

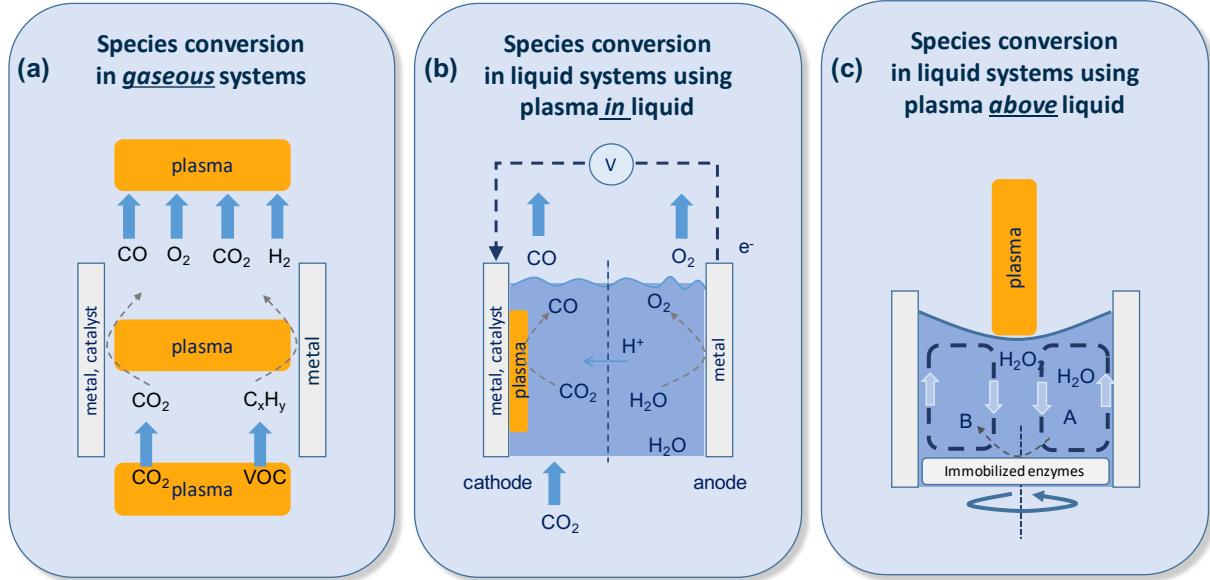
# Research data management for plasma physics, a user example

Achim von Keudell, Marina Prenzel

DPG Roundtable

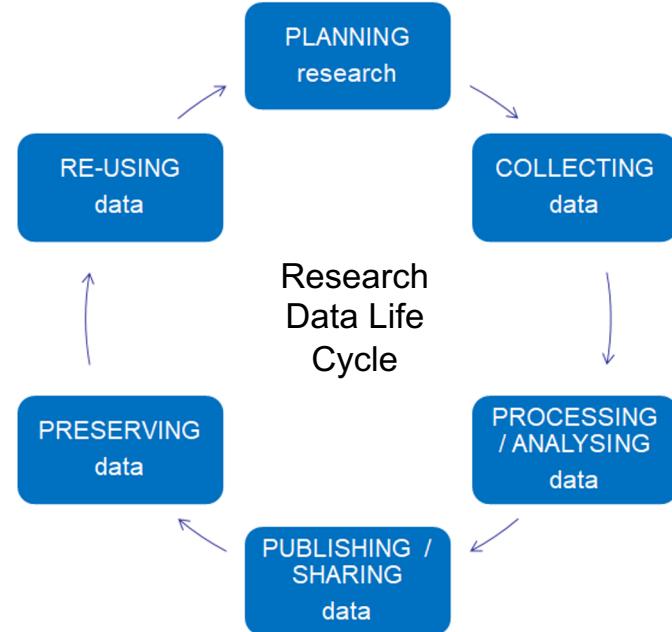
# Research data management @ Bochum

- Starting point was RDM activities in the CRC 1316
- Cooperation LOI with INP Greifswald in 2018



