

# Helmholtz Research Field Matter CNRS / IN2P3



**HELMHOLTZ**  
SPITZENFORSCHUNG FÜR  
GROSSE HERAUSFORDERUNGEN

Depuis 80 ans, nos connaissances  
bâtissent de nouveaux mondes



# Participants

- **CNRS/IN2P3**

- Xxx
- Xxx
- xxx

- **Helmholtz/DESY**

- Xxx
- Xxx
- xxx

- **Helmholtz/KIT**

- Johannes Blümer
- Erik Bründermann
- Klaus Eitel
- Ralph Engel
- Andreas Haungs
- Anke-S. Müller
- Achim Streit
- Kathrin Valerius
- Marc Weber
- Stefan Bekavac
- Manuella Werp

- **Helmholtz/FZJ**

- Xxx
- Xxx
- xxx

- **Helmholtz/GSI**

- Xxx
- Xxx
- xxx

# HELMHOLTZ Research field Matter and CNRS / IN2P3 Lol

Meeting between Helmholtz Association  
President Otmar Wiestler and CNRS  
President Antoine Petit

Signature of an Lol to explore further  
institutional opportunities on high energy  
physics, nuclear physics & astroparticle  
physics

18/02/2019

(extension till June 2021 signed on Feb. 2020)



# CNRS | 10 Institutes

Institute of Biological Sciences (INSB)

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Institute of Chemistry (INC)

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Institute of Ecology and Environment (INEE)

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Institute for Humanities and Social Sciences (INSHS)

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Institute for Engineering and Systems Sciences (INSIS)

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National Institute for Mathematical Sciences and their Interactions (INSMI)

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Institute of Physics (INP)

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Institute for Information Sciences and Technologies (INS2I)

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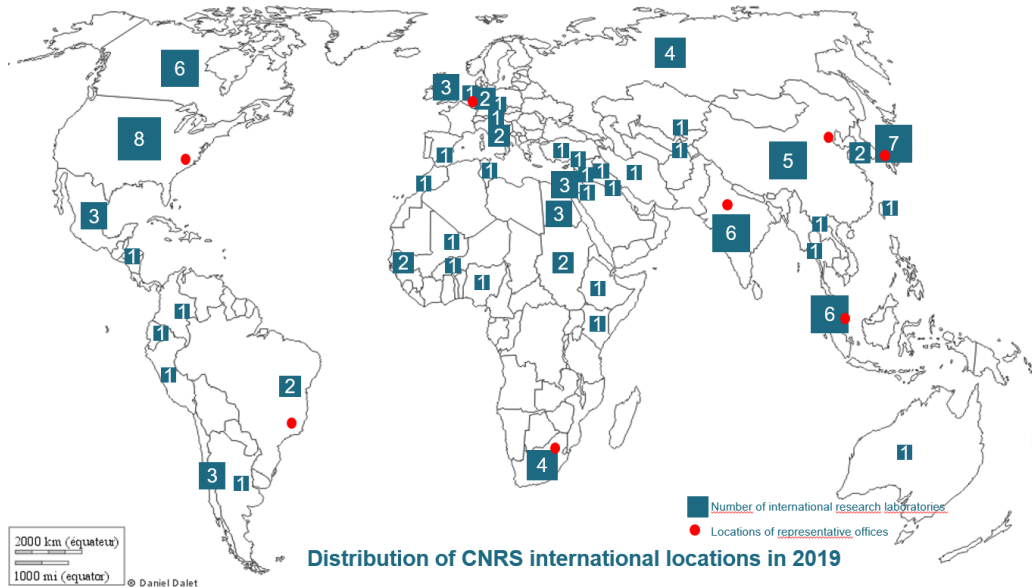
National Institute of Nuclear and Particle Physics (IN2P3)

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National Institute for Earth Sciences and Astronomy (INSU)

# CNRS abroad

- 8 Representative Offices
- 75 International Research Laboratories (IRL)



## IRL in Germany

- Centre Marc Bloch (Berlin)  
Deutsch-Französisches  
Forschungszentrum für Geistes-  
und Sozialwissenschaften  
<https://cmb.hu-berlin.de/zentrum/>
- Future CNRS/Helmholtz IRL?

