Adamant: A JSON-Based Metadata Editor for Researchers

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Leibniz Gemeinschaft

FROM IDEA TO PROTOTYPE

Outline

- **Basics**
  - FAIR data principles
  - Metadata
  - JSON Schema
  - Electronic lab. notebook (eLabFTW)
- **Adamant**
  - Architecture
  - Main features
- **Live Demo**
  - Setting up Adamant
  - RDM workflows with Adamant
  - Other workflows
- **Outlook**

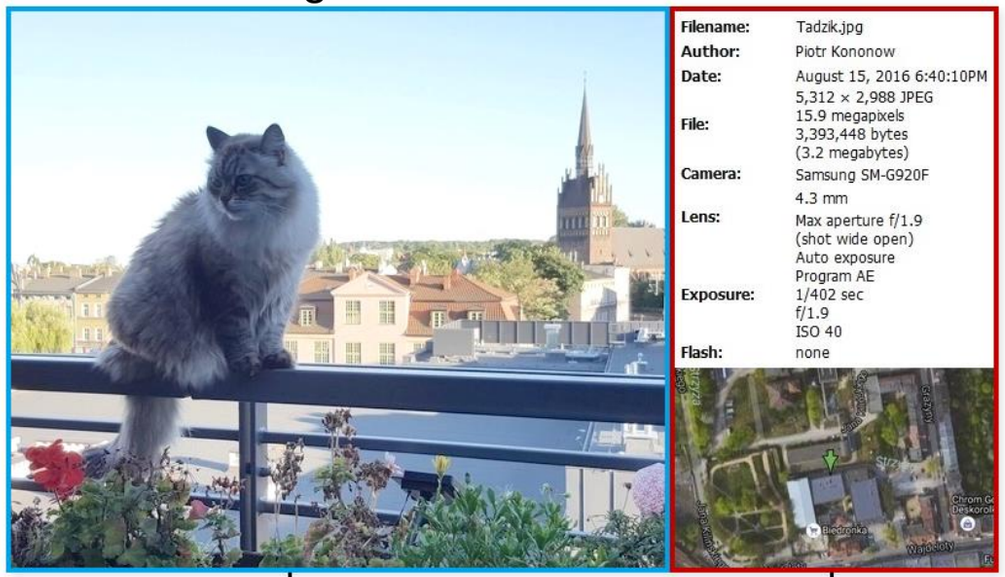
Basics
FAIR data principles

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

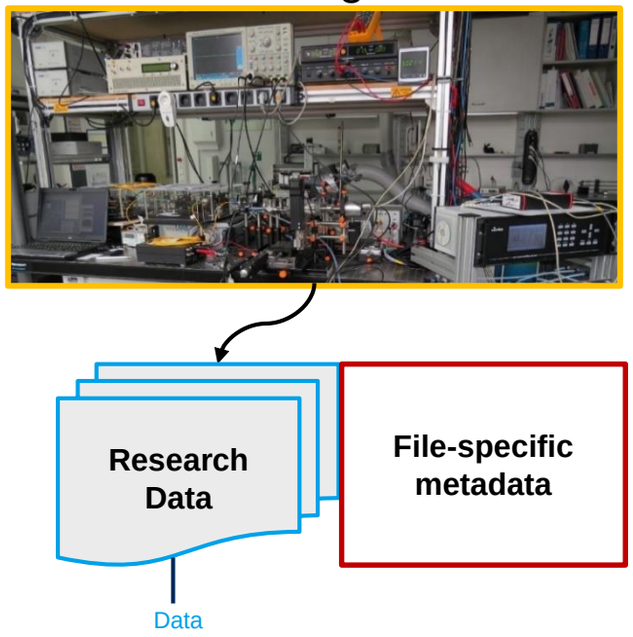
Findable	**A**ccessible	**I**nteroperable	**R**eusable
▪ Identifiable data items ▪ Persistent ▪ Searchable	▪ Retrievable by standardized communication protocols ▪ Authentication where necessary ▪ Access to metadata, even if data is not accessible	▪ Formal, accessible representation of data ▪ Qualified references to other items	▪ Rich and standard-compliant metadata ▪ Proper licensing ▪ Provenance

Basics
What is metadata?

General setting



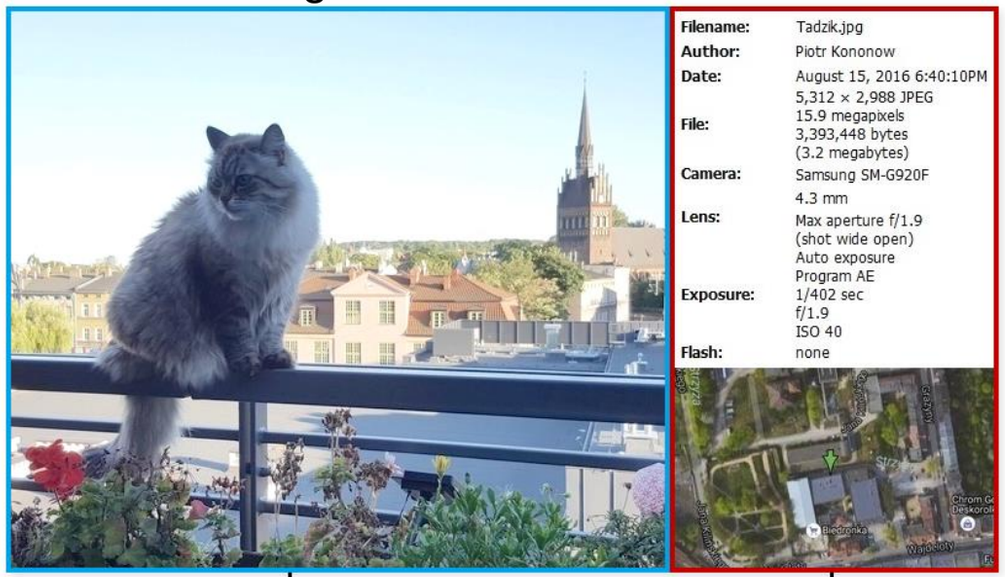
Research setting



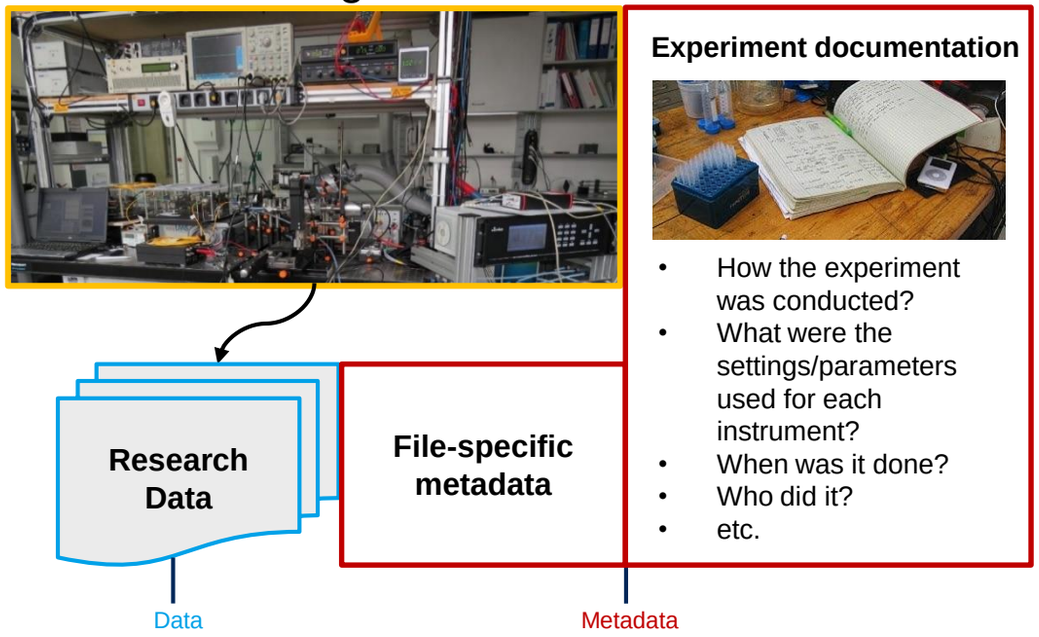
https://dataedo.com/kb/data-glossary/what-is-metadata

Basics
What is metadata?

