

# LaMMB Sample and Measurement Database

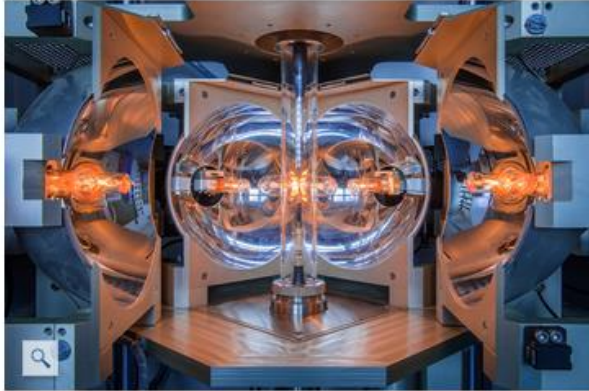
Matthias Zalden,  
Bastian Klemke,  
Klaus Kiefer

Sample Environment (NP-ASE)  
HZB, 11.06.2019

- LaMMB Sample and Measurement Database
  - LaMMB?!
  - Motivation / challenges
  - Data storage
  - Structure of data base
  - Software integration

# LaMMB?!

## CoreLab Quantum Materials



Optical zone melting furnace  
Photo: M. Setzpfandt

The CoreLab Quantum Materials offers a suite of instruments and methods for the synthesis and the investigation of new materials relevant for energy and information technologies. The methods are quite general and can be applied to many other material classes. This CoreLab makes them available to all HZB scientists, external scientists and also commercial users.

If you wish to use this CoreLab, please register [here](#).

### The CoreLab of Quantum Materials consists of three units:

- **Crystal lab**: Synthesis of materials in polycrystalline form, phase analysis, single crystal growth on request
- **Sample preparation lab**: Preparation of materials for further investigations, single crystal orientation, cutting, polishing, etc.
- **Bulk properties lab**: Measurements of a wide range of physical properties as function of temperature, field, and pressure, such as electrical and thermal conductivity, magnetization, AC and DC susceptibility, specific heat, and electri

## LaMMB

Laboratory for Magnetic Measurements at Helmholtz-Zentrum Berlin



[www.helmholtz-berlin.de/quellen/corelabs/quantum-materials](http://www.helmholtz-berlin.de/quellen/corelabs/quantum-materials)



Prof. Dr. Bella Lake  
*Head of Institute*  
*EM-IQM*



Dr. Konrad Siemensmeyer  
*Coordinator*  
*CoreLab Quantum Materials*



Dr. Nazmul Islam



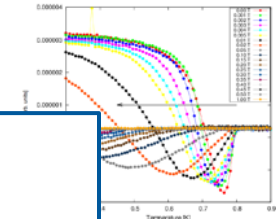
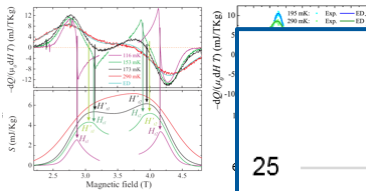
Dr. Bastian Klemke



Dr. Ralf Feyerherm

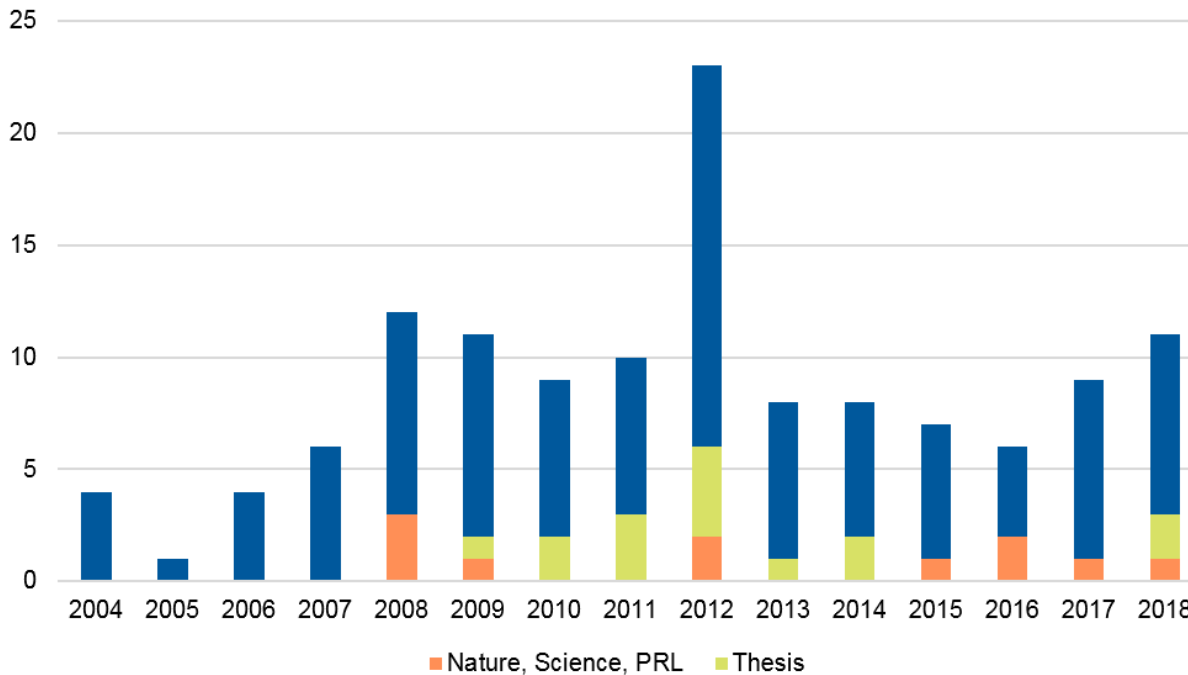
## Laboratory for Magnetic Measurements at Helmholtz-Zentrum Berlin

magnetocaloric effect and entropy of a Bose-Einstein condensate in the insulating antiferromagnet  $\text{Cu}(\text{NO}_3)_2 \cdot 2.5\text{H}_2\text{O}$



... of a bulk metal gas measured developed In situ-Low-Temperature (ISLTS). The arrow denotes strengths.

### LaMMB Publications (since 2017 CoreLab Quantum Materials)



PPMS (LS 220)

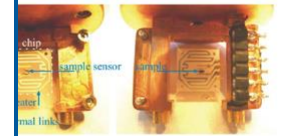
Vibrating  
Magnetometer



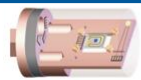
set-up for measurements of dielectric constant



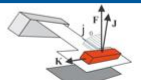
<sup>3</sup>He-stick CM-8T (LS 106)



meter set-up for heat capacity and magnetocaloric effect measurements



set-up for heat capacity and magnetocaloric measurements



cantilever magnetometer

Holmami, J.-O.; Kiefer, K.; Genstner, S.; Sidirinsky, D. & Ferry, R. S. "Dirac Strings and magnetic Monopoles in the Spin Ice  $\text{Dy}_2\text{Ti}_2\text{O}_7$ " *Science*, 2009, 326, 411

Klemke, B. "Thermal Properties of Dysprosium-Titanate in the Spin Ice state" Dissertation, Technische Universität Berlin, 2011

