

DMLAB DMINFRANET DIME

DARK MATTER PROJECTS

IJCLab Dark Matter Day, 6 May 2026

Thomas Schörner
Deutsches Elektronen-Synchrotron DESY



HELMHOLTZ



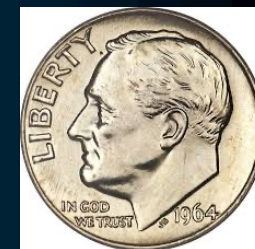
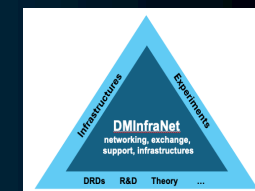
Outline

(Why) Me (?), Helmholtz

DMLab: the Dark Matter Laboratory, a International Research Lab (IRL) of CNRS+DESY(Hamburg)+GSI(Darmstadt)+KIT(Karlsruhe)

DMInfraNet: an input to the update of the European strategy for particle physics

DIME: a DFG-ANR project proposal: "Data management and analysis for Invisible Matter Experiments"



A Word about me

Today: Staff scientist at DESY in Hamburg

Background:

- Experimental collider particle physics, with stations in OPAL (Higgs physics), H1 (QCD), ATLAS (software), ZEUS (QCD / EW), CMS, ...
- Interests in data management, future colliders (ILC / Linear Collider Vision)
- Focus of work: Scientific Assistant to the Director for Particle Physics and spokesperson of the PUNCH4NFDI consortium in the German National Research Data Infrastructure NFDI

Interest in dark matter: Scientifically so far practically zero, but

- strong theme at DESY (LHC, axion / DM experiments ALPS II, BabyIAXO, MADMAX ...)
- of great interest from the FAIR data management side of things

A Word on Helmholtz

... and fundamental science in Germany

Three pillars for fundamental research:

- Universities (Humbolds ideal of “Unity of research and teaching“)
- Max Planck Institutes (“Individual excellence“)
- Research centers (also) as infrastructure providers and hubs – organised in the Helmholtz Association

Helmholtz today:

- 18 centres
- 6.9 BEUR annual budget (36% thereof 3rd-party funding)
- 47000 staff
- 6 research areas, e.g. “Matter“ with a programme „Matter and the Universe“
- Relevant for DMLab: DESY, GSI, KIT (FZJ)



The IRL DMLab – “Dark Matter Lab”

A political birth some years back – the wish of A. Petit and O. Wiestler: F-D IRLs!



Antoine Petit (CNRS) and Otmar Wiestler (Helmholtz) meet on 18/19 February 2019 (credits: CNRS)

An International Research Lab (IRL) of the CNRS is a highly structured, 5-year collaborative research unit that establishes a permanent, physical presence for the CNRS alongside a foreign partner institution. It is the highest level of international cooperation (formerly UMI) designed for joint research, researcher exchanges, and tackling major global scientific challenges.