# CNRS | Former List IN2P3 Labs

Sigle	Intitulé	Ville
APC	<a href="#">Astroparticule et cosmologie</a>	Paris
CCIN2P3	<a href="#">Centre de Calcul IN2P3</a>	Villeurbane
CENBG	<a href="#">Centre d'études nucléaires de Bordeaux Gradignan</a>	Bordeaux - Gradignan
CPPM	<a href="#">Centre de physique des particules de Marseille</a>	Marseille
CSNSM	<a href="#">Centre de sciences nucléaires et de sciences de la matière</a>	Orsay
GANIL	<a href="#">Grand Accélérateur National d'Ions Lourds</a>	Caen
IMNC	<a href="#">Imagerie et modélisation en neurobiologie et cancérologie</a>	Orsay
IPHC	<a href="#">Institut pluridisciplinaire Hubert Curien</a>	Strasbourg
IPNL	<a href="#">Institut de physique nucléaire de Lyon</a>	Villeurbanne
IPNO	<a href="#">Institut de physique nucléaire d'Orsay</a>	Orsay
LAL	<a href="#">Laboratoire de l'accélérateur linéaire</a>	Orsay
LAPP	<a href="#">Laboratoire d'Annecy de physique des particules</a>	Annecy
LLR	<a href="#">Laboratoire Leprince-Ringuet</a>	Palaiseau
LPCC	<a href="#">Laboratoire de physique corpusculaire de Caen</a>	Caen
LPC	<a href="#">Laboratoire de physique de Clermont</a>	Clermont-Ferrand
LPNHE	<a href="#">Laboratoire de physique nucléaire et de hautes énergies</a>	Paris
LPSC	<a href="#">Laboratoire de physique subatomique et de cosmologie</a>	Grenoble
LUPM	<a href="#">Laboratoire Univers et particules de Montpellier</a>	Montpellier
Subatech	<a href="#">Laboratoire de physique subatomique et des technologies associées</a>	Nantes
	<a href="#">Musée et archives de l'institut du radium Pierre et Marie Curie, Frédéric et Irène Joliot</a>	Paris

LPT	Laboratoire de physique théorique (INP Lab)	Orsay
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## MERGER with LMA Villeurbanne

→ IP2I Institut de Physique des 2 Infinis  
(Lyon-Villeurbanne)

M  
E  
R  
G  
E  
R

→ IJCLab Laboratoire de Physique des 2 Infinis  
Irène Joliot-Curie  
(Orsay)

# CNRS | 16 IN2P3 Labs (starting from January 2020)

	IN2P3 Laboratories	
APC	Astroparticule et cosmologie	Paris
CENBG	Centre d'études nucléaires de Bordeaux Gradignan	Bordeaux
CPB	Centre Pierre Binétruy	Berkeley
CPPM	Centre de physique des particules de Marseille	Marseille
IJCLab <b>new</b>	Laboratoire de physique des 2 infinis - Irène Joliot-Curie	Orsay
IP2I <b>new</b>	Institut de physique des 2 infinis	Lyon-Villeurbanne
IPHC	Institut pluridisciplinaire Hubert Curien	Strasbourg
LAPP	Laboratoire d'Annecy de physique des particules	Annecy
L2IT	Laboratoire des 2 infinis de Toulouse	Toulouse
LLR	Laboratoire Leprince-Ringuet	Palaiseau
LPC	Laboratoire de physique de Clermont	Clermont-Ferrand
LPCC	Laboratoire de physique corpusculaire de Caen	Caen
LPNHE	Laboratoire de physique nucléaire et de hautes énergies	Paris
LPSC	Laboratoire de physique subatomique et de cosmologie	Grenoble
LUPM	Laboratoire Univers et particules de Montpellier	Montpellier
Subatech	Laboratoire de physique subatomique et des technologies associées	Nantes