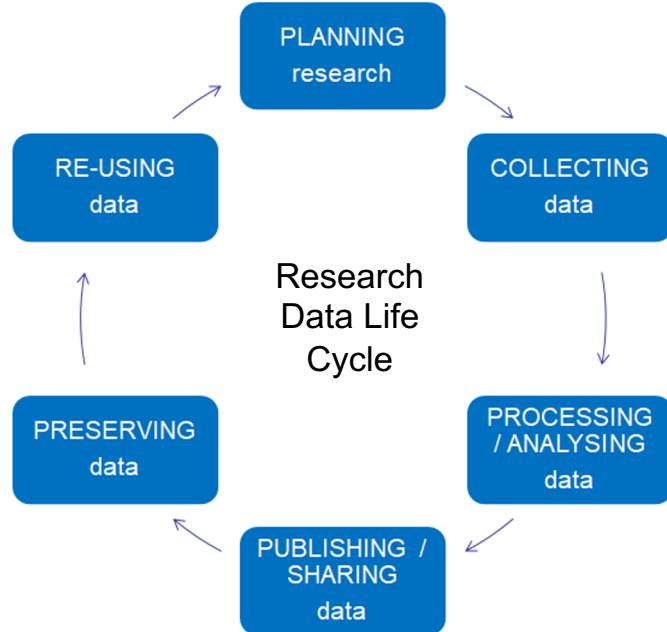
# Motivation for RDM

- Transparency and reproducibility of research
- Validation of research results
- Visibility, scientific recognition and reputation
- External requirements (e.g. publishers, funders)
  
- General goal: make data and metadata
  - **Findable**
  - **Accessible**
  - **Interoperable**
  - **Reusable**
  
- => *Enable full research data life-cycle by following the FAIR data principles*



# Research data management, what is it?

- The goal is to provide “curated” data to the scientific community for re-use
- This allows for
  - easy comparison of data
  - data mining approaches
  - assures quality standards via metadata formats
- These comparisons make sense, if
  - Same experiment/study object
  - Same diagnostic



# Research data management, what is it? - an example

- Various **comparable discharges** exist
  - COST-Jet
  - kINPen
  - GEC cell
  - PKE
  - Industry equipment
- Collecting **comparable data sets** for re-use



This concept does already exist for decades in other communities (nuclear fusion, astronomy, particle physics...)

# Research data management, what is it? - an example

- Data mining becomes possible



## Plasma Technology: An Emerging Technology for Energy Storage

Annemie Bogaerts<sup>✉</sup> and Erik C. Neyts<sup>✉</sup>

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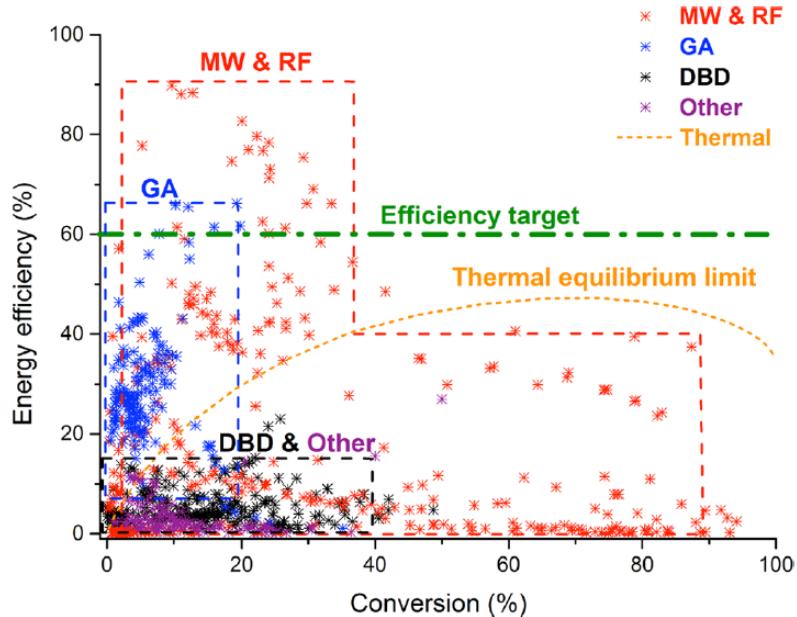
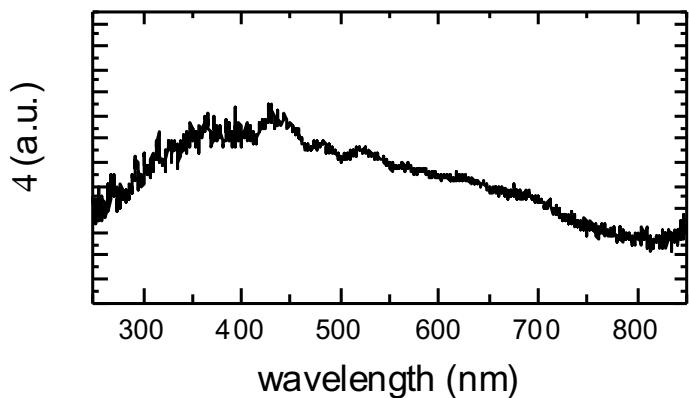


