What is DIG-UM and how does it shape the advancement of AI in basic research

Jan Steinheimer for DIG-UM
(Chair of BDA Topic Group)

DIG-UM

Why this may be interesting for you

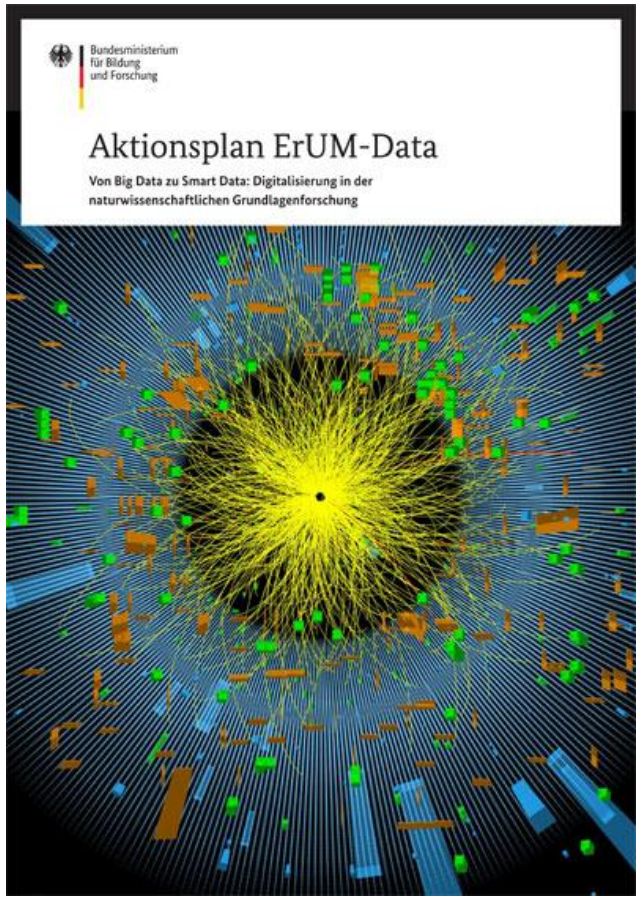
- Why is it worth talking about ways to organize AI community efforts?
- Eventually research with AI needs funding for: personnel, workshops, schools, networking, research visits, (hardware).
- EU commission is planning to spend money.

https://digital-strategy.ec.europa.eu/en/news/researchers-and-innovators-invited-shape-europes-ai-strategy-science

- ErUM-Data Hub and EUCAIF was mentioned as example and to be supported by EU funding.
- What kind of structure do we want to suggest to get a piece of the cake and maintain some influence on what should be funded?
- This talk: Explain how the German ErUM-Communities try to self-organize to maintain agency over the direction that AI funding in physics is used.

What is ErUM-Data

- In 2021, with ErUM-Data, the German government launched a funding scheme for >10 years to fully exploit the potential of data and digitalization in the exploration of the universe and matter at research infrastructures.
- ErUM-data initiated from ministry. Total funding up to 120M€ for 10 years.
- Addresses researchers in several physics communities to do overarching research on new digital technologies for their research.
- Unites about 20,000 scientists from German universities and research centers working on astrophysics, astro-particle physics, hadron and nuclear physics, particle physics, accelerator research, and research with photons, neutrons, and ion beams.
- Difficult to handle, not done by ministry but by communities.

