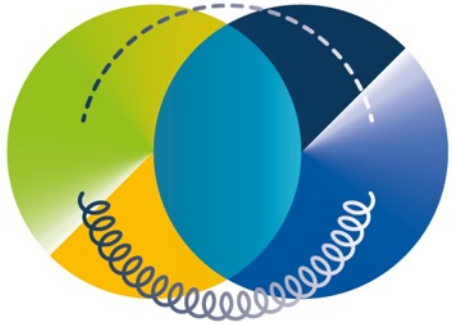


color meets flavor

Search for new phenomena in strong and weak interactions

Introductory meeting for Early-Career Researchers

UNIVERSITÄT BONN

technische universität dortmund

UNIVERSITÄT SIEGEN

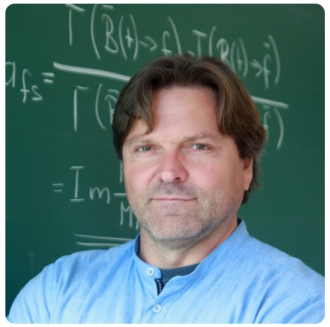
JÜLICH Forschungszentrum

THE CmF TEAM

Spokesperson and co-spokespersons

Prof. Dr.
Jochen Dingfelder
University of Bonn
Spokesperson

Prof. Dr.
Johannes Albrecht
TU Dortmund University
Co-Spokesperson



Prof. Dr.
Alexander Lenz
University of Siegen
Co-Spokesperson

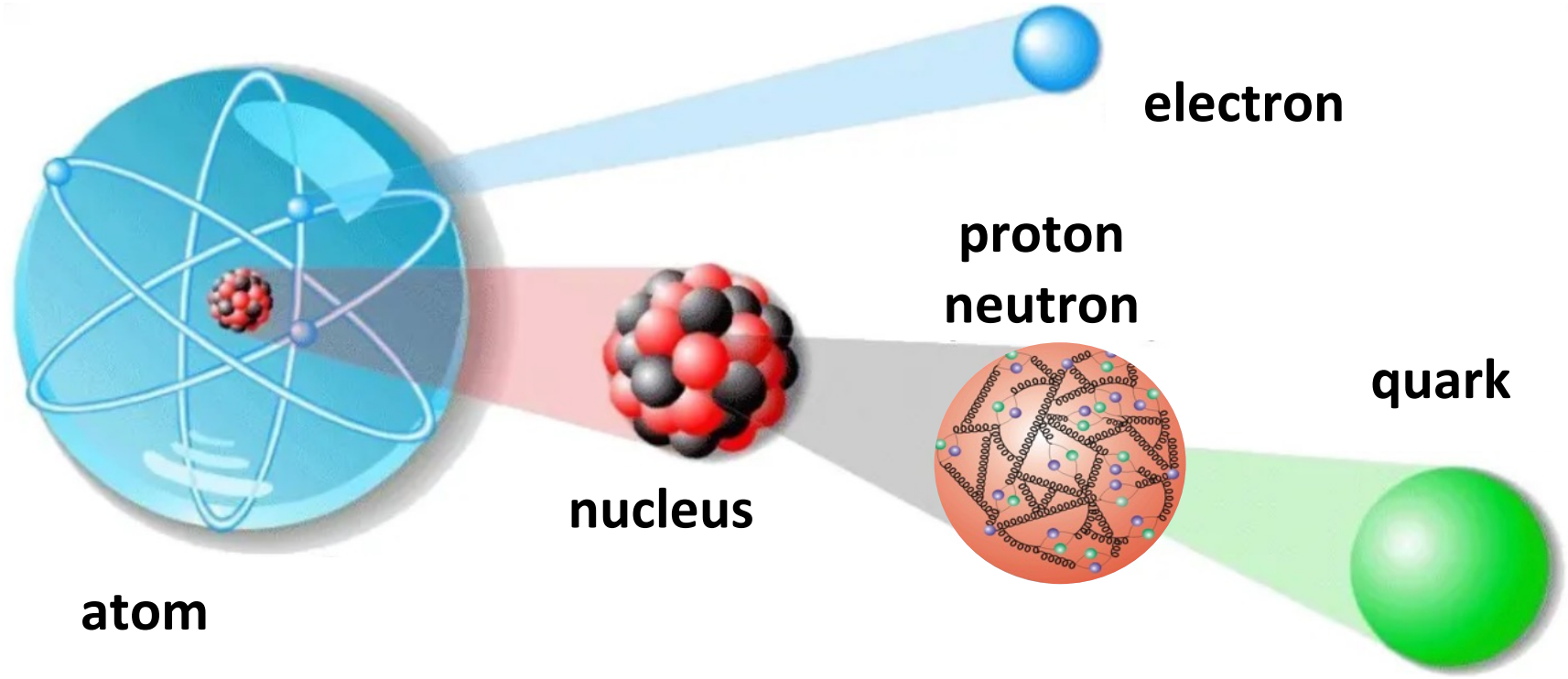
Prof. Dr. Dr. h.c.
Ulf-G. Meißner
Forschungszentrum Jülich
Co-Spokesperson

CmF team ... at constituent meeting in Dortmund

OVERVIEW

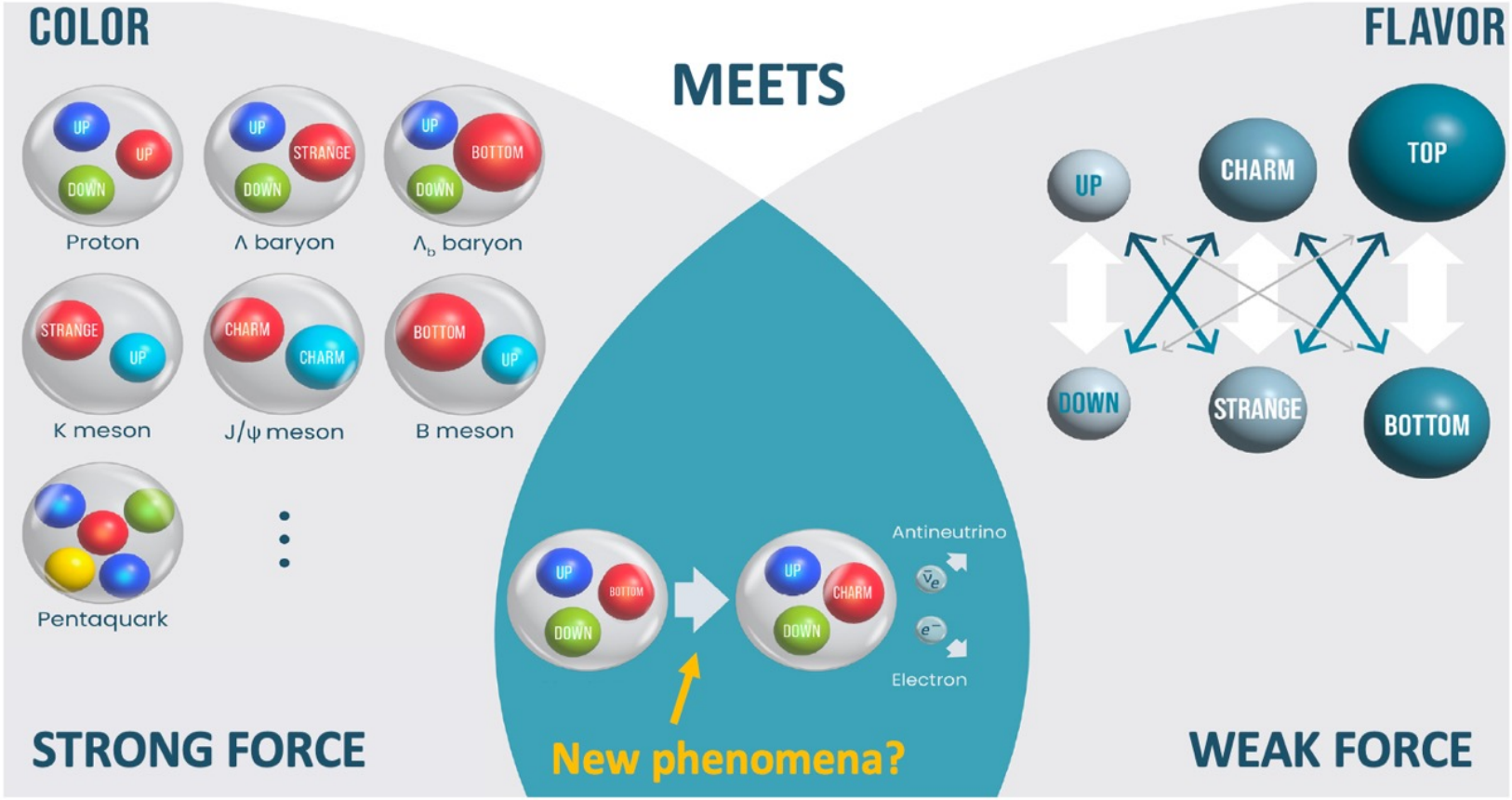
1. **Introduction to CmF**
   - Idea of CmF
   - Research program & goals
   - Structures
   - Governance and administration (Cluster Office)
2. **Becoming a CmF member**
3. **Opportunities for early-career researchers (ECR)**
4. **Discussion time: Q&A**
5. **ECR representatives in CmF**

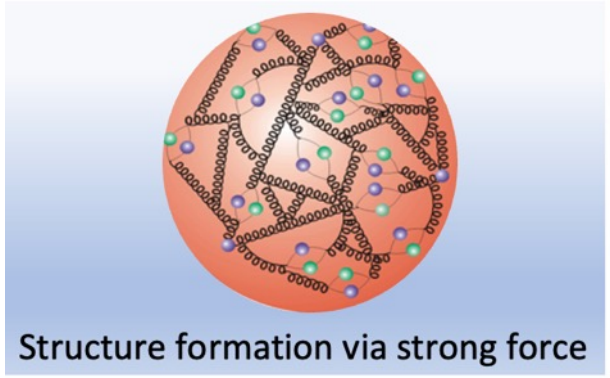
How does matter emerge?

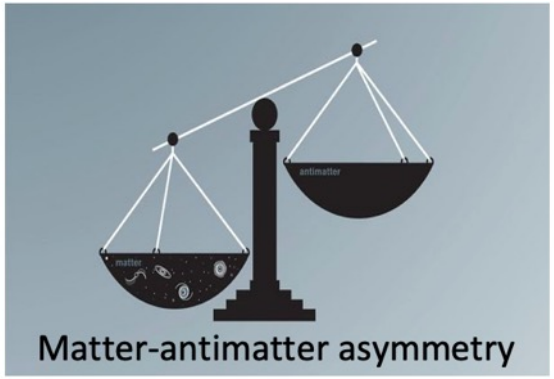


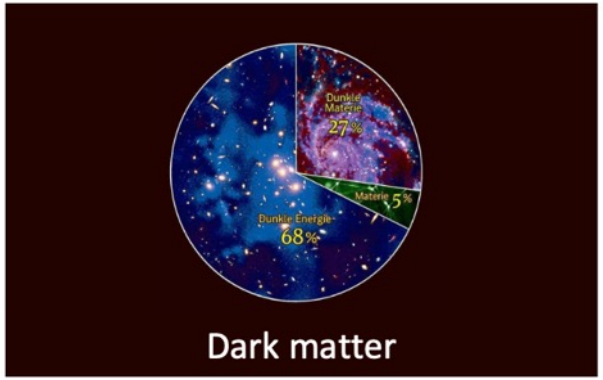
Why is there matter?

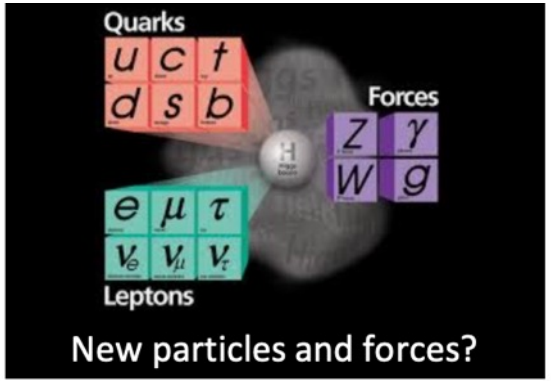
COLOR AND FLAVOR



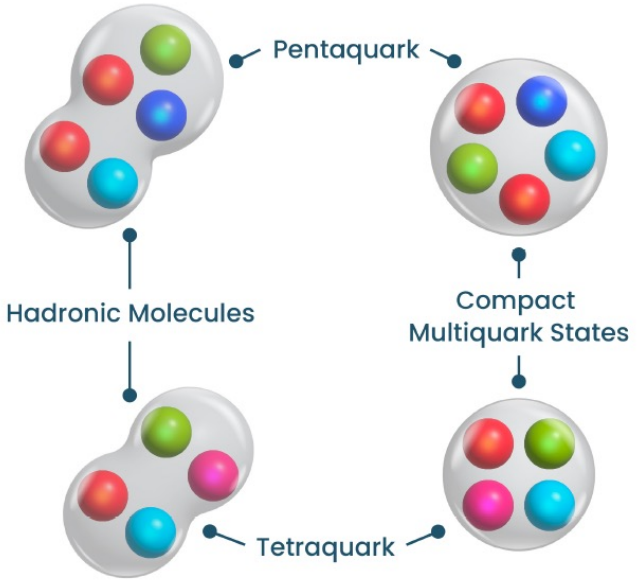




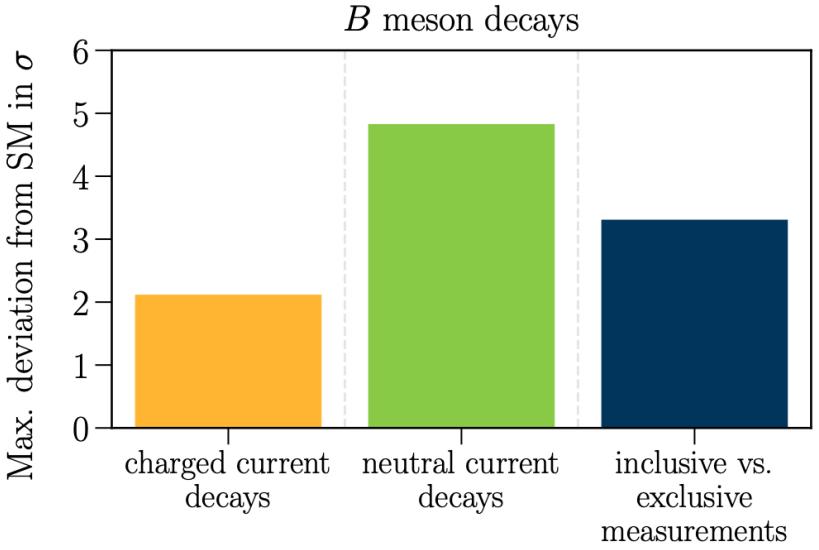




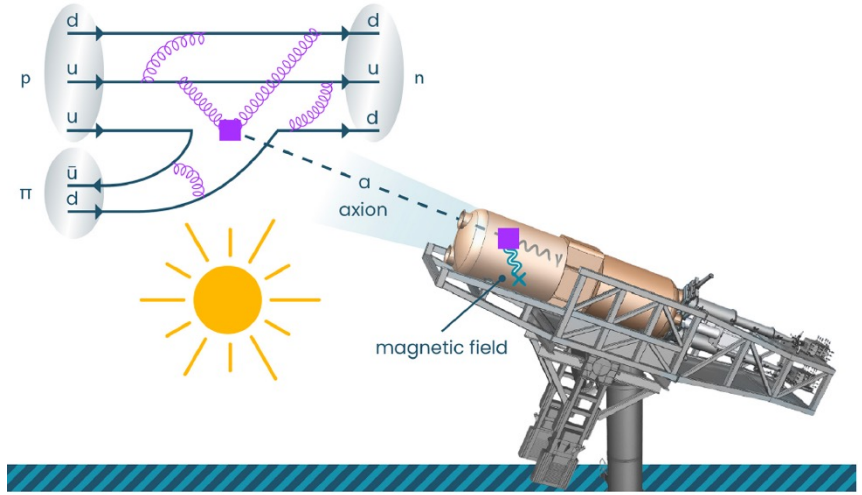
WHY NOW?



