

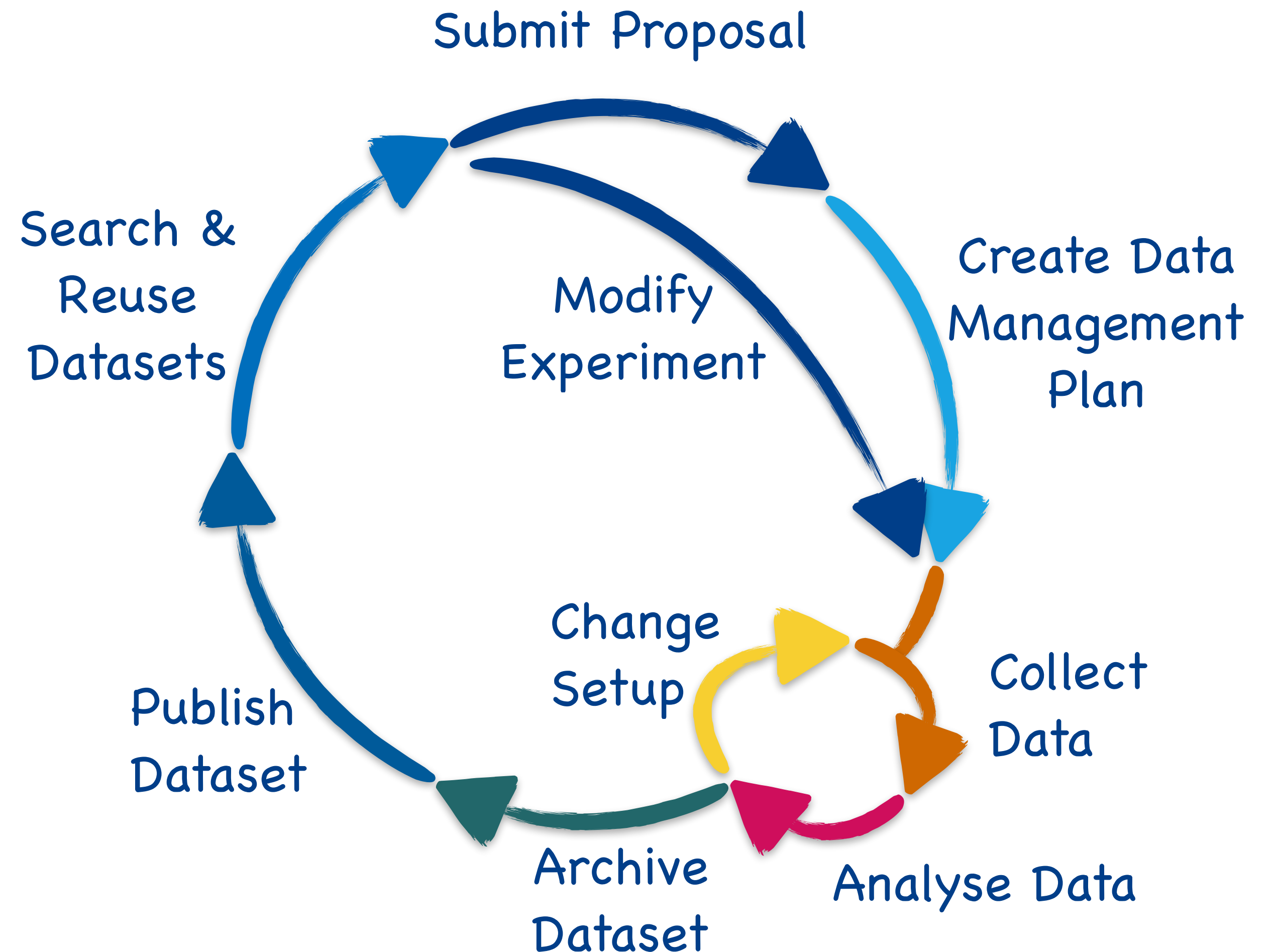
## A FAIRly Integrated Scientific Project Lifecycle

Oliver Knodel, Martin Voigt, Robert Ufer, David Pape, Mani Lokamani, Jeffrey Kelling, Stefan E. Müller, Thomas Gruber, Guido Juckeland, Alexander Kessler, Joachim Hein, Bernd Schuller // contact: o.knodel@hzdr.de



# Our Challenge: An End-to-End Digital Data Lifecycle

- We support many steps of our different research experiment (matter, energy and health) with tools:
  - electronic lab books,
  - interactive analysis,
  - publication of datasets,
  - scientific workflow management,
  - Handle generation and management.
- A uniform and smooth access to and between all services and systems in our ecosystem is necessary.
- The documentation of all these linked resources is essential to create a comprehensible and FAIR data lifecycle.





# The Requirements and Conditions

- Our guidance system was originally intended to provide only the **proposal's metadata**, from internal and external scientists, to allow the assignment of resources.
- Over the time we decided to use the guidance system to answer the most important questions of our scientists:

And how we can support them?!



What are the necessary steps towards a full comprehensible and FAIR research experiment ensuring data provenance?

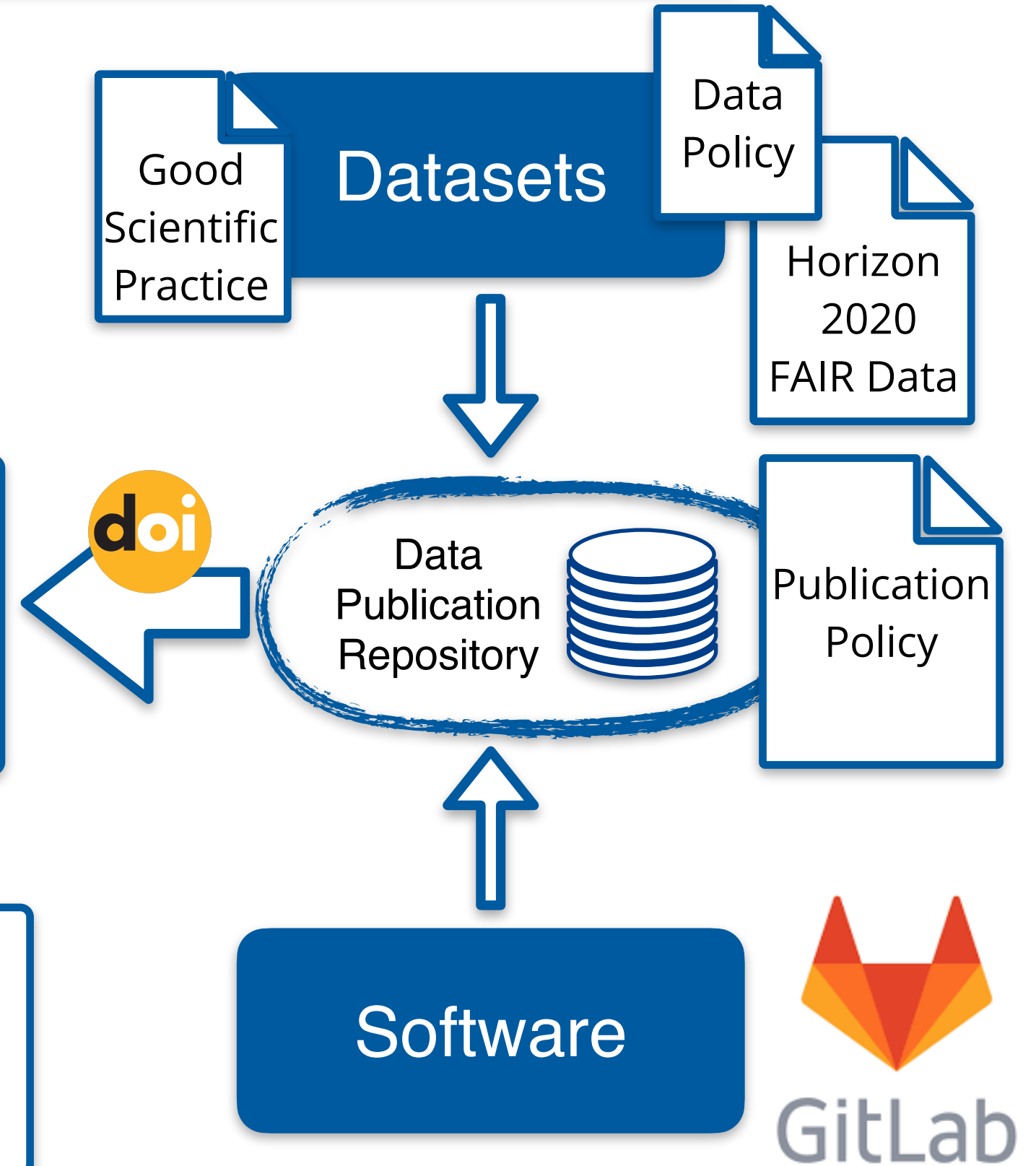
How can we **automate recurring processes** and keep track of status and data products?



Which datasets or software can be **published** (and how)?

How can we bring **new team members** or external scientists into our project lifecycle and all associated tools?

Where are data, software and how can I gain **access** to both of them?

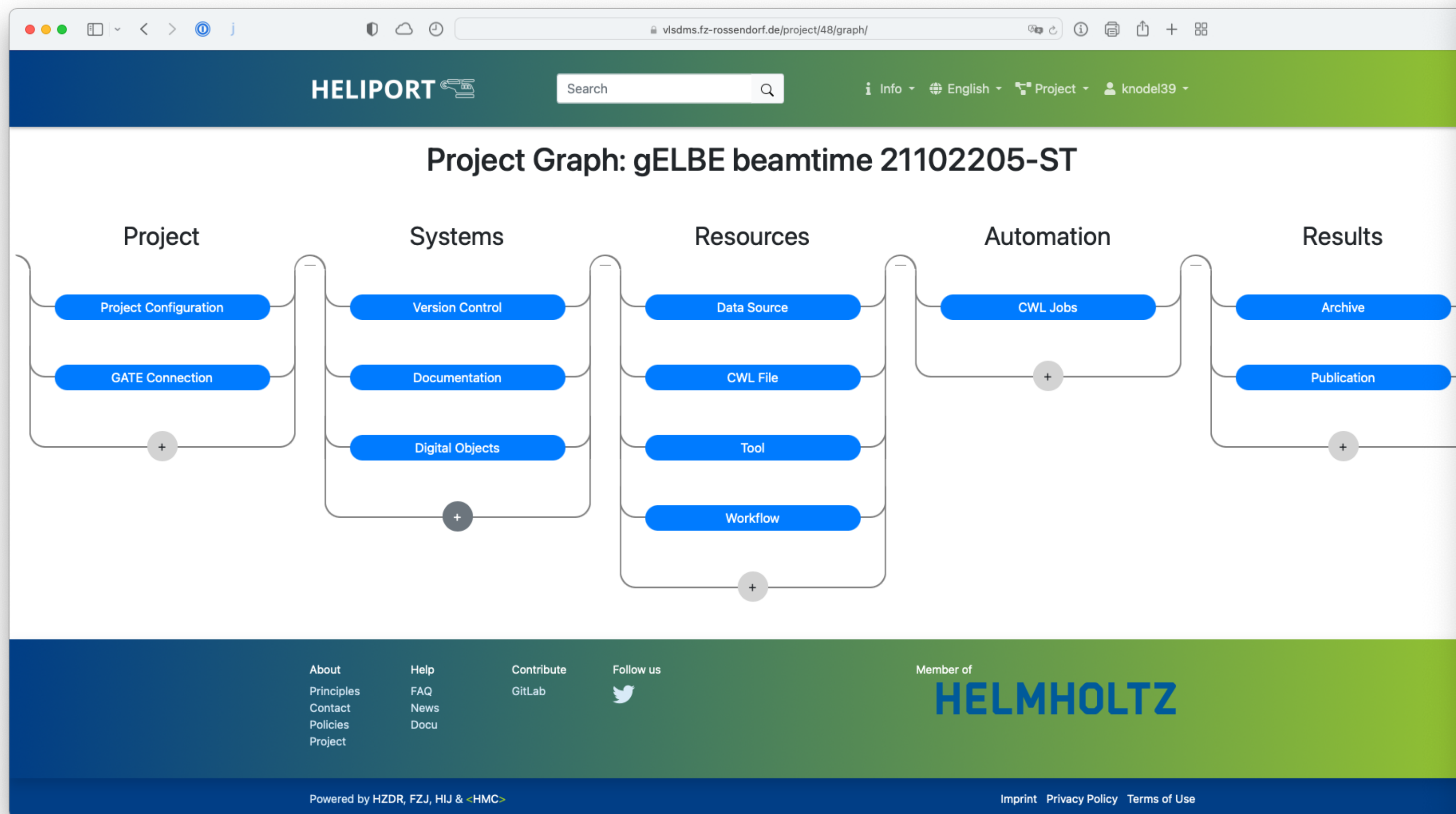


“ The HELIPORT project aims at developing a platform which accommodates the **complete life cycle** of a scientific project and links all corresponding programs, systems and workflows to create a more **FAIR** and comprehensible project description.