Kraemer, C.; Nikseresht, N.; Platek, J. O.; Tsyrlin, N.; Piazza, B. D.; Kiefer, K.; Klemke, B.; Rosenbaum, T. F.; Aeppli, G.; Gannarelli, C.; Prokes, K.; Podlesnyak, A.; Strässle, T.; Keller, L.; Zaharko, O.; Krämer, K. W. & Ronnow, H. M. "Dipolar Antiferromagnetism and Quantum Criticality in  $\text{LiErF}_4$ " *Science*, 2012, 336, 1416-1419

# Motivation / challenges

## Recommendation 7: Safeguarding and Storing of Primary Data

*Primary data as the basis for publications shall be securely stored for ten years in a durable form in the institution of their origin.*



WILEY-VCH

DFG

Recommendation 7: Safeguarding and Storing of Primary Data

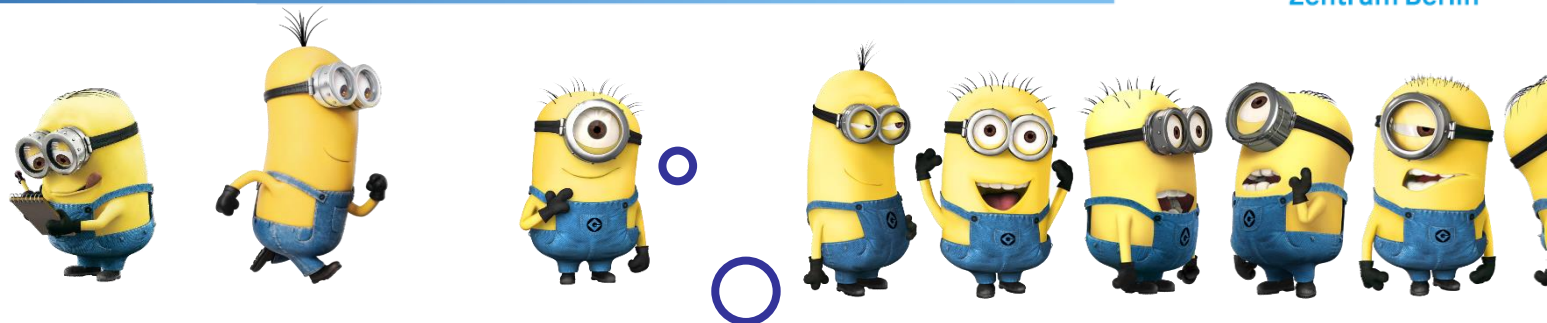
75

### Commentary

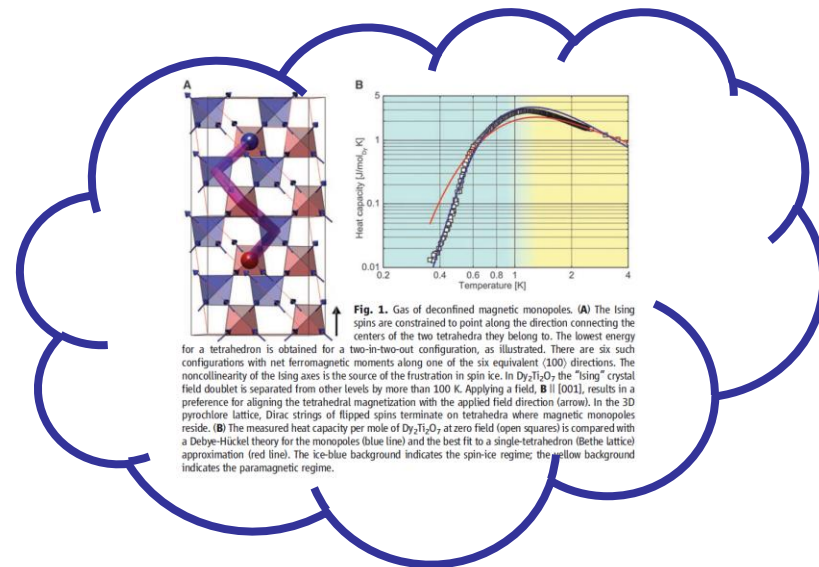
A scientific finding normally is a complex product of many single working steps. In all experimental sciences, the results reported in publications are generated through individual observations or measurements adding up to preliminary findings. Observation and experiment, as well as numerical calculation (used as an independent method or to support data analysis), first produce “data”. The same is true for empirical research in the social sciences.

Experiments and numerical calculations can only be repeated if all important steps are reproducible. For this purpose, they must be recorded. Every publication based on experiments or numerical simulations includes an obligatory chapter on “materials and methods” summing up these records in such a way that the work may be reproduced in another laboratory. Again, comparable approaches are common in the social sciences, where it has become more and more customary to archive primary survey data sets in an independent institu-

User



Sample





## PPMS-14T

### Physical Properties Measurement System (Quantum Design)

The PPMS is a standard instrument system in many laboratories in the world. Its relatively robust nature makes it a uncomplicated tool not only for specialists but also for the occasional user. The built in measurement options like vibrating sample magnetometer (VSM) or electric resistivity are backed by LaMMB-designed measurement options like the dielectric constant measurement.



Technical data	
Room	P-007
Magnetic field (min-max)	14T
Temperature (min-max)	1.8K..400K (1000K)
max. size of sample	

#### measurement options

Option	typ. resolution	max. resolution
<a href="#">vibrating sample magnetometer for PPMS</a>	0.5%	1e-9 Am <sup>2</sup>
<a href="#">DC-resistivity for PPMS</a>	0.01%	
<a href="#">heat capacity for PPMS</a>	2%	K @ 2K
<a href="#">dielectric properties for PPMS</a>	0.0001	
<a href="#">thermal transport measurements for PPMS</a>	5%	2e-6 W/K
<a href="#">AC Suszeptibility for PPMS</a>		



## CM-14.5T

### 14.5T Cryomagnet with VTI or 3He Stick

Versatile low temperature system for high resolution caloric measurements, low temperature dielectric constant, resistivity and magnetization measurements.

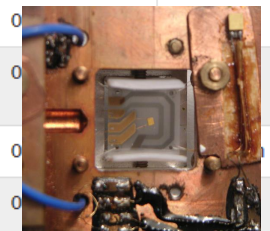
The cryogenic system consists of a Oxford Instruments 14.5 T magnet and a 3He insert. The measurement options were designed and constructed by the instrument responsables which allows for a broad adaptability of both the hardware and the measurement software. The system is mainly dedicated to high resolution caloric measurements at temperatures between 280 mK and 20 K. For heat capacity measurements different techniques like quasi-adiabatic heat pulse, pulse relaxation and continuous cooling and heating can be applied. Magnetocaloric measurements are performed by the quantitative quasi-isothermal magnetocaloric effect method. The systems typical resolution for caloric measurements is about 0.1%. The setup can also be used for low temperature measurements of dielectric constant, electric resistivity and with some restrictions for magnetization.