Figure 2. Comparison of all data collected from the literature for  $\text{CO}_2$  splitting in the different plasma types, showing the energy efficiency as a function of conversion. The thermal equilibrium limit and the 60% efficiency target are also indicated. Adopted from ref 2 with kind permission; published by The Royal Society of Chemistry.

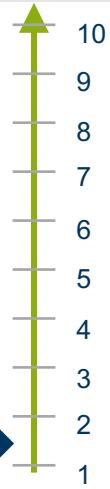
# Research data management, what is it? – how to get there?

- Bachelor student uses a given set-up and generates a set of data (OES)
- Storage of the original data on a **private laptop**
- **No documentation**, no metadata



Advisor has no access to data, no information about calibration etc.  
Chance of data re-use: 0%

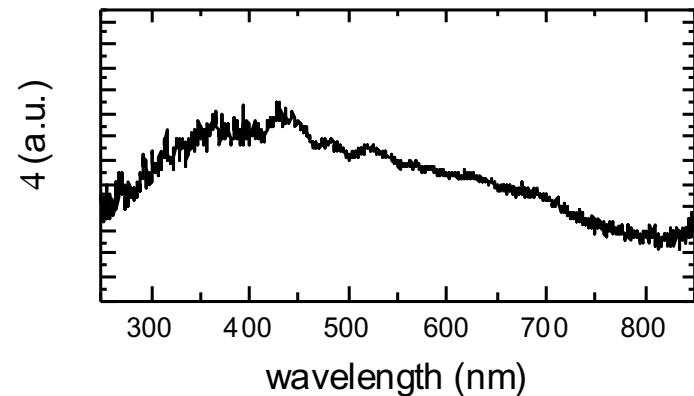
full access and complete documentation



no access and no documentation

# Research data management, what is it? – how to get there?

- Bachelor student uses a given set-up and generates a set of data (OES)
- Storage of the original data on a computer in the cloud and **publication of data and metadata in a public repository**
- Entry in lab book + electronic information on setup, calibration, diagnostics etc. using metadata standard



Community has easy access to data, complete metadata, easy to reconstruct, calibrated  
Chance of data re-use: 100%

full access and complete documentation



no access and no documentation

# Research data management, what is it? – how to get there?

## Local environment

Electronic labbook pro/contra  
Local storage solutions

The screenshot shows a web-based electronic labbook interface. At the top, there's a navigation bar with tabs for 'eLabPTW', 'EXPERIMENTS' (which is active), 'DATABASE', 'TEAM', 'SEARCH', and 'DOCUMENTATION'. Below the navigation is a yellow status bar with the message: 'Please note: this demo is running version 4.0.0-BETA, report any bug you might find!' A red 'Close' button is at the end of the status bar. Below this is a teal header bar with the text 'Experiment was timestamped by Demo User on 2021-05-11 at 17:24:13' and a small download icon. A blue 'Create' button is on the right. The main content area is titled 'Experiments' and shows a single experiment entry. The entry includes a thumbnail image of a test tube labeled 'Test PL test45', a success rating of 5 stars, and a team member listed as 'Owner + Admin(s)'. It also shows the start date 'Started on 2021.05.31'. A prominent message below the entry says 'Mathjax for equations  $K = \frac{[Hg^{2+}][Hg]}{[Hg_2^{2+}]}$  printing to pdf WORKS NOW!' with a green checkmark icon. There are several dropdown menus for 'Type', 'Origin', and 'Features' which are currently empty. At the bottom of the entry, there's a note about using TeX commands for mathematical formulas.



