Karlsruhe Institute of Technology

KAT. Komitee für Astro. Teilchen. Physik

The KAT digitaliziation strategy &

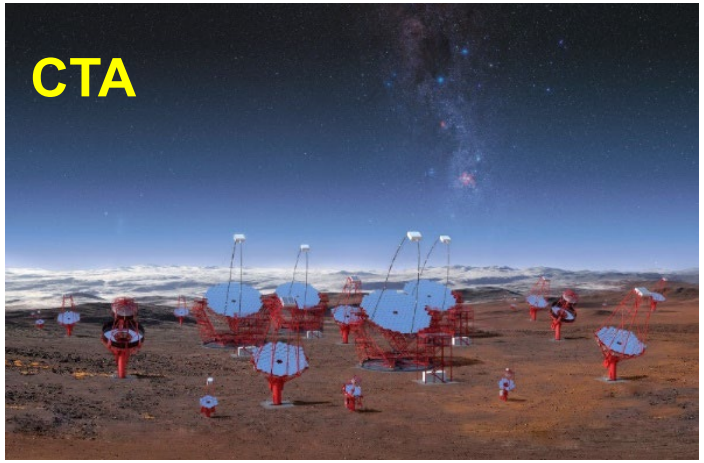
PUNCH 4NFDI

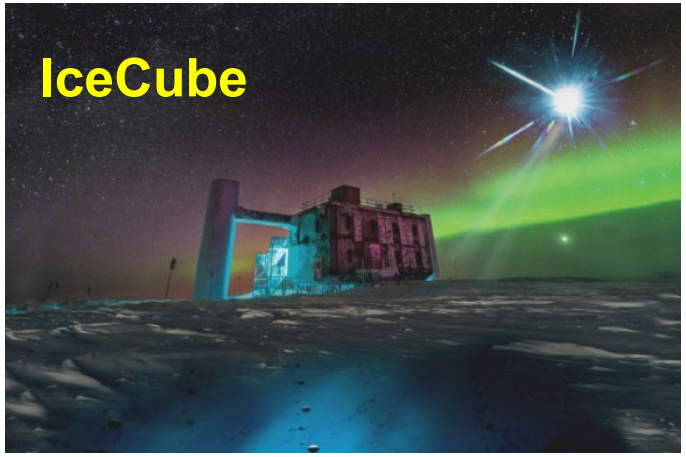
Andreas Haungs, Institute for Astroparticle Physics