Technical data	
Room	LS113
Magnetic field (min-max)	14.5T
Temperature (min-max)	0.28K..300K
max. size of sample	

#### measurement options

Option	typ. resolution	max. resolution
<a href="#">high precision heat capacity setup for 3He stick</a>		
<a href="#">magnetocaloric effect setup for 3He stick (setup identical with HeatCap CM-14.5T 3He)</a>		
<a href="#">DC-resistivity for 3He stick</a>		
<a href="#">dielectric properties for 3He stick (dielectric constant, polarisation, pyrocurrent) only dielectric constant 50Hz..20kHz</a>		



## Calendar of Scheduled Experiments

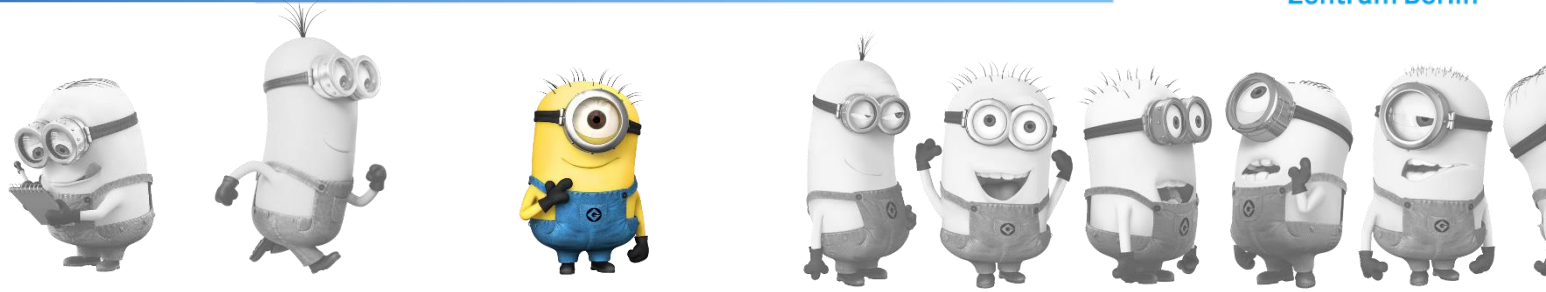
LaMMB

◀ March 2019 ▶

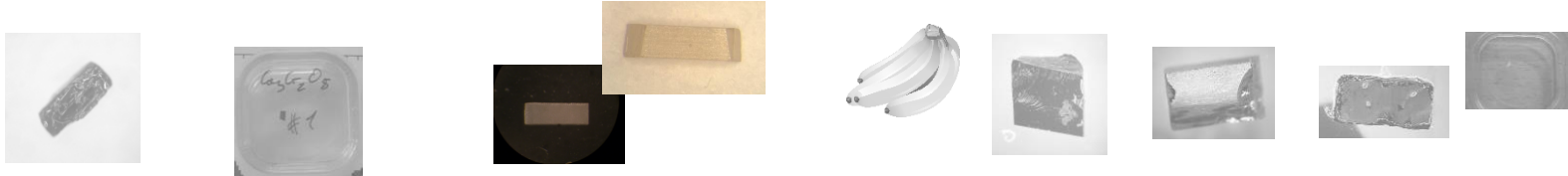
Click on a green field to insert a date (only own measurements) or click on an instrument to request an ordered measurement.

Date	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Day	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu
<u>CM-14.5T</u>	B. Klemke empty cp-chip service																				
<u>CM-17T</u>	service																				
<u>PPMS-14T</u>	+	+	+	Kubatzki TUB ceramics (~20 samples)							Kai Chen NbTi			Kai Chen NbTi	+	+	+	+	Chen Luo DyCo5 thin film		+
<u>MPMS-VSM-7T</u>	Diana service				+	+	+	+	+	+	K.Prokes						+	+	+	+	
<u>Custom</u>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<u>Comsol Multiphysics</u>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

**User**



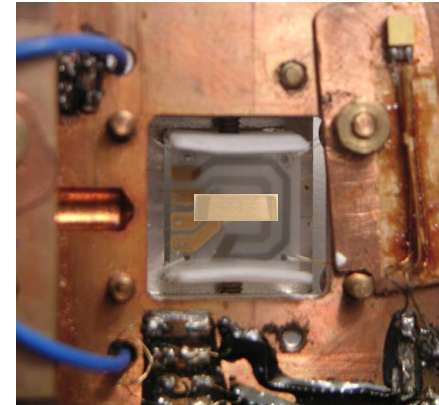
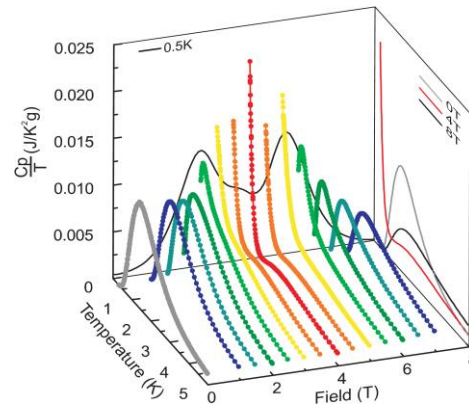
**Sample**



**Device and  
measurement option**



**Measurement  
series**



# Data storage

# Storage Area Network (SAN)

Home Directories

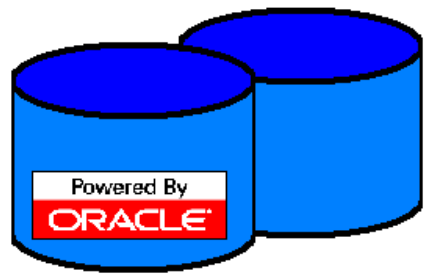
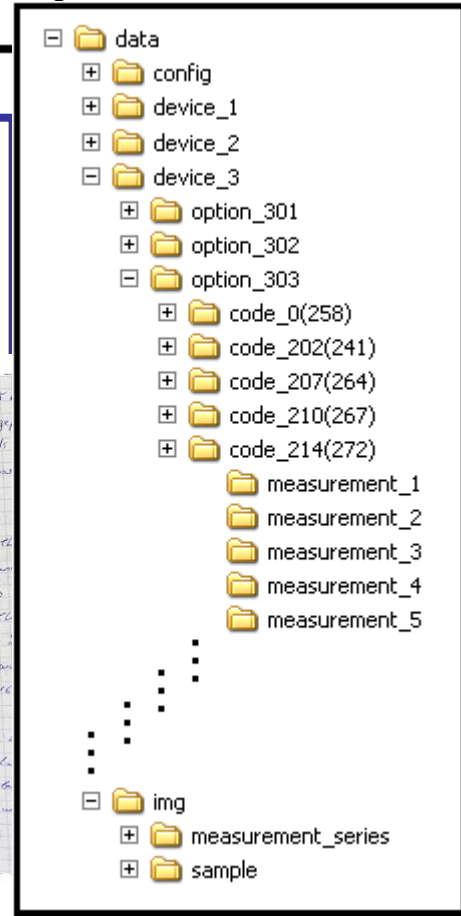
Group Directories

