# Open Material Property Library With Native Simulation Tool Integrations

# MASTO

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# Contents

# What is the software I am developing (internal view)?

- It is a research infrastructure build around material properties
- It is a social media connecting different stakeholders around material property data
- It has (will have) following features
  - Responsive web browser ui
  - Users and communities
  - Data with versioning
  - Seamless integration to external software with native tools
  - Show window for data and communities (including companies)
  - Intelligent searching and adaptive result selection
  - Place to find materials and use them easily with simulation software
  - Place to find people to characterize materials
  - Different ways to find out if data is trustworthy, including possibility to request for a review of imported data

# What do I say to modellers what MASTO is?

- Material property database where people can easily store their material data and use them in their modelling software
- Users can also share data, set-up communities where to put data and restrict access to data
- Material data is indexed with tags to allow easy searching
- Favourite materials can be bookmarked
- It works with your web browser, mobile phone and your simulation software or with a tool designed for your simulation software
- It is a place where you share your (or your projects) material property data

**It saves your time to start doing simulations, comparing properties of different materials and finding materials for your projects**

# What do I say to companies what MASTO is?

- Companies = material manufacturers, dealers etc
- MASTO offers a window for reliably distributing the data of your materials for the users, the device designers and they can easily use your data (more sales)
- You can use it to inform your possible customers about your product portfolio in a level important for special material products (more sales)
- You can find collaborators (experts in materials) to characterize your materials and develop your products (better products, you know what you are selling)

**MASTO is a new kind of show window for your products targeted to experts who select special raw or composite materials for their needs**

# Details

# Features

It must be

- Built without any limitations for the data (something depends on T, something on T, B, RRR, is anisotropic, depends on some other data in the database)
- Open and persistent for citing (means versioning)
- Closed for internal project use (means access control limited area)
- Easy to use (import data, export data)
- Integrated to normal workflow of engineers
- Very little overhead (time) for users for using (actually it must save time)
- Available from internet
- Usable via browser and integrated software tools
- Reliable
- Professionally implemented
- Extendable

# Technological viewpoint

- Somebody must take 100% responsibility for maintaining the application in a cloud service (that will be we) and also in the future in terms of **Editorial and development office of MASTO**
- It should not be one app but several apps working together
  - Backend (i.e. a REST api) for data storage and related logic (heart)
  - WebUI for computer, tablet, mobile access (head)
  - Dedicated tools for integrating data as a code to engineers' needs (hands)
    - Excel
    - Matlab
    - C++
    - Fortran
    - Python
    - Java
    - Comsol?
    - ...

# Economical viewpoint

To make MASTO

- Sustainable, it must be served by a company that knows its product (the software), can develop it and is motivated for the task
- Useful to use, it must have lot of data, I need help for making the initial database sufficiently large to attract people
- Popular, it must be free for public institutions, it must be advertised by having a booth in conferences and relevant exhibitions
- Possible, I need initial seed funding and help in finding industrial partners (I have already invested a lot of time for this)
- Cover expenses, it must cost money to someone (to be find out ways how)

# A technological solution

- Hosting in a cloud service: Microsoft Azure
  - Normal server structure: dev, staging, production
  - Automatic server deployment and management: Ansible
  - Server monitoring: Newrelic
  - Cloud storage: Azure
  - E-mail service: Mailgun
- Database: Neo4j
  - Very flexible graph database (NOSQL db), fast for developing and finding connections for data
- Backend (REST is the only approach): PHP Lumen offers interface
  - GraphAware's client for Neo4j access
  - DECO for data modelling (a descriptive framework based on ideas taken from category theory for representing data and their relations in a meta-programmed framework)
  - JSON as data passing format (automatic object-to-data-to-object mapping)
  - Automatic testing with PHPUnit
  - Lot of other stuff
- WebUI: AngularJs based one page client
  - Javascript, Jade, Sass, development server tools
- Dedicated clients should work like bower, composer, git etc

