



*Sören Kaps, Thorge Petersen*

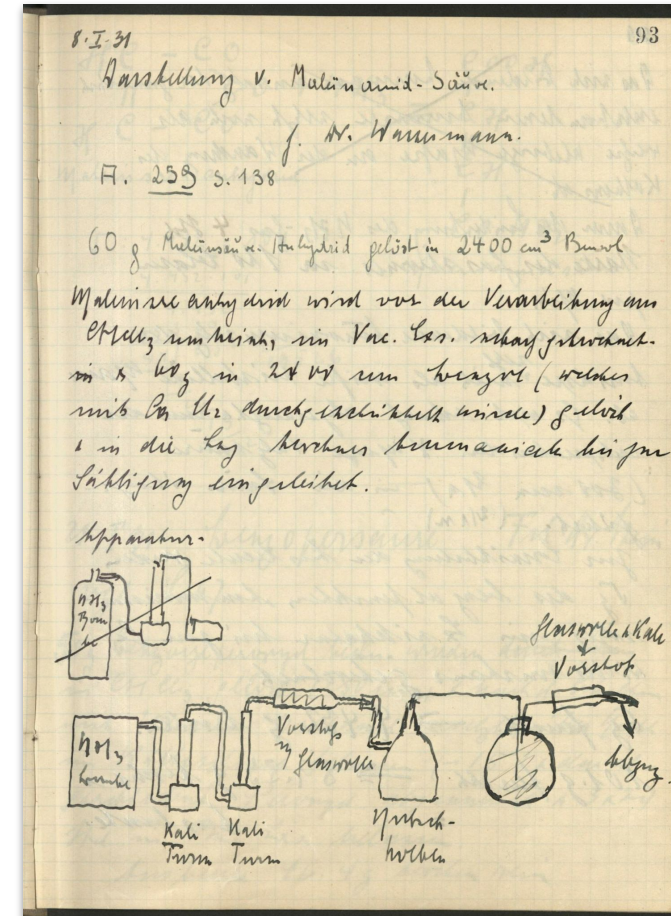
# Efficient Metadata Integration:

User-friendly instrument integration into eLabFTW within CRC 1261

# Laboratory book

The laboratory notebook documents the research process and the research data generated therein.

- Traditionally, laboratory notes were recorded on paper.
- Disadvantages of the paper form
  - Illegible handwriting
  - Not automatically searchable
  - Difficult post-processing and use of templates for recurring processes
  - Limited possibilities for collaborative editing
  - Limited data structuring
  - No remote access possible
  - Inclusion and linking with digital information and resources not possible



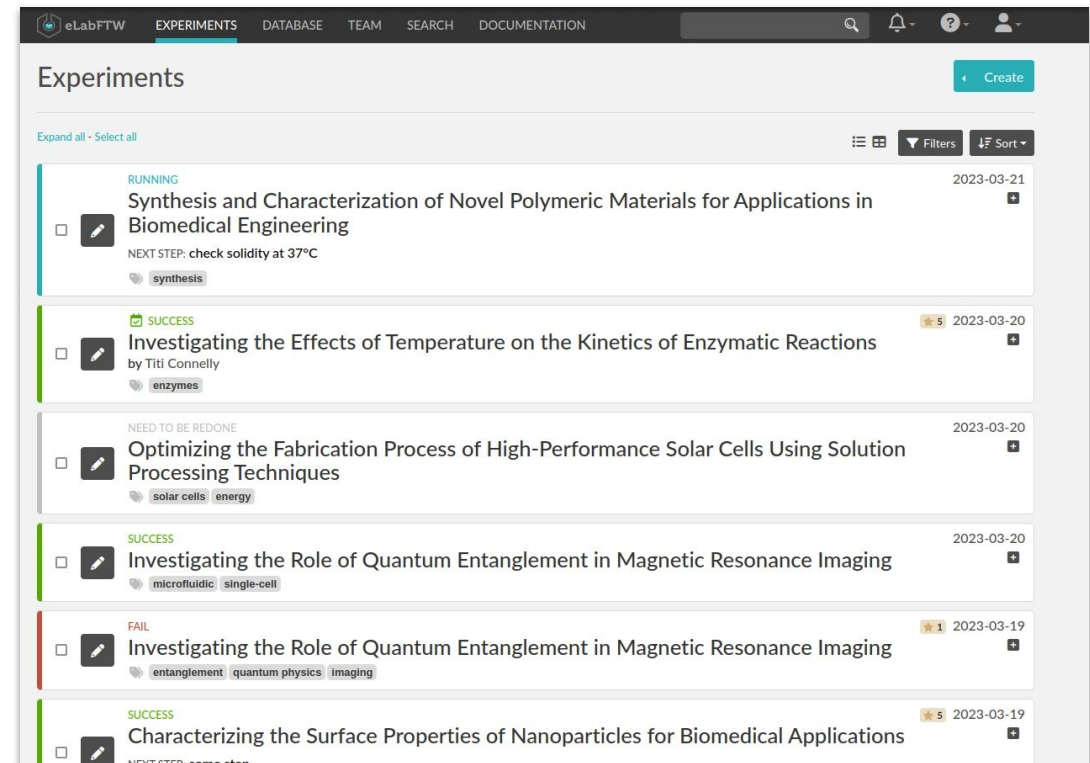
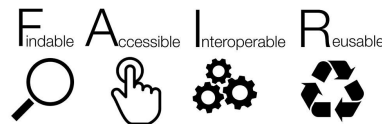
Laboratory notebook of Hans Stocker, Kaiser Wilhelm Institute for Medical Research, 1930, Folio 97.