bensc-probenumgebung

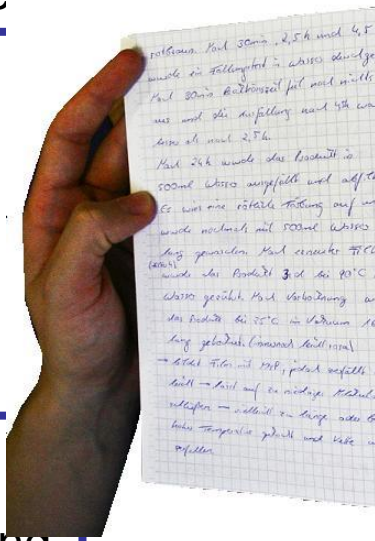
bensc-lammb



**Storage of  
measuerment data**  
in hierachical  
directory structure



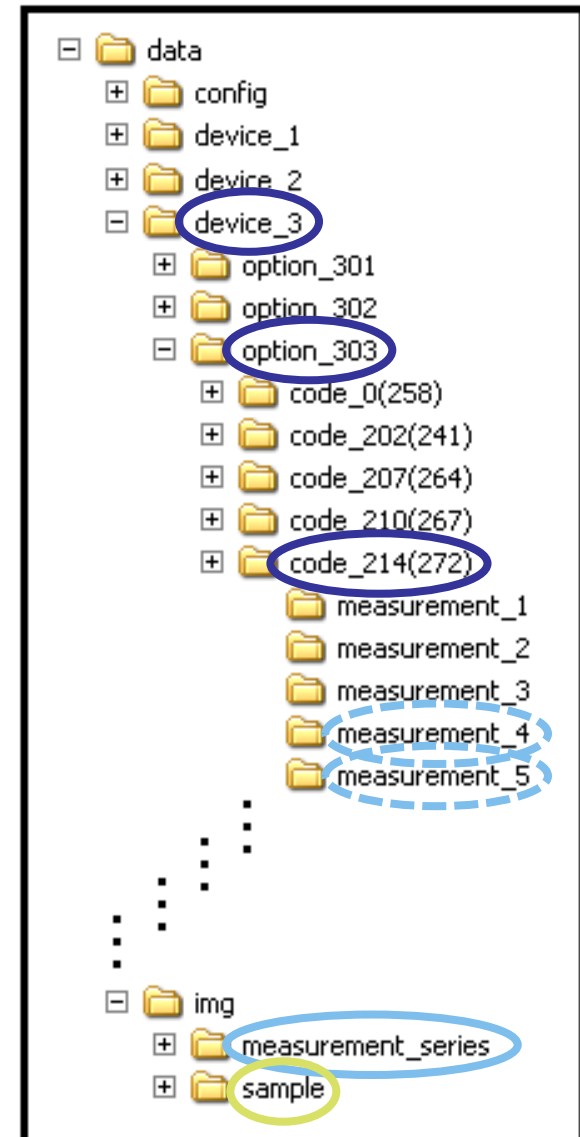
**Database Server**  
measurement data and  
sample management



**Lab Book**

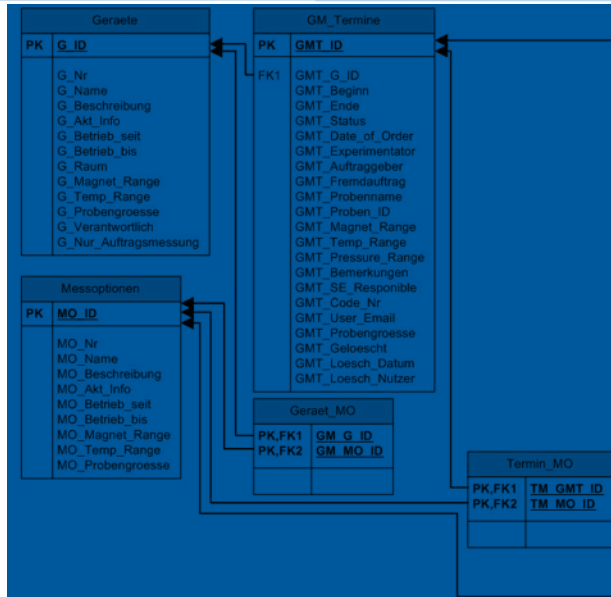
## storage of measurement data (SAN)

- Hierarchical directory structure  
**Device / Option / Code / ...**
- Encrypted Data Upload  
(Authentication via SSH-key)
- Very limited number of user with read access
- No user with write access
- Frequent central data backup

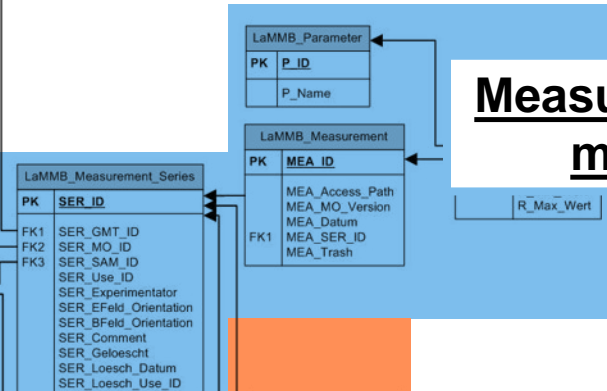


# Structure of data base

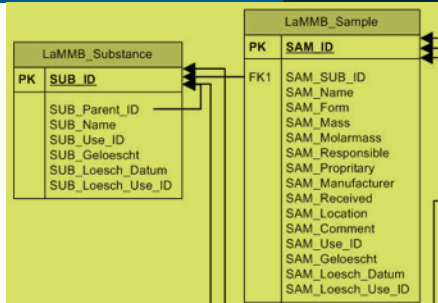
## Device and measurement option & Calendar of Scheduled Experiments