First observations of
exotic multi-quark hadrons

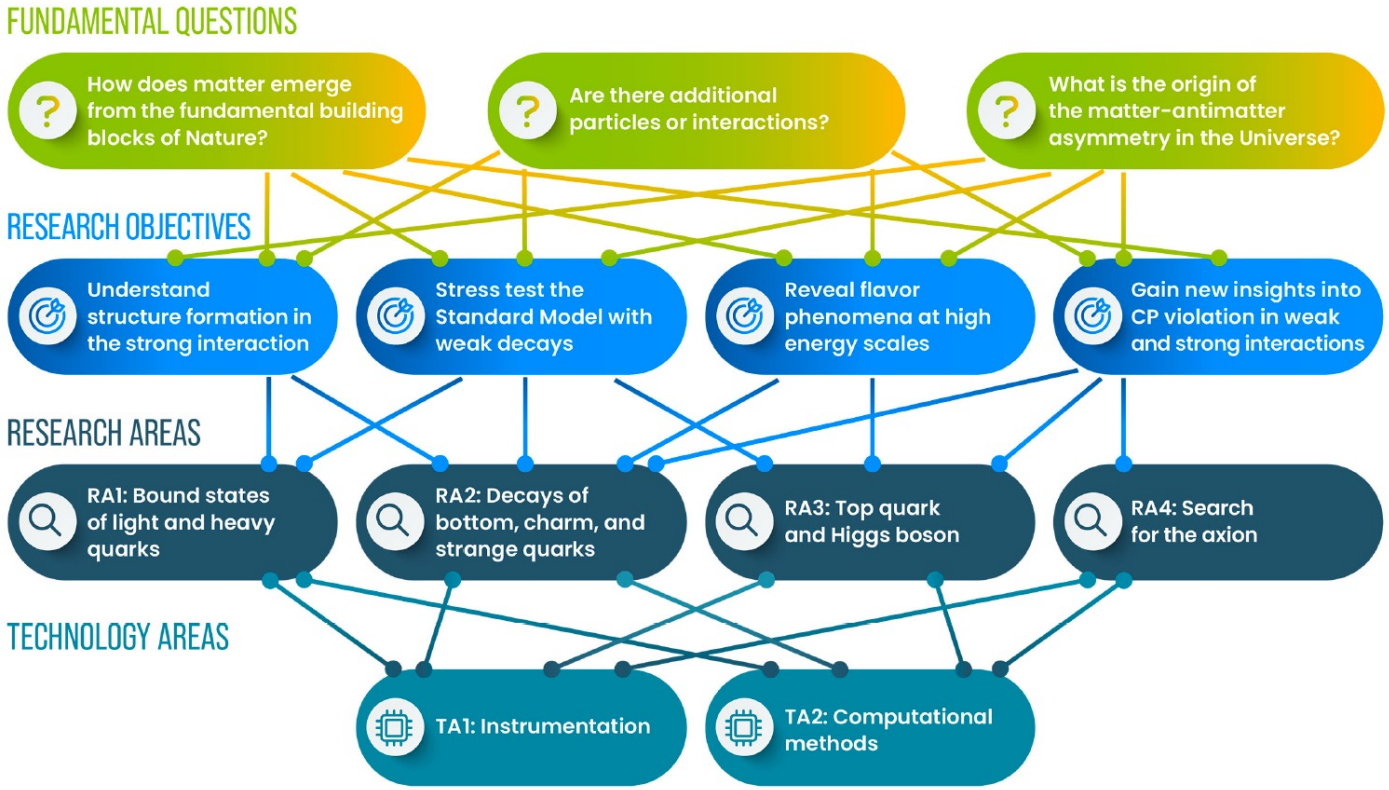


Intriguing measurements
of hadron decays
Flavor anomalies



Strong CP problem
Next-generation axion searches

OBJECTIVES – RESEARCH



Research Objectives

Research (Physics)

1 **Understand structure formation in the strong interaction**
- Spectrum and properties of hadrons
- Search for exotic hadrons in the light and heavy flavor sectors
- Understand the inner structure of hadrons

2 **Stress test the Standard Model with weak decays**
- Strong interaction effects in weak decays of hadrons
- Search for new phenomena in flavor transitions
- Understand the origin of the current flavor anomalies

3 **Reveal flavor phenomena at high energy scales**
- New phenomena in top-quark and Higgs-boson physics
- Search for additional Higgs bosons (extended Higgs sectors)
- Connect precision measurements between all energy scales

4 **Gain new insights into CP violation in weak and strong interactions**
- World-leading searches for the axion
- CP-violating top-quark and Higgs-boson couplings
- Flavor structure of the Standard Model

PERFECT TEAM

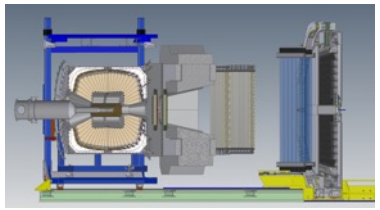
CmF groups **complement each other** in an ideal way and **cover whole energy spectrum**

	UP, DOWN	STRANGE	CHARM	BOTTOM	TOP	HIGGS	AXION
Experiments	INSIGHT @ ELSA (Bonn) AMBER (CERN)		LHCb (CERN) Belle II (KEK)		ATLAS (CERN)		BabyIAXO (DESY) SUPAX (Bonn)
Experimental Groups	Bonn, Dortmund, Siegen		Bonn, Dortmund		Bonn, Dortmund, Siegen	Bonn, Siegen, Dortmund	Bonn, Siegen, Dortmund
Theoretical Groups	Bonn, Jülich		Siegen, Dortmund, Bonn, Jülich		Bonn, Dortmund, Siegen	Bonn, Siegen	Bonn, Dortmund

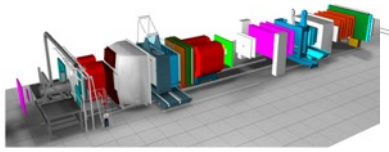
Theories

Chiral Perturbation Theory — Lattice QCD — Heavy Quark Effective Theory — SMEFT — Perturbative QCD