Project Members:



Founded by:

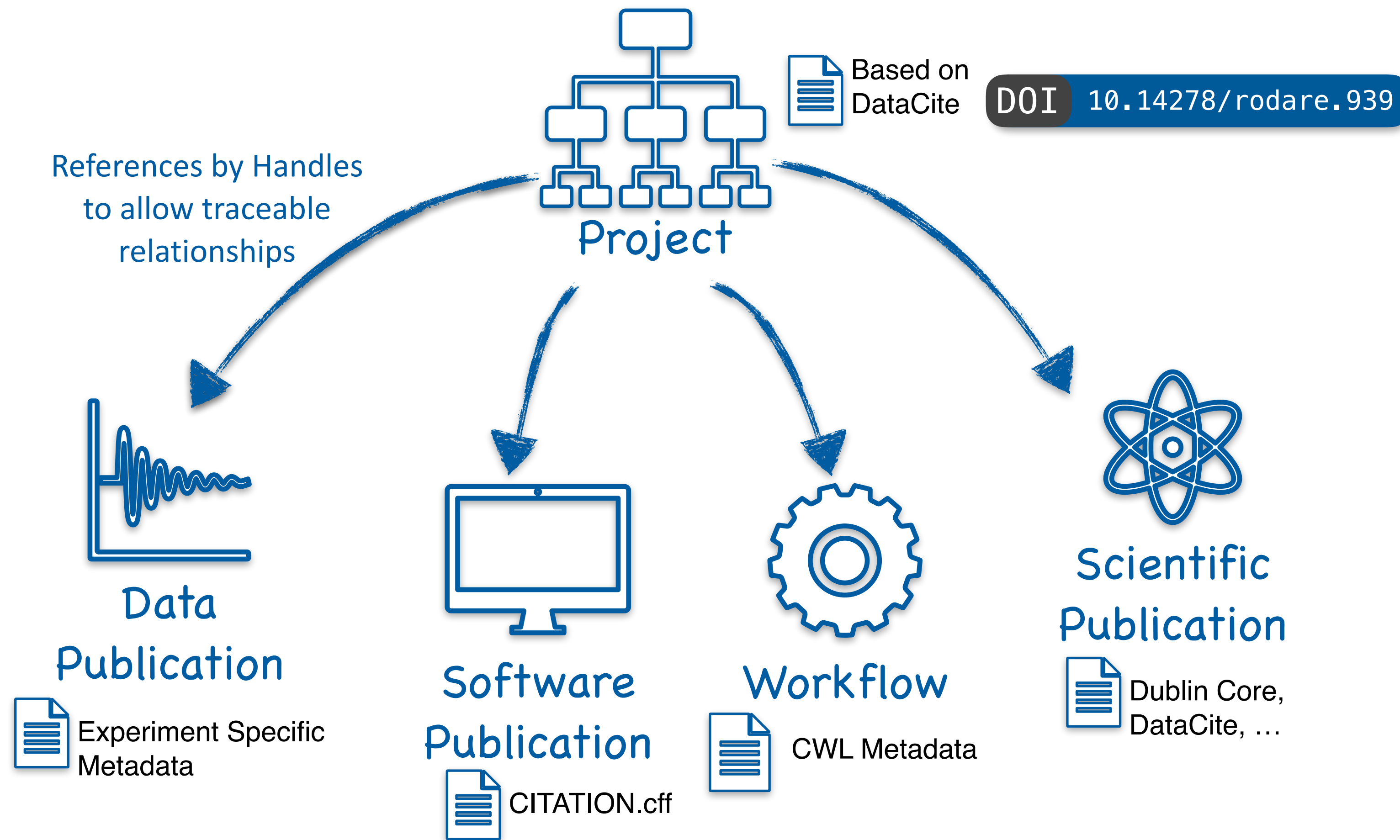


```

{
  "namespaces": {
    "datacite": "http://purl.org/spar/datacite/",
    "rdfs": "http://www.w3.org/2000/01/rdf-schema#",
    "heliport": "https://heliport/schema/",
    "time": "http://www.w3.org/2006/time#",
    "dc": "http://purl.org/dc/terms/"
  },
  "heliport:project_id": 28,
  "datacite:hasIdentifier": "HZDR.FWCC.2021.84769",
  "heliport:uuid": "09779261-200c-48c4-be9c-f298369d6a1c",
  "datacite:handle": "https://hdl.handle.net/None",
  "heliport:project_name": "PaN Research Project",
  "time:hasBeginning": "2021-04-01 09:14:34.296524+00:00",
  "datacite:hasDescription": "",
  "heliport:group": "FWCC",
  "heliport:owner": {
    "datacite:hasIdentifier": "132739",
    "datacite:orcid": null,
    "rdfs:label": "Knodel, Dr. Oliver (FWCC) - 132739"
  },
  "heliport:has_VersionControl": [
    {
      "heliport:version_control_id": 15,
      "datacite:uri": "https://dd",
      "rdfs:label": "Test"
    }
  ],
  "heliport:has_DataManagementPlan": [
    {
      "heliport:data_management_plan_id": 6,
      "datacite:uri": "https://dddd",
      "datacite:hasDescription": "dddd"
    }
  ],
  "heliport:has_Documentation": [
    {
      "heliport:documentation_id": 7,
      "datacite:uri": "https://dddd",
      "heliport:documentation_system": "MediaWiki",
      "datacite:hasDescription": "dddd"
    }
  ],
  "heliport:has_DataSource": [
    {
      "heliport:data_source_id": 11,
      "datacite:uri": "http://ddd",
      "heliport:use_computer": null,
      "rdfs:label": "ddd",
      "datacite:hasDescription": ""
    }
  ]
}

```

# Heliport Metadata Ecosystem



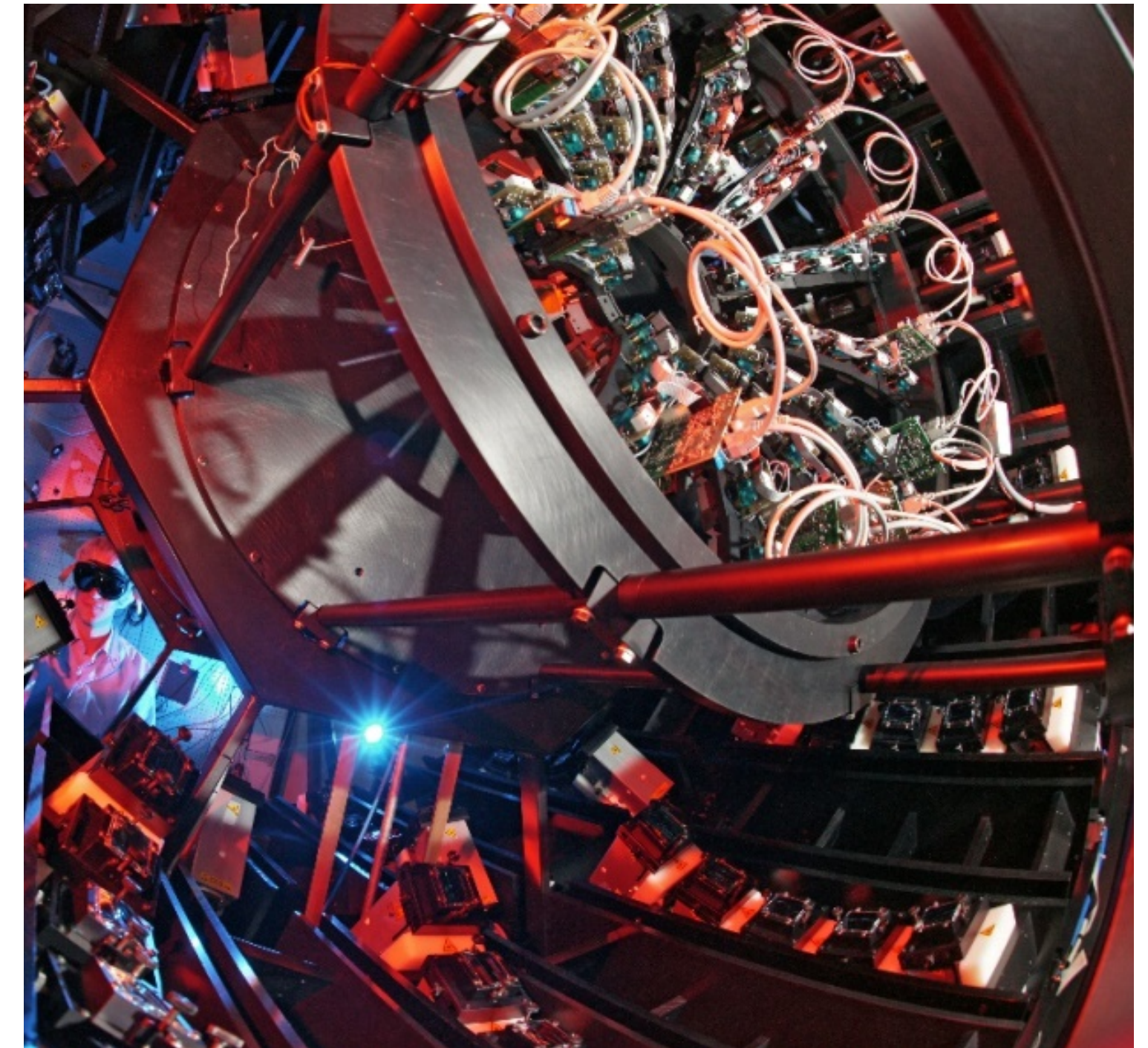
## Our Concept

- In all stages of an experiment Heliport combines information about involved services with PIDs.
- Metadata (stored *near* the PID) is used to transfer information between different systems and a documentation of the project-level workflow is possible.
- The project-level metadata is distributed over all linked third-party systems.
- The metadata from all the involved systems can be exported into an overall schema.

## Example I: POLARIS

# Example: The POLARIS Experiment @ HI Jena

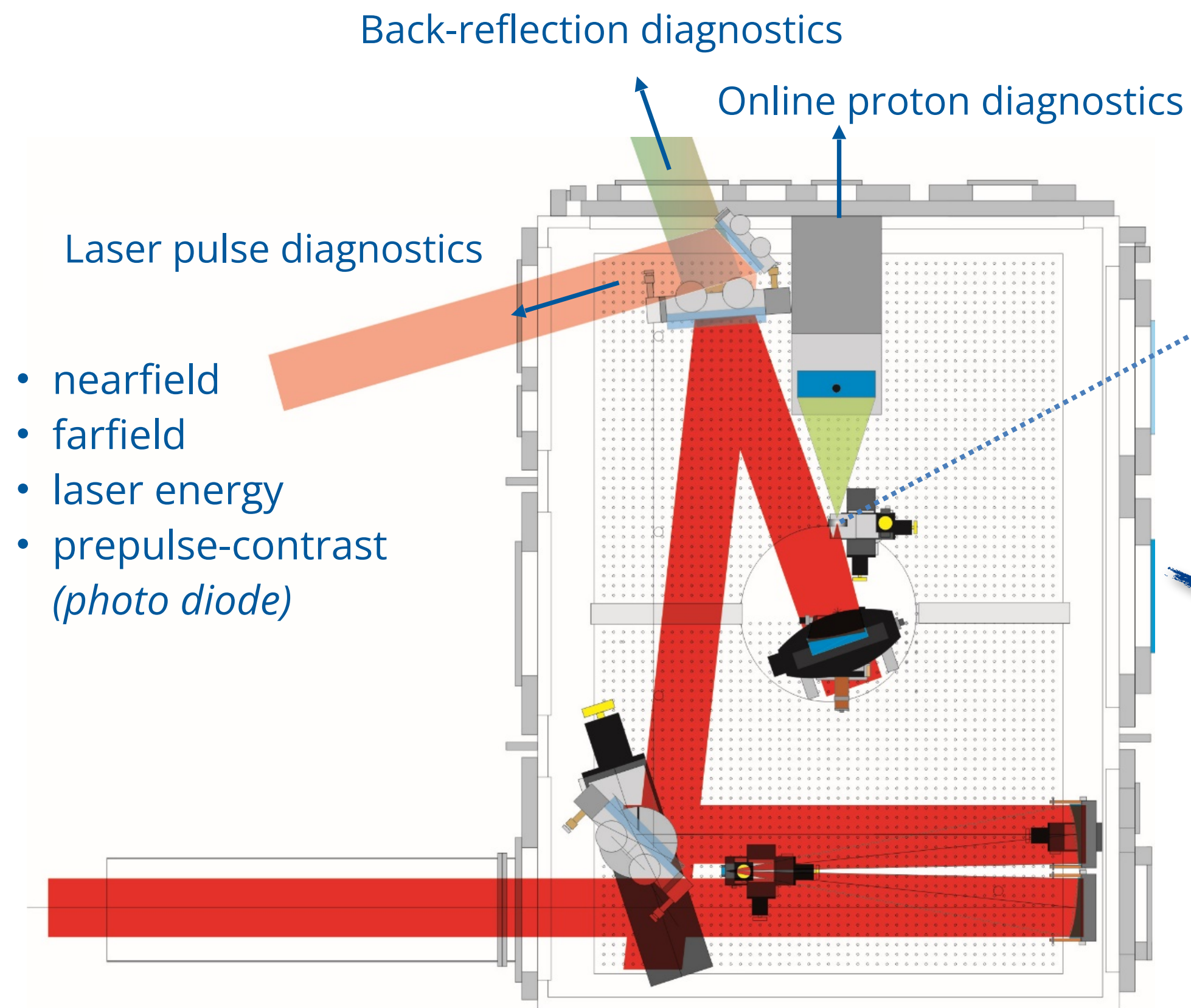
- The **P**etawatt **O**ptical **L**aser **A**mplifier for **R**adiation **I**ntensive **E**xperiments (**POLARIS**) is the only fully diode-pumped, double-CPA laser system worldwide.
- Used for Laser Particle Acceleration Experiments.
- Research project of the Faculty of Physics and Astronomy at the University of Jena and the Helmholtz Institute Jena (HI-Jena).