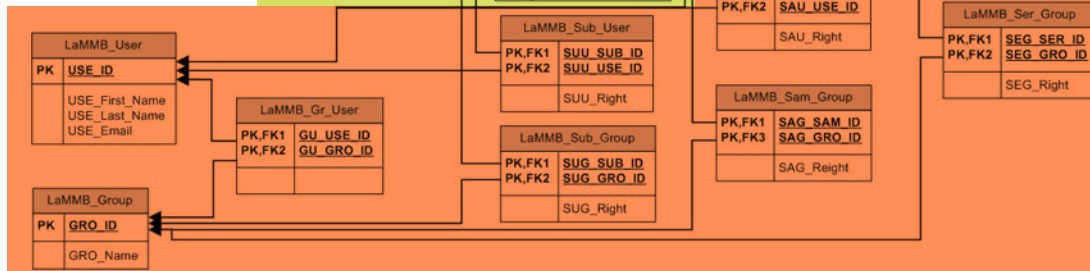
## Measurement series management



## Sample management



## User and access rights management



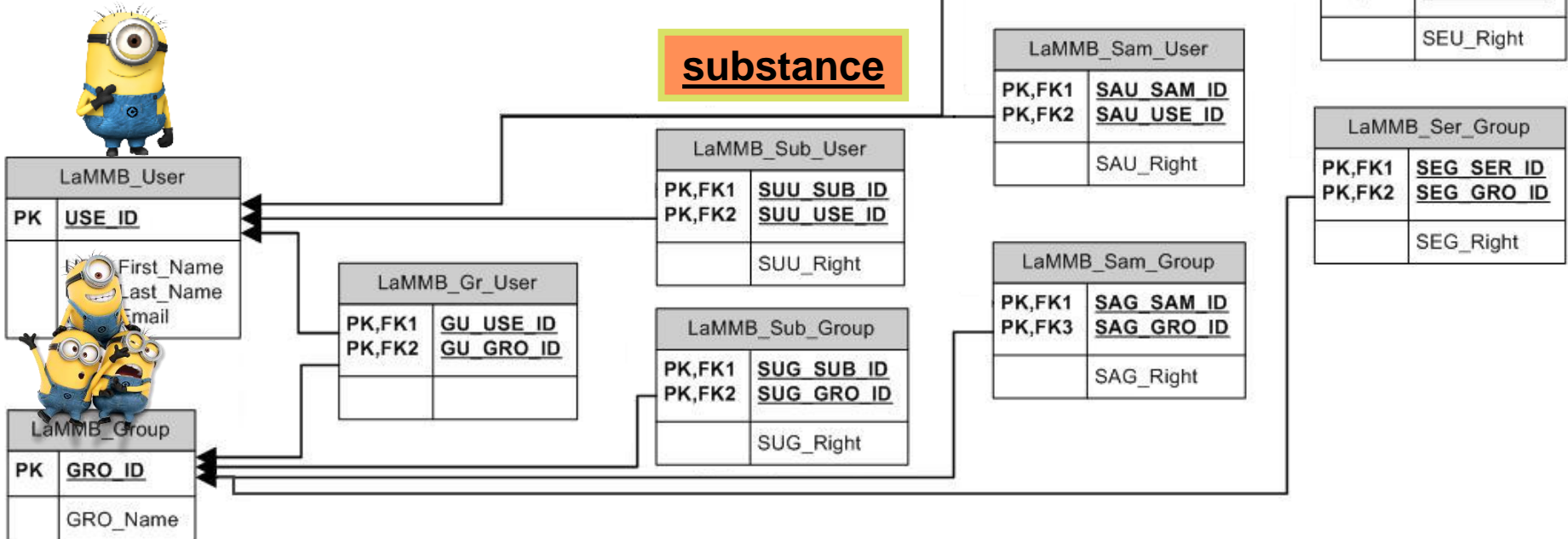


## User and access rights management

## measurement series

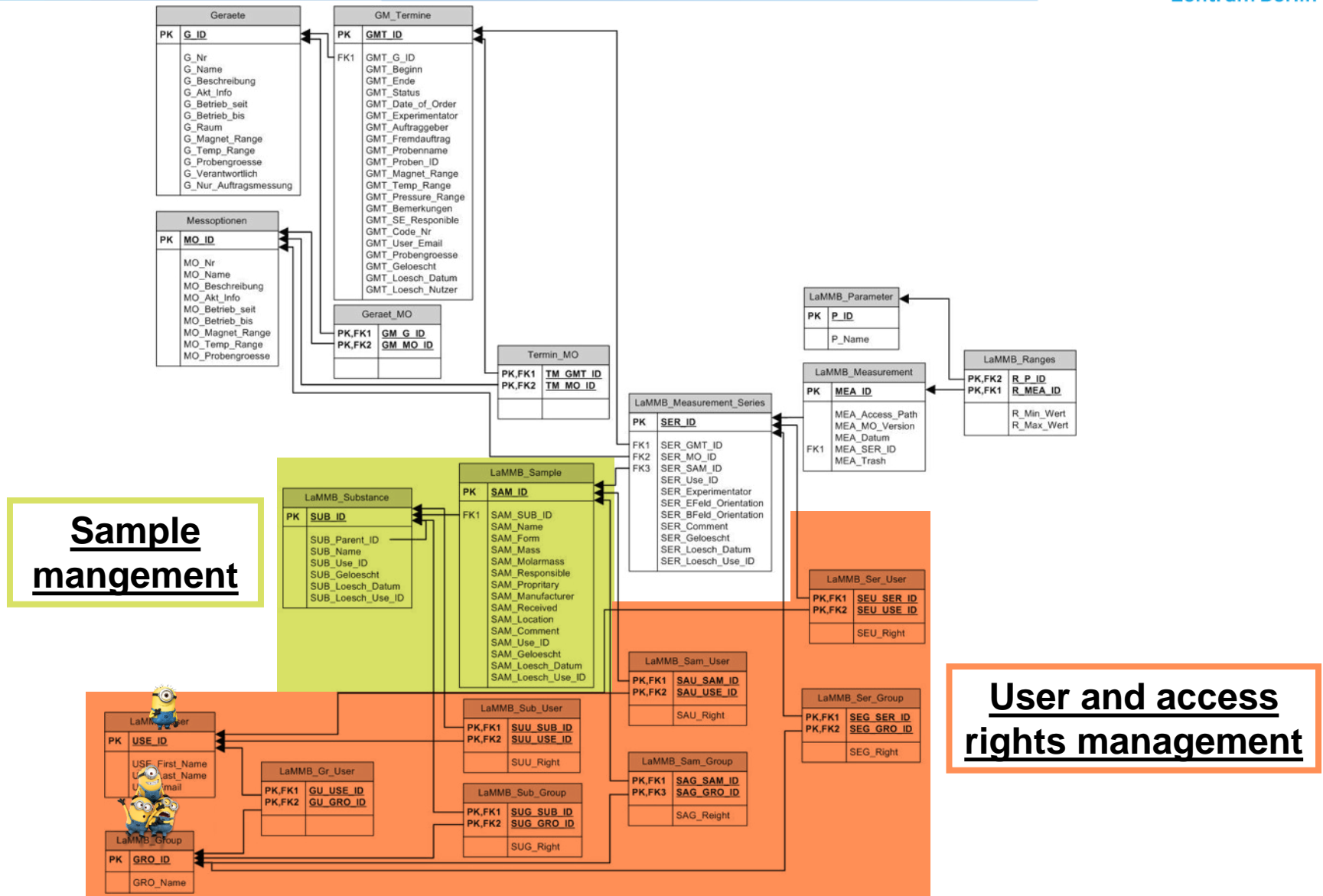
## sample

## substance

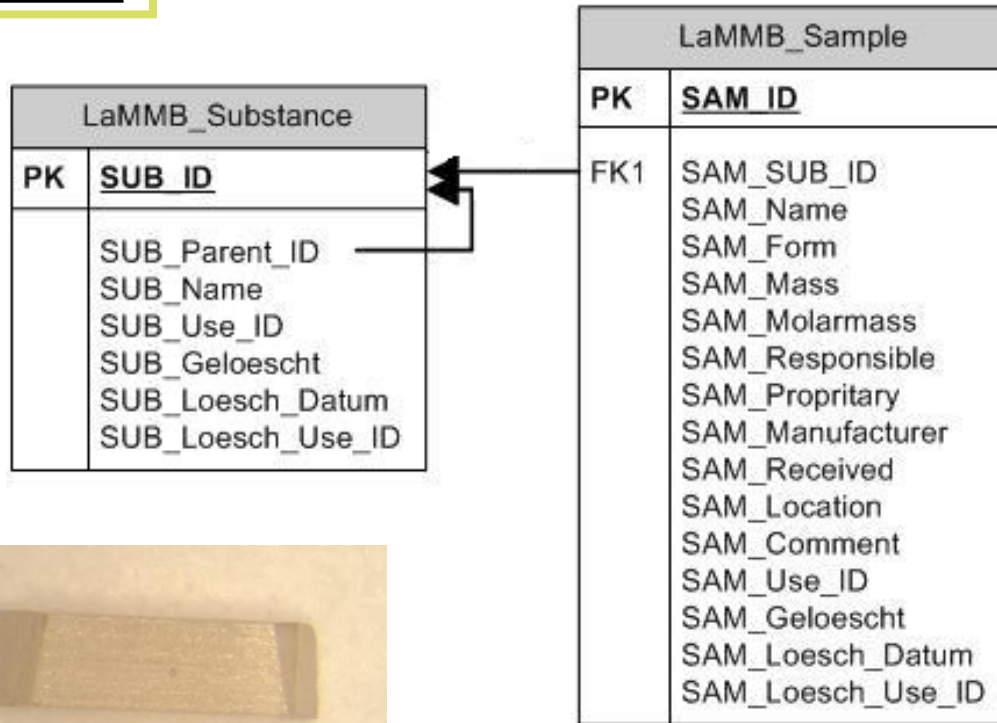


[www.helmholtz-berlin.de/bin/lammb/samplemanagement.pl](http://www.helmholtz-berlin.de/bin/lammb/samplemanagement.pl)