General setting



Research setting



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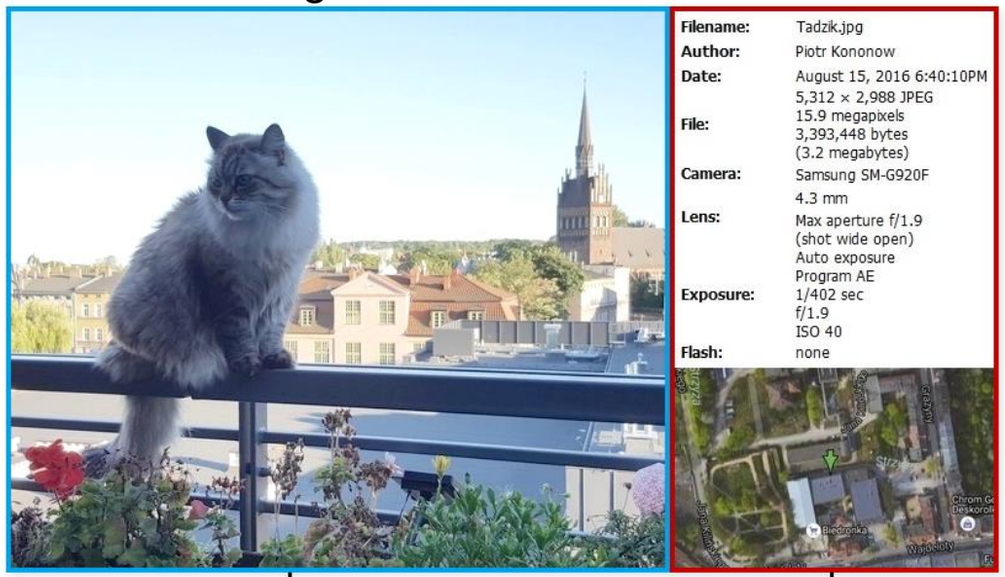
Basics
What is metadata?

General setting



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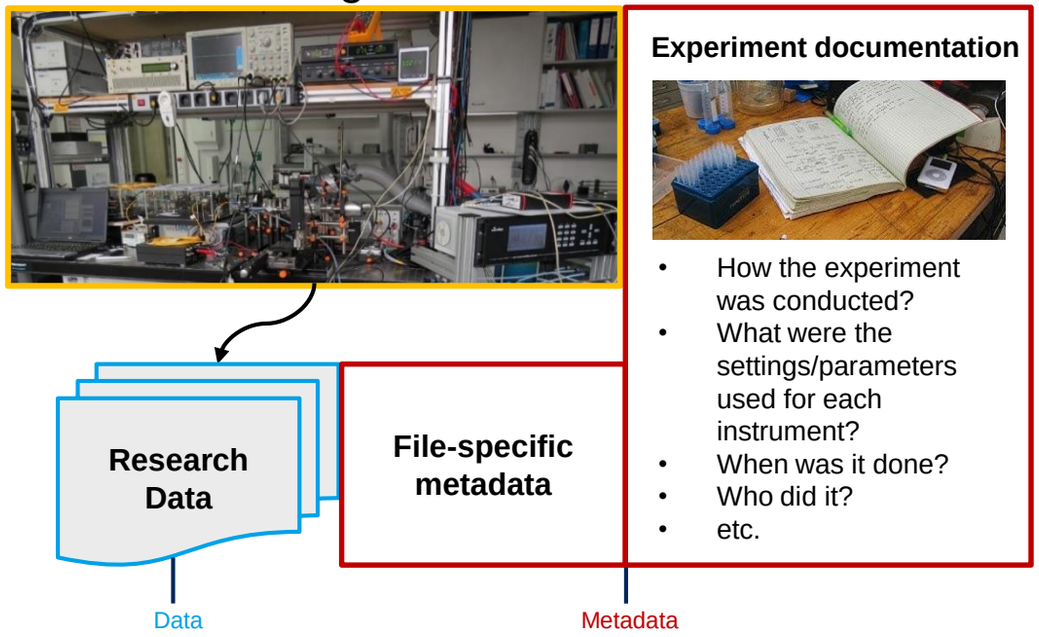


Metadata is simply data about data!

https://dataedo.com/kb/data-glossary/what-is-metadata

Basics
JSON Schema

- From the main site:

  *“**JSON Schema** is a declarative language that allows you to **annotate** and **validate** JSON documents.” – https://json-schema.org/*

Basics
JSON Schema – examples and validation

```
{
  "type": "string",
  "minLength": 2,
  "maxLength": 3
}
```

"A" ✗

"AB" ✓

"ABC" ✓

"ABCD" ✗

```
{ "type": "number" }
```

42 ✓

-1 ✓

Simple floating point number:

5.0 ✓

Exponential notation also works:

2.99792458e8 ✓

Numbers as strings are rejected:

"42" ✗

```
{
  "type": "object",
  "properties": {
    "number": { "type": "number" },
    "street_name": { "type": "string" },
    "street_type": { "enum": ["Street", "Avenue", "Boulevard"] }
  }
}
```

```
{ "number": 1600, "street_name": "Pennsylvania", "street_type": "Avenue" }
```
✓

If we provide the number in the wrong type, it is invalid:

```
{ "number": "1600", "street_name": "Pennsylvania", "street_type": "Avenue" }
```
✗

By default, leaving out properties is valid. See Required Properties.

```
{ "number": 1600, "street_name": "Pennsylvania" }
```
✓

By extension, even an empty object is valid:

```
{ }
```
✓

By default, providing additional properties is valid:

```
{ "number": 1600, "street_name": "Pennsylvania", "street_type": "Avenue", "direction": "NW" }
```
✓

JS package implementing JSON Schema validation:

