Particles, Universe, NuClei and Hadrons for the NFDI

Joe Mohr, LMU on behalf of Thomas Schörner and the PUNCH4NFDI collaboration DIG-UM Big Data Analytics Workshop Munich, 13 March 2025

PUNCH4NFDI funded starting Fall 2021

PUNCH4NFDI-2022-01



PUNCH4NFDI High-Level Milestones

Thomas Schörner ^{1,*} and the PUNCH4NFDI Consortium²

¹Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, D-22607 Hamburg, Germany ²https://www.punch4nfdi.de *Corresponding Author thomas.schoerner@desy.de

4th May 2022

Abstract: The PUNCH4NFDI consortium has defined a set of high-level milestones in order to give an orientation for the consortium's work and outreach. These milestones are summarised in this document.



PUNCH 4 N F D I

The PUNCH4NFDI Consortium in the NFDI

PUNCH4NFDI Consortium Consolidated Work Programme

DIG-UM Big Data | Munich, 13 March 2025

Milestone 1: An integrated prototype package of digital research products, the science data platform, and the Compute4PUNCH compute resources.

Milestone 2: Data irreversibility solutions – a new kind of science in the age of too-large-to-be-stored data streams

Milestone 3: The PUNCH marketplace including notice board and communication tools [...] is established as part of a federated system of discipline-specific market places

Milestone 4: Rolling out P4N outreach and education programme

Who we are ...

20 Co-applicants

22 Participants

- Stable in time, discussions with potential new partners
- Representing O(9000) scientists •



Astronomy — Hadron & nuclear physics Astroparticle physics



0

DIG-UM Big Data | Munich, 13 March 2025



Page 3

Who we are ...

20 Co-applicants

22 Participants

- Stable in time, discussions with potential new partners
- Representing O(9000) scientists •

Particle physics

Astronomy — Hadron & nuclear physics Astroparticle physics

The primary goal is the setup of a federated science data platform, offering the infrastructures and interfaces necessary for the access to and use of FAIR data and computing resources of the involved communities and beyond.

 \mathbf{O}

Mid-Term Evaluation in Bonn



What we want and do

PUNCH4NFDI in a Nutshell









https://results.punch4nfdi.de

Overview of Outputs

Particles, Universe,

	into and support thes		
			search (shift+f to focus)
PUNCH Work			
search	select a tile filter		·
1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PUNCH4NFDI website	000000	PUNCH4NFDI Intranet
PUNCH	The consortium website with general news,	PUNCH	Documents, reports, minutes, communications of the
4 N F D T	information channels, workshop announcements	0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,	Task Areas and their workpackages, drafts for statements, everything which is internal to the work.
	Tags Communication, Statements, Partners,	Intranet	URL https://intra.punch4nfdi.de
	Workshops, News		Access AAI
•		•	Tags Task Areas, NFUT sections, Deliverable reports
1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P4N Mattermost	0 00000 · · · · · ·	P4N Event Calendar
PUNCH	PUNCH4NFDI's internal chat with file sharing	PUNCH	Events, sessions, meetings management, Indico is
4 N F D I	capabilities. Mattermost is hosted at AIP.	4 N F D T	hosted by DESY.
	URL https://mattermost-p4n.aip.de		Access public or AAI
() Mattermost	Tags TA+WP channels, InterTA communication	Coloni	
•		•	
	P4N Sync & Share		P4N AAI
PUNCH 4 N F D I	an online storage service to easily and quickly store data and access it from different end devices. Hosted	PUNCH 4 N F D I	The Community AAI of PUNCH4NFDI, one of the first NFDI AAI, in operation since start of the consortium
	URL https://syncandshare.desy.de		URL https://login.helmholtz.de/punch/
SYNC	Access AAI		Register https://results.punch4nfdi.de/?md=/docs/
SHARE	Tags storage, file sharing, NextCloud	@ HIFIS	Access AAI
			Tags DEN-AAI, AARC, HIFIS, EOSC, Single-Sign On

.....