# Structure of Data Base

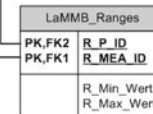
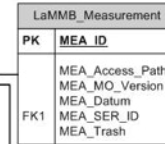
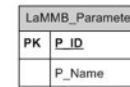
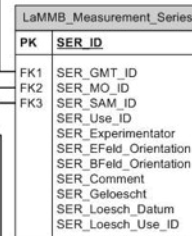
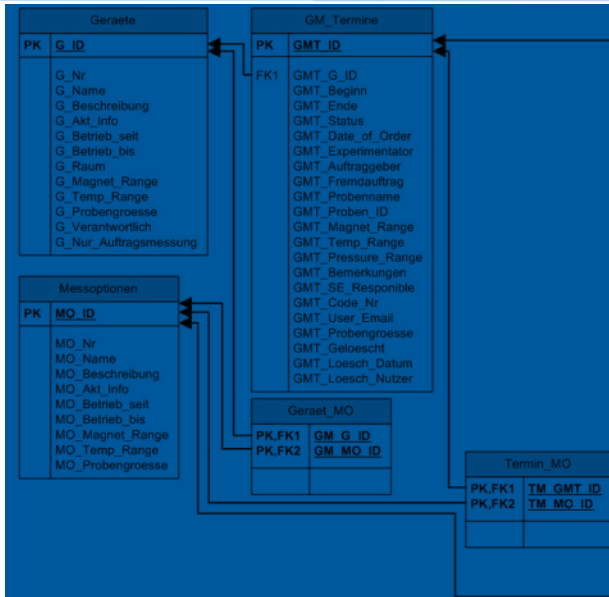


## Sample mangement

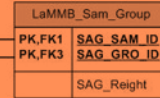
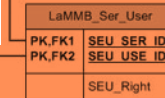
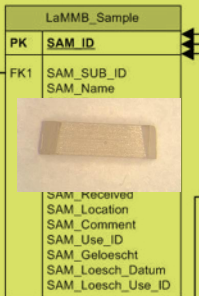
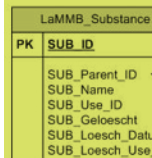


[www.helmholtz-berlin.de/bin/lammb/samplemanagement.pl](http://www.helmholtz-berlin.de/bin/lammb/samplemanagement.pl)

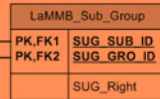
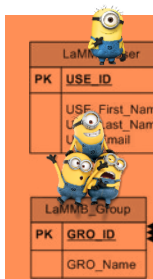
## Device and measurement option & Calendar of Scheduled Experiments



## Sample management



## User and access rights management



# Structure of Data Base

Termin - Mozilla Firefox  
https://www.helmholtz-be 90%

**PPMS-14T**  
Physical Properties Measurement System (Quantum Design)

Status: voller Betrieb

Datum: 14.03.2019

Status: **bestätigt**

eingetragen am: 13.03.2019

belegt von: Kai Chen

Termin typ:  Service  Auftragsmessung  eigene Messung

**Messoptionen**

- VSM PPMS vibrating sample magnetometer for PPMS
- Res PPMS DC-resistivity for PPMS
- HeatCap PPMS heat capacity for PPMS
- Dielectric PPMS dielectric properties for PPMS
- Thermal Transport PPMS thermal transport measurements for PPMS
- ACSusz PPMS AC Suszeptibility for PPMS

Code: 1089

Proposer (full name): Kai Chen

name of experimentalist: Kai Chen

**GM\_Termine**

Code: 1089

Proposer (full name): Kai Chen

name of experimentalist: Kai Chen

Sample Name \*: NbTi

Sample Size \*: 10mm\*10mm

Field Range \*: 5T

Temperature Range \*: 2-300K

Pressure Range \*: 1 atm

Name of SE responsible: Klemke, Bastian (NP-ASE)

Name of SE responsible 2:

Bemerkungen:

Termin speichern

**Equipment tauschen**

PPMS-14T ersetzen durch: PPMS-14T

Ersetzung vornehmen

**Equipment hinzufügen**

CM-14.5T Equipment hinzufügen

Termin löschen

Fenster schließen

## Device and measurement option & Calendar of Scheduled Experiments

LaMMB

March 2019

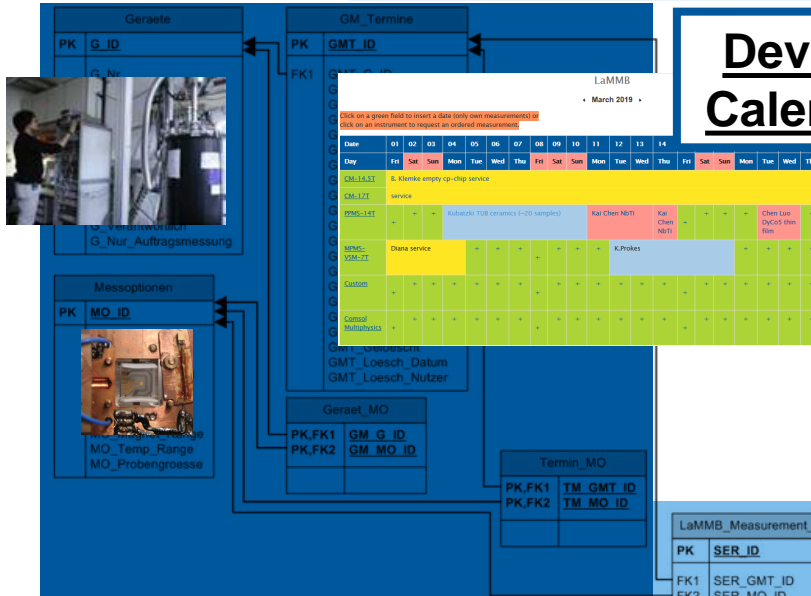
field to insert a date (only own measurements) or comment to request an ordered measurement.

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21		
Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu		
Klemke empty cp-chip service																						
service																						
+	+	Kubatzki TUB ceramics (~20 samples)					Kai Chen NbTi			Kai Chen NbTi	+	+	+	+	+	+	+	+	+	Chen Luo DyCo5 thin film	+	
Diana service				+	+	+	+	+	+	K.Prokes					+	+	+	+	+	+	+	+
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	

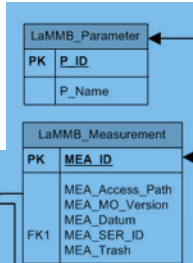


# Structure of Data Base

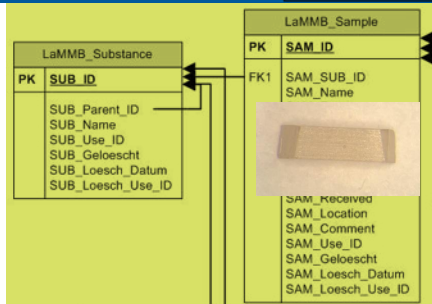
## Device and measurement option & Calendar of Scheduled Experiments