The Path to the IRL DMLab

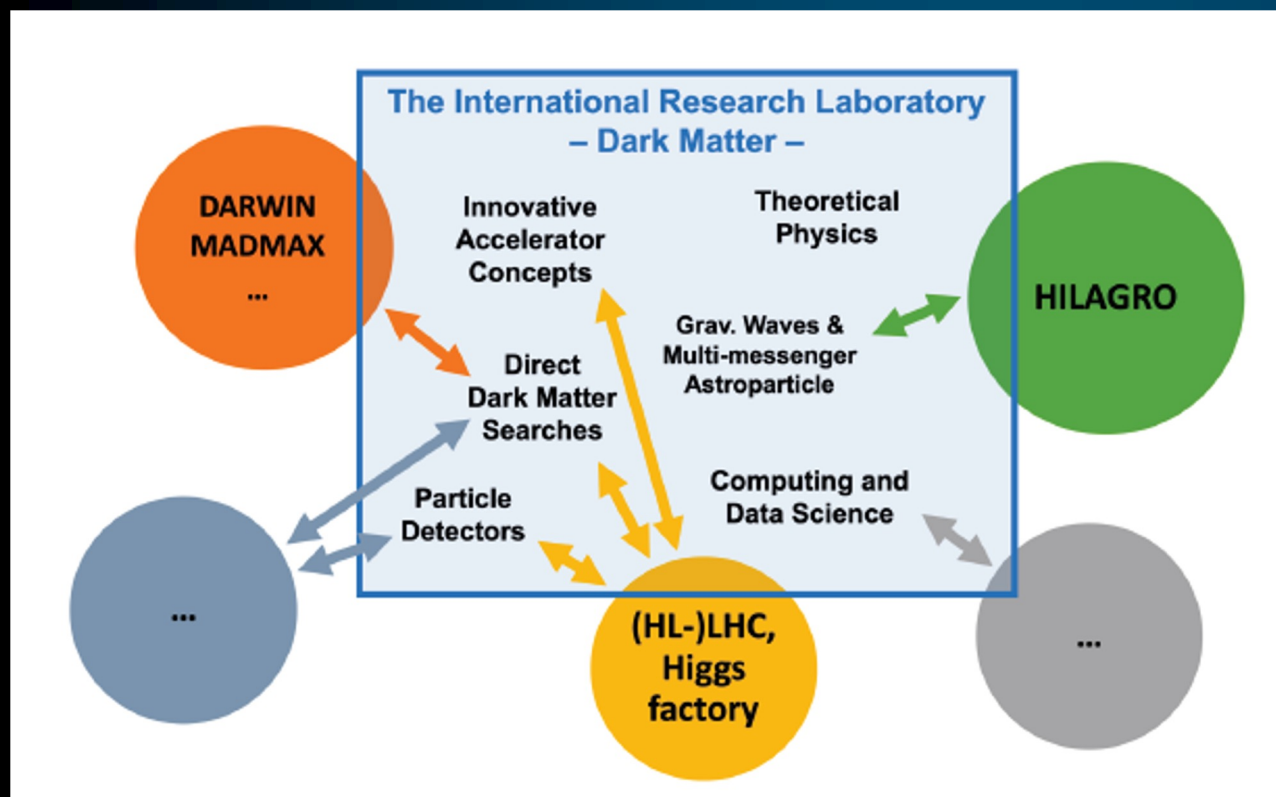
A process driven initially by Reynald Pain and Johannes Blümer

- Between Feb and Jun 2019: Brainstorming including Andreas Haungs and Dirk Zerwas
- July 2019: IN2P3 Visit to KIT: Johannes Bluemer, Klaus Eitel, Manuella Werp, Stefan Bekavac, Andreas Haungs, Patrice Verdier, Thomas Palychata, Dirk Zerwas
- September 2019: Workshop IN2P3 - Helmholtz-Matter in Paris
- April 2019: center presentations of projects (bilateral and uni-lateral)
 - ➔ Thomas Schörner (for Helmholtz) and Dirk Zerwas (for IN2P3) asked to prepare a white paper with bilateral projects, deliverables, expression of interests for long-term visits
- May 2019: first discussion of white paper draft, DESY confirmed as "IRL hub"
- July 2019: White paper approved by all involved parties and sent to Helmholtz and CNRS
- **Official start of IRL DMLab: January 2023 (signed May 2023) with IN2P3 and DESY, GSI, KIT, FZJ (now replaced by one German university seat)**

https://www.desy.de/news/news_search/index_eng.html?openDirectAnchor=2772&two_columns=1

IRL DMLab: Tasks and Scope

Develop new ideas across topic boundaries in bi-national projects, glued together by „dark matter“



Formally

- Living hub at DESY
- Long/short-term visits (sabbaticals)
- Broad and narrow workshops
- Common work
- Joint funding applications

