

Accelerating Science – an Overview of DESY



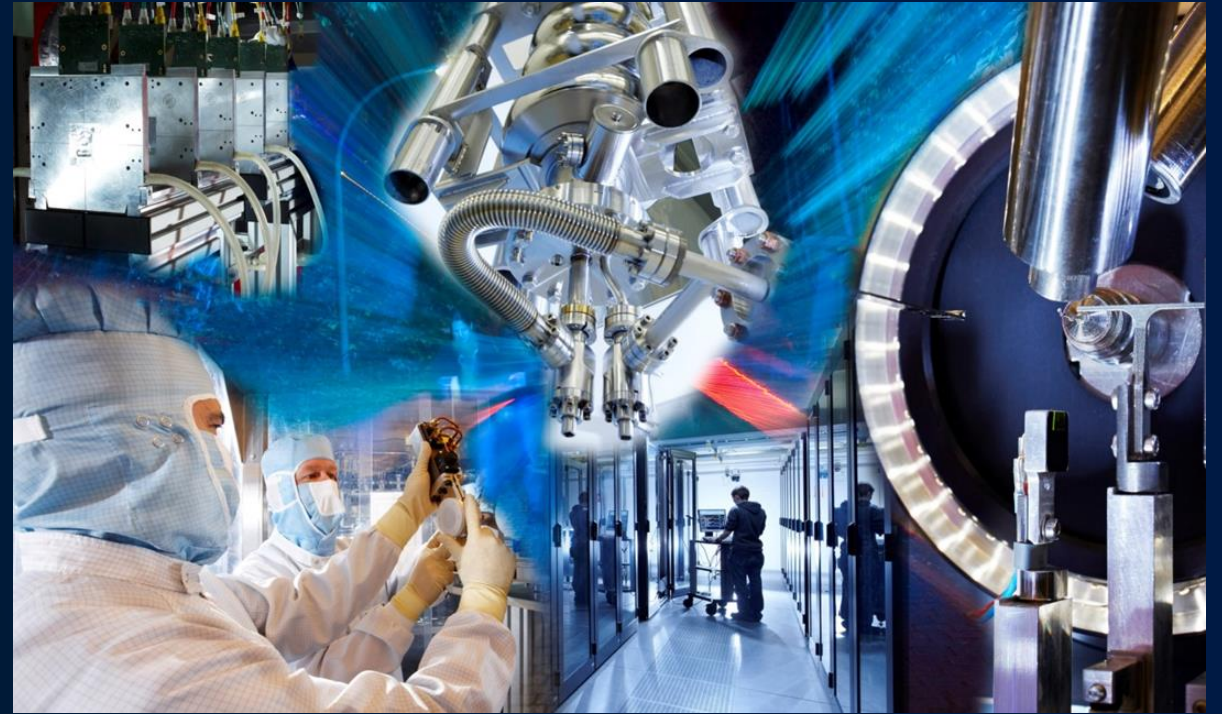
65th Anniversary of DESY's Foundation: Ankara University – DESY Relations

Bilimi hızlandırmak

Frank Lehner

Head of the Directorate's Office, DESY

26 February 2025



www.desy.de

Where is DESY?

