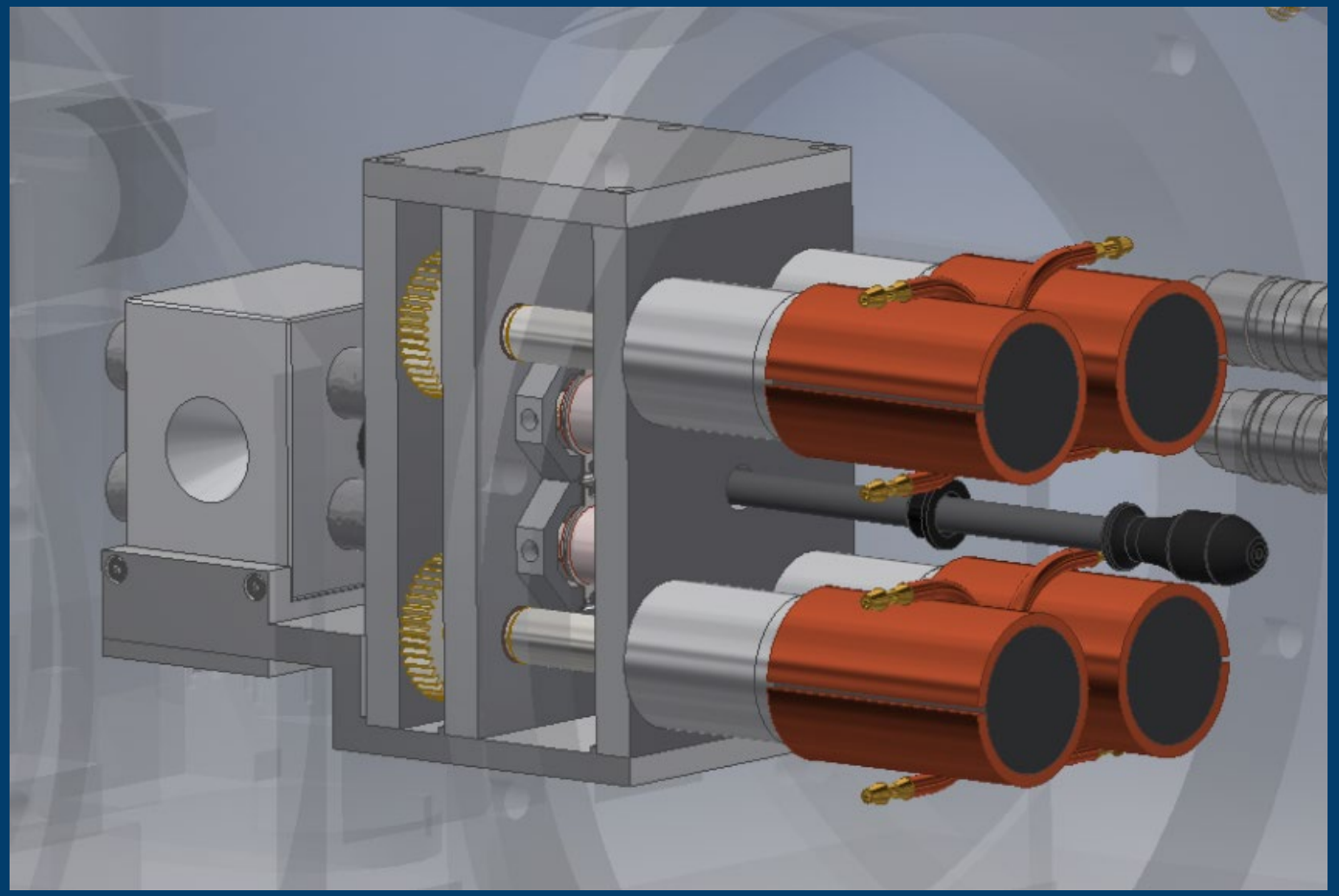
HALBACH ARRAY

ANDREAS MÖLLER

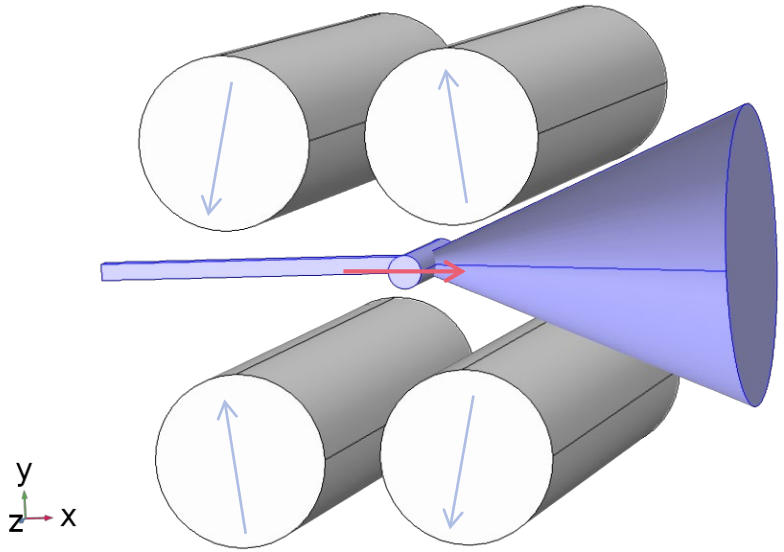


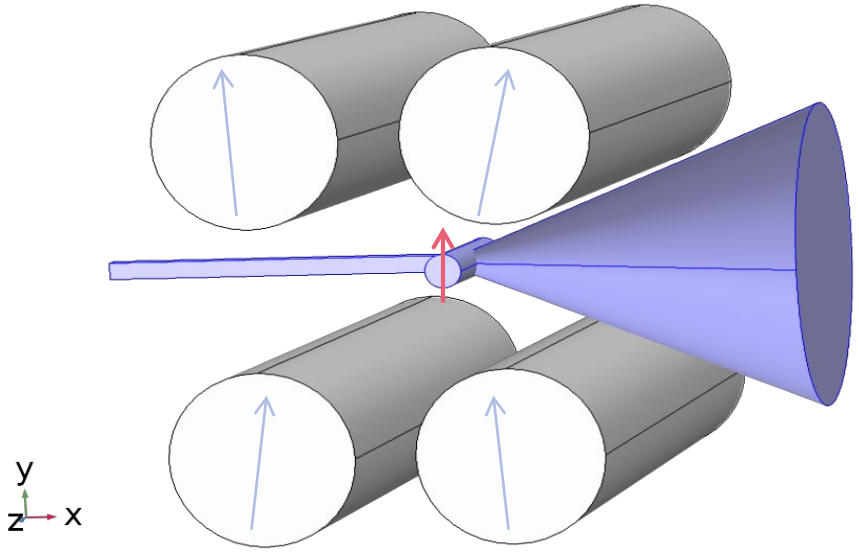
JÜLICH
Forschungszentrum

HALBACH ARRAY