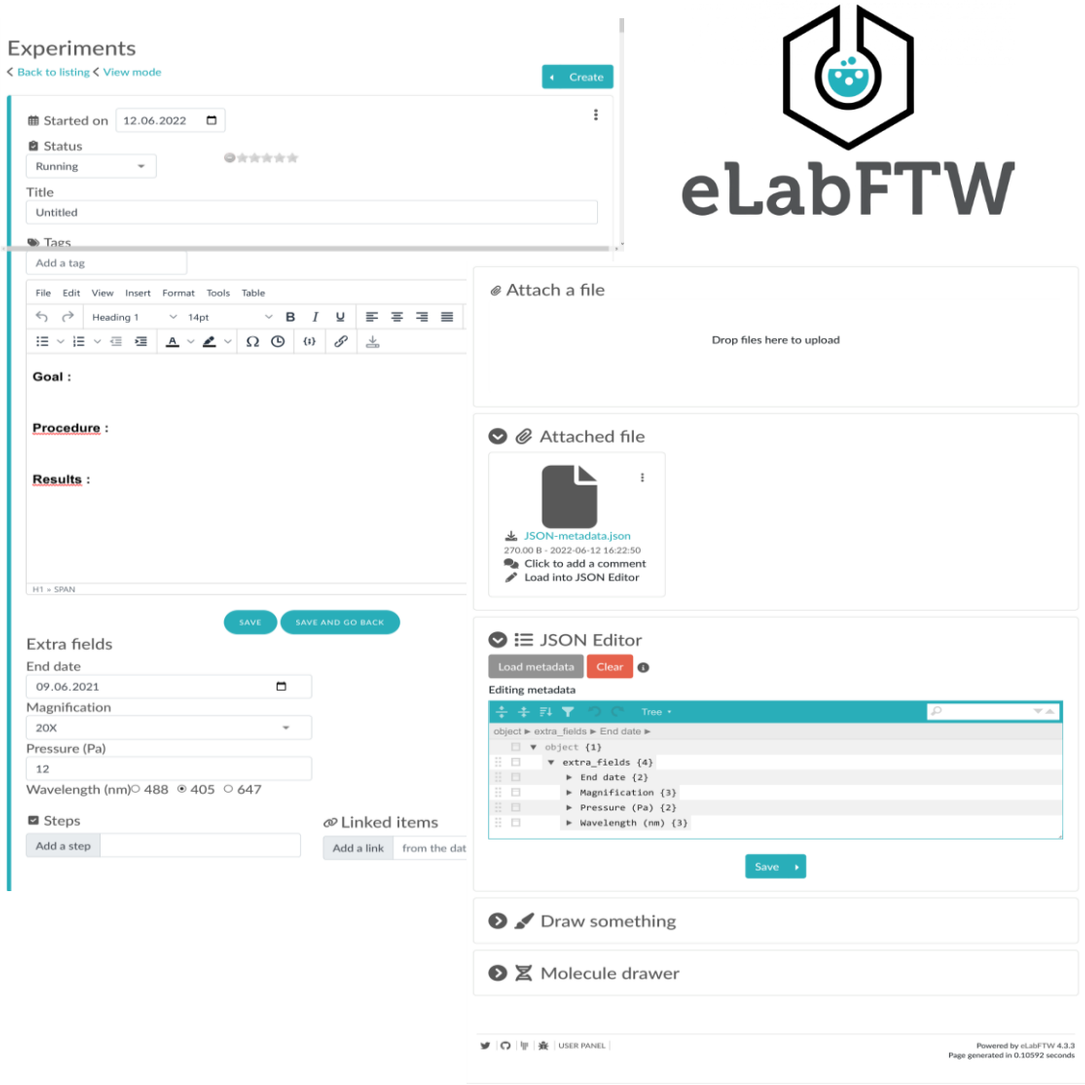
Ajv JSON schema validator

https://json-schema.org, https://ajv.js.org/

Basics

Electronic lab. notebook – ElabFTW: an open-source general purpose ELN

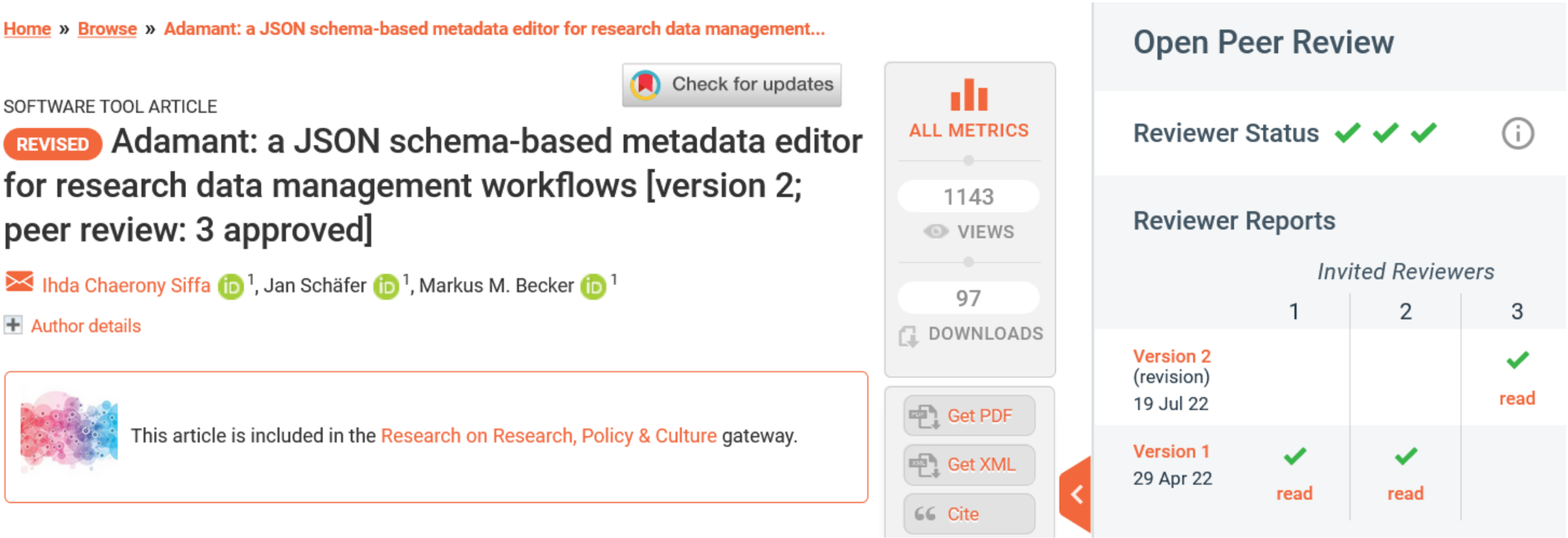
- **It's free and open source**
- **You can self-host it**
- **Flexible and generic, not only for notebook purposes**
  - Experiment templates, easy to create and to tailor
  - Item database
  - Scheduler
  - And many other features



CARPi et al, (2017), eLabFTW: An open source laboratory notebook for research labs, Journal of Open Source Software, 2(12), 146,

Adamant

Technical paper (open peer review)



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Check for updates

SOFTWARE TOOL ARTICLE

REVISED **Adamant: a JSON schema-based metadata editor for research data management workflows [version 2; peer review: 3 approved]**

Ihda Chaerony Siffa [1], Jan Schäfer [1], Markus M. Becker [1]

Author details

This article is included in the Research on Research, Policy & Culture gateway.

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	1	2	3
Version 2 (revision) 19 Jul 22			✓ read
Version 1 29 Apr 22	✓ read	✓ read	

GitHub repository: https://github.com/plasma-mds/adamant

Live playground: https://plasma-mds.github.io/adamant/

Chaerony Siffa I, Schäfer J and Becker MM. Adamant: a JSON schema-based metadata editor for research data management workflows [version 2; peer review: 3 approved]. *F1000Research* 2022, **11**:475