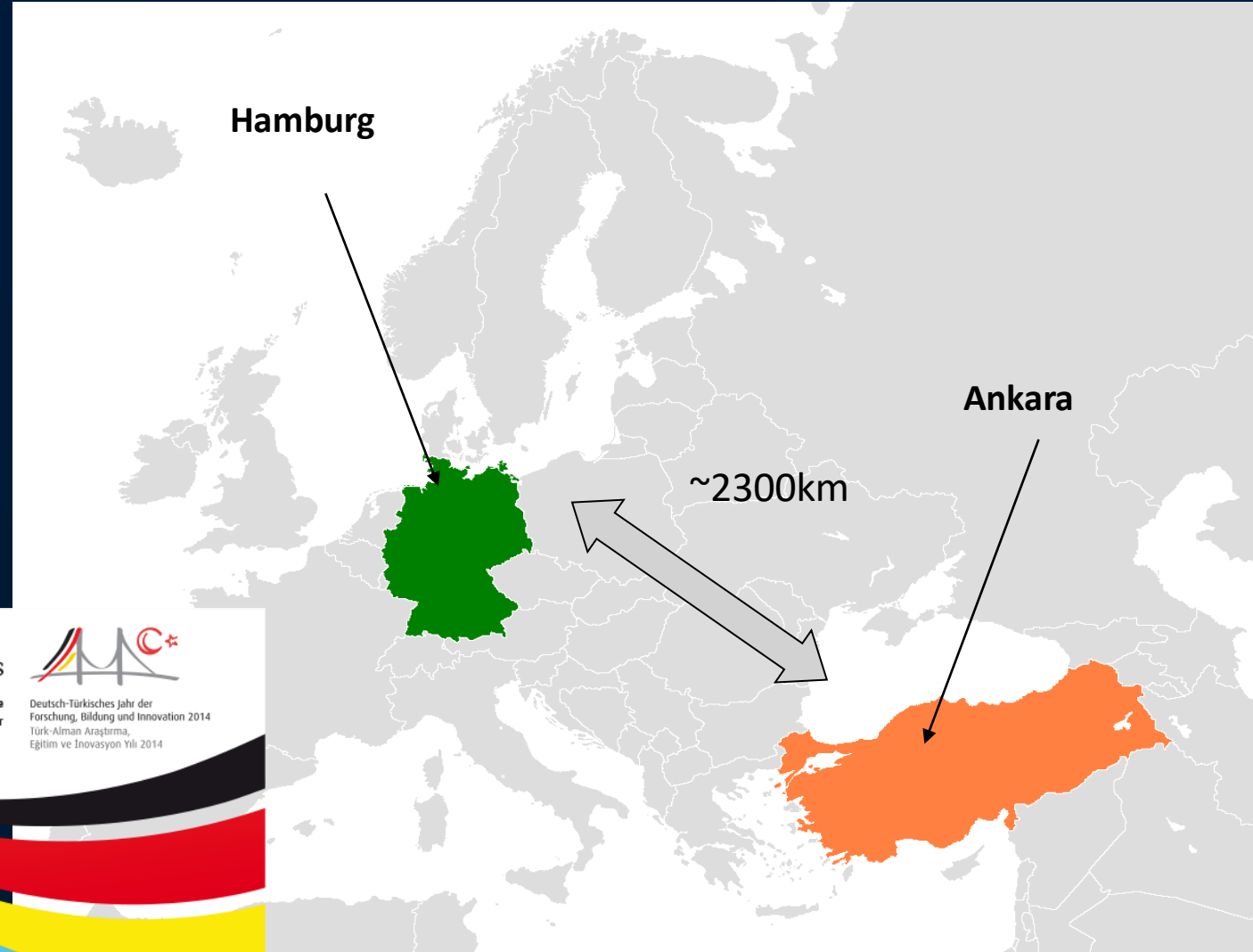


Science Bridging Nations

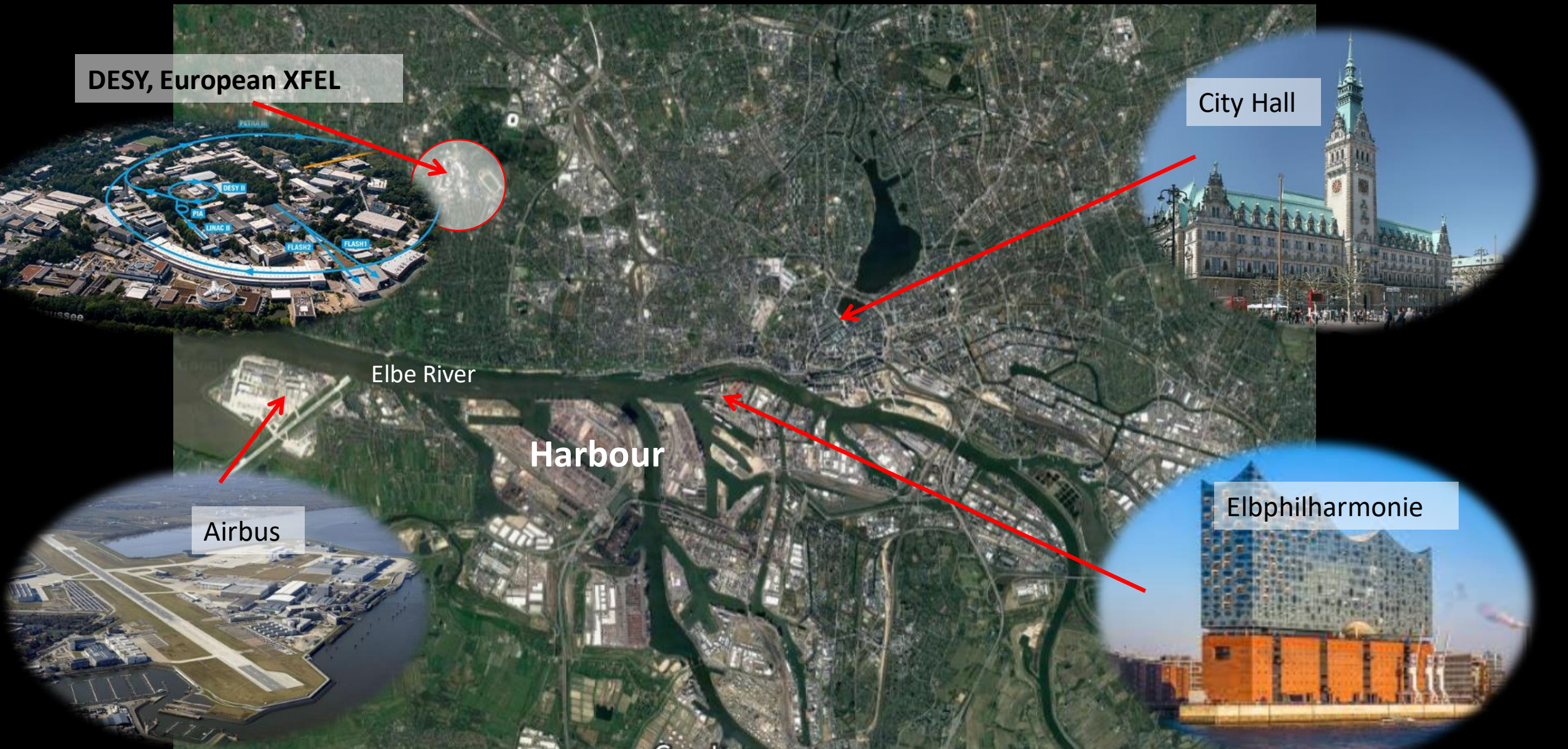
www.deutsch-tuerkisches-wissenschaftsjahr.de
www.turk-alman-bilimyili.com.tr



Deutsch-Türkisches Jahr der
Forschung, Bildung und Innovation 2014
Türk-Alman Araştırma,
Eğitim ve İnovasyon Yılı 2014



Where is DESY?



DESY. 1959-2025 „The Decoding of Matter“

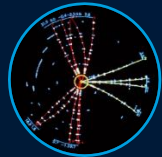


Werner Heisenberg

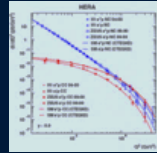


Schütz

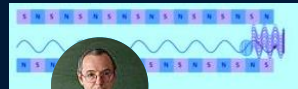
XMCD Effect



Gluon



Electroweak Unification



Saldin

Single-Path X-ray Laser



Proton Structure



Yonath

Ribosom Struktur



TESLA Technology



Chapman

SFX



XFEL LINAC



Leemans

Plasma-Accelerators

DESY



DORIS



PETRA



DORIS-SR



HERA



FLASH



PETRA III-SR



XFEL



1959

1971

1974

1981

1991 Zeuthen

1993

2000

2009

2025



W. Jentschke



W. Paul



H. Schopper



V. Sörgel



B. Wiik



A. Wagner



H. Dosch



B. Heinemann

DESY – Facts & Figures



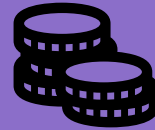
Foundation:
1959 as national
lab

Member of
Helmholtz
Association



Employees:
~3.000 staff
~350 PhDs

More than 3000
international
guest scientists



Budget:
240M€ annual
90:10
federal:state



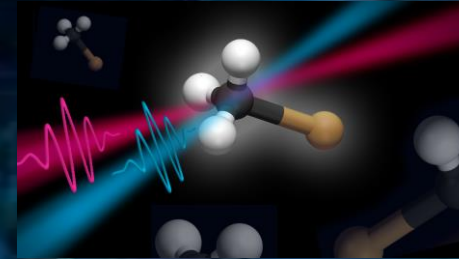
Sites:
Hamburg and
Zeuthen (south
of Berlin)