PUNCH



Page 11





Concrete Benefits: Federated Infrastructures

Compute4PUNCH / Storage4PUNCH

Multicloud efforts

bດse4 ກfdi Basic Servises

Can't simply port solutions

- Workflows differ
- Things don't easily scale
- → Learned where problems are and how to solve them
- → Port this experience to the wider NFDI community

Interface efforts with BMBF ErUM-Data action plan ("Research on Universe and Matter")

- \rightarrow Storage4PUNCH: federated storage technology for existing resources
- \rightarrow Compute4PUNCH: federating heterogeneous compute resources
- \rightarrow Various types of single entry points: unified / simplified access
- \rightarrow Token-based Authentication and Authorization Infrastructure (AAI)

Particle physics: combination of LHC data from ATLAS and CMS exp'ts



First event-by-event combination of data from different LHC experiments → model for synergetic use of data!

MeerKAT On-the-Fly Interferometry



Employed C4P and extensions to dedicated compute clusters to demonstrate radio imaging

Concrete Benefits: Workflow Engines

Compute4PUNCH / Storage4PUNCH Multicloud efforts	REANA "workflow engine" TCANA (CERN)	The Gaia mission has provided an invaluable wealth of astrometric data for ~two billion stars in our Galaxy.
Can't simply port solutionsWorkflows differThings don't easily scale	CERN development: reusable and reproducible research data analysis platform.	
 → Learned where problems are and how to solve them → Port this experience to the wider NFDI community 	First non-CERN instance! Integration with PUNCH4NFDI SDP elements C4P, S4P and others ongoing.	REANA workflow with on PUNCH4NFDI or other resources facilitates reproducibility of analyses over wide community
Interface efforts with BMBF ErUM-Data action plan ("Research on Universe and Matter")	 → Make particle physics development useful for other communities → Exploring applications beyond PUNCH communities 	Panel & holoviews (app.py) S3 Storage Visualization & live interaction with data S3 Storage

Concrete Benefits: (Meta)Data Catalogues

Compute4PUNCH / Storage4PUNCH Multicloud efforts	REANA "workflow engine"	Metadata and data catalogues (ILDG catalogues, SciCat, …) ILDG: International Lattice Data Grid
 Can't simply port solutions Workflows differ Things don't easily scale → Learned where problems are and how to solve them 	CERN development: reusable and reproducible research data analysis platform. First non-CERN instance!	Curation and metadata - concepts for data irreversibility Hans Dembinski ¹ , Hermann Hessling ² , Ramesh Karuppusamy ³ , Michael Kramer ⁴ , Vladimir Lenok ⁶ , Jakob Nordin ⁶ , Susame Pfalzner ² , Andreas Redelbach ² , Dominik Schwar ² , Arno Straessner ¹⁰ , and Vadim Vybornov ¹¹ ¹ Technische Universität Dortmund ³ Hochschule für Technik und Wirtschaft Berlin ³ Max-Planck-Institut für Radioastronomie Bonn ⁴ Max-Planck-Institut für Radioastronomie Bonn ⁴ Max-Planck-Institut für Radioastronomie Bonn ⁴ Max-Planck-Institut für Radioastronomie Bonn
 → Port this experience to the wider NFDI community Interface efforts with BMBF 	 Integration with PUNCH4NFDI SDP elements C4P, S4P and others ongoing. → Make particle physics development useful for other 	⁶ Humboldt-Universität Berlin ⁷ Forschungszentrum Jülich ¹⁶ Trankfurt Institute for Advanced Studies, Universität Frankfurt ¹⁶ Orschungszentrum Jülich ¹⁶ Orschungszentrum Jülich
ErUM-Data action plan ("Research on Universe and Matter")	 communities → Exploring applications beyond PUNCH communities 	Important: compatibility • Successfully exploring • Exploring other solutio

Concrete Benefits

Model basically running – numerous items in prototypical state still (e.g. automatic capture of new DRPs from workflows, ...)