## Repositories

Connected to journal articles

The screenshot shows the homepage of the RUB Research Data Repository. The top navigation bar includes 'RUHR UNIVERSITÄT BOCHUM', the logo 'RUB', and the page title 'Research Data Repository'. Below the navigation is a search bar with a magnifying glass icon. The main content area has a dark blue background with a central image of a plasma discharge. The text 'Research Data' is displayed above the image, followed by a subtitle: 'The research data repository of the RUB Research Department Plasmas with Complex Interactions provides access to the data associated with the scientific publications of the PIs.' Below the image are six circular icons representing different research areas: 'Plasma Science Fundamentals', 'Plasma in Astrophysics', 'Plasma Modeling and Simulation', 'Plasma Chemical Processes', 'Plasma in Liquids', and 'Plasma Medicine'. Each icon has a small descriptive text label underneath it.

# Research data repositories at INP and RUB

**INPTDAT** (<https://www.inptdat.de>) | **RDPCI** (<https://rdpcidat.rub.de>)

Sharing and re-use of research data in the field of plasma technology | Domain specific metadata (Plasma-MDS) | DataCite compatibility | DOI integration

**DKAN** (<https://getdkan.org>)

Open Data Platform | Datastore API | Harvesting | Open Data Schema Mapper | Visualizations | Workflows

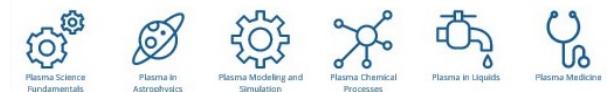
**Drupal** (<https://www.drupal.org>)

Content management | General framework | Interface | Roles and permissions | Static content | User management

**INPTDAT** – The Data Platform for Plasma Technology  
Powered by Leibniz Institute for Plasma Science and Technology



RUB  
UNIVERSITÄT  
BOCHUM    **RUB** Research Data Repository  
Research Department Plasmas with Complex Interactions



# Research data repository at RUB

search

Datasets Data Stories Plasmas Topics Groups Projects Info Log in

/ Home / PIC/MCC simulation / COST-jet / Dataset / Search

**Plasma Source** ▾  
COST-jet   
**Plasma Application** ▾  
**Plasma Diagnostic** ▾  
**PIC/MCC simulation**   
PROES (2)  
TDLAS (1)  
**Plasma Specification** ▾  
Tags ▾  
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Authors ▾  
Resource Quantity ▾  
Resource Filetype ▾  
Funding Agency ▾  
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**3 results**

Sort by Order

Search  Date changed

Experimental and computational investigations of electron dynamics in micro atmospheric pressure radio-frequency plasma jets operated in He/N<sub>2</sub> mixture   
 Plasma Science Fundamentals  
The electron power absorption dynamics in radio frequency driven micro atmospheric pressure capacitive plasma jets are studied based on experimental phase resolved optical emission spectroscopy (PROES) and computational (PIC/MCC) simulations. The...

Control of electron dynamics, radical and metastable species generation in atmospheric pressure RF plasma jets by Voltage Waveform Tailoring   
 Plasma Science Fundamentals  
Atmospheric pressure capacitively coupled radio frequency discharges operated in He/N<sub>2</sub> mixtures and driven by tailored voltage waveforms are investigated experimentally using a COST microplosma reference jet and by means of kinetic simulations as...

Helium metastable species generation in atmospheric pressure RF plasma jets driven by tailored voltage waveforms in mixtures of He and N<sub>2</sub>   
 Plasma Science Fundamentals  
Spatially resolved tunable diode-laser absorption measurements of the absolute densities of He-I (23S1) metastables in a micro atmospheric pressure plasma jet operated in He/N<sub>2</sub> and driven by 'peaks-' and 'valleys'-type tailored voltage waveforms...

