

Electronic laboratory notebooks and other tools for user-friendly research data management workflows with examples from plasma technology



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INP – Leibniz Institute for Plasma Science and Technology



- 1992 formal foundation of INP; 2007 renamed to Leibniz Institute for Plasma Science and Technology
- Largest non-university research institution on low-temperature plasmas and its application in Europe
- Application-oriented fundamental research

From idea to prototype

especially in the research areas

- Plasmas for materials and energy
- Plasmas for environment and bioeconomy
- Plasmas for hygiene and health



Locations:

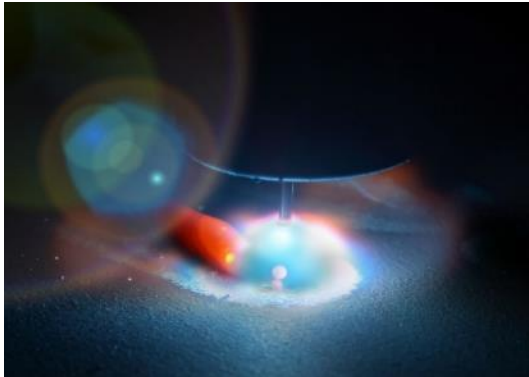
- **Greifswald** (main location including 49 laboratories of all research areas; professorships with University of Greifswald)
- **Rostock/Poppendorf** (cooperation with University of Rostock, professorships including laboratory capacities, Research Factory)
- **Karlsburg** (Competence Centre Diabetes Karlsburg, laboratory capacities with direct connection to the hospital)

Research Division Materials & Energy



Green Ammonia Technologies: renewable energies and plasma-based surface technologies

Photovoltaics, fuel cells, batteries, hydrogen technology, thin-film technology (photonics, functional layers), atmospheric and vacuum-based manufacturing, structure elucidation and investigation of permeation and electrochemical properties of nanomaterials



Thermal Plasma Technologies: development of energy-efficient and resource-saving processes

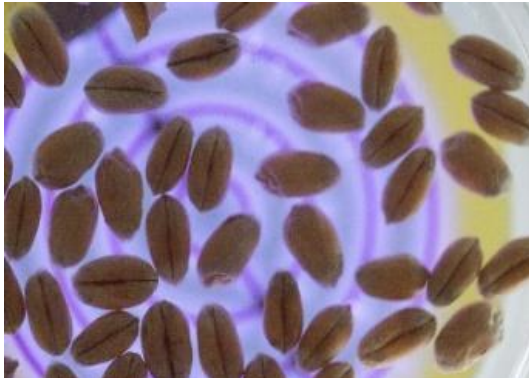
High-current and high-voltage technology, joining technology, switching arcs, green switching technologies

Research Division Environment & Bioeconomy



Plasma Chemical Processes: control of reactive plasma processes

Elementary processes in reactive plasmas, plasma diagnostics and monitoring of plasma processes, non-thermal plasma reactors



Agriculture, Biomass & Decontamination: development and optimisation of plasma-based processes

Decontamination of water and air, seed treatment, crop growth, food hygiene, food processing, new technologies for digestion and processing of biomass and biogenic residues, prototyping of devices



Research Division Hygiene & Health



Plasma Surface Modification: plasma-based surface technologies for Life Science

Implants, therapeutic devices, disposables, biosensor surfaces



Plasma Medicine: Cold atmospheric pressure plasmas for medical applications

Plasma-cell interaction, plasma-tissue interaction, plasma-liquid interaction, prototyping of devices

Cross-topic group 'Plasma Modelling and Data Science'

Modelling & simulation

- Development of models for thermal plasmas, non-thermal plasmas and plasma chemistry
- Development of in-house codes
- Expertise in commercial simulation software
- Modelling and analysis of separate aspects or whole plasma sources and processes

Research data management

- Adoption of the FAIR data principles* for research data in plasma technology
- Standardization of data documentation
- Making data as open as possible and as closed as necessary
- Development of tools to integrate research data management into daily practise

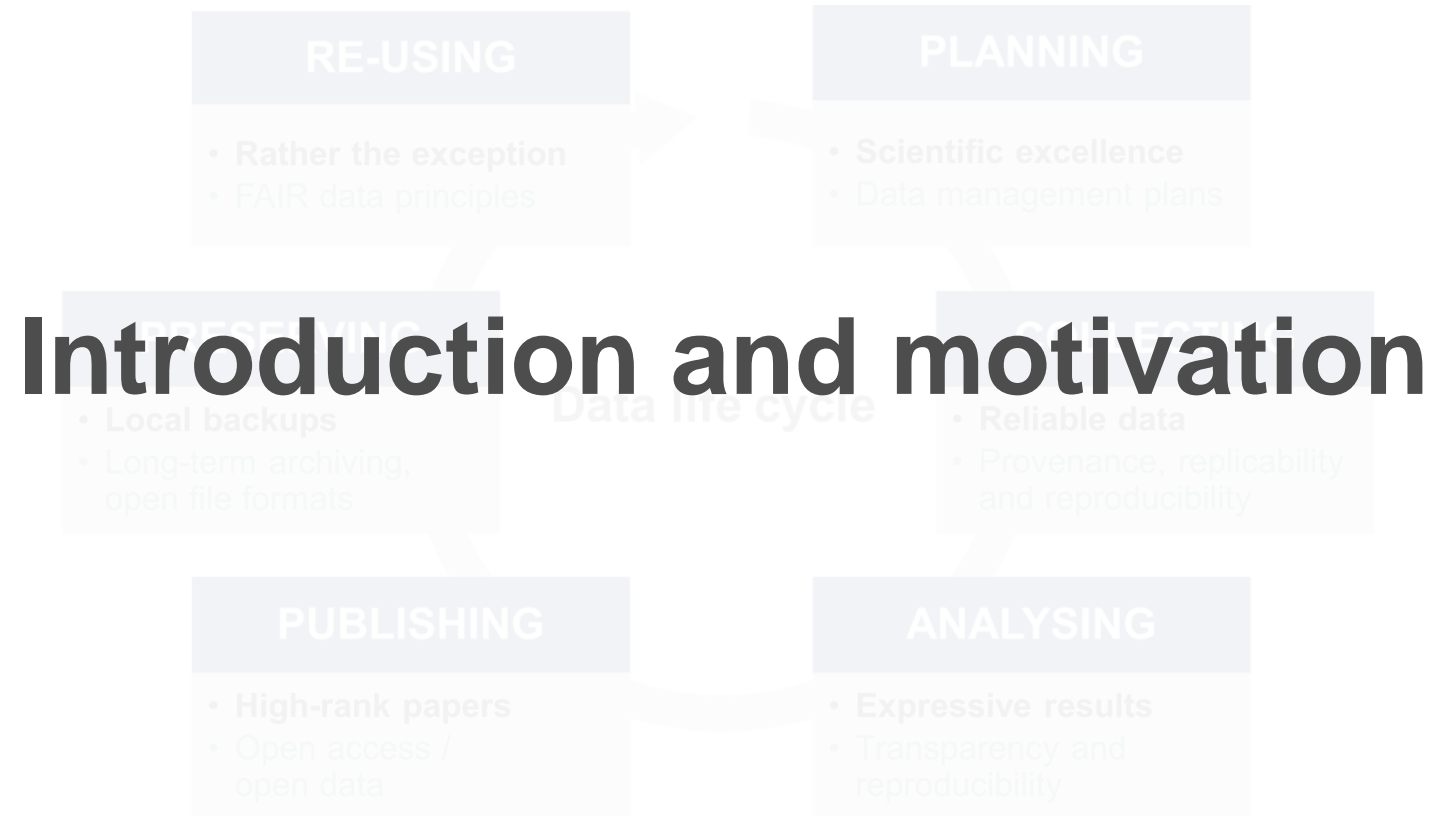
Data science & analysis

- Development of tools and workflows for data processing and analysis
- Design of experiments and modelling for re-usable and comprehensive databases
- Development of concepts and methods for data-driven research using experimental and/or modelling data

*FAIR = Findable, Accessible, Interoperable, Reusable (<https://www.go-fair.org>)

Outline

1. Introduction and motivation
2. BMBF project QPTDat and tools for research data management (RDM) in plasma technology
3. Workflows to bring RDM into the labs
4. Summary

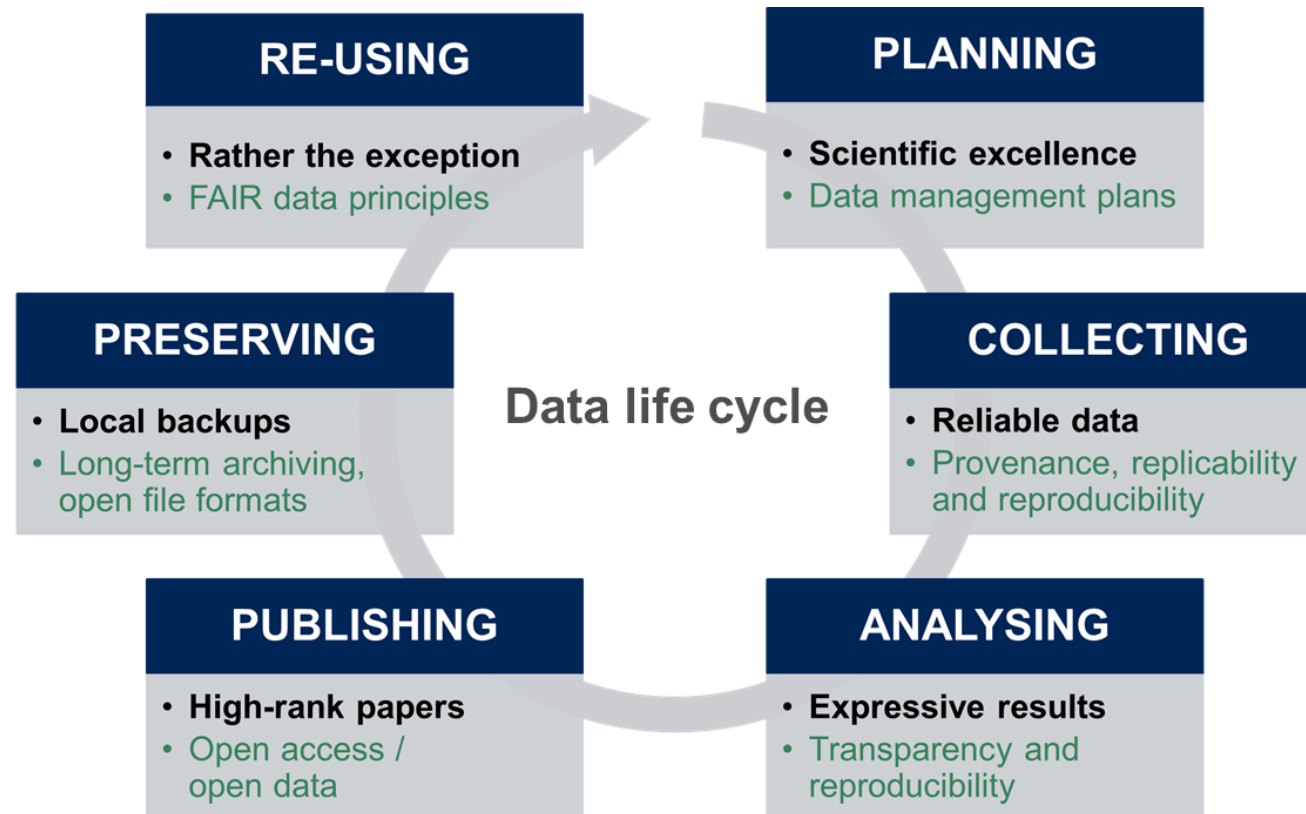


What is research data management all about?