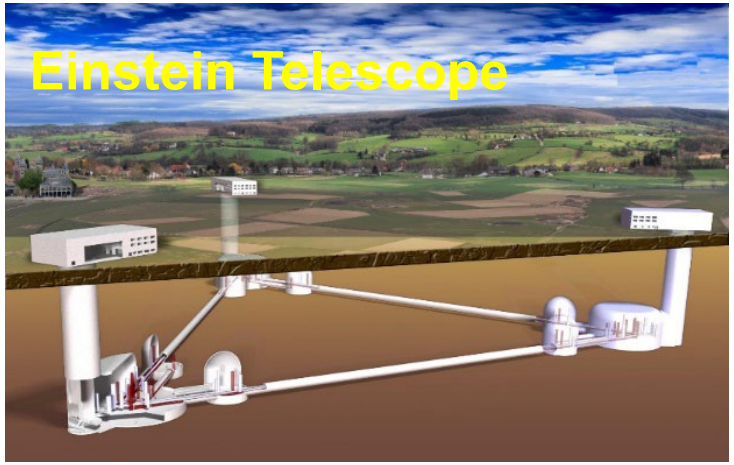
(1) Computing and Data: Status in APP

Flagship Experiments of German Astroparticle Physics

2020+: Consortia in ErUM-Pro







Example Computing Model

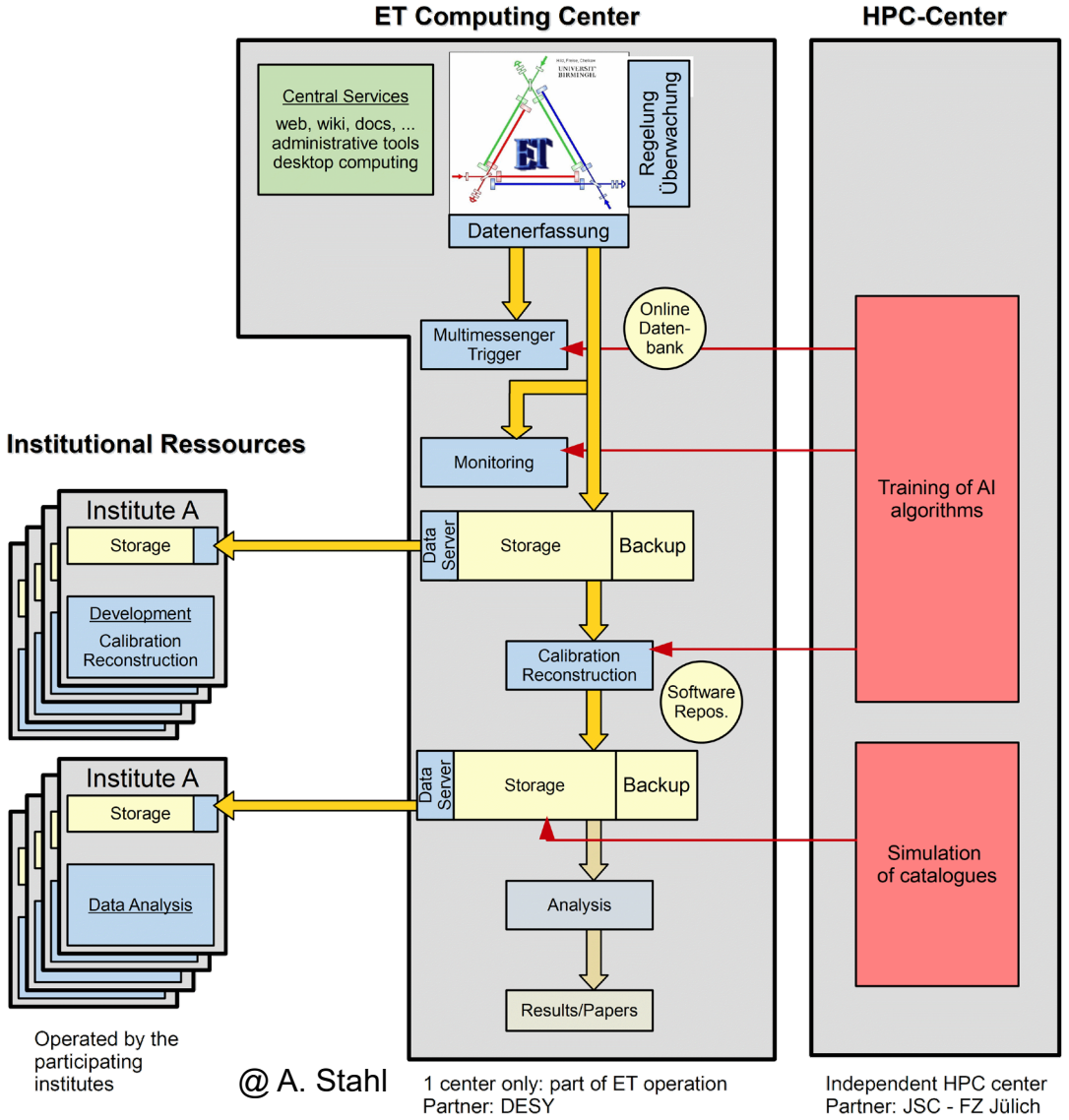
Computing Challenges of Einstein Telescope

Computing Model:

- ET Computing Center, only low latency (= operation costs)
- HPC-Center (= member country costs)
- Institutional Resources (= institutional costs)

Challenge:

- LIGO/Virgo analysis path does not work, since:
  - Many more signals / events
  - Longer signal traces at low frequencies (hours)
  - Parameter set per event much higher (better fit and comparison to template)
  - More parameters available (e.g. polarisation)
  - More types of events, i.e. more template catalogues.
  - Huge amount of (online) monitoring data
- Requests large resources (HPC) for generating and training of catalogues as well as the development of smart algorithms



Example Computing Model

CTA Science Data Management Centre

The Science Data Management Centre coordinates science operations and make CTA's science products available to the worldwide community.