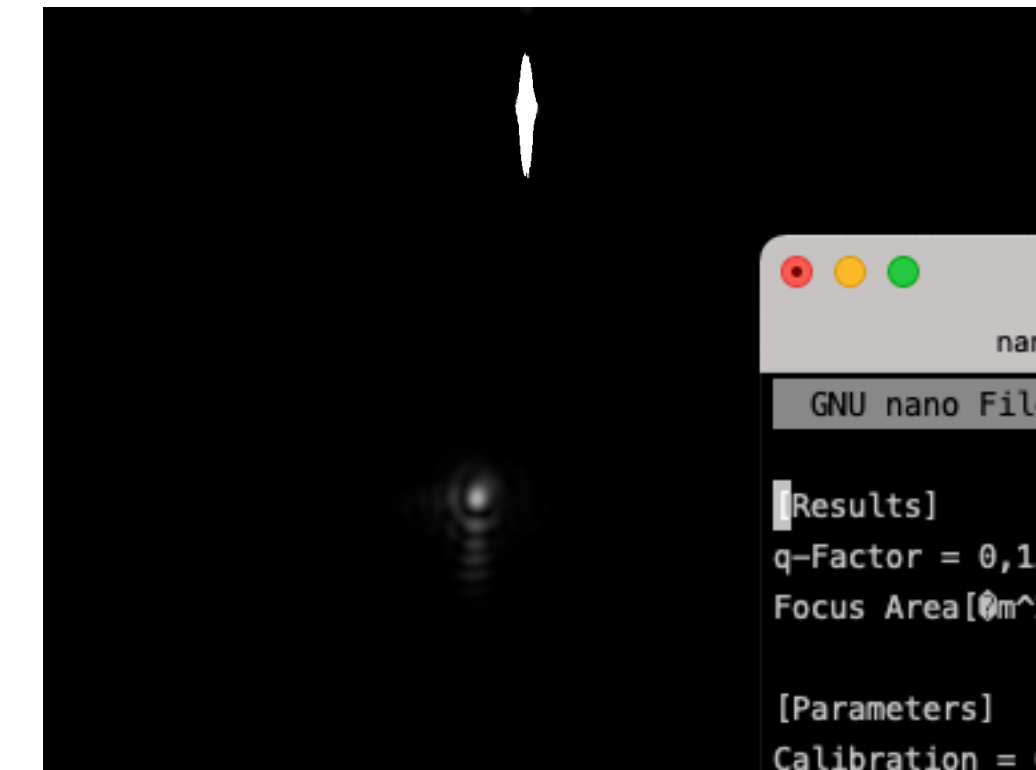
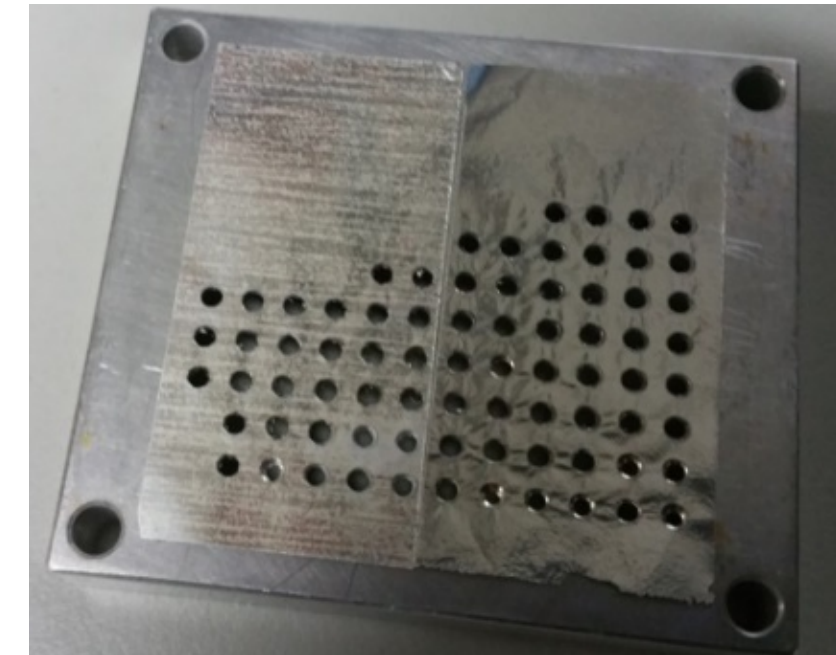
Malte C. Kaluza, Contrast Dependence of Laser-Driven Proton Acceleration, 18<sup>th</sup> Advanced Accelerators Concepts Workshop, Breckenridge, US, (2018)



# POLARIS Experimental Setup



Malte C. Kaluza, Contrast Dependence of Laser-Driven Proton Acceleration, 18<sup>th</sup> Advanced Accelerators Concepts Workshop, Breckenridge, US, (2018)



```

nano
nano (nano)
GNU nano File: ...14.data

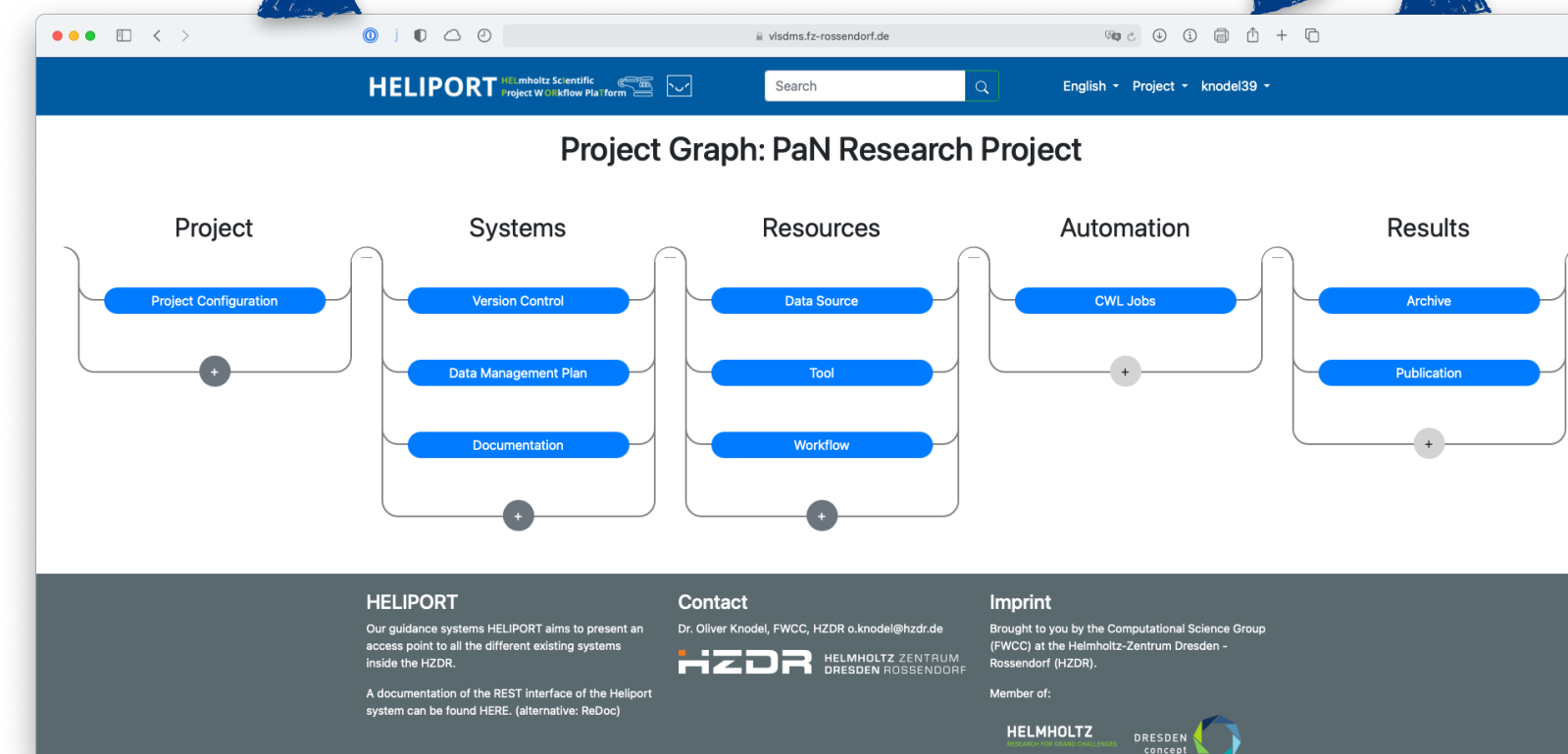
[Results]
q-Factor = 0,150082
Focus Area[0m^2] = 10,055498

[Parameters]
Calibration = 0,130000
Energy[J] = 10,000000
Size of region[px] = 2
#of Areas = 1
Target Point X = 0,000000
Target Point Y = 0,000000
Width Method = "FWHM"

[Parameters.R0I]
GlobalRectangle.0 = 186
GlobalRectangle.1 = 346
GlobalRectangle.2 = 942
GlobalRectangle.3 = 1002

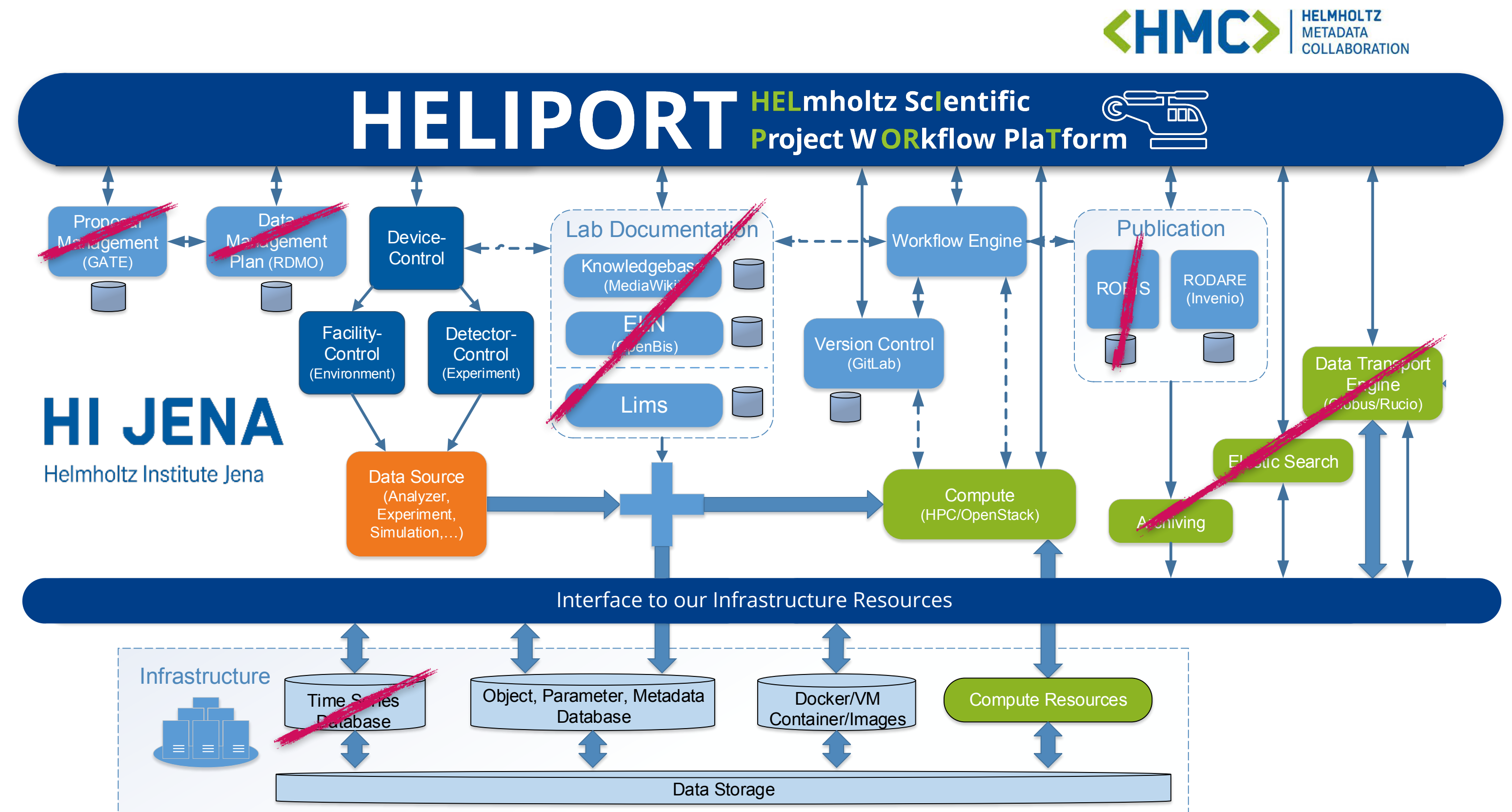
[Parameters.R0IContour.0]
ID = 0
Type = 4
Coordinate.0 = 186
Coordinate.1 = 346
Coordinate.2 = 942
Coordinate.3 = 1002
    
```

In the HELIPORT project, our goal is to bring all together: images, settings, target metadata and everything else.



