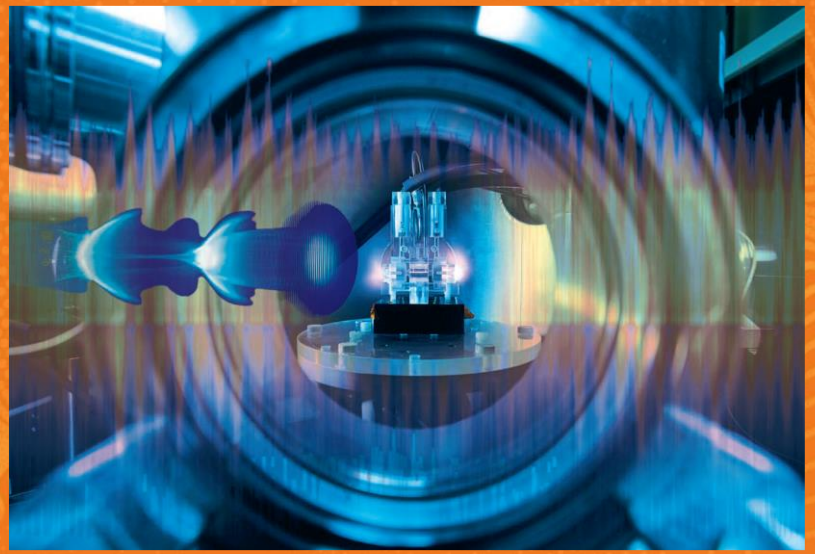
HELMHOLTZ

RESEARCH FOR
GRAND CHALLENGES

PROGRAM
Matter and Technologies

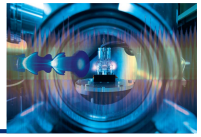


Ties Behnke, Anke Susanne Mueller

Student retreat January 2021

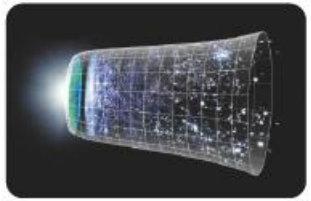
DESY. JÜLICH Forschungszentrum GSI HI JENA HELMHOLTZ Helmholtz Institute Jena HIM HELMHOLTZ Helmholtz-Institut Mainz HZB Helmholtz Zentrum Berlin HZDR HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung IPP KIT Karlsruhe Institute of Technology

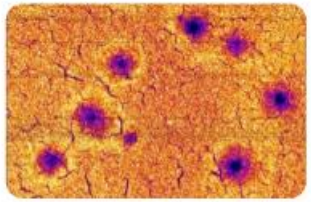
Mission of Matter

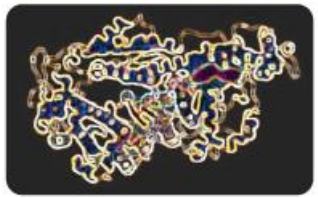


Decyphering the structure and function of matter

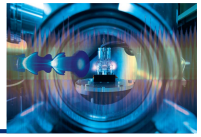
- to find answers to the **grand open questions** of the quantum universe
- to critically contribute to the design of **advanced materials** for future energy-, information- and transport technologies
- to contribute to our understanding of **biomolecular processes** and to the development of **better drugs**