Adamant
Architecture

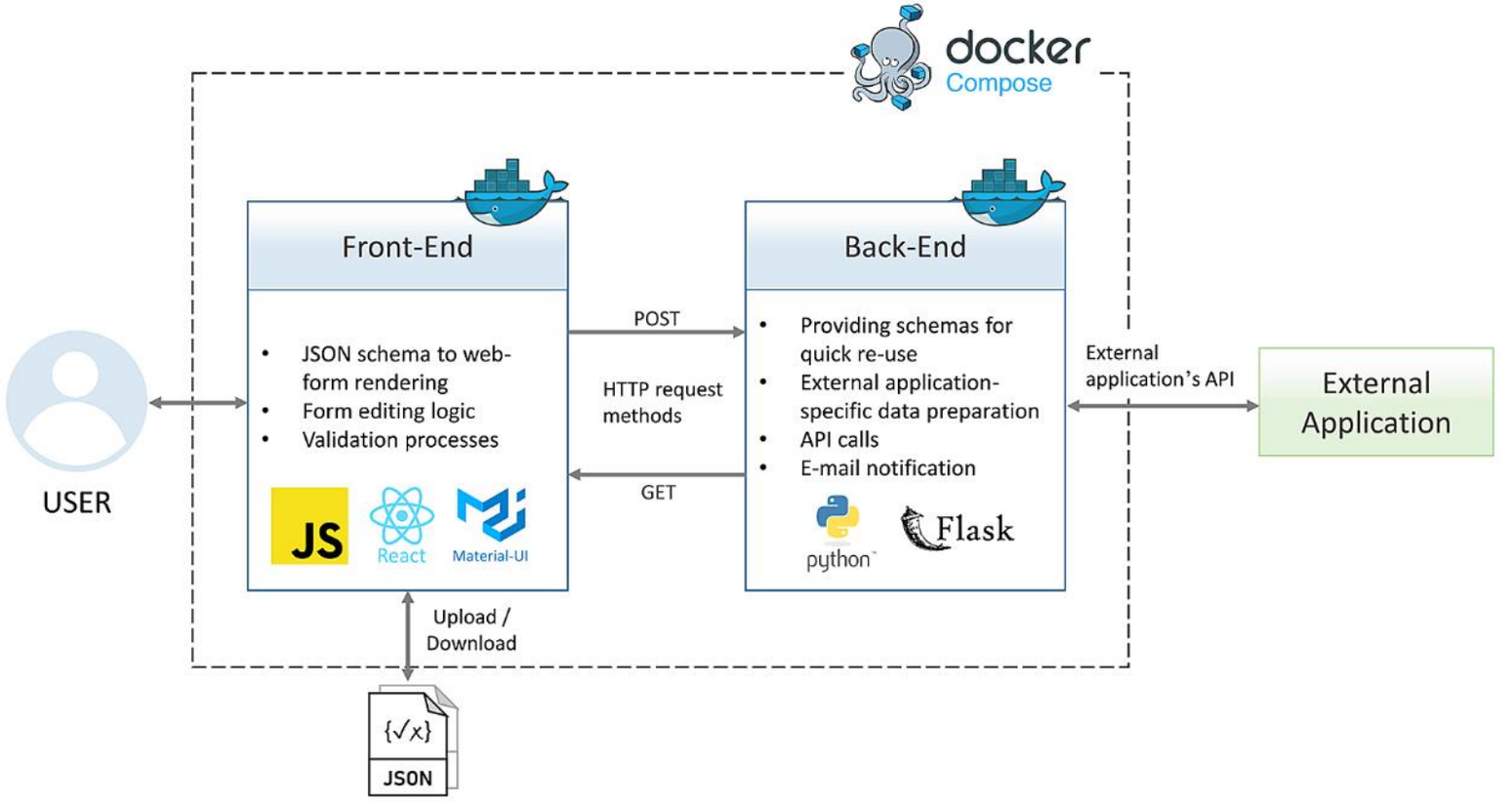


Figure 1. Overview of Adamant's software architecture. API, Application Programming Interface; JSON, JavaScript Object Notation; HTTP, Hypertext Transfer Protocol.

Adamant

Main features – rendering of editable user-friendly web-form

Input: JSON Schema file

```
{
    "$schema": "http://json-schema.org/draft-04/schema#",
    "id": "http://scanning-electron-microscopy",
    "title": "Scanning Electron Microscopy (SEM)",
    "description": "A schema to describe a Scanning Electron Microscopy used in an
        experiment (demo schema)",
    "type": "object",
    "required":["DeviceModel","SEMParameters"],
    "properties": {
        "DeviceModel":{
            "title": "Model of SEM Device",
            "description": "SEM device model used in the experiment",
            "type":"string"
        },
        "SEMParameters":{
            "title": "SEM Parameters",
            "description": "SEM parameters used in the experiment",
            "type":"object",
            "properties": {
                "AccelerationVoltage":{
                    "title": "Acceleration Voltage [kV]",
                    "description": "Voltage applied to accelerate the electrons",
                    "type": "number"
                },
                "WorkingDistance":{
                    "title": "Working Distance [mm]",
                    "description": "Distance from the lens to the sample/specimen",
                    "type": "number"
                },
                "ProbeCurrent":{
                    "title": "Probe Current [nA]",
                    "description": "Electrical current or electron beam focused on the
                        sample/specimen",
                    "type": "number"
                }
            }
        }
    }
}
```

Listing 1. Example of a draft-4 JSON schema containing typical schema-specific keywords presented in blue with their values presented in black, and field element keywords presented in red. JSON, JavaScript Object Notation.

Output: rendered editable web-form

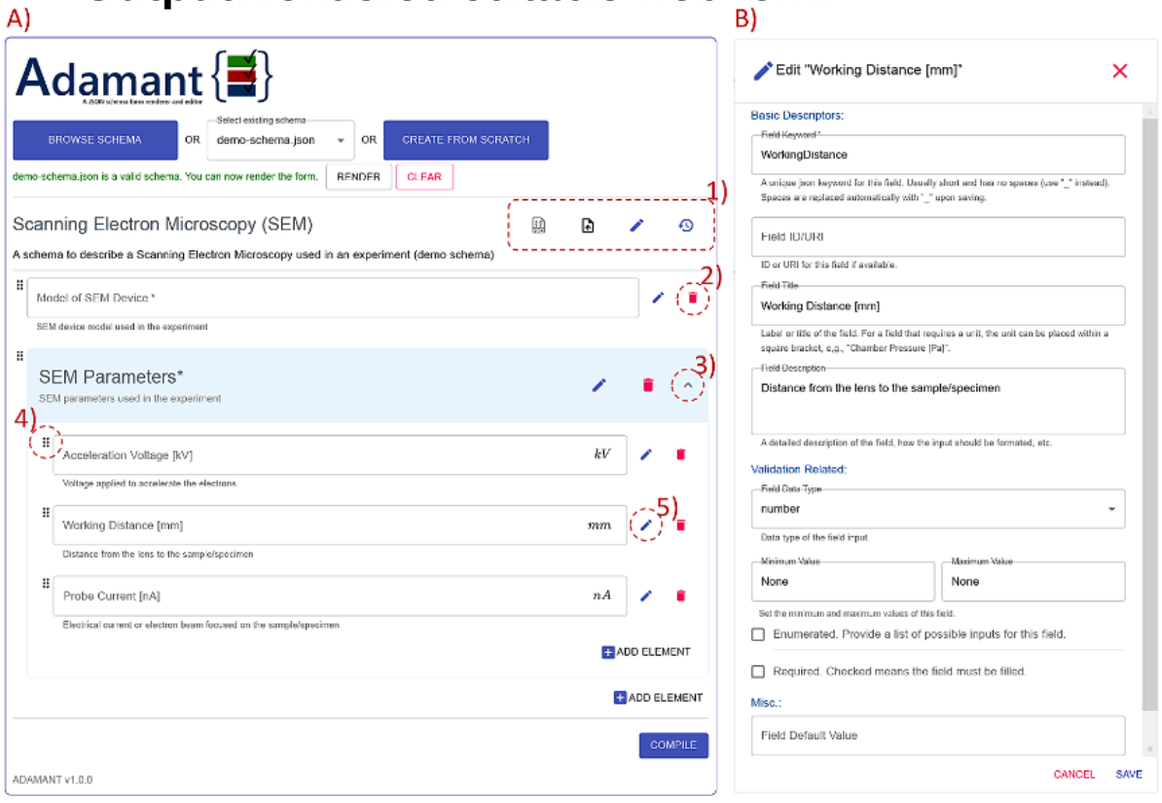


Figure 3. Overview of the Adamant UI with a rendered web-form based on the schema in Listing 1 as an example. (A) Main corpus of the UI; (1) from left to right: JSON schema viewer, auto-populate form, edit schema description, revert all changes; (2) remove form field; (3) collapse or expand the field container; (4) field drag handle; (5) edit field description and (B) field editing panel (as a pop-up on top of the main UI) triggered by clicking (5) the edit button. UI, user interface; JSON, JavaScript Object Notation.