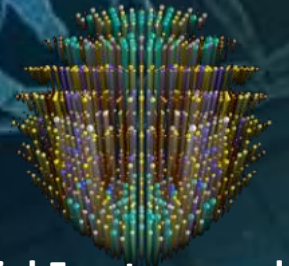
Research Areas:
Particle Physics
Astroparticle P.
Photon Science
Accelerators

Exploration of Matter at the Highest Level

Advancing Knowledge for Science, Industry and Society



Light-Matter Interaction



Serial Femtosecond
X-Ray Crystallography

World-Class Research Facilities for Global Collaboration

Advancing and operating cutting-edge Infrastructures for
Research Innovation and Education



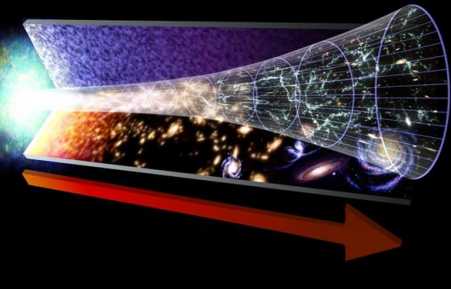
Laser-Plasma - ultimate acceleration

Key Actor in Regional and Global Ecosystems

Strengthening science and innovation ecosystems
through strategic cooperation



TESLA – Attosec Pulses



Fundamental Particles
and Nonthermal Universe

World largest X-ray Machines



CHyN
Center for Hybrid
Nanostructures

DESY Innovation Factory

DAF (1) (2)
Detector Assembly Facility

DESY II

SINBAD
Short and Innovative
Bunches and Accelerators
at DESY

European XFEL

HARBOR
Hamburg Advanced
Research Centre for
Bioorganic Chemistry

DESYUM

WPC
Wolfgang Pauli Centre

Technicum

CMWS
Centre for Molecular
Water Science

CSSB
Centre for Structural
Systems Biology

MPSD
Max-Planck-Institut für
Struktur und Dynamik
der Materie

EMBL
Europäisches Laboratorium
für Molekularbiologie

SHELL
Shielded Experimental Hall

CAST
Center for Accelerator
Science and Technology

CXNS
Centre for X-ray and
Nano Science

CFEL
Center for Free-Electron
Laser Science

FLASH

Start-up Labs Bahrenfeld

PETRA III/IV

Modern large-scale research facilities & technologies @DESY.

The complementary use of unique research facilities in close proximity creates synergies



PETRA III World's largest synchrotron radiation source



FLASH World's first Free Electron Laser



EU-XFEL World's most powerful free electron X-ray laser



Large data storage



Test facilities for new detector technologies



Interdisciplinary centres

DESY. Interdisciplinary research platforms PETRA III, FLASH, XFEL

in concrete planning

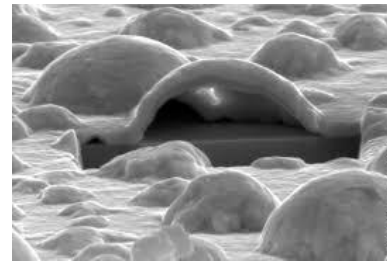
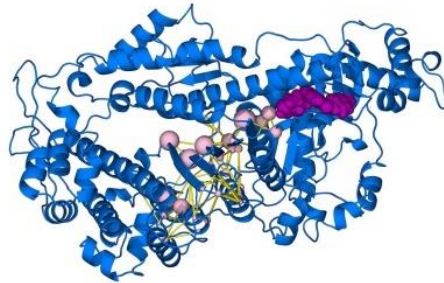
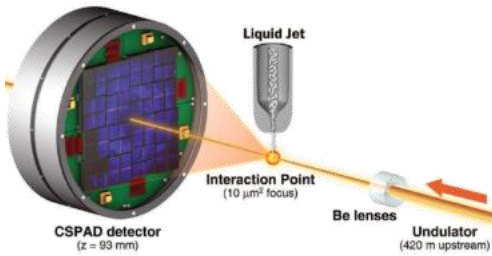
Quantum materials
FEL Research

