

POF V.

Welcome to the MU-FPF retreat

Isabell Melzer-Pellmann, Kai Schmidt-Hoberg
DESY

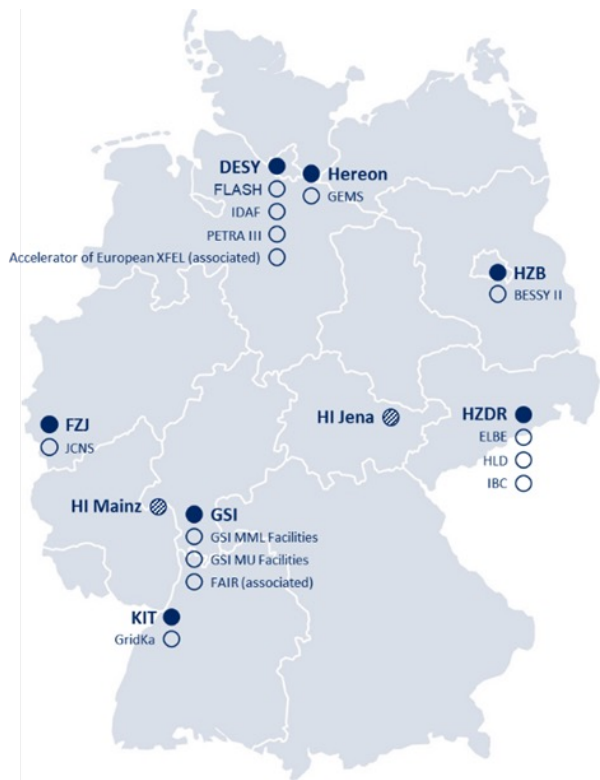
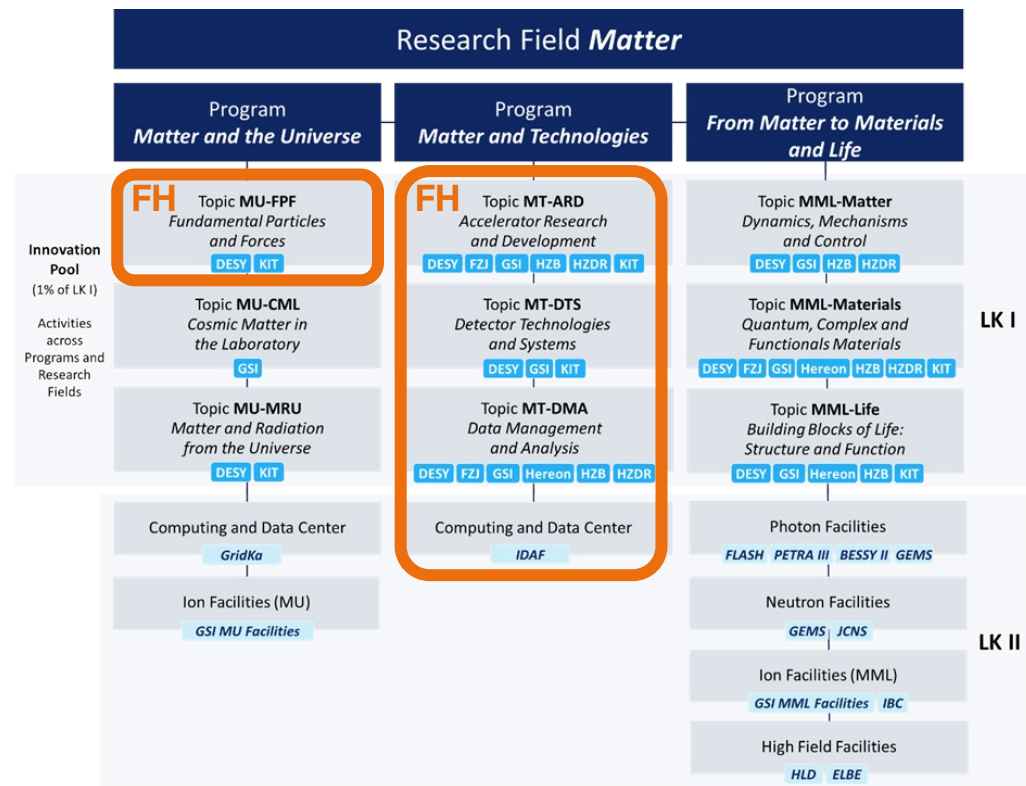
19+20 June 2025