Traditional focus and current status in many research areas

+

Objectives and measures of research data management



FAIR data principles

Seminal paper of M. Wilkinson *et al.* 2016 *Sci Data* **3**, 160018, <https://doi.org/10.1038/sdata.2016.18>
The FAIR Guiding Principles for scientific data management and stewardship

F
indable

- Identifiable data items
- Persistent
- Searchable

A
ccessible

- Retrievable by standardized communication protocols
- Authentication where necessary
- Access to meta data, even if data is not accessible

I
nteroperable

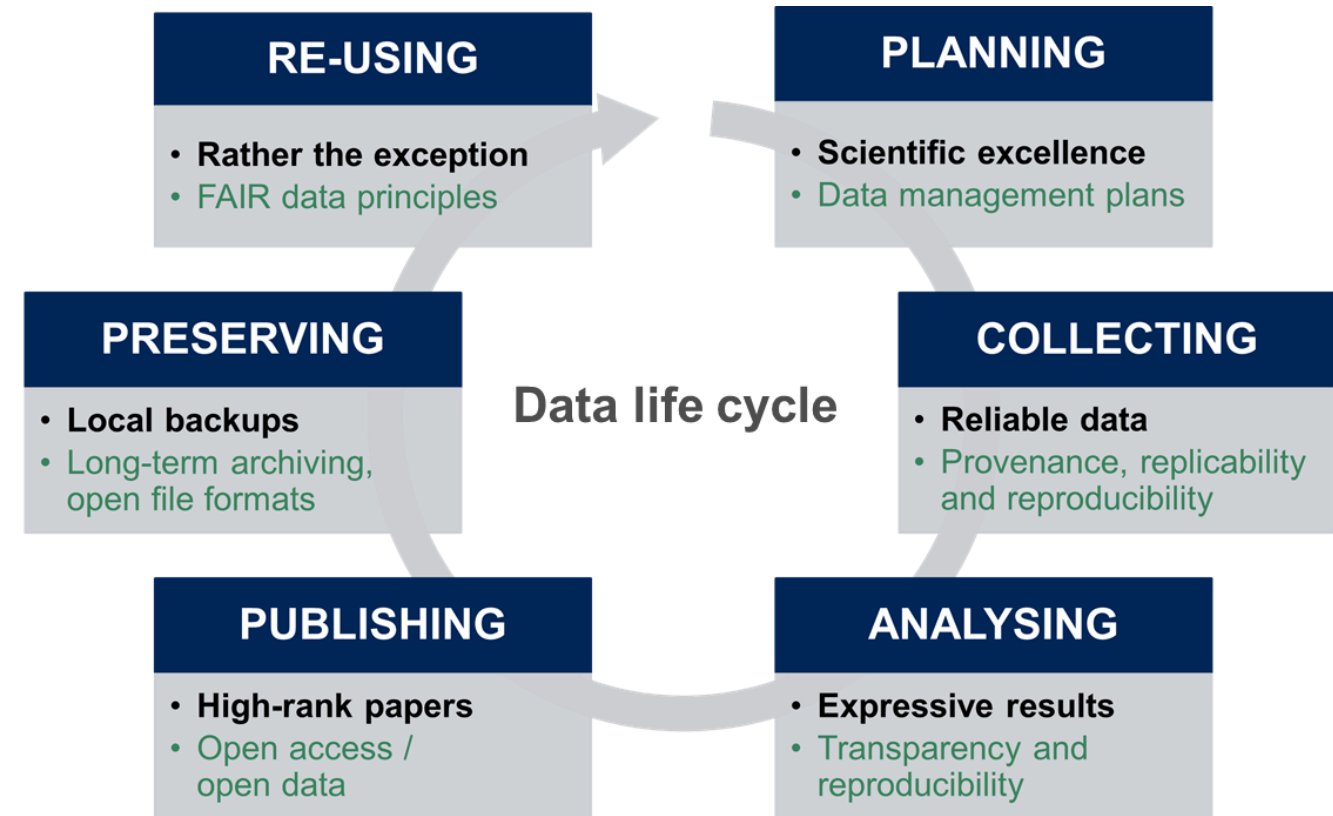
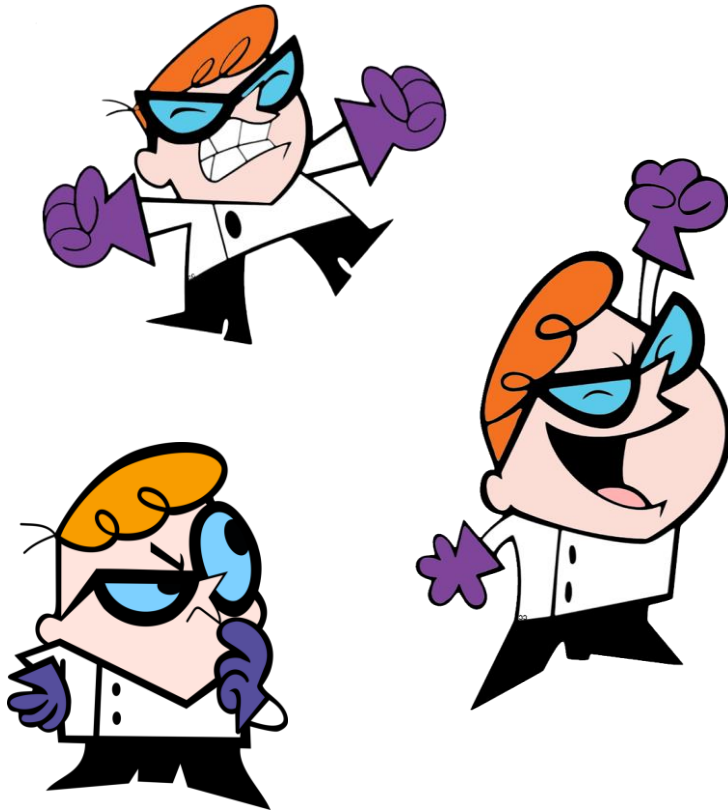
- Formal, accessible representation of data
- Qualified references to other items

R
eusable

- Rich and standard-compliant metadata
- Proper licensing
- Provenance

Diverse view of the requirements of RDM

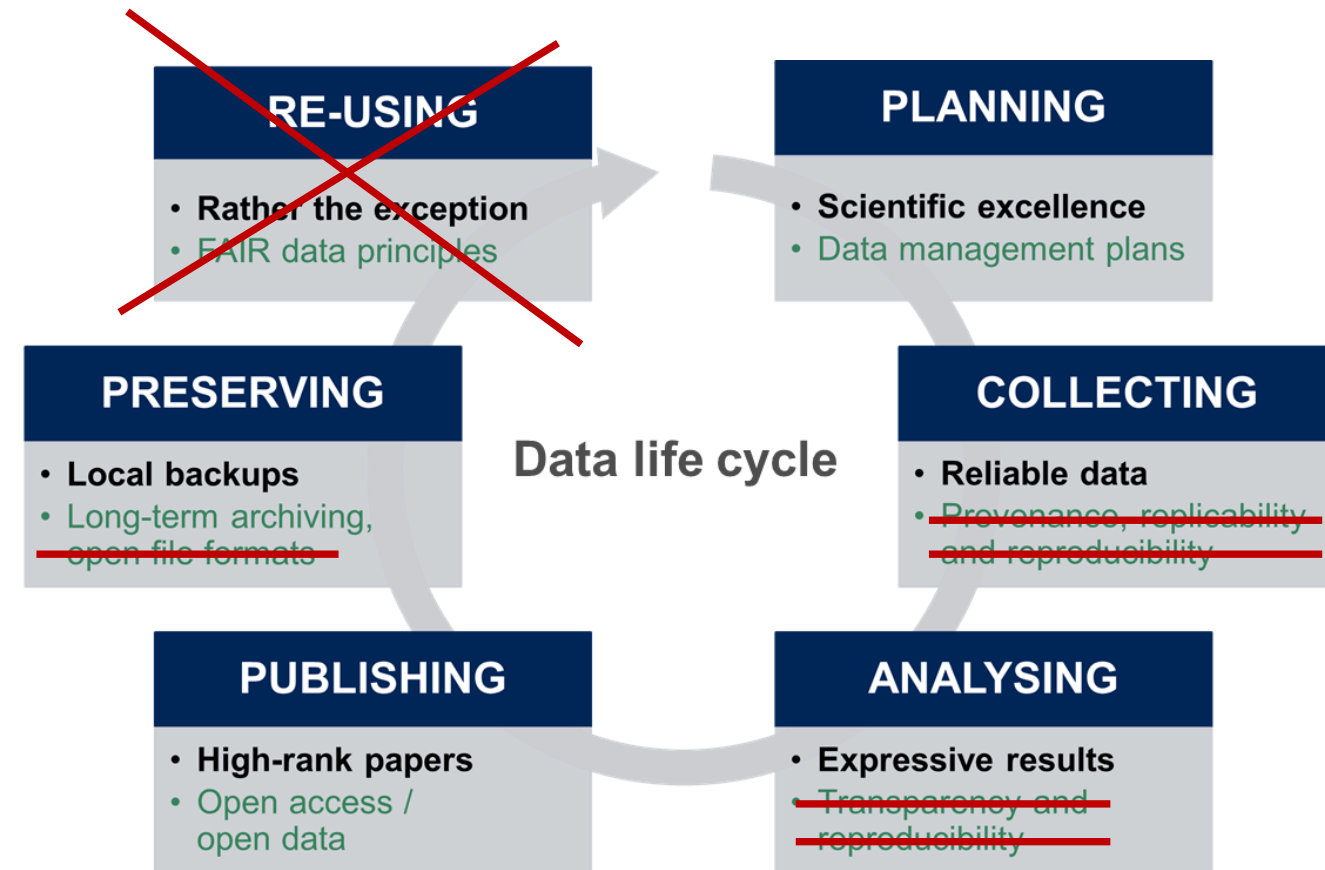
Three groups of researchers



Diverse view of the requirements of RDM

Three groups of researchers

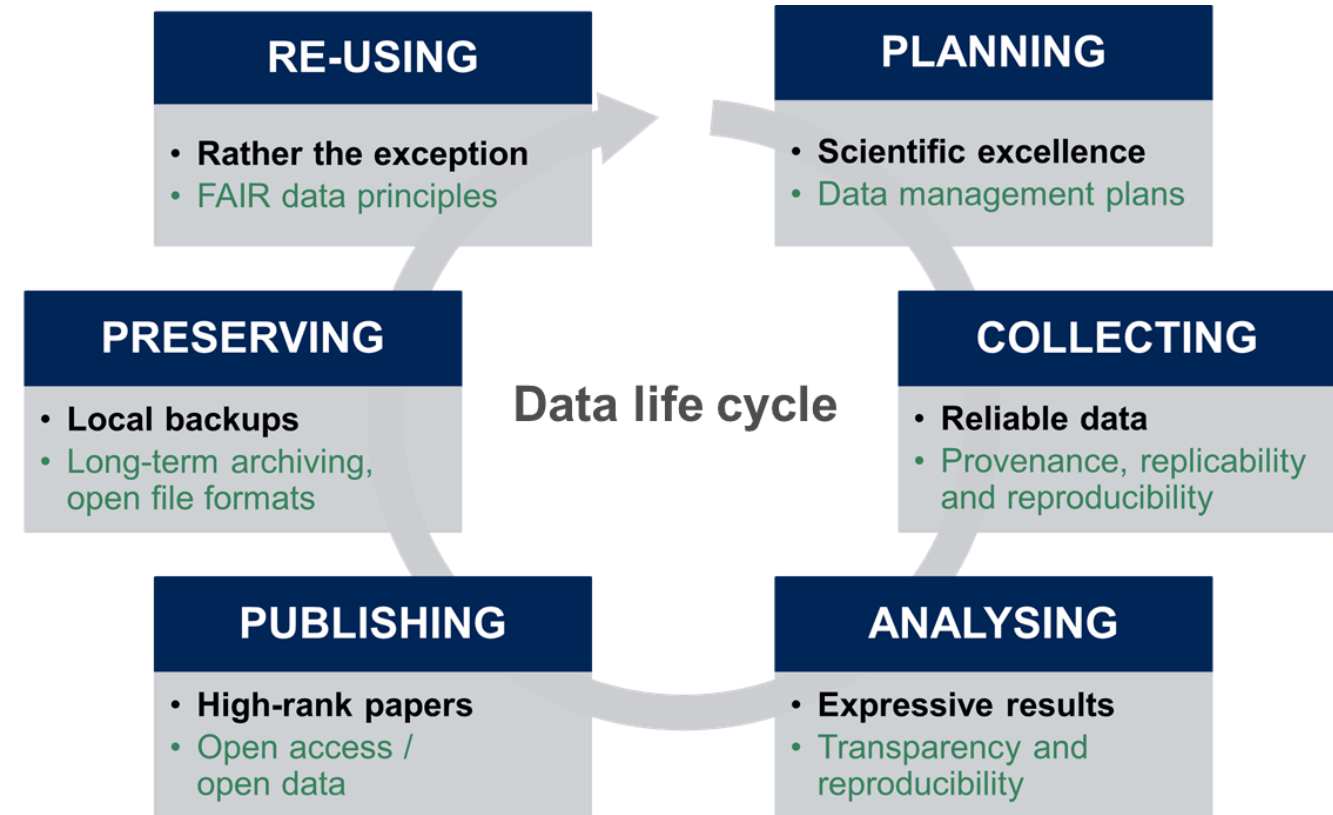
1. Sees no benefit; will comply with the minimum requirements of funders, publishers, etc.; minimal extra effort



