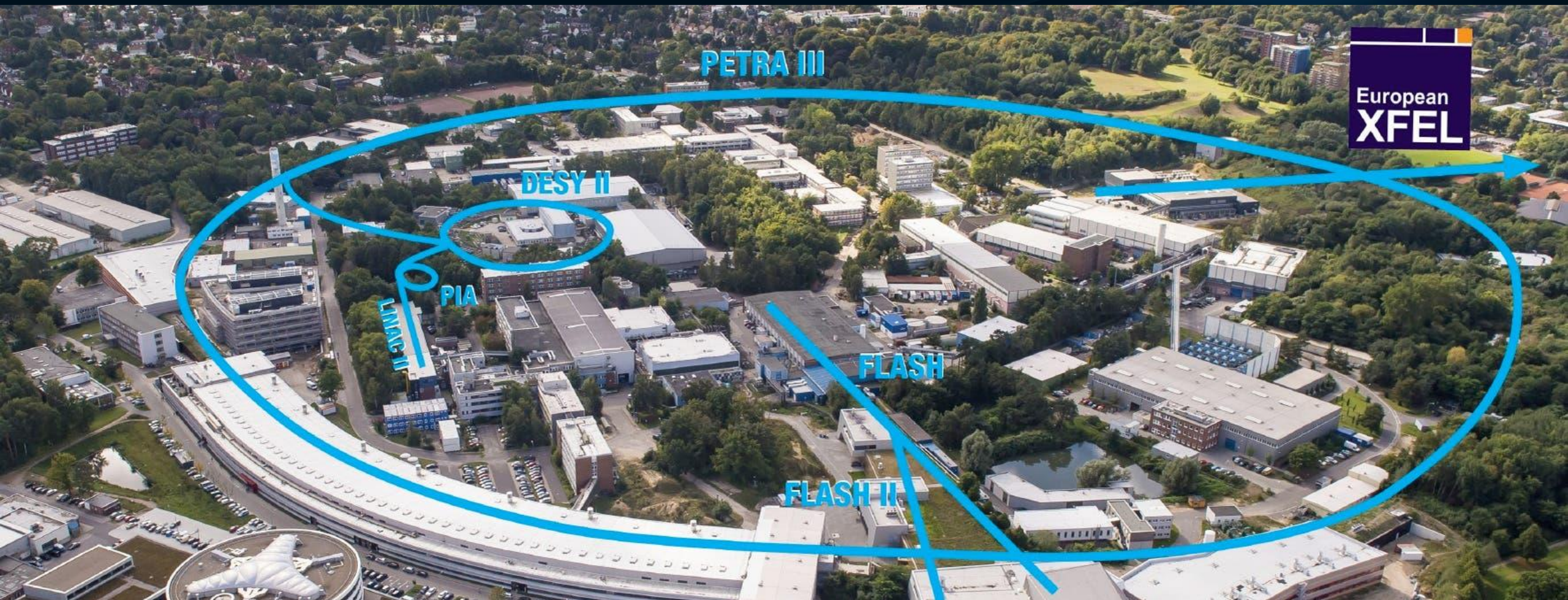


DESY. The Decoding of Matter



Beate Heinemann
Director in charge of Particle Physics



DESY. Facts

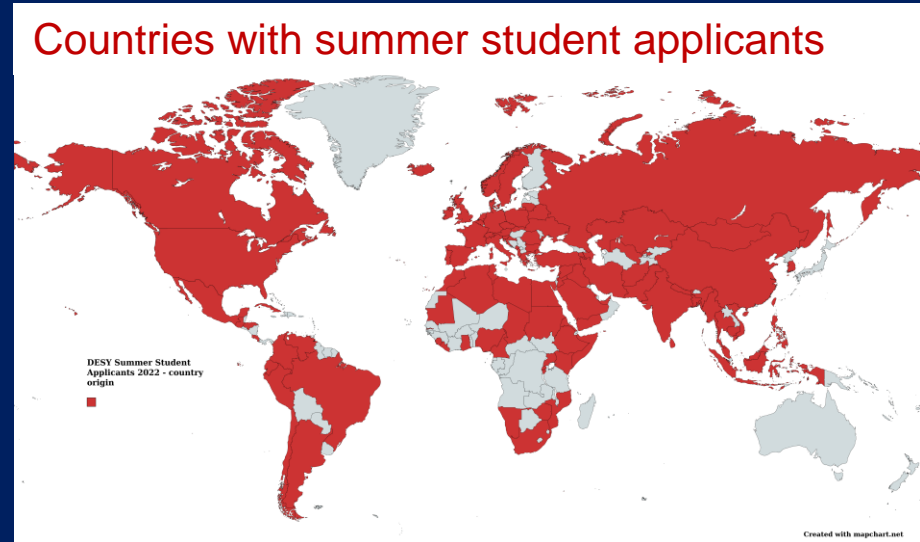
National laboratory founded 1959
2700 employees and >8000 users