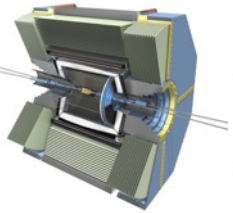
Experiments



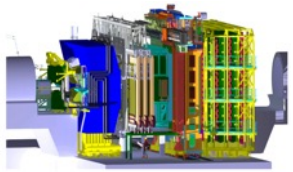
INSIGHT@ ELSA



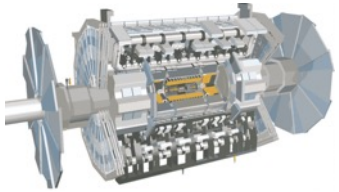
AMBER



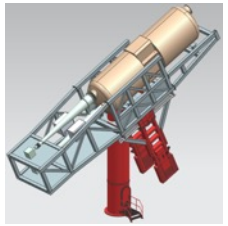
Belle II



LHCb

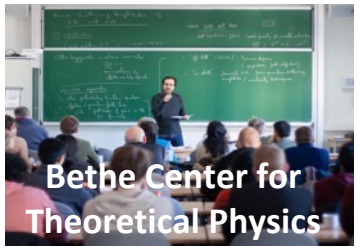


ATLAS



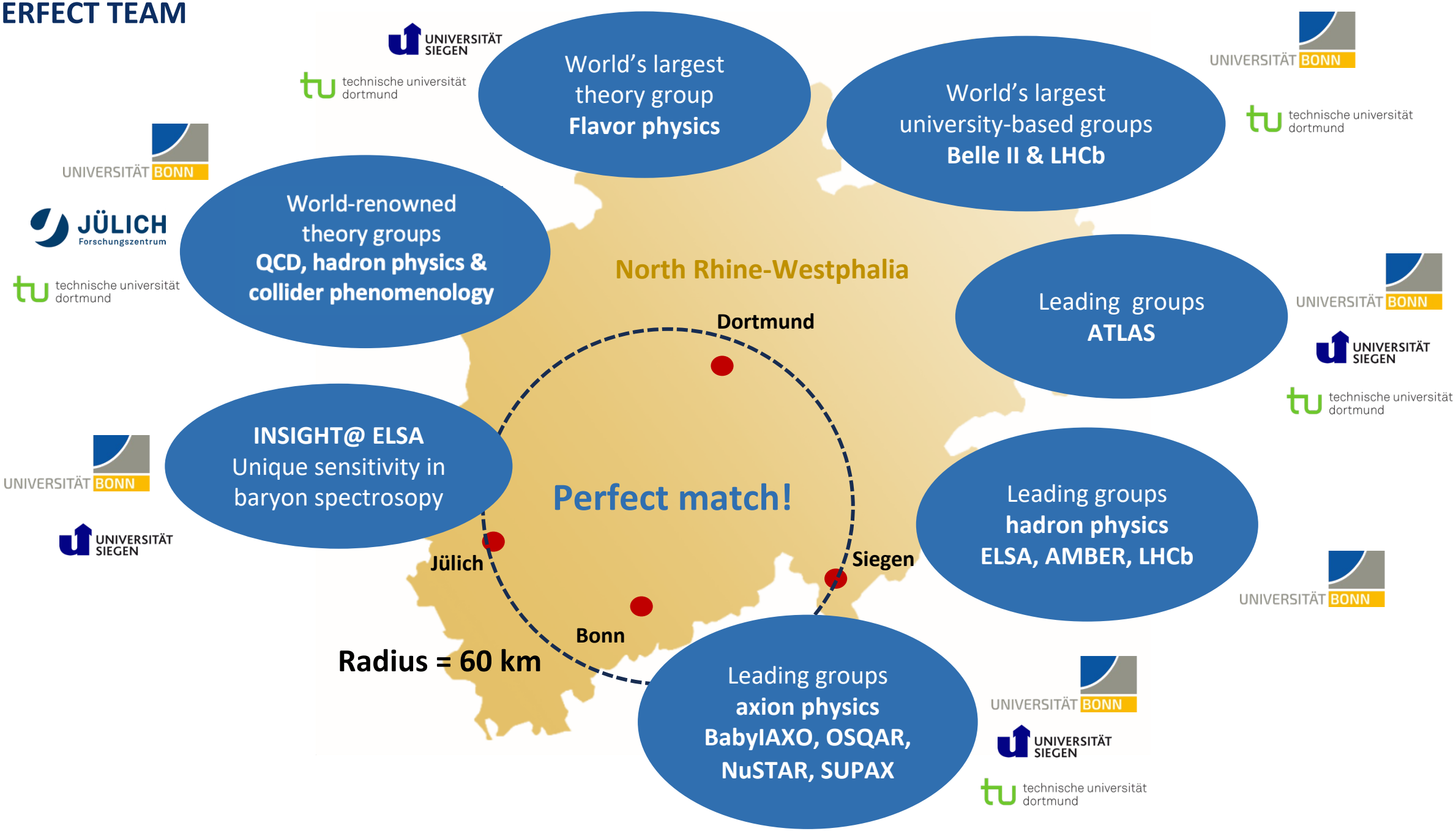
BabyIAXO

Infrastructures



World-leading center for the strong and weak interactions

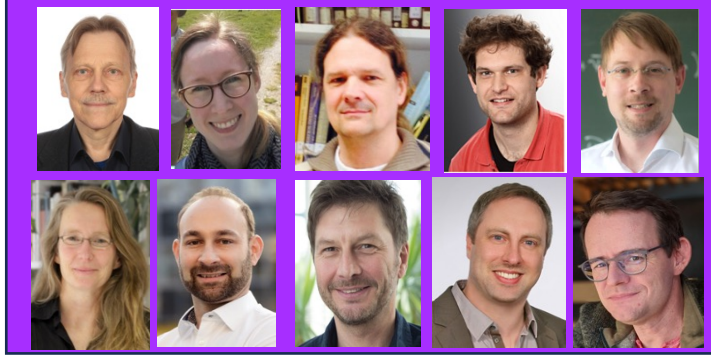
PERFECT TEAM



EXISTING COOPERATIONS AS SEED OF THE CLUSTER

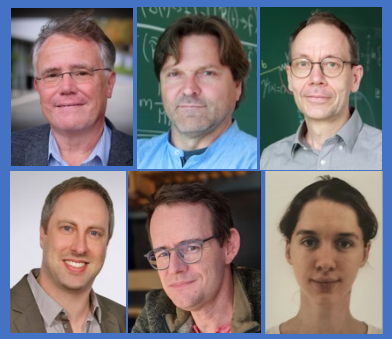
Jülich – Bonn

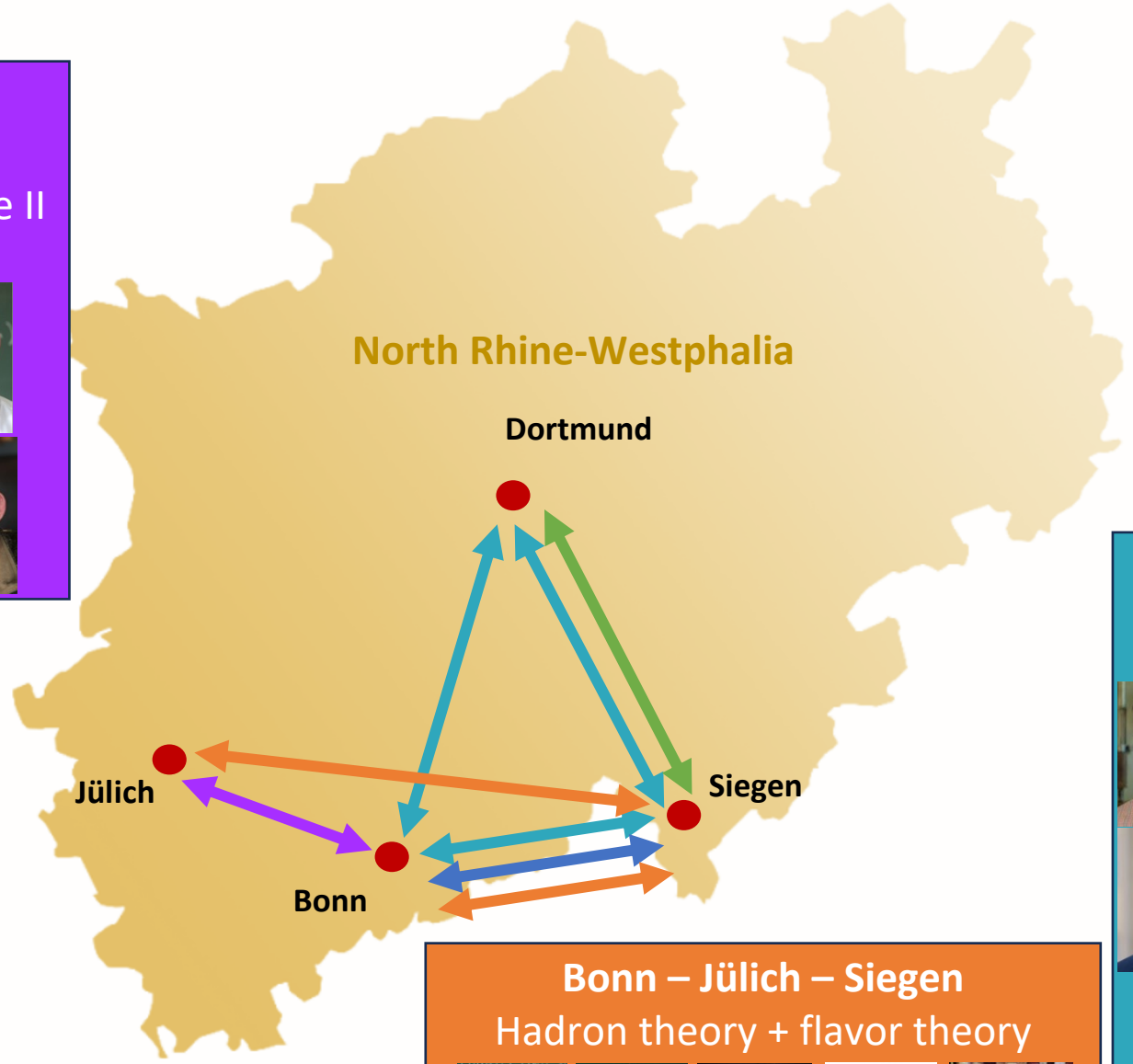
Hadron theory + ELSA, LHCb, Belle II



Siegen – Bonn

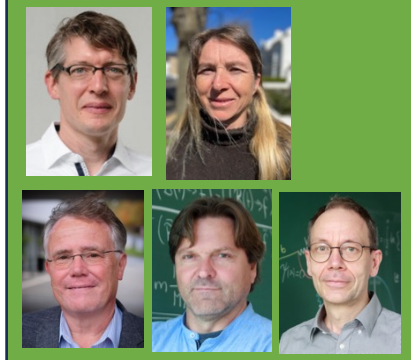
Flavor theory + Belle II





Siegen – Dortmund

Flavor theory + LHCb



Bonn – Dortmund – Siegen

ATLAS / high-energy theory

Axion physics

Bonn – Jülich – Siegen

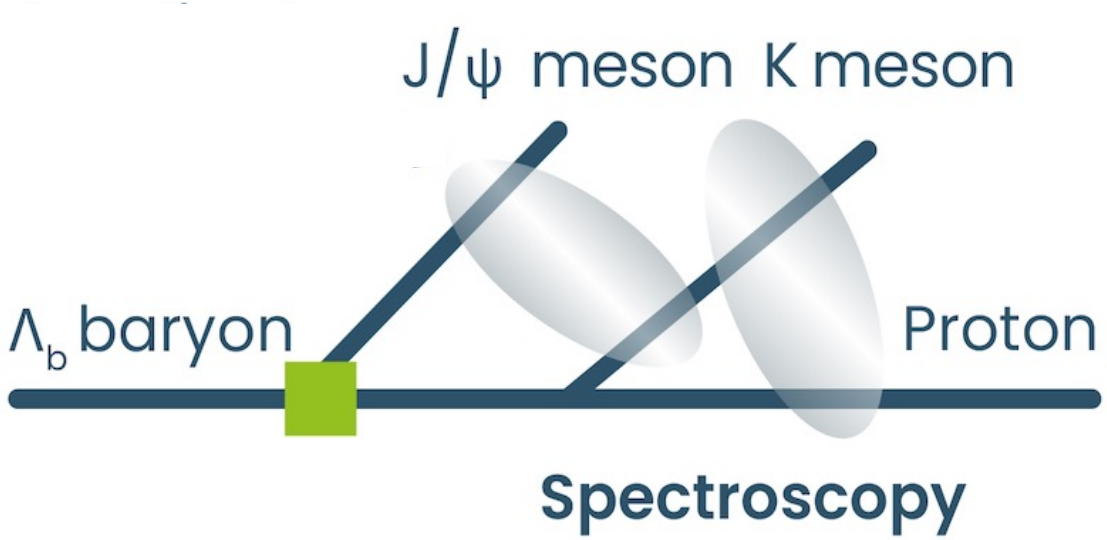
Hadron theory + flavor theory

color meets flavor

RESEARCH PROGRAM

HADRON PHYSICS

STRONG INTERACTION EFFECTS

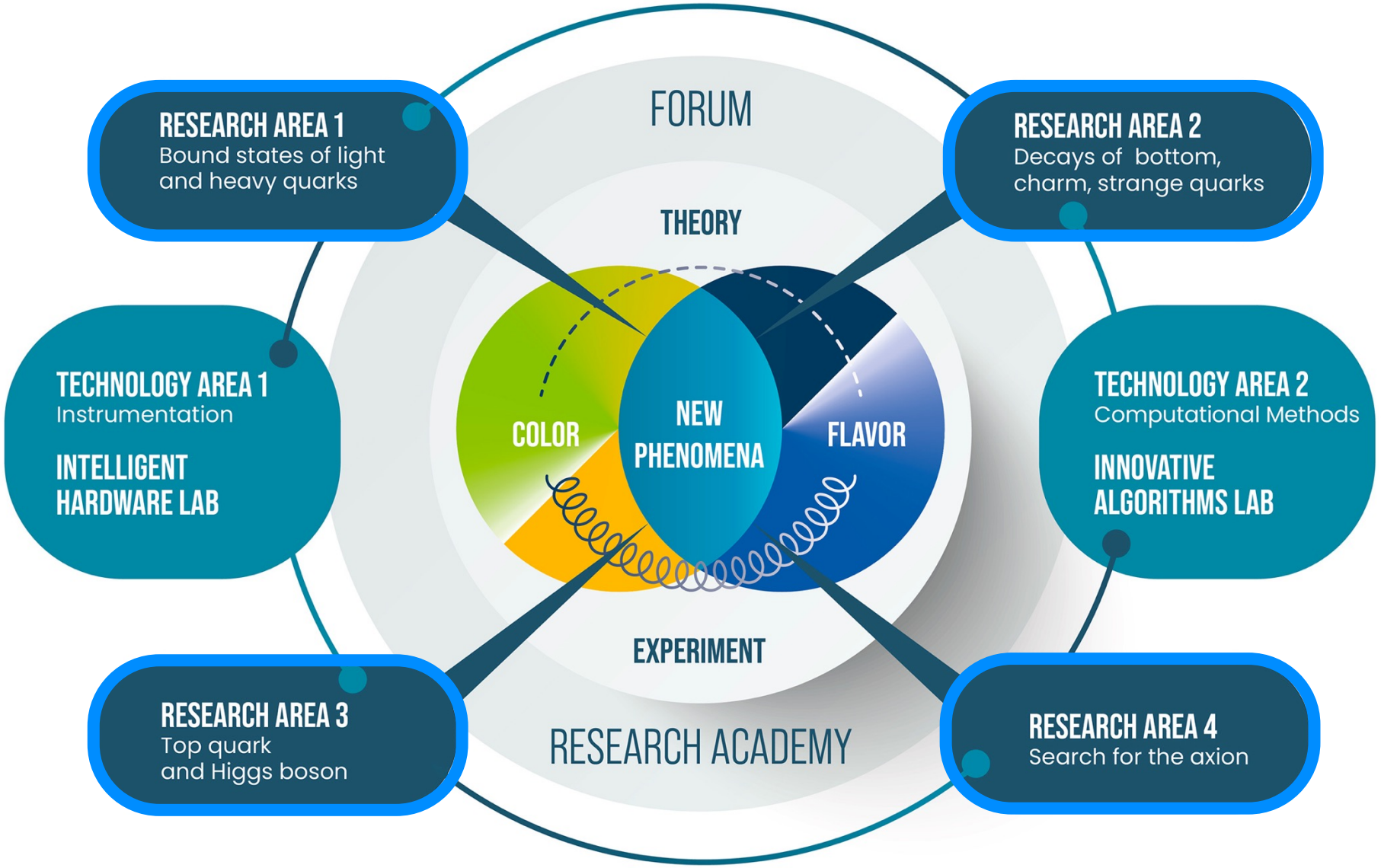


FLAVOR PHYSICS

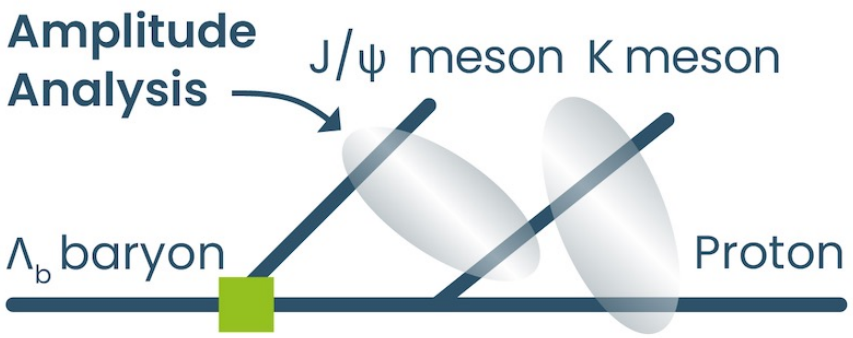
FUNDAMENTAL PROCESS OF WEAK INTERACTION

Requires close collaboration between
hadron physics and high-energy & flavor physics