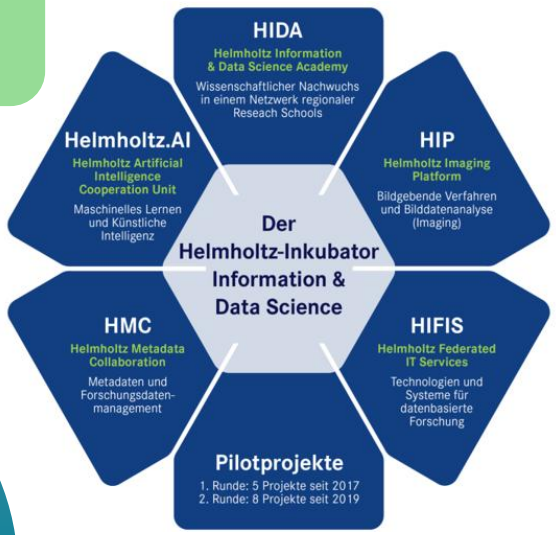


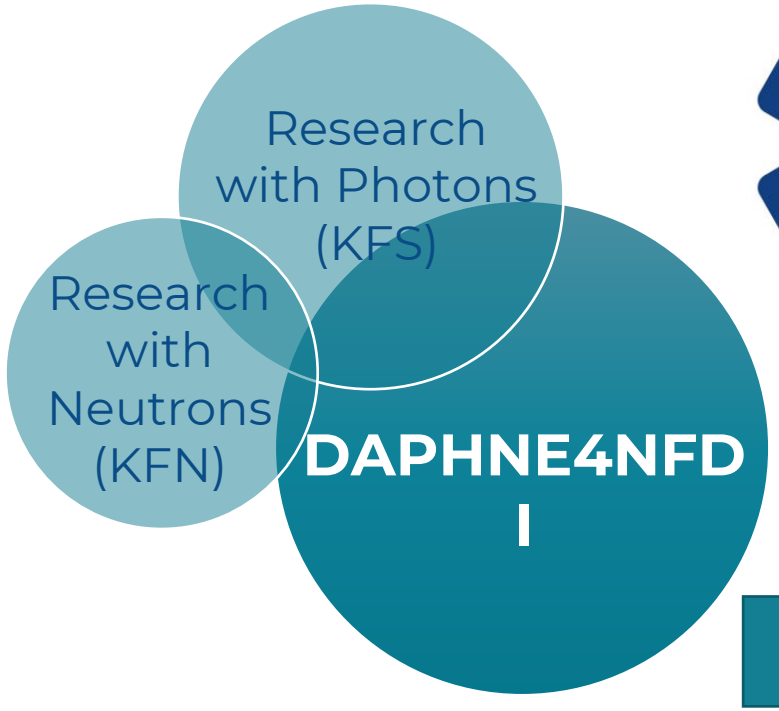
Multiple Connections on Digital Transformation

International EUCAIF

DKZ - Data Competence Centres

Base4NFDI





MTDMA

PUNCH4NFDI

- Astroparticle Physics (KAT)
- Astronomy (RDS)
- Particle Physics (KET)
- Hadrons and Nuclei (KHuK)

Research with Ions (KfSI)

Accelerator Physics (KfB)