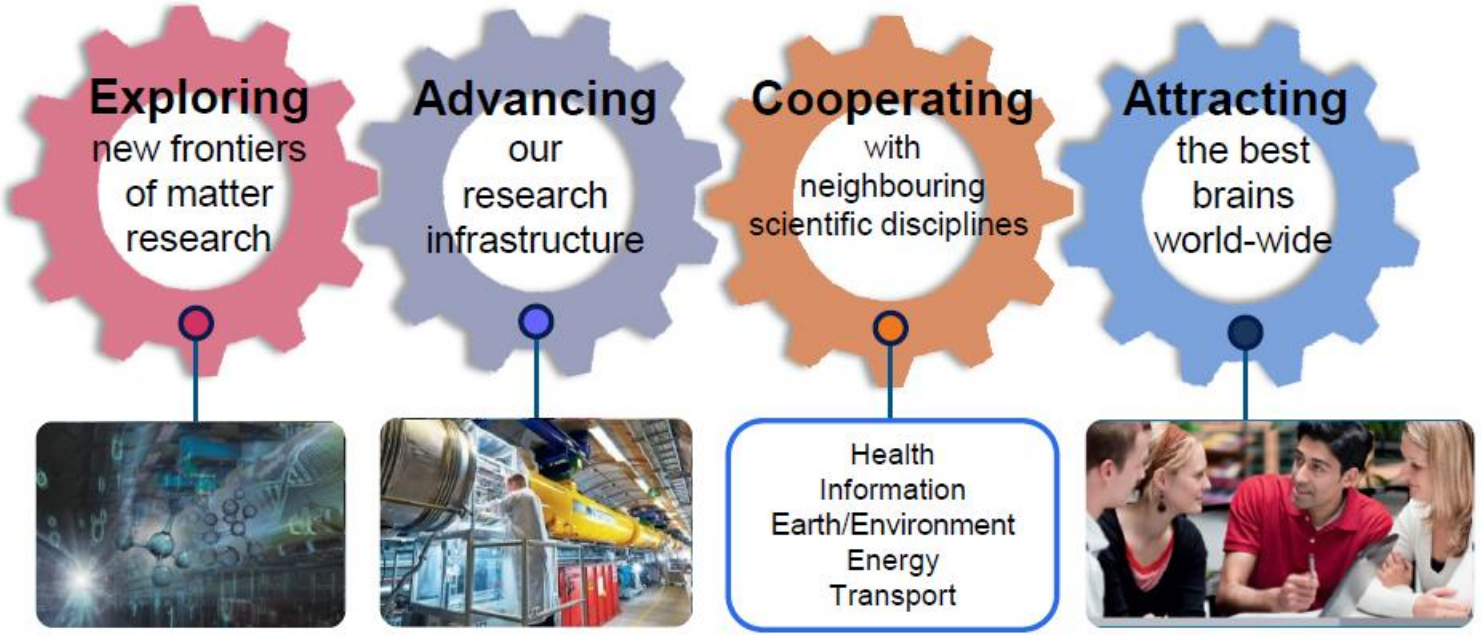






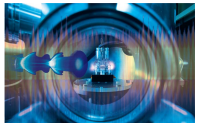
Overall Strategy of the Research Field

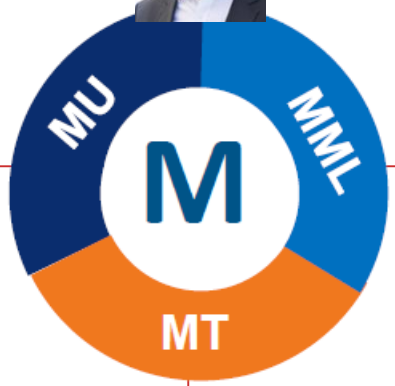




The research field Matter

H. Dosch





R. Engel B. Heinemann

Matter and the Universe (LK I)

Fundamental Particles and Forces	**FPF**
Cosmic Matter in the Laboratory	**CML**
Matter and Radiation from the **Universe**	**MRU**

Facilities (LK II)
Ions
GridKa

T. Stöhlker A. Stierle

From **Matter** to Materials and Life (LK I)

Matter Dynamics, Mechanisms and Control	**Matter**
Materials Complex and Functional Materials	**Materials**
Life Building Blocks of Life: Structure and Function	**Life**

Facilities (LK II)
Photons, Neutrons, Ions
High-Fields

T. Behnke A.-S. Müller

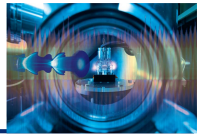
Matter and Technologies (LK I)