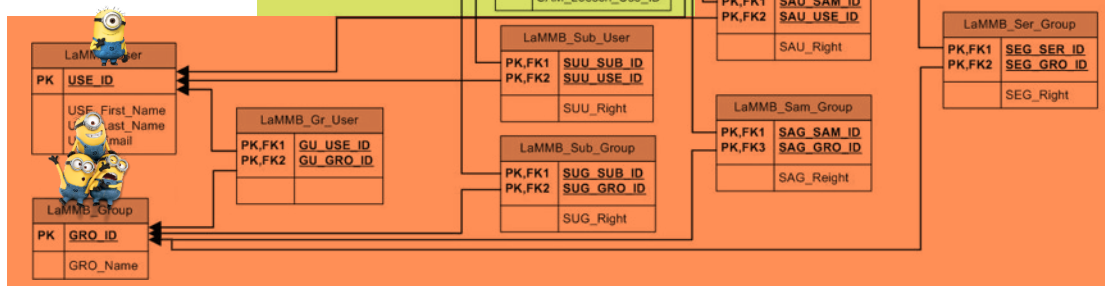
## Measurement series management



## Sample management



## User and access rights management



## Measurement series management

LaMMB_Measurement_Series	
PK	SER_ID
FK1	SER_GMT_ID
FK2	SER_MO_ID
FK3	SER_SAM_ID
	SER_Use_ID
	SER_Experimentator
	SER_EFeld_Orientation
	SER_BFeld_Orientation
	SER_Comment
	SER_Geloesch
	SER_Loesch_Datum
	SER_Loesch_Use_ID

LaMMB	
PK	P
	P

LaMM	
PK	M
FK1	M
	M
	M
	M
	M

**LaMMB - new measurement series**

**measurement series**

reservation code

measurement option

substance

sample

scientist(s)

orientation of electric field

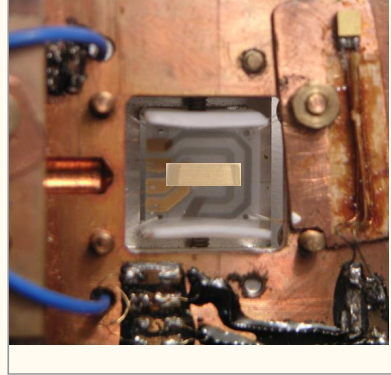
orientation of magnetic field

comment

owner of this dataset

delete measurement series

**pictures of the mounted sample**

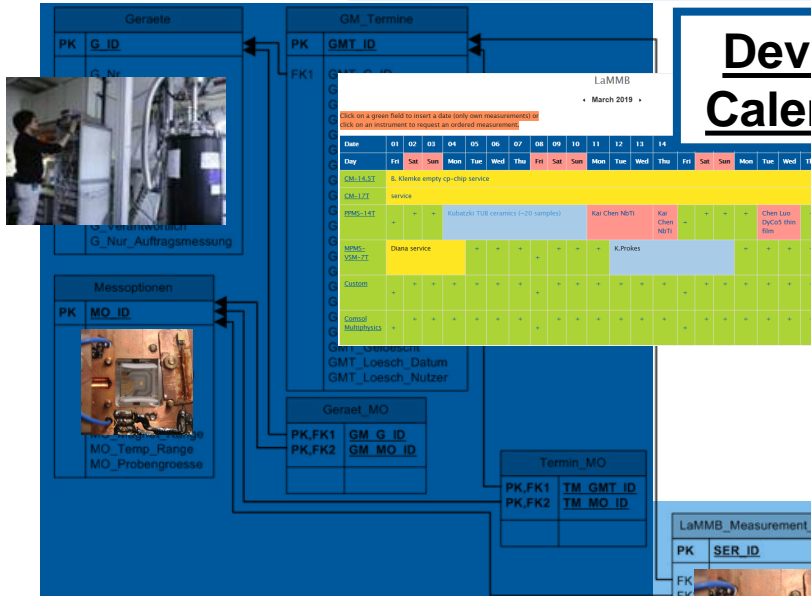


**user authorization**

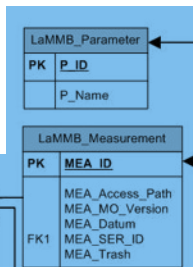
[www.helmholtz-berlin.de/bin/lammb/data\\_visualization.pl](http://www.helmholtz-berlin.de/bin/lammb/data_visualization.pl)

# Structure of Data Base

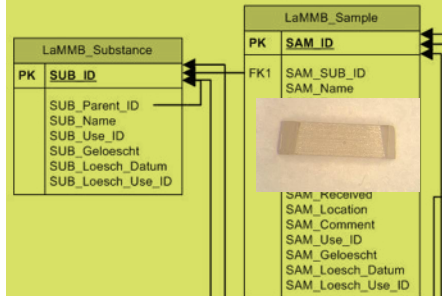
## Device and measurement option & Calendar of Scheduled Experiments