RESEARCH STRUCTURE

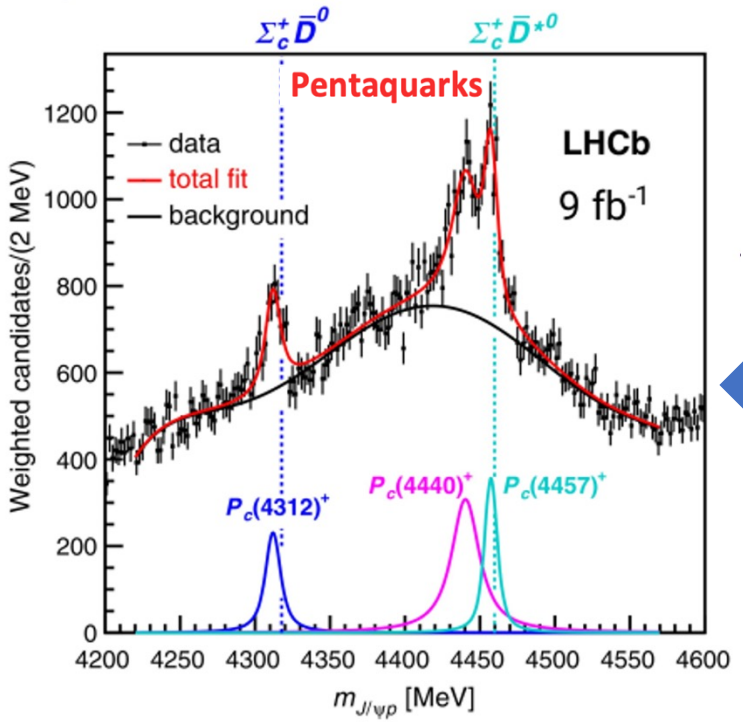


CmF RESEARCH – STRUCTURE FORMATION AND EXOTIC HADRONS



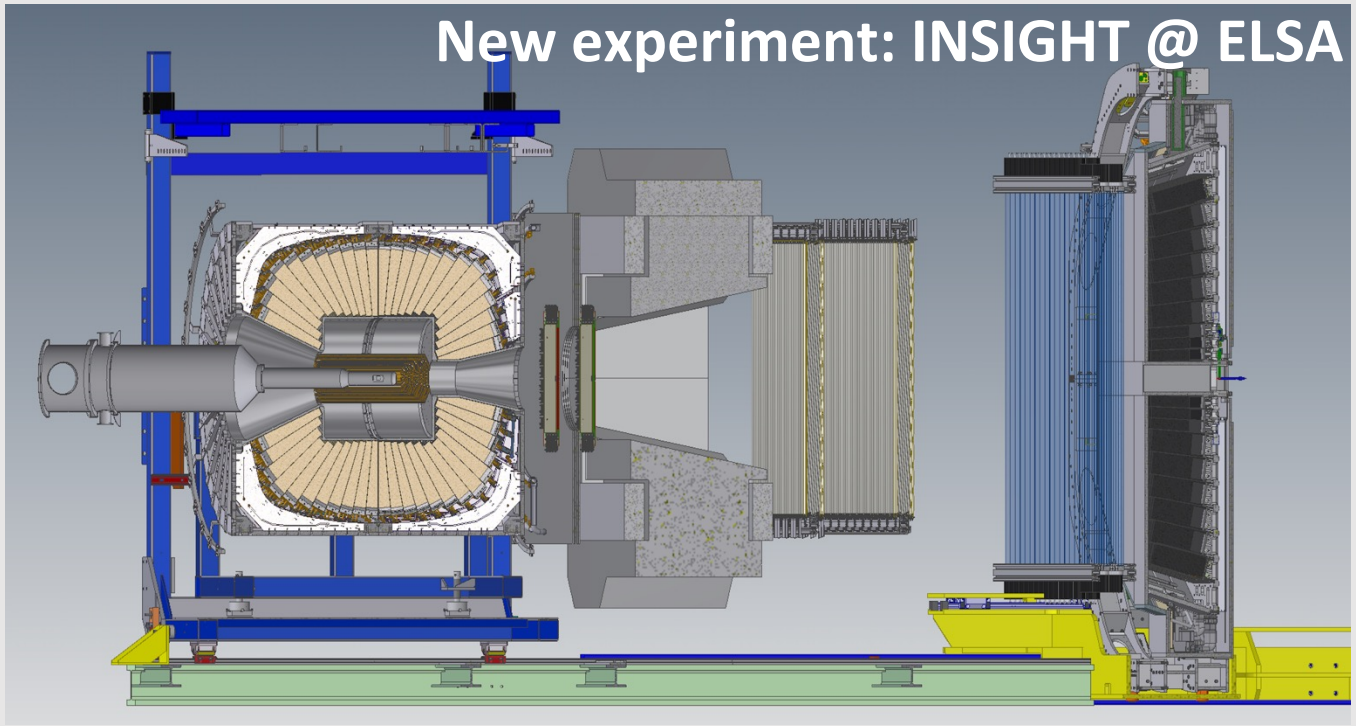
Heavy-flavor quark

Spectroscopy



Common analyses

Properties of exotic hadrons



Polarized beam and **polarized target**

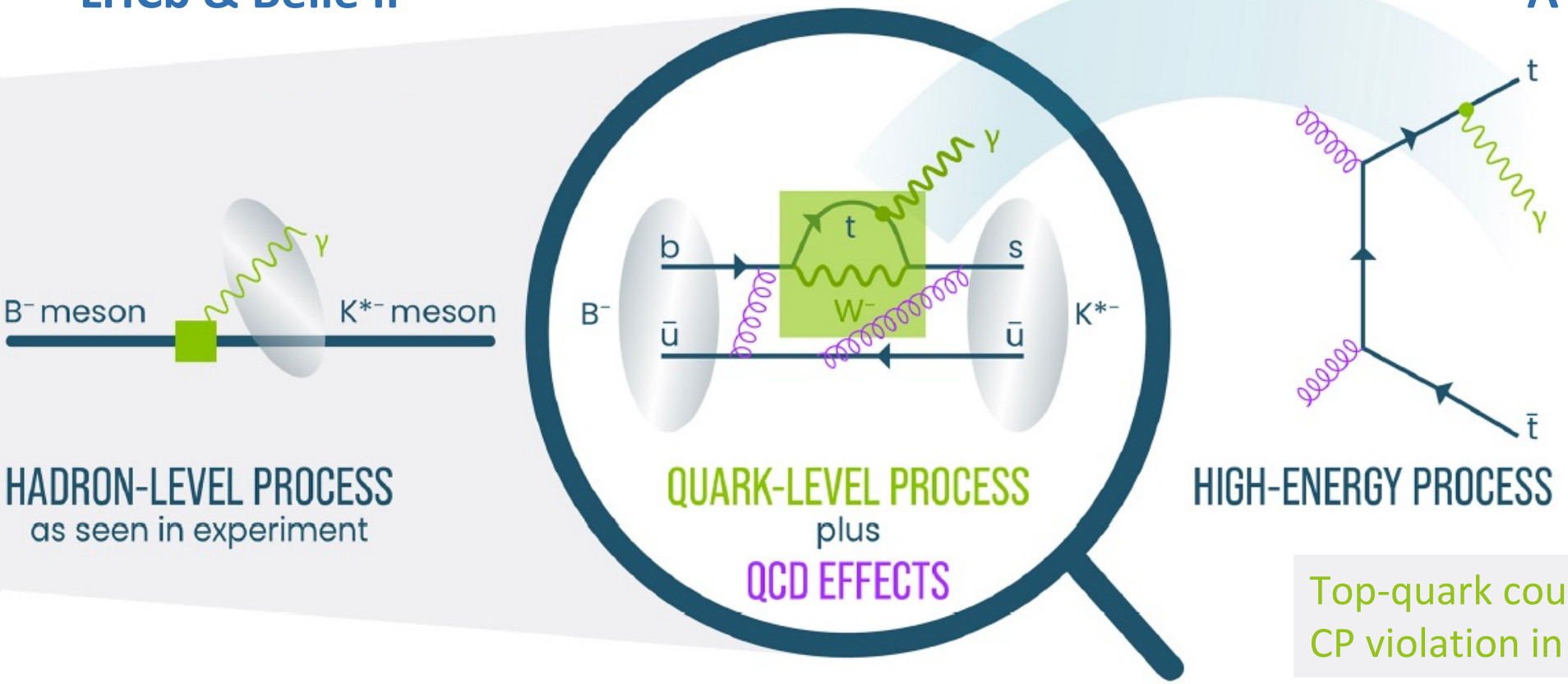
- Study baryons with **light quarks (u,d,s)**
- Search for exotic hadrons

Worldwide unique sensitivity

CmF RESEARCH – CONNECTING ENERGY SCALES

LHCb & Belle II

ATLAS

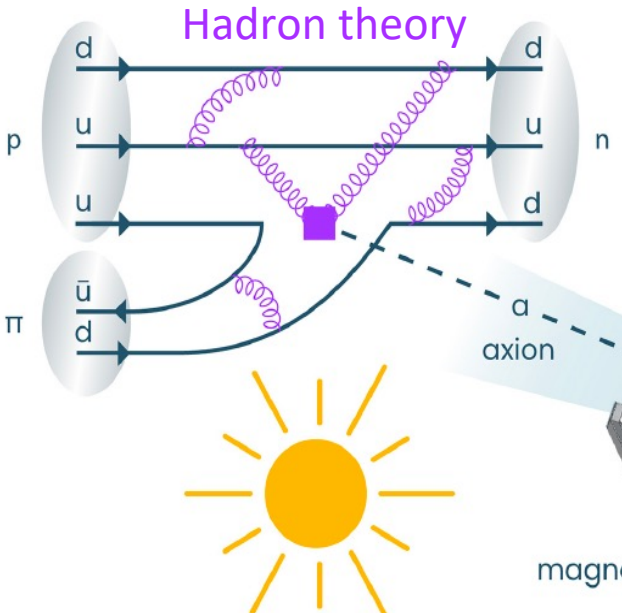


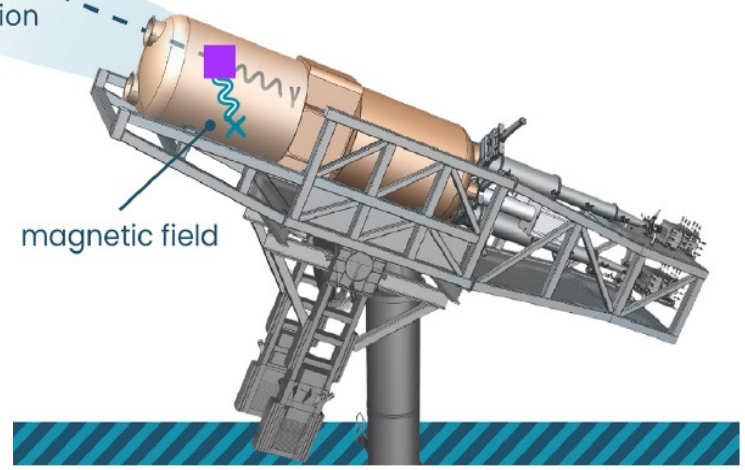
Top-quark couplings
CP violation in top-quark sector

EFFECTIVE FIELD THEORIES + PERTURBATIVE CALCULATIONS

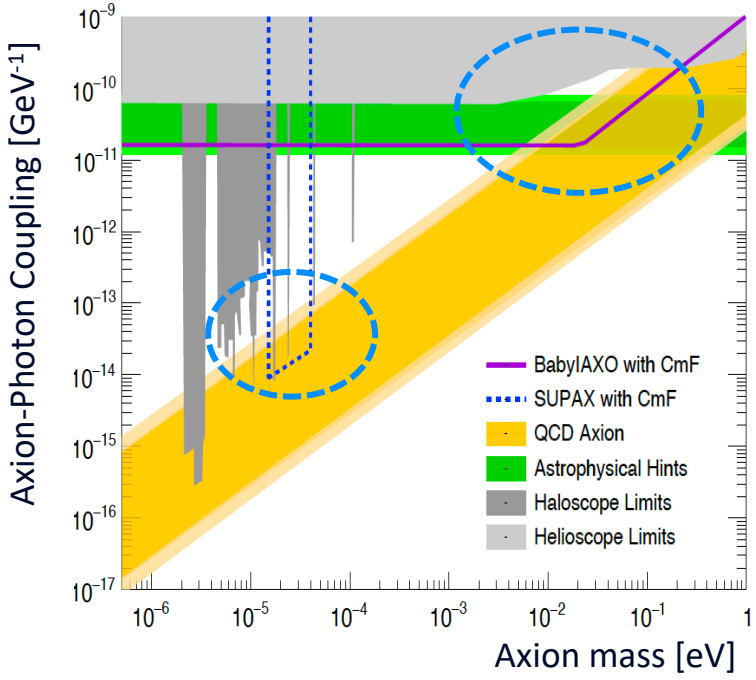
Investigate new phenomena across all energies