Funding

- From CNRS
- From the involved Helmholtz centres

Governance

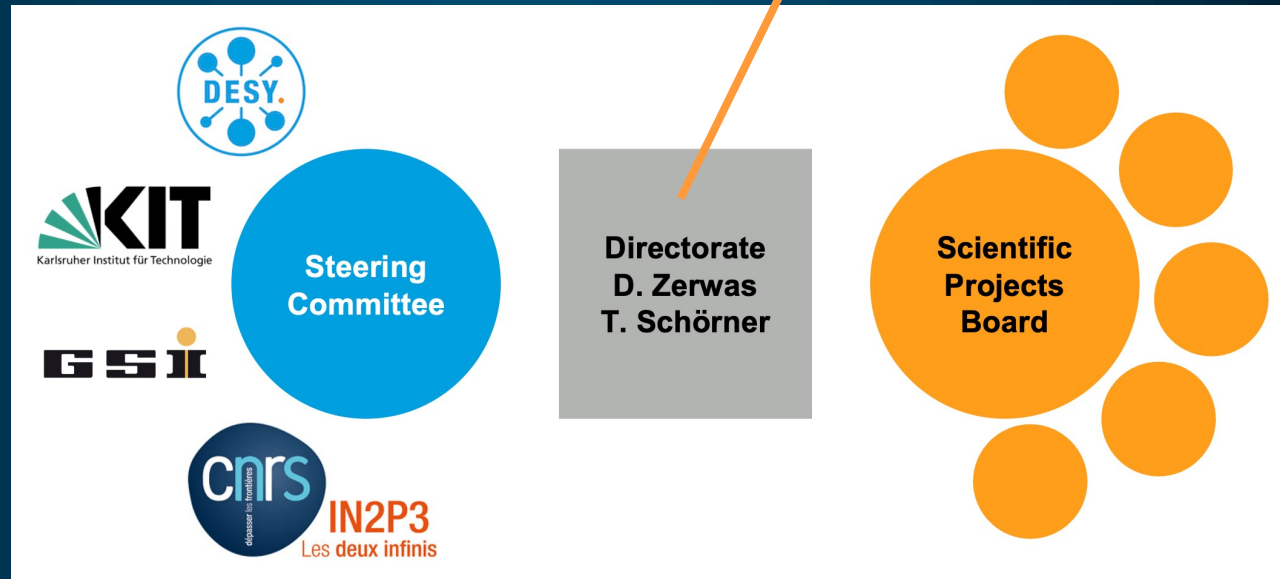
Not much to govern , but ...

French members:

- Christelle Roy
- Patrice Verdier
- Nicolas Leroy
- Laurent Vacavant

German members:

- DESY: Ulrich Husemann
- GSI: Yvonne Leifels
- KIT: Marc Weber
- External: Klaus Desch (Bonn)



In case of questions: mail to
dirk.zerwas@in2p3.fr
thomas.schoerner@desy.de

Projects:

- Searches in DARWIN (Subatech, KIT)
- Searches in MADMAX (CPPM, DESY)
- LPWA of electrons (IJCLab, KIT)
- LPWA of hadrons (LP2i, GSI)
- Precision and ML (IJCLab, KIT)
- High precision for DM (LAPTH, DESY)
- Tracking detectors (IJCLab, DESY)
- CBM-MVD (IPHC, GSI)
- Calorimeters (IJCLab, DESY)
- Dark matter, gravity, cosmology (APC, IJCLab, DES)
- Dark sector searches in neutrino experiments (CPPM, DESY)
- Probing strongly interacting BSM (IP2I, DESY)
- Strangeness in nuclear matter (Subatech, GSI)
- FIPs (IP2I, KIT)

DMLab in Practice

Funding short-term visits, project work, organizing funding applications

Short-term visits

- Typically for 1 to max 4 weeks from a French lab to a Helmholtz lab or a related entity
- At around 1000 Euro / week, the affordable number of weeks we can sponsor depends crucially on CNRS funding.
- Experience: 10-20 stays / year