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# Electronic Laboratory Notebook (ELN)

An ELN is a digital platform that allows researchers to electronically capture, organize, and manage their experimental data, protocols, and results.

- Advanced data entry and templates.
- Improved data organization and retrieval.
- Collaboration
- Archiving and versioning
- FAIR principles



Experiment overview of the ELN "eLabFTW".

Source: <https://www.elabftw.net/#screenshots>

# National Research Data Infrastructure (NFDI)

The ELN Working Group ELN (Common Infrastructure/Base4NFDI) aims to develop and implement services that:

- Assist in selecting suitable ELN software.
- Support implementation across consortia, communities, and individual research groups.

However, there is currently no specific ELN recommendation for our research area.

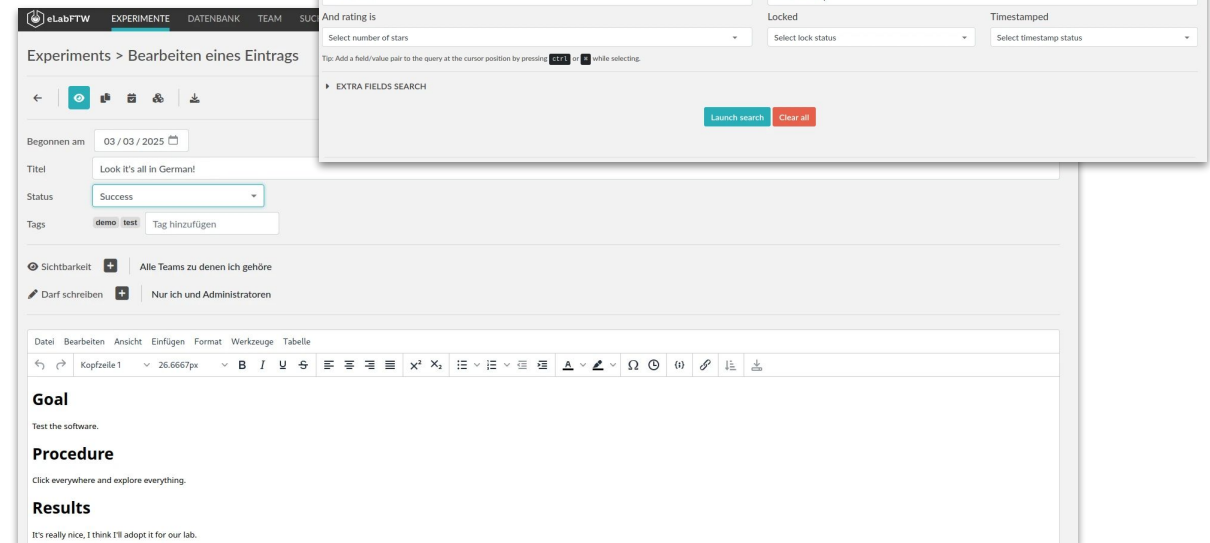


→ CRC 1261 has opted to assess eLabFTW as its current ELN solution.

# eLabFTW Overview

eLabFTW serves as the central hub for managing experimental data within CRC 1261.

