaly detection and prognosis, ML for efficient simulations

InnovEEA – Innovation pool project for Energy Efficient Accelerators
spokesperson: Steffen Grohmann (KIT)
DESY, GSI, HZB, KIT
Efficient cryo-systems for small scale facilities, paving the way for turn key SRF for T > 4.2 K operation, PM magnets, load management

HBS-2 – High current accelerator systems for future high brilliance neutron source
T. Brückel (FZJ)
FZJ, HIM, HZG, HZDR
ST1 – HIGHLIGHTS 2020

SRF Infrastructure for the CW HELIAC-Project completed @ GSI/HMI

- Installation and commissioning with heavy ion beam @ GSI
- Cleanroom operation at HIM

Progress at superconducting Gun Development @ DESY

- Back-wall mechanical stable, correct frequency
- BCP at Zanon \( E_{\text{peak on axis}} \) up to 48 MV/m measured at 16G5
- EP at KEK \( E_{\text{peak on axis}} \) up to 54 MV/m measured at 16G4

Surface treatment of gun cavities

The special cavity geometry require new approaches as compared to accelerating cavities!

EP treatment of 16G4 at KEK
STRATEGISCHES DENKEN – HIGHLIGHTS 2020

ELBE User Operation with Cs$_2$Te Photocathode @ HZDR

- Overheating problems with Cs$_2$Te cathodes solved! (talk A. Arnold)
- 26.3 Coulomb from three Cs$_2$Te cathodes (since May 2020)
  Cs$_2$Te on Cu plug (3 nm Te, 20 nm Cs)

1.3 GHz high-power bERLinPro Couplers Development @ HZB

- Record CW performance target of 120 kW
- So far 43 kW CW & 100 kW @ 1% DF – No thermal or multipacting show stoppers for 120 kW CW operation observed

- Applied power
- Coupler test stand

- Storage days
- QE [%]
- Photocurrent (nA)
- Recorded in TPX with LED 260nm, 150V
- Applied power
- Coupler test stand

A. Jankowiak, J. Osterhoff
Status ARD, 7th MT Days, Online Meeting, 01.02.2021
ST1 – ANY OTHER BUSINESS

Workshops:
- Verbundforschungstreffen BETH (High Brightness Electron beams generated from novel Thermal resistant photocathodes) 20.-21.01.2020 and 10.7.2020 Siegen

New national and international cooperations:
- NICA-Collaboration GSI-JINR (Russia)
- Collaboration HZDR-MSU - development of an SRF photo injector for LCLS II, DOE project submitted
- DESY contract work for ESS, LCLSII, MYRRHA
- HZB – NCBJ (Poland) - collaboration on SRF systems and injectors
- InnoVEEA (HGF-Innovations Pool) “Innovation pool project for Energy Efficient Accelerators”, DESY, HZB, GSI, KI

Berufungen:
- W. Barth (JGU, 05/2021)

Technology transfer with industry:
- HZDR cooperation with IRE/Belgium, DEMCON/NL and RI/Germany to the Light house project (accelerator based production of Mo-99/Te-99)
- HZB R&D for CW SRF Linear accelerators, cathodes und lasers with RI Research Instruments / Germany

Patents:
- Vorrichtung und Verfahren zur Nutzung eines anisotrop magnetoresistiven Sensors zur Bestimmung von Magnetfeldern und Temperaturen, B. Schmitz, O. Kugeler, J.-M. Köszegi, K. Alomari, HZB, Patent Nr. 10 2017 127 578, HZB
- HOM-gedämpfter supraleitender Hohlraumresonator, Nutzung desselben und Verfahren zu seiner Erzeugung, O. Kugeler und A. Neumann, HZB (submitted)
ST1 – PUBLICATIONS 2020


Critical fields of Nb$_3$Sn prepared for superconducting cavities, S. Keckert et al., Superconductor Science and Technology, Volume 32, Number 7

Nitrogen infusion R&D at DESY: a case study on cavity cut-outs

S. Lauber, et al., PRAB, 10.1103/PhysRevAccelBeams.23.114201

W. Barth et al 2020 JINST 15 T12012, "LINAC developments for heavy ion operation at GSI and FAIR", ICFA_Beam_Dynamics_Panel_Newsletters_Special_issue, https://doi.org/10.1088/1748-0221/15/12/T12012