- **~20 personnel will manage CTA's science coordination including software maintenance and data processing for the Observatory.**
- **CTA will generate approximately 100 petabytes (PB) of data by the year 2030.**
- **The SDMC is located in a new building complex at DESY in Zeuthen.**
- **Provides well-established infrastructure and a powerful computing centre.**

@ DESY in Zeuthen

Survey Results for German Astroparticle Physics (2021)

Assessment of the demand for federated resources in computing of APP:

- Total German share of computing requests of the ErUM-Pro projects in addition to usage of institutional resources.
- * CTA: 2/3 are provided by the CTAO
- + Theorie: use of supercomputers of major part, e.g. in Jülich, SuperMUC,……

- Projected requests for 2028: factor ~4 for CPU, Disk and Tape, factor ~10 for GPU (mainly by ET)

Request in 2021	Auger	IceCube	CTA*	ET	KATRIN	GERDA / LEGEND	DARWIN	Multi-Messenger	Theorie	Summe
CPU [CPU-years]	500	2000	1500	0	500	n/a	0	100	2000	6600
GPU [GPU-years]	40	400	0	0	0	n/a	0	50	100	590
Disk [PB]	0.8	2	1.6	0	n/a	n/a	0	0.2	0.1	4.7
Tape [PB]	3	10	0	0	n/a	n/a	0	0	0	13

Projected for 2028	Auger	IceCube	CTA	ET	KATRIN	GERDA / LEGEND	DARWIN	Multi-Messenger	Theorie	Summe
CPU [CPU-years]	800	3000	3000	5000	600	n/a	2500	1000	3000	18900
GPU [GPU-years]	70	600	0	5000	400	n/a	13	500	500	7083
Disk [PB]	1.5	2	7	2	n/a	n/a	1.9	2	0.2	16.6
Tape [PB]	5	20	30	0	n/a	n/a	1.1	4	0	60

Survey Results for Federated Computing Infrastructures (2021)

Assessment of the demand for federated resources in computing of APP:

- To WLCG-like system projected requests of German share of computing requests of the ErUM-Pro projects in addition to usage of institutional resources.
- Projected requests for 2028: factor ~8 for CPU, ~5 Disk and ~10 Tape, factor ~20 for GPU (mainly due to ET)

- Theory: The current needs are met by federal or state-operated supercomputer centers (Jülich SC, Leibniz Center Munich, HLRN, etc.); not clear if this is possible for 2028.

Request in 2021	Auger	IceCube	CTA*	ET	KATRIN	GERDA / LEGEND	DARWIN	Multi-Messenger	Theorie	Summe
CPU [CPU-years]	500	500	500	0	500	n/a	0	100	0	2100
GPU [GPU-years]	40	200	0	0	0	n/a	0	50	0	290
Disk [PB]	0.8	1	0.5	0	n/a	n/a	0	0.2	0	2.5
Tape [PB]	3	0	0	0	n/a	n/a	0	0	0	3

Projected for 2028	Auger	IceCube	CTA	ET	KATRIN	GERDA / LEGEND	DARWIN	Multi-Messenger	Theorie	Summe
CPU [CPU-years]	800	2000	1000	5000	600	n/a	2500	1000	1000	13900
GPU [GPU-years]	70	400	0	5000	400	n/a	13	500	300	6670
Disk [PB]	1.5	2	3	2	n/a	n/a	1.9	2	0.2	12.6
Tape [PB]	5	10	10	0	n/a	n/a	1.1	4	0	30

KAT statement: Federated Infrastructures (2021)

Text as result of this assessment:

The demand for computing resources for astroparticle physics in Germany will increase considerably in the coming years. In 2021, the computing for the German flagship experiments (Auger, CTA, IceCube, ET, KATRIN, Gerda/Legend, DARWIN, Multi-Messenger, Theory) will mainly be carried out via institutional, experiment-specific or, as in the case of theory, federated supercomputer resources and only to a small extent via the German WLCG network. An estimation of the 2021 requirements for the German fair-share of the computing of the international experiments resulted in a sum of 2,000 CPU years, 300 GPU years, 2.5 PB disk space and 3 TB tape capacity, which are already largely covered by the WLCG (Tier-1 and Tier-2). A projection into the year 2028 showed an increased demand of about factor 8 in CPU years, factor 20 in GPU years, factor 5 in disk space and factor 10 in tape capacity.