Adamant

Main features – rendering of editable user-friendly web-form

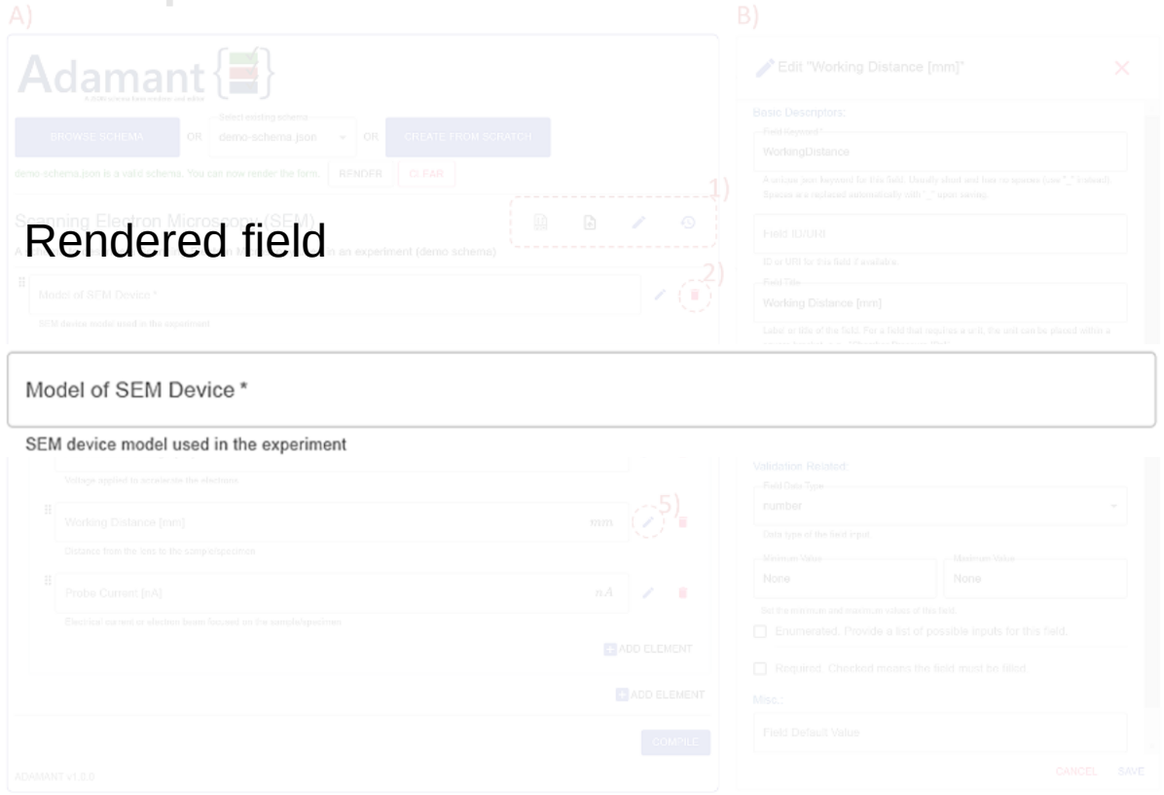
Input: JSON Schema file

Form field specification in the schema

```
"DeviceModel":{
    "title": "Model of SEM Device",
    "description": "SEM device model used in the experiment",
    "type":"string"
},
```

Output: rendered editable web-form

Rendered field



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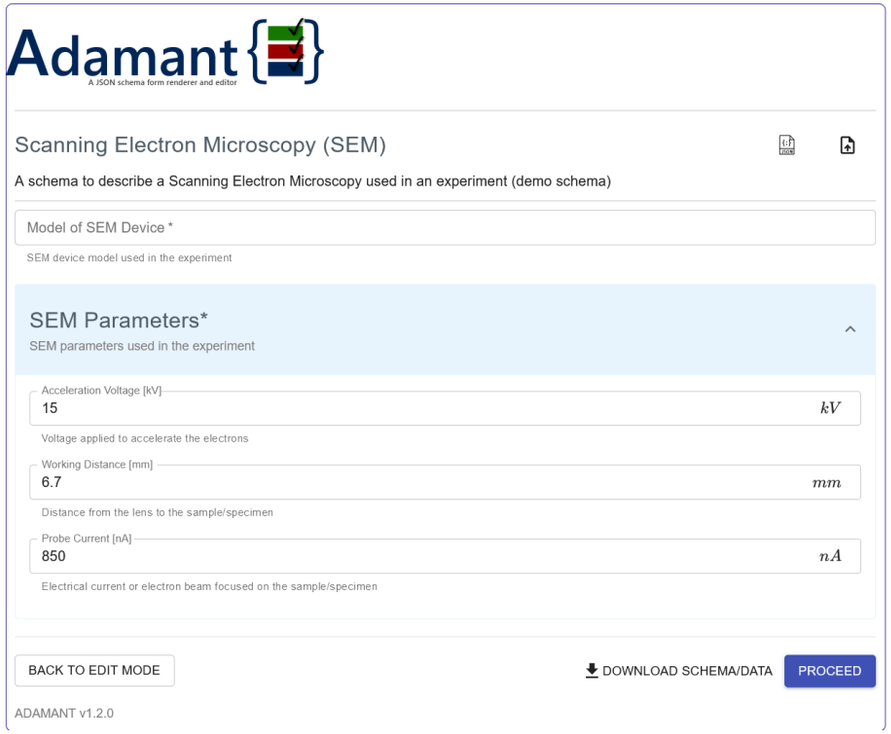
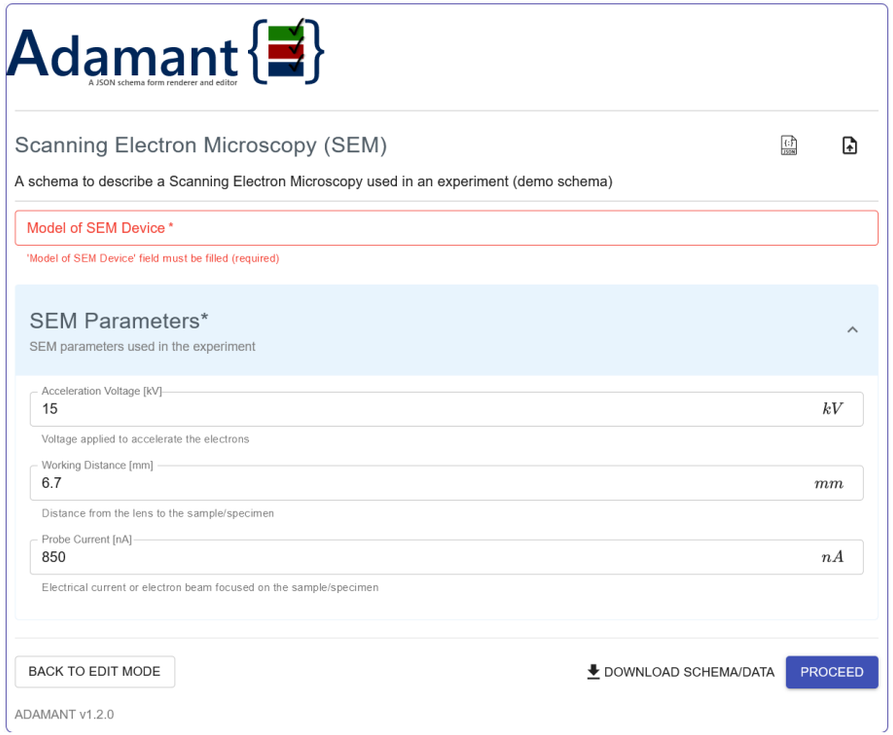
Adamant
Main features – validation of input data