J. Teichert et al., “Successful user operation of the superconducting radio-frequency photo electron gun with Mg cathodes at ELBE”, submitted to PRAB 2020
ST2 HIGHLIGHTS – FAST RAMPED SUPERCONDUCTING MAGNETS

Cold test of fast ramped cos dipole magnet

- GSI continues with developing world wide unique expertise in fast ramped superconducting magnets.
- A full size SIS300 dipole magnet has been developed. The main goal was minimizing the AC loss in the coil by means of a special low loss Rutherford cable.
- The cold mass of the full size SIS300 dipole magnet has been cold tested in a vertical bath cryostat at INFN Milano. A ramp rate of 1 T/s could be reached, which compares to 50 mT/s of usual s.c. magnets with standard Rutherford cable.
- In 2020 the assembled magnet has been send to ILK for preparing a cold test of the full magnet (picture left).

HTS Nuclotron Cable

- So far, fast ramped s.c. accelerator magnets have been build based on two types of cable: a) Nuclotron cable or b) low-loss Rutherford cable.
- GSI is going to further develop the Nuclotron cable by replacing the NbTi strands by an HTS tape.
- In preparation of the EU funded program IFAST, GSI has set-up a collaboration between IEE Bratislava, ILK Dresden and University Twente on the development of an energy efficient ReBCO-HTS based Nuclotron cable and prototyping of a fast ramped magnet. Potential applications for energy technologies, e.g. s.c. energy storage will be studied.
- Recent progress in current limits of commercial HTS tapes may help for generating higher fields strength.
ST2 HIGHLIGHTS – LASER COOLING OF RELATIVISTIC HEAVY IONS

- SIS100 will be the first user synchrotron equipped with a „laser cooler“ world wide.
- Laser-cooled relativistic heavy-ion beams ($\gamma$ up to 13 for $Z = 10 - 60$)
- Only cooling method at relativistic energies (dp/p<10^-7)
- Extraction of very cold and very short ultra-relativistic ion bunches

Net cooling force in the direction of the laser light (longitudinal).

Major highlights:
- Installation of the laser beamline in SIS100 tunnel

• Visiting Scientist Fellowship for Associated Professors of Chinese Academy of Science for D. Winters
• Laser and Particle Beams Young Scientist Award for S. Klammes
ST2 HIGHLIGHTS – BEAM CONTROL AND COOLING ACTIVITIES

Stochastic cooling with slot-ring couplers

R&D objectives:

- advancing slot ring couplers in terms of aperture limitation, frequency range and resonant design
- self-adjusting stochastic cooling
- cooling structures for counter rotating beams for weak focusing lattice
- e-cooling modeling
  - Cooler hardware
  - Cooling process
  - Compensation schemes
- stoco+ecool+target, beam

Successfully tested with PANDA cluster target at COSY

Activities to use machine learning at COSY

in the scope of Helmholtz AI Consulting

- CosyMIMOpt – better measurement and model matching with genetic algorithm
- MALIA - injection optimization for COSY and SIS 18 with reinforcement learning and transfer learning
- find correlations in spin tune data and COSY settings
ST3 NEWS – ARD TEST FACILITIES AND HIGHLIGHTS

First user beam time @ARES end of 2020

Parameters

- C: Commisioning
- T: Target
  * (w/o bunch compression)

**ARES Contact:** Florian.Burkart@desy.de

62 h stability at 156 MeV with 2.4e-04
14 h stable at 5.8e-05 relative stability

Q1/2021

ARES in operation & open for access: new facility for accelerator R&D across subtopics (ST2, ST3, ST4) & novel acceleration techniques testbed (DLA)

ARES Contact: Florian.Burkart@desy.de
**Achieved**

- Reinforcement Learning framework developed on HighFlex2
- easy deployment of ML algorithms on an FPGA
- DDPG* algorithm tested with very low latency of 17\,μs