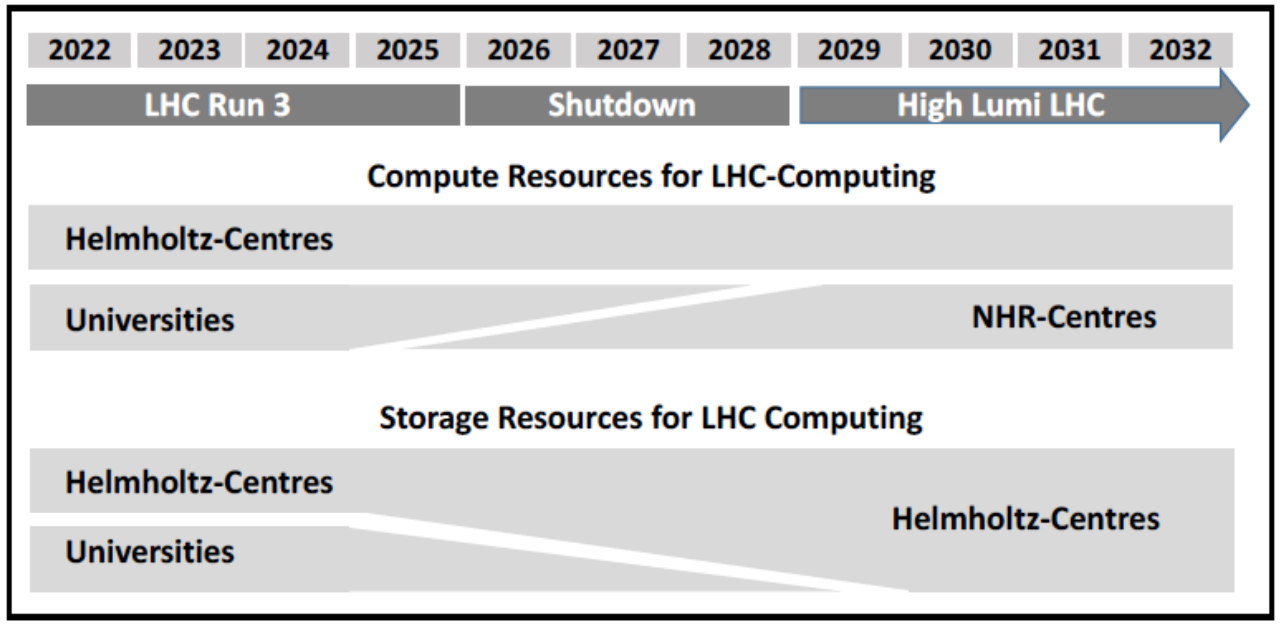
KET Computing Strategy for HL-LHC

Transformed Model for WLCG Resources in Germany

Strategic vision by particle physics community in Germany for HL-LHC era:

- Complete pledged WLCG mass storage to be provided by Helmholtz Centres (DESY, GSI, KIT) and MPP
- CPU pledge from University Tier-2 Centres to be provided by NHR centres
  strong believe that NHR centres predestined for this task according to their mandate

(consensus after long and wide discussion btw. all involved parties and current resource providers)



Transition period 2025-2028:

- already available hardware will be operated at university sites
- new resources to be installed and provided at Helmholtz and NHR centres

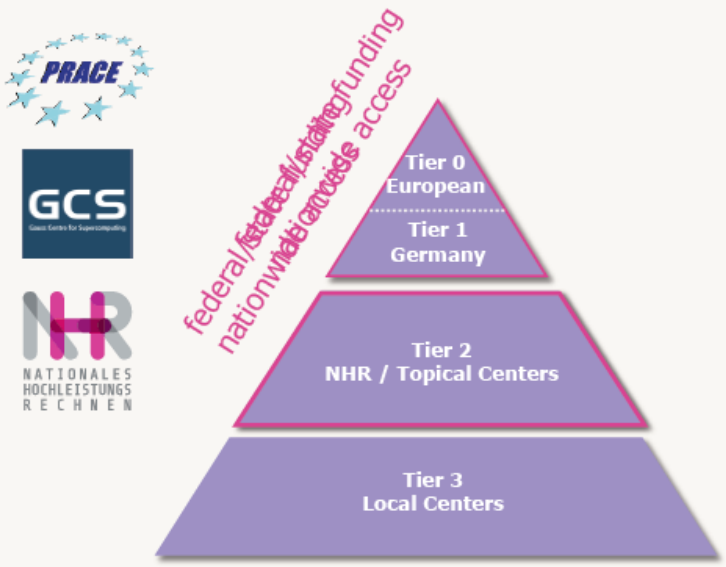
NHR Computational Physics Symposium (7+8/11/2022);
https://events.uni-paderborn.de/event/403/

Markus Schumacher for KET, 8 Nov 2022

National High-Performance Computing (NHR) Program

https://nhr-verein.de

NHR as Part of German HPC Infrastructure



- Recommendation by Research Council to introduce Tier-2 National High Performance Computing (NHR) infrastructure
- Competitive applications in 2020
  - official start: Jan 1, 2021
  - total funding 625M Euro (2021-2030)
  - currently 9 NHR centers
- Key aspects
  - joint federal/state-funding
  - transition from regional to competence-oriented for nationwide use
  - free access for all researchers from German universities
  - strengthen methodological competences through coordinated training, continuing education of users
  - specific support for young scientists