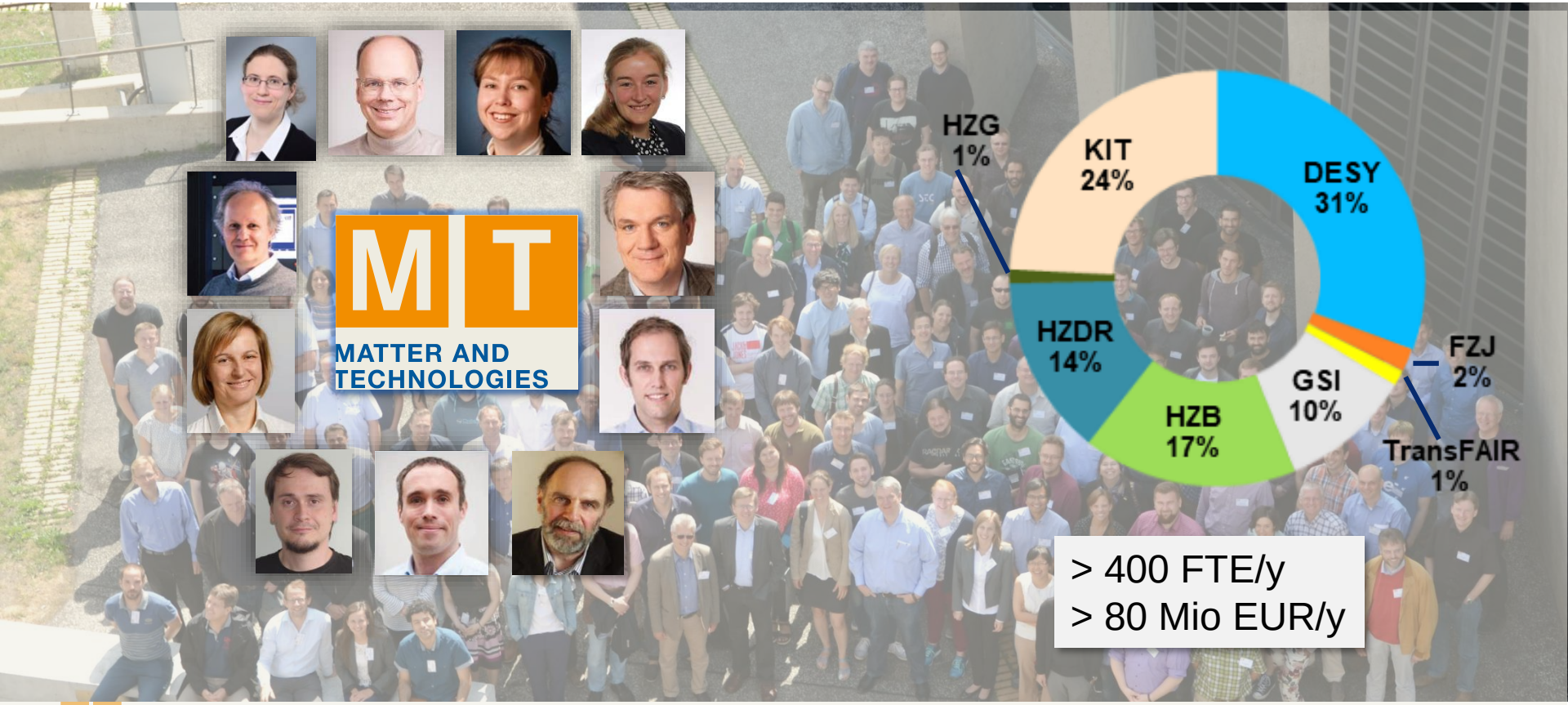
Accelerator Research and Development	**ARD**
Detector Technologies and Systems	**DTS**
Data Management and Analysis	**DMA**

