DESY. The Decoding of Matter

Research with impact

TOP 2:

Report from the Directorate

303rd Meeting of the Scientific Committee

Hamburg
15 June 2023

Edgar Weckert

Current challenges: Accelerator operation at DESY is massively endangered

Energy costs and general inflation

Expected tariff increases

Construction costs development

Self-managed funds

In view of the dramatic price increase for electricity and helium, accelerator operation at DESY is massively endangered

Energy costs and general inflation

- **Increase in energy prices** Additional costs at DESY ca. 15 M€, relief through price brakes 4.2 M€
- BMBF hardship fund: "Ensuring access for users, especially for **energy-intensive research infrastructures"**
- Operationally necessary for DESY: **electricity, gas, heat** as well as **helium and liquid nitrogen**
- Gases are indispensable, especially for **establishing the operating temperature** of the Linear accelerators XFEL and FLASH & operation of PETRA III beamlines
- DESY will claim **additional costs of ca. 10 M€** from the hardship fund **(**of which 6 M€ for electricity and 3.5 M€ for helium alone)

General inflation

- Historically high inflation leads to **loss of 6 M€ in purchasing power** for non-personnel funds (without energy and construction)

Current challenges: dramatic increase of personnel costs

Expected tariff increases

- Annual increase of the DESY budget **2** %
- ver.di wage demand **10.5% p.a.**
- Every percentage point raise in tariffs increases DESY personnel costs by 2.15 M€
- Measures:
  - **No dismissals**, but new appointments and reappointments of permanent positions only in **mission-critical exceptional cases**
  - Division-specific personnel planning 2023 - 2027
  - Careful consideration of tasks and resources - **reduction and elimination of services and activities unavoidable, prioritization, transparency and communication essential**
  - Focus on **young scientists and engineers**
  - Discussion of savings options for **bonuses and allowances**
  - Use of **cover eligibility for non-personnel funds** (around 70 M€)

Tariff increase
(5.5 % + 3,000 € one-time payment)/2a

Current challenges

Self-management funds, carry over („Selbstbewirtschaftungsmittel (SBM)“)

- Special campus funds: 235 M€ (+additional 36 M€ from Hamburg) allocated in large tranches from 2017 to 2023
- Special funds accounted for 99 % of investment SBM in 2022
- 2022 SBM limit was met (with BMBF support)

- Time lag between inflow and outflow of special funds:
  - Complex construction procedures
  - Earmarking of special funds
  - Reprioritization needs

- Compliance with SBM limit 2023 very challenging, losses in the millions possible
- Political support may be required: maximum eligibility for coverage, reassessment
- Additional self-commitment by HGF (2023: 75% of the SBM of 2021)

DESY. Recall 2018 „Strategy 2030“

2018 Major Goals

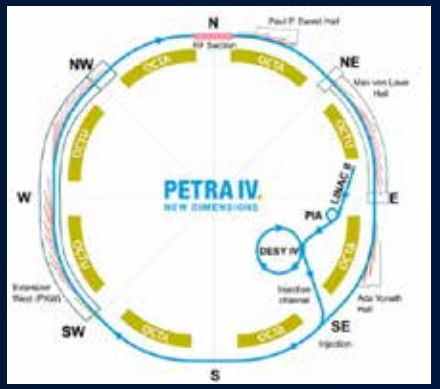
- PETRA IV next major project
- Joint FLASH@XFEL strategy ➔ FLASH2020+
- Contributo to upgrade of the LHC experiments
- Expansion of astroparticle physics
- Development of novel accelerator concepts
- Promotion of innovation and technology transfer
- Development data and of scientific computing concept (CDCS)
- Adaptation of supporting infrastructures and administration

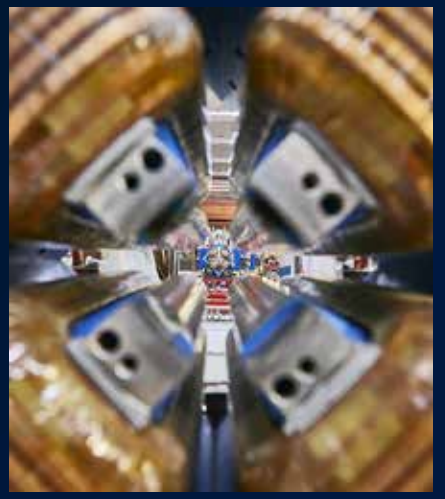
What did we achieve so far ?