*Deep Deterministic Policy Gradient, actor-critic algorithm

*LCLS-I undulators:*
- 2 undulators in Zeuthen now
- 1 undulator re-measured at DESY HH (compatible with SLAC measurements)
- Transverse gradient \( B_t(x) \) leads to off-axis trajectory of 17 MeV beam in x-plane
  - Steering coils to correct transverse gradient impact

**AI deployed on hardware**

First steps at real-time control of physical processes with ML

- Reinforcement Learning framework developed on HighFlex2
- easy deployment of ML algorithms on an FPGA
- DDPG* algorithm tested with very low latency of 17\,μs

*Deep Deterministic Policy Gradient, actor-critic algorithm

**See also**

ST2-Highlight talk
A. Santamaria

T. Boltz, W. Wang, et al, TUCPL06, ICALEPCS 2019

**Status THz@PITZ - Demonstrator source for pump-probe experiments at E-XFEL**

**PITZ/DESY Zeuthen**

**AMALEA**

**ACCLAIM**

**KARA/KIT**

**InnoPool**

**ST3 NEWS – HIGHLIGHTS AND ARD TEST FACILITIES**
ST3 NEWS – HIGHLIGHTS AND ARD TEST FACILITIES

Developments for “green” photocathodes

Helicity flipping of X-Rays with unprecedented speed increased from 0.1 kHz to MHz ($10^4$) by using a double undulator straight and 2nd orbit setup using TRIBs.

Two orbit operation using TRIBs at BESSY II

First user operation week in 2020 in two-orbit mode using TRIBs.

Next user operation week this year 2021.

Reproducible QE for KCsSb

Cathode Thickness QE

$\text{Cs}_2\text{Te}$ 71 nm ($\text{Te}=10$ nm) 13% @ 254 nm

KCsSb 154 nm ($\text{Sb}=5$ nm) 6% @ 514 nm

NaKSB(CS) 93 nm ($\text{Sb}=7$ nm) ~4% @ 514 nm

QE~6% @ 514 nm

Towards coherent ultrafast spectroscopy at IR-FEL

Polar plot of FEL phase

Electro-optic sampling

Standard detection unsorted

Sorted, with phase filter

Helicity flipping of X-Rays with unprecedented speed

Courtesy: S. Kovalev, ST3-Highlight talk

See also ST2-Highlight talk, M. Ries

ST3 – ANY OTHER BUSINESS

(WORKSHOPS, TECH-TRANSFER, PATENTS, …)

- Virtual Meetings 2020 (Online: Annual MT Meeting 17.-18. June)
  - 7th Workshop Diagnostics Experts of European Light Sources, Elettra Sincrotrone Trieste and ALBA [59 registered participants], 16. June
  - 9th Int. Beam Instrumentation Conference, Brazil, 14.-18. September
  - 8th Annual MT ARD ST3 Meeting, KIT, Karlsruhe (101 [85 registered] participants), 23.-24. September
  - 24th European Synchrotron Light Source RF Workshop, KIT, Karlsruhe (44 participants), 4.-5. November
  - 9th MicroTCA Workshop for Industry and Research, DESY, Hamburg [198 registered participants], 1.-3. December

9th Annual MT-ARD-ST3 Meeting, Sep/Oct 2021, DESY, Hamburg
Registration: https://indico.desy.de/indico/event/28823/ to be confirmed

- Materials 2020 (mostly Open Access)
  - DEELS: https://indico.cern.ch/event/892013/
  - ARD-ST3: https://indico.desy.de/event/25669/
  - ESLS-RF: https://indico.desy.de/event/27019/
  - MicroTCA: https://indico.desy.de/event/27340/

See more in ARD-ST3 presentations
ST4 NEWS – INCREASING STABILITY
Extended run times for laser-accelerated electrons and protons

**Electrons**
- Repeated 24 hour operation of a laser-plasma accelerator demonstrated at LUX
- High statistics enables decoding the sources of energy variability

**Protons**
- Reproducible performance over months enabled first in-vivo irradiation studies at highest dose rate at HZDR
- *See highlight talk by F. Kroll, Wed. 03.02.21, 11.15*
ST4 NEWS – ADVANCED DIAGNOSTICS AND MACHINE LEARNING