- Type checking and visual feedback

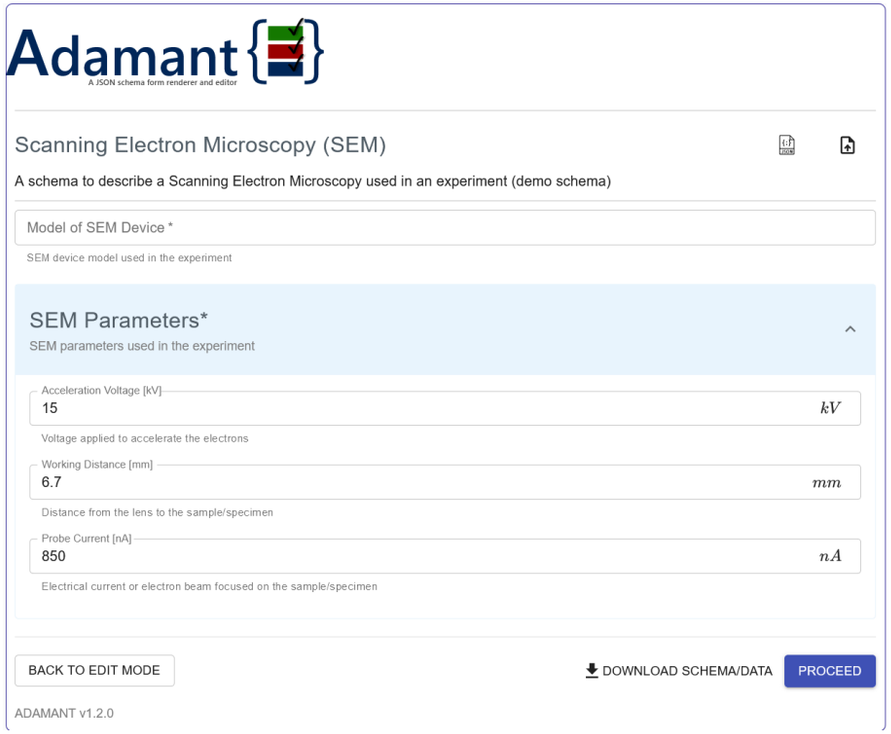


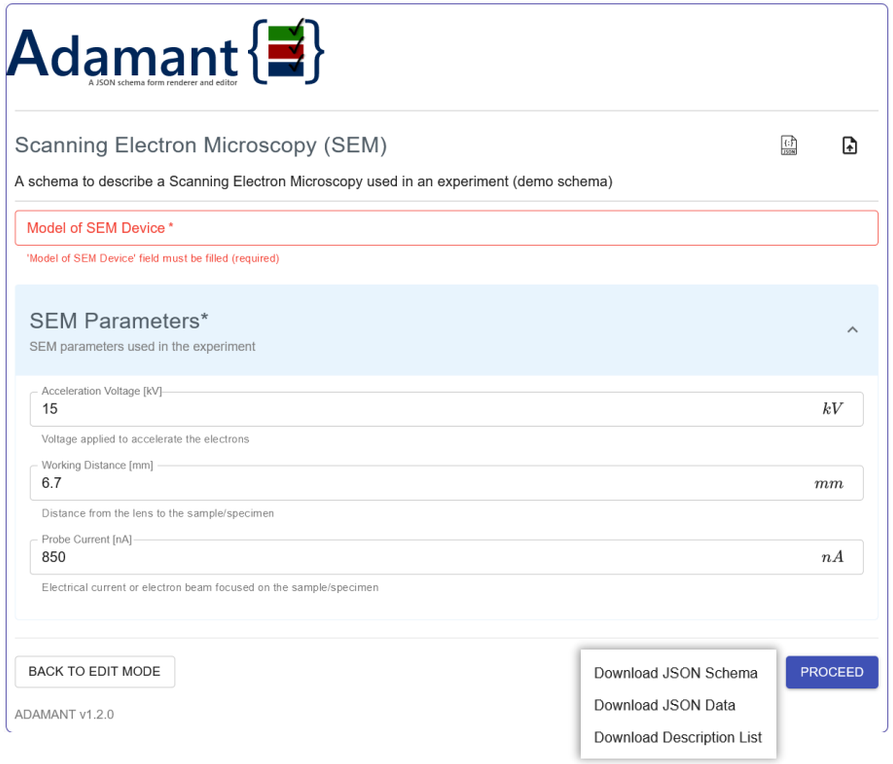


Adamant

Main features – downloadable schema and JSON data

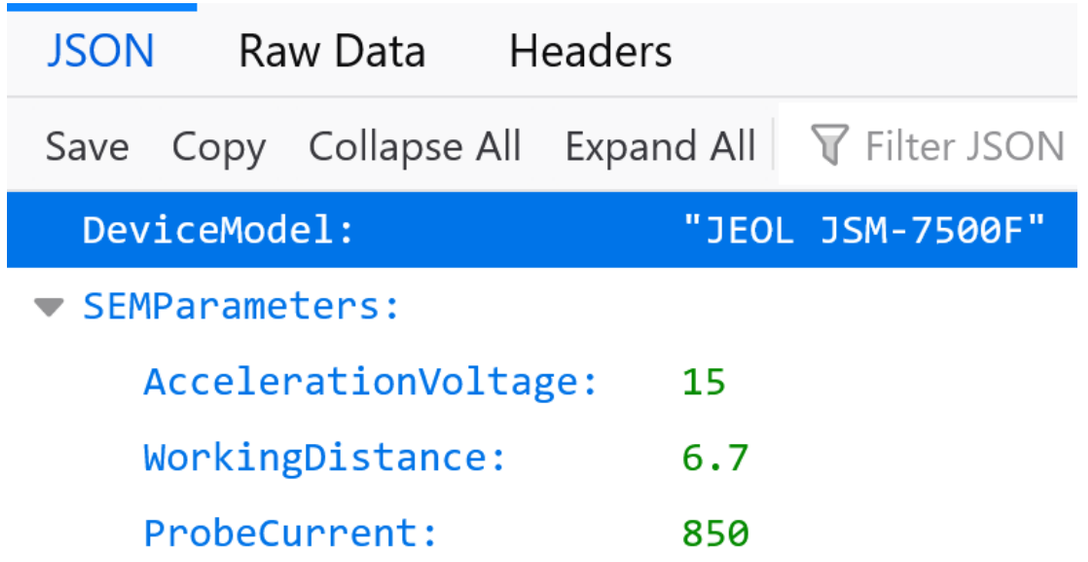
- Type checking and visual feedback

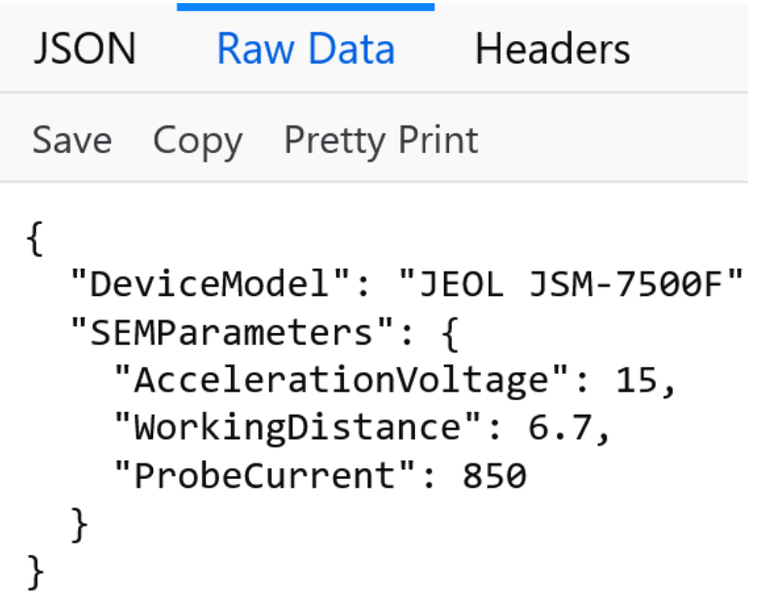




Adamant
Main features – downloadable schema and JSON data

- Downloaded JSON data collected / metadata





Live Demo

Setting up Adamant for development and deployment

GitHub repository: https://github.com/plasma-mds/adamant

Development

Setting up Adamant on a local machine for development:

- `$ git clone https://github.com/csihda/adamant.git` —clone the repository
- `$ cd adamant` —go to adamant project directory
- `adamant$ npm install` —install the dependencies for the client-side
- `adamant$ cd backend` —go to backend directory
- `adamant/backend$ python -m venv venv` —create a python virtual environment
- `adamant/backend$ ./venv/Scripts/activate` —activate the virtual environment
- `adamant/backend$ pip install -r requirements.txt` —install the dependencies for the back-end
- `adamant/backend$ cd ..` —go back to adamant project directory
- `adamant$ yarn start-api` —start the back-end
- `adamant$ yarn start` —on a new terminal, in the adamant project directory, start the front-end

By default, Adamant is accessible at `http://localhost:3000`.

Deployment

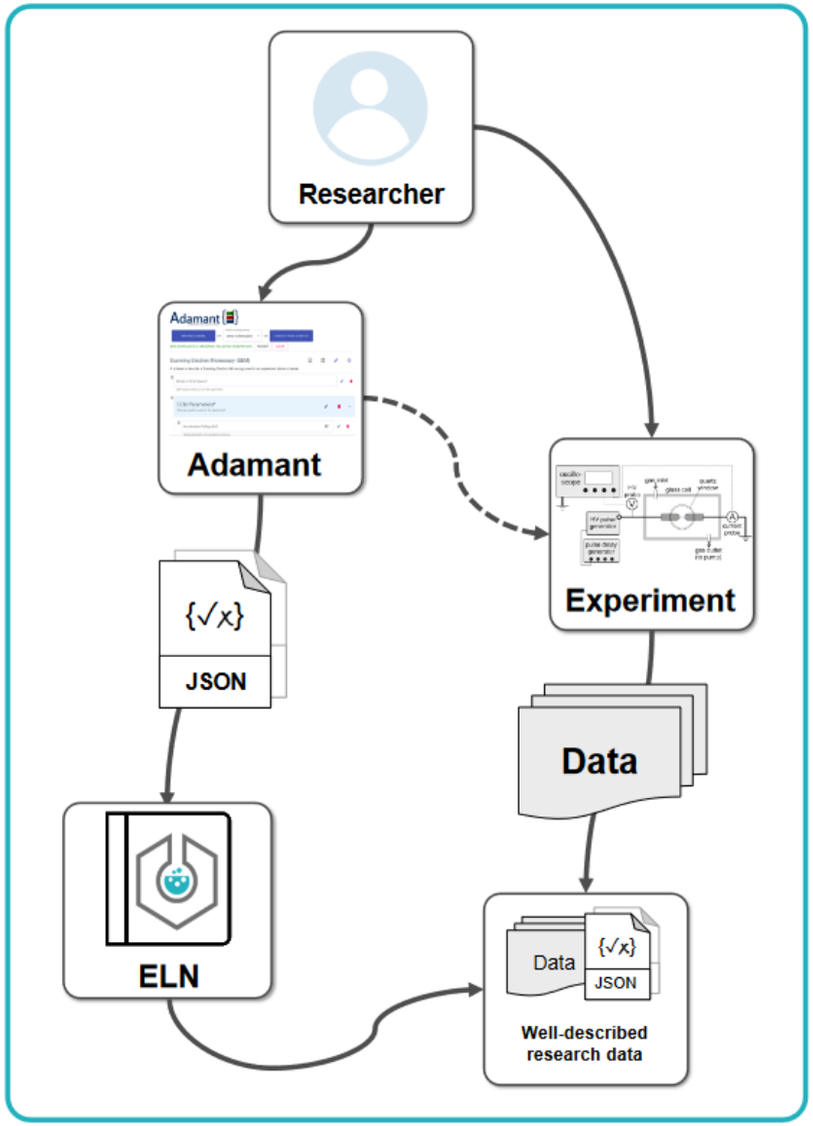
We recommend deploying Adamant with docker-compose, which can be done with ease:

- `$ git clone https://github.com/csihda/adamant.git` —clone the repository
- `$ cd adamant` —go to adamant project directory
- `adamant$ docker-compose build` —build the docker images for both back-end and front-end
- `adamant$ docker-compose up -d` —start both client and server containers, i.e., the whole system

By default, the deployed system can be accessed at `http://localhost:3000`.

Live Demo

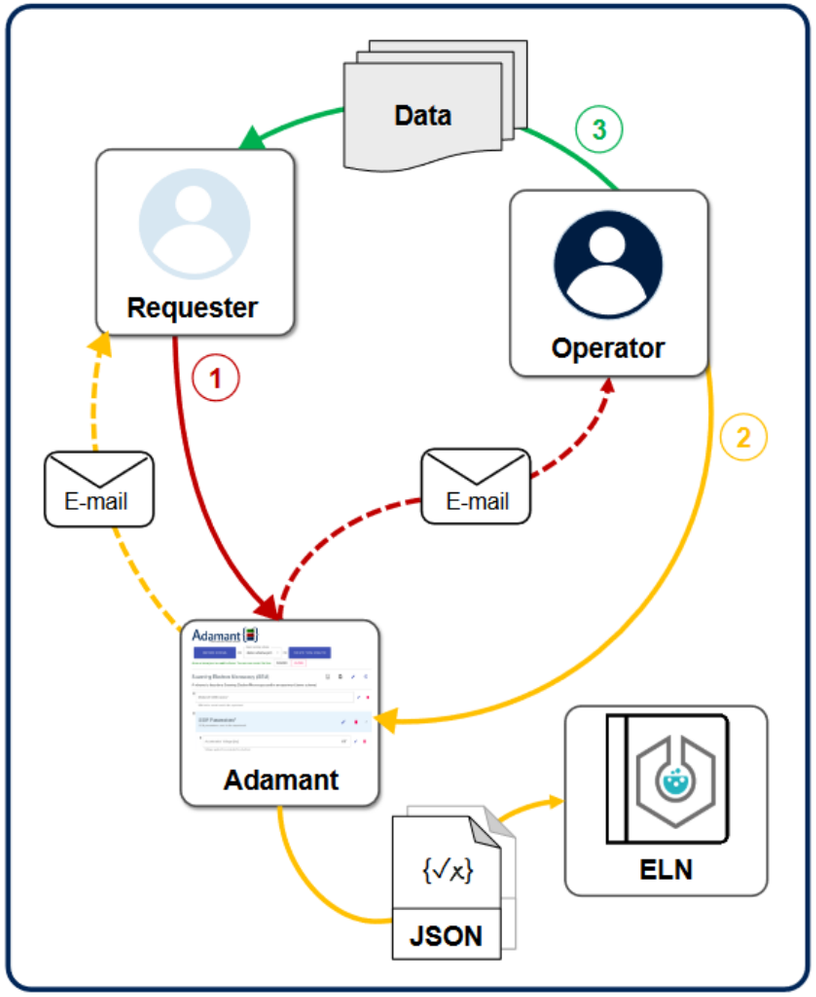
Generic schema-based metadata collection



- Browse, select, or create experiment schema and render the web-form
- Fill in relevant information regarding the experiment
- Submit to store experiment metadata and the used schema in the ELN system
- Experiment metadata can be re-used for dataset publication and other automated processes

Live Demo

Job request of scientific instrument operation



❑ **Motivation**:

Only a handful of researchers can operate a certain advanced scientific instrument. The instrument has to be more accessible to researchers with different skillsets to improve research outputs. A more automated workflow to request an instrument operation is required to make life easier.

❑ **Workflow**:

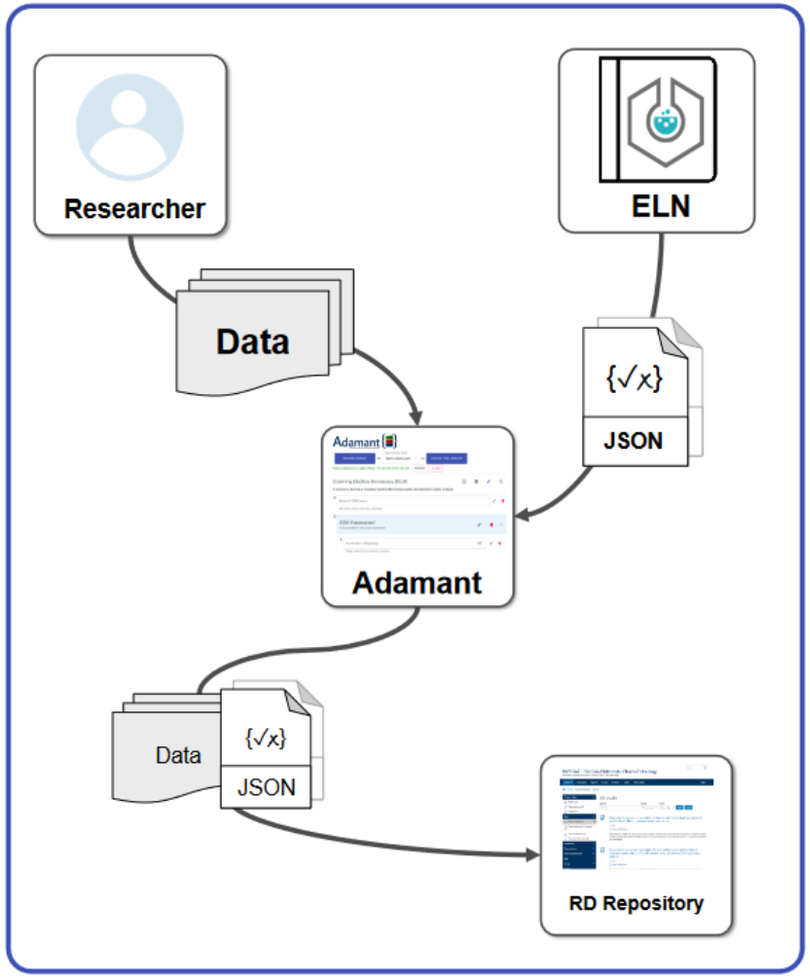
(1) Job request initiation by the requester (researcher who is not an expert on the instrument);

(2) Processing of the request by the operator (expert on the instrument), experiment metadata is stored in ELN;

(3) Handing of research data (results) from operator to requester

Other workflows

Dataset preparation and publication (under preparation)



- Gather and load the data into Adamant
- Re-use experiment metadata stored in the ELN system
  to describe the dataset
- Adjust or extend the metadata as needed
- Submit the prepared dataset to a research data repository system (e.g., https://www.inptdat.de for datasets related to plasma science and technology)

Other workflows

Compilation of input configurations for plasma simulations (under preparation)