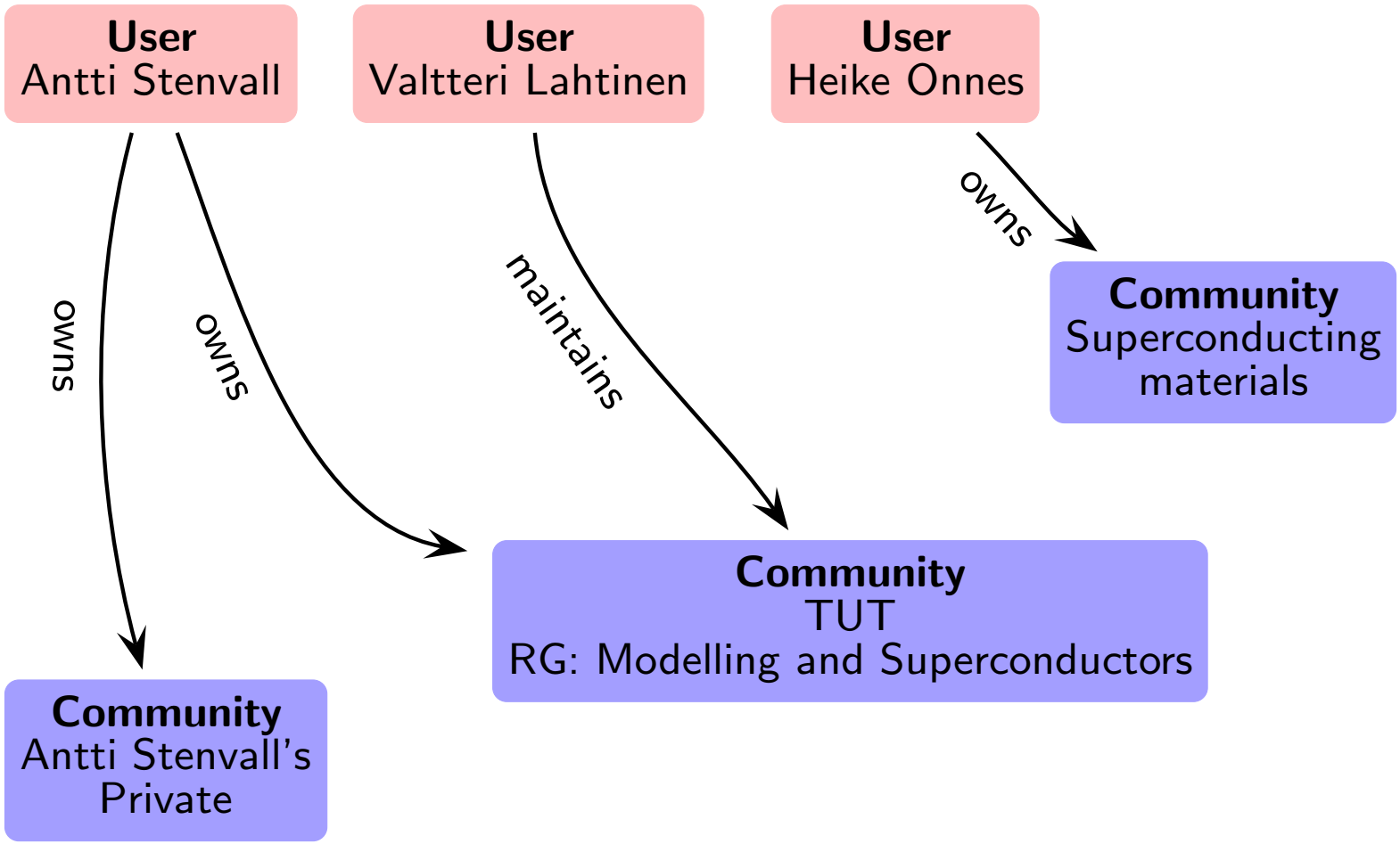
# Schematic of organizing the data

**User**
Antti Stenvall

**User**
Valtteri Lahtinen

**User**
Heike Onnes