November 7, 2022 NHR Computational Physics Symposium

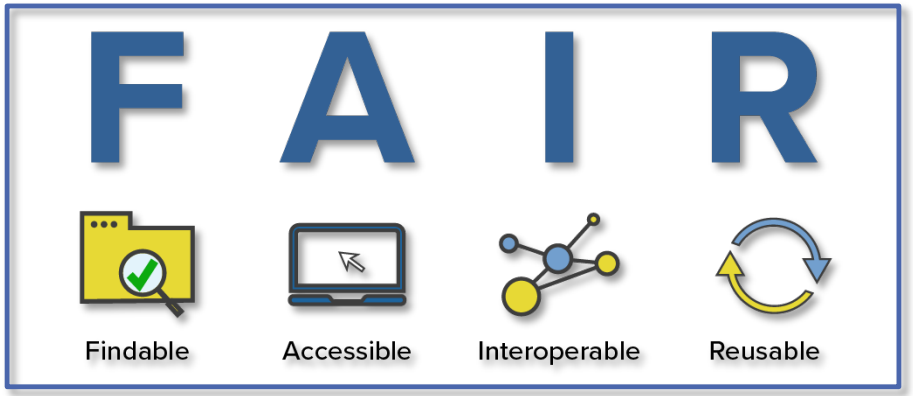
Christian Plessl, Paderborn

Paderborn Center for Parallel Computing | KIT | NHR National High-Performance Computing Center | NHR SW

NHR Computational Physics Symposium (7+8/11/2022); https://events.uni-paderborn.de/event/403/

Structured FAIR Data Management in APP?

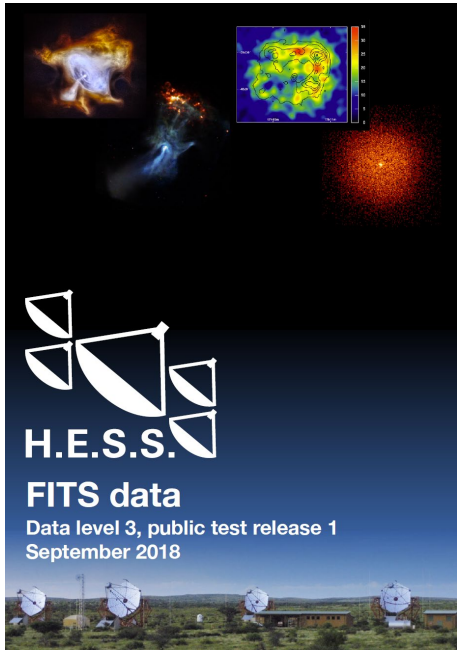
- IMHO: it is still in its infancy!
- Though there are a few projects, e.g. in Helmholtz-programs, PUNCH, ErUM-Data, ACME
- Or dedicated service tools are going to be more FAIR, e.g. CORSIKA, Gammapy, AMPEL, KATRIN, etc.



One aspect: Open Data
(Open Data is _not_ (only) Outreach)

- KCDC, Auger Open Data, H.E.S.S., IceCube, ….