High-quality beams from laser-plasma accelerators

Helmholtz Zukunftsthemen (IVF 2017-2020) Femtoscale Probing / Plasma Accelerators

• Development of advanced diagnostics as bridges to predictive simulation capability / ML
• Successfully completed with ~100 publications (1 RMP, 3 Nat.C., 4 PRX, 13 PRL, many collaborative projects)

Innovationpool Project ACCLAIM

• Develop and apply AI/ML methods to (among others) plasma accelerators
• 3 years, started 2021

Example application:

• Experiment: accelerator tunes to sub-percent energy spread electron beams using bayesian optimization
• See highlight talk by S. Jalas, 03.02.2021, 14.45
GERMAN COMMITTEE FOR ACCELERATOR PHYSICS (KFB)

Founded in 2010
- max. 12 members (Universities, Helmholtz, Labs, International)
- elected by engineers and scientist working in the field
  = “Forum Accelerator Physics” (please register)

4th period of the KfB 2019 to 2022
Michaela Arnold, TU Darmstadt
Oliver Boine-Frankenheim, TU Darmstadt
Florian Hug, Uni Mainz
Shaukat Khan, TU Dortmund (spokesperson)
Marc Wenskat, Uni Hamburg
Sabrina Appel, GSI
Erik Bründermann, KIT (deputy spokesperson)
Bastian Härer, KIT
Thorsten Kamps, HZB
Peter Michel, HZDR
Michaela Schaumann, CERN

www.beschleunigerphysik.de
GERMAN COMMITTEE FOR ACCELERATOR PHYSICS (KFB) IN 2020

Last KfB elections in December 2019
- term: 2019 to 2022
- turnout: 75% of the Forum

Annual meeting of the Forum
- 07.09.2020 preceding the Verbundforschungsworkshop (see below)

ErUM (Erforschung von Universum und Materie)
- previously known as "BMBF Verbundforschung"
- call for proposals for topic "Particles" in 2020 (topic "Matter" in 2021)
- 28./29.05.2020: strategy meeting*
- 07./08.09.2020: Verbundforschungsworkshop (TU Darmstadt)*
- 01.11.2020: deadline for proposals

Preparations for a "strategy paper 2030"
- 05./06.09.2019: workshop at TU Darmstadt
- technology, user aspects, strategic recommendations ...
- general discussions finalized, draft in progress

https://www.beschleunigerphysik.de/media/kfb-broschuere_1.2.1_2016-07-01_compressed.pdf
GERMAN COMMITTEE FOR ACCELERATOR PHYSICS (KFB) IN 2020

ErUM-Data – from Big Data to Smart Data
- activities in three topics: "Research Data Management", "Federated Digital Infrastructures", "Software & Algorithms"
- digitization board: KfB represented by Erik Bründermann (KIT)
- proposal for adminisitrative office "ErUM-Data Hub"
- 12.11.2020: action plan published

More frequent meetings of the KfB
- four formal meetings in 2020*
- monthly "coffee sessions"* via video conference

Miscellaneous activities
- promoting our field, networking, information, education ... e.g.:
- 30.06.2020: Michaela Schaumann, KfB status report at DAC/CERN (Forum Deutscher Angestellten, Fellows und Doctoral Students)

https://www.bmbf.de/upload_filestore/pub/Aktionsplan_ErUM_Data.pdf
2020

• **DPG Spring-Meeting in Dresden was cancelled due to the pandemic**

• **Machine Learning Seminar, 14.09.-15.09.2020**
  The hybrid seminar on machine learning covered many important topics and gave an insight into the methods and applications of machine learning in accelerator physics. In addition, we took the opportunity to award the AKBP Prizes: Horst Klein Research Award 2020 and DPG Young Scientist Award for Accelerator Physics 2020.
WORKING GROUP ON ACCELERATOR PHYSICS OF DPG (AKBP)

2021

- **DPG Spring-Meeting in Dortmund, 15.03. - 19.03.2021**
  
  
  hybrid*: Plenary and invited speakers on site in Dortmund; Participants of the conference and other speakers online. The usual parallel sessions will take place exclusively online.
  