# HELIPORT and the Infrastructure at Helmholtz Institute Jena

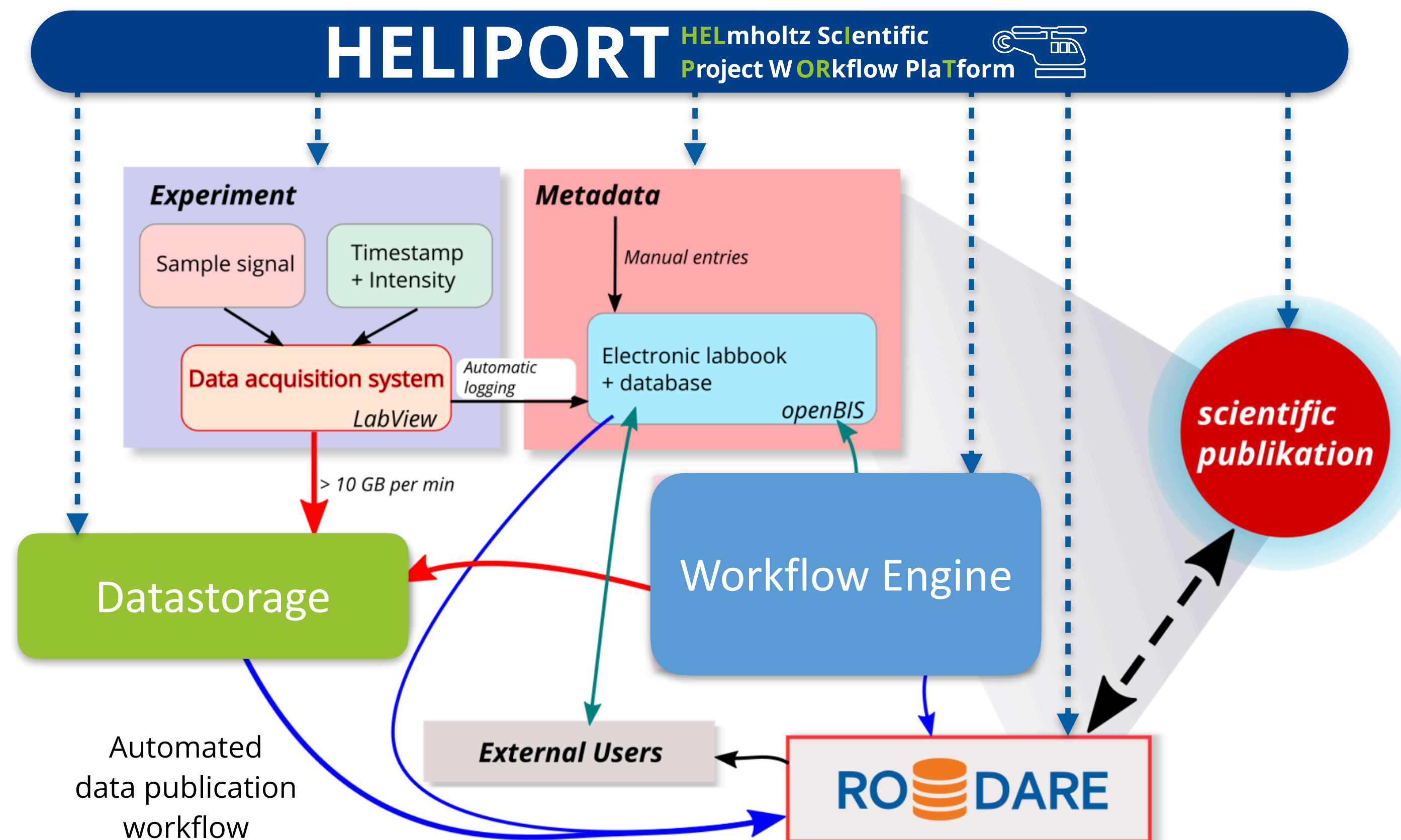
- HELIPORT was initially developed to provide access to the computing Infrastructure at the HZDR.
- The infrastructure at Jena is different, but the important systems are available:
  - HPC Infrastructure and Data Management\*,
  - Data Acquisition, and
  - Git Repositories
- And others are in development:
  - Lab Documentation,
  - Workflow engine, and
  - Data Repository.



## Example II: TELBE

# TELBE Data Flow

- Terahertz facility at the ELBE center for High-Power Radiation Sources.
- In the future HELIPORT should guide external scientists through the complete experiment.

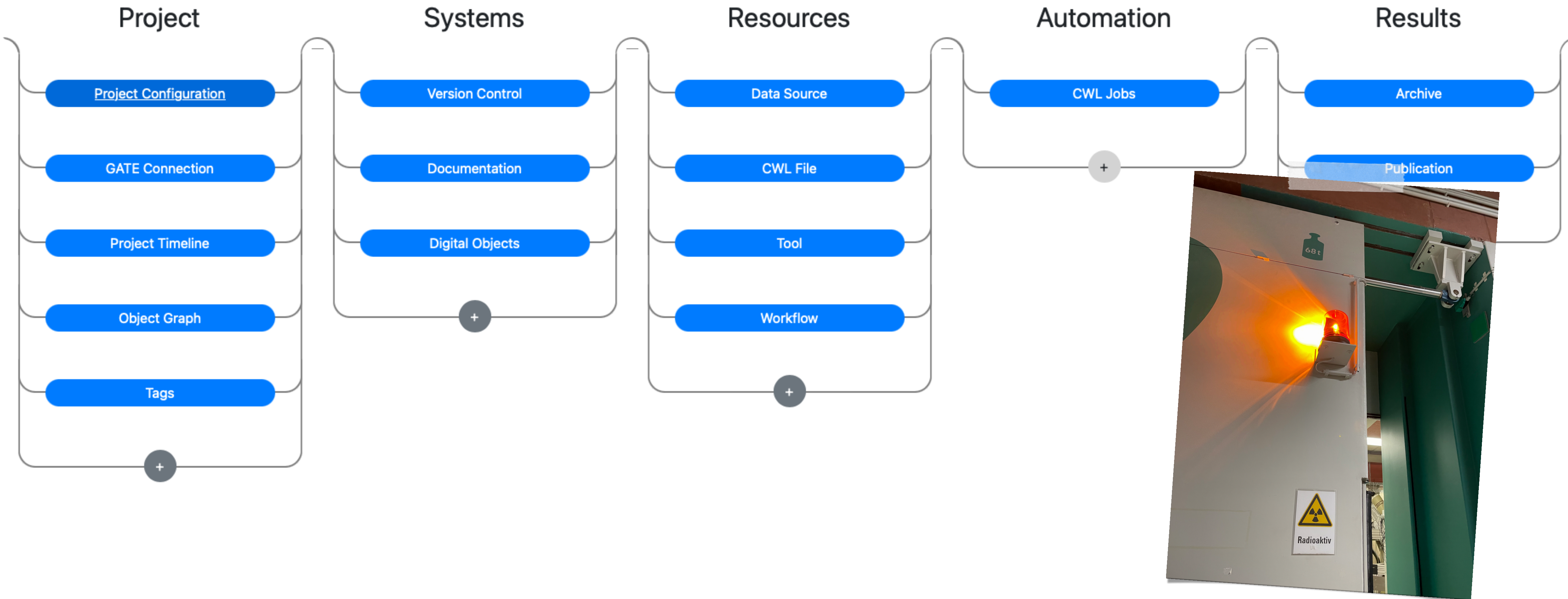


## Appearance and Components

...explained with Example III

# Use-Case Project II: gELBE Beamtime 21102205-ST

- A simple detector test for the Mu2e experiment at Fermilab at our ELBE facility.
- All related resources are summarized in HELIPORT:



# The Initial Proposal Metadata

## Proposal Metadata

- Title, abstract, status, ID,
- Proposer, experimentalist, local contact, experimental team, and
- Experiment schedule.

## Additional Metadata within HELIPOINT

- Extended user information (name, mail, OrcID),
- HZDR ID (Heliport Handle),
- Additional members with contributions,
- And: documentation, datasets, workflows, systems (infrastructure), software repositories, publications, ...

## Next Metadata Fields

- Instrument or beam-line,
- Funding,
- Scientific method,
- ....

The screenshot displays the HELIPOINT web interface. The top navigation bar includes the HELIPOINT logo, a search bar, and links for Info, English, and Project. The main content area shows the 'Gate Project' details for GATE-2205. The project title is 'Tests of the detector system for the Stopping Target Monitor of the MU2E experiment in a high flux pulsed gamma (Resubmission of 20101909-ST due to COVID pandemic)'. The proposer is 'Mueller, Dr. Stefan (FWCC) - 7394 (Owner of Project "gELBE beamtime 21102205-ST")'. The abstract describes the gELBE pulsed gamma beam setup. Below the project details, there are sections for 'Co-Proposers' and 'Experimentalists', both listing 'Ferrari, Dr. Anna (FWKH) - 5161' and 'Knodel, Dr. Oliver (FWCC) - 132739'. On the right side, a 'Settings' panel is visible, showing 'User Information' with fields for Backend (LDAP), User-ID (knodel39), Surname (Knodel), Givenname (Oliver), E-Mail (o.knodel@hzdr.de), Group (FWCC), Institute (FZR), and ORCID (https://orcid.org/0000-0000-0000-0000). An 'Edit' button is located at the bottom of the ORCID field.

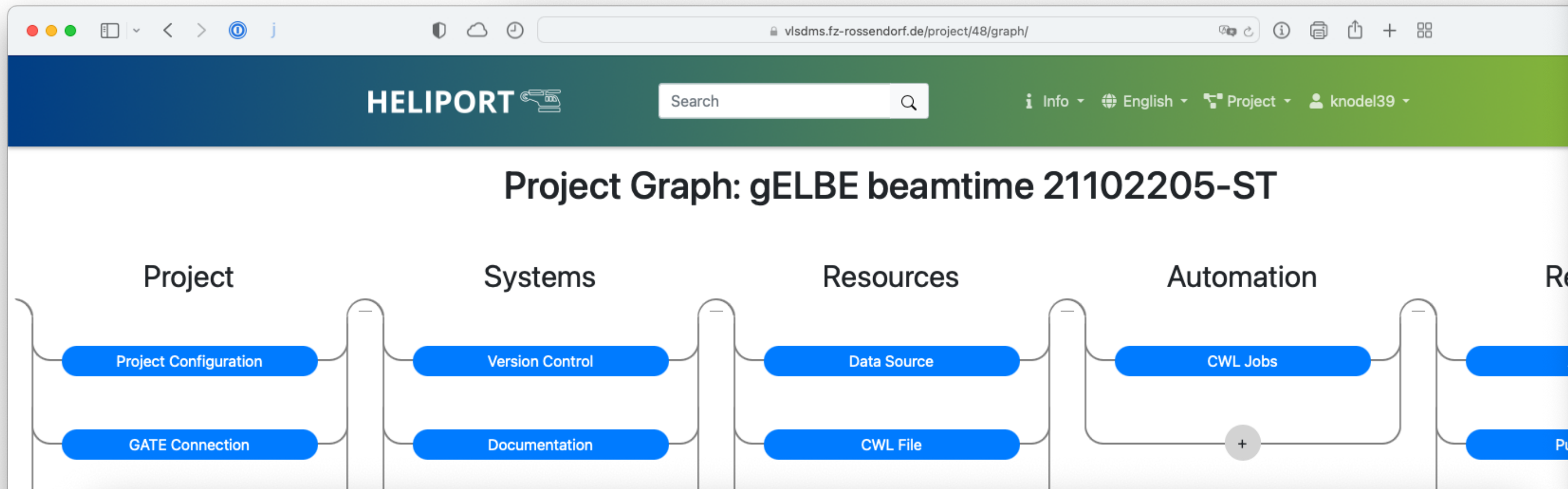
Gate Project	
GATE-ID	2205
Title	Tests of the detector system for the Stopping Target Monitor of the MU2E experiment in a high flux pulsed gamma (Resubmission of 20101909-ST due to COVID pandemic)
Proposer	Mueller, Dr. Stefan (FWCC) - 7394 (Owner of Project "gELBE beamtime 21102205-ST")
Abstract	The gELBE pulsed gamma beam, with narrow pulses set to about 600 kHz repetition rate - the choice of the ELBE micropulses at 406 kHz or 812.5 kHz is ideal in our case- is the unique facility in the world suited to study the performance of the Stopping Target Monitor detector of the Mu2e Experiment. The STM monitor has the crucial role to normalize the cross-section of the muon conversion rate in the Mu2e Experiment. The ability to operate at high repetition rates of the beam and have at ELBE the unique position for the Mu2e Experiment.
Proposal	21102205-ST
Restricted	no
Responsible Experimentalist	Mueller, Dr. Stefan (FWCC) - 7394
Local Contact	Schwengner, Dr. Ronald (FWCC) - 7394

Co-Proposers	
Person	Ferrari, Dr. Anna (FWKH) - 5161
Person	Knodel, Dr. Oliver (FWCC) - 132739

Experimentalists	
Person	Ferrari, Dr. Anna (FWKH) - 5161
Person	Knodel, Dr. Oliver (FWCC) - 132739