ErUM Data

Martin Erdmann, RWTH Aachen University

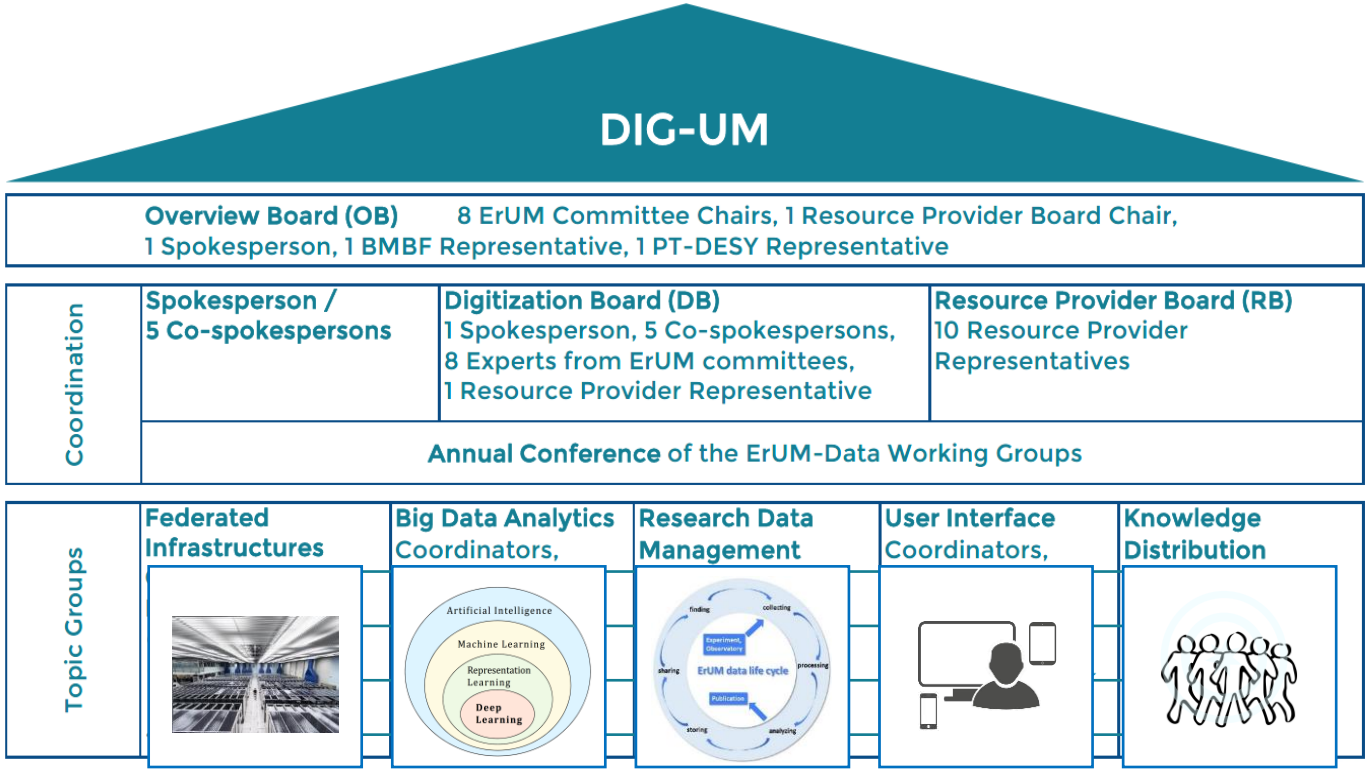
DIG-UM

DIG-UM a community organization

- To represent the communities DIG-UM was initiated.
- Representatives from every physics community.
- Topic groups for topical input.
- DIG-UM itself is NOT funded.

Community

KAT	Astroparticle
KET	Particle
KfB	Accelerators
KFN	Research with Neutrons
KFS	Resarch with Synchrotron Radiation
KFSI	Research with nuclear Probes and Ions
KHuK	Hadrons and Nuclei
RDS	Astronomy