  AKBP: One plenary talk and several parallel sessions

- **Workshop on Lepton Accelerators (planned for Fall 2021)**
  
  The AKBP prizes will be awarded during this event.
  
  Nomination *in English, Deadline: 28 February 2021*
  
  - Horst Klein Research Award via E-mail: atoosa.meseck@helmholtz-berlin.de
  - DPG Young Scientist Award:
## DISCUSSION ROOMS FOR THE ARD PARALLEL SESSIONS

**Tuesday, 02.02.2021, ARD parallel 01 (13:00 – 15:00)**

Talks: [https://desy.zoom.us/j/93264574820](https://desy.zoom.us/j/93264574820)

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<td>Jens Knobloch – Discussion</td>
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<td>ARD -ST2</td>
<td>Peter Spiller – Discussion</td>
<td><a href="https://desy.zoom.us/j/96840753583">https://desy.zoom.us/j/96840753583</a></td>
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<td>ARD -ST3</td>
<td>Erik Bründermann – Discussion</td>
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<td>ARD -ST4</td>
<td>Andreas Maier – Discussion</td>
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<td>ATHENA</td>
<td>Ulrich Schramm – Discussion</td>
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**Wednesday, 03.02.2021, ARD parallel 02 (09:00 – 10:30)**

Talks: [https://desy.zoom.us/j/92659828168](https://desy.zoom.us/j/92659828168)

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<td>03</td>
<td>David Ondreka – Discussion</td>
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<td>04</td>
<td>Johannes Hornung – Discussion</td>
<td><a href="https://desy.zoom.us/j/94579072950">https://desy.zoom.us/j/94579072950</a></td>
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## DISCUSSION ROOMS FOR THE ARD PARALLEL SESSIONS

### Wednesday, 03.02.2021, ARD parallel 03 (10:30 – 12:00)

| Talks: [https://desy.zoom.us/j/92659828168](https://desy.zoom.us/j/92659828168) |
|---|---|
| Talk 01: Dmitry Bazyl – Discussion | [https://desy.zoom.us/j/91721625288](https://desy.zoom.us/j/91721625288) |
| Talk 02: André Arnold – Discussion | [https://desy.zoom.us/j/95169062129](https://desy.zoom.us/j/95169062129) |
| Talk 03: Andrea Bellandi – Discussion | [https://desy.zoom.us/j/96073955705](https://desy.zoom.us/j/96073955705) |
| Talk 04: Florian Kroll – Discussion | [https://desy.zoom.us/j/98477299244](https://desy.zoom.us/j/98477299244) |

### Wednesday, 03.02.2021, ARD parallel 04 (13:00 – 14:30)

| Talks: [https://desy.zoom.us/j/92659828168](https://desy.zoom.us/j/92659828168) |
|---|---|
| Talk 01: Georgia Paraskaki – Discussion | [https://desy.zoom.us/j/98565185945](https://desy.zoom.us/j/98565185945) |
| Talk 02: Sebastian Klammes – Discussion | [https://desy.zoom.us/j/98994808718](https://desy.zoom.us/j/98994808718) |
| Talk 03: Sebastian Keckert – Discussion | [https://desy.zoom.us/j/91904815724](https://desy.zoom.us/j/91904815724) |
| Talk 04: David Haider – Discussion | [https://desy.zoom.us/j/98623691119](https://desy.zoom.us/j/98623691119) |

### Wednesday, 03.02.2021, ARD parallel 0% (14:30 – 16:00)

| Talks: [https://desy.zoom.us/j/92659828168](https://desy.zoom.us/j/92659828168) |
|---|---|
| Talk 01: Markus Ries – Discussion | [https://desy.zoom.us/j/93748437918](https://desy.zoom.us/j/93748437918) |
| Talk 02: Sören Jalas – Discussion | [https://desy.zoom.us/j/97345835237](https://desy.zoom.us/j/97345835237) |
| Talk 03: Andrea Santamaria – Discussion | [https://desy.zoom.us/j/94861586289](https://desy.zoom.us/j/94861586289) |
Thank you for your attention.

And many thanks to many contributors:
and all of you for your contributions to our Topic