Structural Biology
Infection Research

Nanotechnology
Nanomaterial Design

Theory
Interdisciplinary
Concepts

Water
Molecular
Water Research



cXNs
Center for
X-ray and Nanoscience

WPC
Wolfgang Pauli-
Centre

CMWS
Centre for Molecular
Water Science

DESY
Max-Planck Society
University Hamburg

DESY
EMBL
HZI, FZJ
BNITM, LIV
UKE, MHH
UHH

**) DZIF
Members*

DESY
University Kiel
Hereon
Technical University
Hamburg-Harburg

DESY
University Hamburg

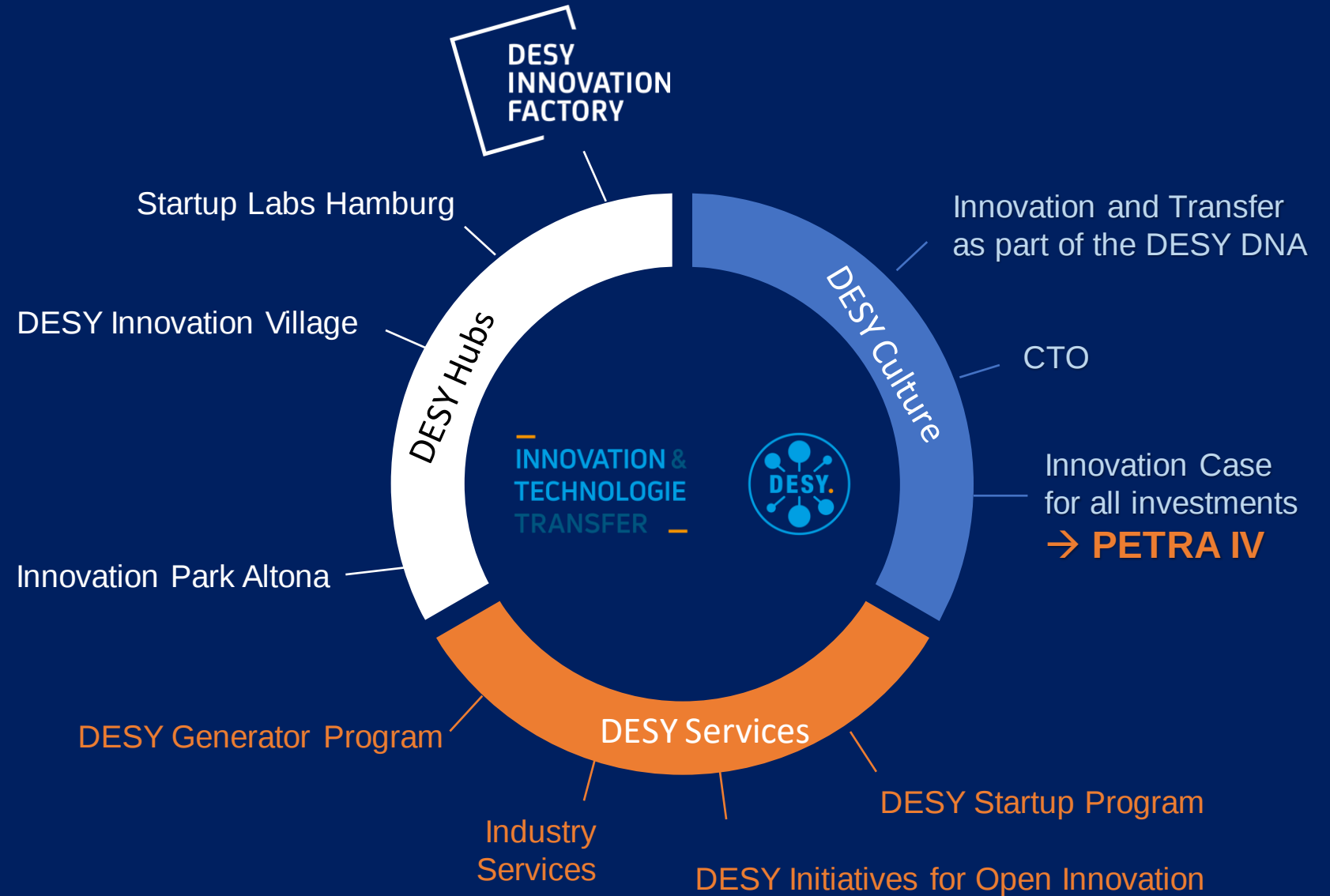
DESY
European
Consortium

UFZ, GFZ
HZB

DESY. Significant momentum in innovation activities in the DESY ecosystems in Hamburg and Zeuthen.



Startup Labs Hamburg
Start 2019
DESY-UHH-FHH



PETRA III fact sheet

DESY's Brilliant Synchrotron Radiation Source

Timeline of PETRA:

- 1978: **PETRA I** for particle physics (gluon discovery)
- 1988: **PETRA II** as pre-accelerator for HERA
- 2010: **PETRA III** as 3. generation synchrotron radiation source (High Brilliance X-ray Source for Nano Science)

2029 (planned): **PETRA IV** as 4. generation synchrotron radiation source (Ultimate 3D X-ray Microscope)

DESY is collaborating with several strong partners



electron energy	6 GeV
stored current	100 / 120 mA (1% top-up)
emittance ($h \times v$)	1.3 nmrad $\times$ 20 pmrad
circumference	2304 m
photon energy range	4-40eV, 250 eV - 200 keV
beamlines in operation	25
beamlines under construction	1
beamlines in planning	1
user operation (hours/year)	5000
bunch separation	192 ns or 16 ns

PETRA III. was never in lockdown during the pandemic

Operation (on-site under strict access and hygienic rules or remote) during COVID-19 has enabled key research



S. Günther *et al.*, Science (2021),
DOI: [10.1126/science.abf7945](https://doi.org/10.1126/science.abf7945)

J. Qiao *et al.*, Science (2021),
<https://doi.org/10.1126/science.abf1611>

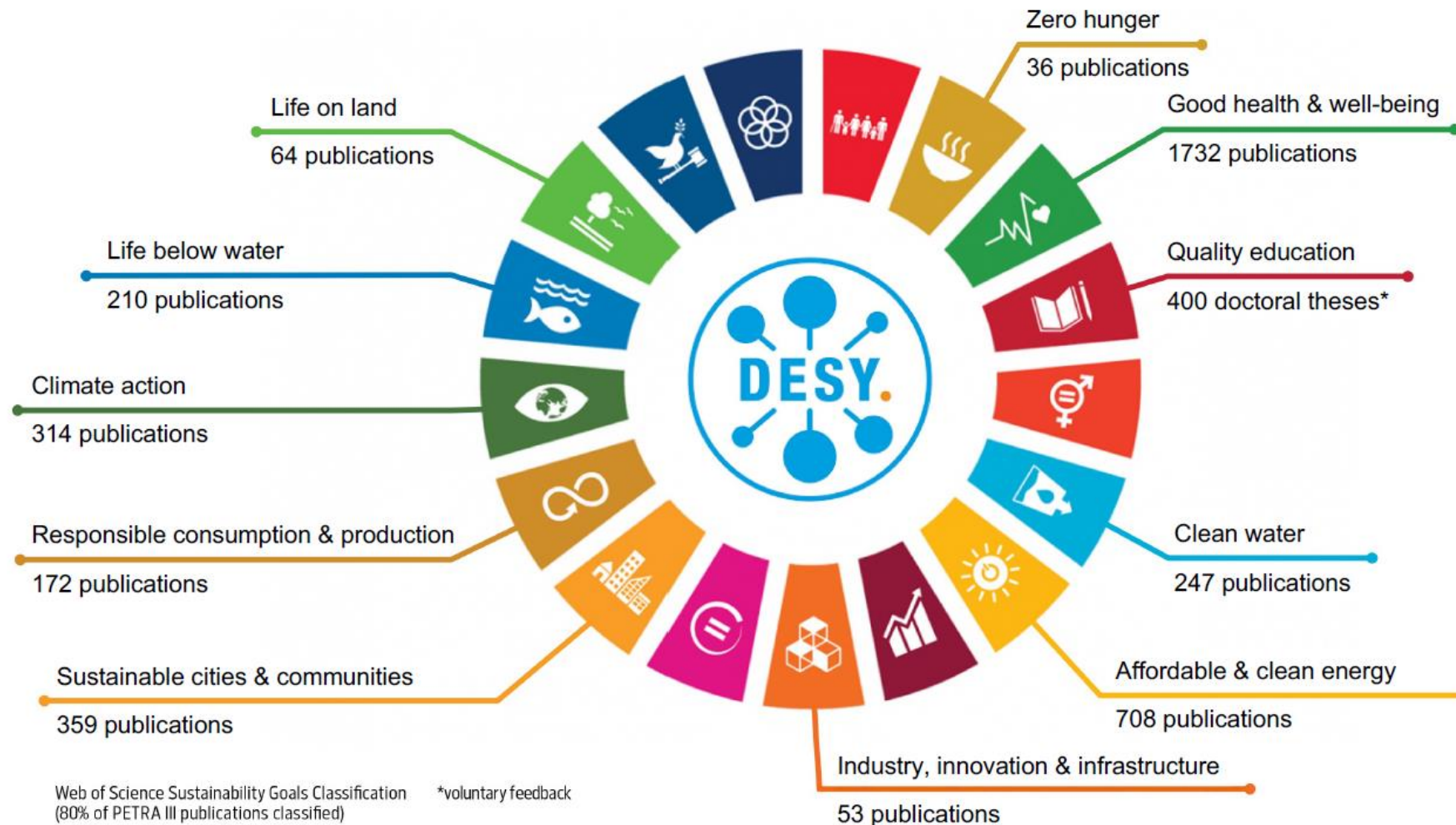
S. de Munck *et al.*, Nature (2021),
<https://doi.org/10.1038/s41586-021-03959-5>