Diverse view of the requirements of RDM

Three groups of researchers

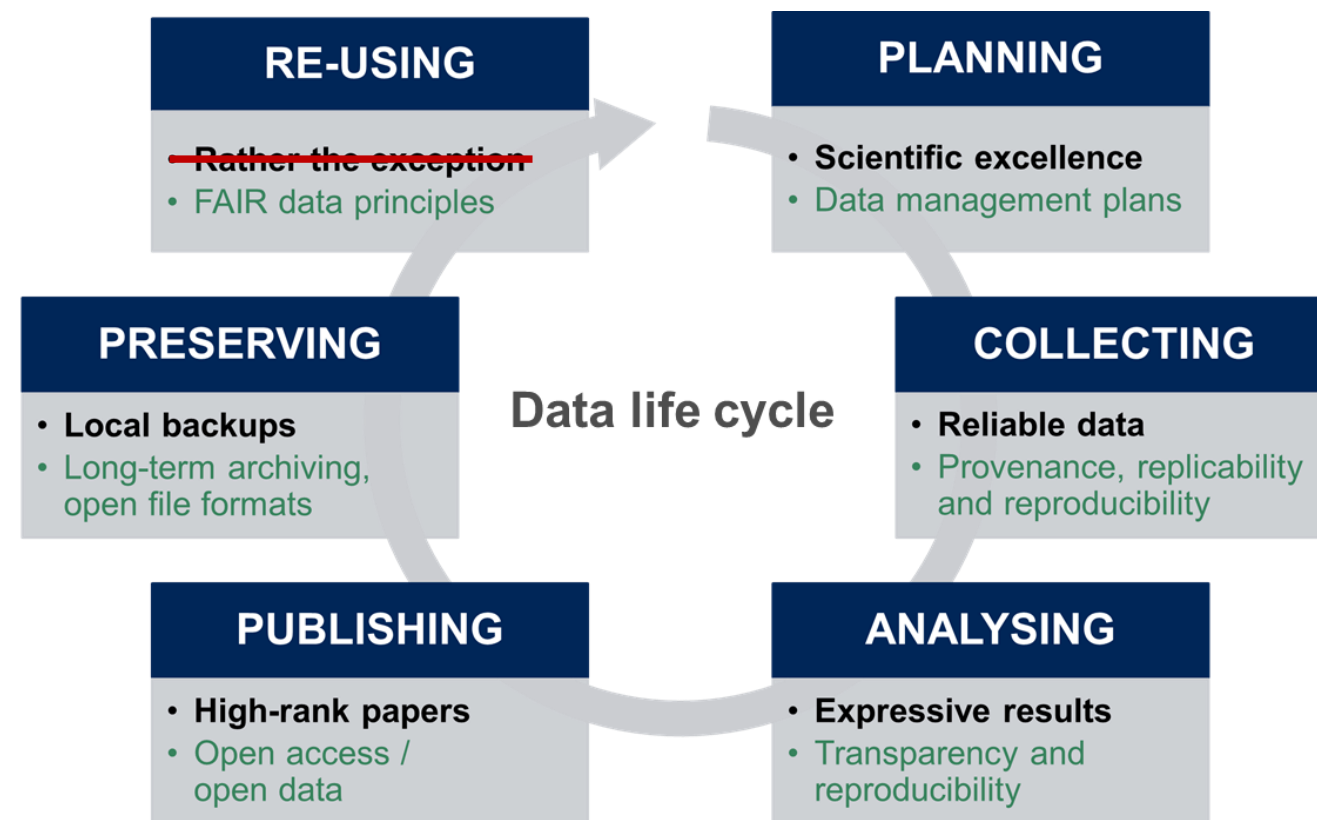
2. Data champion; knows about RDM tools and standards; meets the requirements by far; medium extra effort



Diverse view of the requirements of RDM

Three groups of researchers

3. Sees potential benefit for own research; not familiar with RDM; very high extra effort



Typical example from plasma technology

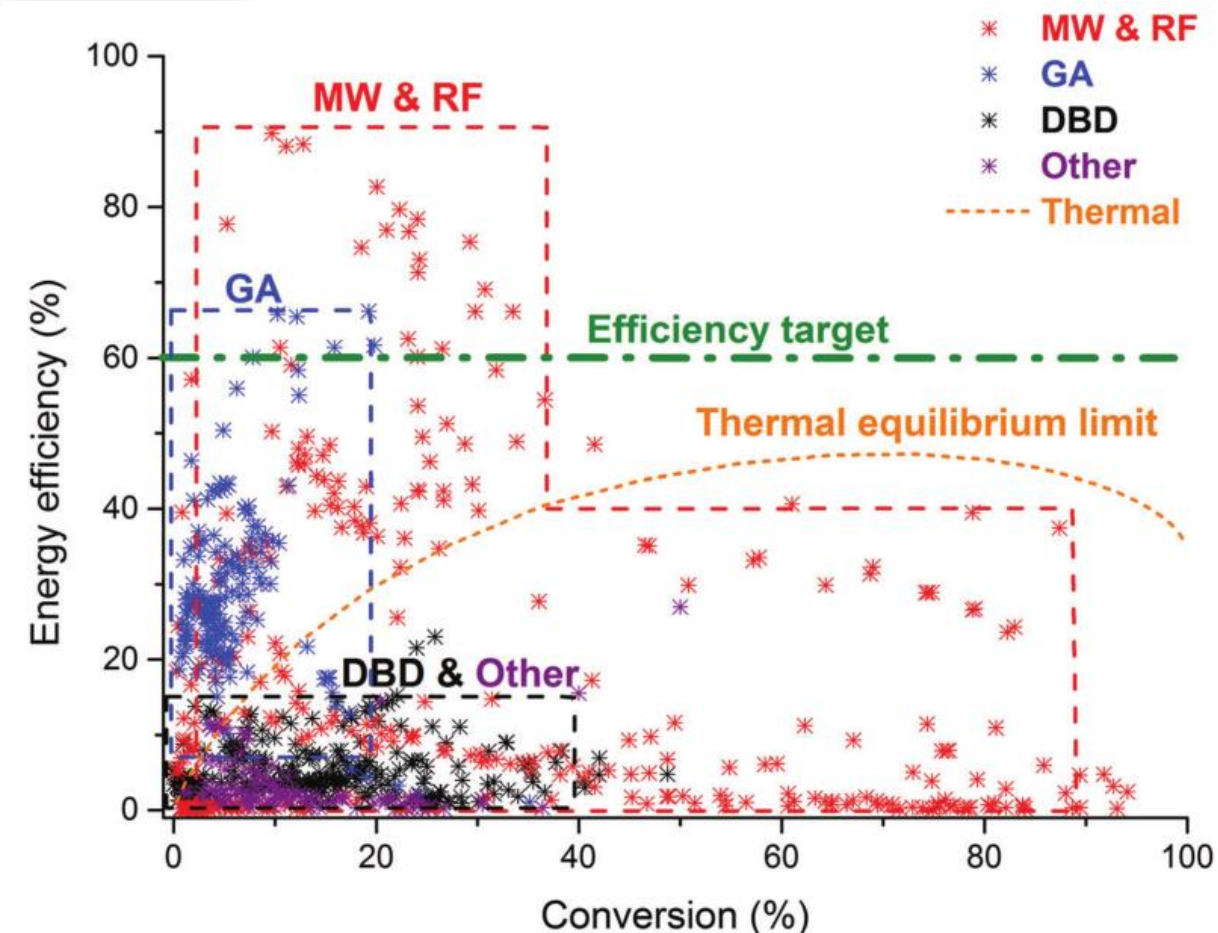


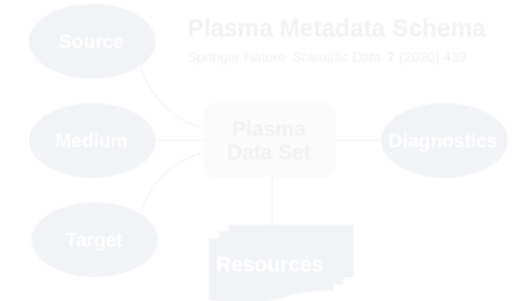
Fig. 32 from R. Snoeckx, A. Bogaerts 2017 *Chem. Soc. Rev.* **46** 5805: Comparison of all the data collected from the literature for CO₂ splitting in the different plasma types, showing the energy efficiency as a function of the conversion.

- Data is published with journal publications
- Digital data available from the corresponding author “on reasonable request”
- Manual “data mining”



<http://clipart-library.com/clipart/1716690.htm>

Quality criteria and RDM
infrastructure for
plasma technology



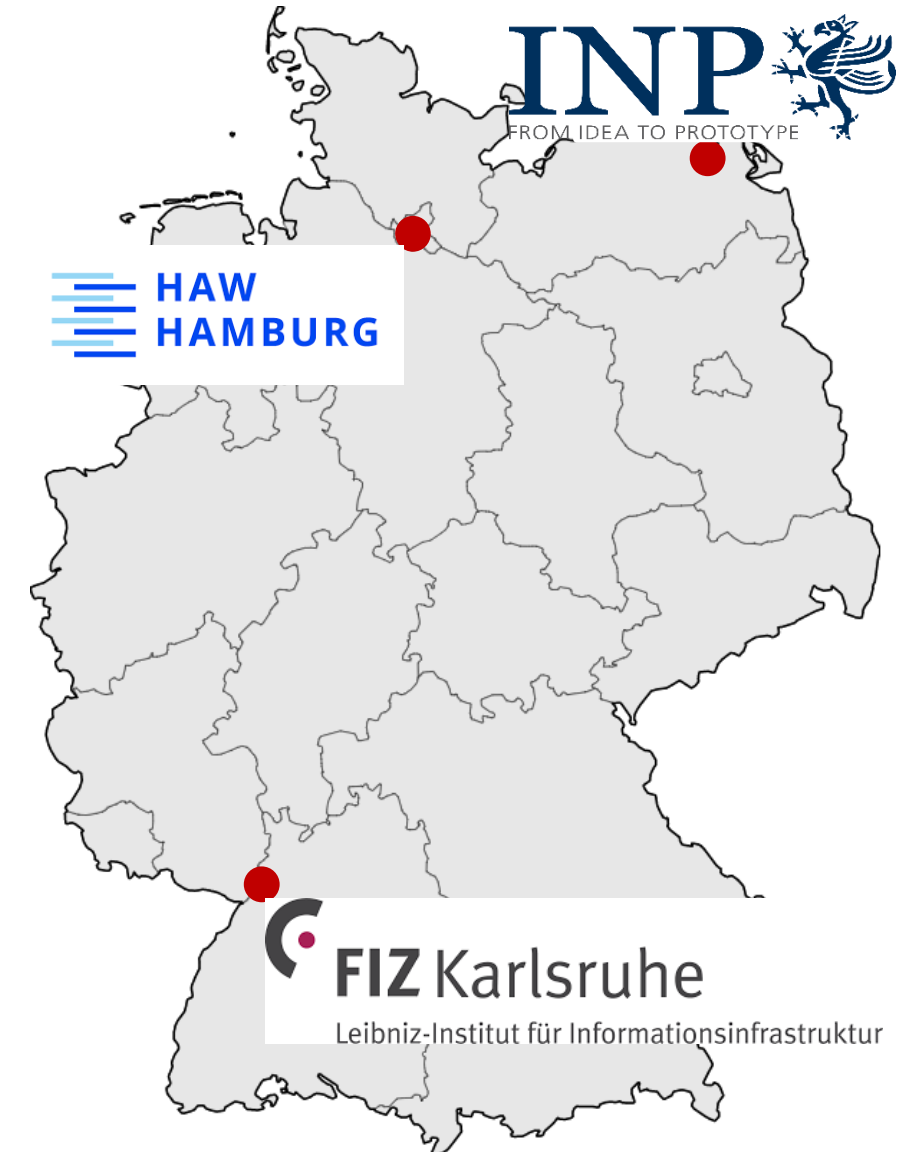
BMBF project QPTDat and tools for research data management (RDM) in plasma technology