# Schematic of organizing the data



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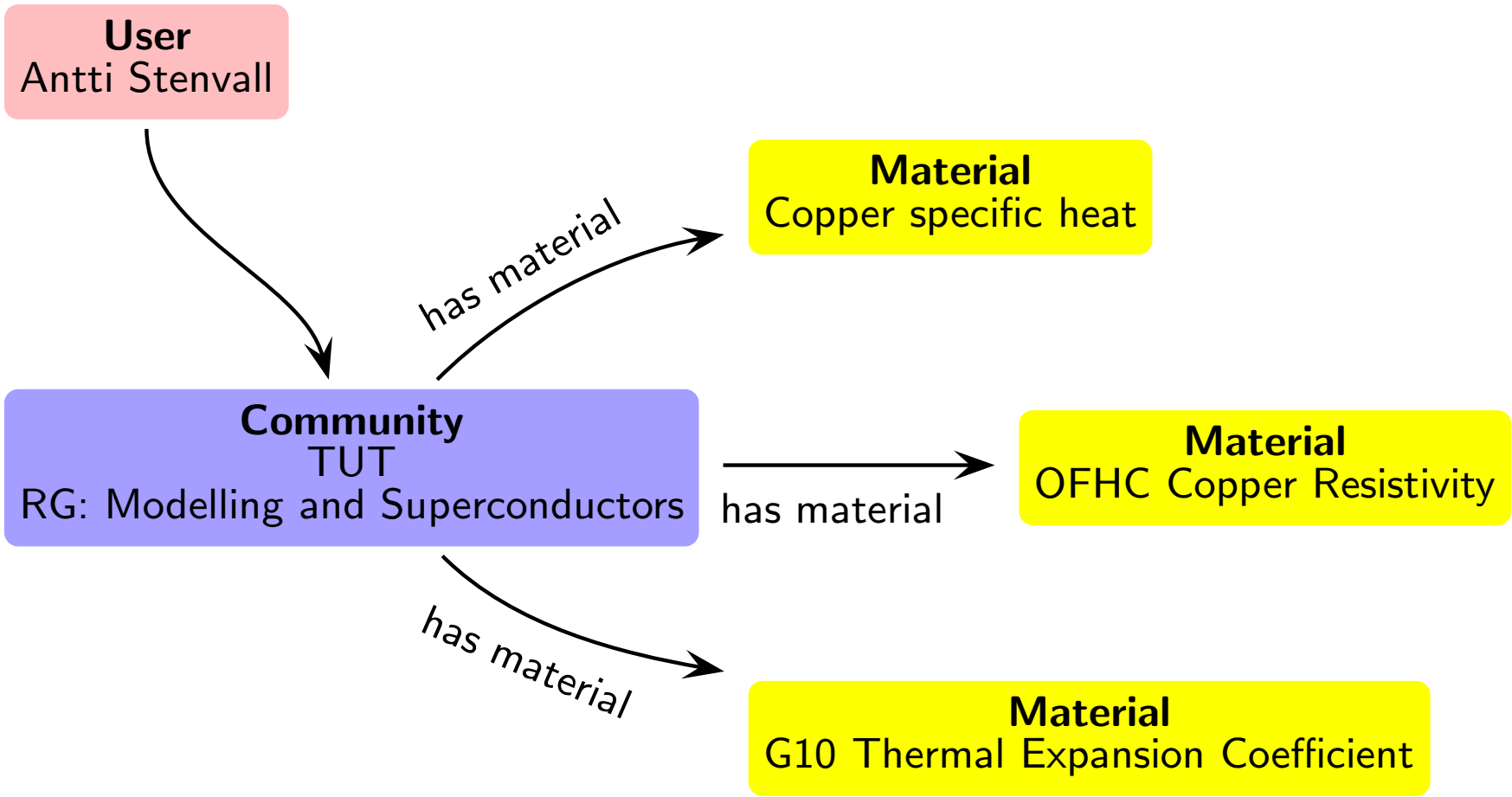