# CNRS | 8 IN2P3 Platforms

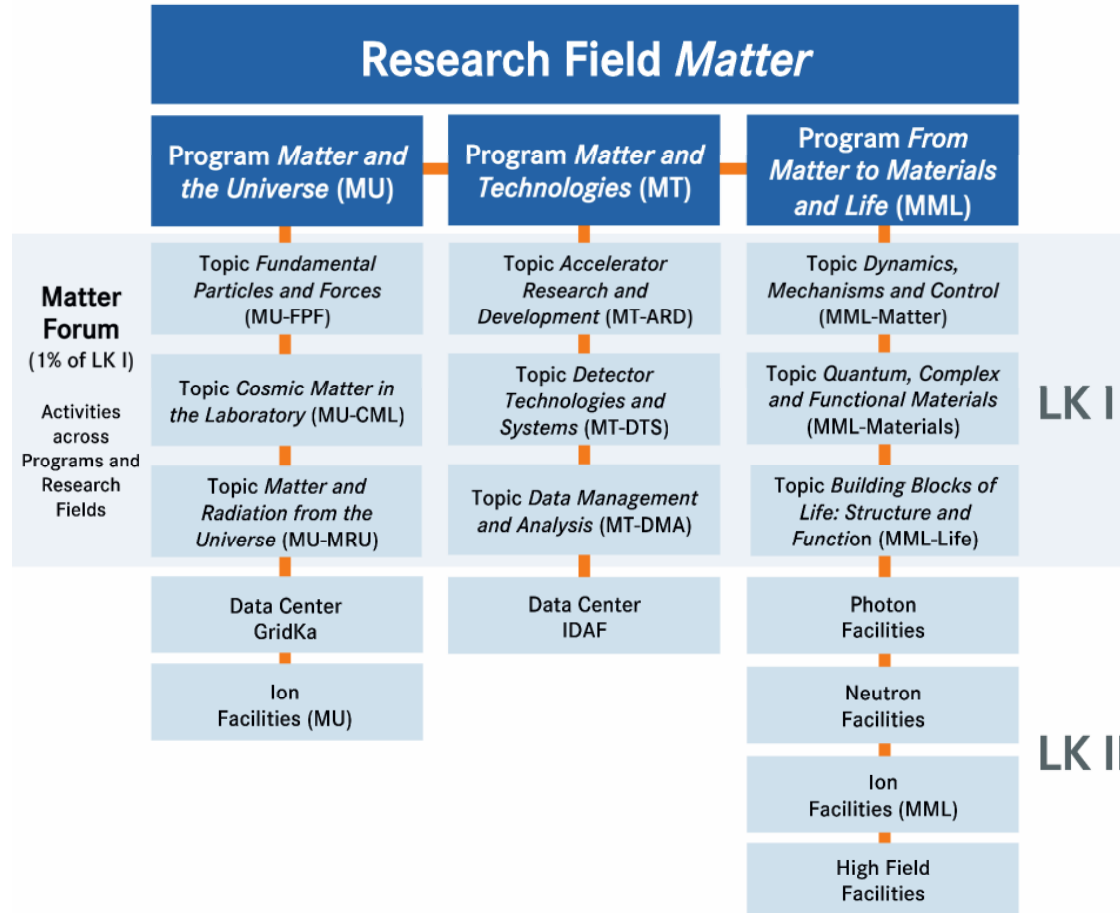
	IN2P3 Platforms	
EGO	European Gravitational Observatory	Pisa
CCIN2P3	Centre de Calcul IN2P3	Lyon/Villeurbanne
GANIL	Grand Accélérateur National d'Ions Lourds	Caen
LMA	Laboratoire des matériaux avancés	Lyon/Villeurbanne
LNCA	Laboratoire neutrinos Champagne Ardenne	Rancennes
LSM	Laboratoire souterrain de Modane	Modane
OMEGA	Organisation de microélectronique générale avancée	Palaiseau
MC	Musée Curie	Paris



# Helmholtz Association | 6 Research Fields

	ENERGY
	EARTH & ENVIRONMENT
	HEALTH
	AERONAUTICS, SPACE AND TRANSPORT
	KEY TECHNOLOGIES
	STRUCTURE OF MATTER

# Helmholtz Research Field „Matter“



# CNRS | International Research Laboratory (IRL)

- International scheme in which research work is jointly conducted around a shared scientific focus
- Funding for structured international collaboration
- Call for proposals: anytime
- Duration: 5 years (+ further 5 years periods upon agreement)
- CNRS participation:
  - Specific resources (investments, equipments, operations)
  - Assignment of personnel (in addition to the resources pooled by the institutions involved and directly provided by participating laboratories)
  - CNRS funds (75.000 € - 100.000 € over the duration)
- Balance between institutional partners in contributing resources

# CNRS-HELMHOLTZ Institutional Cooperation Advantages

- Deepen research activities in the field of matter
- Increase the visibility of CNRS & Helmholtz Matter Research
- Facilitate French-German or European tender applications for funding:
  - ANR / DFG
  - DAAD / Campus France / Ambassade de France
  - UFA / DFH
  - Horizon Europe
- Strengthen existing co-operations
- Foster new projects in fields of common interest  
(dark matter, astroparticle physics, neutrinos, gravitational waves, technologies)