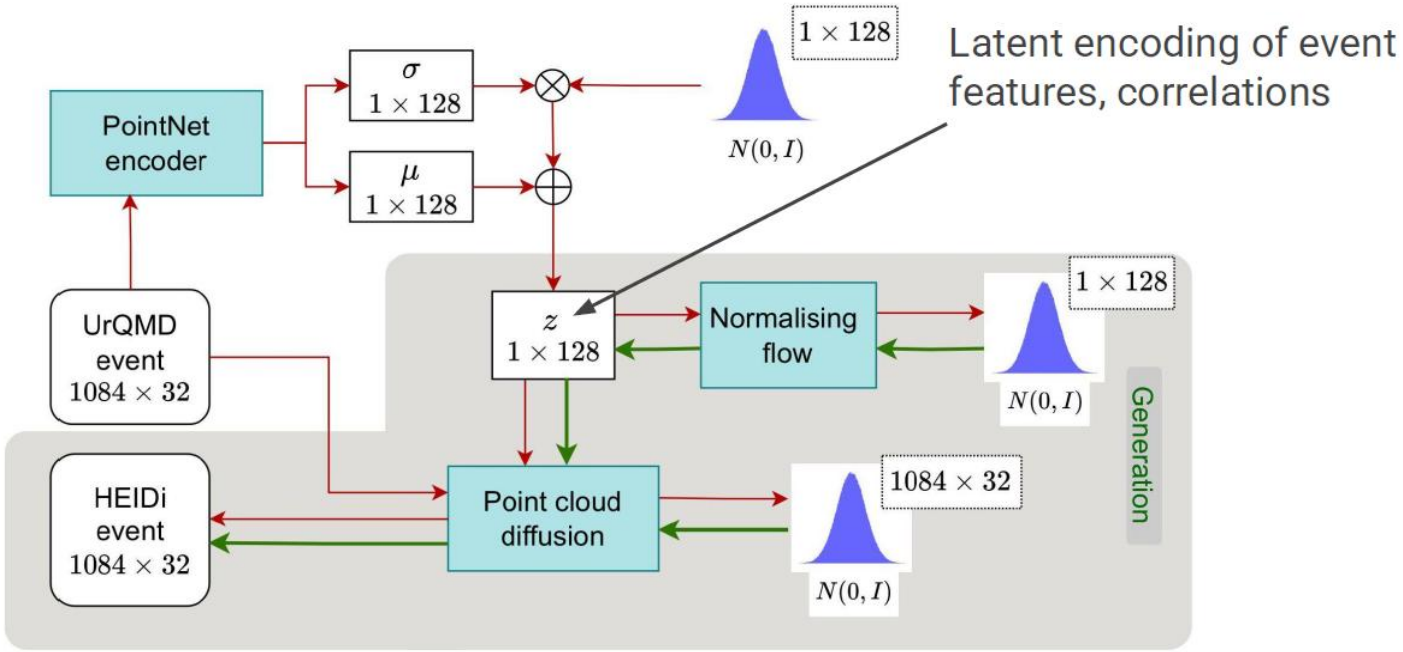
The topic groups

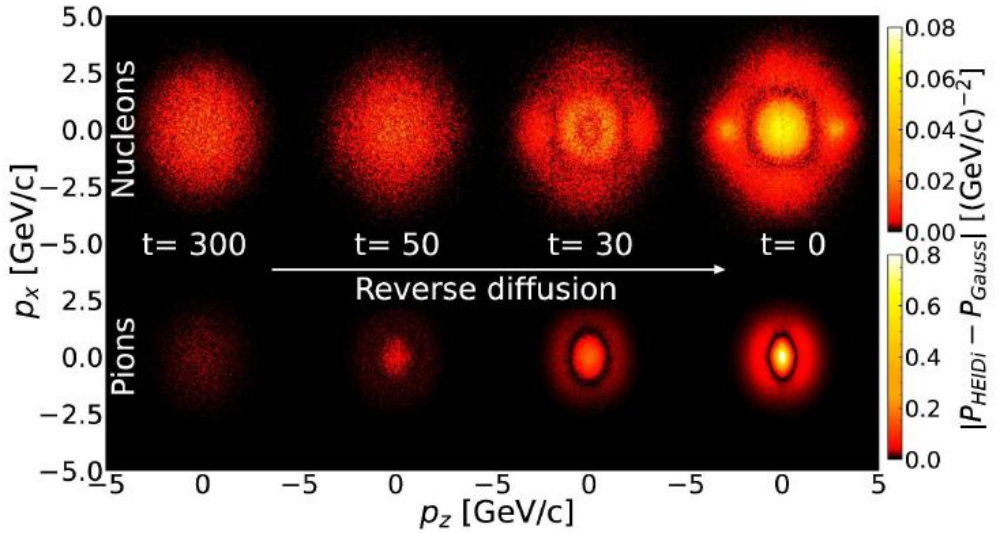
- The TG representative and deputy are proposed by the Digitization Board and appointed by the Overview Board for a term of two years to ensure representation of all communities.
- Topic groups are where the different funded consortia can meet.
- **For AI: BDA important**
- Regular online meetings and annual in-person workshop to promote cross-consortia exchange.

https://erumdatahub.de/en/

BDA – focus on AI in data analysis, interpretation and simulation: Selected results from the BDA annual meeting in march 25.