CmF RESEARCH – QCD AXION





BabyIAXO



CmF enables construction of BabyIAXO by contributing the magnet

SUPAX
Superconducting radio-frequency cavity

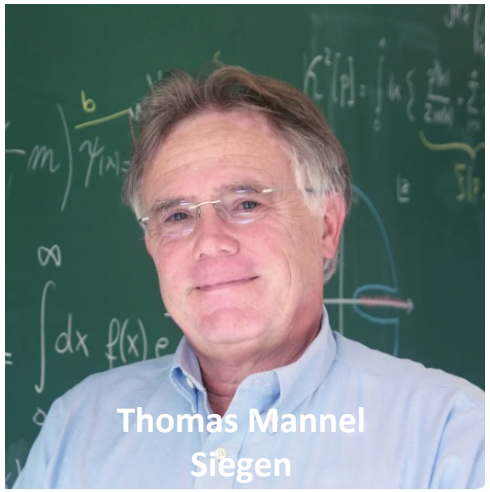
RESEARCH AREAS – CONVENERS

Research Area 1

Bound states of light and heavy quarks

Research Area 2

Decays of bottom, charm, strange quarks



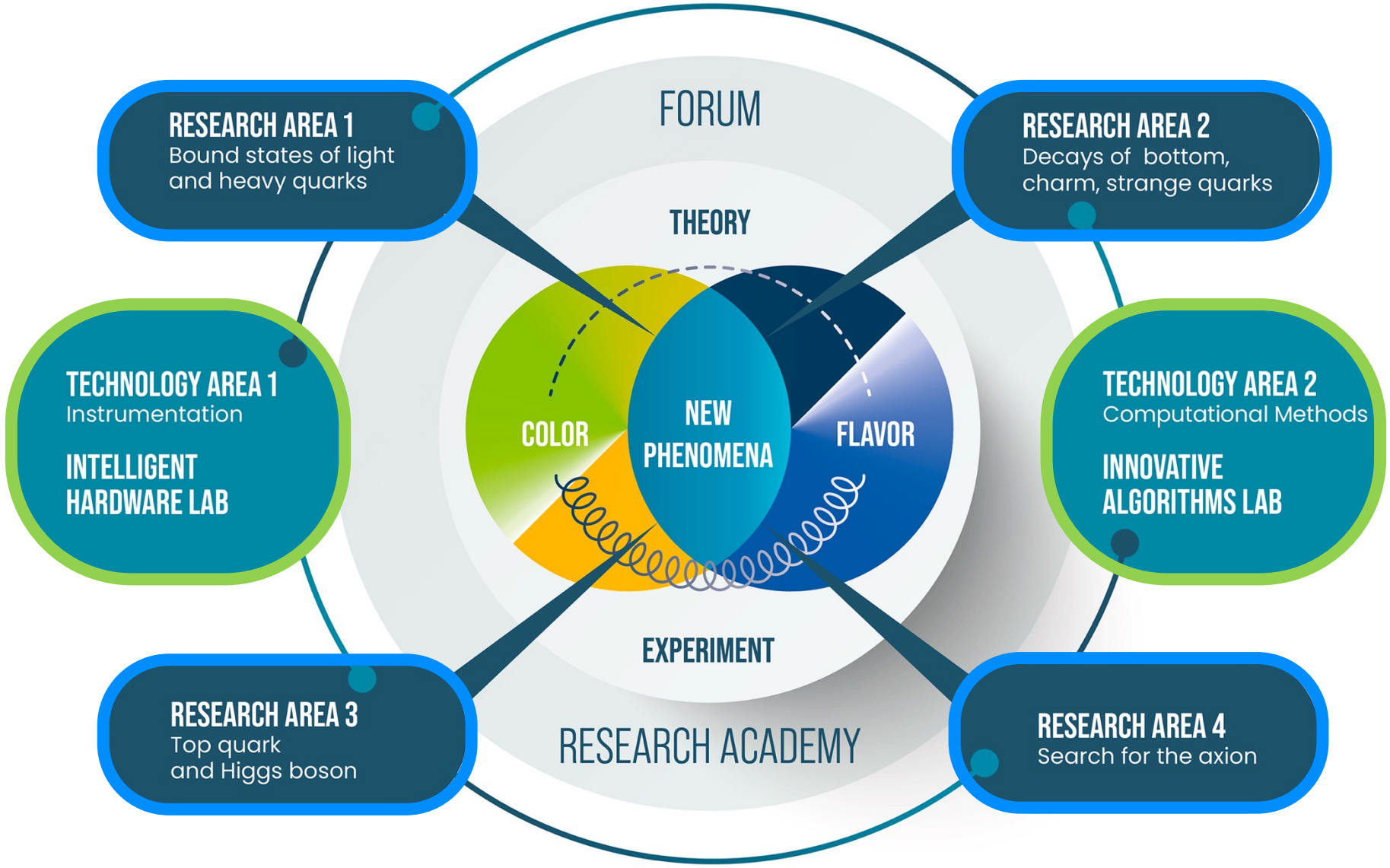
Research Area 3

Top quark and Higgs boson

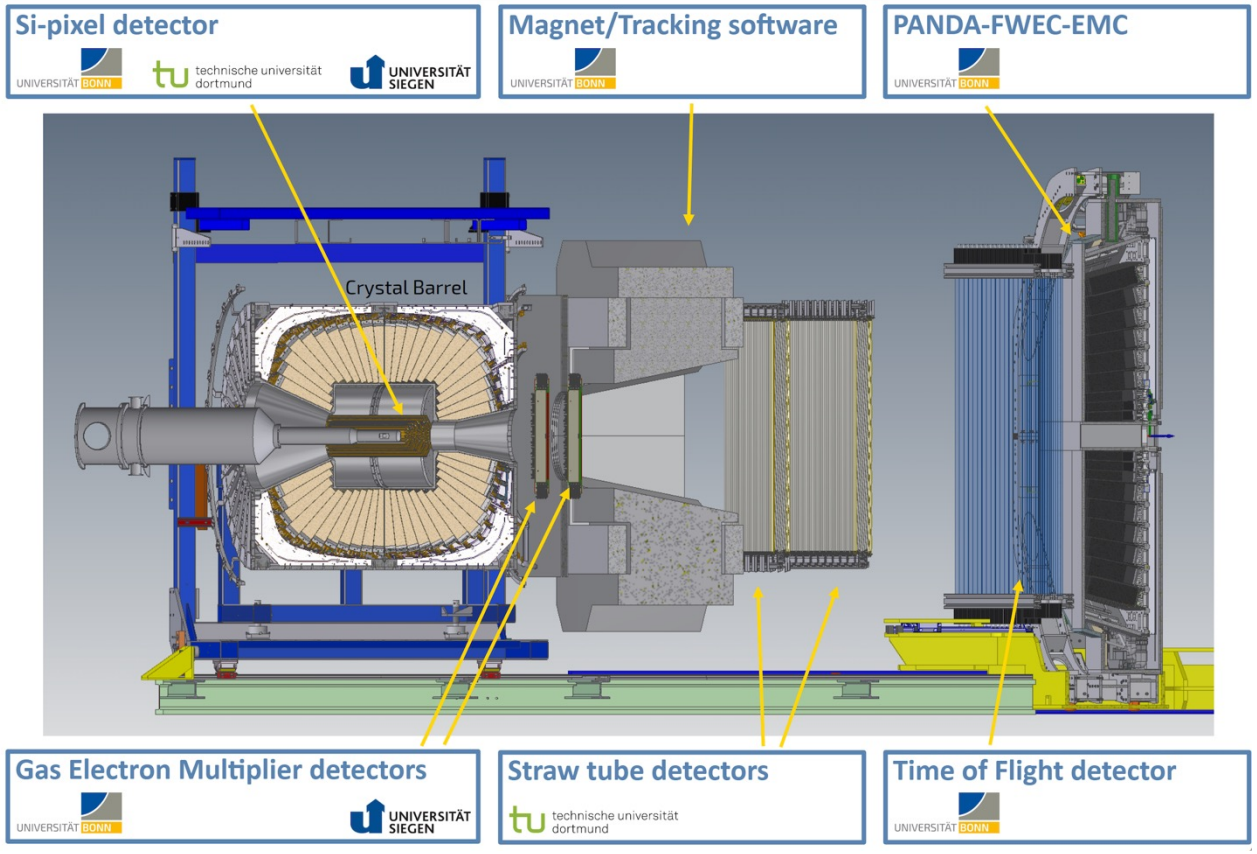
Research Area 4

Search for the Axion

RESEARCH STRUCTURE – TECHNOLOGY AREAS



TECHNOLOGY AREA INSTRUMENTATION: INSIGHT @ ELSA

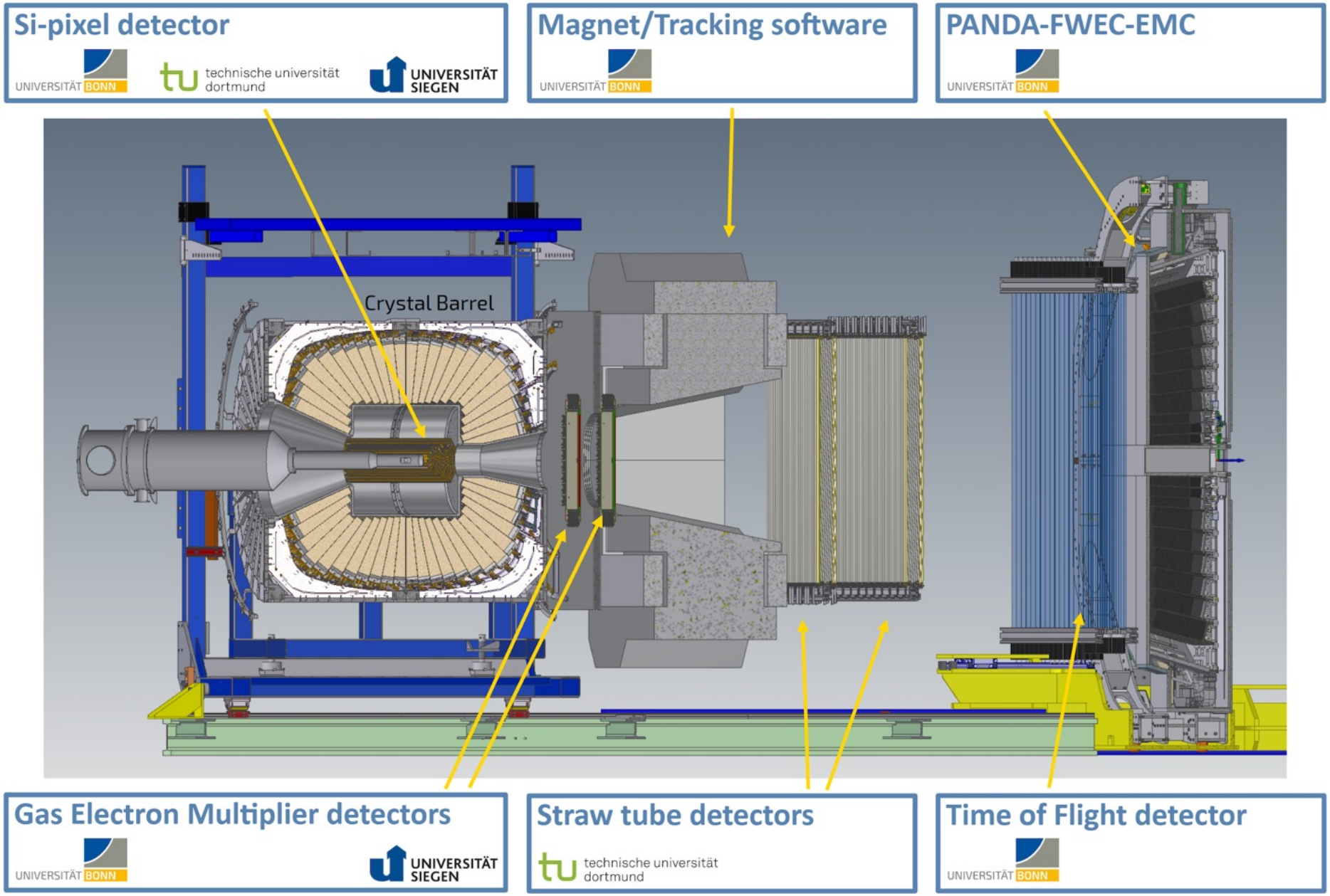


Construction, operation & physics harvest
by **all experimental CmF groups**

Ideal combination of detector expertise

Reusing components of TU Dortmund's **DELTA accelerator**

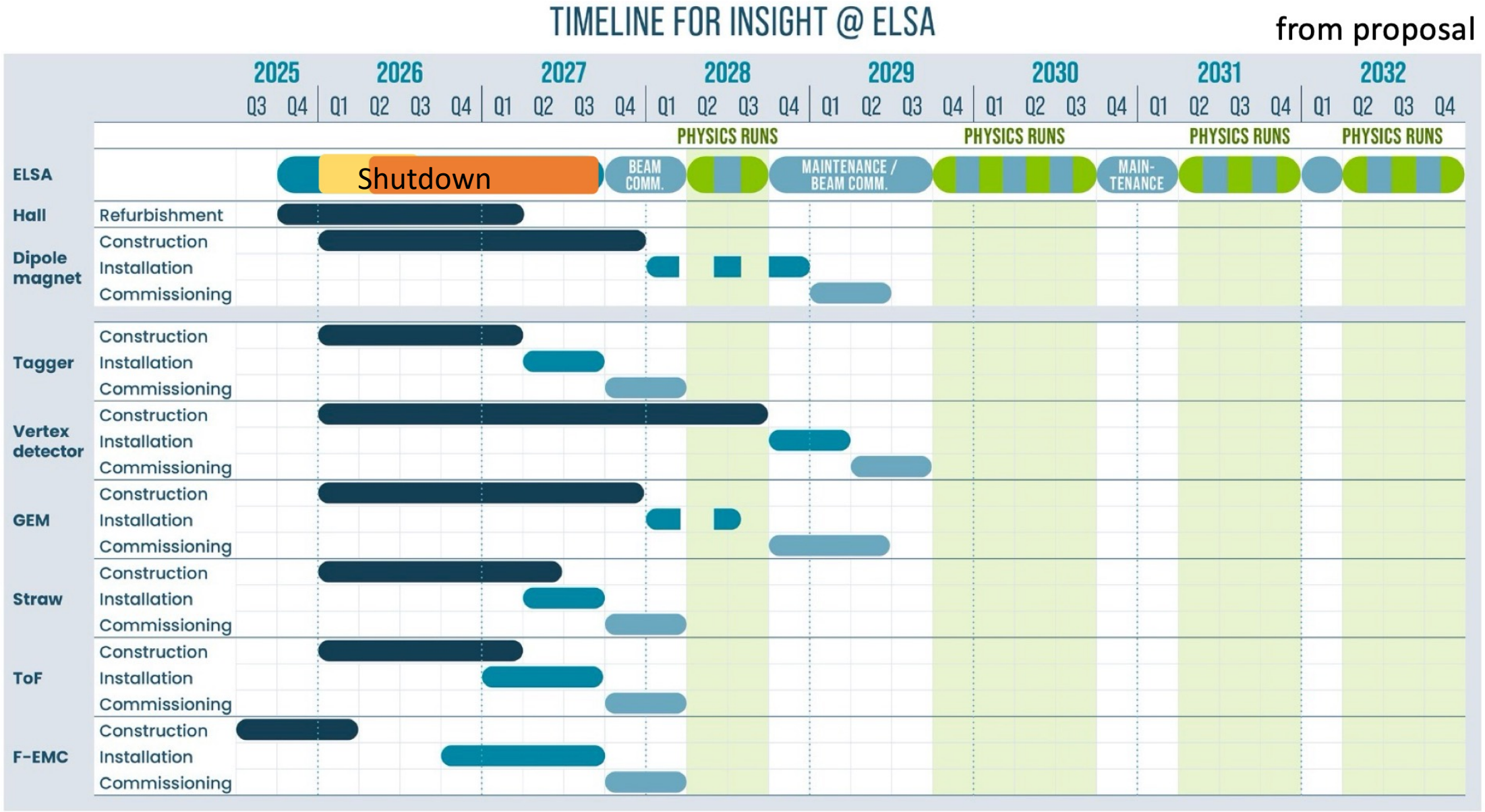
INSIGHT @ ELSA



INSIGHT @ ELSA

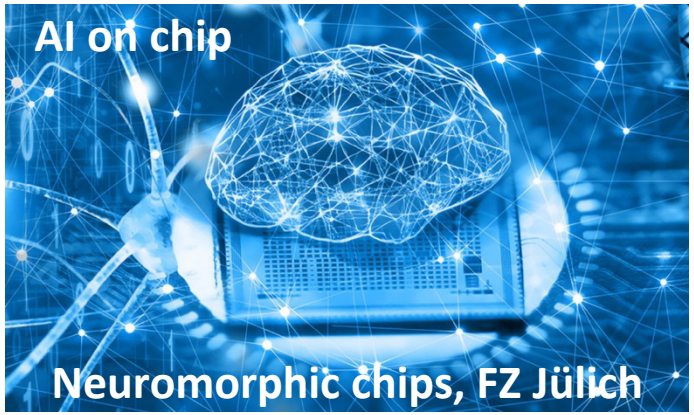
Synchrotron capacitors replacement (done by ELSA team)

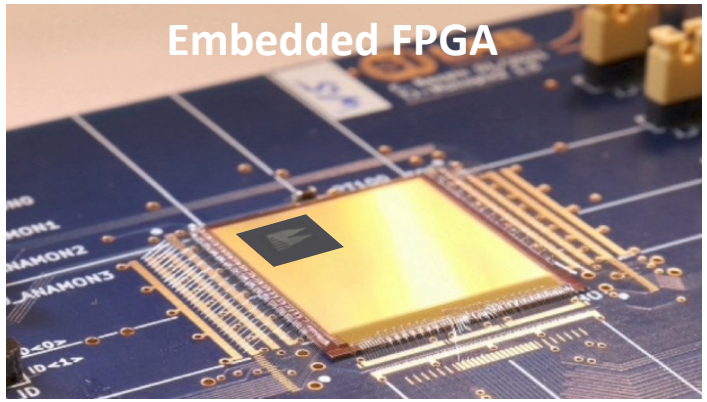
Cooling plant, hall fire protection, move power supply, reconnect E3 (BLB)