C. D. Siewert *et al.*, Cells (2020),
<https://doi.org/10.3390/cells9092034>

Our users make an impact

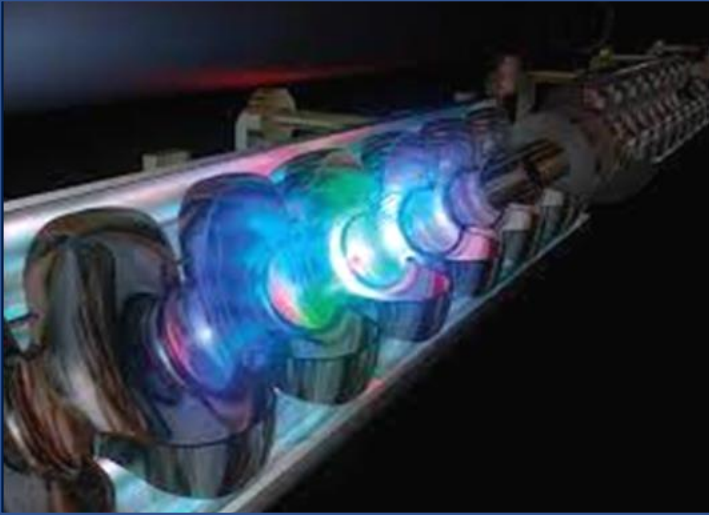


Analysis for PETRA III: Contribution to the UN sustainable development goals



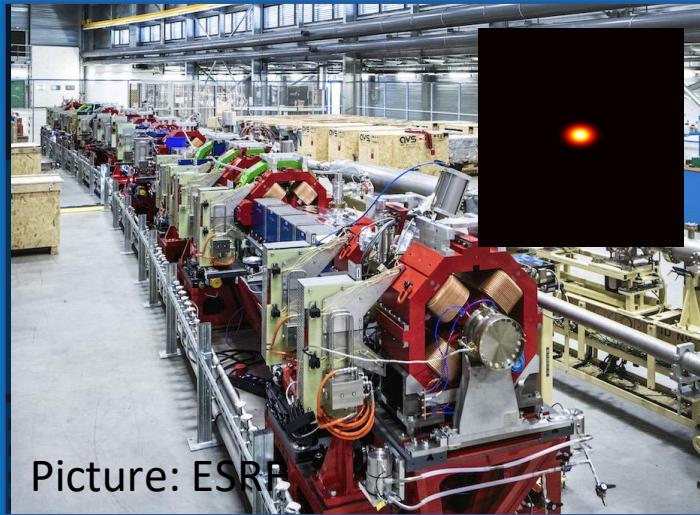
DESY. R&D in new accelerator technologies for high-brilliance sources

World-leading technologies



Superconducting technology

Moonshot FLASH
Mars shot XFEL, LCLS2

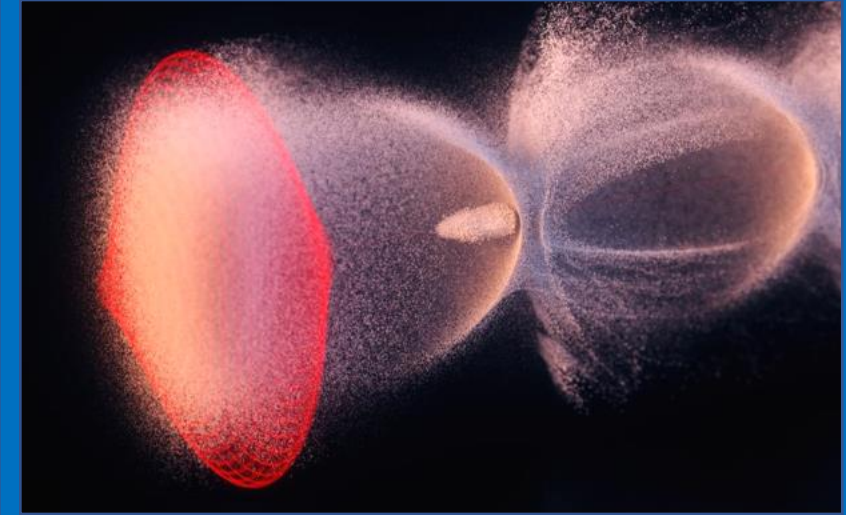


Picture: ESRF

Multibend Achromat technology

PETRA IV H6BA

developed in cooperation with ESRF
Build all (!) worldwide upgrades
to the disruptive European technology