Funding applications

- **2025 DFH-UFA: successful**
DFH-UFA: 10.8K
- **2024 Procope24+: successful**
DAAD: 6K, French Embassy in Berlin: 4K
- **2024 MITI PhD Thesis:**
Plasma: IJCLab "with" KIT
- **2024 Internship**
DESY (Axion group)
3rd year Ecole Polytechnique
- **2022 MITI PhD Thesis:**
Madmax: CPPM "with" DESY

Also

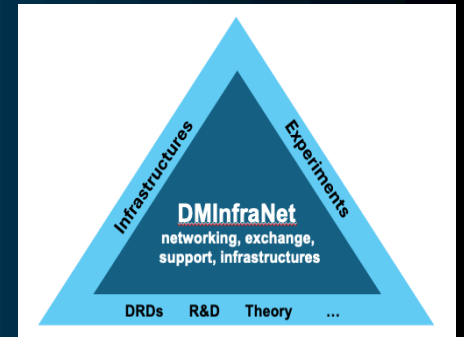
- 2024 ANR-DFG: HALOX (direct searches):
ANR: 300K, Germany: 475K
- 2023 ANR-DFG: CALO5D (detector development):
ANR: 500K , Germany: 500K
- 2025: DMInfraNet input to ESPPU
- 2026: DIME project proposal (DFG-ANR)

DMInfraNet

Enhancing European cooperation in the search for dark matter

Enhancing European Cooperation in the Search for Dark Matter

Bernard Andrieu¹, Ties Behnke², Philip Bechtle³, Xavier Bertou⁴, Jose Busto⁵, Susana Cebrián⁶, Marco Cirelli⁷, Javier De Miguel⁸, Laurent Derome⁹, Cristinel Diaconu⁵, Caterina Doglioni¹⁰, Guiliana Fiorillo¹¹, Davide Franco¹², Juan Fuster¹³, Romain Gaïor¹, Erika Garutti¹⁴, Claudio Gatti¹⁵, B. Gimeno-Martinez¹³, Frédéric Girard¹, Roxanne Guenette¹⁶, Matthias Hamer³, Sophie Henrot-Versillé⁴, Thibaut Houdy⁴, Fabrice Hubaut⁵, Adrian Irles¹³, Yoann Kermaidic⁴, Marcin Kuźniak¹⁷, Axel Lindner², Julien Masbou¹⁸, Giovanni Mazzitelli¹⁵, Akira Miyasaki⁴, Enrique Minaya⁴, Konstantinos Nikolopoulos^{14,19}, Federica Petricca²⁰, Roman Pöschl⁴, Pascal Pralavorio⁵, Florian Reindl^{21*}, Leszek Roszkowski^{17,27}, Daniel Santos⁸, Jochen Schieck^{21,22*}, Thomas Schörner^{2,23*}, Silvia Scorza⁸, Luca Scotto Lavina¹, Steinar Stapnes²⁴, Achille Stocchi⁴, Maxim Titov²⁵, Julia K. Vogel²⁶, Masayuki Wada¹⁷, Jonathan Wilson⁴, Yajing Xing¹ and Dirk Zerwas^{23*}



Signed by ~60 individual authors from: Austria, France, Germany, Poland, UK, Spain

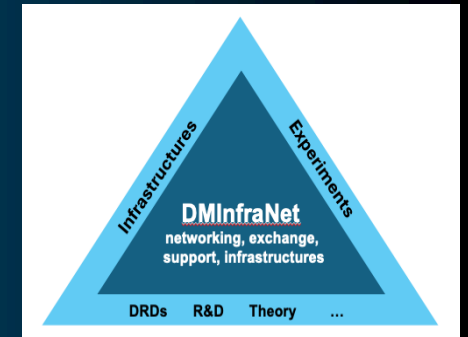
The search for dark matter is an exciting topic that is pursued in different communities over a wide range of masses and using a variety of experimental approaches. The result is a strongly correlated matrix of activities across Europe and beyond, both on the experimental and the theoretical side. We suggest to encourage and foster the collaboration of the involved institutions on technical, scientific and organisational level, in order to realise the synergies that are required to increase the impact of dark matter research and to cope with the increasing experiment sizes. The suggested network — loosely titled "DMInfraNet" — could be realised as a new initiative of the European strategy or be based on existing structures like iDMEu or DRD. The network can also serve as a nucleus for future joint funding proposals.