Blockchain for (meta-) data
certification and
reputation monitoring

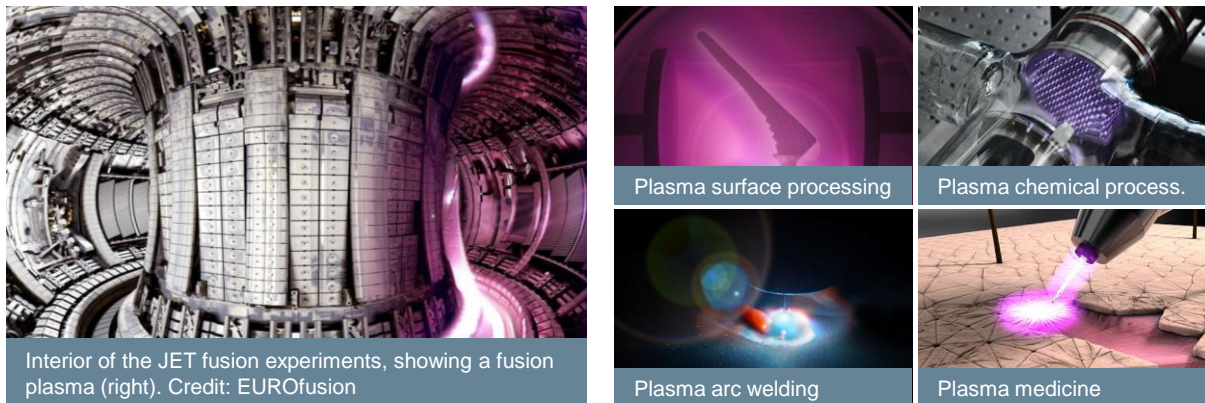
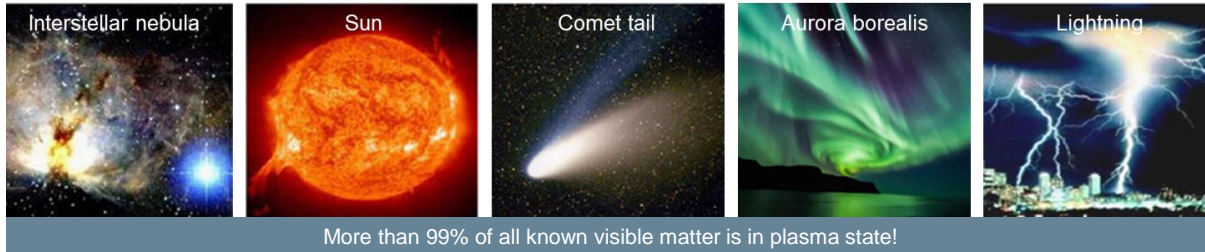


QPTDat project overview

- “Quality Assurance and Linking of Research Data in Plasma Technology - QPTDat”
- Joint project funded by Federal Ministry of Education and Research (BMBF)
- Three project partners:
 - Leibniz Institute for Plasma Science and Technology (INP)
 - FIZ Karlsruhe – Leibniz Institute for Information Infrastructure
 - Hamburg University of Applied Sciences (HAW Hamburg)
- Project period: 06/2019–12/2022
- Read more at <https://www.inptdat.de/project-qptdat>



From plasma science to FAIR data



Types of research data

Structured and unstructured data files, databases, images, videos, research software, ...

Diagnostic methods in plasma physics

Probe measurements, spectroscopy, microscopy, simulations, ...

Metadata and data should be easily **findable** for both humans and computers.

Data need to be **interoperable** with other data, software or workflows for further processing.

F

A

I

R

Data must be **accessible**, i.e. users need to know how they can be retrieved.

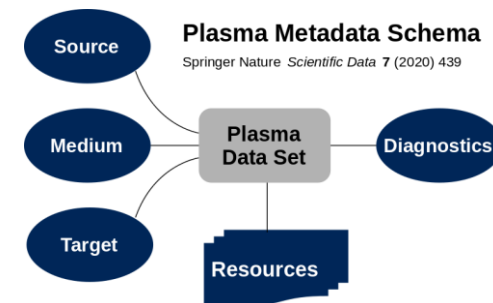
Metadata and data should be well described so that they are **re-usable** within their scope.

M. Becker *et al.* (2022) "Towards implementation of the FAIR principles in plasma science". <https://doi.org/10.5281/zenodo.6483610>

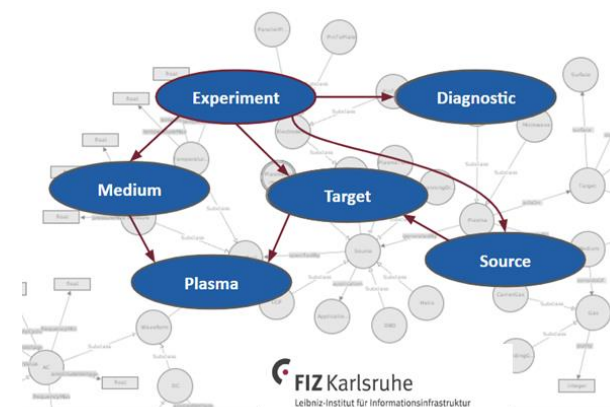
RDM approach followed in QPTDat project



Quality criteria and RDM infrastructure for plasma technology



Ontology and knowledge graph for semantic linking of (meta-)data



Blockchain for (meta-) data certification and reputation monitoring



What are Metadata? What are they for?

Stil

- ☐ Straight (gerades Bein)
- ☐ Loose Fit
- ☐ Skinny (enganliegendes Bein)
- ☐ Slim (schmales Bein)
- ☐ Tapered (schmal zulaufendes Bein)

Weitere

Bundweite (Inch)

24	25	26	27	28
29	30	31	32	33
34	35	36	37	38
39	40	41	42	43

Beinlänge (Inch)

27	28	29	30	31
32	33	34	35	36
37	38			

Farbe

Black	Grey	White	Brown	Green	Red	Pink
Orange	Yellow	Light Green	Teal	Dark Blue	Purple	
Light Yellow	Light Green	Light Blue				

Marke

- ☐ Levi's
- ☐ Diesel

Suchergebnis auf Amazon.de

https://www.amazon.de/s/ref=sr_nr_n_0?fst=as%3Aoff&rh=n%3A77028031%2Cn%3A178689031%2Cn%3A1981298031%2Ck%3Ajeans%2Cn%3A1981350031&bbn=1981298031&keywords=jeans&ie=

Stil: Straight (gerades Bein) | Loose Fit | Skinny (enganliegendes Bein) | Slim (schmales Bein) | Tapered (schmal zulaufendes Bein) | Weitere

Filtern nach

Versandoption (Was ist das?)

- ☒ prime
- ☐ Kostenlose Lieferung ab EUR 29 Bestellwert

Kollektion

- ☐ Frühjahr/Sommer 2018
- ☐ Herbst/Winter 2017

Neuheiten

- Letzte Woche
- Letzter Monat
- Letzte 3 Monate

Stil

- ☐ Straight (gerades Bein)
- ☐ Loose Fit
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Marke

- ☐ Levi's
- ☐ Diesel

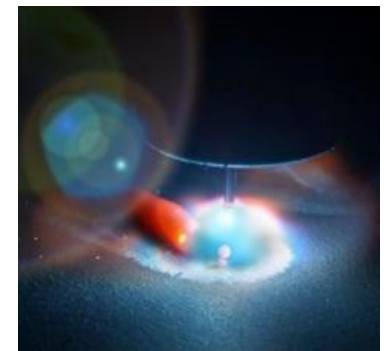
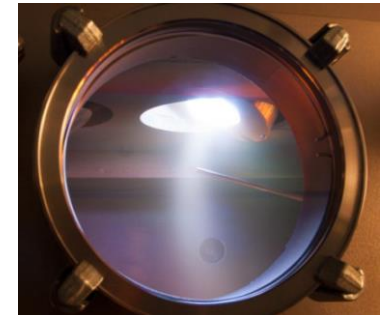
Product Listings:

- Red Bridge Herren Denim Jeans** (Slim Fit) - EUR 39,90
- ESPRIT Herren Straight Jeans** (Slim) - EUR 42,64
- A. Salvarini Designer Herren Jeans** (Basic Stretch) - EUR 34,90
- TOM TAILOR Herren Jeanshose** (1/1 Marvin Straight) - ab EUR 35,40
- MERISH 5-Pocket Denim Jeans** (Slim Fit) - EUR 39,90
- Rock Creek Herren Jeans** (Stretch Regular) - EUR 39,90
- A. Salvarini Designer Herren Jeans** (Regular) - EUR 39,90
- JACK & JONES Herren Jeanshose** - ab EUR 31,82
- Levi's Herren Jeans** (511 Slim Fit) - ab EUR 36,21

Metadata help you to find relevant objects.
e.g. Men - Jeans - Waist - Length - Label

General concept for metadata in plasma technology

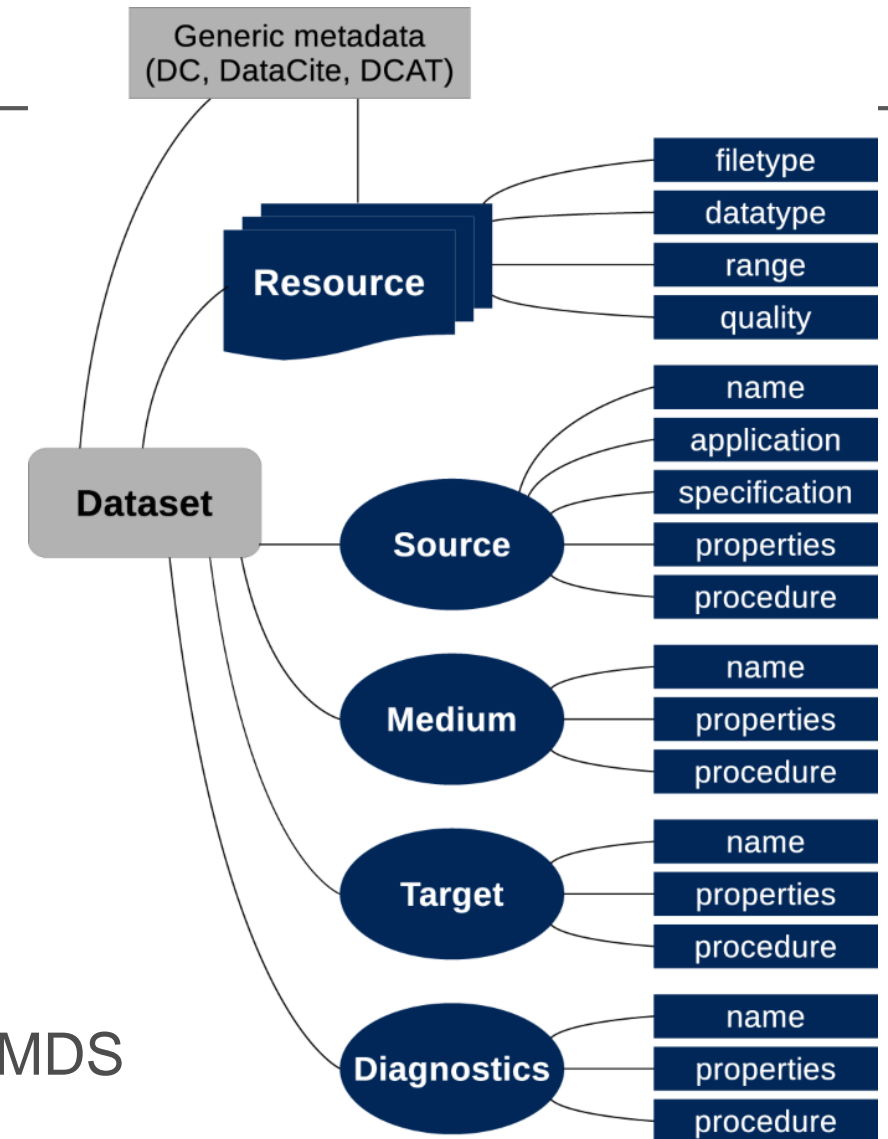
- Plasma
 - ... is generated by a plasma **source**
 - ... is operated with/in a **medium**
 - ... is sometimes used to treat a **target**
- **Diagnostics** (experimental and/or computational methods) are used to study the plasma, medium and/or target
- Stored research data (**resources**) are often useless without information about the whole process
- Specification of the plasma helps to find relevant data sets