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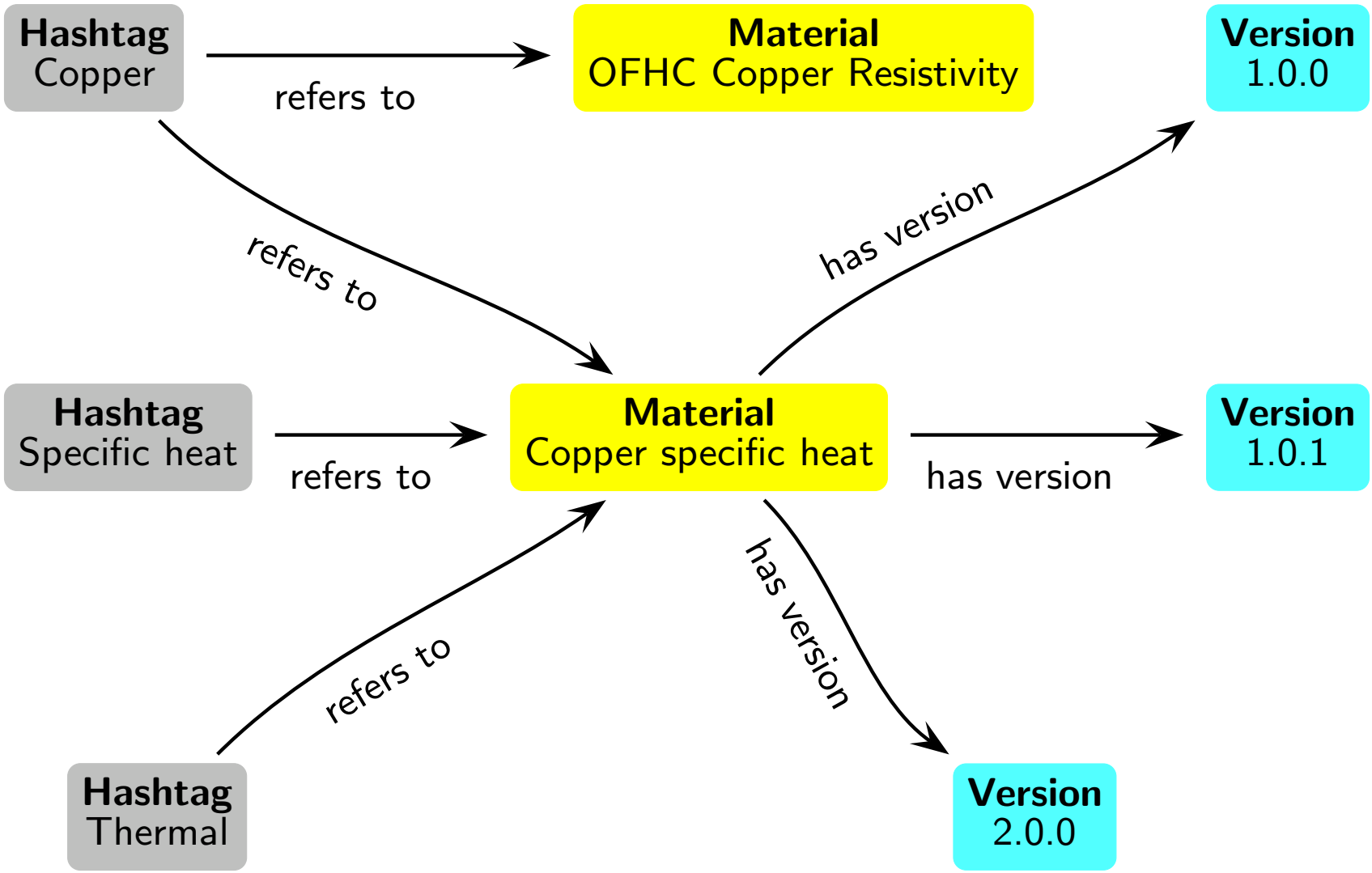