DMInfraNet

Enhancing European cooperation in the search for dark matter

Rational:

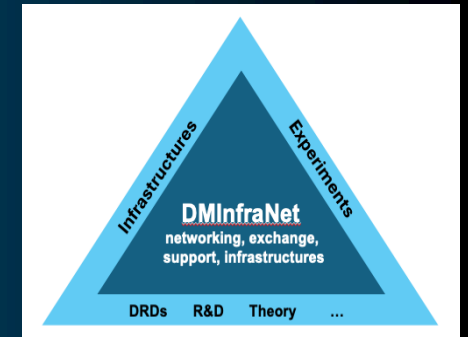
- European strategy for particle physics focuses much on flagship colliders (HL-LHC, future flagship colliders, ...)
 - But 2020 update also stresses: *"The quest for dark matter [...] are crucial components of the search for new physics. [...] A diverse programme that is complementary to the energy frontier is an essential part of the European particle physics strategy. Experiments in such diverse areas that offer potential high-impact particle physics programmes at laboratories in Europe should be supported [...]"*
 - Large variety of theoretically motivated dark matter candidates, ranging over several orders of magnitude in mass and interaction cross-section
 - very different experimental approaches employing different technologies
 - a lot of very diverse technical expertise at various places
 - In addition, efforts growing in size and complexity – i.e. more and more difficult for individual (small) institutions to realise experiments – need for increased collaboration.
- ➔ **increased cooperation to take the field to the next level!**



DMInfraNet

Enhancing European cooperation in DM searches

- Mutual support for existing and future projects
- Identification of common interests, sounding board for ideas, needs, expertise
- Access to infrastructures, strengthening of competence centers
- Help community speak with one voice
- Communication structures and collaborative tools
- Joint solutions for common questions (software, data management, ...)
- Education aspect
- Increased strategic weight in Europe



- New structure established by encouragement of ESPPU process?
- Enhancement of iDMEu activities?
- Extension of DRD activities at higher TRL levels: implementation of existing and new technologies
- ...

Document specifies underground facilities, accelerator-related facilities, connections to DRDs, concrete experiments, and lab / national activities