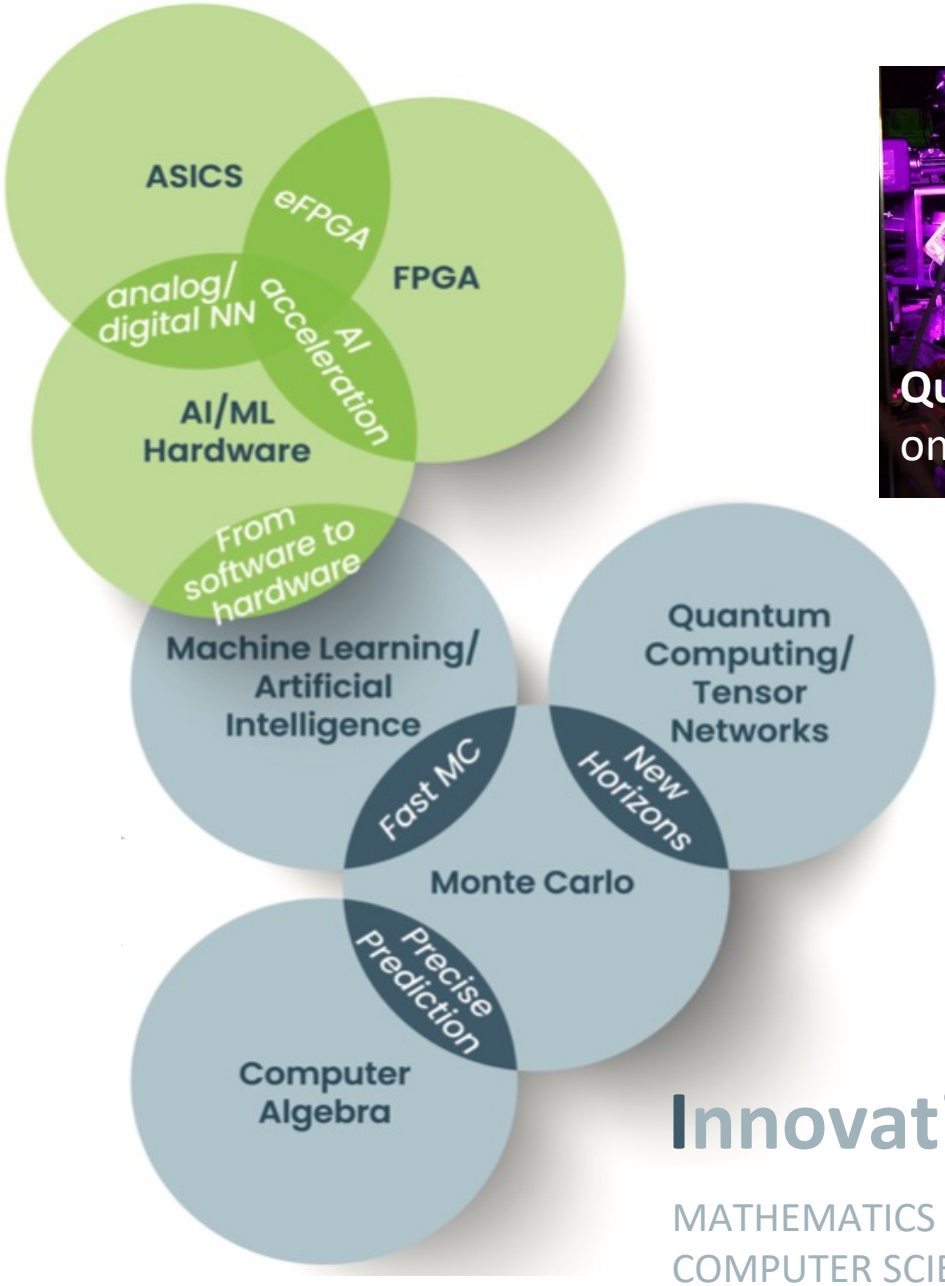


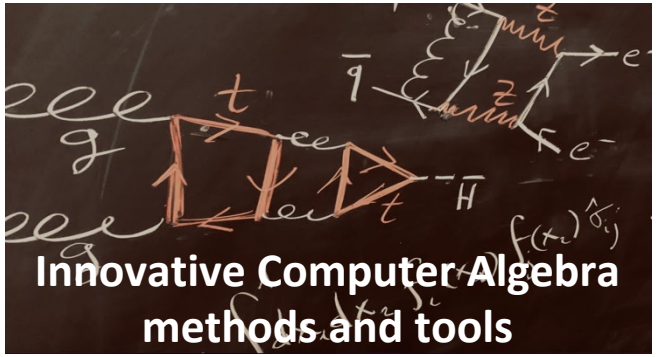
Intelligent Hardware Lab

ELECTRICAL ENGINEERING
COLOGNE CHIP









Innovative Algorithms Lab

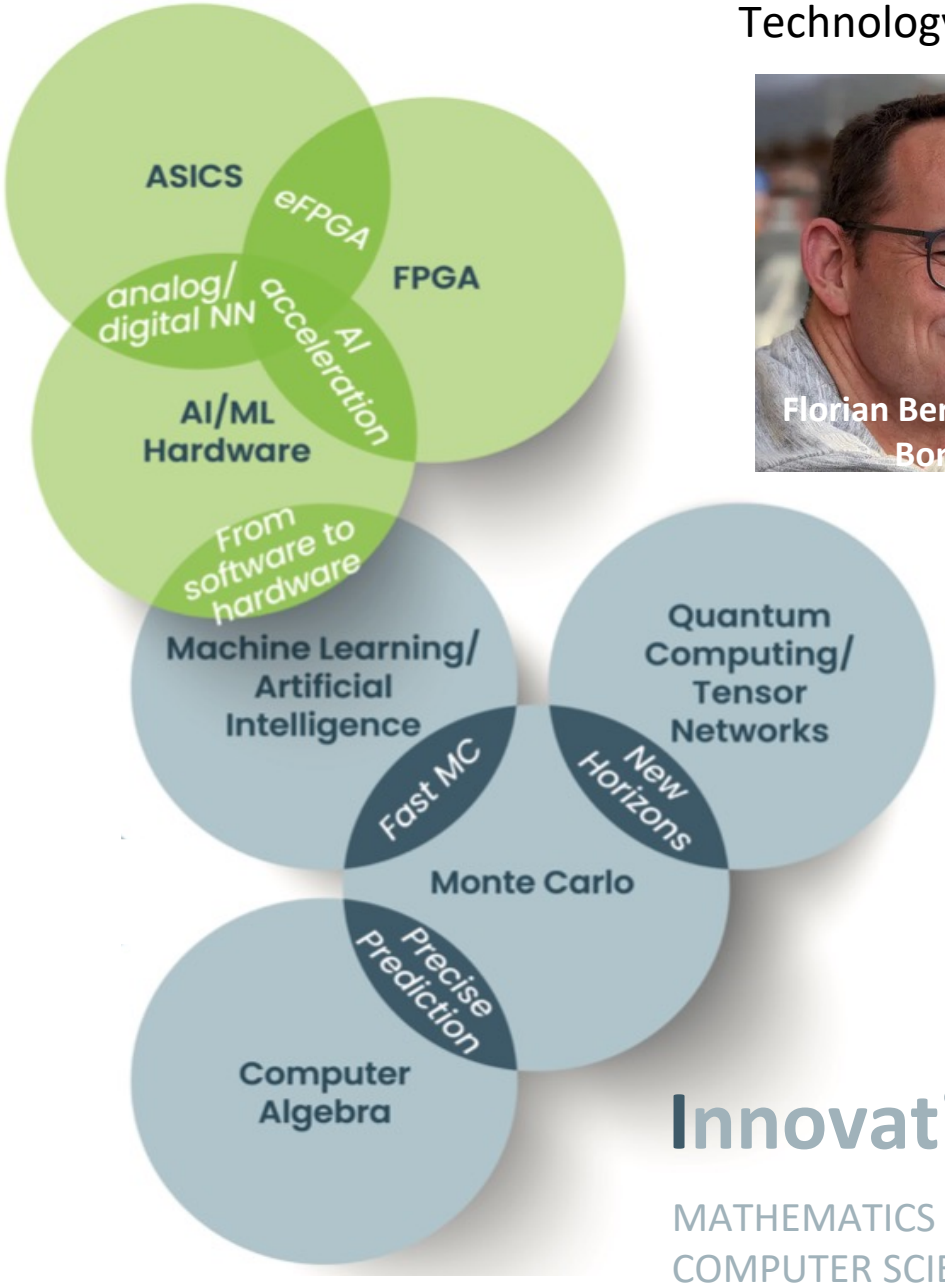
MATHEMATICS
COMPUTER SCIENCE
LAMARR INSTITUTE FOR MACHINE LEARNING & AI

Intelligent Hardware Lab

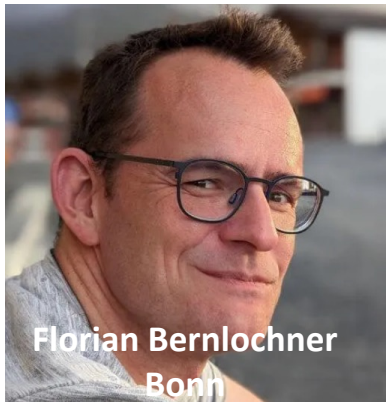
ELECTRICAL ENGINEERING
COLOGNE CHIP

IHL leaders

Technology Area 1 Conveners



Technology Area 2 Conveners = IAL leaders

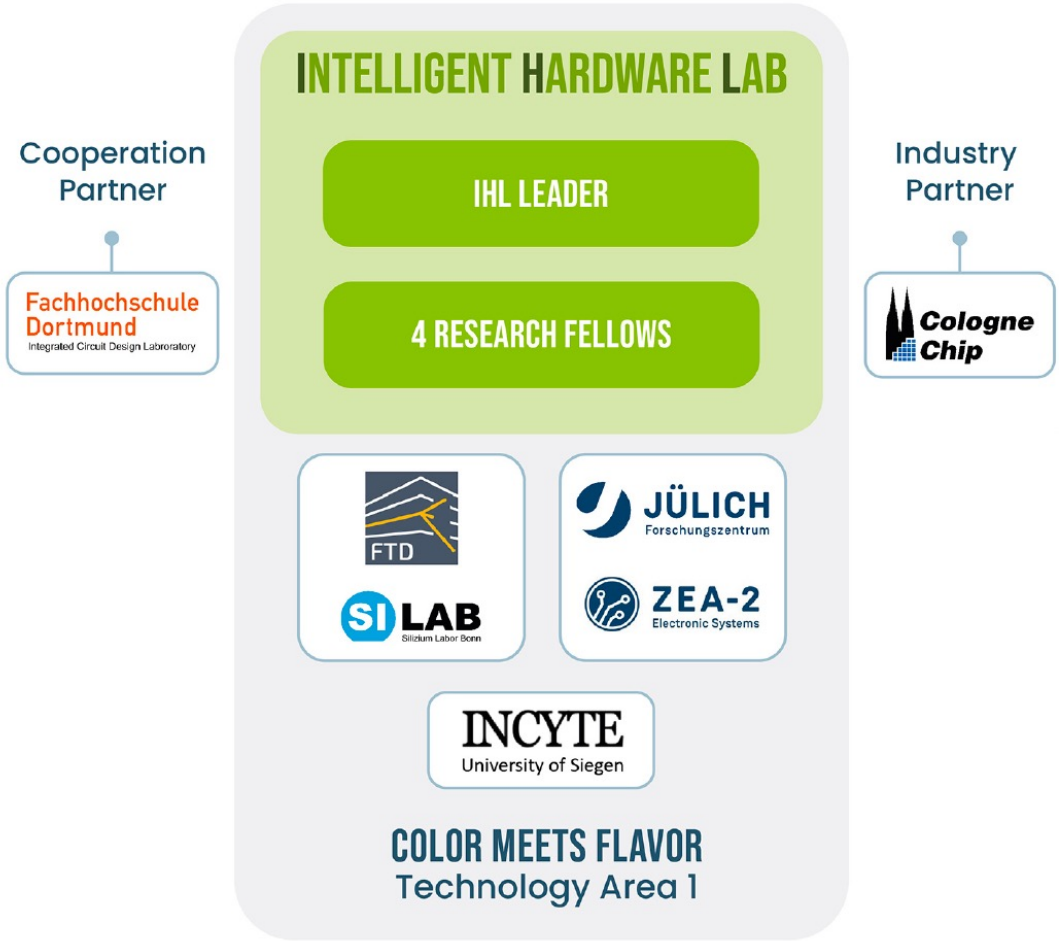


Innovative Algorithms Lab

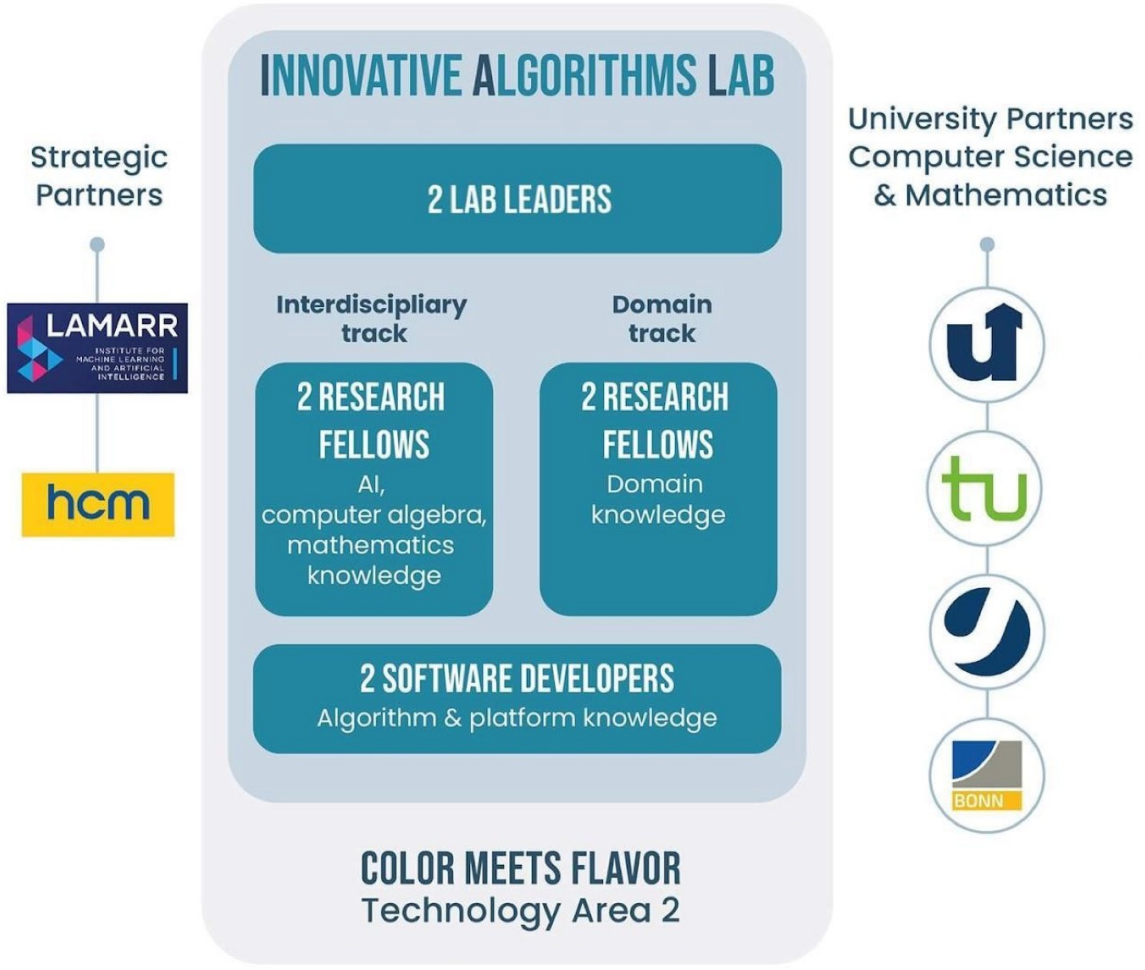
MATHEMATICS
COMPUTER SCIENCE
LAMARR INSTITUTE FOR MACHINE LEARNING & AI

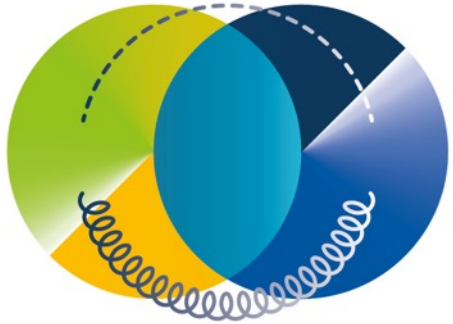
TECHNOLOGY AREAS – LABS

Intelligent Hardware Lab



Innovative Algorithms Lab





color meets flavor

ENVIRONMENT AND STRUCTURES

STRUCTURES FOR EFFICIENT COLLABORATION

VIRTUAL &
IN PRESENCE

CmF SEMINAR
CmF COLLOQUIUM

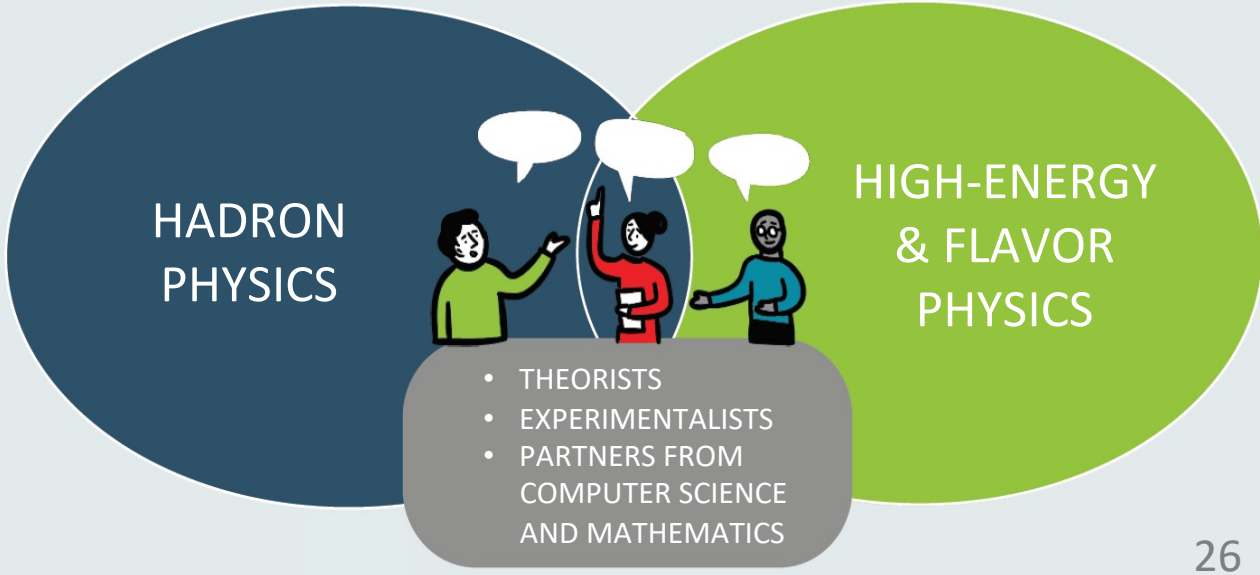
"COLOR MEETS FLAVOR"
CONFERENCE SERIES

INTERNATIONAL
VISITOR PROGRAM

CmF Forum

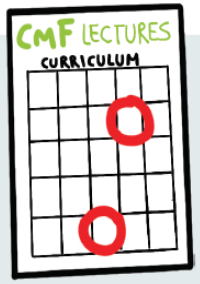
+ CmF RETREATS
+ R&D FORUM
+ IAL WEEKS
+ TRAININGS
+ many more