Two locations: Hamburg and Zeuthen
(near Berlin)



International DESY

- **Long tradition of intl. collaboration since the 1970s**
 - Many partners in Europe, Asia, North America
 - More than 8000 users world-wide perform research here
- **DESY staff: 78 nationalities**
 - 75% German (among scientists: 71%)
 - 15% other European countries (e.g. Russia and Italy)
 - 8% Asia (e.g. China, India Iran Pakistan)
 - 2% from Africa, Americas, Australia
- **International program for summer students**



The Decoding of Matter

Mission: Turning science data into knowledge on structure and dynamics of matter at all scales

What role do high energy particles play in cosmic evolution?

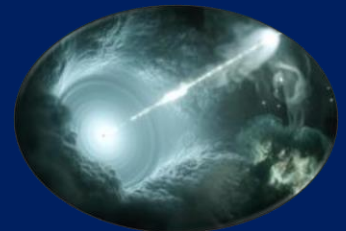
What is dark matter?

Can we understand infection on the molecular level?

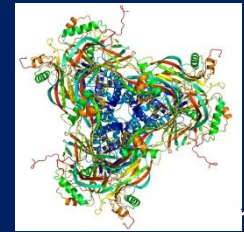
How can we control the function of materials on the level of individual electrons and spins?

Is there a common origin of all fundamental forces?

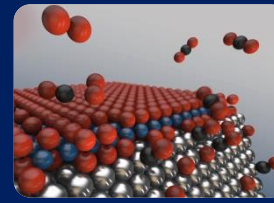
What is the precise mechanism that gives particles its mass?



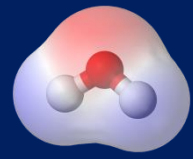
Galaxy



Protein



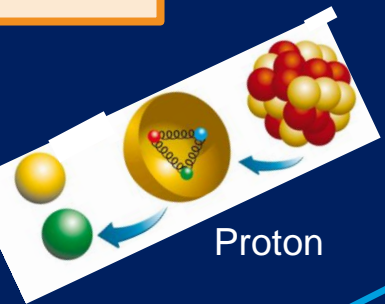
Nanoparticle



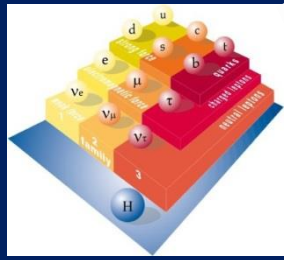
Molecule



Atom



Proton



Quark

How do we build compact accelerators?

Accelerators



Detectors



Computing

How do we take pictures with a rate of millions/second?

How can we meet the data challenge in today's experiments?