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**Plasma Source** ▾  
COST-jet   
**Plasma Application** ▾  
**Plasma Diagnostic** ▾  
**PIC/MCC simulation**   
PROES (2)  
TDLAS (1)  
**Plasma Specification** ▾  
**Tags** ▾  
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**Authors** ▾  
**Resource Quantity** ▾  
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**APPT**  
The group "Allgemeine Elektrotechnik und Plasmatechnik" at the faculty for engineering and information science.

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The information on this page (the dataset metadata) is also available in these formats.  
 via the DIKAN API

Field	Value
Publisher	APPT
Authors	L. Bischoff G. Hübner I. Korolov Z. Donko P. Hartmann - -
Show more	
Release Date	2020-09-30
Identifier	e8c69f1b-9224-4475-919f-d6bda667882e
Permanent Identifier (URI)	<a href="https://rdpcidat.rub.de/node/181">https://rdpcidat.rub.de/node/181</a>
Is supplementing	<a href="https://doi.org/10.1088/1361-6595/aaf35d">https://doi.org/10.1088/1361-6595/aaf35d</a>
Plasma Source Name	COST-jet
Plasma Source Application	Diagnostics
Plasma Source AC	

Experimental and computational investigations of electron dynamics in micro atmospheric pressure radio-frequency plasma jets operated in He/N<sub>2</sub> mixture

Plasma Science Fundamentals

The electron power absorption dynamics in radio frequency driven micro atmospheric pressure capacitive plasma jets are studied based on experimental phase resolved optical emission spectroscopy (PROES) and computational (PIC/MCC) simulations. The jet is operated at 13.56 MHz in He with different admixture concentrations of N<sub>2</sub> and at several driving voltage amplitudes. We find the spatiotemporal dynamics of the light emission of the plasma at various wavelengths to be markedly different. This is understood by revealing the population dynamics of the upper levels of selected emission lines/bands based on comparisons between experimental and simulation results. The populations of these excited states are sensitive to different parts of the electron energy distribution function and to contributions from other excited states. Mode transitions of the electron power absorption dynamics from the Ω- to the Penning-mode are found to be induced by changing the N<sub>2</sub> admixture concentration and the driving voltage amplitude. Our numerical simulations reveal details of this mode transition and provide novel insights into the operation details of the Penning-mode. The characteristic excitation/emission maximum at the time of maximum sheath voltage at each electrode is found to be based on two mechanisms: (i) a direct channel, i.e. excitation/emission caused by electrons generated by Penning ionization inside the sheaths and (ii) an indirect channel, i.e. secondary electrons emitted from the electrode due to the impact of positive ions generated by Penning ionization at the electrodes.

electron dynamics micro atmospheric pressure radio-frequency plasma jet

**Dataset Info**

# Research data management, current status

- Nobody knows exactly what RDM is
- All funding institutions insist or will insist on proper RDM rules
- RDM for local bookkeeping vs. RDM to provide open data to the scientific community

## Current counterarguments

“It is almost impossible to sort the data acquired in the past”

“My industry partners do not allow me to release the data”

“Scientist of country XXX will steal my data”

“The DFG might want this now, but that may pass”

“Why should I work on this, if my collaboration partner not doing anything”

“Each journal has now the possibilities or sometimes the obligation to upload the original data”

“I am only putting some effort in this, if I get funding sum XXX”

“I have a wonderful freeware tool to digitize points out of a PDF document, I do not need RDMs”

“I am only putting some effort in this, if I get funding sum XXX”

# Research data management, the next steps

- Create awareness for the topic, educate the ECR in that field
- Identify Partners at other institutions  
(Univ. Kiel, Univ. Greifswald .... , Fraunhofer, Leibniz-Institutes etc.)  
to motivate to setup their own repositories  
At the end they will all be linked
- Collect the demands of the community !
- Use the plasma.mds standard <https://www.plasma-mds.org>  
(see presentation M. Becker)
- Develop metadata standards for specific diagnostics
  - emission spectroscopy
  - mass spectrometry
  - probes
  - ....

This is a long term endeavor and the community is only at the very beginning