KASCADE KCDC Cosmic ray Data Centre

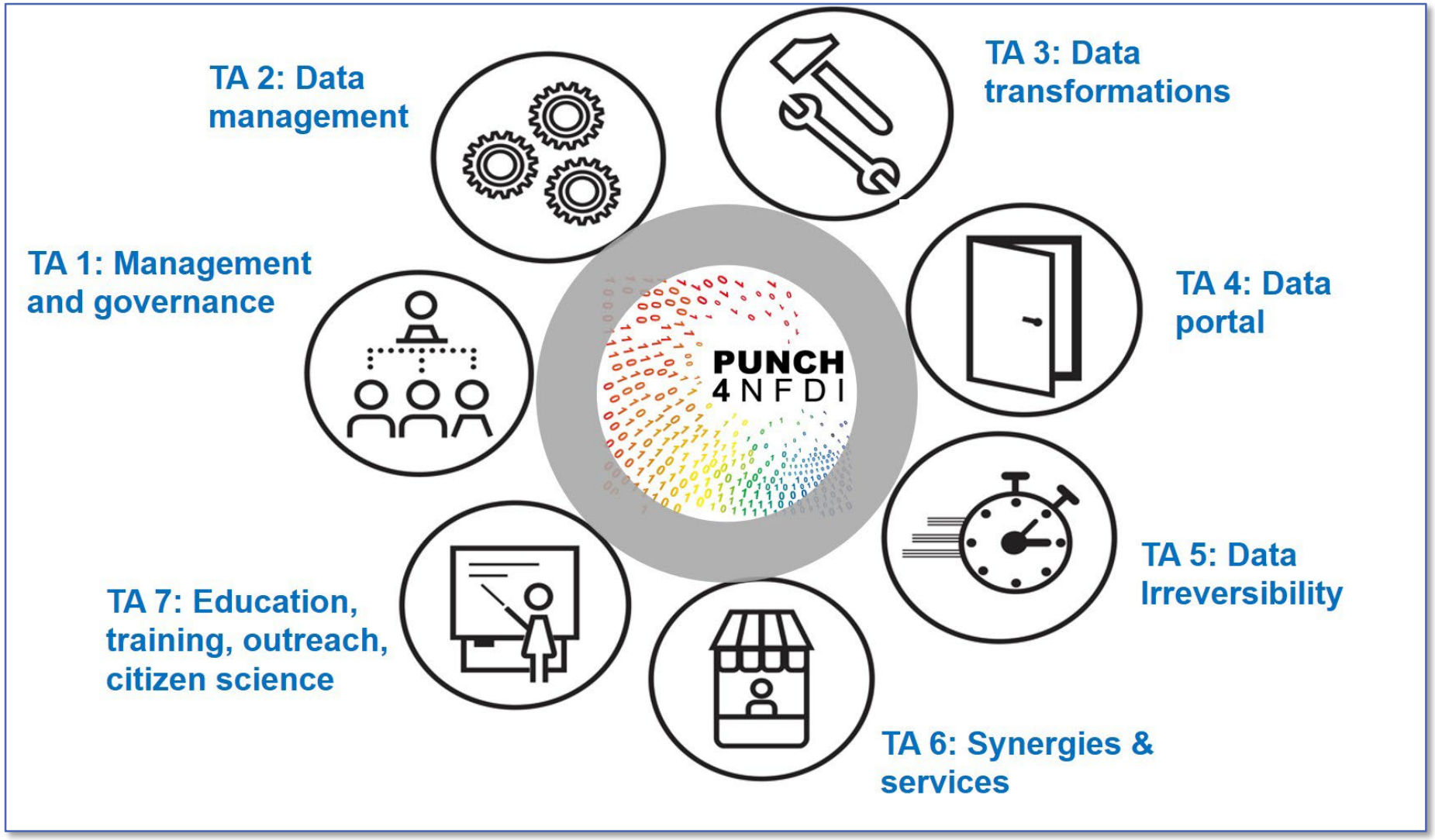


(2) Services:

where this digitalization is developped ?

PUNCH4NFDI

- **P**articles, **U**niverse, **N**u**C**lei and **H**adrons for the NFDI
- https://www.punch4nfdi.de/