Connections

Cooperation in NFDI

Sections and Base4NFDI

Section "Common Infrastructures"

010

101

- Present in numerous WGs
- IAM4NFDI: PUNCH-AAI
- Multicloud Base proposal
- nfdi.software

IAM4_nfdi Methy and Access Management for the German National Bessarch Data International Bessarch Data International Composition of the International Data International Data International Data International Data International Data Data International Data International Data International Data Data International Data Intern

Abstract MC4NFDI Submission Round 08/2024

Section "Training & Education"

- Focus on school pupils: "Masterclasses"
- Work on curricula: contribution to "Lernzielmatrix"

Section "Metadata"

- Contributions to WGs
- e.g. research software metadata \rightarrow publication:

Results on a Survey on Research Software Metadata in the NFDI Consortia Version 10. 15.08 2024

Contact persons Stephan Ferenz, Leyla Jael Castro

Authors

Leyla Jael Castro (0000-0003-3986-0510) Stephane Ferenz (0000-0001-9523-7227) Hamideh Hajiabadi (0000-0002-5793-452 Patrick kuckert (0000-0002-2944-0426) Christian Schmidt (0000-0002-2944-0426) Christian Schmidt (0000-0002-2944-0425) Alexander Struck (0000-0002-1713-9223)

10.5281/zenodo.12704413

Section "ELSA"

- Ethics of AI in research as a topic
- Data protection along DSGVO via terms of use with providers (AAI → IAM4NFDI, file systems → provider)

Section "Industry Engagement"

Little involvement (minor connections to industry or commercial applications)

Relevant Developments

Context for continuation proposal PUNCH 2.0

German Center for Astrophysics

A large-scale research center in the region in the center of Europe.

German Center f. Astrophysics:

- To be completed in 2026.
- Astrophysics, digitalisation, and technology development
 Attracts user community, impact on data access / management

Square Kilometre Array SKA

- Planned radio observatory
- Unprecented ZB datasets

New solutions for big data and real-time processing



Artificial intelligence Massive impact on how we do analysis, build and operate instruments





High-Luminosity LHC upgrade:

 Will increase LHC data by factor of up to 10 starting 2030

New models for big and distributed data handling and real-time computing

European Open Science Cloud

Development of research
 environments

Collaboration and integration (Lol in August 2024)



Conclusions and Outlook

PUNCH4NFDI Consortium now fully established

- Stable in composition and work programme
- Integrated into the national and international environment
 of the communities
- Integrated into the NFDI and its sections, contributing to Base4NFDI proposals along its expertise

Realising benefits and adding value to our communities

- Rolling out of work programme according to plan
- Putting in place more and more elements of Science Data Platform and other services
- Focus: Adding use cases and growing a user community

PUNCH4NFDI is looking forward

- Intense "PUNCH-2.0 discussions" on topics and partners.
- Considering substantial changes to portfolio in view of developments of past years
- Turning more and more to production and operation of reliable services.

Annual Meeting 2024, Bonn

PUNCH-2.0 Planning | Kassel 18 February 2025



Prof. Joseph Mohr (LMU, joseph.mohr@physik.lmu.de)

The PUNCH4NFDI Consortium

Spokespersons

PD Dr. Thomas Schörner (BLV, DESY, <u>thomas.schoerner@desy.de</u>) Dr. Andreas Haungs (Satzung, KIT, <u>andreas.haungs@kit.edu</u>) Dr. Christiane Schneide (deputy Satzung, DESY, christiane.schneide@desy.de)

Contact

Mail: <u>punch4nfdi@desy.de</u> Web: <u>www.punch4nfdi.de</u> Mastodon: @punch4nfdi@nfdi.social



Acknowledgements



Funded in parts by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation)

- project number 460248186 (PUNCH4NFDI).