From generative models for nuclear collsions (see also talk by Kai Zhou, Jun 18, 3:09 PM):

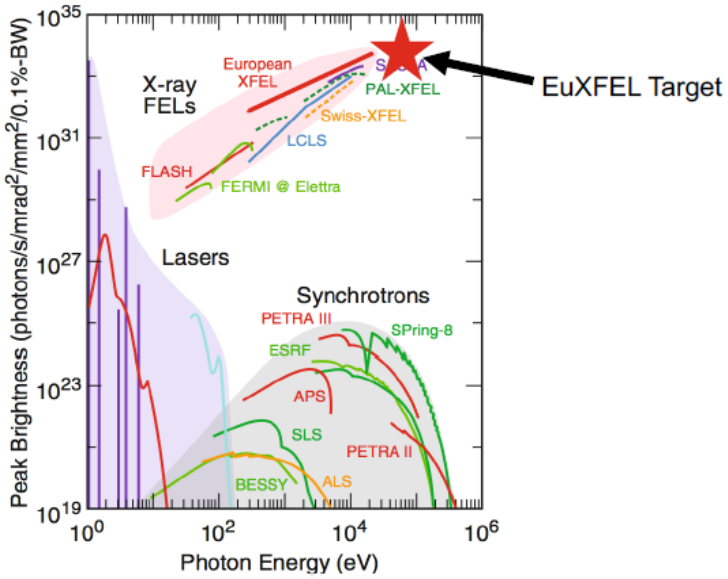




M. Omana Kuttan, K. Zhou, J. Steinheimer and H. Stoecker," [arXiv:2412.10352 [hep-ph]].

BDA – focus on AI in data analysis, interpretation and simulation: Selected results from the BDA annual meeting in march 25.

To laserpulse shaping (OPAL FEL) and Element spectral analysis (EvalSpec-ML)

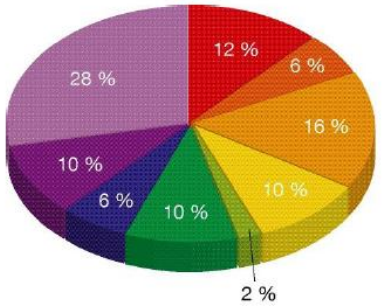


Henrik Tünnermann (DESY)

Key results:

1. Shaping of UV Flat-top profiles through SLM
2. Generation of first flat-top electron bunches
3. Shaping of arbitrary UV picosecond pulses

After 2nd meeting already synergy effects between consortia where presented.
Cross-community collaboration (Astro&Neutrons)

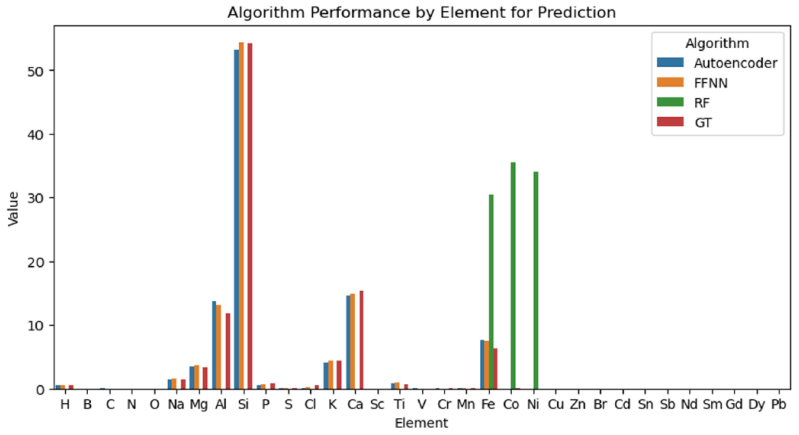


Broad use case

Elemental analysis for various scientific fields!