PETRA IV:

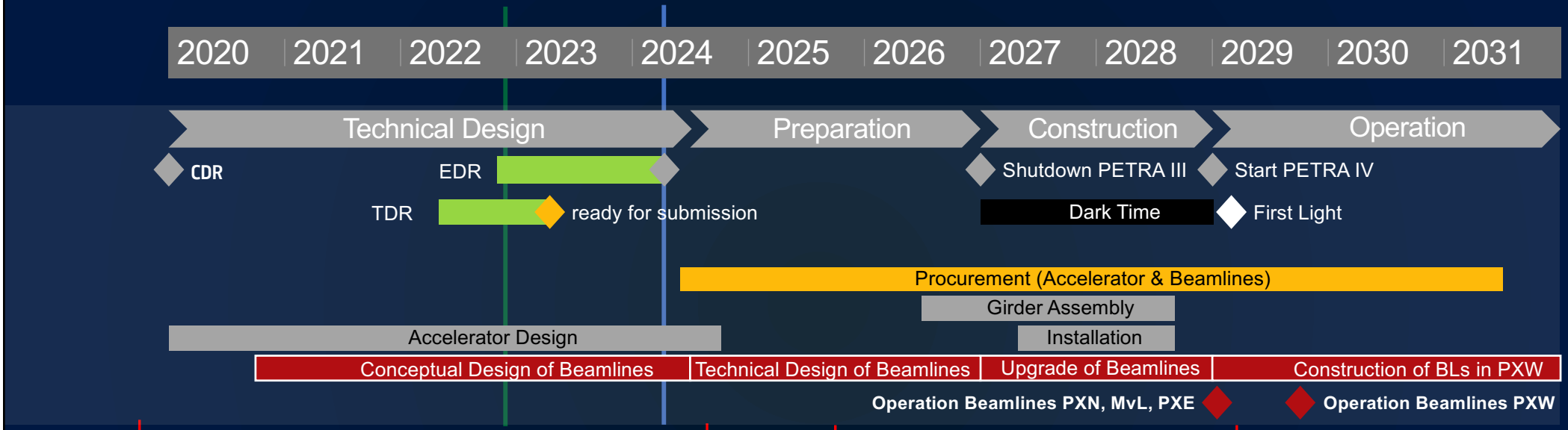
Project team under the leadership of Riccardo Bartolini and Harald Reichert has delivered the plan for the world-leading X-ray microscope

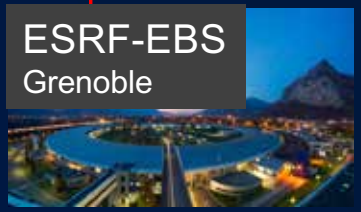
- H6BA lattice freeze 2022
- 30 Mio funding for TDR
- Campus logistic plan ready
- TDR ready for submission





DESY. PETRA IV timeline





6 GeV H7BA

6 GeV H7BA

6 GeV H7BA

6 GeV H6BA (neu)
2,3 km perm. Magnet-Tech.

FLASH-XFEL Strategy

Markus Gühr – New Head of the FLASH facility

- Upgrade programme FLASH 2020+

  Advanced technologies – science case revisited

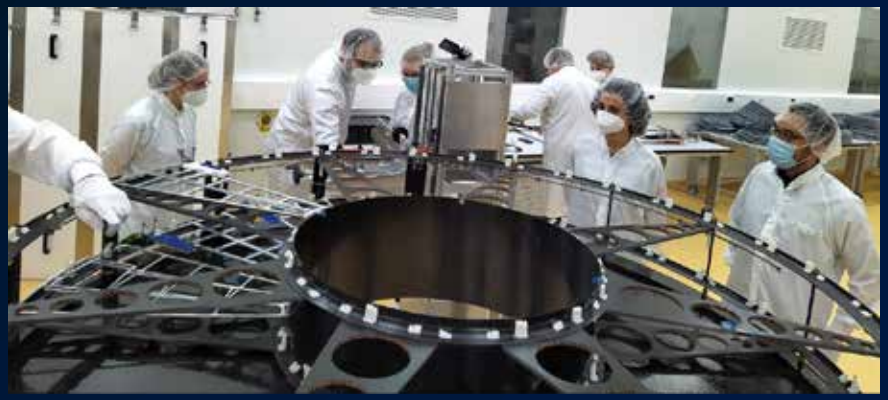
- Revision of the DESY 2030 Strategy
  - Keeping FLASH facility independent of EuXFEL facility
  - Develop a common FEL strategy with EuXFEL
  - Independent FLASH also important for beam driven plasma acceleration