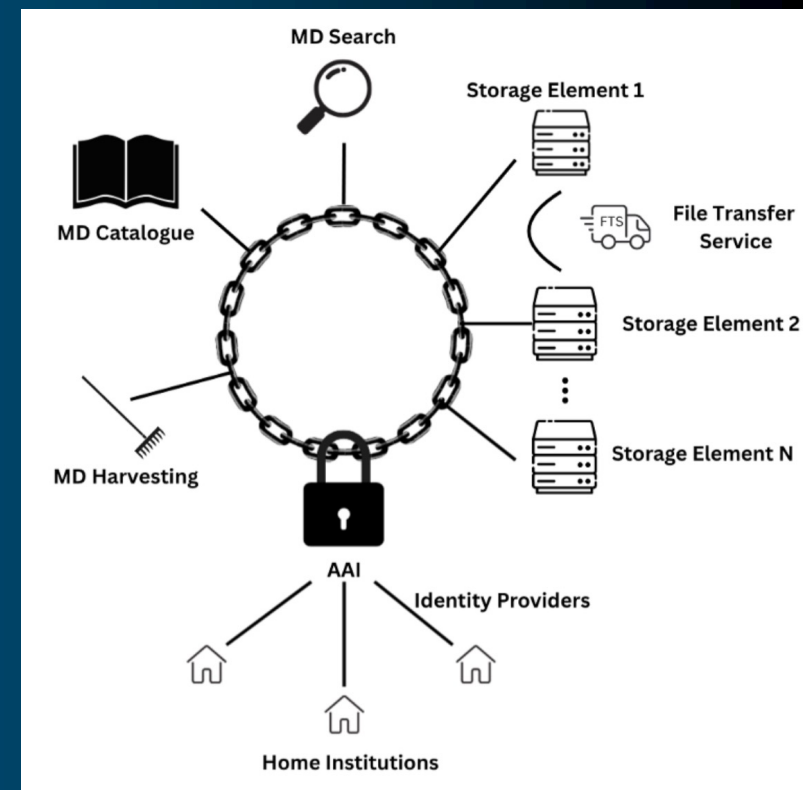
The DIME Project

Data management and analysis for Invisible Matter Experiments



- With DMInfraNet submitted, and no concrete recommendation in the ESG document: need for demonstrations of benefits from collaboration
→ idea of DIME – with a focus on data management
- Numerous projects either not specific for DM data (PUNCH4NFDI, EOSC, ESCAPE) or only loose link / data set collections (iDMEu, DMDC@Munich, ...)
→ unified access to dark matter data, connection of efforts in DM community, and tools and workflows for efficient and experiment-overarching dark matter data analysis desired.

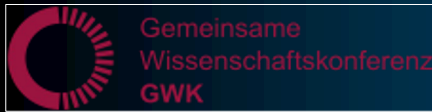
DIME as first step towards concretely implementing the ideas sketched in DMInfraNet.



Data management model for DIME

PUNCH4NFDI

Particles, Universe, NuClei and Hadrons for the NFDI: National Research Data Infrastructure