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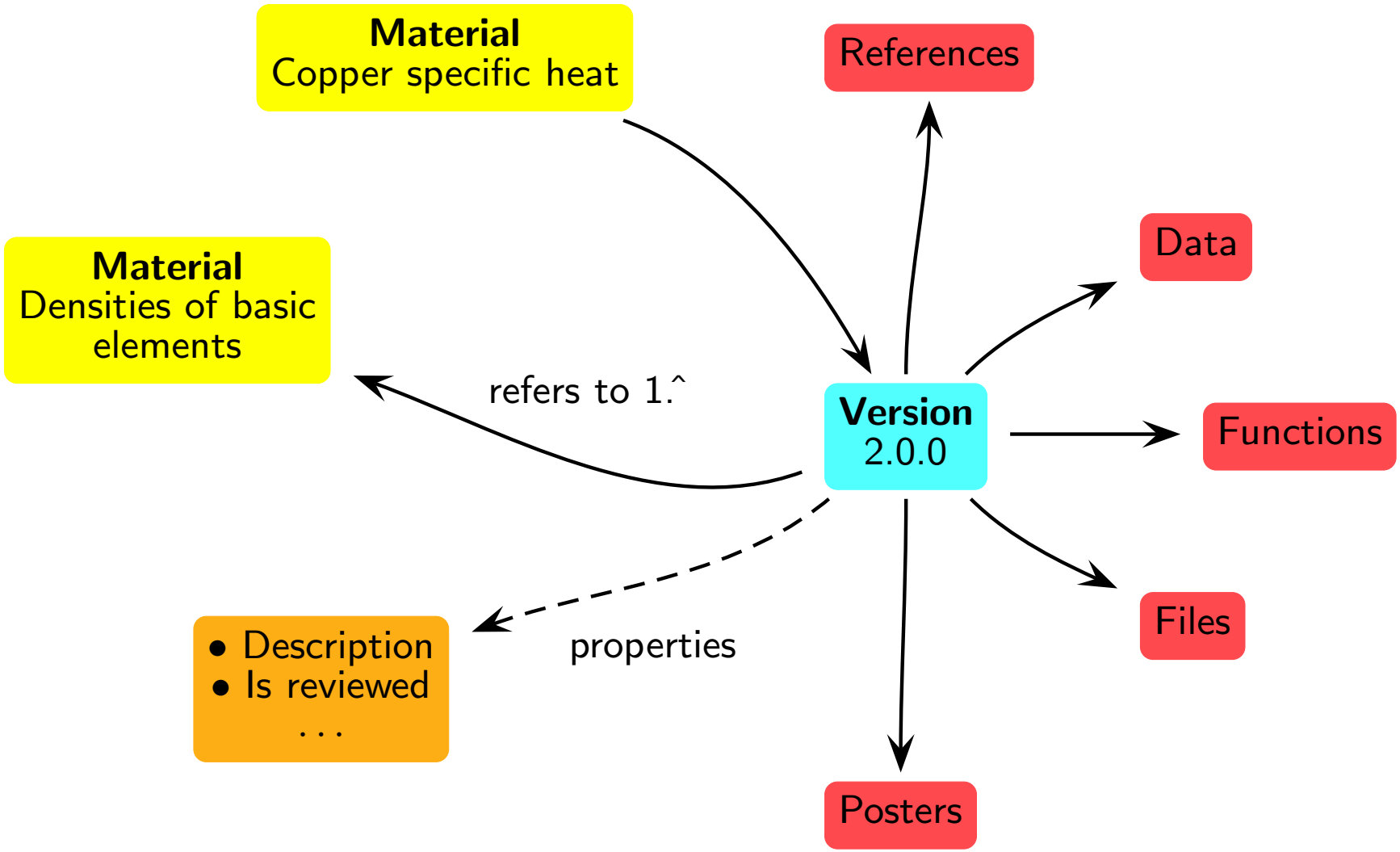
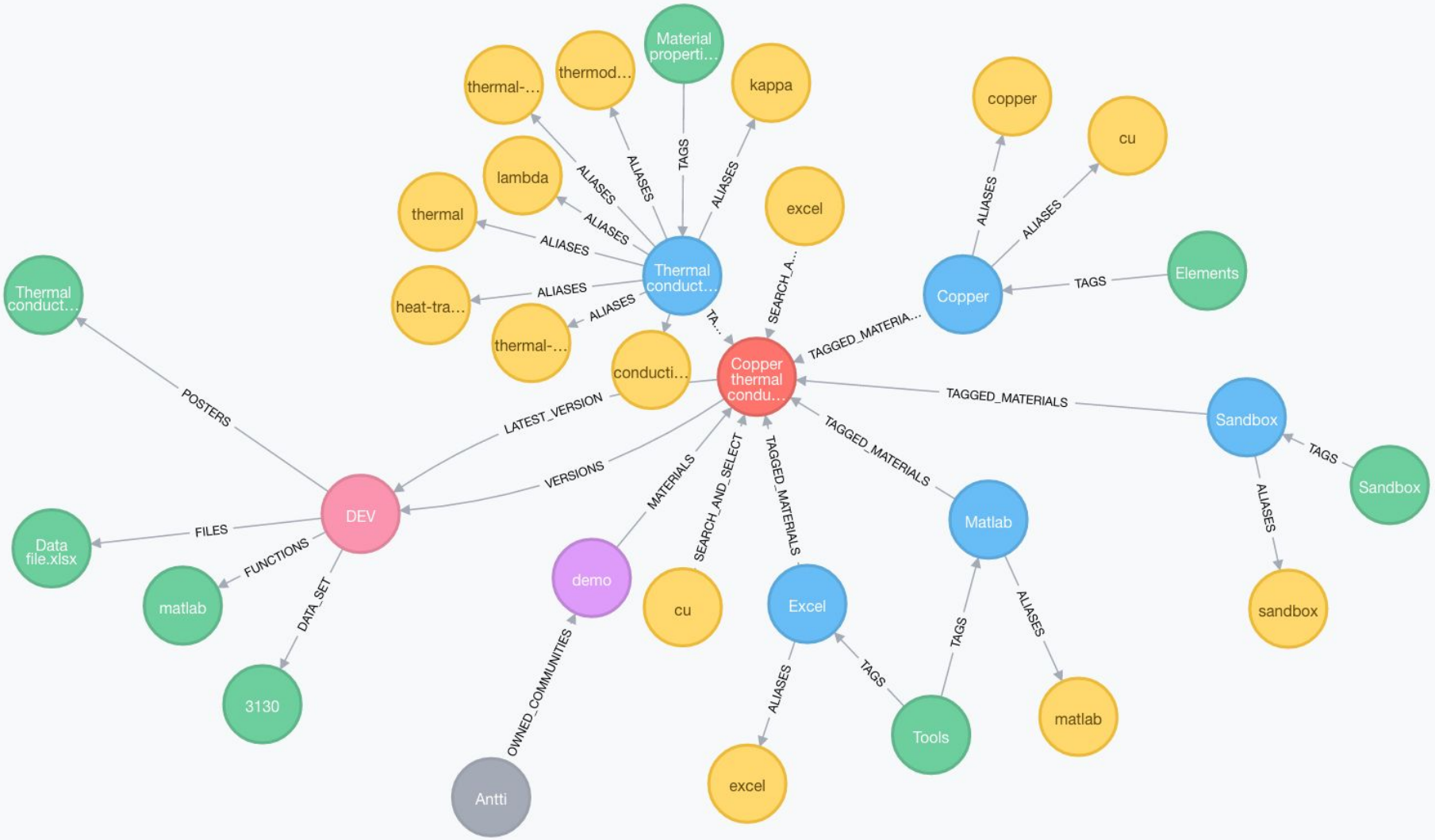