- Open Source
- User-friendly interface
- Versatile data and metadata capture
- User management and access control
- Categorization, tagging, search and filter functions
- Electronic signature and timestamp (data integrity)
- Well-documented REST API
- Accessibility across different devices



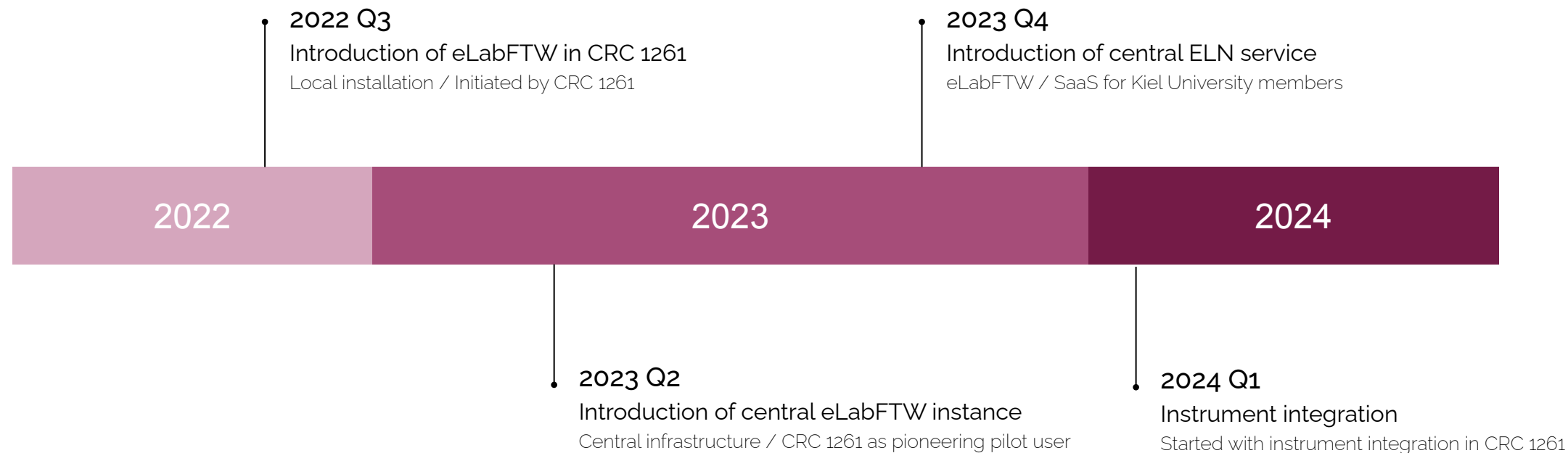
Screenshots of the ELN "eLabFTW".

Source: <https://www.elabftw.net/#screenshots>

eLabFTW Demo:  
<https://demo.elabftw.net>

# eLabFTW Rollout History

The introduction of eLabFTW at Kiel University was significantly driven by the CRC 1261.