Settings	
User Information	
Backend	LDAP
User-ID	knodel39
Surname	Knodel
Givenname	Oliver
E-Mail	o.knodel@hzdr.de
Group	FWCC
Institute	FZR
ORCID	<a href="https://orcid.org/0000-0000-0000-0000">https://orcid.org/0000-0000-0000-0000</a>

# Documentation and Repositories



HELIPORT

Projects > gELBE beamtime 21102205-ST > Version Control

### Version Control

ID	Name	Open	Edit	Remove
28	TRCprocess	<a href="#">Open</a>	<a href="#">Edit</a>	<a href="#">Remove</a>

### Add a Source Code Repository

HZDR GitLab Other New

1 2 ... search

- OpenFOAM / FWDC / Cases  
Various case set-ups for OpenFOAM and Baseline workflow. [Import](#) [Open](#)
- OpenFOAM / FWDC / Developments  
Source code for HZDR Multiphase Addon for OpenFOAM provided by [The OpenFOAM Foundation](https://openfoam.org/). More information can be found [here](https://www.hzdr.de/openfoam). [Import](#) [Open](#)

HELIPORT

Projects > gELBE beamtime 21102205-ST > Documentation

### Documentation

ID	Description	System	Open	Edit	Remove
11	Experimental Setup (Room 540/109)	MediaWiki	<a href="#">Open</a>	<a href="#">Edit</a>	<a href="#">Remove</a>
12	HedgeDoc - Mu2e @ELBE Labbook	HedgeDoc	<a href="#">Open</a>	<a href="#">Edit</a>	<a href="#">Remove</a>
13	HedgeDoc - Mu2e @ELBE Requirements and Procedure	HedgeDoc	<a href="#">Open</a>	<a href="#">Edit</a>	<a href="#">Remove</a>
16	Cloud storage containing Pictures, Software, Presentations related to the beamtime (Password: ELBE2021)	Lims	<a href="#">Open</a>	<a href="#">Edit</a>	<a href="#">Remove</a>

### Add a Documentation

Description:

Link:

System:

[Add](#) or create one with [OpenBis](#), [MediaWiki](#), [MediaWiki \(FWK\)](#), [Lims](#) or [HedgeDoc](#)

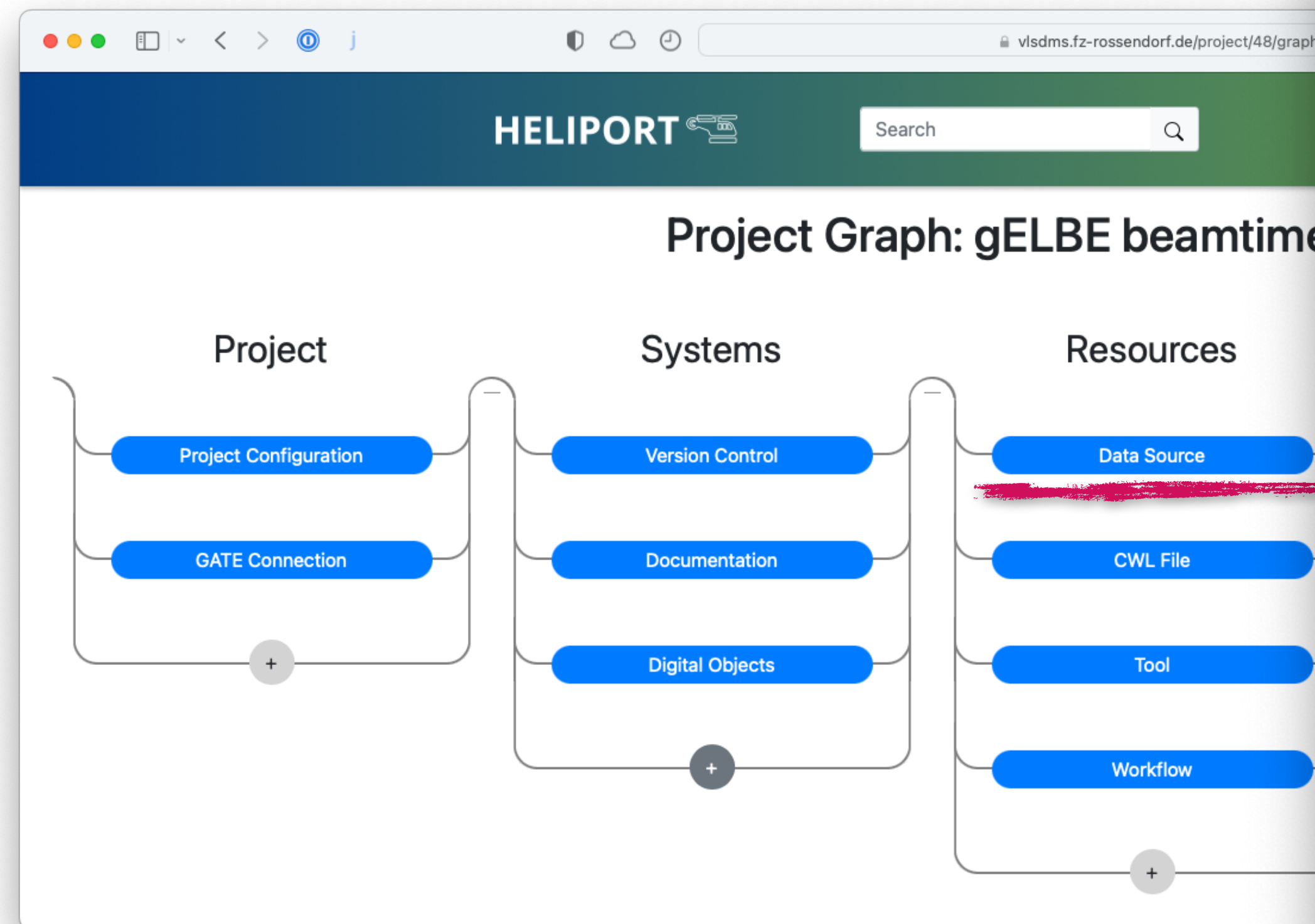
[Open](#)

- [ker, Carina \(FWCC\) - 386](#) [Open](#)
- [eller, Dr. Stefan \(FWCC\) - 4](#) [Open](#)
- [ller, Lenz \(FWU\) - 146409](#) [Open](#)
- [e, David \(FWCC\) - 139658](#) [Open](#)



# Data Sources can be Registered...

...and files (selected for publication) can be transferred directly to the data publication.



The screenshot shows the HELIPOINT file management interface for the path 'Projects > gELBE beamtime 21102205-ST > Data Sources > Mu2e on bigdata > Beamtimedata2021 > Beamtime\_DSPEC\_data'. The interface includes a search bar, a 'Select:' dropdown with options 'All', 'Files', and 'Directories', and a search filter 'name, size or date'. Below this, the title 'Beamtime\_DSPEC\_data' is displayed. A list of files and folders is shown, each with a checkbox, a name, a size, and a timestamp. The 'Data Source' resource type is highlighted with a red underline. The list includes folders for dates 15092021, 16092021, and 20092021, and files named 'ELBE TI Current-data-2021-09-17 16\_52\_59.xlsx', 'ELBE\_2021-09-15.png', and 'ELBE\_2021-09-16.png'. Action buttons like 'Publish Zipped x', 'Publish x', and 'Add Tag' are visible next to the files.

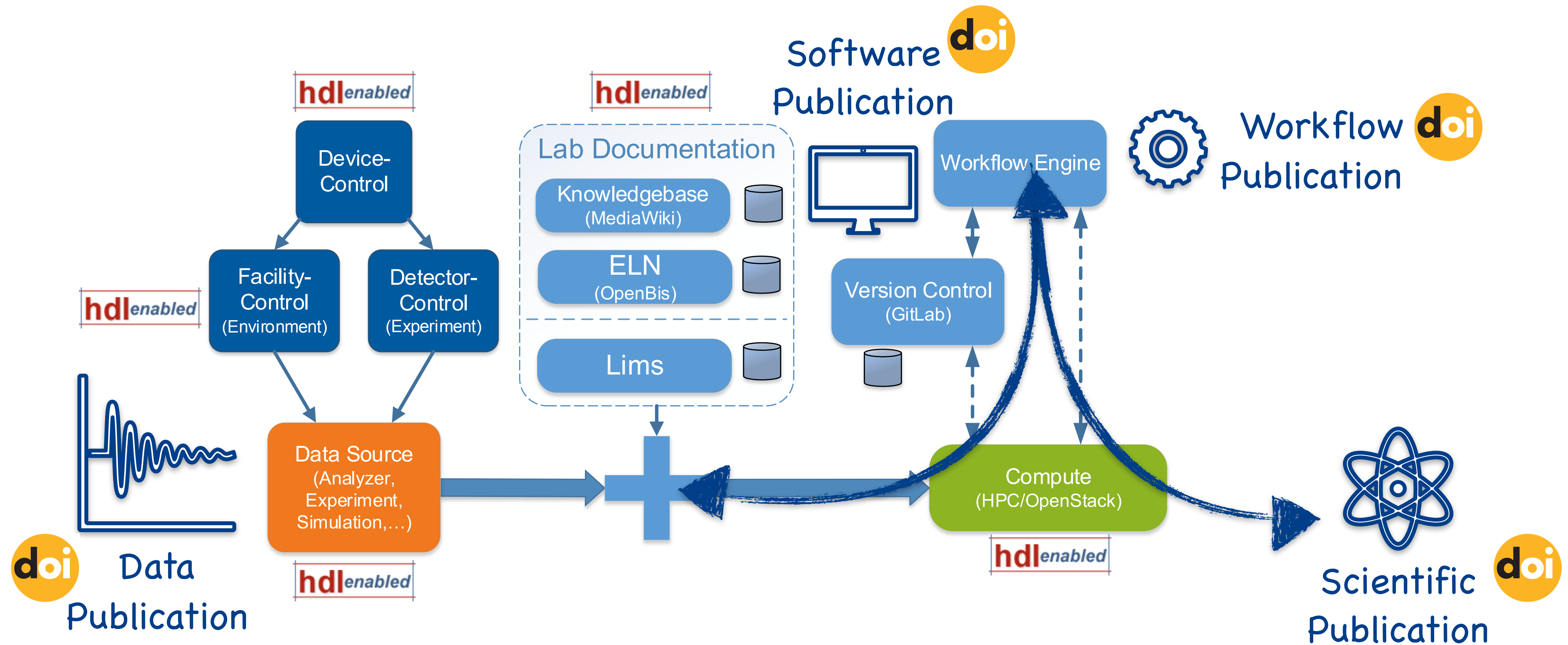
# Integration in an Overall Data Publication

The image illustrates the integration of data from a proposal system (HELIPORT) into a data repository (RODARE). It shows three overlapping browser windows:

- Left Window (HELIPORT):** Displays the 'Gate Project' page for 'gELBE beamtime 21102205-ST'. It includes metadata such as GATE-ID (2205), Title, Proposer (Mueller, Dr. Stefan), Abstract, Proposal (21102205-ST), and a list of Co-Proposers and Experimentalists.
- Middle Window (HELIPORT):** Shows the 'Project Graph: gELBE beamtime 21102205-ST'. It features two columns: 'Systems' (Version Control, Documentation, Digital Objects) and 'Resources' (Data Source, CWL File, Tool, Workflow). A blue arrow points from the 'Data Source' node to the dataset page.
- Right Window (RODARE):** Shows the dataset page for 'Tests of the detector system for the Stopping Target Monitor of the MU2E experiment in a high flux pulsed gamma beam'. It includes the title, authors, abstract, and a preview of the data files (Beamtime\_DSPEC\_data.zip) with a directory listing of files like ELBE\_Run2\_NaI.Spe, etc.

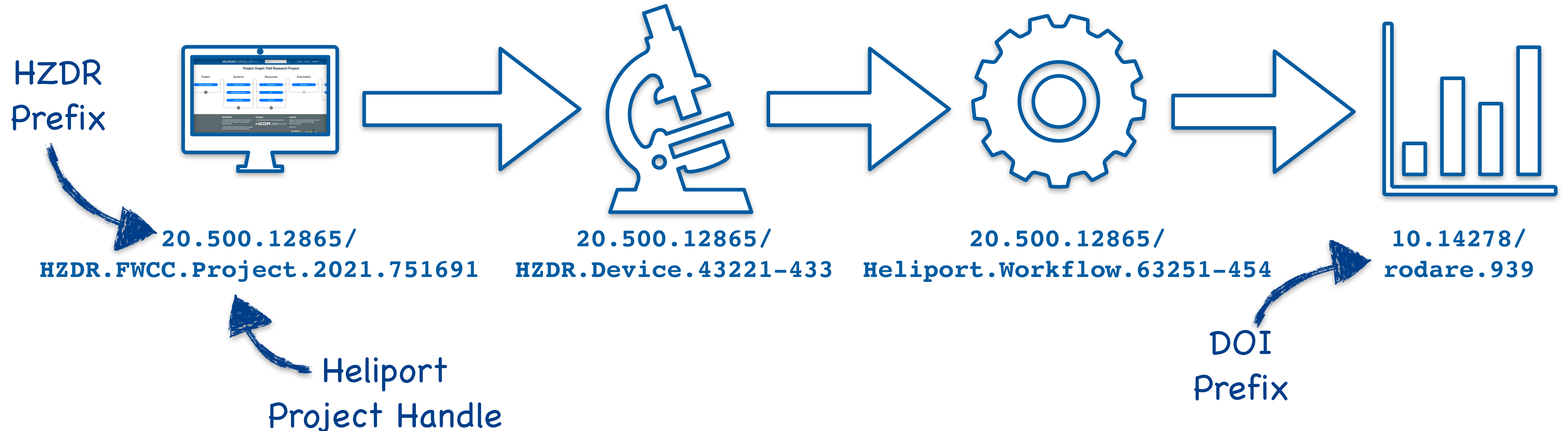
- Automated data publication with:
- Metadata from Proposal System
  - Data sources registered and selected in HELIPORT

# Different Types of (Data) Publications and Data Provenance



# Persistent Identifiers (Handles) and Digital Objects in Heliport

Heliport can be linked with local Handle servers (e.g. [handle.hzdr.de](http://handle.hzdr.de)) to generate uniform global PIDs for our digital objects and various systems and services.