Plasma technology

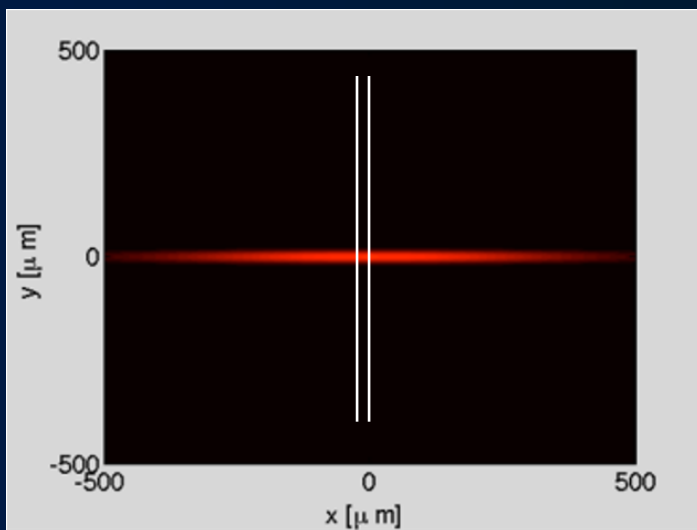
Moonshot: **PETRA IV** plasma injector
Translation in market

LASER R&D @ DESY

DESY. PETRA IV - Exploring the quantum world

PETRA III

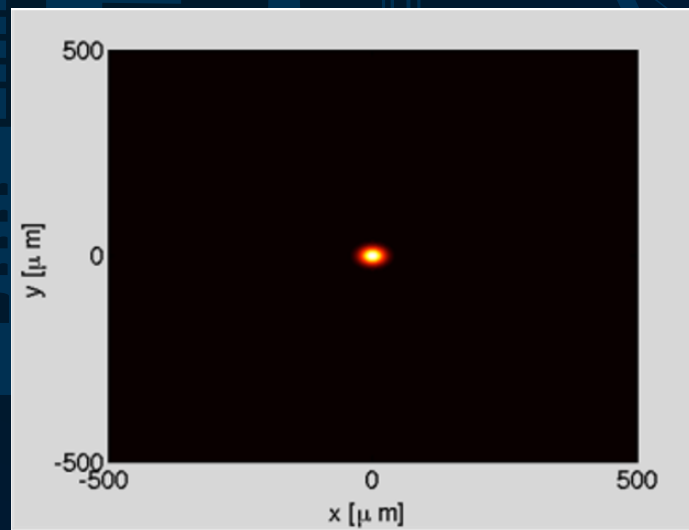
the best X-ray source for more than a decade
but no suitable microscope
for
Investigations on the quantum scale



Electron beam
in the PETRA III ring

PETRA IV

World-leading X-ray microscope
for
Design and control of materials
on the quantum scale



Electron beam
in the PETRA IV H6BA ring



National roadmap process
Submission of the PETRA IV
application October 25, 2024

500-fold (!)

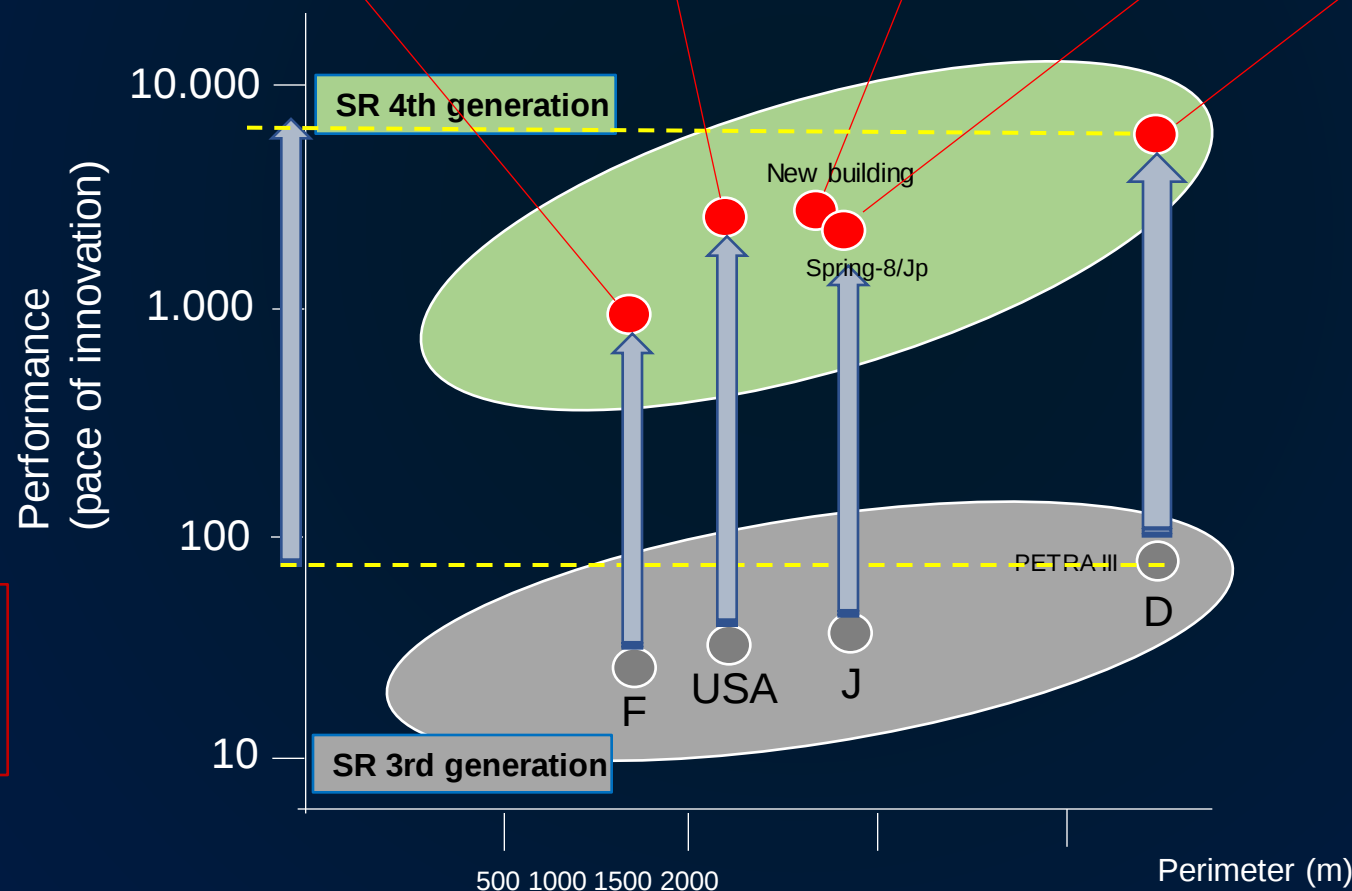
Increased performance

- Disruptive new Insights
- Innovations on the Nano scale

DESY. The international competition never sleeps!