HELMHOLTZ



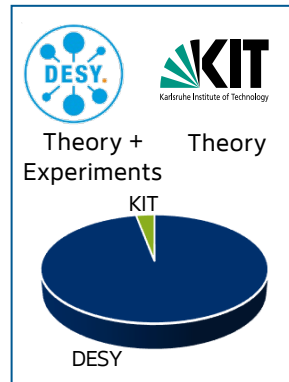
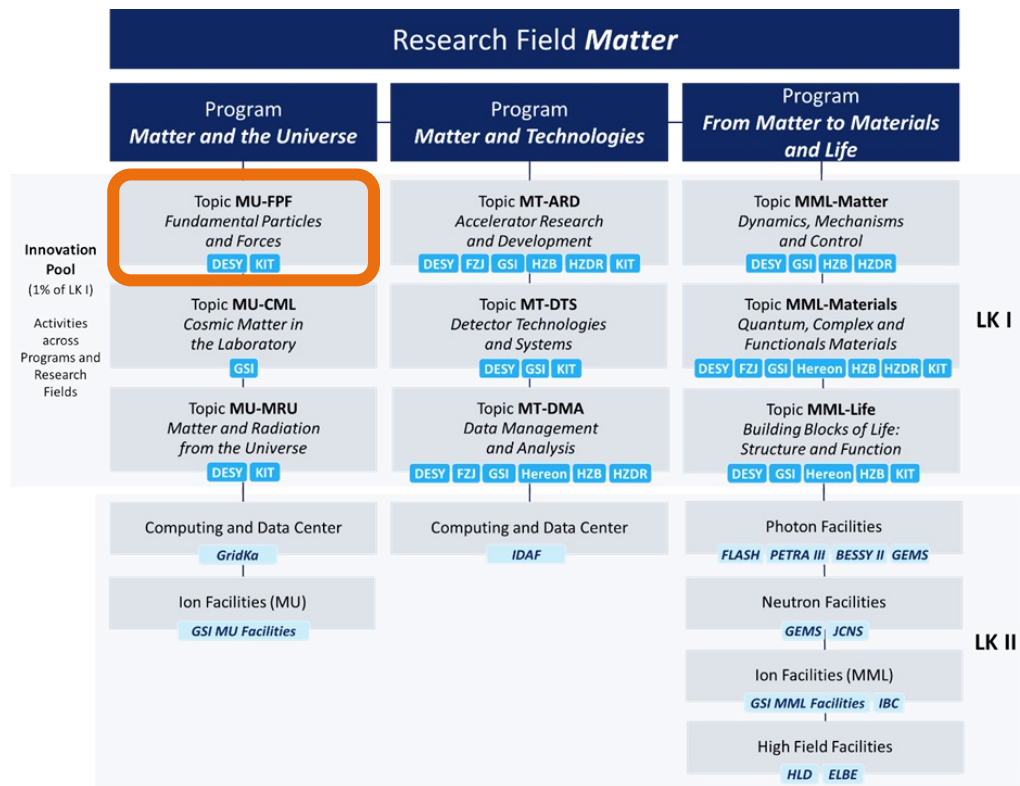
Research field Matter

The status quo in PoF IV



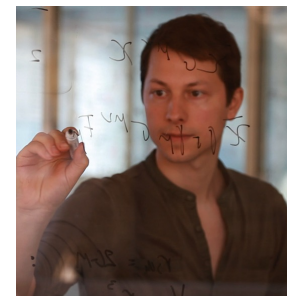
Research field Matter

Topic "Fundamental Particles and Forces" aka FPF



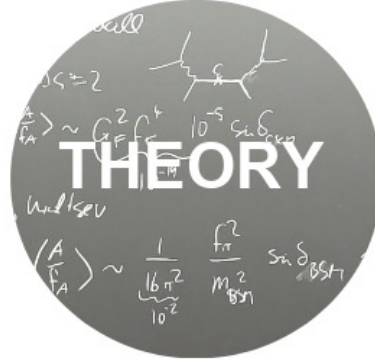
- 2 Helmholtz centers
- 3 locations
- 158 scientists
- 78 Ph.D. students
- 34 MEUR costs / a
- 42 nationalities (numbers from 2023)

Topic spokespersons:
Isabell Melzer-Pellmann, Kai Schmidt-Hoberg



Towards PoF V

Focus areas in MU-FPF (Fundamental Partices and Forces)



Off-site experiments:

Key contributions (data analysis, commissioning and operation) to global projects at CERN and KEK:

- ATLAS and CMS
- Belle II

Engage in future collider decision and preparation

New detector project?