# International Research Laboratory (IRL) | French-German Applications for Fundings

- UFA / DFH | financial support for:
  - French-German Doctoral School (next call: May 2020)
  - Doctoral students for French-German “Thèses en Cotutelle” (anytime)
  - French-German Scientific Workshops (Deadlines: 15.04, 15.06 & 15.10)
- DAAD / Campus France
  - PHC Procope | Mobility funding to support French-German projects (deadline 29.06.2020 | project start 01.01.2021)
  - PHC Procope plus | Organization of French-German scientific conferences (deadline 29.06.2020 | project start 01.01.2021)
- Ambassade de France |
  - Procope-Mobility: Mobility grants to France (for doctoral students, post-docts and early-career researchers working in Germany) (Deadlines in March)
- ANR / DFG

# State of the Cooperation

- 22/01/2003: Signature of a Scientific cooperation agreement between CNRS and Helmholtz Association
- CNRS and Helmholtz scientists are both involved in different projects like: CALICE, Accelerator Development, Plasma / EuPRAXIA, Tier-1-Centers GridKa & CC Lyon, APPA-FAIR, BIOPHYS, Phenomenology and ML, SIS/FAIR E range, MadMax, DARWIN, JEDI / CPEDM, Gravitational Waves, CTA, Auger, HE Neutrinos, NUSTAR-FAIR, HADES, several CERN projects...
- 18/02/2019: Signature of an Lol to explore further institutional opportunities on high energy physics, nuclear physics & astroparticle physics (extension until June 2021)
- Survey for Labs, Centers, and working groups interested in participation; identification of suitable projects
- 06/08/2019: Helmholtz Matter Steering Committee supports the project
- 2020: Proposals for a **Helmholtz International Lab** & an **International Research Laboratory (IRL)**

# Helmholtz | Helmholtz International Labs

- Focusing on an innovative, forward-looking research topic  
Joint Research infrastructures
- Funding for strategic institutional partnership
- Call for proposal: March 2020
- Duration: 5 years
- Funds: max 1,2 Mio€ / year (ratio 1:1:2)
  - Helmholtz Initiative and Networking Fund: max 300T€ / year
  - Helmholtz Centers: max 300T€ / year
  - International partner: max 600T€ / year

# HELMHOLTZ Research field Matter and CNRS / IN2P3 Cooperation

## International Research Laboratory

### **Helmholtz International Lab** for the Advancement of Gravitational Wave Observation

FZJ Jülich

#### **HILAGRO**

KIT Karlsruhe  
GSI Darmstadt  
DESY Hamburg

IP2I Lyon & LMA  
IJCLab Orsay  
LAPP Annecy  
IPHC Strasbourg  
APC Paris  
CCLyon

LLR Palaiseau  
CENBG Bordeaux  
LPNHE Paris  
Subatech Nantes  
CPPM Marseille  
LPSC Grenoble



# International Research Laboratory (IRL) | Topic Gravitational Waves

- **Helmholtz International Lab for the Advancement of the Gravitational Wave Observation (HILAGRO) 2021-2025**  
IP2I, IJCLab, IPHC, LAPP, KIT, DESY, GSI | Proposal submitted