Facilities (LK II)
IDAF

We Research Technologies

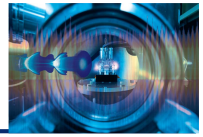
Matter and Technologies

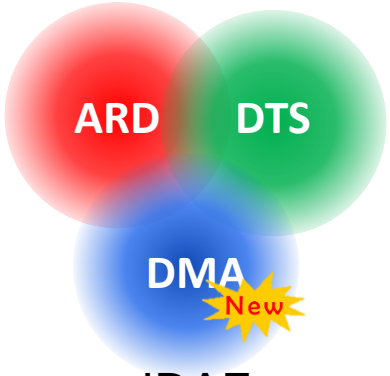




Matter and Technologies

Technologies for Science



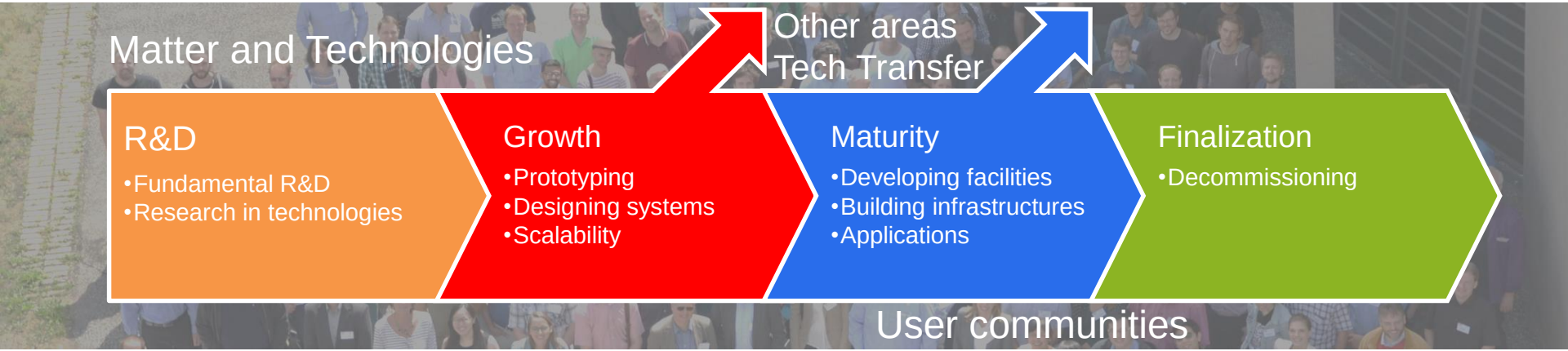


IDAF

Accelerator science
Detector science
Data analytics

- Research in *Matter* is bold and broad
- It relies on people and on advanced technologies

MT is a program for the future of *Matter*
closely intertwined with MML and MU



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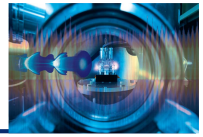

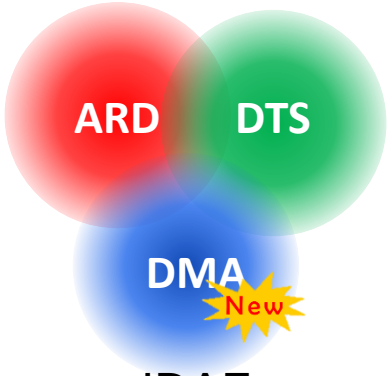

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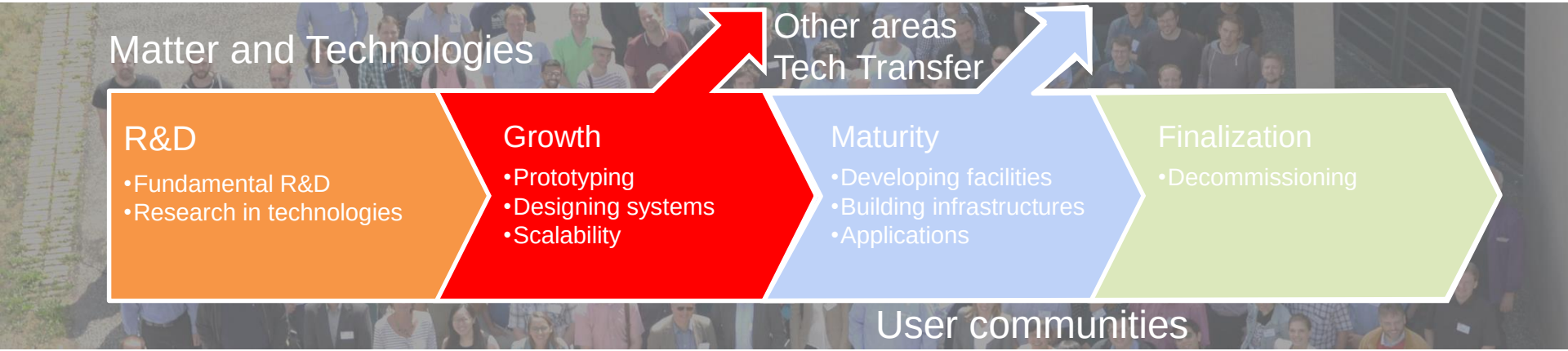
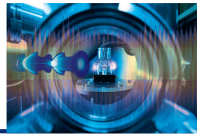