# Scientific Software Development and Reproducible Workflows

ID	Name	Cluster Login	Directory on Cluster	Status
46	cat chain	hemera	~/heliport_jobs	✓
44	echo cat sleep	Choose a Login	~/heliport_jobs	✓
44	echo cat sleep	hemera	~/heliport_jobs	✓
51	one bad deed per week	Choose a Login	~/heliport_jobs	✗
51	one bad deed per week	hemera	~/heliport_jobs	✗
41	sleep 5 seconds	Choose a Login	~/heliport_jobs	!
41	sleep 5 seconds	hemera	~/heliport_jobs	!

- Capsuling every step in a workflow adapts the FAIR principles.
- Analysis and Pre-/Postprocessing steps needs to be:

- Documented and
- Reproducible



Workflow Engine

Version Control

Compute (HPC, OpenStack)

UNICORE



HELIPORT

HELIPORT Edit a Scientific Workflow

Name: curl and cat stdout and stderr

Description:

```

graph LR
    link((link)) --> curl((curl))
    curl --> cat_1((cat_1))
    curl --> cat((cat))
  
```

Buttons: Save, Cancel, Fit to Screen, Delete Selection

ID	Name	Description
35	echo	

Buttons: Add



# Scientific Software Development and Reproducible Workflows II

HELIPORT HELmholtz Scientific Project Workflow Platform

English Project knodel39

### Jobs

ID	Name	Cluster Login	Directory on Cluster	Status
46	cat chain	hemera	~/heliport_jobs	✓
44	echo cat sleep	Choose a Login	~/heliport_jobs	
44	echo cat sleep	hemera	~/heliport_jobs	
51	one bad deed per week	Choose a Login	~/heliport_jobs	
51	one bad deed per week	hemera	~/heliport_jobs	
41	sleep 5 seconds	Choose a Login	~/heliport_jobs	
41	sleep 5 seconds	hemera	~/heliport_jobs	

HELIPORT HELmholtz Scientific Project Workflow Platform

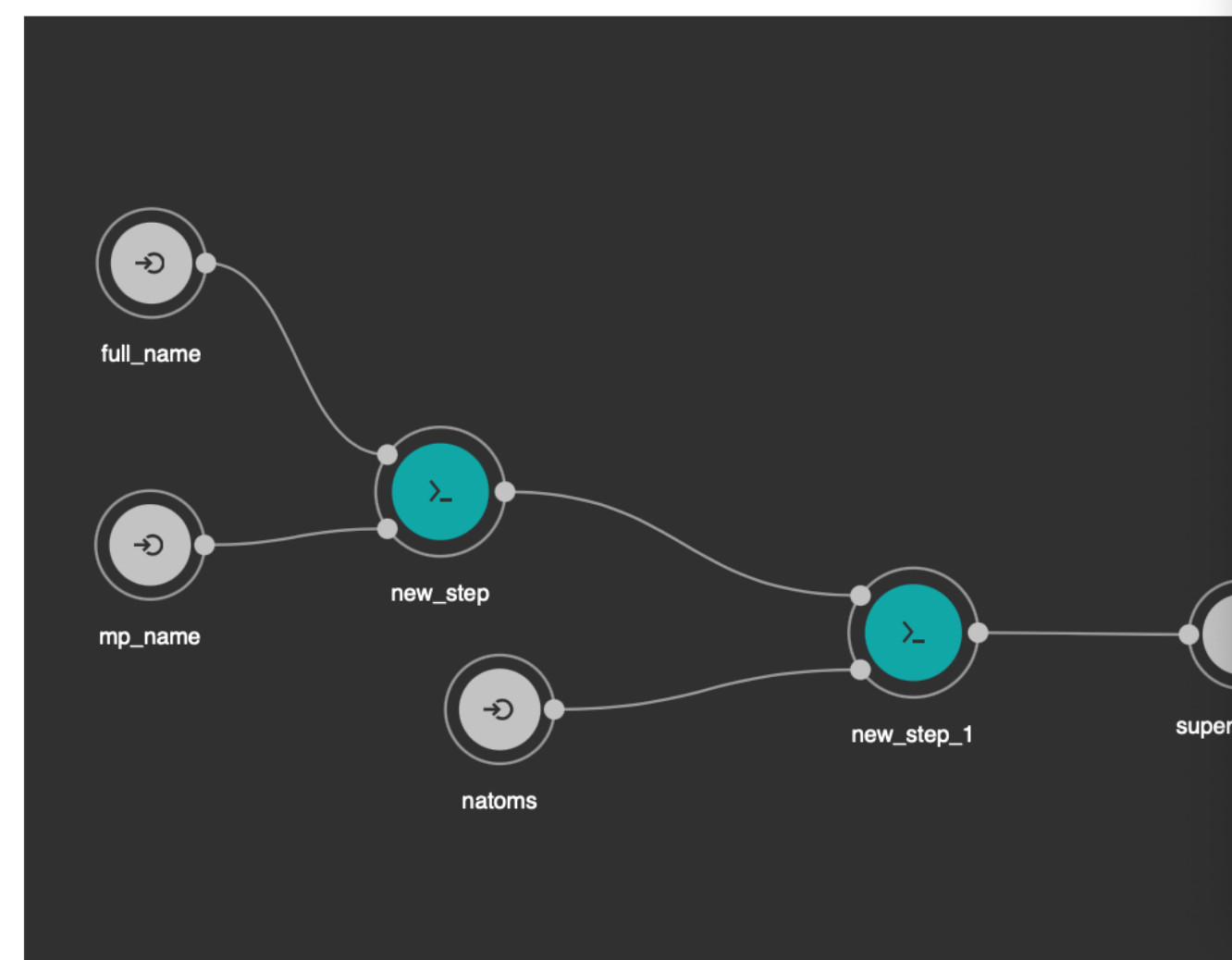
English Project

Projects > Transferability of LDOS based ML for Materials Science > Workflows > Create supercell from element and structure

### Edit a Scientific Workflow

Name: Create supercell from element and structure

Description: Given the full name of an element, the structure description from the MaterialsProject and a number of atoms, create a supercell in VASP POSCAR format.



Buttons: Save, Cancel, Fit to Screen, Delete Selection

HELIPORT HELmholtz Scientific Project Workflow Platform

English Project knodel39

Projects > Transferability of LDOS based ML for Materials Science > Jobs > Test job

Output Details

### Test job Run

```

93% | 1.1MB 9.0MB/s eta 0:00:01
93% | 1.1MB 11.2MB/s eta 0:00:01
94% | 1.1MB 11.5MB/s eta 0:00:01
95% | 1.1MB 10.1MB/s eta 0:00:01
96% | 1.1MB 11.5MB/s eta 0:00:01
97% | 1.1MB 12.5MB/s eta 0:00:01
98% | 1.2MB 10.7MB/s eta 0:00:01
99% | 1.2MB 11.9MB/s eta 0:00:01
99% | 1.2MB 11.9MB/s eta 0:00:01
100% | 1.2MB 650kB/s
[?25hCollecting mpy-extensions (from cwltool)
Downloading
https://files.pythonhosted.org/packages/5c/eb/975c7c080f3223a5cdaff09612f3a5221e4ba534f7039db34c35d95fa6a5
/mpy_extensions-0.4.3-py2.py3-none-any.whl
Collecting requests>=2.6.1 (from cwltool)
Cache entry deserialization failed, entry ignored
Downloading
https://files.pythonhosted.org/packages/29/c1/24814557f1d22c56d50280771a17307e6bf87b70727d975fd6b2ce6b014a
/requests-2.25.1-py2.py3-none-any.whl (61kB)
[?25l
16% | 10kB 27.2MB/s eta 0:00:01
33% | 20kB 25.3MB/s eta 0:00:01
50% | 30kB 25.5MB/s eta 0:00:01
66% | 40kB 26.3MB/s eta 0:00:01
83% | 51kB 23.9MB/s eta 0:00:01
100% | 61kB 994kB/s
[?25hCollecting shellescape<3.5,>=3.4.1 (from cwltool)
Downloading
https://files.pythonhosted.org/packages/51/b6/986c99a10040beaaefca1ad6c93bd7738cb8e4f52f6caed13d3ed1caa7e4
/shellescape-3.4.1-py2.py3-none-any.whl
Collecting psutil (from cwltool)
Cache entry deserialization failed, entry ignored
Downloading
https://files.pythonhosted.org/packages/e1/b0/7276de53321c12981717490516b7e612364f2cb372ee8901bd4a66a000d7
/psutil-5.8.0.tar.gz (470kB)
[?25l
2% | 10kB 11.5MB/s eta 0:00:01
4% | 20kB 14.2MB/s eta 0:00:01
6% | 30kB 16.6MB/s eta 0:00:01
8% | 40kB 18.4MB/s eta 0:00:01
10% | 51kB 19.5MB/s eta 0:00:01
13% | 61kB 20.7MB/s eta 0:00:01
    
```

# Relations Between Digital Objects

- Relations between digital objects are visualized to provide a top-level view on the project with dependencies.
- With a graphical representation, objects and the processes on our infrastructures are comprehensible.
- Also the components and relations between simulation and experiment can be visualized.

The screenshot shows the HELIPORT web interface. The top navigation bar includes the HELIPORT logo, a search bar, and user information (Info, Project, knodel39). The breadcrumb trail indicates the current view: Projects > Digital Twin Showcase > Graphs > Simple Visualization.

Below the breadcrumb trail, there are three configuration panels for defining relations. Each panel has a 'Color' and 'Dashed' checkbox, and a table with columns for 'Property Path', 'ID', and 'Reverse'.

Color	Dashed	Property Path	ID	Reverse
Red	<input type="checkbox"/>	derived_from	2364	<input checked="" type="checkbox"/>

Color	Dashed	Property Path	ID	Reverse
Red	<input type="checkbox"/>	has_input	2374	<input checked="" type="checkbox"/>
		result_of	2375	<input checked="" type="checkbox"/>

Color	Dashed	Property Path	ID	Reverse
Grey	<input checked="" type="checkbox"/>	simulation_of	2365	<input checked="" type="checkbox"/>

Buttons for 'Save', 'Cancel', and 'Add Edge' are located at the bottom of the configuration panels.

Below the configuration panels is a graph visualization. The graph shows a flow of digital objects and processes. A thick green diagonal line separates the 'Simulation (Digital Twin)' (top) from the 'Experiment' (bottom). Nodes include Simulation Parameters, Feasibility Study (Simulation), Initial Simulation, Simulation Results, Simulation (fine granular), Publication, Experiment Run 1, Experiment Run 2, Experiment Run 3, Feasibility Study, and Setup Parameters. Red arrows indicate dependencies and relationships between these objects.

# Data provenance and Comprehensibility

- For many systems and services we still have to develop necessary plug-ins for the integration into Heliport.
- The versioning of an experiment lifecycle is unavoidable and we are still discussing how we can present the feature in our web frontend:
  - A Git project with all metadata to restore a lifecycle,
  - Or an implementation direct in Heliport?
- Inheritance of projects,
- Different views based on roles (owner, beam line scientist, data curator, ...)

The screenshot shows the Heliport web interface. The browser address bar displays 'visdms.fz-rossendorf.de/project/74/timeline/'. The page header includes the 'HELIPORT' logo, a search bar, and navigation links for 'Info', 'Project', and the user 'knodel39'. The main content area is titled 'Timeline of gELBE beamtime 21202619-ST' and includes a checkbox for 'Show timeline in project graph'. The timeline consists of several entries, each with a date and time, a title, and a description:

- May 3, 2022, 2:28 p.m.**  
**TRCprocess**
- April 29, 2022, 12:47 p.m.**  
**Alex Keshavarzi's github repo (use branch McrDev)**
- April 29, 2022, 12:43 p.m.**  
**/bigdata/GATE21202619ST/Data**  
Filesystem on /bigdata containing the beamtime data.
- April 28, 2022, 1:19 p.m.**  
nothing
- April 20, 2022, 11:17 a.m.**  
**DSPEC\_LaBr**  
This folder contains the DSPEC-runs taken with the LaBr detector, exported to the HZDR cloud. Password is "ELBE2022"
- April 14, 2022, 12:04 p.m.**  
Run logbook
- April 6, 2022, 5:07 p.m.**  
Cloud folder (Password: ELBE2022)



# Heliport REST API

- The API provides access to our full Heliport infrastructure:
  - Proposal access (GATE),
  - Handle management,
  - CWL execution and monitoring,
  - Project metadata export,
  - Digital Object and
  - Lifecycle management.
- API documentation (ReDOC) available.
- Essential to integrate the Heliport Infrastructure in Experiments.
- Everything can be documented with less user interaction.