Plasma metadata schema

Plasma-MDS

- Metadata schema for applied plasma science
- Standardized description of
 - plasma source
 - plasma medium
 - plasma target
 - diagnostics / modelling / simulations
 - resources (data)
- Research data repositories implementing Plasma-MDS at Leibniz-INP (<https://www.inptdat.de>) and Ruhr University Bochum (<https://rdpcidat.rub.de>)



St. Franke *et al.*, *Sci. Data* **7**, 439 (2020)
<https://doi.org/10.1038/s41597-020-00771-0>

Ontologies for implementation of FAIR data principles

**An ontology is an explicit, formal specification of a shared conceptualization
=> formal knowledge representation**

Findable

- All classes, properties and instances have their own unique resource identifier

Accessible

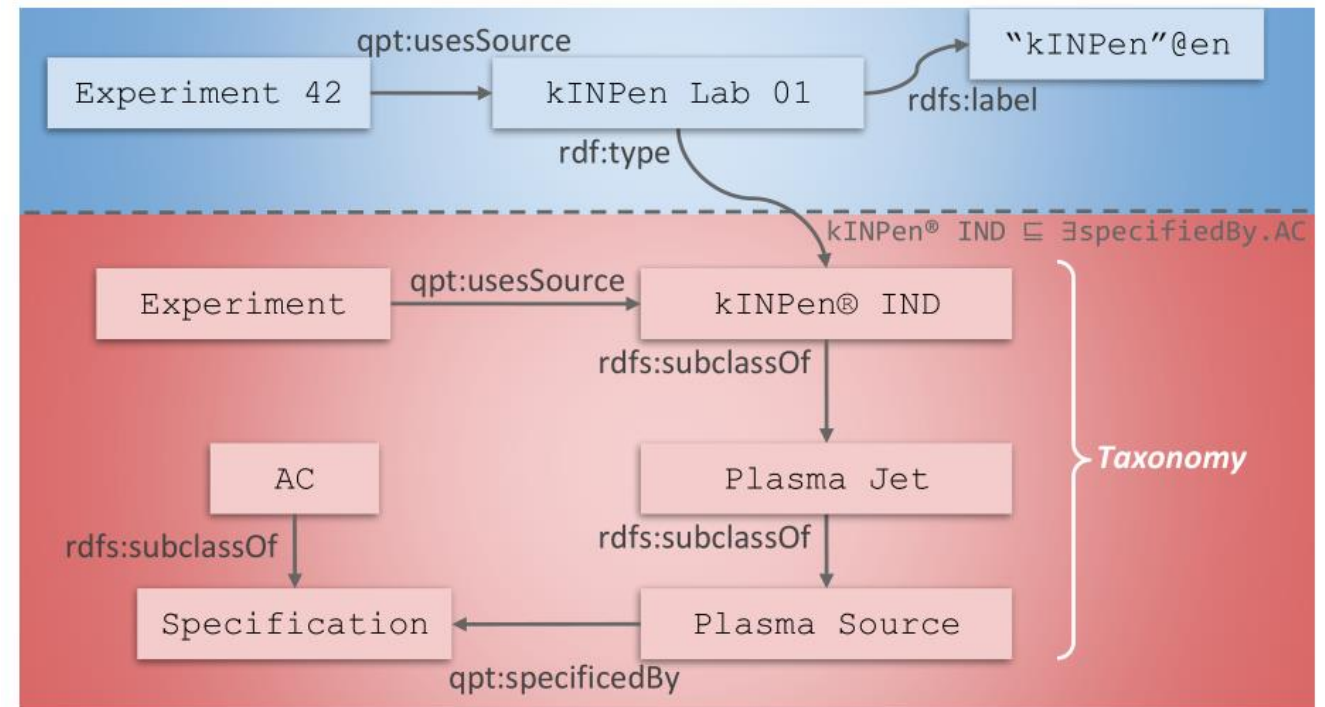
- Use of standards, e.g. RDF, OWL, SPARQL

Interoperable

- Formal and broadly applicable language for knowledge representation
- Ontologies are underspecified → easy to extend, connect to other ontologies

Reusable

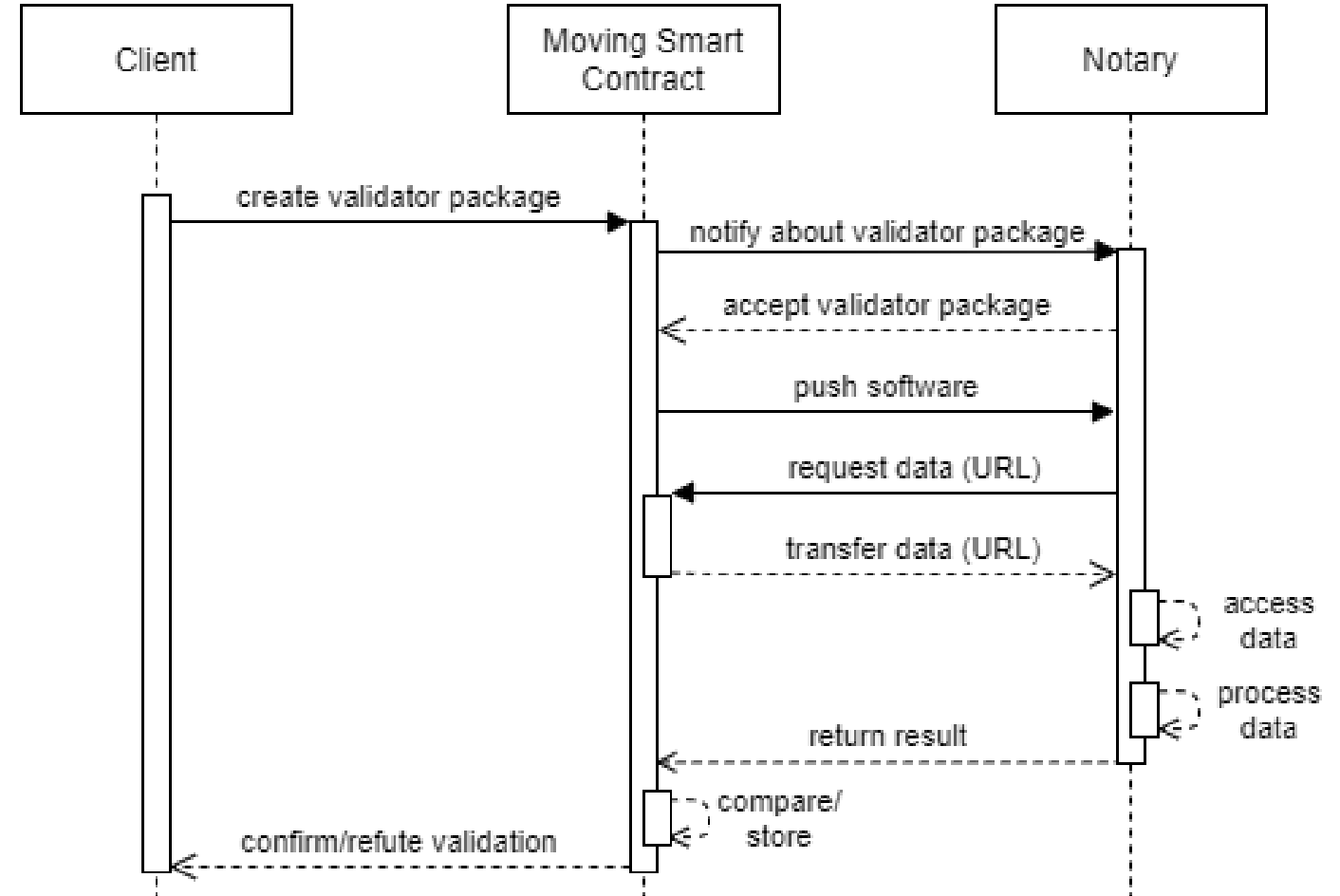
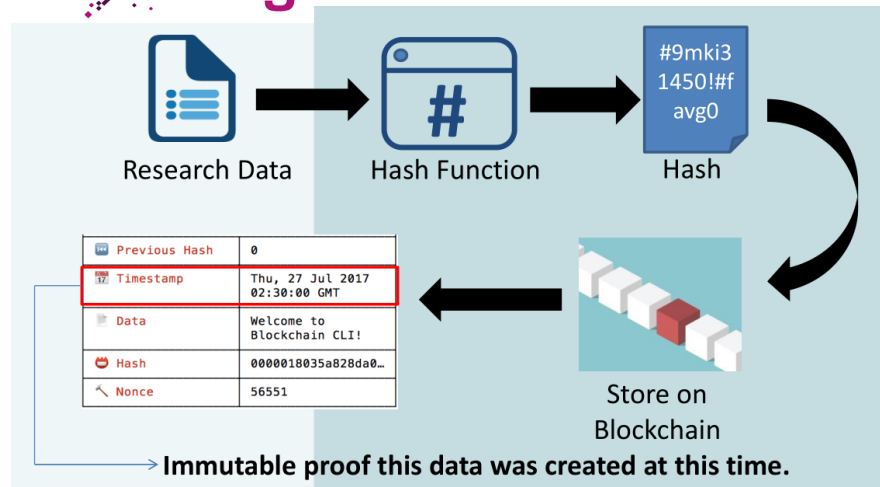
- Documented and curated using community standards



Blockchain for trust in data

- Integrity of a publication record in distributed systems provided by consensus mechanisms of distributed ledger technologies
- Trust into validity and tamper proofness of data during processing

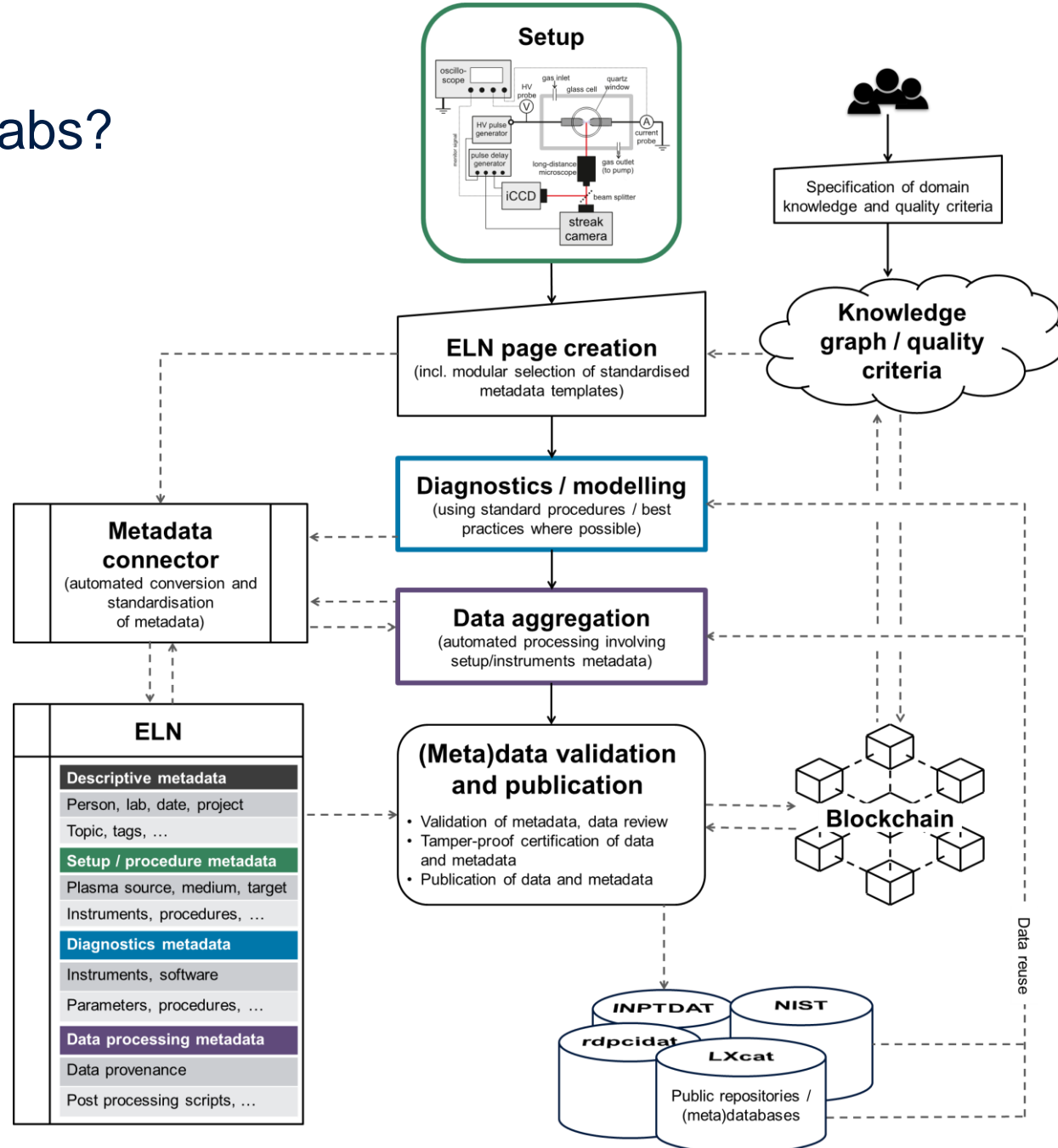
bloXberg



S. Tripathi *et al.* (2022) "Moving smart contracts: a privacy preserving method for off-chain data trust". <http://arxiv.org/abs/2205.08440v2>