The future „Big 5"



phys:
diffraction limited
maximum
Photon energy (eV)

4th generation based on
European development:
Hybrid Multibend Achromat
Technology (HMBA)

Global competition
for the best radiation source

→ Innovation machines for
High-tech developments

APS-U and HEPS overtake all
European SR sources in terms of
performance in 2025

→ **PETRA IV** confidently secures
the global leadership !!!

Cooperation counts

Visits of Turkish Delegation January 2014 at DESY/XFEL

Workshop in Istanbul July 2014

Public Roadshow Event at Turkish Universities May 2015

- initiated during the Turkish-German Year of Science (2014)



Deutsch-Türkisches Jahr der
Forschung, Bildung und Innovation 2014
Türk-Alman Araştırma,
Eğitim ve İnovasyon Yılı 2014



Brilliant Light

A roadshow about Hamburg's large-scale research facilities

Deutsches Elektronen-Synchrotron DESY and European XFEL in Hamburg, Germany, operate worldwide unique, large-scale research facilities to boost science, technology and innovation. Their extremely powerful X-rays serve as super microscopes and highspeed cameras for scientists from many disciplines. This roadshow will highlight these brilliant lightsources and their exciting scientific opportunities, technologies and research cooperations.

Mo, 4 May 2015 – İstanbul Üniversitesi, Fen Fakültesi

Dekanlık 3. Kat. Kurul Salonu

Tue, 5 May 2015 – Türk-Alman Üniversitesi, Beykoz/İstanbul

Derslikler Binası, Konferans Salonu

Wed, 6 May 2015 – Public Colloquium, Ankara Üniversitesi Rektörlüğü

100. Yıl Salonu, Saat: 17:00

Helmut Dosch (Chair of the Board of Directors, DESY)

Serguei Molodtsov (Scientific Director, European XFEL)

Thu, 7 May 2015 – Ankara Üniversitesi Rektörlüğü, 100. Yıl Salonu,

Tandoğan, Ankara

Fri, 8 May 2015 – TOBB Ekonomi ve Teknoloji Üniversitesi, Ankara

Ana Bina, Sergi Alani, 1. Kat Toplantı Salonu

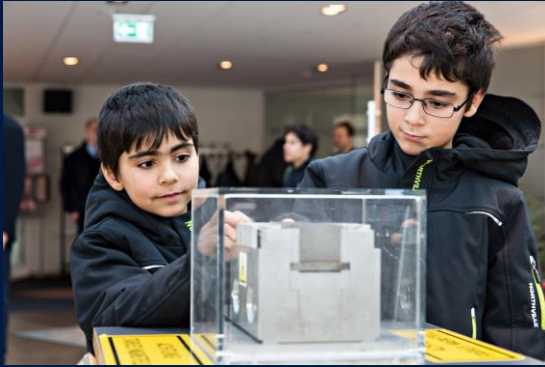
The exhibition is open from 9-18h.
Science talks start every day (except Wednesday)
at 10h and 14h and cover:
- Introduction to DESY and European XFEL
- Overview of their scientific applications
- Reports by Turkish scientists about their research
in Hamburg



Cooperation counts



Public German-Turkish Science Day in Hamburg in Dec 2015
Workshop DESY/XFEL-Turkish Science Community – January 2016



Deutsch-Türkischer Wissenschaftstag Alman-Türk Bilim Günü

Erlebe und Entdecke die Wissenschaft in den Forschungszentren DESY und European XFEL
Bilimi, araştırma merkezleri DESY ve Avrupa XFEL'de yaşa ve keşfet

5.12.2015, 12-18h

Programm | Program

- Rundgang durch Labore und Werkstätten | Laboratuvar ve atölyelerin tanıtımı
- Informationsstände | Bilgi ve danışma masaları
- Interessante Vorträge | Önemli konferanslar
- Führungen | Rehberli tanıtımlar
- Mitmachaktionen und Quiz mit Preisen | Katılımcı faaliyetleri ve ödüllü bilgi yarışmaları
- Exponate/Ausstellung | Sergiler

Wir richten uns insbesondere an türkische Schülerinnen und Schüler in Hamburg, um ihnen die Faszination der Naturwissenschaften und Technik früh zu vermitteln.

Amacımız, özellikle Hamburg'da okula giden Türk öğrencilere Bilim ve Teknolojinin cazibesini erken yaşlarda iletmektir.

Mehr Informationen | Geniş Bilgi için:
Telefon: 040/8998 3613
E-Mail: desypr@desy.de

Mit Unterstützung des türkischen Generalkonsulats.
Hamburg Türk Başkonsolosluğu'nun desteği ile.

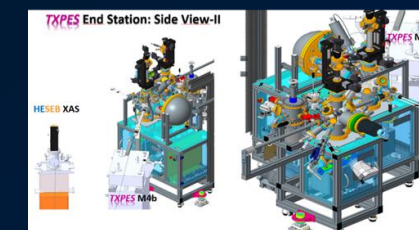
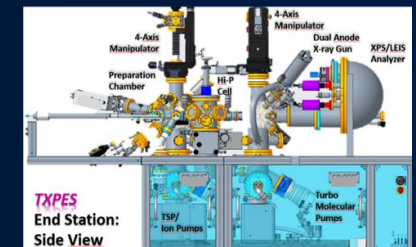
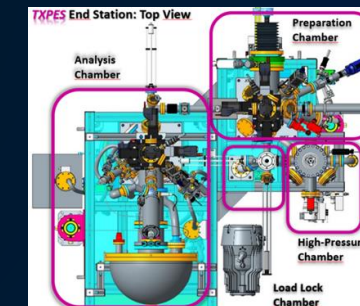
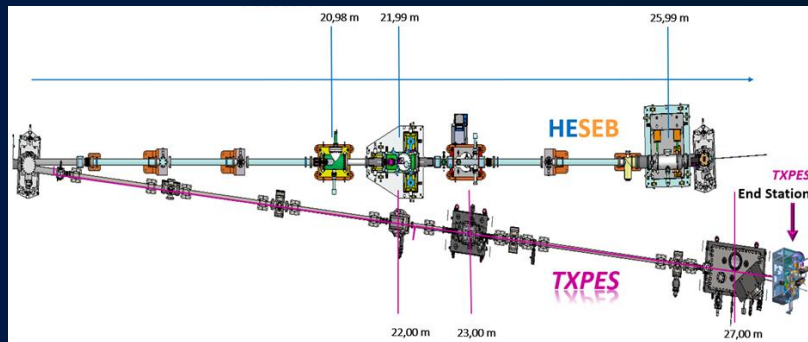
Hamburg