The screenshot displays the Heliport REST API documentation interface. The browser address bar shows the URL: `vlsdms.fz-rossendorf.de/redoc/#operation/createDigitalObject`. The interface is divided into several sections:



- Navigation:** A sidebar on the left contains a search bar and a list of API endpoints: `api`, `gate-connection`, `version-control`, `data-management-plan`, `documentation`, `data-source`, `publication`, `cwl-execution`, `digital-objects`, `listDigitalObjects` (GET), `createDigitalObject` (POST), `retrieveDigitalObject` (GET), `updateDigitalObject` (PUT), `partialUpdateDigitalObject` (PATCH), `destroyDigitalObject` (DEL), and `token`.
- Endpoint Details:** The main area shows the `createDigitalObject` endpoint under the `Digital Objects` category. It specifies the `REQUEST BODY SCHEMA: application/json`.
- Request Body Schema:** A table lists the required fields for the request body:

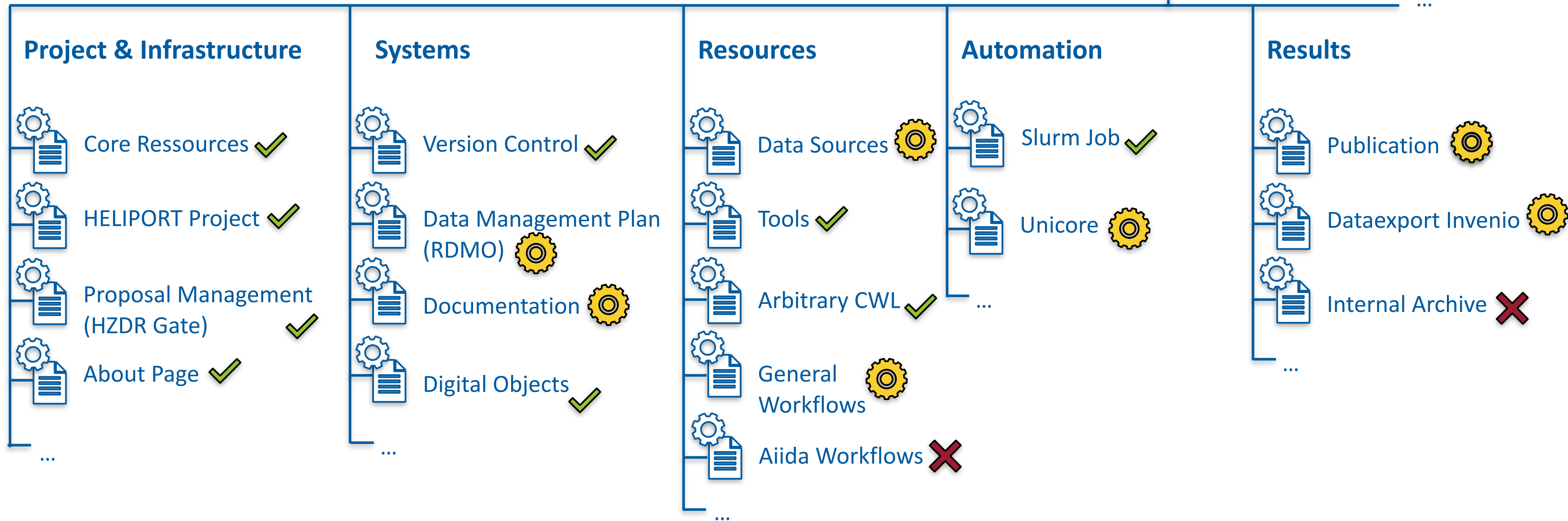
Field	Type	Constraints
<code>project</code>	integer	required
<code>handle</code>	string	≤ 100 characters, Nullable
<code>relation</code>	string	required
<code>category</code>	string	required
<code>description</code>	string	required
- Responses:** A section titled "Responses" shows a sample response for status code `201`.
- Request samples:** A section titled "Request samples" shows a sample JSON payload:

```
{  "project": 0,  "handle": "string",  "relation": "string",  "category": "string",  "description": "string"}
```
- Response samples:** A section titled "Response samples" shows a sample JSON response for status code `201`:

```
{  "digital_object_id": 0,  "project": 0,  "handle": "string",  "relation": "string",  "category": "string",  "description": "string"}
```

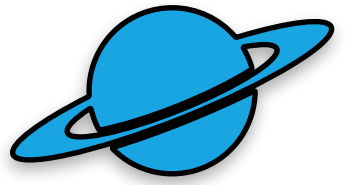
# Modular HELIPORT Design (Django Apps)

- Microservice architecture based on Django plugins,
- All plugins offer a REST API, usable in internal workflows,
- Source code available under GNU GPLv3  on  and DOI [10.14278/rodare.947](https://doi.org/10.14278/rodare.947)

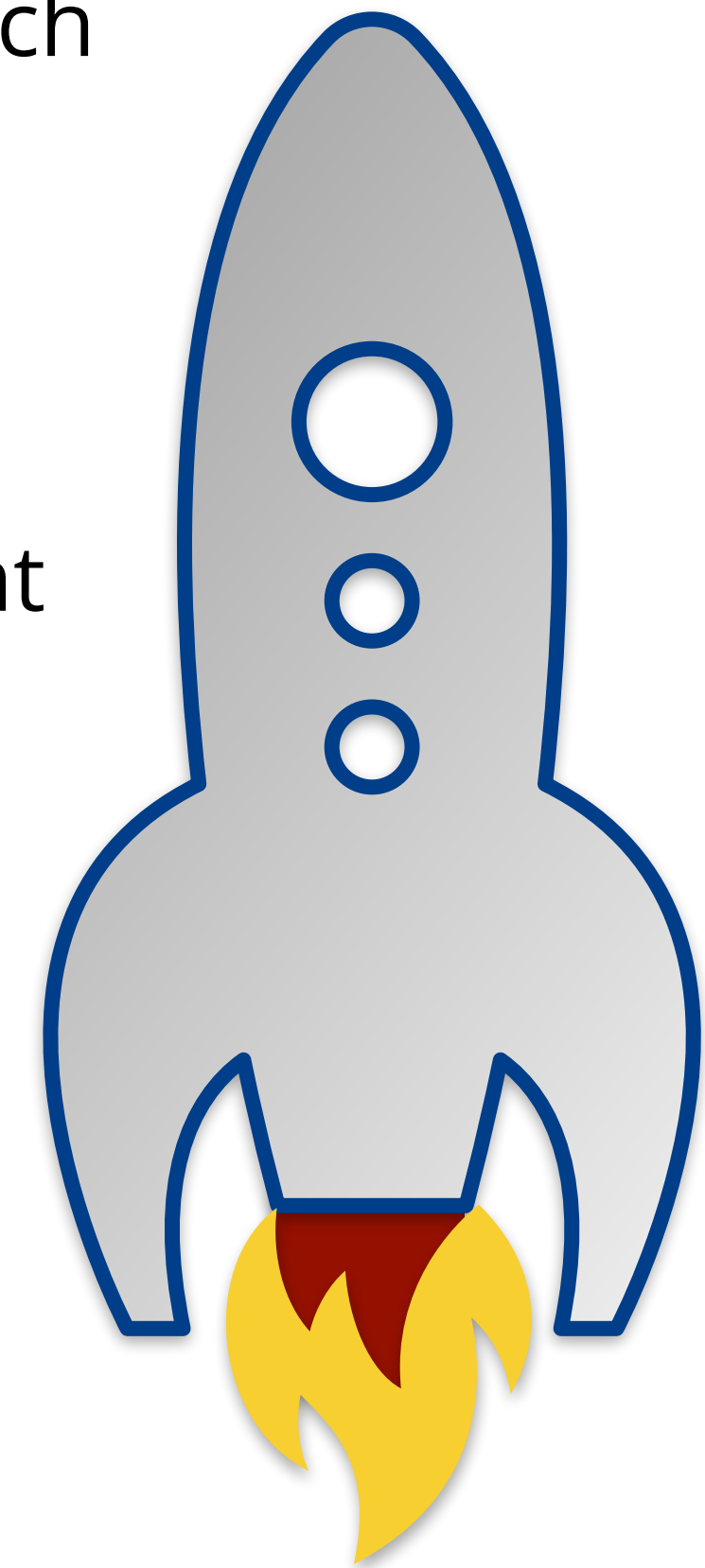
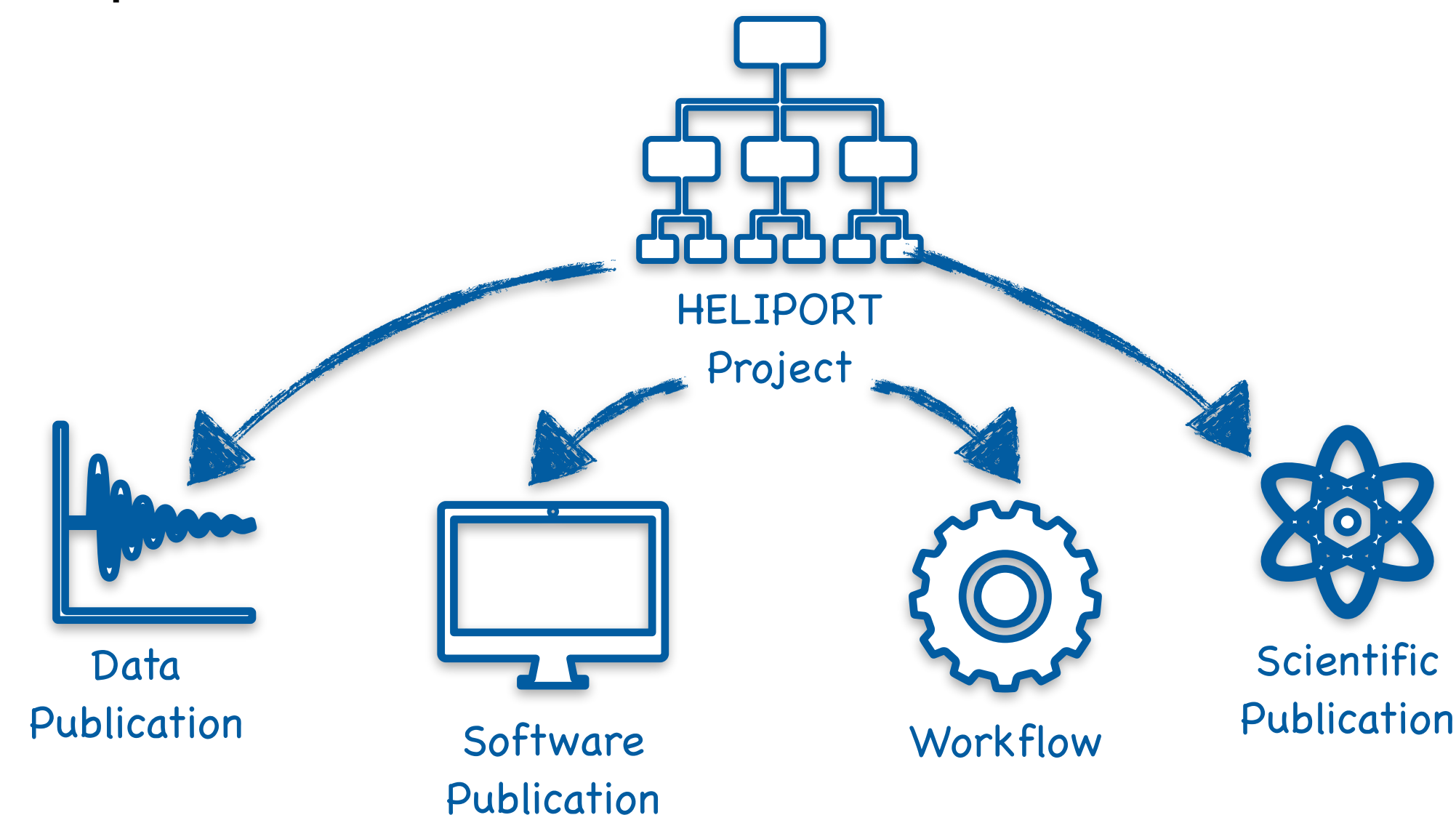