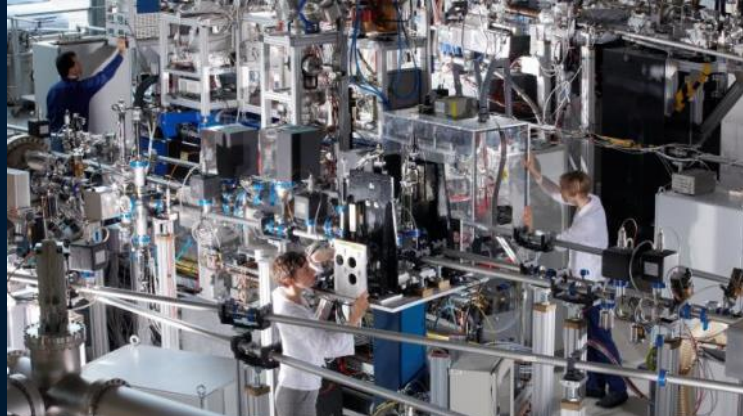
DESY – Areas of Research



Modern research infrastructures @DESY



PETRA III World's largest synchrotron X-ray source



FLASH World's first free electron laser



EU-XFEL world's most powerful free electron laser



Large Computing Center



Test facilities for detectors



Interdisciplinary Research Centers

PETRA III

World leading facilities for photon science

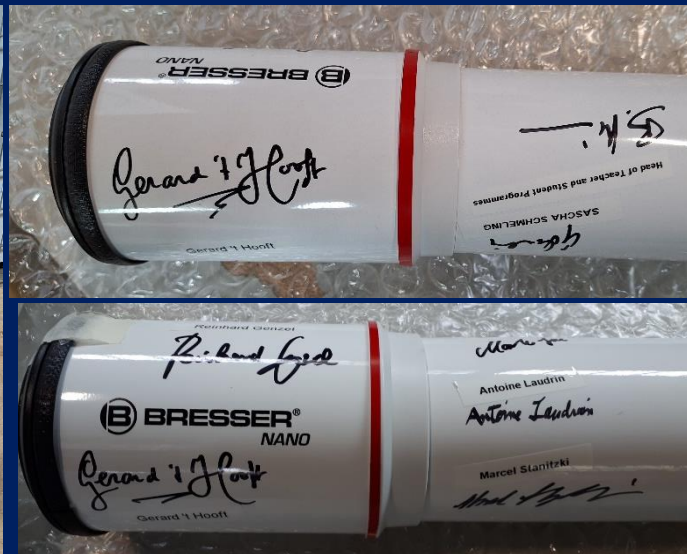
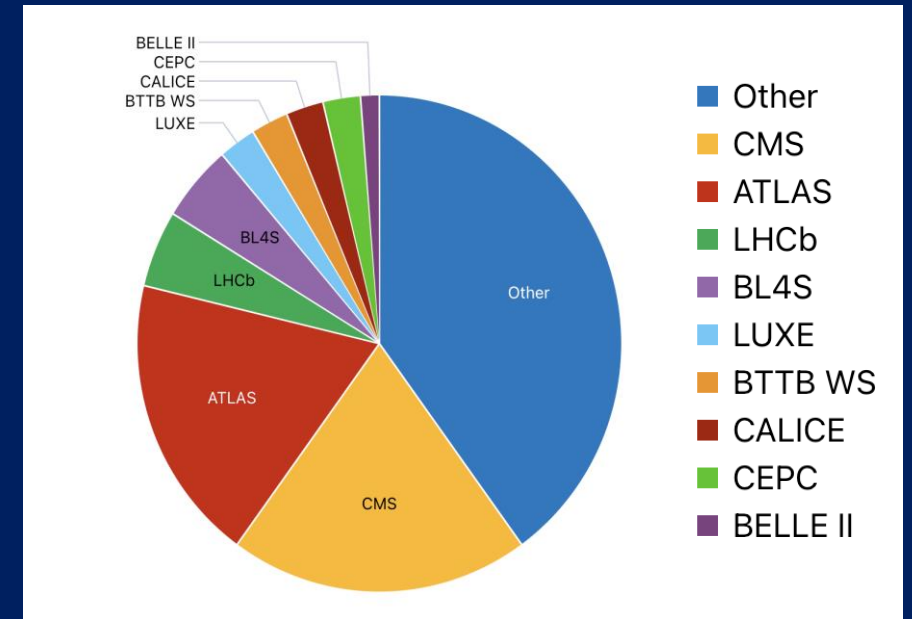
- > PETRA III operating since 2013, 27 beam lines
- > About 10000 user visits per year (45% intl.); 800 publications/year
- > Beamlines support science and industrial research
- > Data sets getting larger and more complex => need intelligent computing



DESY Test Beam

2024 Run is ongoing

- 2023: 396 users (about 50% from Germany)
 - Wide portfolio from LHC to CEPC
- Education and Outreach key part of the facilities
 - Beamline4Schools: joint initiative with CERN
 - US school coming this week
 - Schwartz-Reisman School with Israeli high school students
 - HighRR School (Heidelberg) with 33 PhD and MSc students doing experiments at the beam lines



High-RR School



Schwartz-Reisman School

International Cooperations

DESY as strong partner in international research projects



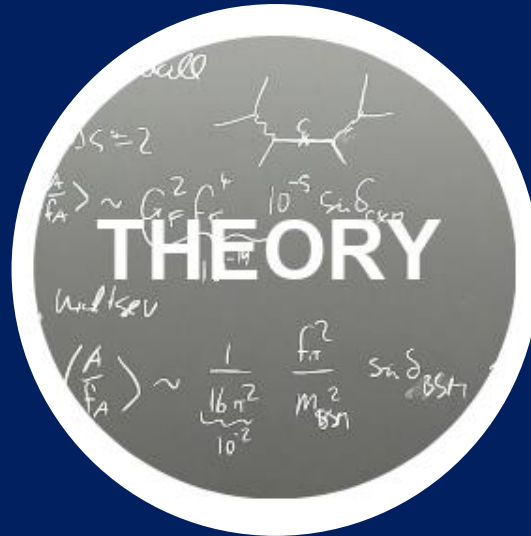
Four pillars of particle physics at DESY