SESAME - a special place for cooperation



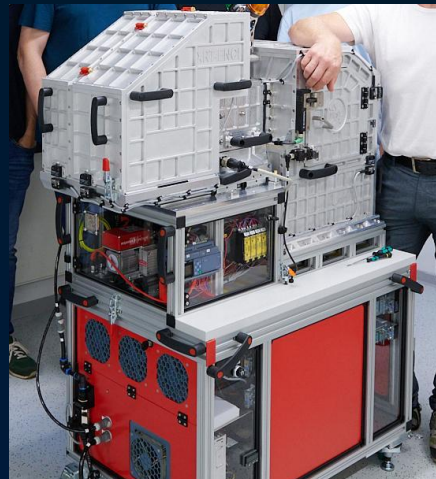
- SESAME - Synchrotron-light for Experimental Science and Applications in the Middle East, Jordan
- Türkiye – Member of SESAME / Germany (through DESY) is observer
- Helmholtz Soft X-Ray Beamline (HESEB) – Turkish Soft X-ray Photoelectron Spectroscopy (TXPES) Cooperation - cooperation DESY-Ankara



Cultural Heritage

- Cuneiform writing believed to be invented by Sumerians ~middle 4th millennium BCE
- Many clay cuneiform tablets enclosed / sealed in a clay envelope
- Museum of Anatolian Civilisation in Ankara has outstanding collection of clay tables of Assyrian cuneiform
 - => a huge treasure of cultural heritage
- ENCI - mobile CT scanner for analysing cultural heritage objects – developed by DESY
- Specialized for closed cuneiforms
- Reveal the “hidden”

Thanks to Avni Aksoy / U Ankara for his great help

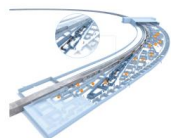


Museum Director Yusuf Kırac and the ENCI team at the Museum of Anatolian Civilisations in Ankara.



GASOLINE Project

- A TÜBİTAK-BMBF funded collaboration between U Ankara and DESY using genetic algorithms to optimize synchrotron and FEL beamlines
- two Workshops in 2022 and 2024
- organized by B. & D. Ketenoğlu et al.



The International GASOLINE Project

Bilateral Cooperation within BMBF (Germany) and TÜBİTAK (Turkey)



Genetic Algorithms based Synchrotron radiation Optimization for an X-ray beamLINE

Turkish Side (Supporting Foundation*, University and Collaborators)

The Scientific and Technological Research Council of Turkey (TÜBİTAK*)

Department of Engineering Physics, Ankara University (Dr. Didem Ketenoğlu, Assoc. Prof. Dr. Bora Ketenoğlu)

Department of Computer Engineering, Ankara University (Assoc. Prof. Dr. Gazi Erkan Bostancı, Assoc. Prof. Dr. Mehmet Serdar Güzel, Dr. Ayhan Aydın)



TÜBİTAK



Germany Side (Supporting Foundation*, Research Institute, University and Collaborators)

Bundesministerium für Bildung und Forschung (BMBF*)

Deutsches Elektronen-Synchrotron (DESY) and Tohoku University* (Manuel Harder, Dr. Engin Eren, Dr. Zhong Yin)

Institute of Experimental Physics, Hamburg University (Dr. Michael Martins)

International Hybrid Workshop on Start-to-End Beamline Optimization for Synchrotron Radiation and Free-Electron Laser Facilities through Artificial Intelligence Approaches

23-24 November 2022, DESY-Hamburg-Germany



- The international workshop principally aims to bring "SR & FEL beamline scientists, computer engineers and physicists" together on a dedicated interdisciplinary scientific research basis.
- Development and validation efforts on the software GASOLINE (Genetic Algorithms based Synchrotron radiation Optimization for an X-ray beamLINE) will be discussed in detail.
- Beamline scientists' comments and recommendations on the international bilateral cooperation project GASOLINE, which is jointly funded by TÜBİTAK (Turkey) and BMBF (Germany), will be adapted to the software for a broad range of SR and FEL beamlines.

Organizing Crew

DR. MICHAEL MARTINS

ASSOC. PROF. DR.
BORA KETENOĞLU

DR. KAI TIEDTKE

DR. DIDEM KETENOĞLU

ASSOC. PROF. DR.
GAZİ ERKAN BOSTANCI

DR. MICHAEL MEYER

DR. ENGİN EREN

MANUEL HARDER

<https://indico.desy.de/event/36469/>

Contact

Michael Martins: michael.martins@uni-hamburg.de
Didem Ketenoğlu: dketen@eng.ankara.edu.tr

DESY. – now 65 years and full in (E)motion



The place to be ...
and for future DESY-Ankara cooperation

Thank you - Teşekkür ederim

DESY. fosters global Collaboration in pioneering large-scale Research Projects.



- 1 - 5
- 6 - 50
- > 50



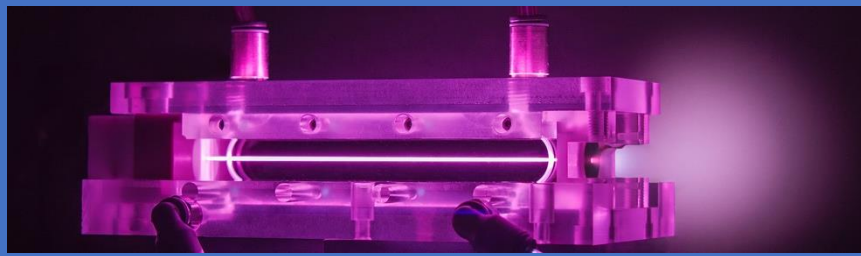
DESY. is pioneering the Accelerators of tomorrow.



Cold Technology „TESLA“



Plasma Technology



DESY
Accelerator R&D