# eLabFTW Adoption Overview

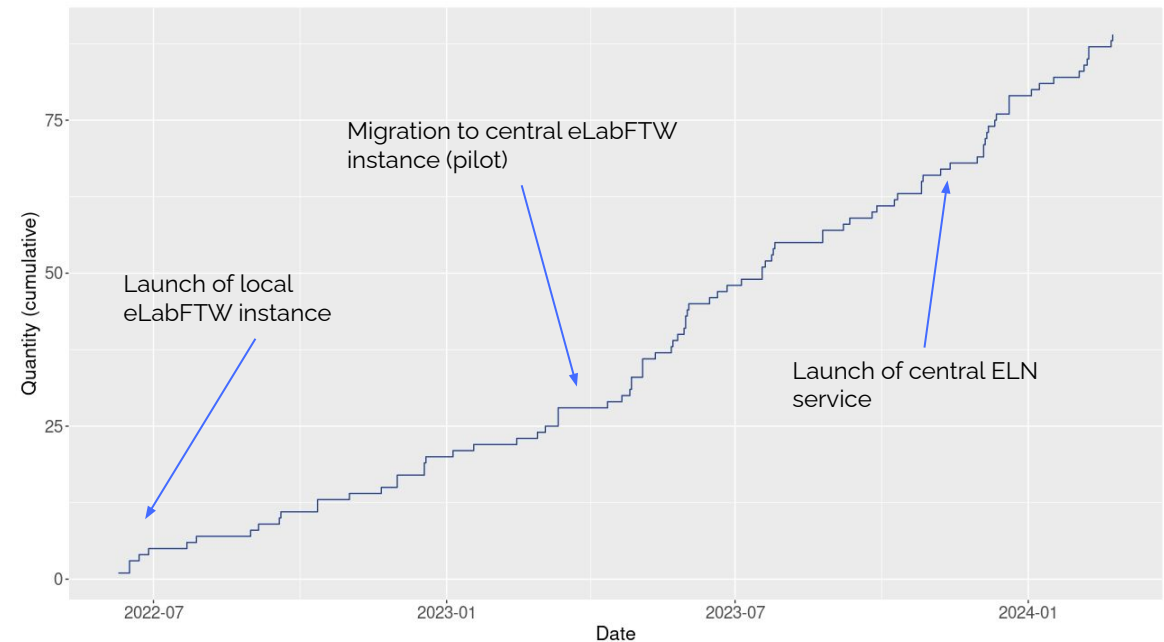
## CRC 1261

- >40 users
- >120 experiments
- Multiple groups
- Usage of templates (e.g., for wafercut process flow)
- Resources (mainly for measurement instruments)
- Heavy usage of scheduler for booking resources
- **Automated instrument data integration**

## University-wide

- ~175 users
  - >30 teams
  - >1.1k experiments
  - ~2GB current experiment disk usage
- Note: Large files are stored externally and linked in eLabFTW.

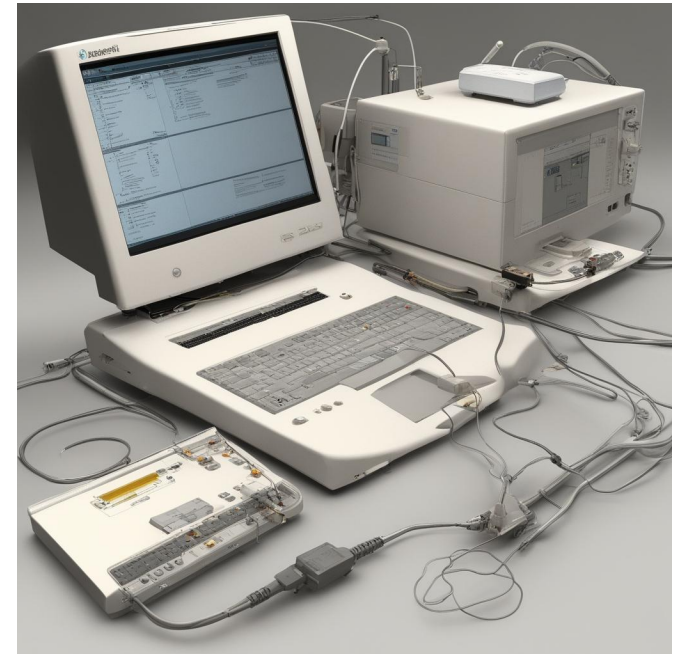
eLabFTW Experiments of CRC 1261



# Instrument Integration

Instrument integration reduces manual data entry, minimizes errors, and improves data reproducibility.

- Laboratory instruments generate a **vast amount of data during experimentation**, including parameters, measurements, timestamps, and instrument settings.
  - IoT integration is transforming laboratory operations.
- Efficient instrument integration into ELNs becomes imperative.



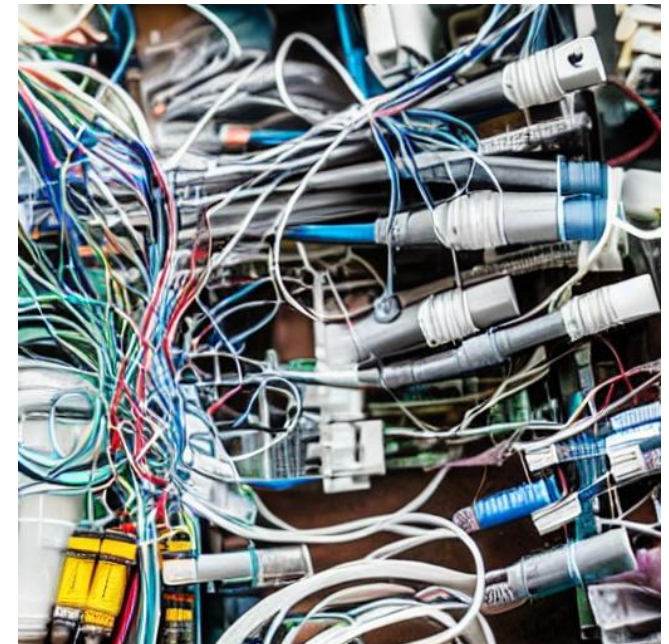


# Challenges in Instrument Integration

The integration of laboratory instruments poses significant difficulties:

- **Heterogeneity:** Data in varying formats and protocols.
- **Volume and Complexity:** High-throughput instruments
- **Data Security:** Sensitive instrument data
- **Flexibility:** Workflows and laboratory requirements evolve over time
- **Adoption:** Complement the researchers' work rather than complicate it

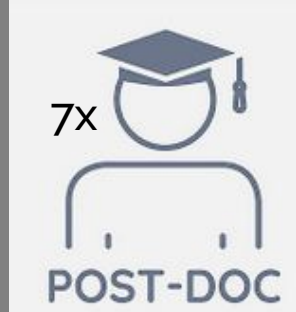
→ Focus on user-friendly integration and specific use cases.



# How do people work in a real environment?

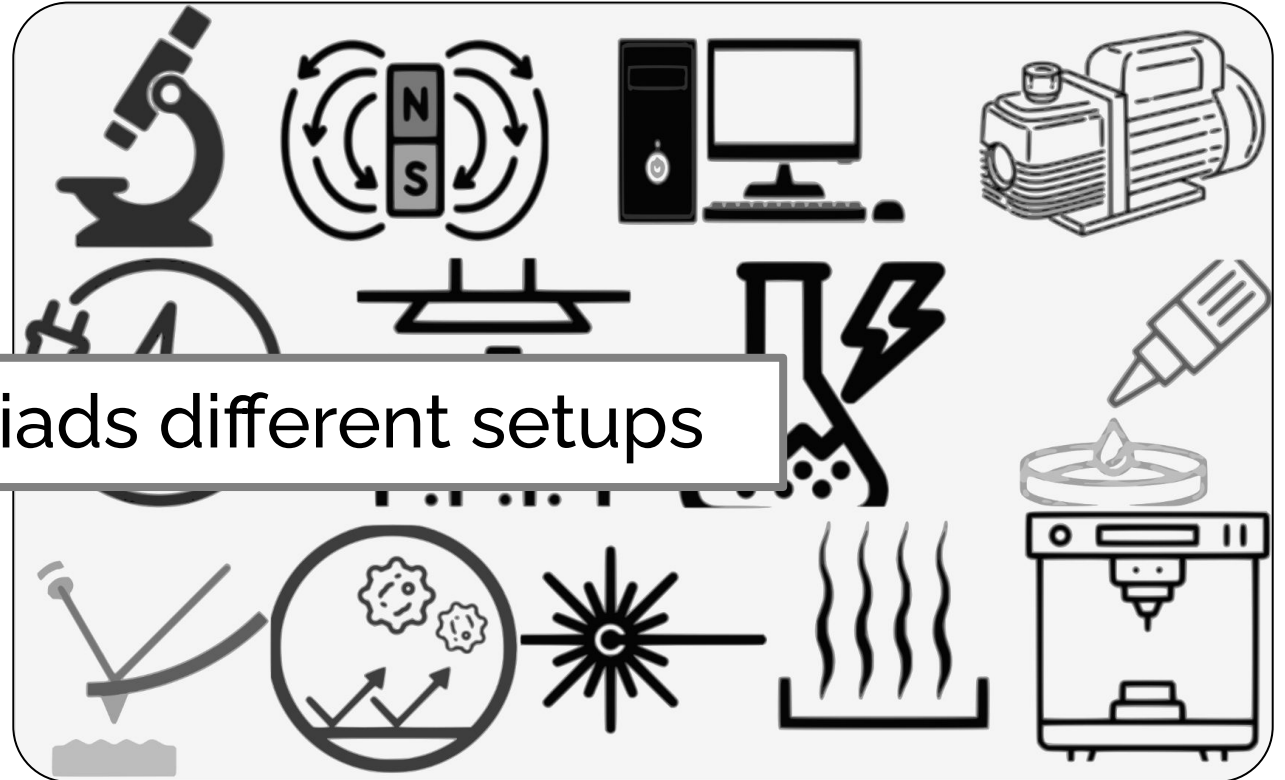
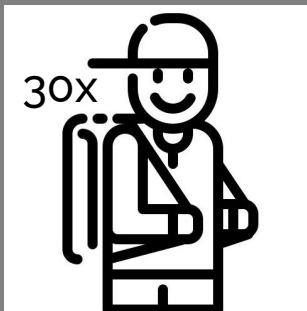


Prof. Rainer Adelung



Functional Na

~60 people + myriads different setups



Ideal conditions to learn how to implement a digital lab book.