The Challenges

Changing the Way we do Science



Accelerators

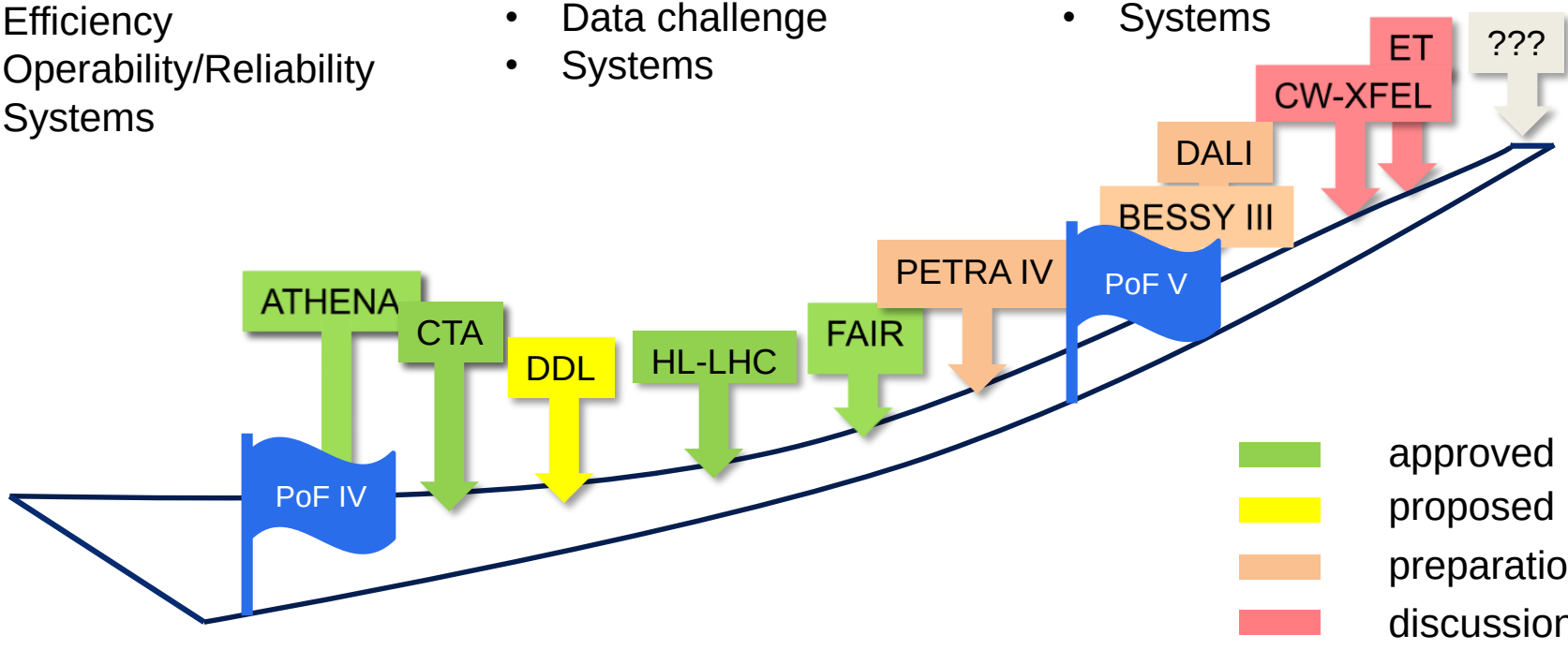
- Performance
- Compactness
- Efficiency
- Operability/Reliability
- Systems