DFG Deutsche Forschungsgemeinschaft

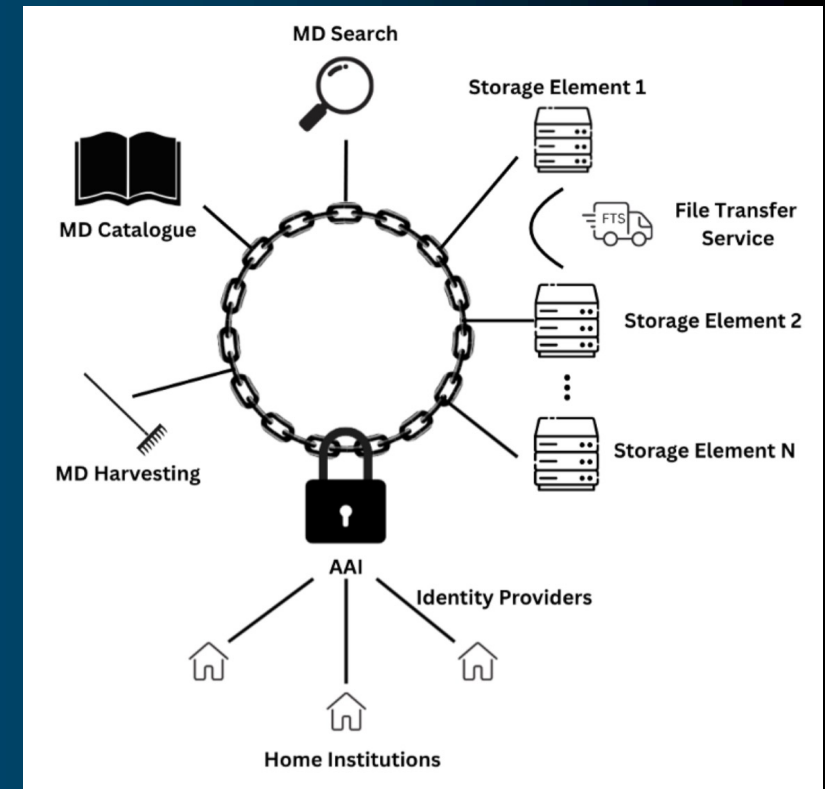


Sustainable research data utilisation

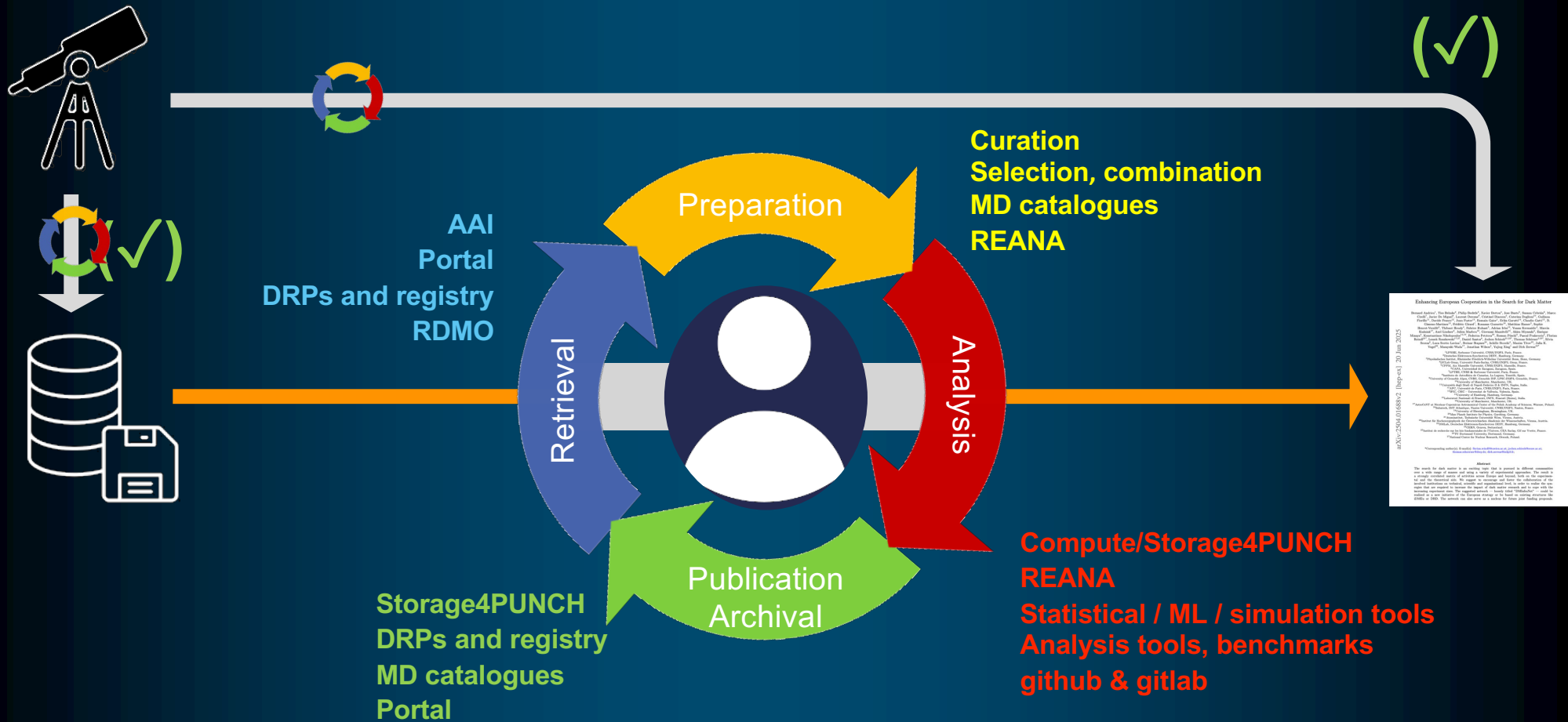
- Establishment of FAIR data management solutions
- Connection to int'nal efforts (EOSC)
- Bottom-up approach of 26 discipline-specific consortia (5 years a 5 MEUR)