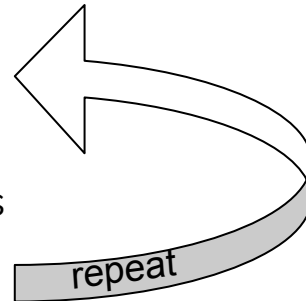
# How to motivate 60 people?

- Nobody likes changes
- Scientists are lazy (find an efficient way to get the work done)

## External Motivation

“Forcing” people has many drawbacks:

- Define rules
- Explain rules
- Threaten with consequences
- Check if rules are followed



## Internal Motivation

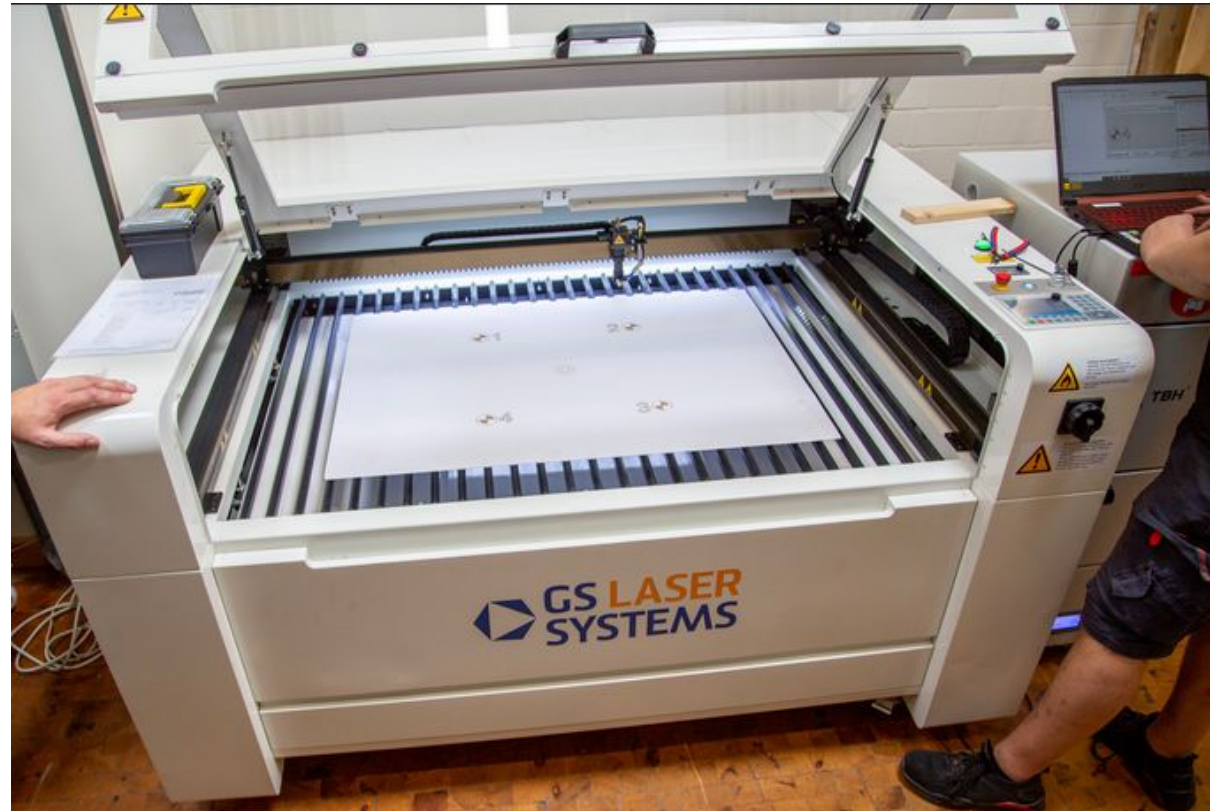
The benefit of using must be big enough.