Key contributions to global projects at CERN and KEK

- HL-LHC
- Belle II

Closely work with German universities (natl. hub)



Establish WPC as world-leading interdisciplinary centre for theoretical physics

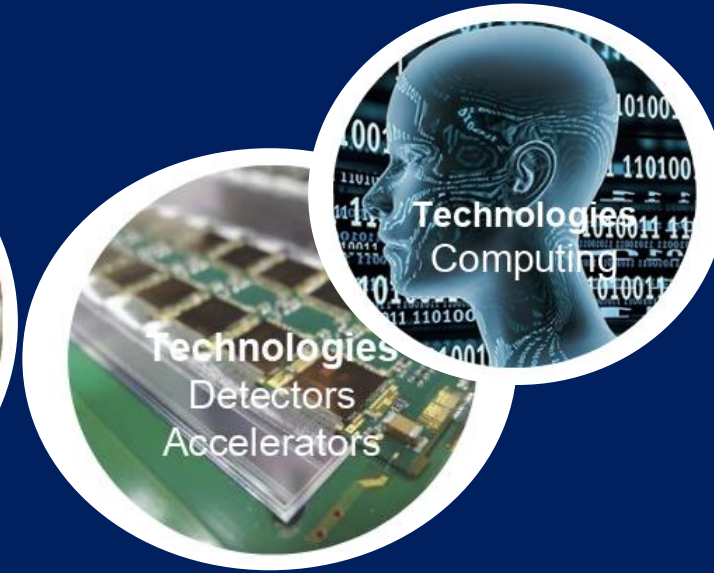
Idea factory for future science endeavours



ALPS II: first data 2023

BabyIAXO, LUXE
MADMAX: >2029

New ideas: VMB @ ALPS II, R&D on HF GW local exp'ts (complements ET)



Strengthen innovation in detectors and computing

Increase 3rd party funding

Strengthen exchange across divisions

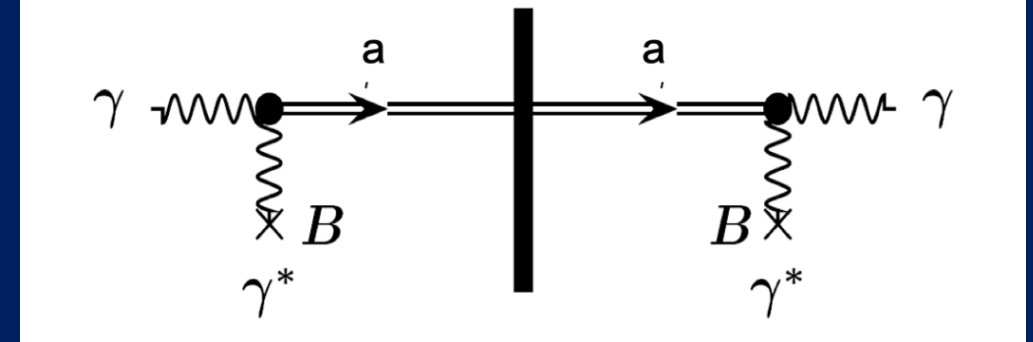
Work closely with German universities

On-site research facilities: ALPS II

International experiment at DESY



- Search for fundamental particles that could constitute the dark matter in the Universe
- 250 m string of superconducting magnets from previous accelerator (HERA)
- Data taking starting last year