 Available
  In development
  Planned

# Conclusions

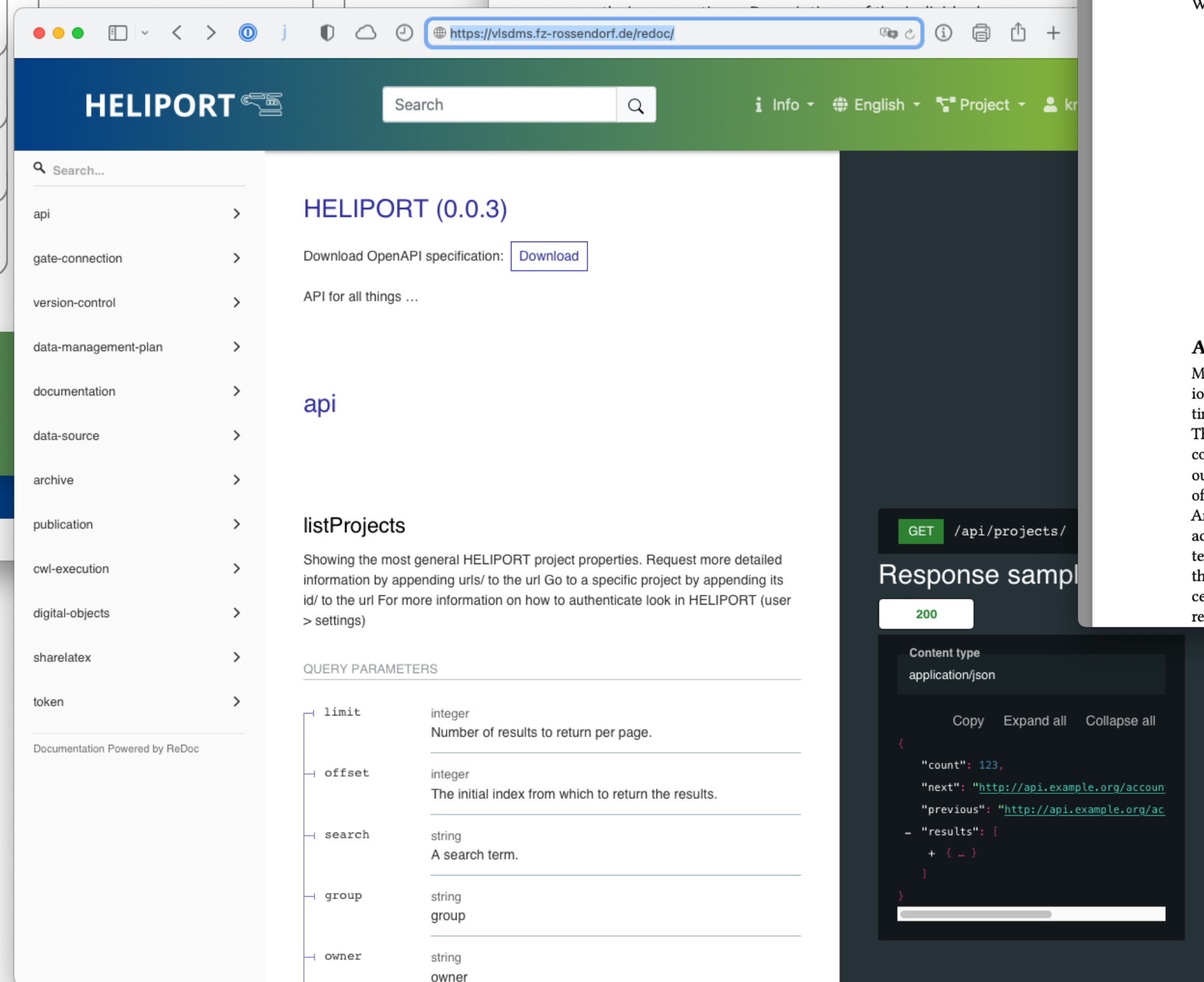
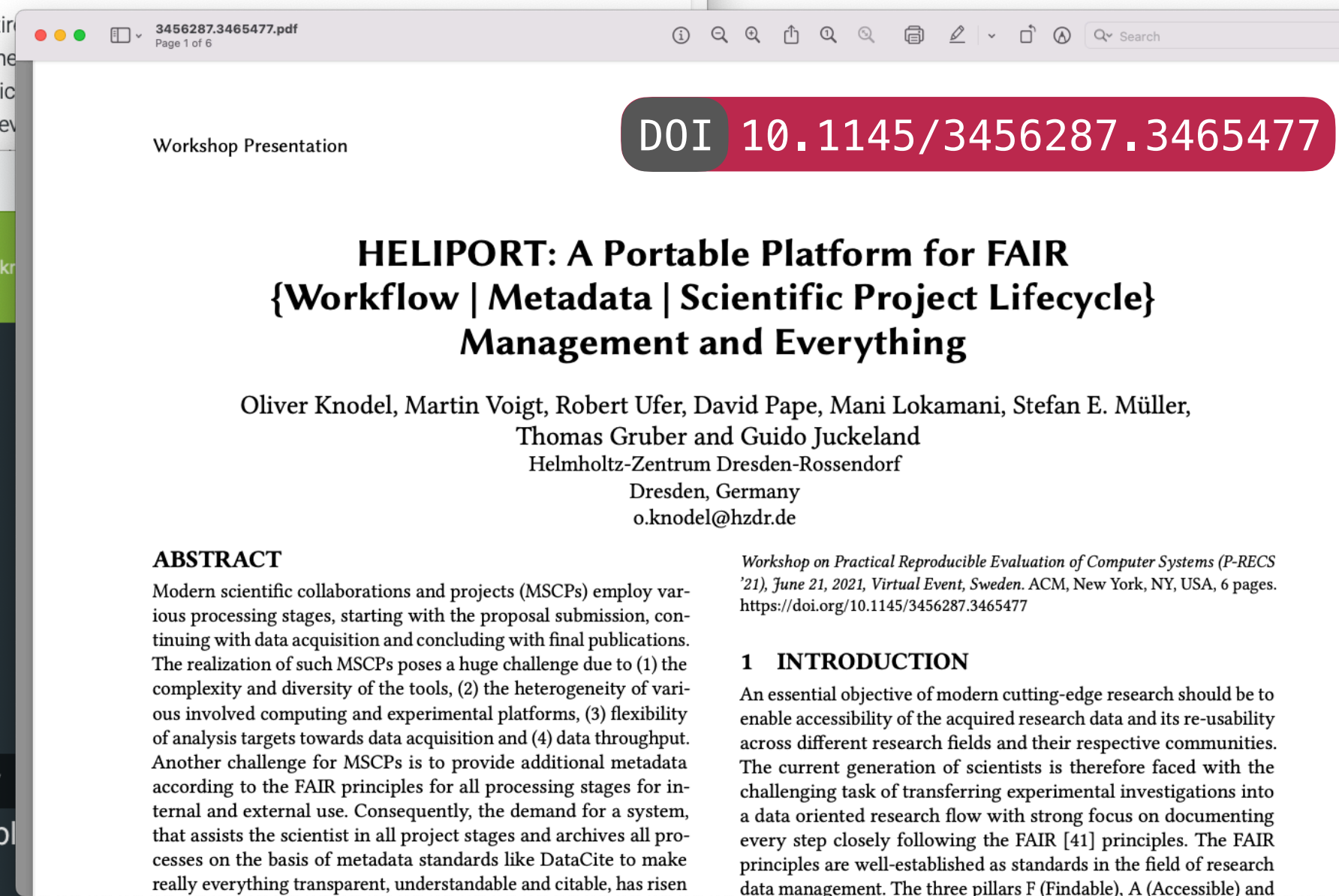
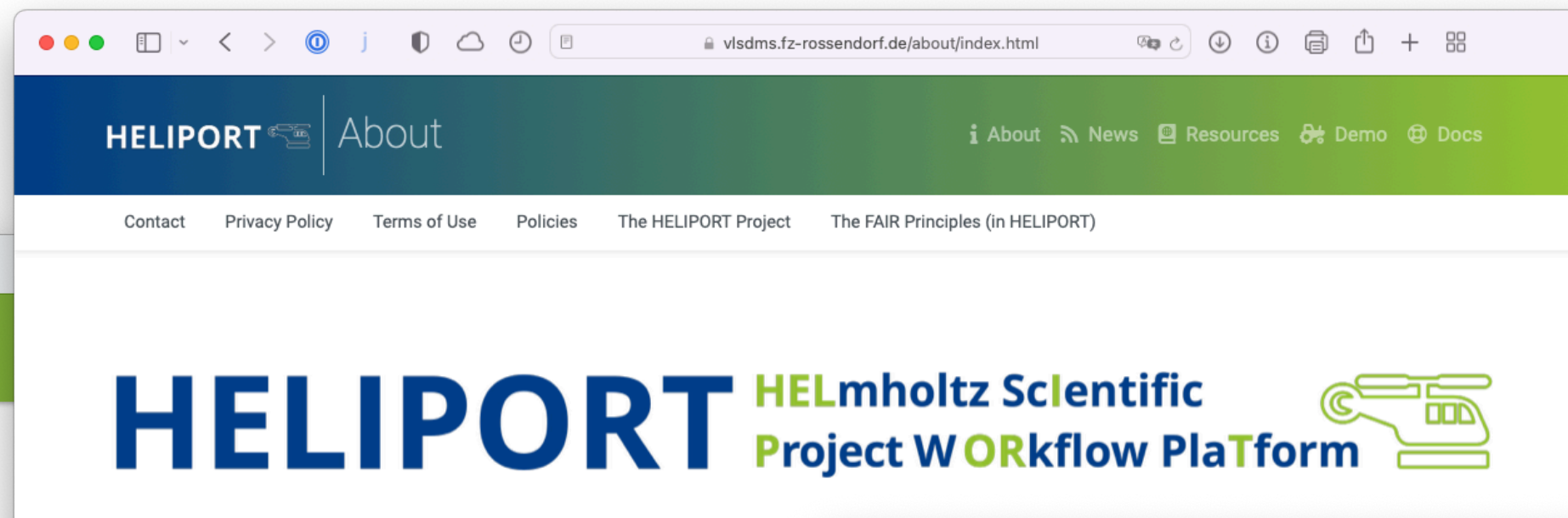
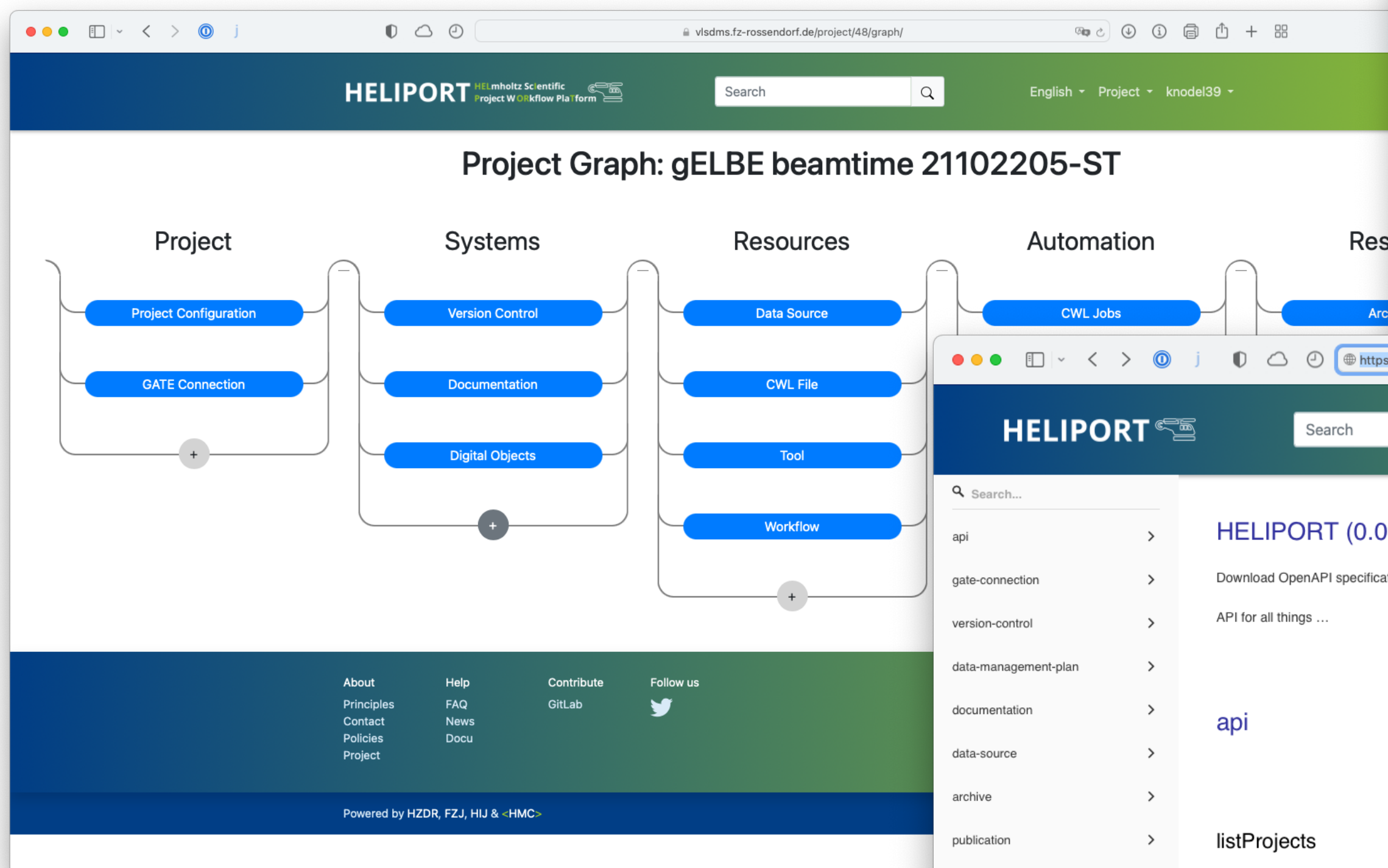


- A guidance system that describes and collects all metadata from the systems involved is desirable and leads us to a fully **FAIR** and comprehensible research project.
- The computational workflows are essential to keep track of everything what happened during the experiment.
- With all data products registered in one system we can promote the different data publications to make the research more visible and comprehensible.



# Resources

Website: [heliport.hzdr.de](https://heliport.hzdr.de)



Demo: [heliport.hzdr.de/app](https://heliport.hzdr.de/app)

API Doc: [heliport.hzdr.de/redoc/](https://heliport.hzdr.de/redoc/)