Theory:

Establish the Wolfgang-Pauli Center as world-leading interdisciplinary center for theoretical physics

Idea factory for future science endeavours

On-site experiments:

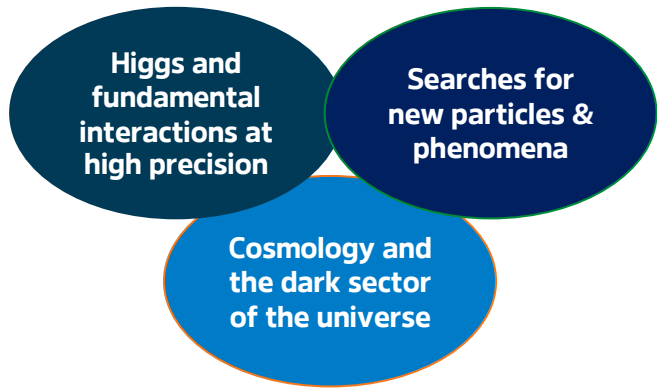
- Planned axion experiments: BabyIAXO, MADMAX
- QED at the extreme: LUXE

New ideas:

- VMB @ ALPS II
- High-frequency GW experiments

Changes from PoF IV to PoF V

Foreseen change / adaption of subtopic structure



PoF IV → PoF V

Pushing the limits of our understanding of fundamental interactions

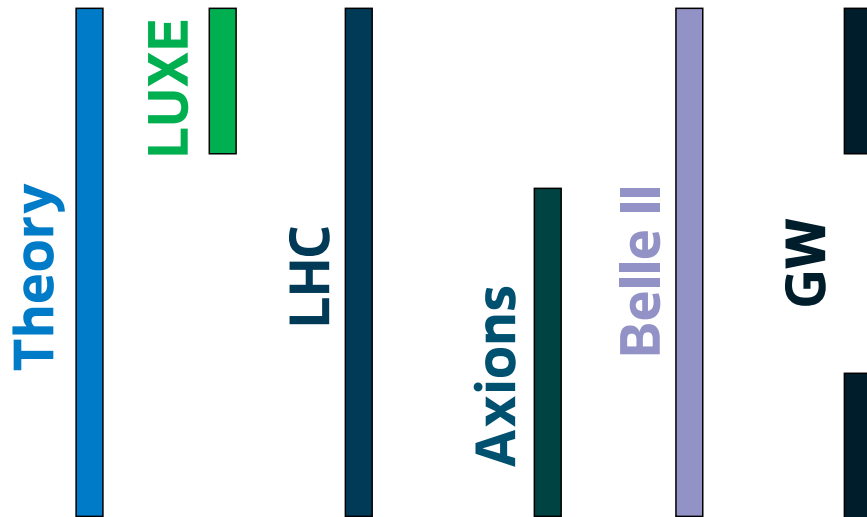
The origin of mass, the flavour puzzle, and the imbalance between matter and anti-matter

The evolution of the early universe and the nature of the dark sector

Motivation for the change: closer to the science drivers, less thematic overlap between subtopics.

Changes from PoF IV to PoF V

Foreseen change / adaption of subtopic structure



Pushing the limits of our understanding of fundamental interactions

The origin of mass, the flavour puzzle, and the imbalance between matter and anti-matter

The evolution of the early universe and the nature of the dark sector

Testbeam Facility (DESY)



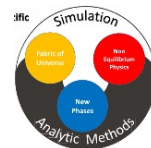
Detector Assembly Facility (DAF, DESY)



Computing Centres GridKa and IDAF



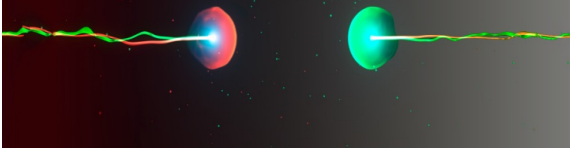
Wolfgang Pauli Centre



PoF V Subtopic Structure and Science Drivers

Our science drivers address the big questions of nature: Understanding the quantum universe

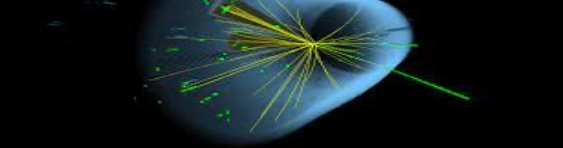
Fundamental interactions



Pushing the limits of our understanding of fundamental interactions

- Strong-field QED
- QCD (incl. lattice calc.)
- Electroweak (EW) precision and Higgs physics (HH and Higgs potential)
- Searches for extensions of the SM (e.g. SUSY, additional gauge bosons,...)
- Search for the unknown (aka anomaly detection)

The mass puzzle



The origin of mass, the flavour puzzle, and the imbalance between matter and anti-matter