# A view from actual database

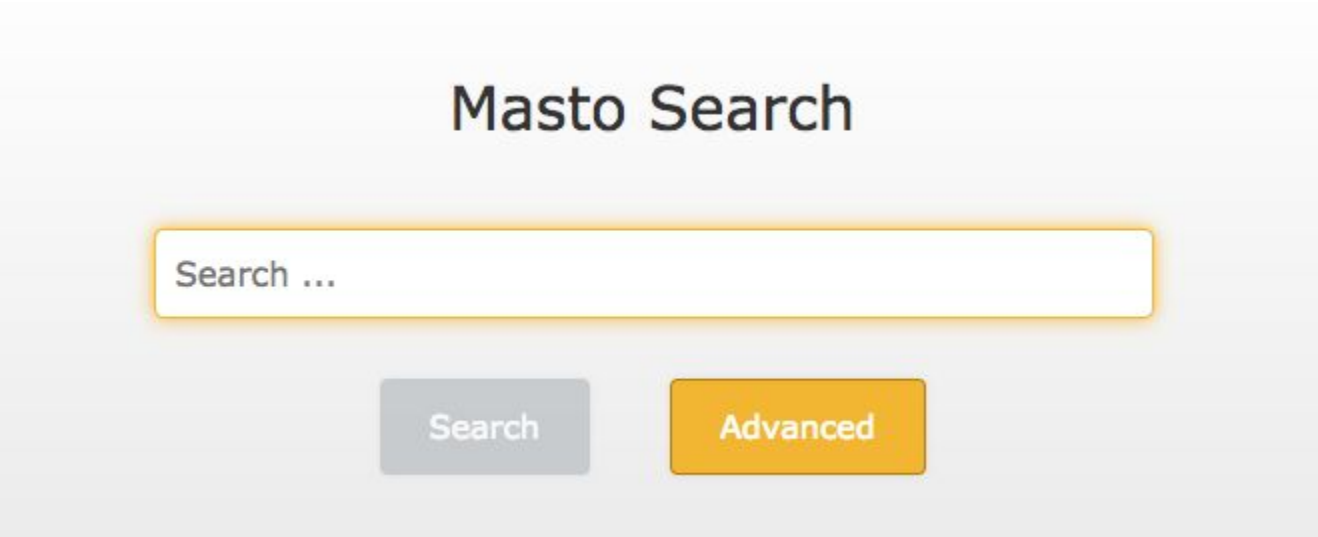


# Searching

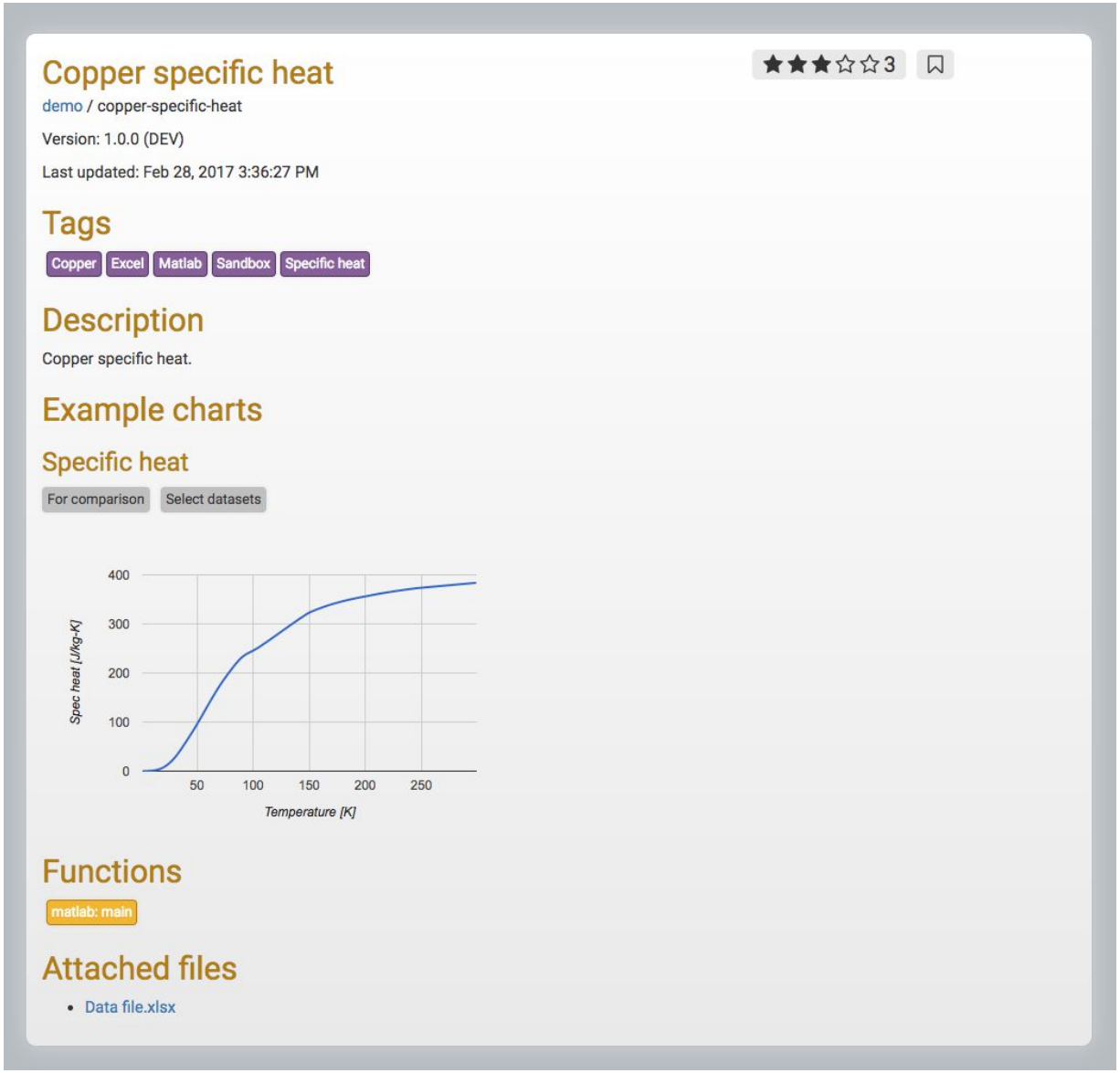
- Indexing with hashtags
- Rating system
- Click system
  - Save searches and find out what users select based on searches
- Communities
- Favourite communities
- Advanced search TBD