# Lasercutter as first device to be included

| Before eLabFTW                           | After eLabFTW                                 |
|--|---|
| mechanical key needed                    | software unlocks laser                        |
| report of errors broken equipment needed | report errors & bugs automatically via GitLab |
| manual documentation                     | eLabFTW using predefined template             |



authorize via RFID using eLabFTW API key





# DigitalLab

## Implemented Features

- Authorization
  - RFID Tag
  - User + password
- Use predefined eLabFTW template
- Add/Filter/Use Tags
- WYSIWYG Editor
- Attach/Upload files via drag&drop
- Load old experiments
- Copy experiments
- Get help & report bugs
- Show status of connected devices

Digital Lab

**General Information**

Username: Sören Kaps **Logout**

Active since: Monday-16:08:59

Machine: LaserPC

**Saved successfully**

**Experiment Information**

Machine Tags: Lasercutter, Manufacturing

Active Tags:

Update Available Tags

> Maywald  
< Bizerba

Clear Tags

Up Down

New Tag

**Help**

Help

About

Report Bug

Create/Update Experiment List Experiments

Update List

Get all experiments Get User Experiments Get Experiments by Active Tags

|    | Title         | Operator | id   | date       | tags                          | Gas | Power | Speed | Material | Thickness |
|----|---------------|----------|------|------------|-------------------------------|-----|-------|-------|----------|-----------|
| 1  | Pumpenpla...  | Jara     | 1101 | 2024-04-09 | Lasercutter Manufacturing ... | air | 100.0 | 20.0  | PMMA     | 10.0      |
| 2  | meywald_di... | Jara     | 1077 | 2024-04-04 | Lasercutter Manufacturing ... | air | 100.0 | 20.0  | PMMA     | 5.0       |
| 3  | Pumpenpla...  | Jara     | 963  | 2024-03-19 | Lasercutter Manufacturing     | air | 100.0 | 20.0  | PMMA     | 5.0       |
| 4  | Untitled ...  |          | 924  | 2024-03-15 | Lasercutter Manufacturing     | air | 100   | 20    | PMMA     | 5         |
| 5  | Verschraub... | Jara     | 901  | 2024-03-14 | Lasercutter Manufacturing ... | air | 100.0 | 10.0  | POM      | 5.0       |
| 6  | kabelclip     | Jara     | 887  | 2024-03-13 | Lasercutter Manufacturing ... | air | 100.0 | 20.0  | POM      | 5.0       |
| 7  | Untitled ...  |          | 864  | 2024-03-12 | Lasercutter Manufacturing     | air | 100   | 20    | PMMA     | 5         |
| 8  | Kain Aero eg  | roku     | 807  | 2024-03-05 | Lasercutter Manufacturing     | air | 25.0  | 50.0  | aero eg  | 4.0       |
| 9  | Pumpenpla...  | Jara     | 792  | 2024-03-01 | Lasercutter Manufacturing     | air | 100.0 | 5.0   | PMMA     | 10.0      |
| 10 | Frame for ... | jlu      | 789  | 2024-02-29 | Lasercutter Manufacturing     | air | 100.0 | 20.0  | PMMA     | 3.0       |
| 11 | cutting       | mjgo     | 783  | 2024-02-27 | Lasercutter Manufacturing     | air | 100.0 | 20.0  | PMMA     | 5.0       |
| 12 | Alginate ...  | mjgo     | 781  | 2024-02-27 | Lasercutter Manufacturing     | air | 100.0 | 20.0  | PMMA     | 5.0       |
| 13 | cutting ...   | mjgo     | 780  | 2024-02-27 | Lasercutter Manufacturing     | air | 100.0 | 20.0  | PMMA     | 5.0       |
| 14 | Glaskammer... | roku     | 765  | 2024-02-22 | Lasercutter Manufacturing ... | air | 100.0 | 15.0  | PMMA     | 10.0      |

Transfer to Experiment View

User DB ElabFTW Relais Box RFID Reader

# Report bugs

Dialog

Title

Laser not working

Description

Laser stopps without reason after 15 Minutes.

OK Cancel

Report Bug

Browse


Modified

2023 11:...

2023 09:...

2023 09:...

2023 10:...