- Dynamics of EW symmetry breaking
- Higgs as portal to new physics
- Search for additional Higgs bosons
- Top and B and Tau physics
- Charge-parity violation
- Lepton flavor universality

The dark universe



The evolution of the early universe and the nature of the dark sector

- Cosmology (inflation, baryogenesis,...)
- Searches for dark matter candidates (incl. collider searches, Axions, ALPs,...)
- Gravitational waves
- EW phase transition

Timeline for submission of the strategy report

- **Today**
FH MU-FPF retreat to collect input for the writing team
- **21 July**
Present first summary of the strategy (including inputs from retreat) at the FH retreat
Collect further input during the retreat
- **Summer 2025 (~July, not yet defined further)**
Definition of the "Startwerte" by the DESY directorate
- **15 August**
Writing team to finalize input for first version for FPF and then circulation with FH internal reviewers
- **~September:**
First version of the report should be ready
- **15 December 2025**
Handing in of the report; then discussion in the MB, layout and proof-reading
- **17 March 2026**
Final version to be handed in

Let's get started!

Questions to be answered in the report

- **Brief description of challenges, scientific goals and strategic relevance, also in relation with research policy objectives and in the context of international developments.**
- **Key questions:**
 - How would you rate the objectives of the topic with regard to **scientific relevance and leadership**?
 - Which pressing societal or **scientific challenges** does it address?
 - How would you rate the topic's potential **impact** with regard to the research field, its technologies and its societal context?
 - How would you evaluate its **alignment with the research policy objectives** of the research field (and with the strategy of the program)?
 - Do you envision **further objectives** that the topic should consider addressing?

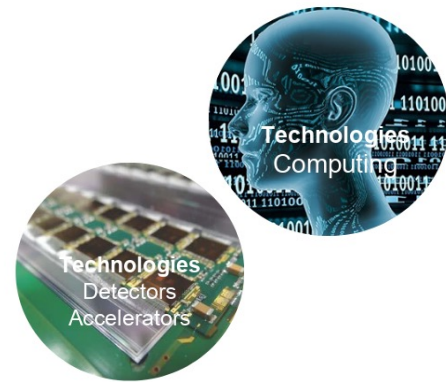
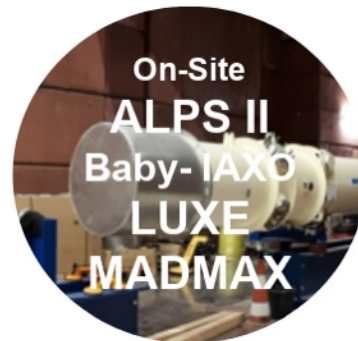
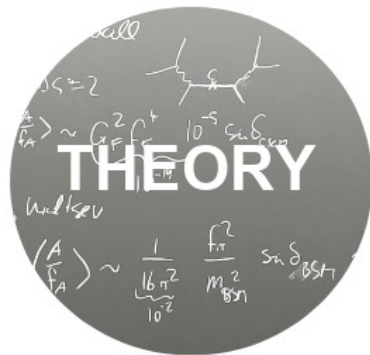
Panel members nearly finalized

Norbert	Holtkamp	SLAC, USA (Chair)
Klaus	Blaum	MPG, Germany
Pascale	Ehrenfreund	GWU, USA
Trevor	Forsyth	LINXS, Sweden
Giovanna	Fragneto**	ESS, Sweden
Rolf	Heuer	
Berthold	Schmidt	TRUMF, Germany
Ora	Furman	Hebrew University of Jerusalem, Israel
Patrizia	Rossi	Jefferson Lab, USA
Christian	Rüegg	PSI, Switzerland, Chair
Francesco	Sette	ESRF, France
Daniel	Zajfman	Weizmann, Israel

Backup / further info

Particle Physics at DESY: the Next 10-15 Years

Specific focus areas



Key contributions to global projects at CERN and KEK

- HL-LHC preparation and running in 2029 onwards
- Belle II: expect ~50/ab by 2034

Engage in planning and preparation for future projects (EPPSU decision by 2028)

Maintain broad and world-leading portfolio.

Establish WPC as world-leading interdisciplinary center for theoretical physics

Theory as "Idea factory"

ALPS II: first science run started running in May 2023.

BabyIAXO, LUXE: Solve challenges & find financial resources for PoF V

MADMAX: proof concept in prototyping phase & find financial resources

New ideas, e.g. HF GW local experiments (complementing ET)

~50% of topic resources go into technical work!

Strengthen innovation in detectors and computing

Increase 3rd party funding

Strengthen exchange across divisions

Mid- and Long-Term Strategy

Fundamental Particles and Forces