➔ **See talk on FLASH2020+ Status, Plans and Perspectives by Markus Gühr**

HL-LHC DESY contribution to ATLAS and CMS

Beate Heinemann – New Director of Particle Physics Division

DESY **Detector Assembly Facility** operational
Fabrication and assembly of endcaps ongoing



Astroparticle Physics

New Research Division at DESY
Christian Stegmann Founding Director

Astroparticle Physics @ DESY – a vibrant new pillar

- CTA (slowly) getting reality - SDMC Building in Zeuthen
- IceCube preparing for upgrade (IceCube Gen2)
- successful acquisition of substantial funds for the establishment of a German center for astrophysics (DZA)
- Preparatory work on the realization of the Einstein Telescope

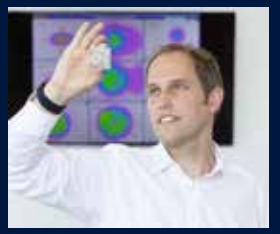
Novel Accelerators

Wim Leemans – New Director Accelerator Division

J. Osterhoff and A. Maier – new lead scientists

Plasma acceleration robustly implemented in the lab

- Two pillars:
  - Laser-Plasma KALDERA LUX
  - Electron-Plasma FLASHForward
- Roadmap for first demonstrators
  - Moonshot Plasma injection into PETRA IV
- Industry cooperations



Jens Osterhoff
FLASHForward

Andreas Maier
KALDERA LUX

Innovation and Technology Transfer

Arik Willner - new (first) DESY-CTO

Associated to the Board of Directorial as a representative in all matters related to innovation

- Innovation and Technology Transfer
  → new pillar in the DESY strategy
- Comprehensive ITT strategy
  ➔ showing strong impact
- DESY Innovation Village
- Start-up Labs Bahrenfeld
- in preparation: DESY Innovation Factory

DESY INNOVATION FACTORY
Accelerator for Life Sciences and New Materials

HI ACTS

Brain Gain

Development of Leading Scientists 2010-2022

DESY Division	W3 Positions in the year	
	2010 →	2022
Particle Physics	6	14
Photon Science	3	13
Astroparticle Physics	2	7
Accelerator	1	6
Innovation	-	1

A true success story !

What are we still working on ?

Data and Computing Concept

We have elements of the new data and computing structure but no structure yet.

DESY IT
New appointment successor V. Gülzow

DESY IDAF
Capacity increase

AI-supported operation
PETRA IV

Campus Partner
UHH Informatik
TUHH
HSU

European Strategy
DIGITAL
LEAPS
LEAPS INNOVATION

HGF-Matter MT-DMA
→ **PoF V**
Request of more resources

ROCK-IT
Demonstrator
Autonomous Operation

Helmholtz
Data Incubator
HIFIS (infrastructure)
HIP (imaging)
HAICU (AI tools)

Data Science Graduate School
DASHH

Strategy Update Goal

Keeping the lab in an international leadership position through

carrying out cutting edge research in all areas
operating leadership research facilities
devising an efficient ecosystem for research and innovation
attracting the best brains

Strategy Update goals

Measures to achieve these goals

Devise a new **integrated lab concept** for Research and Innovation

Contribute to the **Grand Challenges** of our times

Prioritize current and upcoming projects accounting for available resources (DESY CD process)

DESY.
Strategy-Update

The new integrated lab concept

National Analytic Centre

- X-rays
- Lasers & Electrons
- Accelerators
- Detectors
- Computing

Transformative Concept

Integrating
- Cutting edge technologies
- Word-leading facilities
- Novel access models

Transforming the impact
- by opening all facilities to the broadest possible community ranging from academia to industry and providing data-based solutions

- **Enabling** national technology souvereignty in key technologies

- **Supporting** the national „Zukunftsstrategie“

TRANSFORMATION Project

National Analytics Centre

The decoding of matter

Data-based solutions for the design of new materials and drugs

DESY INNOVATION FACTORY

Internationally leading accelerator facilities

X-ray laser
EU.XFEL - FLASH
"terra incognita"

Synchrotron radiation
PETRA III-IV
3350 users/year
Industry access

Plasma accelerator
KALDERA
novel compact accelerators

HIGHTECH ANALYTICS PLATFORM

Analytics a la Carte

Operando · in vivo extreme conditions
all relevant time and length scales
Materials and drug research