 **ska@tf.uni-kiel.de: 1 neue Nachricht**

**DigitalLab | Laser not working (#21)** DigitalLab Reporter (@pr...

DigitalLab Reporter created an issue: <https://cau-git.rz.uni-kiel.de/FunctionalNanomaterials/DigitalLab/-/issues/21> Laser stopps without reason after 15 Minutes. -- This project does not include diff previews in email notifications.




Reply to


FunctionalNanomaterials / DigitalLab / Issues / #21


## Laser not working

☒ Open ☐ Issue created 1 minute ago by DigitalLab Reporter


Laser stopps without reason after 15 Minutes.

 0  0 

 Drag your designs here or [click to upload](#).

**Child items**  0

No child items are currently assigned. Use child items to break down this issue into smaller parts.

**Linked items**  0

Link issues together to show that they're related. [Learn more](#).

### Activity

- DigitalLab Reporter added **Lasercutter** label just now

Fast & easy communication

# Universal Software for ~~all~~ many setups

## Template in web UI

▼ EXTRA FIELDS

|           |   |  |
|-----------|---|--|
| Operator  | <input type="text"/>  |  |
| Material  | Which material are u using<br>PMMA                                  |  |
| Thickness | 5   |  |
| Power     | Laserpower in %<br>100  |  |
| Speed     | Cutting speed in mm/s<br>20   |  |
| Gas       | <input checked="" type="radio"/> air <input type="radio"/> nitrogen |  |

provide Template ID

## Templates in DigitalLab

Title

Description

|           |   |  |
|-----------|---|--|
| Operator  | 12  |  |
| Material  | PMMA  |  |
| Thickness | 5,00  |  |
| Power     | 100,00  |  |
| Speed     | 20,00   |  |
| Gas       | <input checked="" type="radio"/> air <input type="radio"/> nitrogen |  |

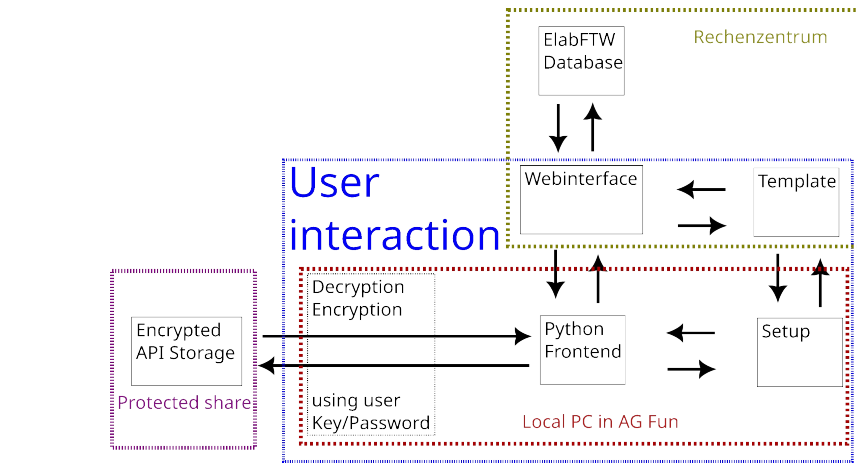
elabFTW templates speed up documentation time

# Summary & Outlook

- Successful implementation using a real device
- Positive feedback from the users

## Next Steps:

- Include more setups
  - Web site based version
    - For mobile devices
    - For setups w/o PC
    - Easy Login (RFID tag)
    - Template ID provided via RFID or QR-code
- Codebase will become open source
- PIDs for instruments



219:5000/labbook/58

### Furnace

Content  
ZnO

Duration  
05:00

Furnace  
Carbolite

Temperature  
1150

User  
ergr

### Previous Experiments

| Date                | User | Content | Furnace | Duration | Temperature |
|---------------------|------|---------|---------|----------|-------------|
| 2024-04-24 16:17:22 | ergr | asd     | F4      | 01:00    | 1           |
| 2024-04-24 16:17:13 | ergr | zno     | F4      | 01:00    | 1           |
| 2024-04-24 16:13:52 | ergr | zno     | F4      | 01:00    | 1           |
| 2024-04-24 16:12:40 | ergr | sad     | F4      | 01:00    | 1           |
| 2024-04-24 16:12:20 | ergr | dsaf    | F4      | 01:00    | 1           |
| 2024-03-21 15:07:52 | Ergr | Tio2    | F4      | 01:00    | 550         |