Detectors

- Resolution
- Speed
- Data challenge
- Systems

Data analytics

- Data challenge
- Algorithms
- Systems



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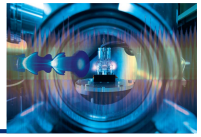

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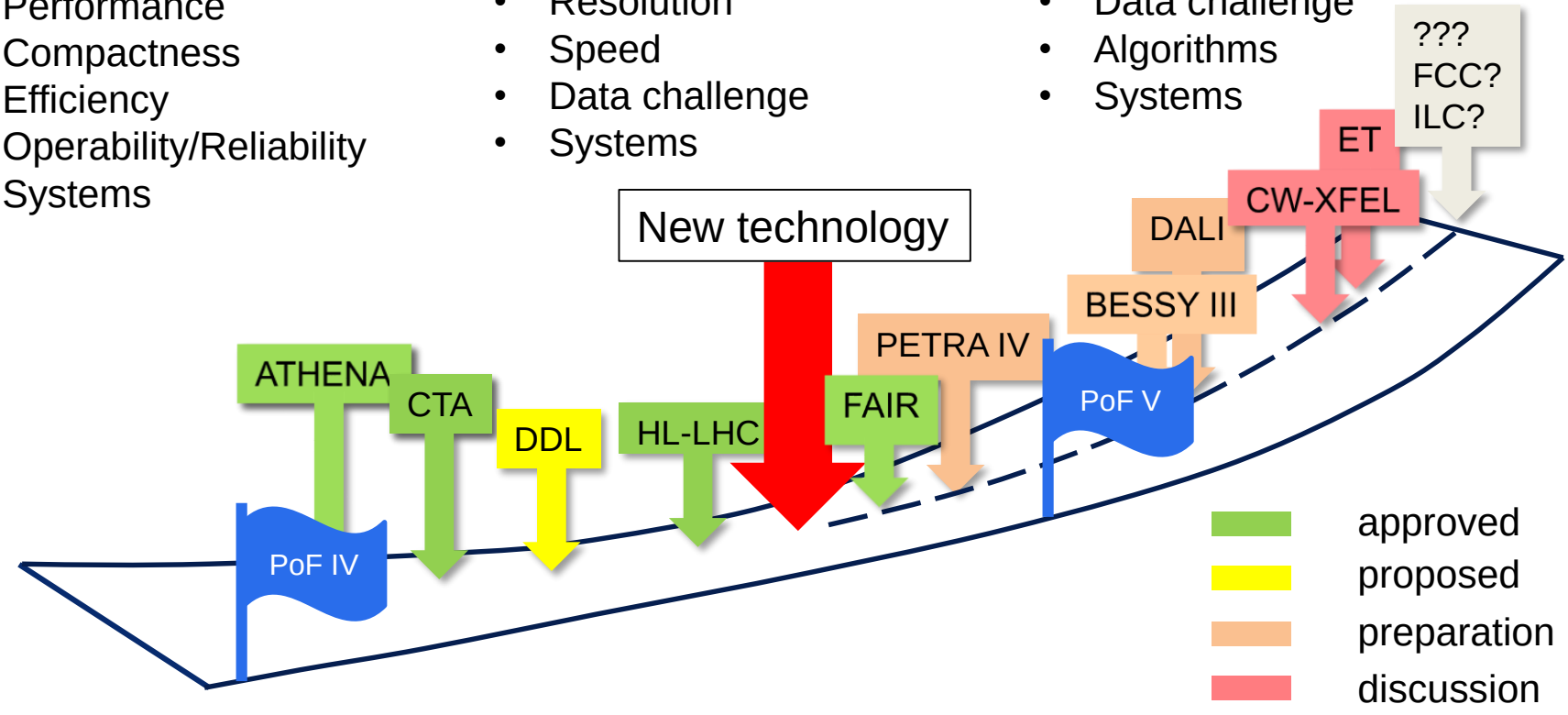