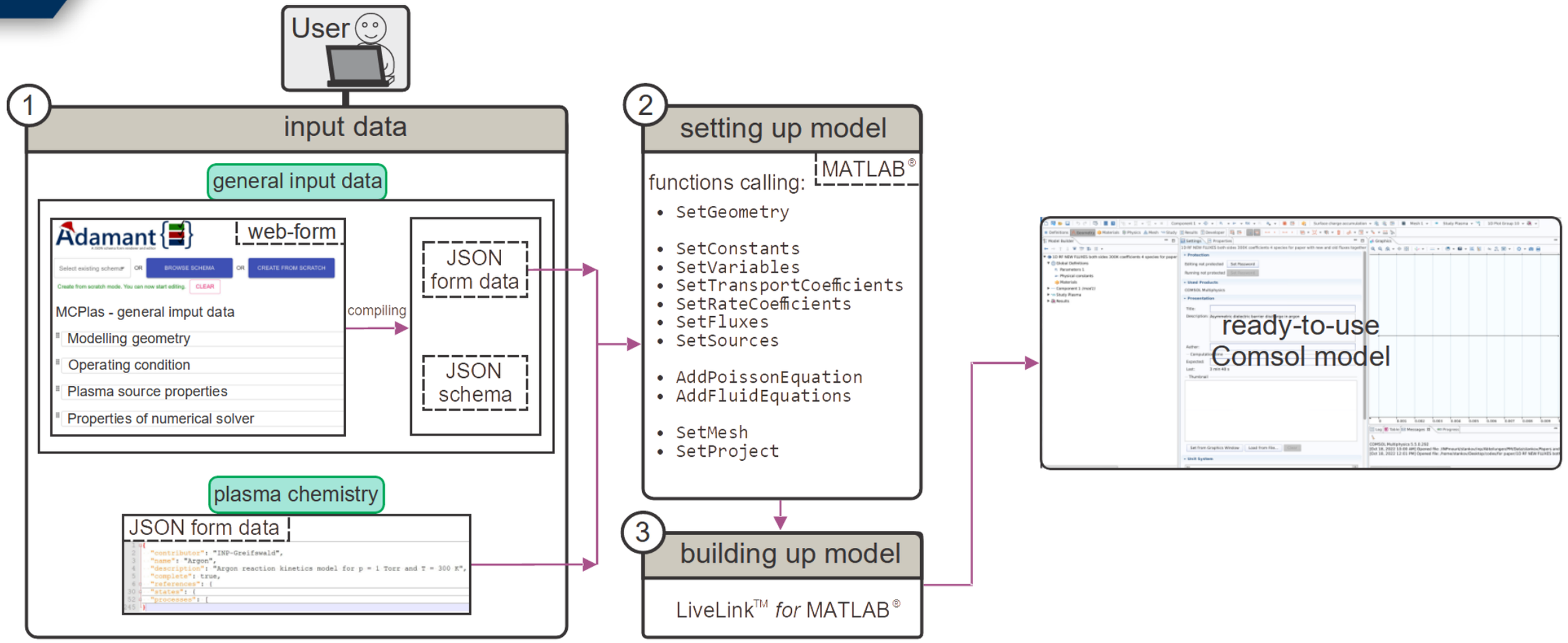
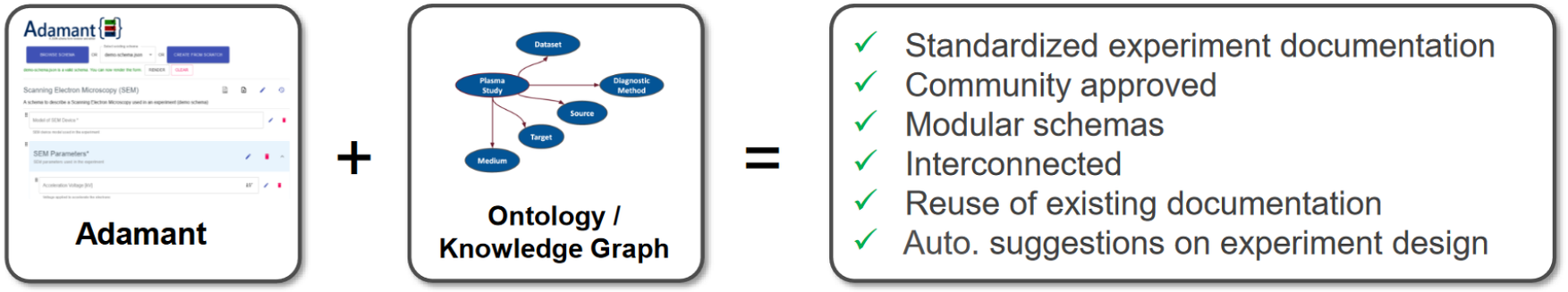


Figure credit: Marjan Stankov

Outlook
Further feature developments

- More JSON Schema keyword implementations
- Better UI and UX
- Ontology / Knowledge graph integration



- Many more!

Acknowledgement

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From left to right:

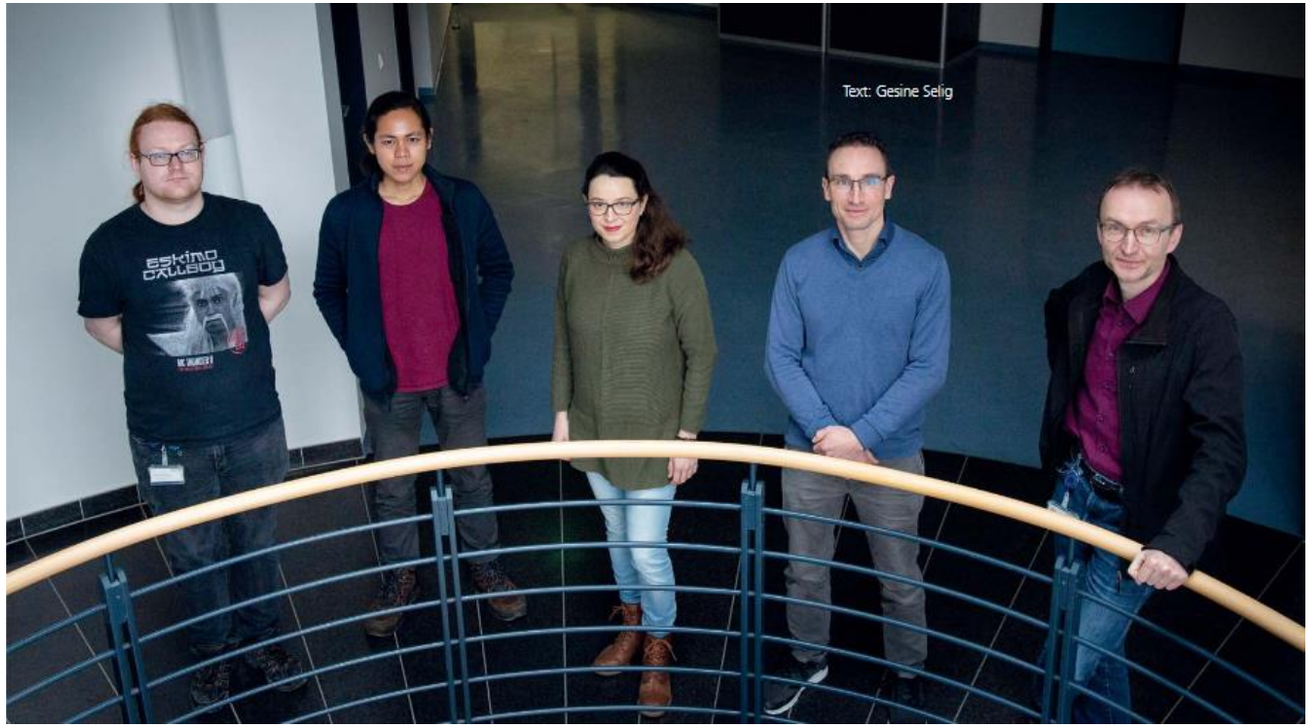
Nick Plathe

Ihda Chaerony Siffa

Laura Vilardell Scholten

Markus M. Becker

Steffen Franke (Alumnus)



BMBF Project:

QPTDat
Quality | Plasma Technology | Data

SPONSORED BY THE
Federal Ministry of Education and Research

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