Particles, Universe, NuClei & Hadrons 4 NFDI

- ~40 institutions*Max Planck, Helmholtz, universities, Leibniz)
- Focus: "last golden mile of RDM" → enabling scientists to more easily extract more science from a FAIRification of existing and new data
- Keywords: Federated compute and storage, AAI, REANA and workflows, digital research products and registry,



Data management model for DIME
PUNCH4NFDI deliverable



The DIME Project

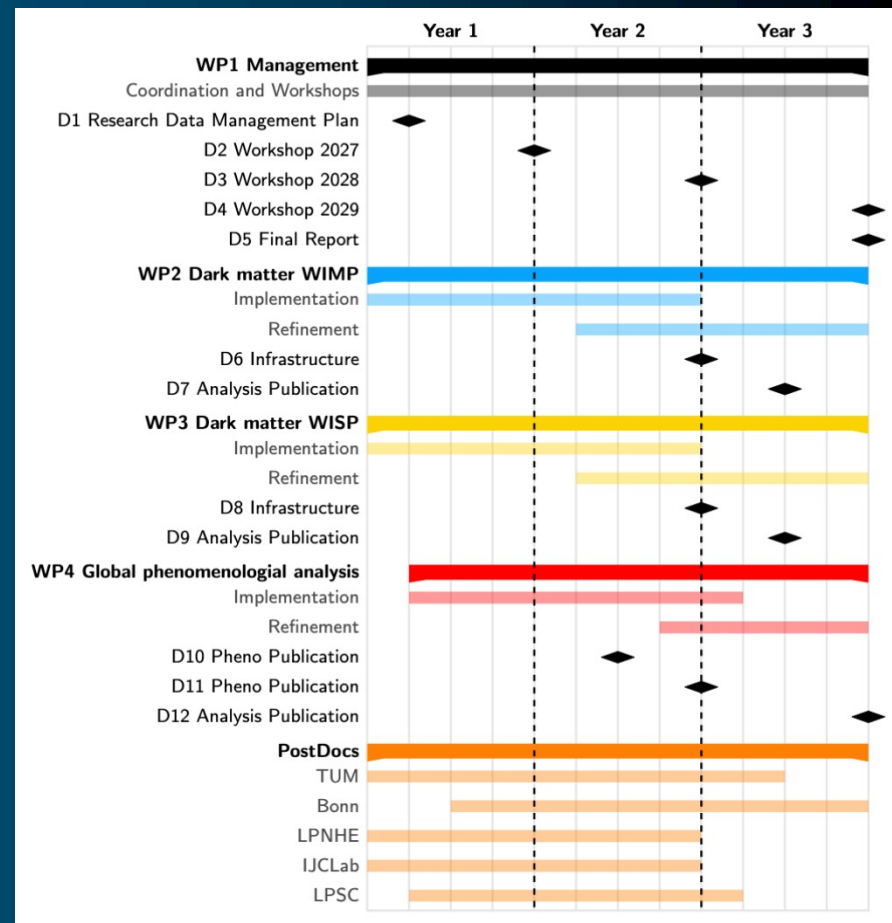
Data management and analysis for Invisible Matter Experiments



Objective 1: Building on DMDC & PUNCH4NFDI, create RDM environment for various DM data sources with i) AAI, ii) searchable (meta)data catalogue building on e.g. DMDC, ILDG, iii) code repository, iv) REANA workflow installation.

Objective 2: Create workflows using O1 for XLZD and MADMAX, demonstrating validity and usefulness + potential for extensions (only 2 demonstrators + pheno!)

Objective 3: Perform combined DM analysis across different masses, combining several experiments (building on O1,O2)

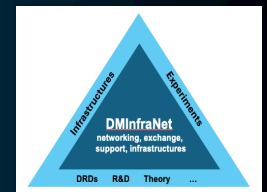


Summary

DMLab: the Dark Matter Laboratory, an CNRS International Research Lab



DMInfraNet: an input to the update of the European strategy for particle physics



DIME: a DFG-ANR project proposal: "Data management and analysis for Invisible Matter Experiments"



Thank You.

Contact

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