Data and IT expertise/service

Big Data Infrastructures
Analysis of complex data
AI/ML - Automation

Spin-off culture

DESY Innovation Village
Start-Up Labs Bahrenfeld
DESY Innovation Factory

Transfer-Potentials (2020-2030)

Leap innovation: Plasma accelerator
X-ray imaging of tomorrow
New therapy concepts

DEEPTECH TRANSFER

Modern ecosystem: From basics to market products

Service for industry
Support deep-tech companies
Transfer DESY technology/know-how

Industry cooperation

QMH

Hub for quantum materials
(under construction)

Cutting edge RESEARCH

SCIENCE CITY Hamburg Bahrenfeld

UHH - University of Excellence
➢ 20 DESY professorships

Interdisciplinary research platforms

CFEL
Quantum materials

CSSB
Bio-materials

CXNS
Nano-materials

Modern concepts in training and career planning

- Pupil labs
- DASHH
- PIER
- COAST
- Skilled workers-Training

World-leading expertise in matter research

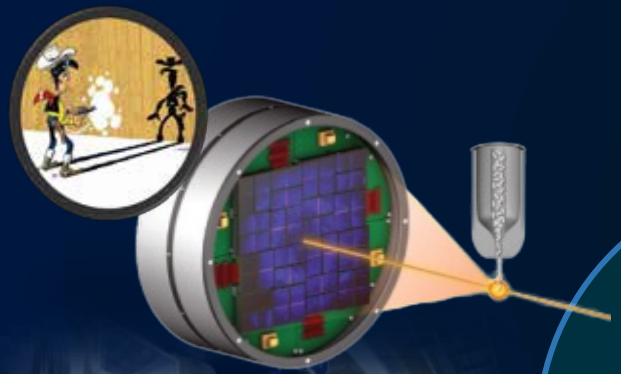
Precision X-ray analytics
Particle accelerator
Laser and plasma technologies
Research with complex data sets

Applications in
- **Material development**
- **Medicine**

DESY.

Advanced Analytical Facilities

world-leading concept



PETRA IV

In vivo, operando
X-Ray microscopy
X-ray Imaging

Dynamic Function

Structure

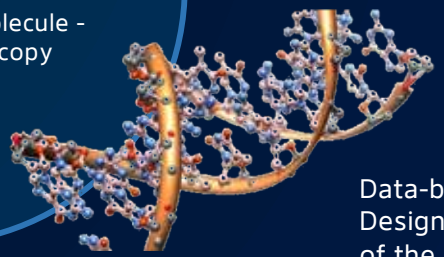
FLASH EU.XFEL

Ultrafast
X-ray
diffraction
spectroscopy

Design Ligands

Cryo-EM

Single Molecule -
Microscopy



Data-based
Design/Control
of the molecular
functions

DESY. Strategy-Update

Opening
New Windows
into
particle acceleration,
the quantum world and
the universe

Plasma Acceleration Roadmap

KALDERA LUX FLASHForward
ATHENA-SINBAD

„from acceleration to accelerators"

DESY Quantum Initiative

- Quantum Materials
- Quantum Sensors
- Quantum Computing
- Quantum Control of Matter and Energy

Dark Matter Search ALPS II BabyIAXO
Gravitational Waves Einstein Telescope

DESY.

New Windows into Particle Acceleration

From Breakthroughs to Innovation

Two leadership facilities in plasma accelerations

KALDERA

FLASHForward

KALDERA . PLASMABESCHLEUNIGER

Andreas R. Maier *et al.*, Physical Review X, 2020

DESY has launched a Quantum Initiative

Chair: **Kerstin Borras**

Integration of all Quantum- activities and - competences

DESY. QUANTUM

Encompassing four pillars

Q-Computing	**Q-Materials**	**Q-Sensing**	**Q-Control**
Development of Algorithms	Development of novel materials	Development of advanced concepts	of complex molecules
PI	**Karl Jansen**	**Kai Rossnagel**	**Ties Behnke** **Heinz Graafsma**	**Jochen Küpper** **Melanie Schnell**

DESY. New Windows into the Universe

DESY Projects in Dark Matter Search

- ALPS II — in operation
- BabyIAXO — in preparation*)
- (MADMAX) — tbd**)

*) delays because of Russia (sc-Al coils)
**) inter alia depending on decisions in MP

Gravitational Wave Detection

European project Einstein Telescope

- Formation of a European Consortium
- Site Selections Process
- Securing Funding for Construction and Operation
- Decision on DESY role