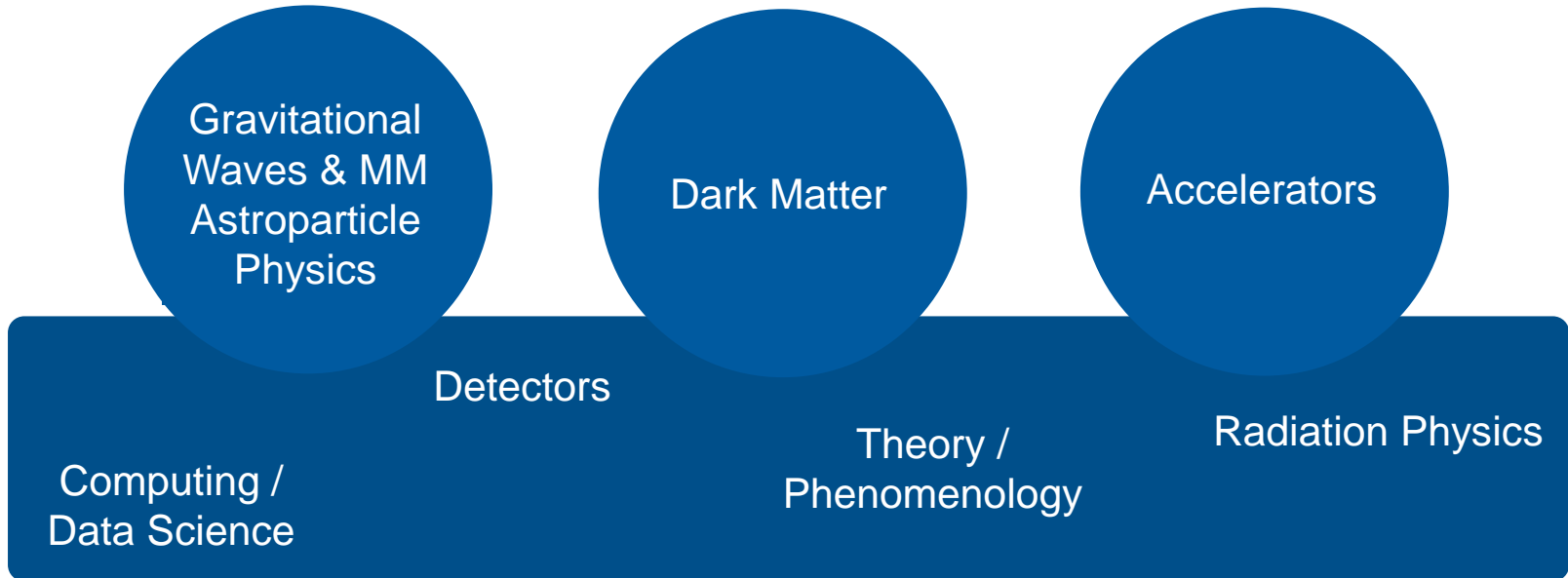


- Cryogenic Mirrors for the third Generation of Gravitational Wave Detectors: Investigate the use of superfluid  $4\text{He}$  (He-II) for cooling of 3<sup>rd</sup> generation gravitational wave detectors
- Setup of a network of cosmic ray detectors at Virgo as part of a future monitoring system of the European Einstein Telescope
- Explore signatures of the high density Equation-of-State in gravitational waves from neutron star mergers
- Preparation of multi-messenger follow-up studies of gravitational wave events

# HELMHOLTZ Research field Matter and CNRS / IN2P3 Bilateral Cooperations

	IJCLab Orsay	LLR Palaiseau	CENBG Bordeaux	IPHC Strasbourg	LPNHE Paris	SubaTech Nantes	CPPM Marseille	LPSC Grenoble	APC Paris	IP2I Lyon & LMA	LPC Clermont -Ferrand	LAPP Annecy	CC-IN2P3 Lyon
KIT	Auger EuPRAXIA Pheno/ML	EuPRAXIA		HILAGRO		DARWIN	HVCM OS	Theory	HE v	HILAGRO	Theory	HILAGRO	HILAGRO Tier 1/2
DESY	CTA EuPRAXIA sup.c. RF CALICE data sci. Theory	CTA EuPRAXIA CMS		HILAGRO Si Det.	CTA ATLAS		Axions		HE v			HILAGRO	Tier 1/2
GSI	HILAGRO NUSTAR- FAIR HADES		APPA- FAIR	NUSTAR- FAIR Ge Det. BIOPHYS		SIS/FAIR				HILAGRO			
FZJ								JEDI					
IPP	EuPRAXIA	EuPRAXIA											

# International Research Laboratory (IRL) Main & Transverse Topics



# State of the Cooperation | Bilateral projects

## Gravitational Waves

Gravitational Waves			
Project	Germany		France
Gravitational Waves	DESY - Marek Kowalski	MU/T3	APC - Matteo Barsuglia
CTA	DESY - David Berge	MU/T3	IJCLab/LLR/LPNHE (J. Biteau, S. Fegan, J.P Lenain)
Auger	KIT - ETP - Ralph Engel	MU/T3	IJCLab - Isabelle Lhenry Yvon
HE Neutrinos	DESY - NN KIT - IKP - Andreas Haungs	MU/T3	APC - Antoine Kouchner
NUSTAR-FAIR	GSI - Klaus-Dieter Groß	MU/T2	GANIL - Nathalie Lecsne, Olivier Sorlin IPHC - Gilbert Duchene IJCLab - Araceli Lopez-Martens Radomira Lozeva
HADES	GSI - Klaus-Dieter Groß	MU/T2	IJCLab - Beatrice Ramstein