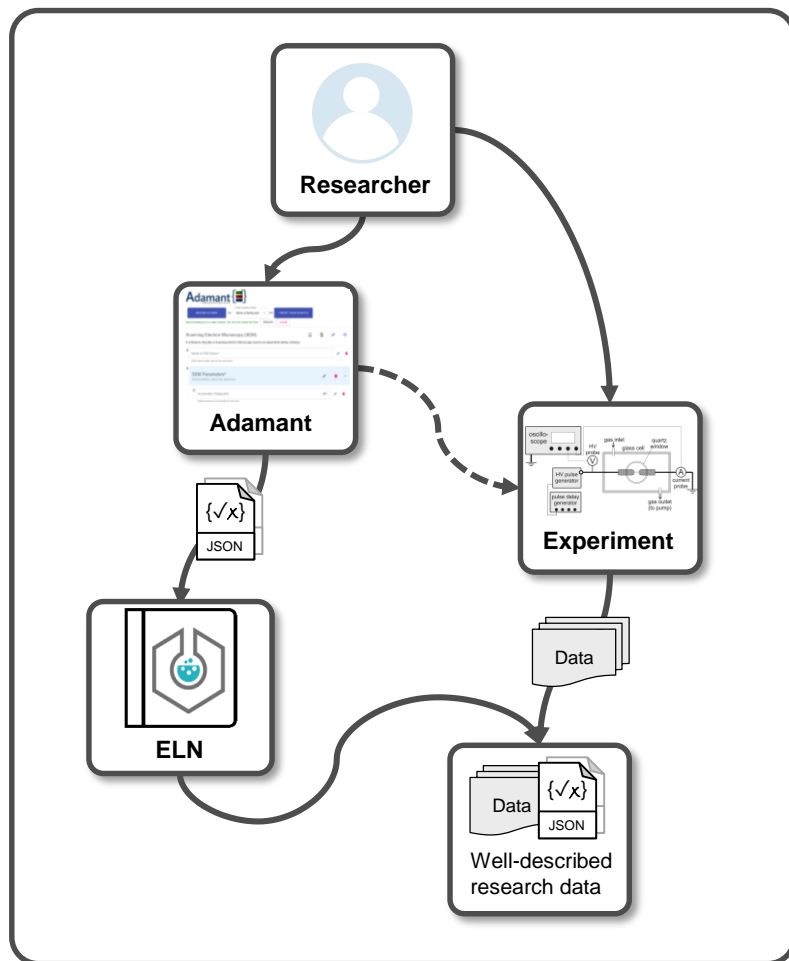
But – how to bring this into the labs?

- Collection of structured and standardized metadata should be part of the **research workflow**.
- Electronic lab notebooks (ELN)** are a proper means to store the metadata.
- Automation** and no duplication of work as far as possible.

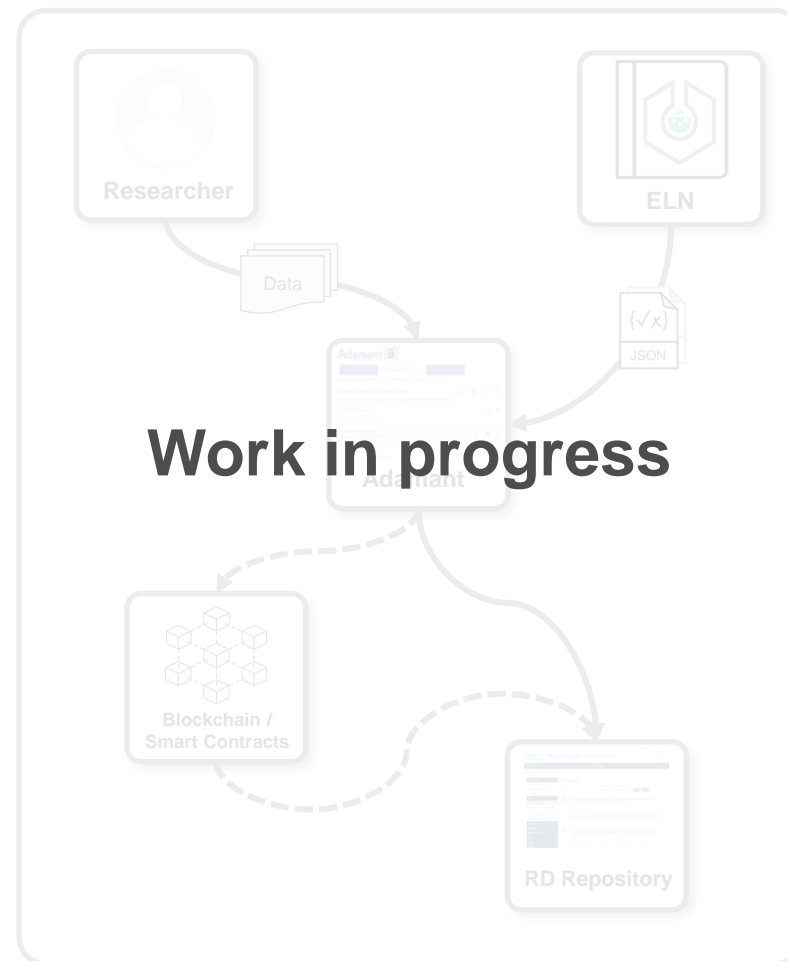


Workflow implementation with Adamant and eLabFTW

Documentation of experiments leading to FAIR data



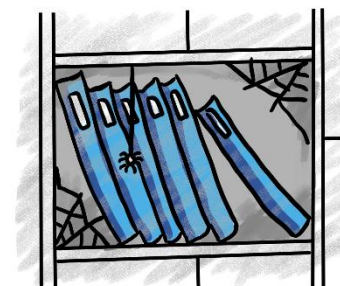
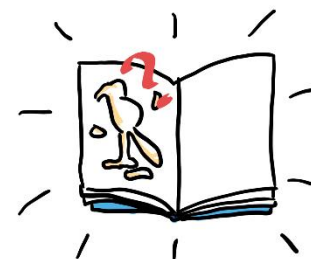
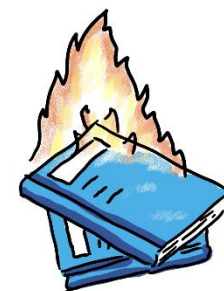
Publication of FAIR-assured dataset with records of ownership



Reasons for the open source ELN system eLabFTW

- It's free (like in freedom)
 - You're not bound to intentions of a company
 - You have full control over all aspects of the service
 - You can tailor the experience to your needs
- It's free (like a free beer)
 - You don't have to pay money for using it
- Flexible, lightweight environment, not only for notebook purposes
 - Experiment templates, easy to create and to tailor
 - Item database
 - Scheduler

And in any case, with some advantages over paper books...



Picture: Nick Plathe

Issues with eLabFTW

- Insecurities concerning eLabFTW being “the” ELN, more suitable ELNs exist, e.g. in the biotech field
- No pre-defined templates, direct use of standardized vocabularies / schemas not supported
- Unstructured content in the experiment description can hardly be re-used for automated processing
- Flat hierarchy of “Extra fields”
- JSON editor with limited accessibility

The screenshot displays the 'Experiments' page in eLabFTW. At the top, there's a navigation bar with 'Back to listing' and 'View mode' links, and a 'Create' button. The main form includes fields for 'Started on' (12.06.2022), 'Status' (Running), 'Title' (Untitled), and 'Tags'. Below these is a rich text editor with sections for 'Goal', 'Procedure', and 'Results'. The 'Extra fields' section contains input fields for 'End date' (09.06.2021), 'Magnification' (20X), 'Pressure (Pa)' (12), and 'Wavelength (nm)' (488, 405, 647). There are also buttons for 'SAVE' and 'SAVE AND GO BACK'. A 'Steps' section with an 'Add a step' button and a 'Linked items' section with an 'Add a link' button are also visible. On the right side, there's a sidebar with an 'Attach a file' section, an 'Attached file' section showing a file named 'JSON-metadata.json', and a 'JSON Editor' section with a tree view of the metadata. At the bottom, there are sections for 'Draw something' and 'Molecule drawer'. The footer shows the user panel and page generation information.

Adamant – a general purpose tool for schema based metadata collection

Adamant { }

A JSON schema form renderer and editor

BROWSE SCHEMA OR Select existing schema demo-schema.json OR CREATE FROM SCRATCH

demo-schema.json is a valid schema. You can now render the form. RENDER CLEAR

Scanning Electron Microscopy (SEM)

A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Model of SEM Device *

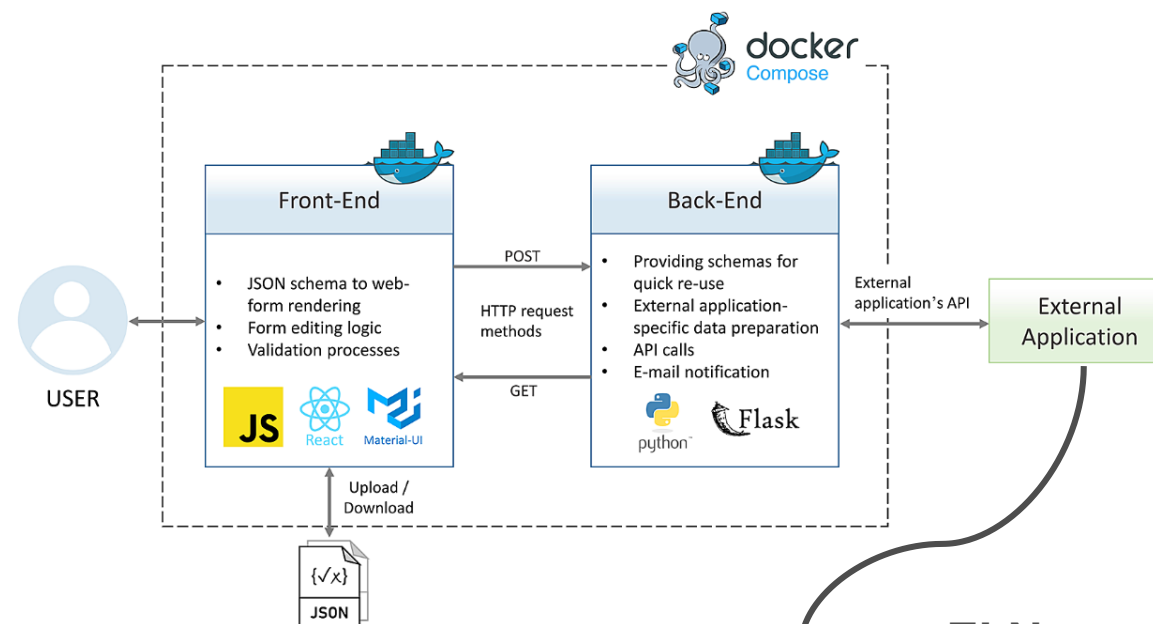
SEM device model used in the experiment

SEM Parameters*

SEM parameters used in the experiment

Acceleration Voltage [kV]

Voltage applied to accelerate the electrons



- User-friendly web tool built on top of JavaScript and Python
- Simplifying the use and creation of metadata schemas
- Human- and machine readable metadata collection
- Incorporating different components to achieve integrated RDM workflows

Experiments

Back to listing

plasma chemistry APP1

Running Team Owner Admin(s)

Started on 2022-05-10

SEM Experiment (Adamant demo)

Scanning Electron Microscopy (SEM)

Model of SEM Device	JEOL JSM-7900F
Acceleration Voltage [kV]	15
Working Distance [mm]	0.7
Probe Current [nA]	850