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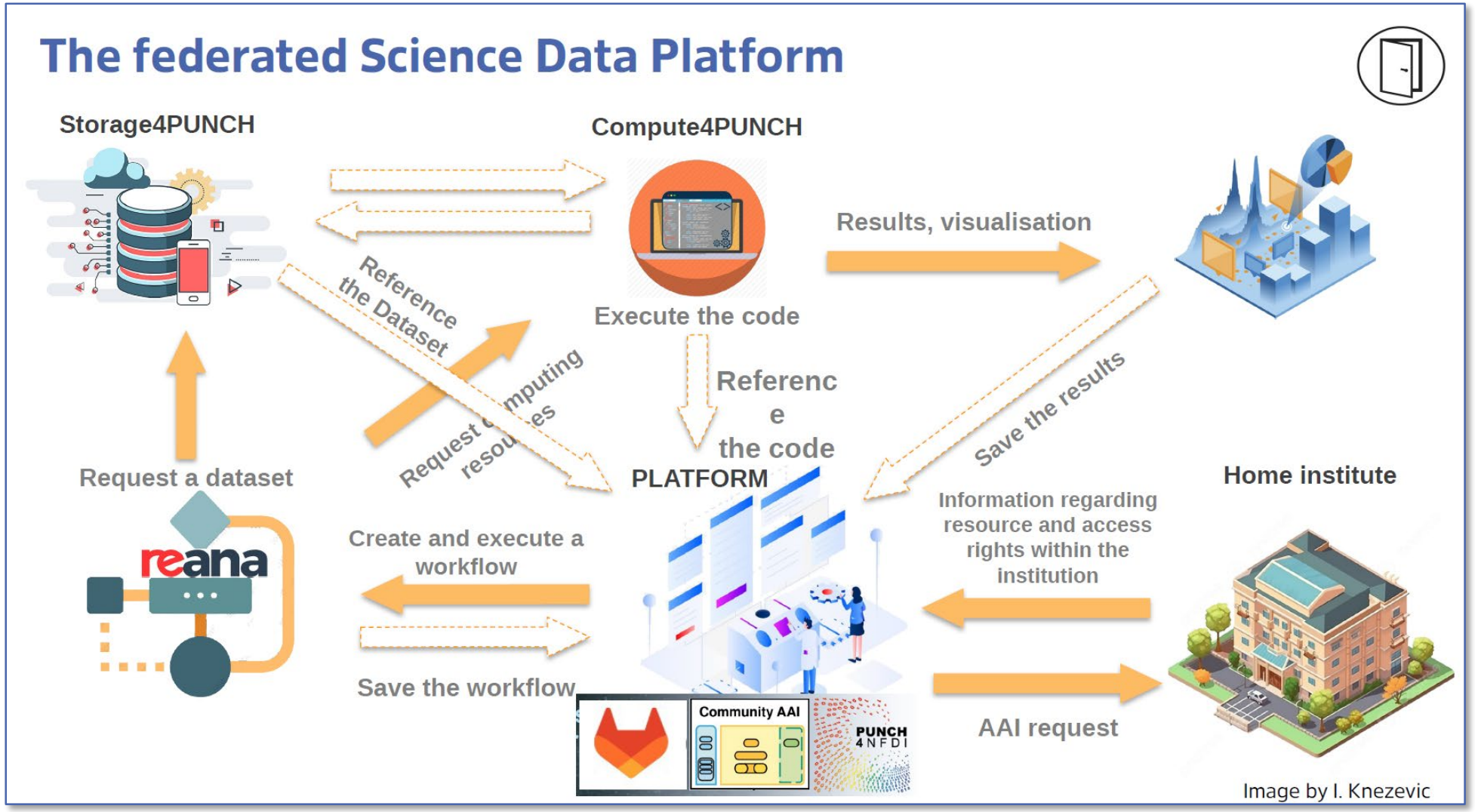
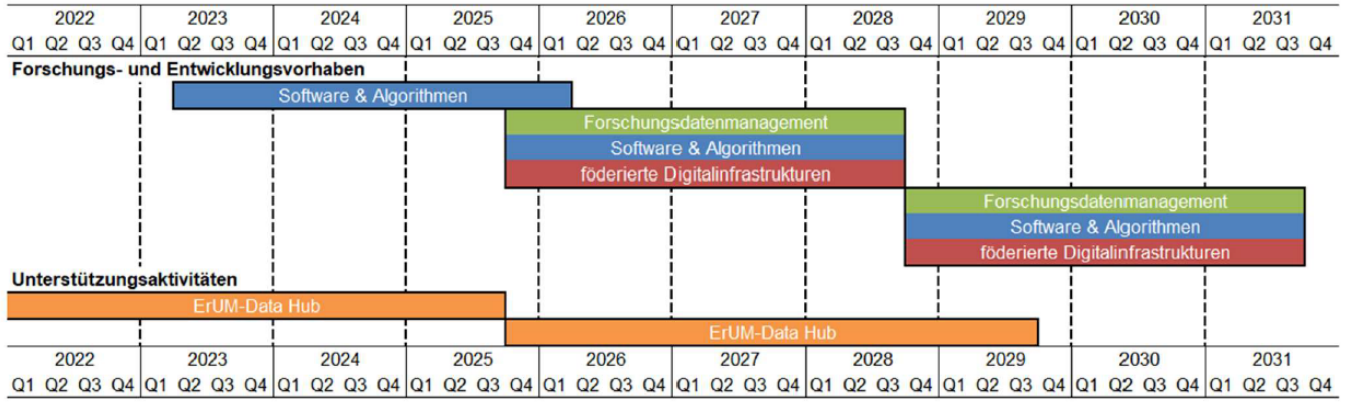


Message to KAT:

Discuss use cases for the SDP or parts of it (PUNCH toolbox for Data Management and Analysis) and attract new users!