# User interface

- Try it yourself: http://dev.masto.eu.com/



# View on material property



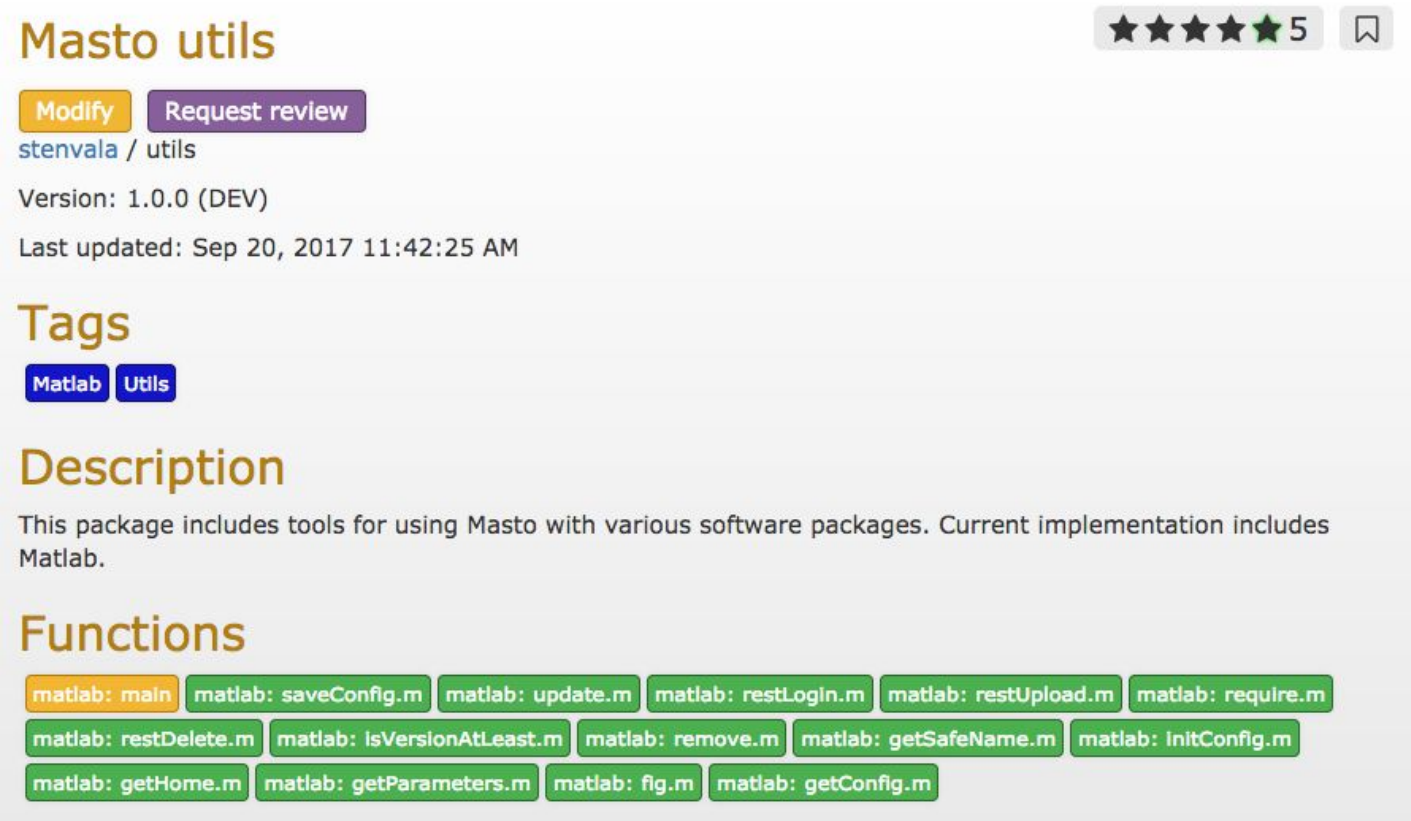

- LaTeX and html support for description

And

- Dependencies
- References

# Utils

- There is already utility package for integrating MASTO to Matlab (I have also scripts for uploading material data directly from Matlab or with Excel files, there is no graphical UI for this yet)



# Using with Matlab

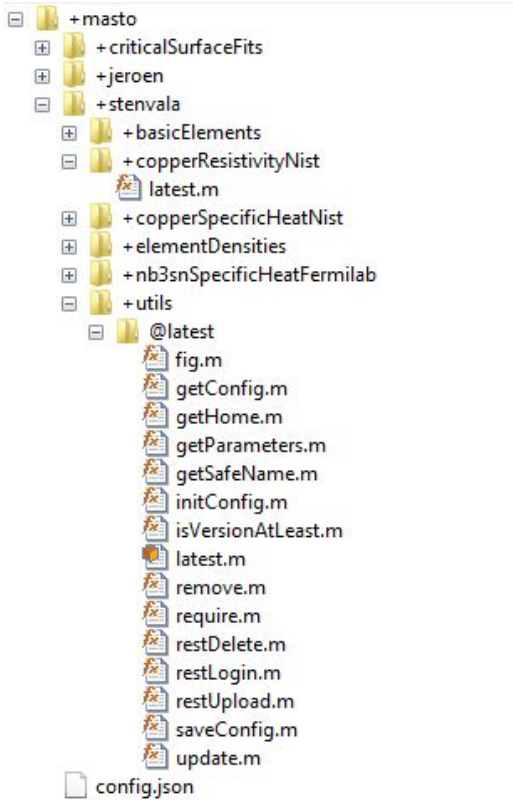
http://dev.masto.eu.com/public/api/languages/language/matlab

- Needs initialization script
- Then, require some material (also specific version can be required in the future, default is latest)

```
masto.stenvala.utils.latest.require('demo', 'epoxy-thermal-conductivity');
```

Community

Material




- And use

```
T = linspace(4.2, 300, 1e3);
thermalCond = masto.demo.epoxyThermalConductivity.latest(T);
figure(1);
plot(T, thermalCond);
```

# Future

- Get funding and realize the plan, next week I will send my first real application, so far I have done everything on my free time

# Conclusions

- We have an idea to build new kind of a research infrastructure/social media where material property data is in the core
- Currently my focus in TUT is in MASTO, extending the demo and make a real project from it (either internally or in an European consortium with partners from FuSuMaTech consortium, I try both)
- MASTO is tomorrow's platform for sharing material property data and using it in modelling with ANY software
- There is something for all the stakeholders around material property data