# State of the Cooperation | Bilateral projects

## Dark Matter

Dark Matter			
Project	Germany		France
XENON/DARWIN	KIT - IKP - Klaus Eitel, Kathrin Valerius	MU/T3	Subatech/LPNHE - Julien Masbou / Luca Scotto Lavina IJCLab - Carla Macolino
Axions (MadMax)	DESY - Axel Lindner	MU/T1	CPPM - Pascal Pralavorio
JEDI, CPEDM (2x)	FZJ - Hans Stroehler	MU/T2	LPSC - (Maud Baylac)

# State of the Cooperation | Bilateral projects

## Accelerators

Accelerators			
Project	Germany		France
Plasma / EuPRAXIA	KIT - IBPT - Anke-S. Müller, Erik Bründermann DESY - Ralph Assmann, Jens Osterhoff IPP - Frank Jenko	MT/ARD	LLR - Arnd Specka IJCLab - Nicolas Delerue
Superconducting RF	DESY (Hans Weise)	MT/MU	IJCLab (W. Kaabi)
JEDI, CPEDM (2x)	FZJ - Hans Ströher	MU/T2	LPSC (Maud Baylac)

Further KIT-CNRS accelerator project [ANR-DFG]: *ULTRASYNC Exploration et contrôle ULTRArapide de la dynamique des paquets d'électrons dans les sources de lumière SYNChrotron*, KIT-IBPT (KARA), PhLAM (UMR 8523: CNRS, Uni Lille), SOLEIL (CNRS, CEA)

# State of the Cooperation | Bilateral projects

## Detectors

Detectors			
Project	Germany		France
CALICE	DESY - Felix Sefkow	MT/DTS	IJCLab - Roman Poeschl
HVCMOS	KIT - IPE - Ivan Peric		CPPM - Marlon Barbero
Silicon Detectors	DESY - Marcel Stanitzki	MT	IPHC - Marc Winter
ATLAS Upgrades	DESY - Ingrid Gregor	MU	LPNHE – (Giovanni Calderini)
CMS Upgrades	DESY - Guenter Eckerlin	MU	LLR - (Christophe Ochando)
Germanium Detectors	GSI		IPHC - Gilbert Duchene
APPA-FAIR	GSI - Klaus-Dieter Groß	MML	CENBG - Beatriz Jurado

# State of the Cooperation | Bilateral projects

## Computing and Data Science

Computing and Data Science			
Project	Germany		France
Phenomenology & ML (2x)	KIT - ITP - Dieter Zeppenfeld	MU/T1	IJCLab - David Rousseau
Data Science	DESY - Frank Gaede KIT – Andreas Kopmann, Erik Bründermann, Günter Quast, Manuel Giffels,	MT/MU	IJCLab – (David Rousseau) CC Lyon – Frederic Suter
Tier 1 and 2	KIT - SCC - Andreas Heiss, Andreas Paetzold, Achim Streit DESY - Volker Guelzow	MU/T1	CC Lyon - PE Macchi



# State of the Cooperation | Bilateral projects

## Theory and Phenomenology

Theory and Phenomenology			
Project	Germany		France
Phenomenology & ML (2x)	KIT - ITP - Dieter Zeppenfeld	MU/T1	IJCLab - David Rousseau
Phenomenology/Theory	DESY - Christophe Grosjean	MU/T1	IJCLab - Ulrich Ellwanger
Phenomenology/Theory	KIT - Margarete Muehlleitner	MU/T1	LPC - (Ana Teixeira)
SIS/FAIR E range	GSI - Klaus-Dieter Groß	MU/T2	Subatech - Joerg Aichelin

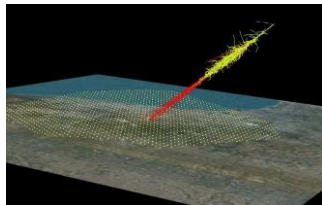
# State of the Cooperation | Bilateral projects

## Radiation Physics

Radiation Physics			
Project	Germany		France
BIOPHYS	GSI - Klaus-Dieter Groß	MML	IPHC - Christian Finck
BIOMAT	GSI - Klaus-Dieter Groß	MML	

# International Research Laboratory (IRL) | Topic Multi-Messenger Astroparticle Physics

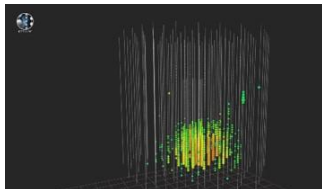
- IN2P3 and Helmholtz are key players in the major global facilities for studying the High-Energy Universe:



Ralph Engel, KIT  
Isabelle Lhenry-Yvon, IJCLab



David Berge, DESY  
J. Biteau, S. Fegan, J.P Lenain  
IJCLab/LLR/LPNHE

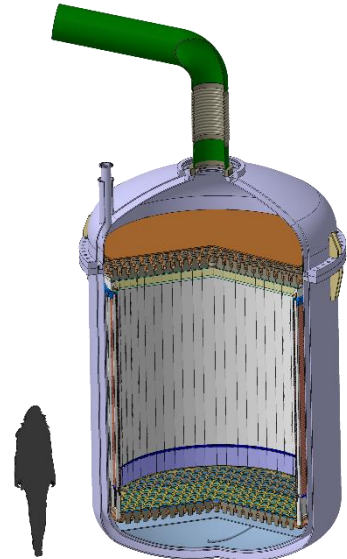


Andreas Haungs, KIT  
NN, DESY  
Antoine Kouchner, APC

- Possible IRL-cooperation
  - Fostering synergies between major infrastructures
  - R&D on light detectors (SiPM, e.g.)
  - Studies on future observatories (GCOS, e.g.)
  - Real-time alert system for MM
  - Application of modern IT technologies (deep learning on GPU or FPGA, e.g.)
  - Digitization of the research field (research data management, e.g.)
  - Promotion of an open science culture

# International Research Laboratory (IRL) | Topic Dark Matter

- **Direct DM search with dual-phase xenon TPC technology**
  - XENONnT at LNGS: commissioning 2020/2021
  - DARWIN 50t astroparticle physics observatory (2026++)
- Joint membership in XENON & DARWIN:  
KIT (ETP, IKP, IPE) – IJCLab(LAL), LPNHE, Subatech  
K. Valerius, G. Drexlin – C. Macolino, L. Scotto Lavina, D. Thers
- Potential joint projects within an IRL:
  - TPC electrode design & manufacturing
  - liquid xenon cryogenic system
  - liquid xenon purification & distillation
  - analyses & simulations (e.g. DARWIN sensitivity)
  - joint PhD programme (cotutelle)



# International Research Laboratory (IRL) | Topic Accelerators

- **Aligned to Helmholtz's „Matter and Technologies“ and ARD**
  - KIT & IN2P3/CNRS already joint in EuroCirCol, CompactLight, ARIES
  - IRLs could serve as French-German kernel in European projects
  - **KIT**: strong link to KfB (German committee for accelerator physics)
- **Enable novel and efficient operation modes for storage rings**
  - Sustainable, **energy-efficient**, reduced environmental footprint
  - Implement **artificial intelligence** support; link to **Topic Data Science**
- **Advanced beam control, diagnostics & dynamics**
  - Diagnose every particle bunch; **define & provide standards**
  - Imaging towards gigaframes/s; **attosecond metrology**
  - Synchronization and control towards 1 fs
- **Compact plasma accelerators**
  - Projects in the context of **ATHENA's DESY&KIT collaboration**
  - **KIT**: R&D program with a focus on plasma injectors for storage rings