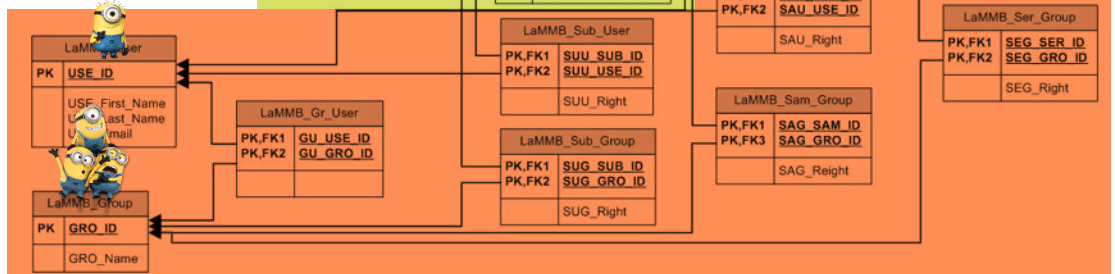
## Measurement series management



## Sample management



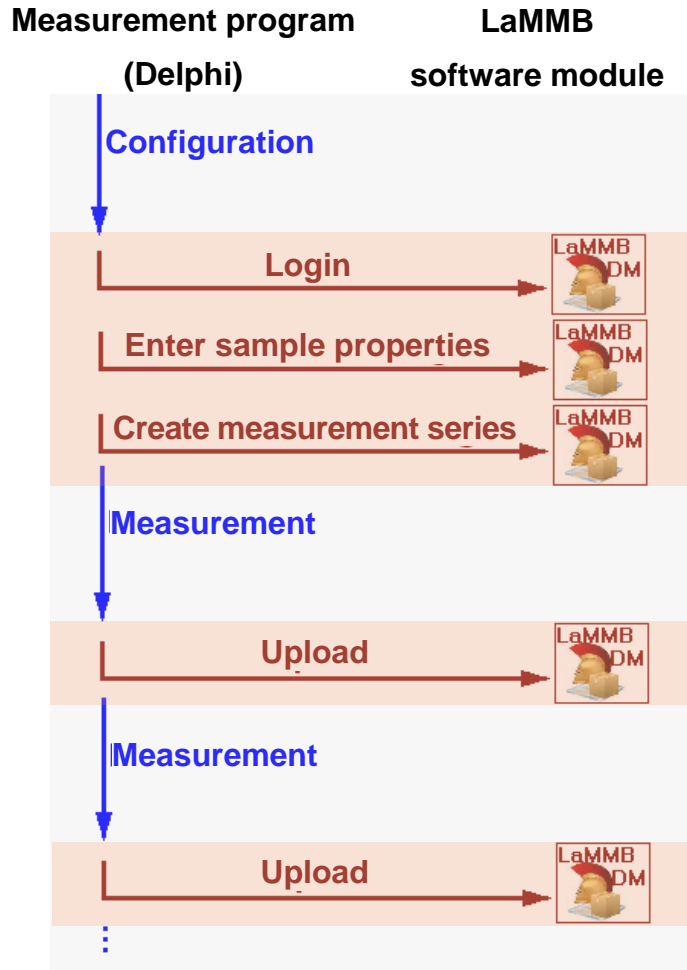
## User and access rights management



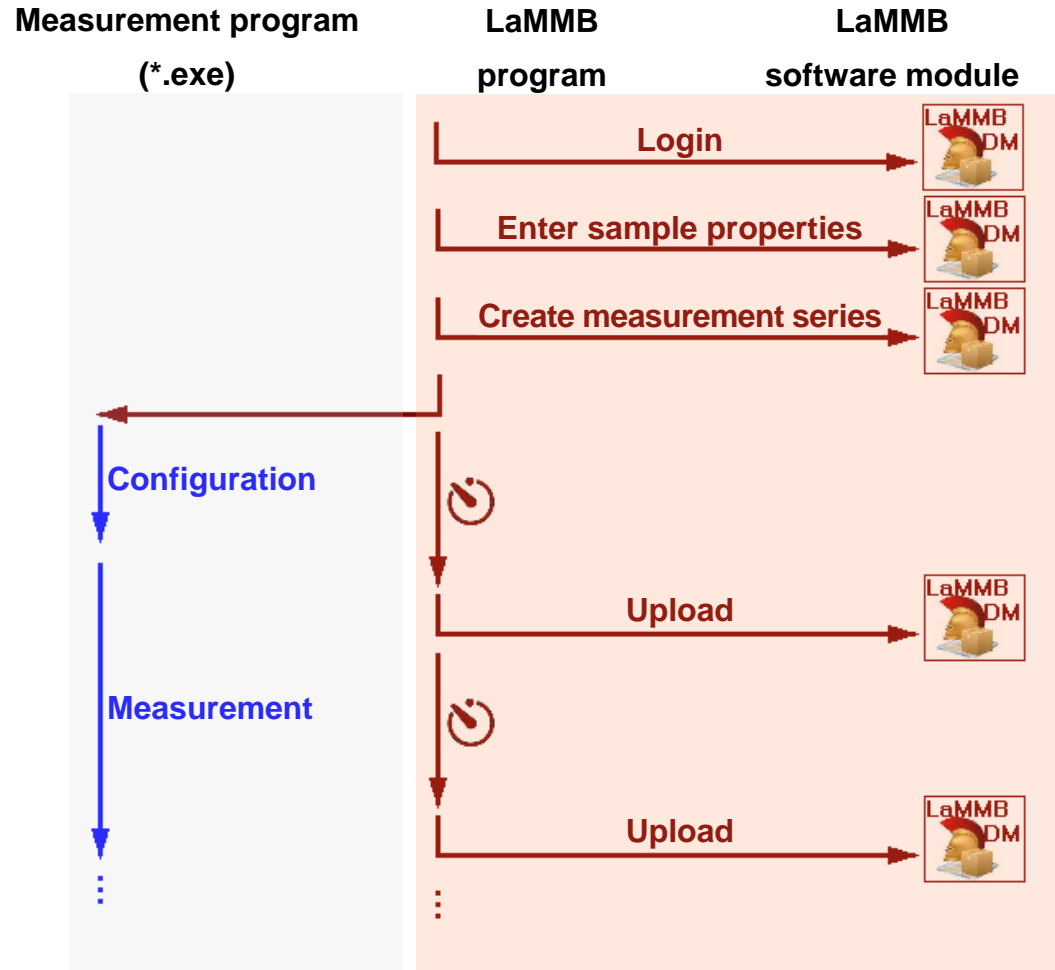


# Software integration

## Type 1

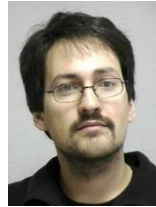


## Type 2



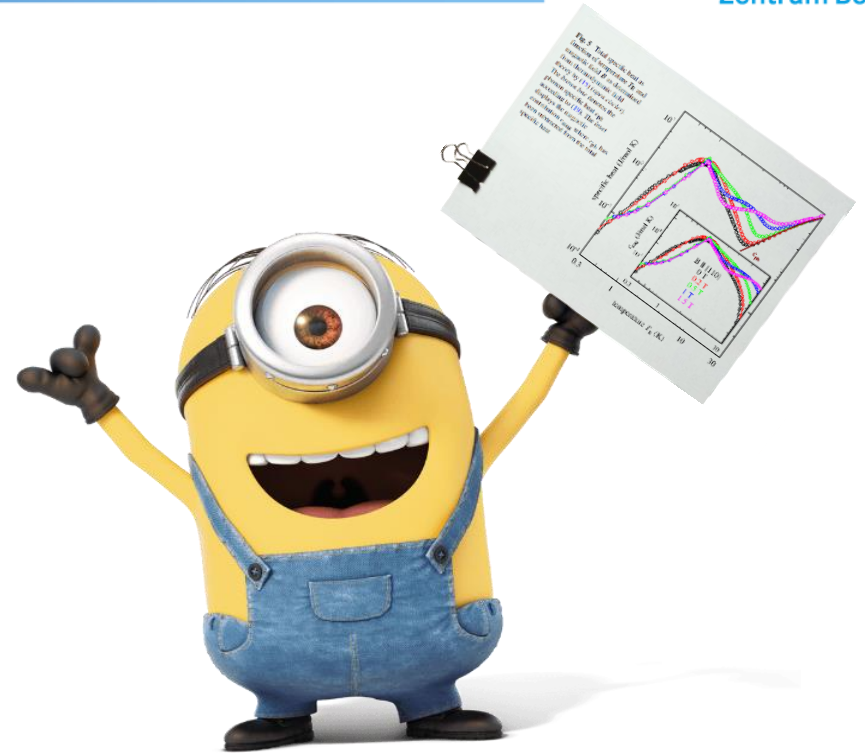


B. Klemke



K. Kiefer

**Thank you for  
your attention!**



M. Schröder



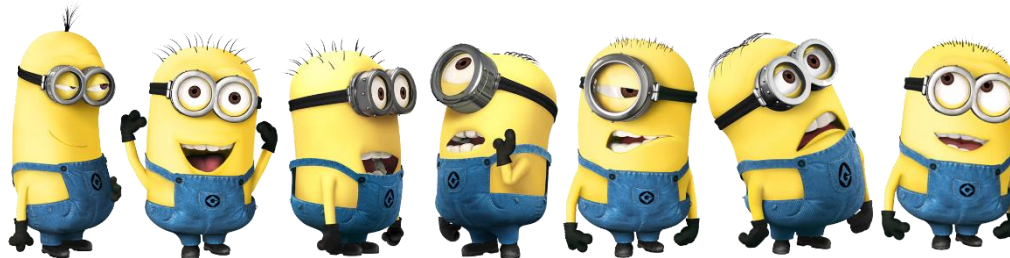
M. Zalden



P. Schlott



D. Eric



[www.helmholtz-berlin.de/user/experimental-infrastructures/lab-clusters/lammb/index\\_en.html](http://www.helmholtz-berlin.de/user/experimental-infrastructures/lab-clusters/lammb/index_en.html)

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