- Archeology
- Biology
- Chemistry
- Condensed Matter Physics
- Crystallography
- Geo Sciences
- Materials Science
- Medicine
- Nuclear Physics

Algorithm	MSE	MAE	MSBE
Autoencoder	**0.38**	0.06	**1.42**
CNN	36.08	0.52	37.70
LR	72.84	1.64	75.94
FFNN	0.57	**0.05**	1.58
RF	61.05	1.32	63.38



*Boschmann et al. Automation of PGAA Spectra Analysis with Deep Learning, 2024 IEEE 22nd International Conference on Industrial Informatics (INDIN), 2024

Christian Stieghorst TUM

Boschmann, D., Stieghorst, C., Knezevic, D., Kadri, L., & Niggemann, O. (2024). In 2024 IEEE 22nd International Conference on Industrial Informatics (INDIN) (pp. 1-8). IEEE.

DIG-UM

More contributions to this conference from ErUM-Data projects

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Transfer Learning for Smart Background Simulation at the Belle II Experiment

David Giesegh, Boyang Yu, Nikolai Krug, Thomas Kuhr
LMU Munich

17/06/2025
EuCAIFCon 2025

Belle II | Bundesministerium für Forschung, Technologie und Raumfahrt | KISS

A QGP Trigger based on Convolutional Neural Network for the CBM Experiment

A. Belousov[1] and I. Kisel[1,2,3,4]

Goethe-University Frankfurt, Frankfurt am Main, Germany
Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany
Helmholtz Research Academy Hesse, Frankfurt am Main, Germany
Helmholtz Center for Heavy Ion Research, Darmstadt, Germany

HFHF GSI FAIR CBM

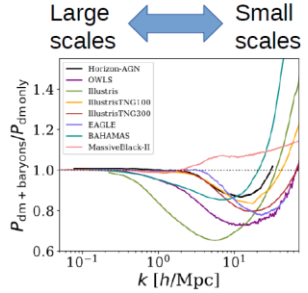
Ivan Kisel EuCAIFCon 2025,

Learning Optimal and Interpretable Summaries of Galaxy Catalogs with SBI

with Sven Krippendorf, Jochen Weller, and Klaus Dolag

- Numerical simulations for non-linear structures in the Universe
- ies in small-scale eld significant ent in known s
- s reflected beyond mmary statistics?
- d and analyze optimized summary statistics

Large scales ⟷ Small scales



Chisari+ 19

TUM LMU ORIGINS | KISS | LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

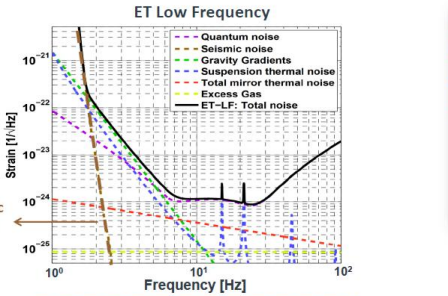
han@physik.lmu.de 17/06/2025

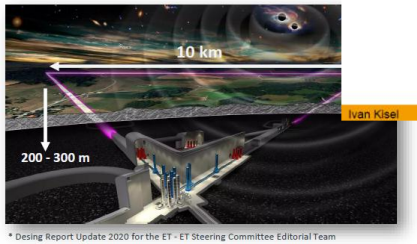
Towards a Seismology Foundation Model

Waleed Esmail
Universität Münster, Institute für Kernphysik, Münster, North Rhine-Westphalia

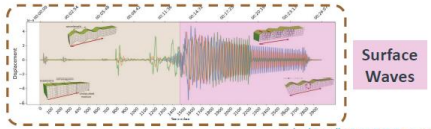
Universität Münster

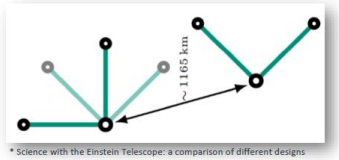
The Einstein Telescope (ET)