Cross-functional research teams



STRUCTURES FOR AN OPTIMAL WORK ENVIRONMENT

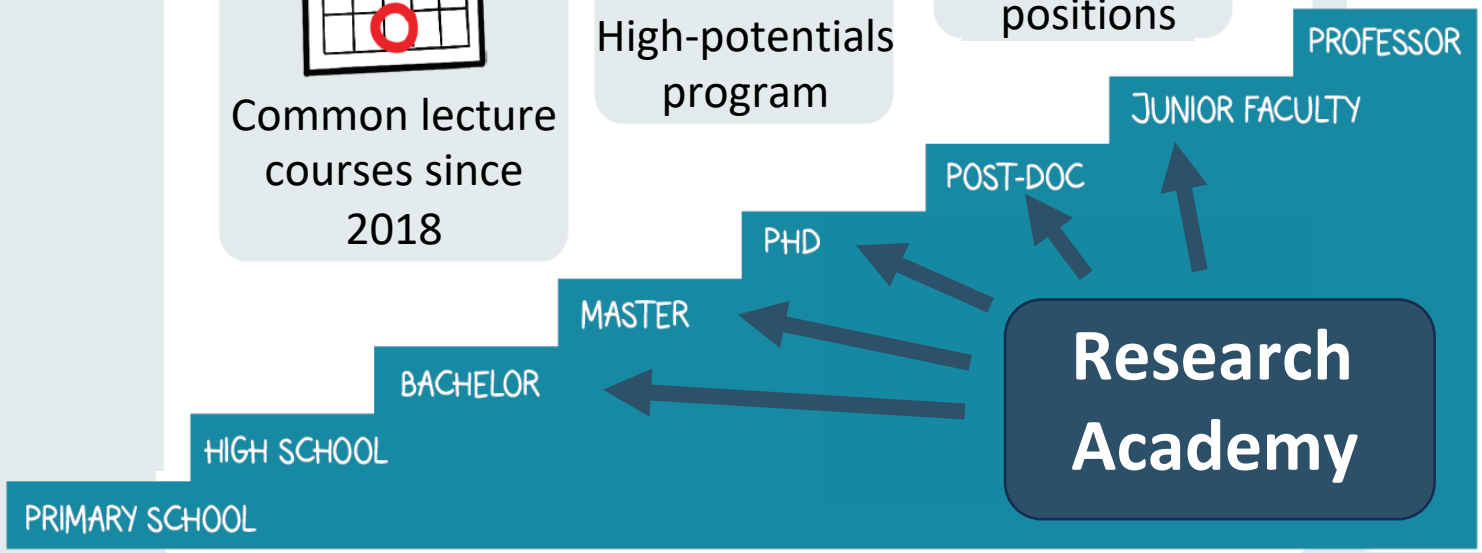
EARLY-CAREER RESEARCHERS



Common lecture courses since 2018

High-potentials program

Permanent positions



EQUITY & DIVERSITY

CmF in primary & high schools
Early access to underrepresened groups

- **PRIMARY-SCHOOL PROGRAM**
- **HIGH-SCHOOL PROGRAM**
- **TEACHER PROGRAM**

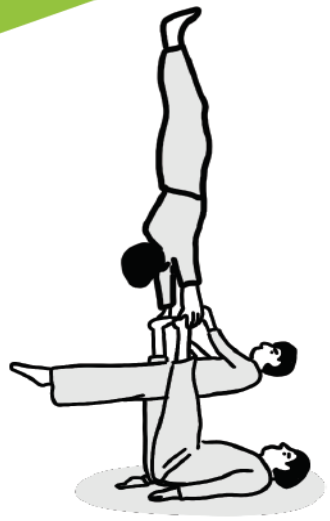
STRUCTURES FOR AN OPTIMAL WORK ENVIRONMENT

RESEARCH DATA MANAGEMENT

IMPROVED PERMEABILITY
BETWEEN EXPERIMENTS

SCIENCE COMMUNICATION, TRANSFER

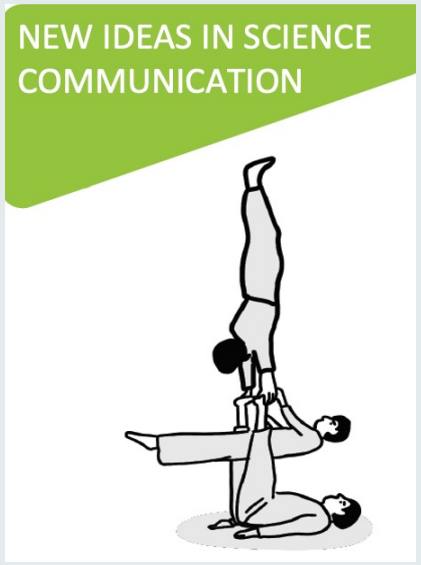
NEW IDEAS IN SCIENCE
COMMUNICATION



KNOWLEDGE TRANSFER

TOP-NOTCH SCIENCE COMMUNICATION

PHYSIKSHOW



CmF MEETS ARTS

New audiences

PLETHORA OF EXISTING AND NEW OUTREACH ACTIVITIES

News on our webpage

© Chinese Academy of Sciences

Chinese Academy of Sciences honors Prof. Ulf-G. Meißner

February 5, 2026

© Sascha Hüttenhein / University of Siegen

Prof. Alexander Lenz introduces Color meets Flavor at "Zwischen Brötchen und Borussia"

January 26, 2026

Prof. Thomas Mannel receives the Daldalos Coin

November 21, 2025

Helmholtz "Color meets Flavor" Excellence Network Approved

November 19, 2025

Podcast on elementary particle physics

December 13, 2024

Color meets Flavor at first Dortmund Science Night

September 28, 2024

© Dirk Mandelbaum

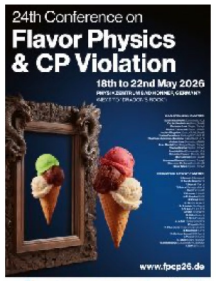
Third edition of "Physics at the Apollo" thrilled the audience

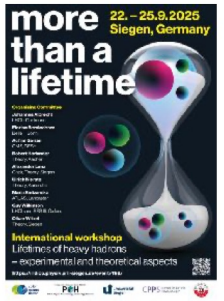
January 12, 2026

© Volker Lannert / University of Bonn

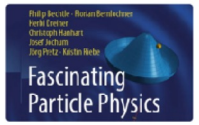
Prof. Herbert Dreiner receives Georg-Kerschensteiner-Prize

January 5, 2026





September 22, 2025



English Edition of "Fascinating Particle Physics" published

December 2, 2025

Color meets Flavor Constituent Meeting

July 15, 2025

55th Autumn School on High-Energy Physics

Projects on our webpage

Projects

Outreach group: Subatomic Heroes. Siegen

September 24, 2025

© Jürgen Huhn/TU Dortmund

Zwischen Brötchen und Borussia. Dortmund

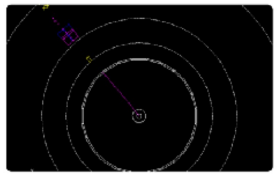
September 24, 2025

Netzwerk Teilchenwelt Masterclasses. Bonn, Dortmund, Siegen

September 24, 2025

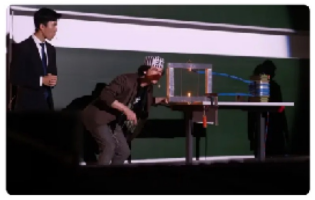
Explaining physics with acrobatics. Siegen

September 24, 2025



© CERN OPAL Masterclass

Machine Learning Masterclass. Bonn



© Barbara Frommann / Uni Bonn

Physics Show. Bonn

Rent A Prof. Siegen

Excursion to Forschungszentrum Jülich

Also on 9th February 2026

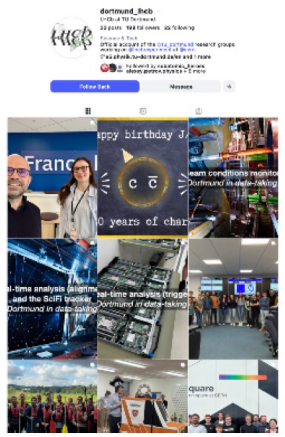
June 27, 2023

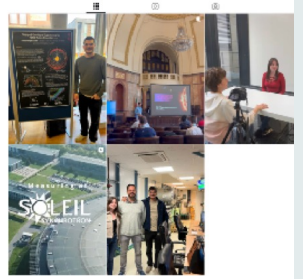
First Color Meets Flavor PhD School

A Color edition is planned for 2028

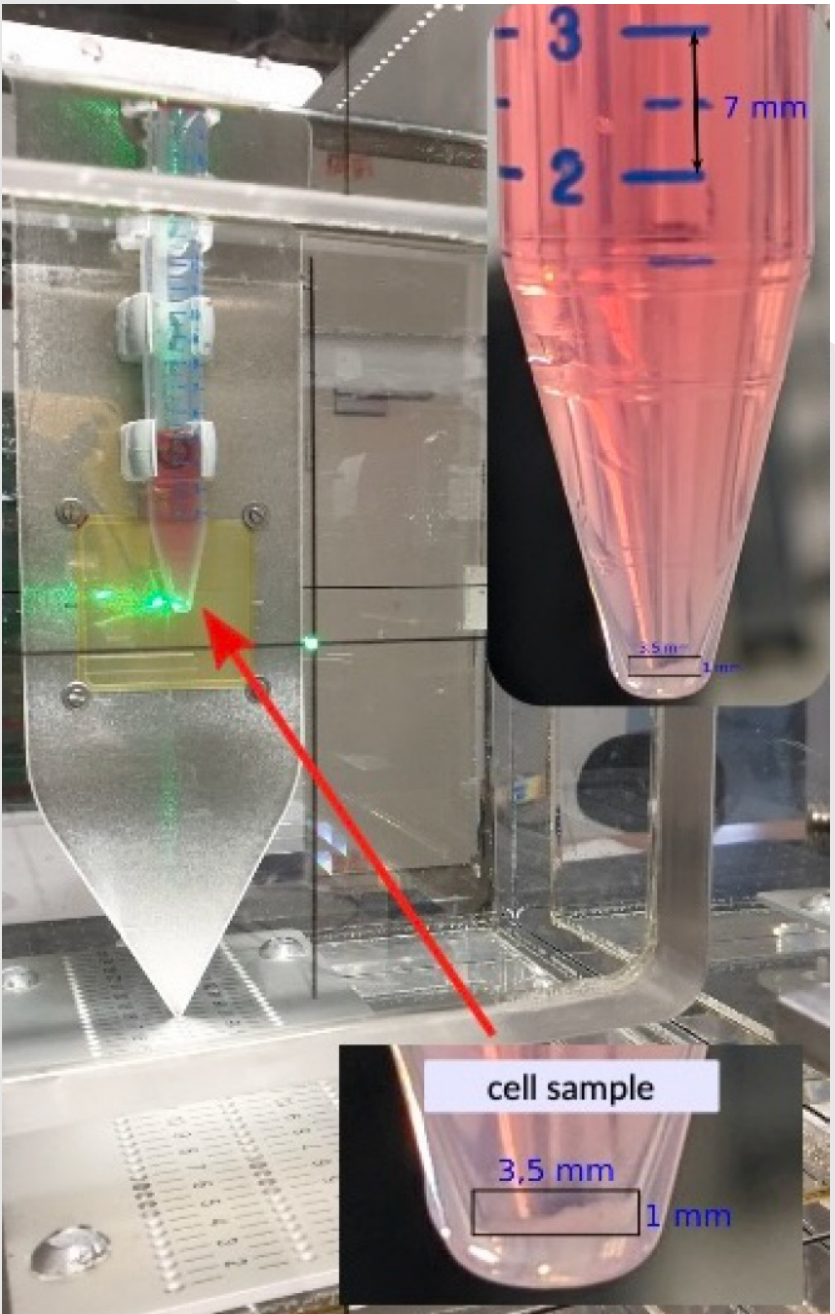
March 18, 2024

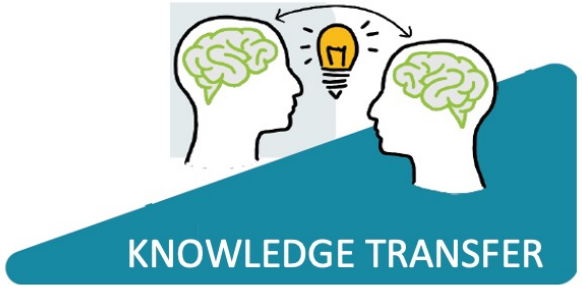
Social Media





TRANSFER TO INDUSTRY AND SOCIETY





INDUSTRY HUB

connects CmF with industry

ACCELERATOR

FLASH radiotherapy @ ELSA

DETECTORS AND ASICs

Imaging applications

SIMULATION

e.g. in medical physics

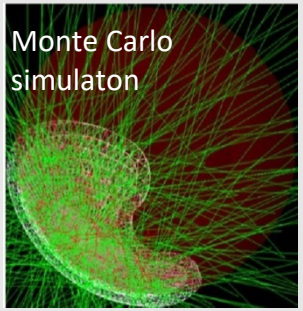
DATA SCIENCE

Industrial data mining, statistical analysis

point8
data matters.