ErUM-Data call 2024



From: E.Lilienthal KAT Meeting Bad Honnef, 2 Dec 2022

- **ErUM-Data call**
  - **Call for projects 30. September 2024 ➔ deadline 15. January 2025 https://pt.desy.de/bekanntmachungen/30092024_data/index_ger.html**
  - **Start of the funding period will be 1 October 2025**
  - **projects should be community overarching, and industry involvement is welcome**

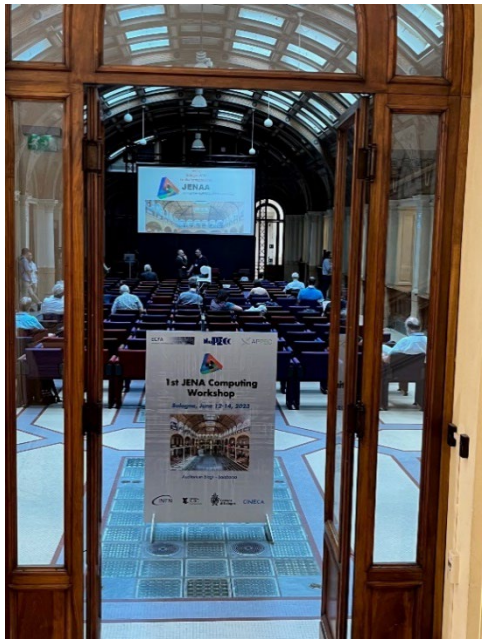
➔ **Consortia are formed for all three areas**

- **DIG-UM Annual Meeting 3-Dec-2024, 14:30**
- **ErUM-Data Hub organizes manifold workshops, see www.erumdatahub.de**
- **Connection ErUM-Data and EuCAIF (JENAS Network on AI) ; Next EuCAIF Conference scheduled for 15-20th of June 2025, Sardinia.**

JENA Computing Initiative

JENAA
Joint ECFA-NuPECC-APPEC Activities

- 1st JENA Symposium: 14-16 October 2019 in Orsay, France https://jenas-2019.ijclab.in2p3.fr
- 2nd JENA Symposium: 3-6 May 2022 in Madrid, Spain https://indico.cern.ch/event/1040535
- 3rd JENA Symposium: 8-11 April 2025 at RAL, UK https://indico.cern.ch/event/1440480/



- **One Topic: Future European Federated Computing**

  Initiation started by workshop https://agenda.infn.it/event/34738/

  Target: European white paper on (ENA) computing as input for the next JENA Symposium 2025 to discuss with representatives of funding agencies

  Dedicated working groups (to look deeper) on five areas:

  - HPC: https://indico.scc.kit.edu/e/JENA_computing_wp1/
  - Software: https://indico.scc.kit.edu/e/JENA_computing_wp2/
  - Data Management: https://indico.scc.kit.edu/e/JENA_computing_wp3/
  - ML & AI: https://indico.scc.kit.edu/e/JENA_computing_wp4/
  - Training: https://indico.scc.kit.edu/e/JENA_computing_wp5/

ACME

HORIZON-INFRA-2023-SERV-01-02 (domain: Astronomy & Astroparticle physics)

- Topic: **better access of users to RI services to advance frontier knowledge**
- Consortium: 41 partners, 15 countries, >30 research infrastructures
- Kick-off Meeting in Paris 16-17/9/2024 https://indico.in2p3.fr/event/33636/

ErUM-Prisma Trialogue (Sustainability)

- Working group „Sustainability in Computing“
- Recommendations in 5 categories:
  - The **cultural change** to sustainable computing in all areas of ErUM research should be actively supported.
  - The energy and resource efficiency of **IT infrastructures** should be presented transparently and must continue to be increased.
  - In the **life cycle analysis** of the required digital devices, the total costs must be optimized
  - Huge data streams management requires development of corresponding **algorithms and processes** for a FAIR and therefore sustainable data analysis and data reduction
  - **Software development**, which plays a central role in the sustainable use of resources, is to be promoted more intensively

(3) Discussion

Questions / Discussion

Which role can/will play PUNCH4nfdi for the digitalization of Astroparticle Physics?

- What are the inherent needs for APP, in Germany: KAT
- How Astroparticle Physics will participate in WLCG, NHR, EuroHPC?
- How concrete shall be the connection Digitalization & Sustainability
- What is our role in PUNCH, ErUM-Data, etc.?
- …. ?

…a little off-topic: Do we face the trap of justification vs. funding?

Earmarked funding vs. intrinsic research?

Do we want „digitalization for the research field“ or „digitalisation research with possible application for the research field“ ?

Do we want „sustainable research“ or „sustainability research“ ?