This template was generated with ADAMANT v1.0.0

Last modified on 2022-05-10 17:35:34

Unique eLabID: 20220510-889e331af0e734e35193ad151e3573f58a62948c

Attached files

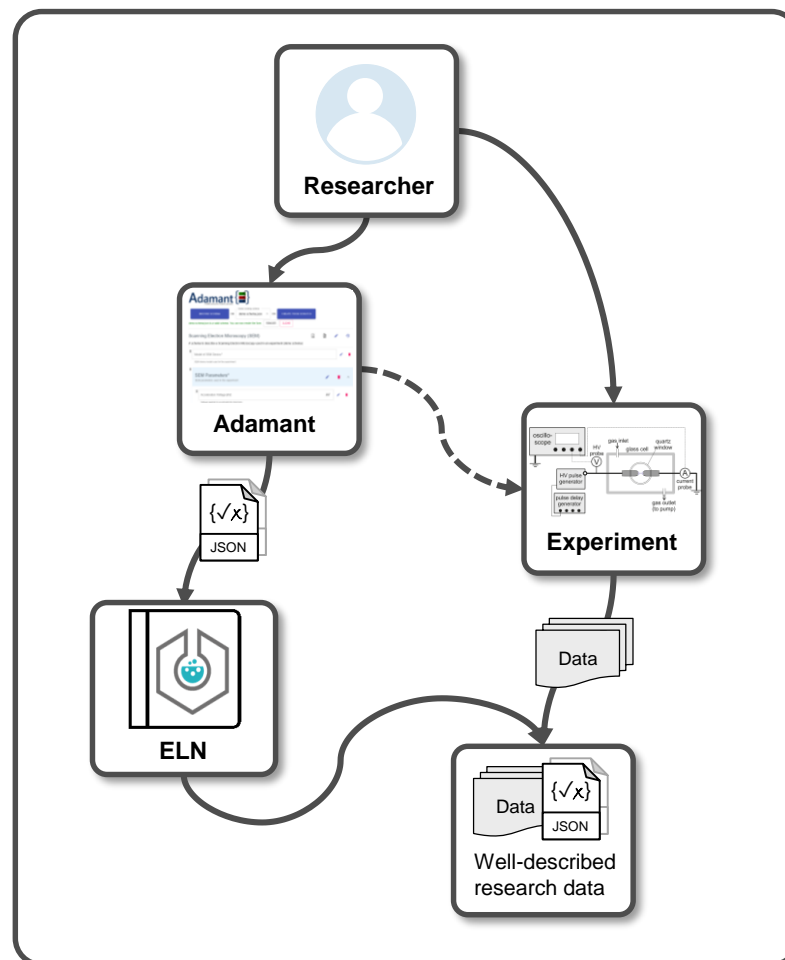
- json_schema.json 1.00 KiB - 2022-05-10 17:35:34 Load into JSON Editor
- json_data.json 124.00 B - 2022-05-10 17:35:34 Load into JSON Editor

I. Chaerony Siffa *et al.* (2022) *F1000Research* 11, 475
<https://doi.org/10.12688/f1000research.110875.1>

Workflows to bring RDM into the labs



Workflow for collection of structured metadata



Workflow for collection of structured metadata

1

Adamant { }

A JSON schema form renderer and editor

BROWSE SCHEMA OR Select existing schema demo-schema.json OR CREATE FROM SCRATCH

demo-schema.json is a valid schema. You can now render the form. RENDER CLEAR

Scanning Electron Microscopy (SEM)

A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Model of SEM Device*

SEM device model used in the experiment

SEM Parameters*

SEM parameters used in the experiment

Acceleration Voltage [kV] kV

Voltage applied to accelerate the electrons

Working Distance [mm] mm

Distance from the lens to the sample/specimen

Probe Current [nA] nA

Electrical current or electron beam focused on the sample/specimen

+ ADD ELEMENT

+ ADD ELEMENT

COMPILE

ADAMANT v1.0.0

- Upload an experiment schema, or select from the list, or create from scratch
- Edit web-form if necessary, then compile

Workflow for collection of structured metadata

1 Adamant

2 Adamant

3 Adamant

4 Adamant

5 Adamant

6 Adamant

7 Adamant

BROWSE SCHEMA

Scanning Electron Microscopy (SEM)

A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Model of SEM Device *

SEM device model used in the experiment

SEM Parameters*

SEM parameters used in the experiment

Acceleration Voltage [kV] *kV*

Voltage applied to accelerate the electrons

Working Distance [mm] *mm*

Distance from the lens to the sample/specimen

Probe Current [nA] *nA*

Electrical current or electron beam focused on the sample/specimen

BACK TO EDIT MODE

DOWNLOAD SCHEMA/DATA

PROCEED

ADAMANT v1.0.0

ADD ELEMENT

COMPILE

ADAMANT v1.0.0

Input experiment metadata

Unique eLabID: 13c05eb1eaa46

GET TAGS

CANCEL CREATE EXPERIMENT

Workflow for collection of structured metadata

1 Adamant { }
A JSON schema form renderer and editor

BROWSE SCHEMA OR Select existing schema demo-schema.json OR CREATE FROM SCHEMA

demo-schema.json is a valid schema. You can now render the form. RENDER CLEAR

2 Scanning Electron Microscopy (SEM)
A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

3 Scanning Electron Microscopy (SEM)
A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Model of SEM Device *

SEM device model used in the experiment

SEM Parameters *

SEM parameters used in the experiment

Acceleration Voltage [kV]
15 kV
Voltage applied to accelerate the electrons

Working Distance [mm]
6.7 mm
Distance from the lens to the sample/specimen

Probe Current [nA]
850 nA
Electrical current or electron beam focused on the sample/specimen

BACK TO EDIT MODE DOWNLOAD SCHEMA/DATA PROCEED

ADAMANT v1.0.0

4 Adamant { }
A JSON schema form renderer and editor

BROWSE SCHEMA OR Select existing schema demo-schema.json OR CREATE FROM SCHEMA

demo-schema.json is a valid schema. You can now render the form. RENDER CLEAR

5 Scanning Electron Microscopy (SEM)
A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

6 Scanning Electron Microscopy (SEM)
A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

7 Scanning Electron Microscopy (SEM)
A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Unique eLabID: 734e35193ad151e3573f58e62948c

CANCEL CREATE EXPERIMENT

- Proceed to review before submission
- Given inputs are validated against the schema

Workflow for collection of structured metadata

1 Adamant { }
A JSON schema form renderer and editor

BROWSE SCHEMA OR Select existing schema demo-schema.json OR CREATE FROM SCRATCH

demo-schema.json is a valid schema. You can now render the form. RENDER CLEAR

Scanning Electron Microscopy (SEM)
A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Model of SEM Device*
SEM device model used in the experiment

SEM Parameters*
SEM parameters used in the experiment

Acceleration Voltage [kV]
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Voltage applied to accelerate the electrons

Working Distance [mm]
6.7 mm
Distance from the lens to the sample/specimen

Probe Current [nA]
850 nA
Electrical current or electron beam focused on the sample/specimen

BACK TO EDIT MODE DOWNLOAD SCHEMA/DATA PROCEED

ADAMANT v1.0.0

- Visual notification for fields with invalid inputs
- Correct the discrepancy
- Optionally, JSON schema and data can be downloaded
- Proceed again

Workflow for collection of structured metadata

Adamant { }
A JSON schema form renderer and editor

BROWSE SCHEMA OR Select existing schema demo-schema.json OR CREATE FROM SCRATCH

demo-schema.json is a valid schema. You can now render the form. RENDER CLEAR

Scanning Electron Microscopy (SEM)

A schema to describe a Scanning Electron Microscopy used in an experiment (demo schema)

Model of SEM Device*
JEOL JSM-7900F
SEM device model used in the experiment

SEM Parameters*
SEM parameters used in the experiment

Acceleration Voltage [kV]
15 kV
Voltage applied to accelerate the electrons

Working Distance [mm]
6.7 mm
Distance from the lens to the sample/specimen

Probe Current [nA]
850 nA
Electrical current or electron beam focused on the sample/specimen

BACK TO EDIT MODE DOWNLOAD SCHEMA/DATA PROCEED

ADAMANT v1.0.0

- Visual notification for fields with invalid inputs
- Correct the discrepancy
- Optionally, JSON schema and data can be downloaded
- Proceed again

Workflow for collection of structured metadata

1 Adamant { }

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+ ADD ELEMENT

+ ADD ELEMENT

COMPILE

ADAMANT v1.0.0

5 Form review and submission

Please review your filled form before submitting.

Scanning Electron Microscopy (SEM)

Model of SEM Device JEOL JSM-7900F

SEM Parameters

Acceleration Voltage [kV] 15

Working Distance [mm] 6.7

Probe Current [nA] 850

This template was generated with [ADAMANT v1.0.0](#)

CANCEL SUBMIT

• Review the filled form then submit

GET TAGS

CREATE EXPERIMENT

Workflow for collection of structured metadata

1

2

3

4

5

6

7

Adamant { }

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Electrical current or electron beam focused on the sample/specimen

ADD ELEMENT

ADD ELEMENT

COMPILE

ADAMANT v1.0.0

- Provide necessary information required by the ELN system, and create the experiment

✕

Create eLabFTW Experiment

eLabFTW

Your eLabFTW main URL *

https://pm-labbook.intranet.inp-greifswald.de/

Your eLabFTW token *

358854901b5feb4f4a2f2a3994a8787c194e323627fef51d13c05eb1eaa46

Experiment title

SEM Experiment (Adamant demo)

Tags

plasma chemistry × APPJ ×

GET TAGS

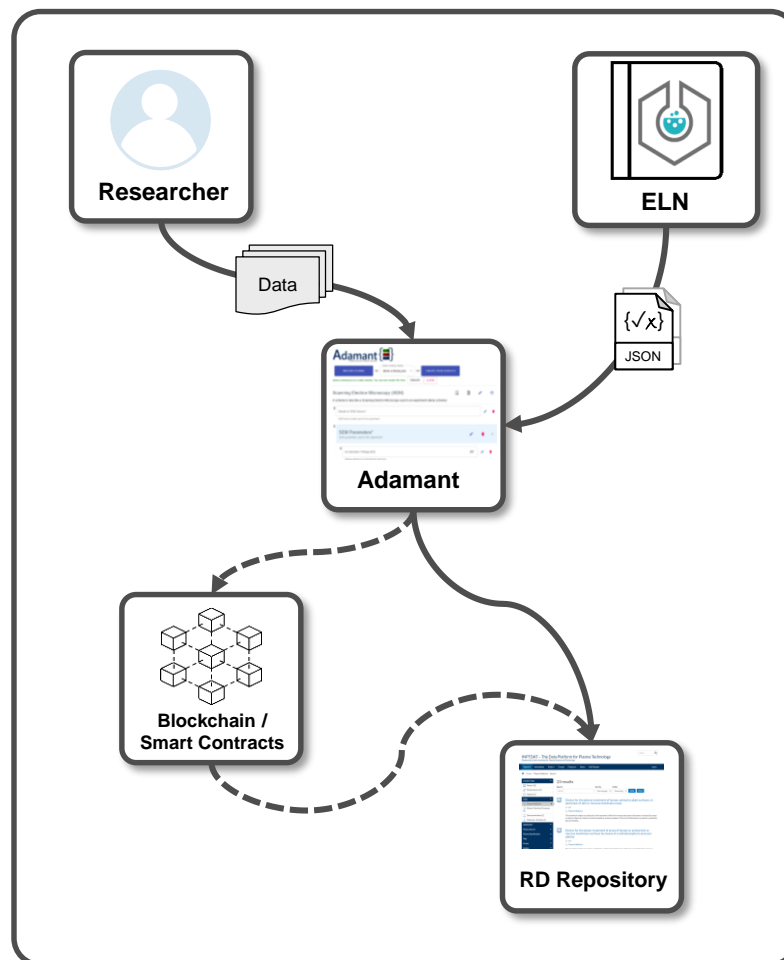
Press the "GET TAGS" button to retrieve available tags from your eLabFTW system. Note: you have to provide the eLabFTW main URL and token to enable the button.