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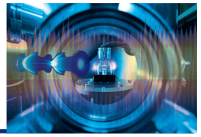

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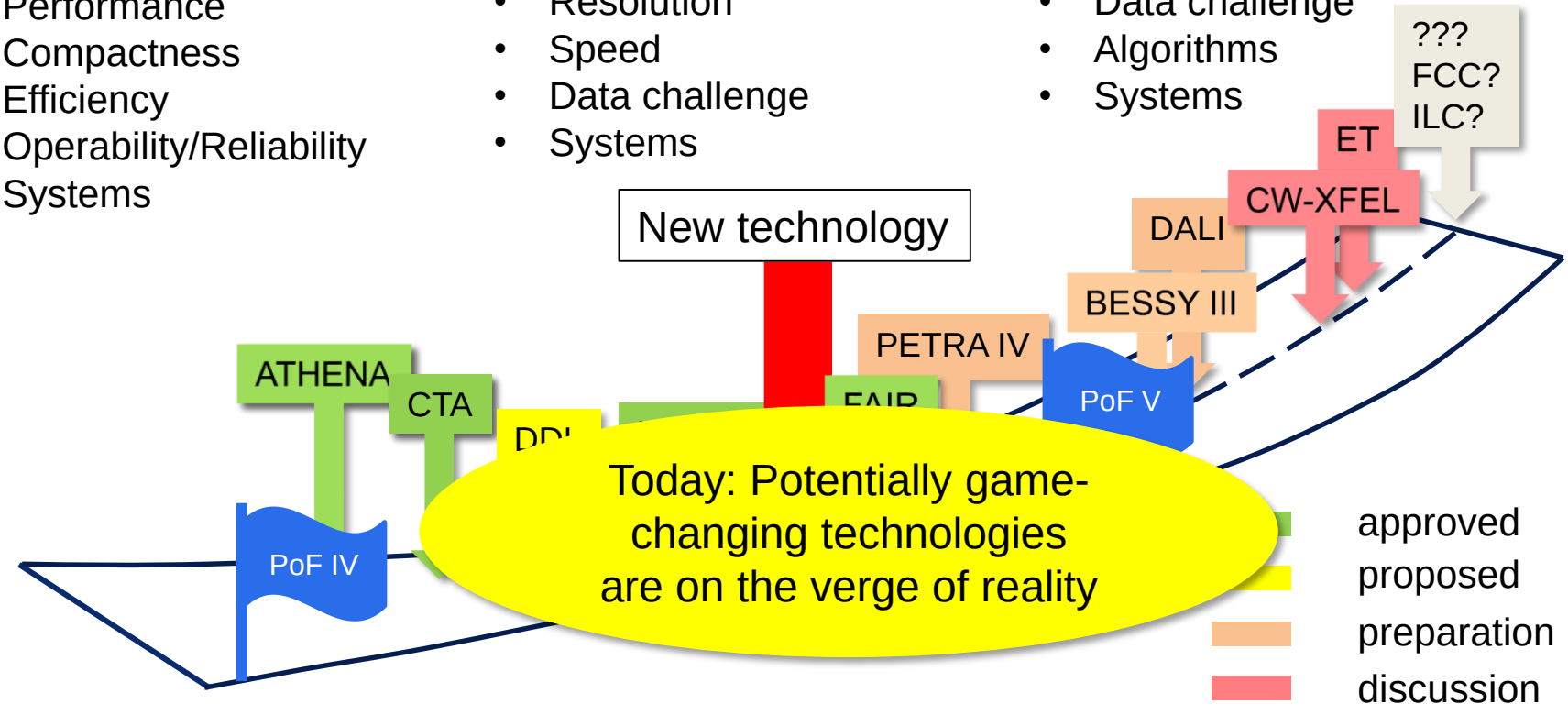
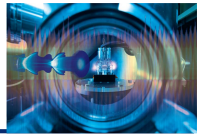


The MT Structure



Program *Matter and Technologies* (MT)
T. Behnke (DESY) | A.-S. Müller (KIT)