-

DESY. Strategy-Update

Ecosystem
for Research and Innovation

Basic research
Future Technologies
Social Challenges

Data-based Solutions

Reaching out to the broadest impact of DESY Science

New Quality of Cooperation with

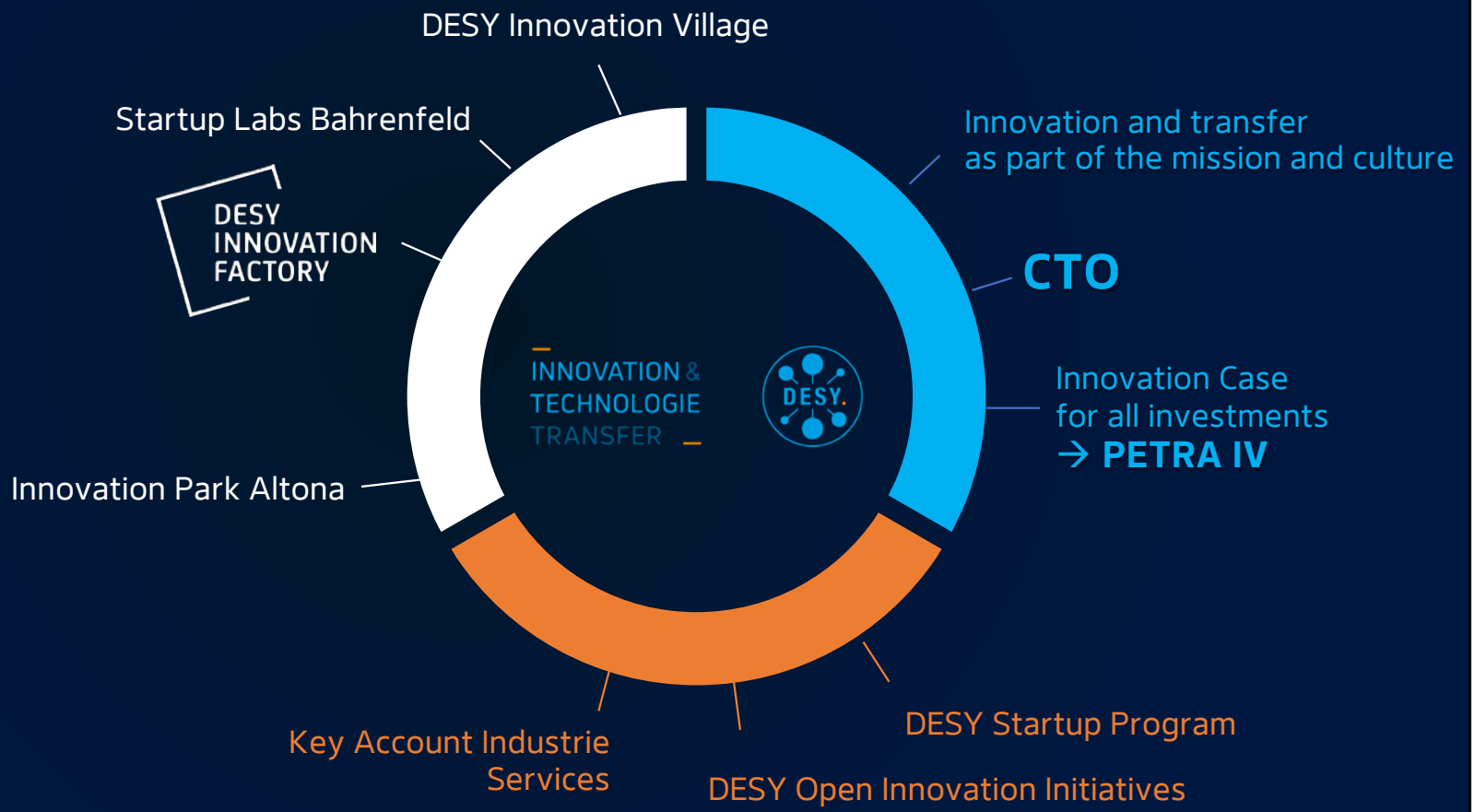
- European competence teams
- Industry
- Fraunhofer – SME

Strategic access to DESY infrastructures

Key contributions to

- Fighting Climate Change
- Assuring Bio-Preparedness
- The Circular economy

ITT Strategy



DESY. Strategy Review & Re-Boost Process