* Desing Report Update 2020 for the ET - ET Steering Committee Editorial Team





* Science with the Einstein Telescope: a comparison of different designs

Waleed Esmail – EuCAIF2025 – June 17, 2025

17.06.2025

1

Belle II PXD background generation using generative models

Fabio Novissimo, Nikolai Krug, Thomas Kuhr
LMU München

EuCAIFCon, June 17th 2025

KISS | Belle II | Bundesministerium für Bildung und Forschung

Why the ErUM-Data HUB is so essential

- The annual meetings and topical workshops of the TGs are supported by the ErUM-data HUB.
- Not only that. The ErUM-Data-Hub also received funding:
- 2,5M€ / 4 years.
- Activities from schools, event support, knowledge (wiki) to outreach.

ErUM-Data-Hub @ Aachen

The Networking and Transfer Office serving Digital Transformation in Research on Universe & Matter in Germany

Martin Erdmann , Angela Warkentin, Jan Bürger, Benjamin Fischer, Stefan Fröse, Ulla Lardinoix, Judith Steinfeld

Contact: info@erumdatahub.de

Networking

Education

Transfer

Hannover Messe

ERUM DATA HUB

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Federal Ministry of Education and Research

erumdatahub.de

DIG-UM

Teaching digital competencies in suitable venues (supported by DIG-UM and the TGs)

Event	Location
Train-the-Trainer Deep Learning “Basic Concepts”	RWTH Aachen University
Train-the-Trainer Deep Learning “Advanced Concepts”	Bergische Universität Wuppertal
Deep Learning School „Basic Concepts“	Landhaus Nordhelle, Meinerzhagen
Conceptual Advances in Deep Learning	Hotel zur Post, Wiehl
Active Training Course „Advanced Deep Learning“	Landhaus Nordhelle, Meinerzhagen


RWTH Aachen University


Hotel zur Post, Wiehl

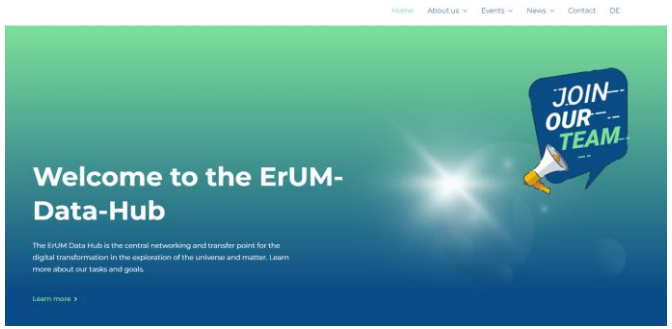

Landhaus Nordhelle, Meinerzhagen


Bergische Universität Wuppertal

Martin Erdmann, RWTH Aachen University

DIG-UM

ErUM-data HUB
Providing high-quality contents for ErUM Scientists



erumdatahub.de

Aimed at ErUM communities and the interested public

- General Information
- ErUM, DIG-UM
- Events & Documentation
- Contact, Links & Partner

Launched in February 2024:

The ErUM-Data-Hub Podcast

The time has come!

In our new Podcast "Sternenstaub & andere Materie" (Star dust & other matter) we dedicate ourselves to the small and big questions of physics and explore the universe and matter together with you. Unfortunately, the Podcast is only available in German.

Listen on Spotify

Listen on Apple Podcasts

DOWNLOAD

Follow us

Launched in January 2025:

The ErUM-Data wiki: https://wiki.erumdatahub.de/bin/view/Main/

- Free after registration.
- Information on DIG UM and ErUM-Data.
- Materials for lectures, e.g. on AI topics.
- Meetings, minutes, mailing lists and an event calendar

Martin Erdmann, RWTH Aachen University

Transfer to the European scale?

- Is there something we can learn for the EU ambitions?
- Most importantly: funding for networking is essential and can have large impact.
- How to convince the commission? (Something for the discussions)

- Other aspects: Sustainability… in both senses (climate and sustainable knowledge)