Topic *Accelerator Research and Development* (MT-ARD)	Topic *Detector Technologies and Systems* (MT-DTS)	Topic *Data Management and Analysis* (MT-DMA)
A. Jankowiak (HZB) | J. Osterhoff (DESY) DESY, FZJ, GSI* with HIM and HI Jena, HZB, HZDR, KIT	M. Weber (KIT) | S. Masciocchi (GSI) DESY, GSI* with HIM and HI Jena, KIT	M. Bussmann (HZDR) | V. Gülzow (DESY) DESY, FZJ, GSI with HI Jena, HZB, HZDR, HZG
Subtopic 1 *Advanced CW SRF Systems*	Subtopic 1 *Detection and Measurement*	Subtopic 1 *The Matter Information Fabric*
Subtopic 2 *New Concepts and Prototypes for Maximizing the Performance of Hadron and Electron Accelerators*	Subtopic 2 *System Technologies*	Subtopic 2 *The Digital Scientific Method*
Subtopic 3 *Advanced Beam Control, Diagnostics and Dynamics*	Subtopic 3 *Science Systems*	Subtopic 3 *The Digital Experiment and Machine*
Subtopic 4 *Ultra Compact, Novel Accelerators and their Applications*		

LK I

User Facility IDAF
C. Voss

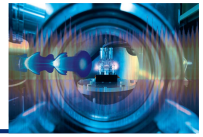
LK II

Management role

- Develop Strategy
- Reconcile Center – Program Strategies
- Foster Cooperation
- Implement Networking
- People

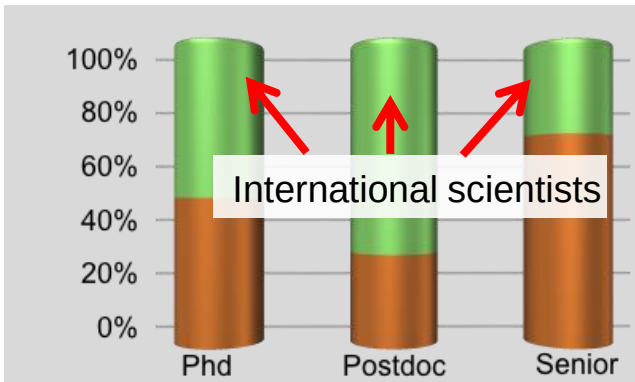
People Matter

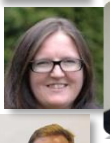
Visibility & Attractiveness of MT

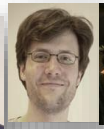


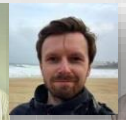
Establish research into technologies as a recognized research activity in its own right
Create visibility and recognition for science and people

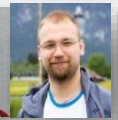
We are a diverse group of excellent and highly motivated people in MT











People

The MT

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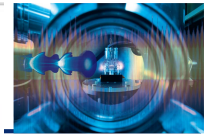

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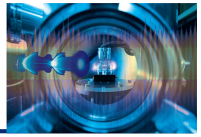
The way into the future: new issues in POFIV

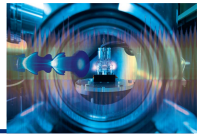


- Data science in a broad sense gains importance
  - ACCLAIM as a new project for machine learning in science
  - DMA is gathering speed
  - Integration into more global activities like Helmholtz Digital Strategy etc

- Sustainability
  - Is our science sustainable
  - Pilot topic in ARD
  - Innoeeva project to initiate concrete projects in this area

Our Way into the Next 7 Years

Our Vision



MATTER AND TECHNOLOGIES

PoF III

Establish MT
Set up structures
Build up infrastructure

ARD
DTS
DMA
New
IDAF

PoF IV

Make new accelerators happen
Push the detection limits
Master the data challenge

- ✓ Exciting Science
- ✓ Research infrastructures
- ✓ Common projects
- ✓ Vibrant community
- ✓ Working structures
- ✓ International visibility

ATHENA

\+ DDL New