CANCEL
CREATE EXPERIMENT

Workflow for collection of structured metadata

- Experiment metadata in the ELN system
- JSON Schema and JSON data (experiment metadata) are attached to the experiment

Workflow for publication of FAIR-assured dataset with records of ownership

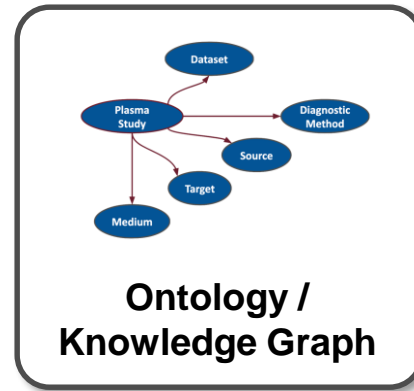


Next step: ontology integration

Ontology and knowledge graph for standardized and *assisted* experiment design, and quick re-use of existing metadata




+



=

- ✓ Standardized experiment documentation
- ✓ Community approved
- ✓ Modular schemas
- ✓ Interconnected
- ✓ Reuse of existing documentation
- ✓ Suggestions on experiment design

Concept for ontology integration



A JSON schema form renderer and editor

BROWSE SCHEMA

OR

Select existing schema

OR

CREATE FROM SCRATCH

pak-schema.json is a valid schema. You can now render the form.

RENDER

CLEAR

Extended Plasma-MDS for PAK

No description available

Plasma Source

Plasma Target

Target Name

Corn seeds

Name of the target name the plasma source is acting on either directly or mediated by the above named medium. Examples: Si wafer, distilled water, Escherichia coli.

Target Properties

Properties of the target. Format is open. Example: silicon wafer: 100 mm diameter, prime grade, orientation 100.

Target Procedure

Standard procedure to prepare the target (pre-treatment). Format is open. Example: E. coli prepared on glass substrate according to internal procedure XY.

ADD ELEMENT

ADD ELEMENT

COMPILE

ADAMANT v1.0.0


Because you have "Plasma Source" and "Plasma Target".
Suggested field elements: Source and Plasma Target.
Click to read more

- + Diagnostics ?
- + Amount of seeds ?
- + Used seed accession(s) ?


 Loading more suggestions
 Please wait

Existing metadata ☐ ✕

Concept for ontology integration



A JSON schema form renderer and editor

BROWSE SCHEMA

OR

Select existing schema

OR





CREATE FROM SCRATCH

pak-schema.json is a valid schema. You can now render the form.

RENDER

CLEAR

Extended Plasma-MDS for PAK

No description available

Plasma Source

Device which creates the plasma by (partially) ionizing a given medium.

Source Name

kINPen-49

Name and/or type of the plasma source used in the study. Examples: kINPen, COST Jet, CCP.

Source Properties

Source Procedure

+ ADD ELEMENT

Plasma Target

+ ADD ELEMENT

ADAMANT v1.0.0

COMPILE

Suggested field elements

We found several existing metadata based on your input

kINPen-495AD

?

Use this metadata

kINPen-496GCE

?

kINPen-49C

?

Ongoing community effort for ontology development

- Regular community metadata meetings
- Collection of schemas and ELN templates using GitHub
- Markdown tables** for definition of metadata requirements
- Automated generation of **schemas and templates** using GitHub actions

Key	Title	Description	Type	Required	Default value
name	Name	Name of the plasma source device	string	true	
dissipatedPower	Power [W]	Power dissipated in the plasma	number	false	
reflectedPower	Reflected power [%]	Part of the input power which is reflected and not coupled to the electrode	number	false	
ppVoltage	Voltage (p-p) [V]	Peak-to-peak voltage	number	true	

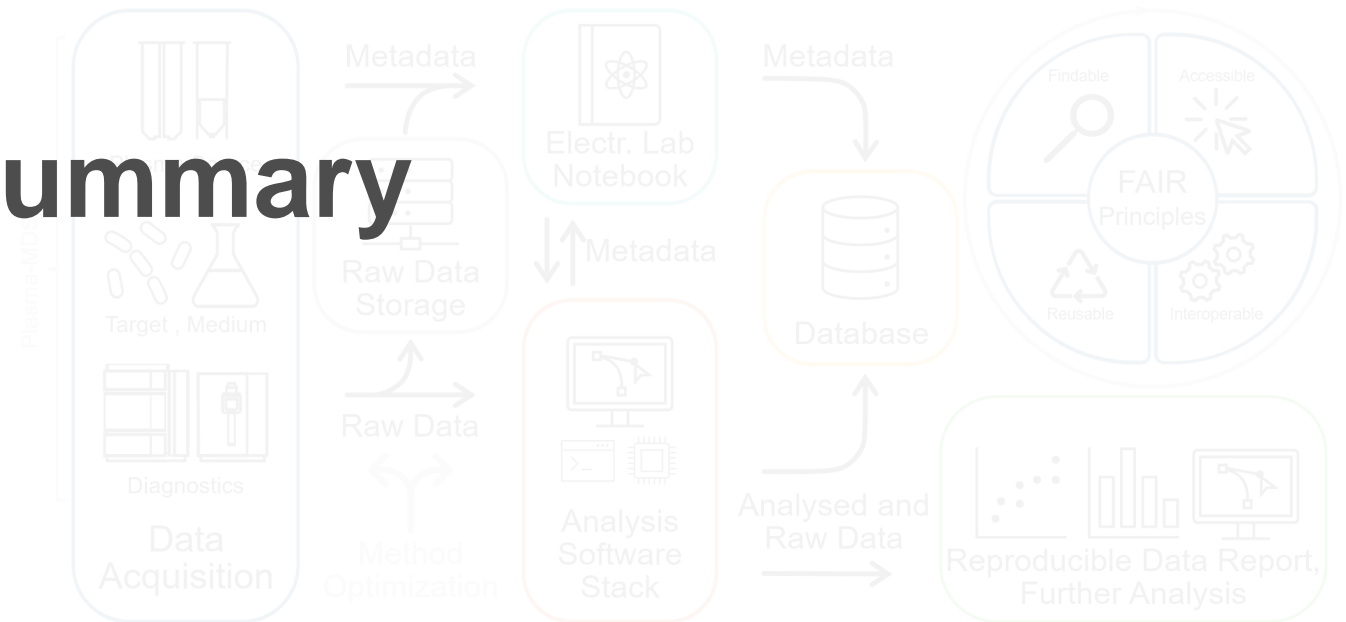
github-actions ... on 18 Jan

..

- device-elab-descriptionlist.tpl 3 months ago
- device-json-schema.json 3 months ago
- device.md 3 months ago
- experiment-elab-descriptionlist.tpl 3 months ago
- experiment-json-schema.json 3 months ago
- experiment.md 3 months ago

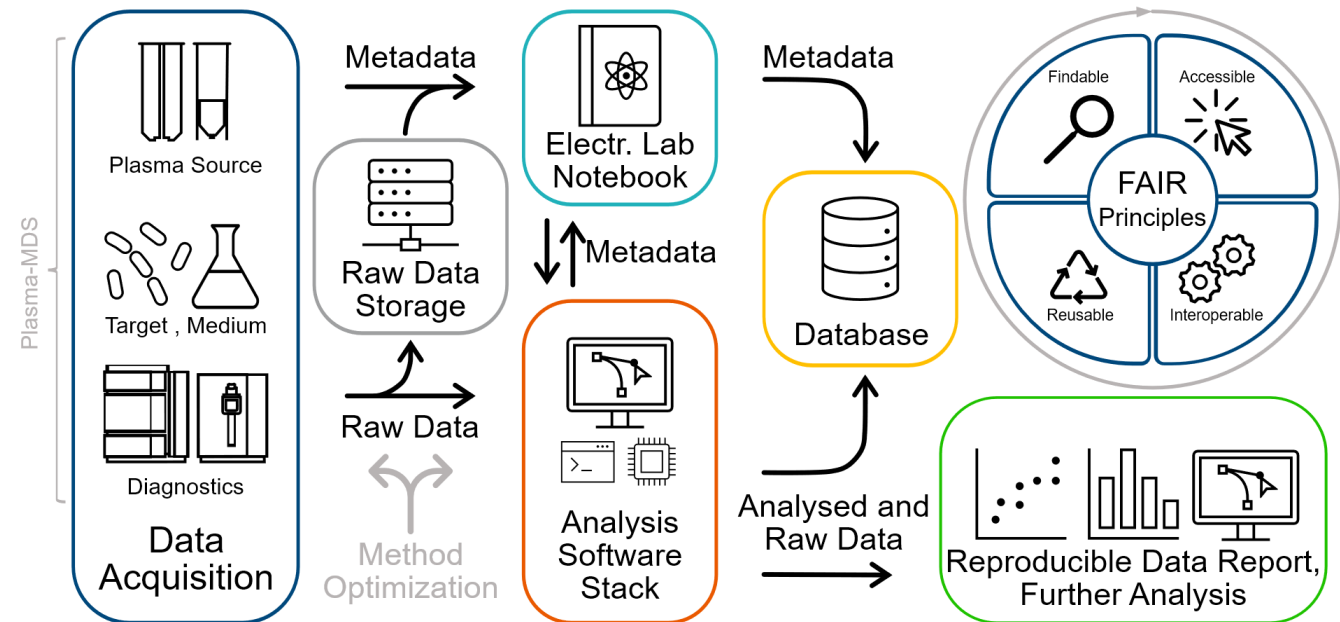
- User-friendly tools and integrated RDM workflows are required to enable adoption of the FAIR data principles.
- Structured domain-specific metadata facilitate re-use of data and metadata.
- RDM tools and services (ELN, data repository, ontologies, blockchain, ...) can be connected through intuitive user interfaces like Adamant
- Programmatic data processing and analysis remains an issue

Summary



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- User-friendly tools and integrated RDM workflows are required to enable adoption of the FAIR data principles.
- Structured domain-specific metadata facilitate re-use of data and metadata.
- RDM tools and services (ELN, data repository, ontologies, blockchain, ...) can be connected through intuitive user interfaces like Adamant.
- Programmatic data processing and analysis remains an issue.



N. Plathe *et al.* (2021) "Methods and tools for data-driven science in applied plasma physics".
<https://doi.org/10.5281/zenodo.5579012>

Acknowledgment

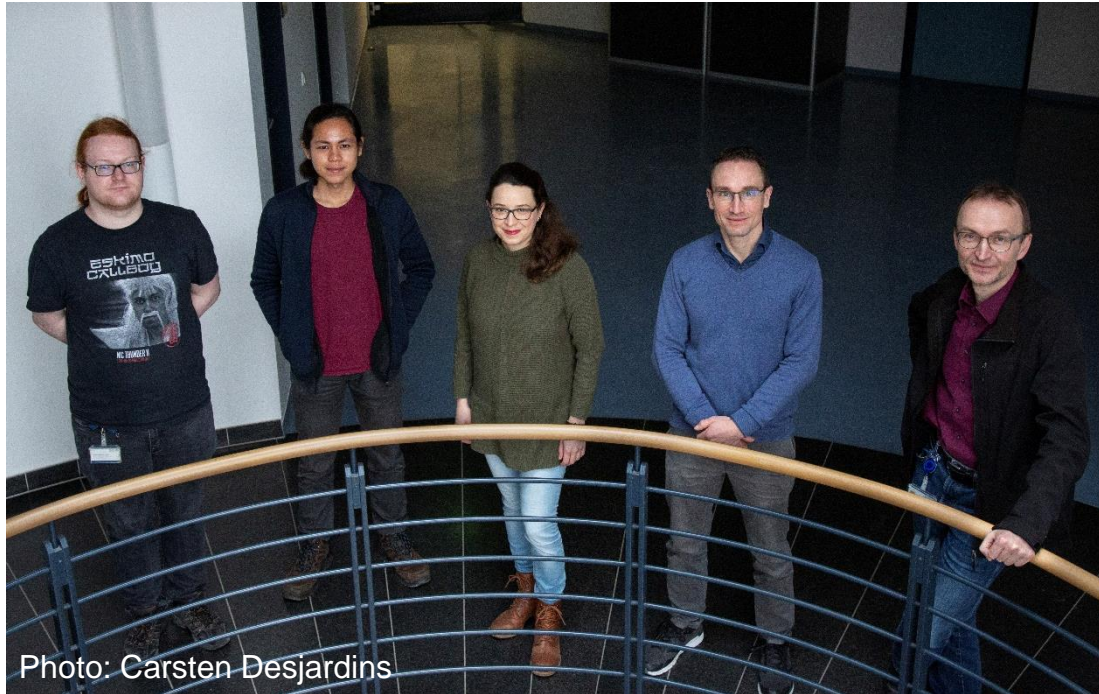


Photo: Carsten Desjardins

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and Research

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