Start-up TU Dortmund

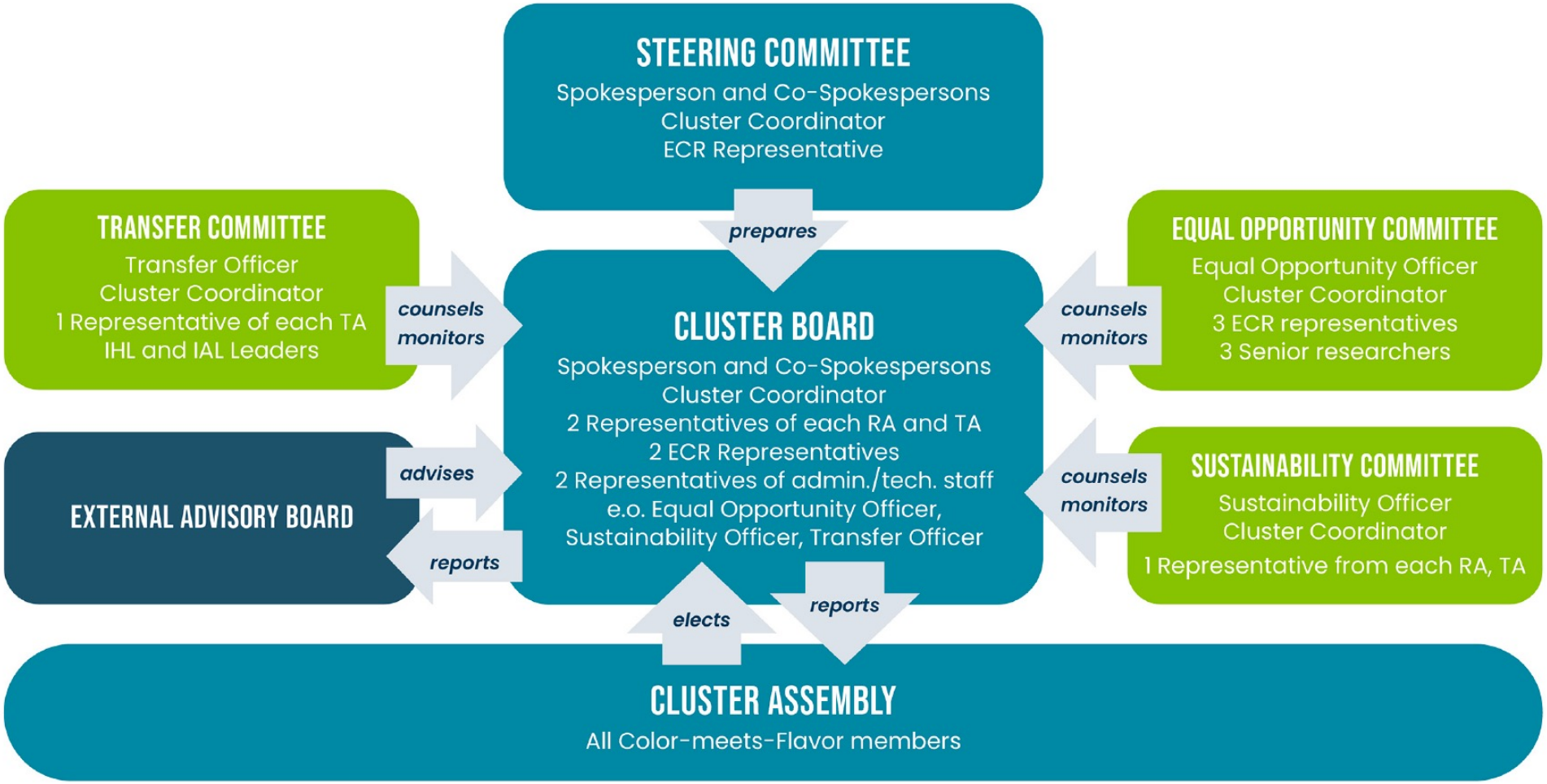
Model developed @ TuDo



color meets flavor

GOVERNANCE
ADMINISTRATION
ORGANIZATION

GOVERNANCE


STEERING COMMITTEE
Spokesperson and Co-Spokespersons
Cluster Coordinator
ECR Representative
prepares
TRANSFER COMMITTEE
Transfer Officer
Cluster Coordinator
1 Representative of each TA
IHL and IAL Leaders
counsels
monitors
CLUSTER BOARD
Spokesperson and Co-Spokespersons
Cluster Coordinator
2 Representatives of each RA and TA
2 ECR Representatives
2 Representatives of admin./tech. staff
e.o. Equal Opportunity Officer,
Sustainability Officer, Transfer Officer
counsels
monitors
EQUAL OPPORTUNITY COMMITTEE
Equal Opportunity Officer
Cluster Coordinator
3 ECR representatives
3 Senior researchers
advises
reports
EXTERNAL ADVISORY BOARD
counsels
monitors
SUSTAINABILITY COMMITTEE
Sustainability Officer
Cluster Coordinator
1 Representative from each RA, TA
elects
reports
CLUSTER ASSEMBLY
All Color-meets-Flavor members

GOVERNANCE

already elected

STEERING COMMITTEE
Spokesperson and Co-Spokespersons
Cluster Coordinator
ECR Representative

prepares

TRANSFER COMMITTEE
Transfer Officer
Cluster Coordinator
1 Representative of each TA
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CLUSTER BOARD
Spokesperson and Co-Spokespersons
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EQUAL OPPORTUNITY COMMITTEE
Equal Opportunity Officer
Cluster Coordinator
3 ECR representatives
3 Senior researchers

advises
reports

EXTERNAL ADVISORY BOARD

counsels
monitors

SUSTAINABILITY COMMITTEE
Sustainability Officer
Cluster Coordinator
1 Representative from each RA, TA

elects
reports

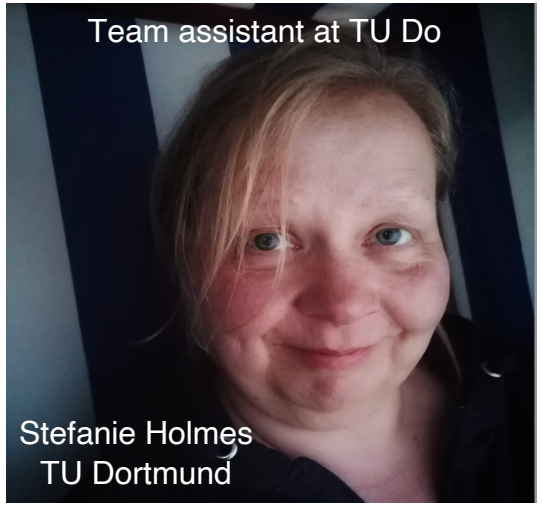
CLUSTER ASSEMBLY
All Color-meets-Flavor members

Next steps:

- Orientation meetings for ECR, admin. & techn. staff → temporary representatives as guests
- Formal election of ECR, admin. & techn. representatives at General CmF Assembly in July

CLUSTER ADMINISTRATION – THE CLUSTER OFFICE

Cluster Office Members	FTE	Main tasks
Cluster Coordinator	1.0	General coordination of CmF activities and structural measures, financial planning, quality assurance
Research Academy Coordinator	0.5	Coordination of Research Academy
Forum Scientific Secretary	0.5	Coordination of CmF Forum, incl. international visitor program
Science Communicator	0.5	Science communication, outreach
Event Manager	0.5	Planning and support for CmF events
Cluster Team Assistant	1.0	Day-to-day administrative support



NEW PERSONNEL: CLUSTER PROFESSORSHIPS + INVESTIGATOR GROUPS + PROJECT POSITIONS

Professorship	Univ.	
Cluster Professorships		
W3 BSM Phenomenology (TH)	UBo	→ offer made
W3 Computational Physics (TH)	USi	→ offer made
W2 Heavy Particles at ATLAS (EXP)	TUDo	
W2 Flavor Physics at LHCb (EXP)	TUDo	
W2 Detector Physics (EXP)	USi	→ offer made
W2 Hadron Spectroscopy at Belle II (EXP)	UBo	
Strategic professorships in preparation for CmF		
W2 Theoretical Particle Physics (TH)	TUDo	E. Stamou
W2 Hadron Physics at ELSA (EXP)	UBo	P. Hurck
W2 Non-Collider Particle Physics (EXP)	TUDo	J. Vogel
Additional new professorships to be installed in the context of CmF		
W3 Accelerator Physics (EXP)	UBo	
W3 Light New Physics & Dark Sectors (EXP)	TUDo	

+ 3 **Investigator Groups** (temp. W2 with 1 PhD position and own yearly budget)

+ several **doctoral and postdoctoral positions** for proposed projects

ADMISSION OF MEMBERS

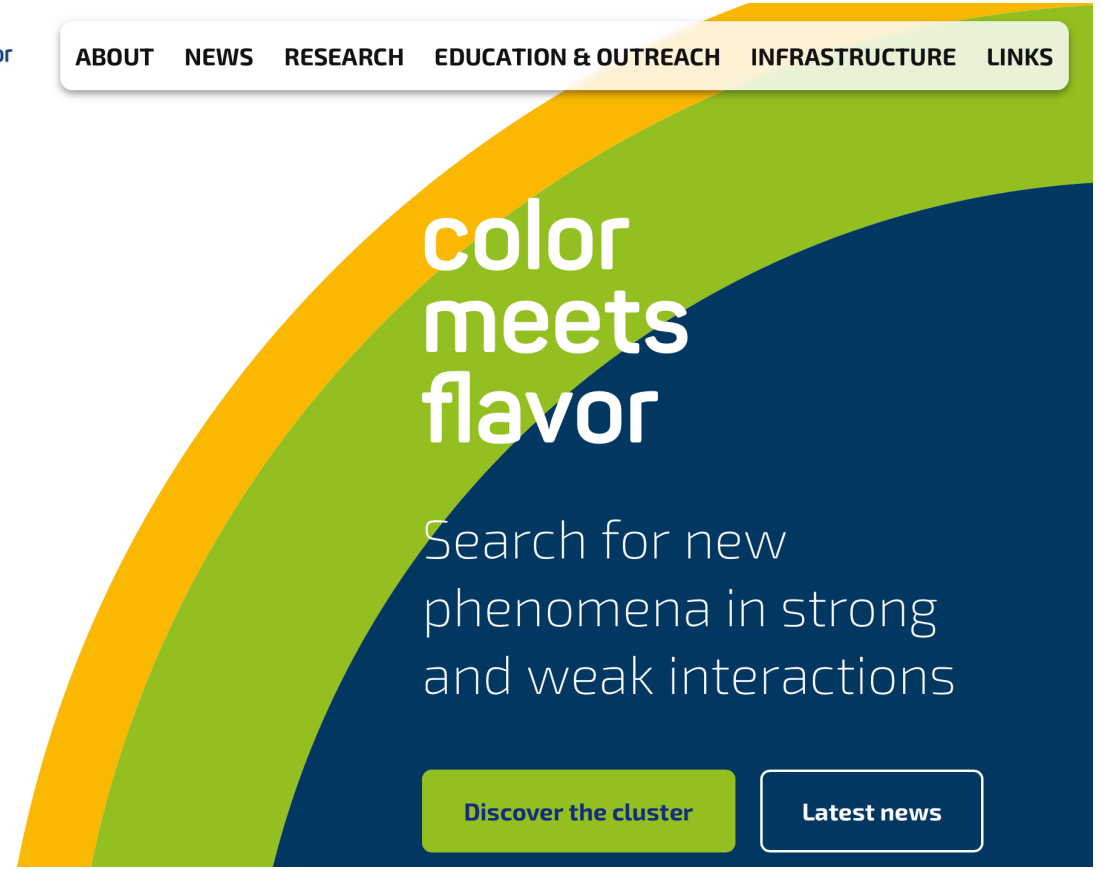
1. Faculty members → **regular members** → application incl. CV and publications
2. Scientific staff + postdocs → **regular members** → application incl. CV and publications
3. Doctoral students → **student members** → to be requested by group leader (CV)
4. Technical and administrative staff → **non-scientific members** → to be requested by group leader (CV)
5. Scientists from external institutions → **associate members** → upon request by regular member (CV and pub.)

Online registration form for CmF membership:

https://indico.hiskp.uni-bonn.de/category/117/

CmF WEB PAGE

https://color-meets-flavor.de



EMAIL LISTS

Format: *cmf-xxx@listen.uni-bonn.de*

• cmf-all	All users
• cmf-cb	Cluster Board
• cmf-sc	Steering Committee
• cmf-ra1	RA1
• cmf-ra2	RA2
• cmf-ra3	RA3
• cmf-ra4	RA4
• cmf-ta1	TA1
• cmf-ta2	TA2
• cmf-ihl	IHL
• cmf-ial	IAL
• cmf-transfer	Transfer Committee
• cmf-edi	Equal Opportunity Committee
• cmf-sustainability	Sustainability Committee
• cmf-eab	External Advisory Board
• cmf-ecr	Earl Career Researchers
• …	

The lists are restricted to official **CmF members**.

If you are a member, you can subscribe at *https://listen.uni-bonn.de*

color meets flavor

OPPORTUNITIES FOR EARLY-CAREER RESEARCHERS

Research Academy

- BSc:
  - For undergraduate students: customized summer projects within CmF groups
  - Three selected BSc students per year will be offered funding to write the BSc theses at CERN/KEK

- MSc:
  - **Joint MSc program**: The curricula of the MSc programs in physics at the three universities are similar and include a significant fraction of elective courses. We will coordinate our teaching activities to create a joint MSc program, allowing students to choose from all the courses offered and to get the credits acknowledged at their university. By offering video broadcasts of the courses, the range of possible specializations can significantly be expanded compared to the MSc courses offered locally.
  - **MSc scholarships**: Each year, competitive MSc scholarships will be awarded to the most promising (local, national, and international) BSc graduates.

Doctoral researchers

- **CmF lecture program**: existing, but will need to be filled with life
  https://color-meets-flavor.de/education/lectures
  → we will coordinate the lectures between the sites and add targeted advanced lectures (from instrumentation to theoretical methods)
- **Cross-disciplinary secondments**: doctoral researchers are encouraged to do a secondment involving a project in experiment, theory, or industry beyond the fields of their theses. Industry secondments will be organized by the Industry Hub.
- **Joint doctoral supervision**: The thesis advisor will be supported by two additional CmF scientists, preferentially from the other cluster sites, serving as co-supervisors.
- **Internationalization**: For doctoral researchers, CmF will provide sponsoring for extended research stays abroad and also encourage international secondments.

Postdoctoral researchers

- **Career Development Fund**: All postdoctoral researchers in CmF have the opportunity to participate in high-quality courses on leadership, management and personal development
- **Guided teaching opportunities:** We encourage co-teaching with experienced colleagues, assisted by specific training lectures.
- **Project Seed Fund**
  - We encourage ECRs at all career stages to come up with their own research or development ideas. The academic age of the applicant will be appropriately considered in the evaluation of the project sketch and the funding decision

CmF Forum: platform for communication and exchange

- Gaol: ensure collaboration of groups through a series of regular events
- CmF Colloquium / CmF Seminar
- International workshops (funding available)
- IAL lecture weeks, the R&D Forum, training events for the IAL and IHL
- International Visitor Program
  - renowned researchers on sabbatical to spend extended periods of time at CmF
  - Student visits
  - Grant writing visits
  - …

BACKUP

color meets flavor will deliver …

- a **leading new experiment in hadron physics** with cutting-edge technology
- a **magnet for BabyIAXO** which makes the experiment happen
- two **interdisciplinary technology labs** with huge innovation potential
- a consortium that closely **connects**
  - high-energy and hadron physics
  - experimenters and theorists
  - three universities and FZ Jülich in the state of NRW
  - leading groups in color & flavor physics
- a **sustainable cooperative structure** that rests on both tradition & experience and dynamic potential for understanding and discovery

color meets flavor will enable us to …

- resolve the **origin of the flavor anomalies**
- understand the **nature of the exotic hadrons**
- clarify the **light-baryon spectrum** with INSIGHT
- open up a **new era in axion physics**

World-leading center for the physics of the strong and weak interaction