Computing Facility at DESY in Hamburg

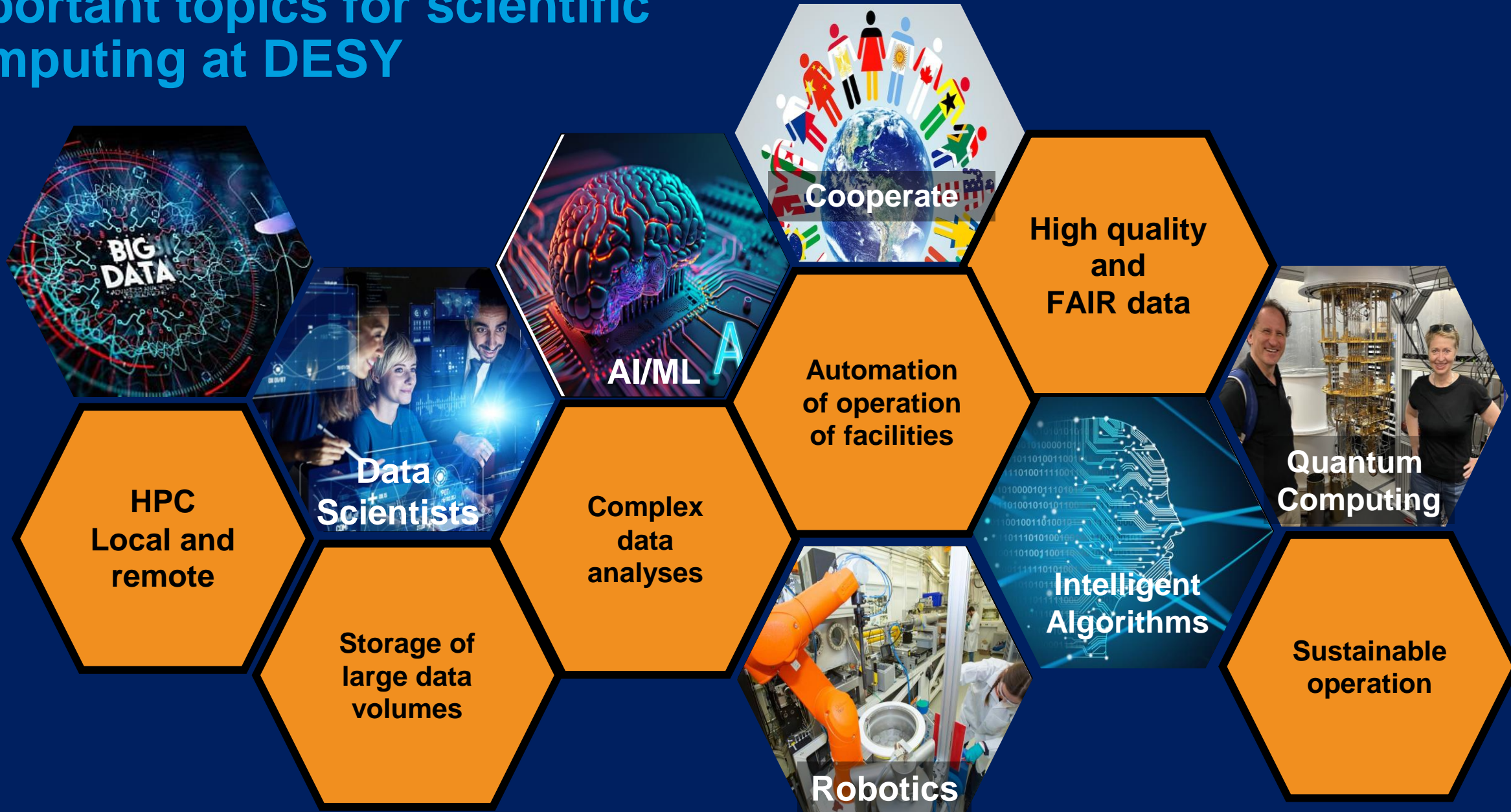
High throughput and high performance for large and complex data

Item	2023	2030
Area [m ²]	1,100	2,000
Power Usage [MW]	1.3	3-4
Storage (tape & disk) [PB]	330	5000
CPU cores	60,000	250,000
GPU cores	350	2,000



$$\text{PUE} = \frac{\text{power used by IT equipment}}{\text{power used by building}}$$

Important topics for scientific computing at DESY



Sustainable Computing Workshops

A new series of workshops at DESY

- Participants learn and practice sustainable computing methods and focus on efficient usage of resources
- Examples of topics covered: unit testing, continuous integration, documenting code in GIT, working on the NAF, batch computing, best coding practices...
- Organized by IT experts and the FH Sustainability Forum
- About 20-30 PhD students and postdocs participated in each workshop



Advanced
**FH Sustainable
Computing
Workshop**

**IT WORKS ON MY MACHINE:
A workshop on software testing**

Are you tired of

- debugging the same things over and over?
- complaints from others that your code doesn't work?
- spending time on manually testing your code?

Come to our workshop to learn unit testing and how to write testable software!

[https://indico.desy.de/event/44051/
fh-forum-sustainability@desy.de](https://indico.desy.de/event/44051/fh-forum-sustainability@desy.de)

**April 26, 2024, 9-13h
Building 3, BAH1**



Have a wonderful CERN computing School at DESY!



CERN
School of Computing

45th CERN School of Computing



8 – 21 September 2024
Hamburg, Germany