FCC-hh vacuum chamber tests

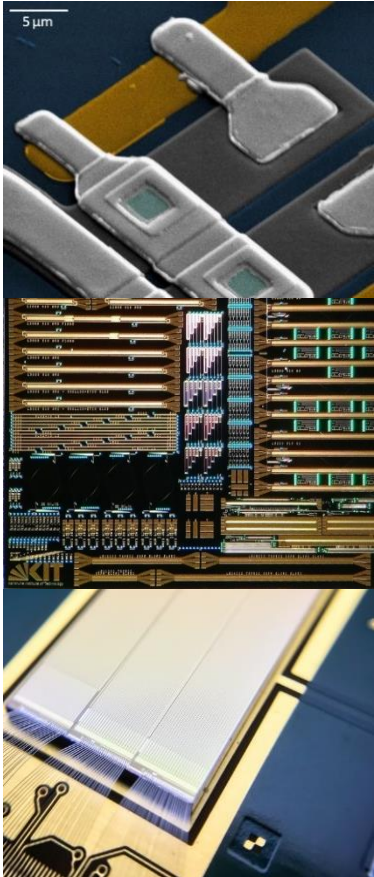


Accelerators & Detection Systems



# International Research Laboratory (IRL) | Transverse Topic Detectors

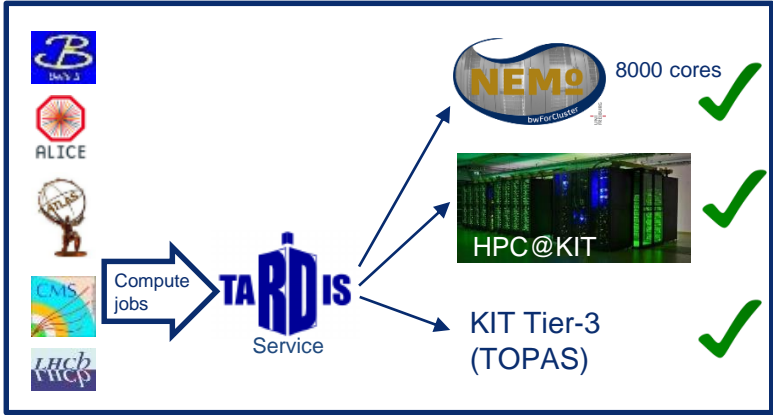
- Superconducting detectors to study the cosmic inflation by measuring the CMB polarization
- Optical terabit/second optical data transmission systems and silicon photonics for detector instrumentation
- Monolithic CMOS sensors and silicon sensors with picosecond time resolution for future tracking detectors



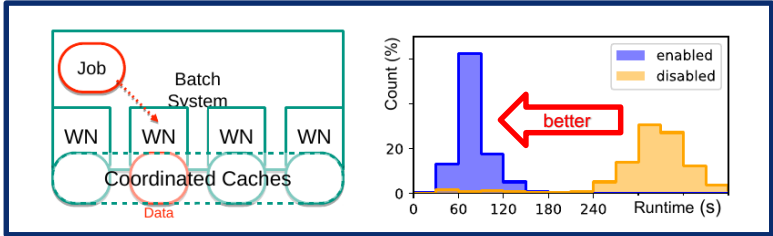
# International Research Laboratory (IRL) | Transverse Topic Computing & Data Science

- Addressing changing computing models towards the HL-LHC
  - Multi-site storage federations towards **exascale data lakes** + increasing remote data accesses
  - Integrating **opportunistic resources** (HPC, scientific and commercial clouds, GPUs)
  - **Speeding-up analysis tasks** through sophisticated data and workload management, job and data scheduling and optimized hardware & software co-design
- **Increased tape backend performance** with dCache and HPSS optimizations

### Workload management services

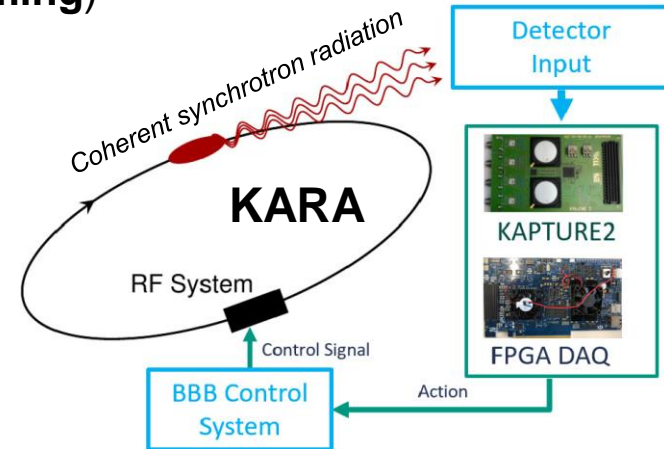


### Highly optimized analysis cluster



# International Research Laboratory (IRL) | Transverse Topic Computing & Data Science

- **Applications of Artificial Intelligence, Machine (ML) and Reinforcement Learning (RL)**
  - **KIT: Accelerate ML algorithms in real-time** for accelerator physics applications and control
    - **Training on 1-ms timescales** implemented directly on hardware
      - ICALEPCS 2019: AMALEA publication\* = starting point to explore collaboration with CNRS
    - **Big data analysis (gigabytes per second data streaming)**
- **Innovationspool AMALEA**
  - Accelerating Machine Learning for Physics
  - PL: Frank Gaede (DESY)
    - Centers: DESY, HZB, HZDR, KIT (-IPE/-IBPT)
  - ML applications to challenging projects  
in HEP, Photon-Science & Accelerator Physics
- **DESY&KIT: : Helmholtz AI Project «Autonomous Accelerator»** *Reinforcement Learning*



\* <https://publikationen.bibliothek.kit.edu/1000099095>



# International Research Laboratory (IRL) | Questions? ...Discussion