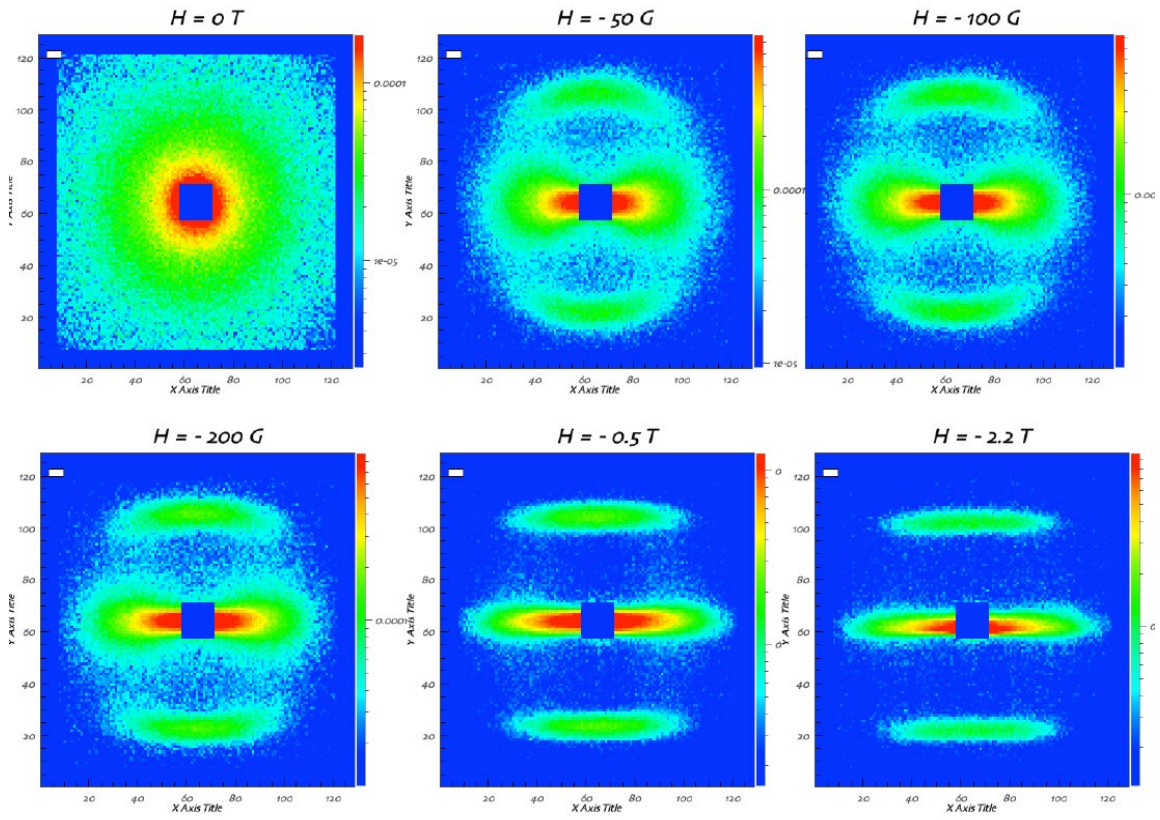
Overview

- Magnetic Field at Sample Position ± 0.5 T (?)

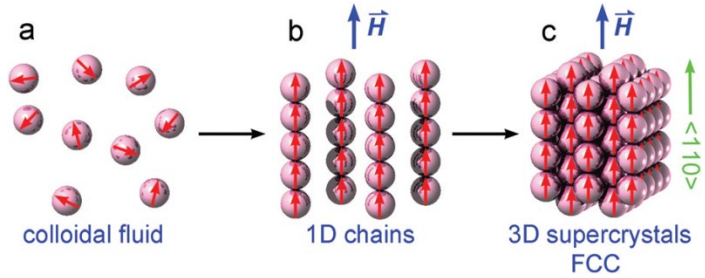




SCIENTIFIC CASE



N. Nandakumaran, JCNS-2

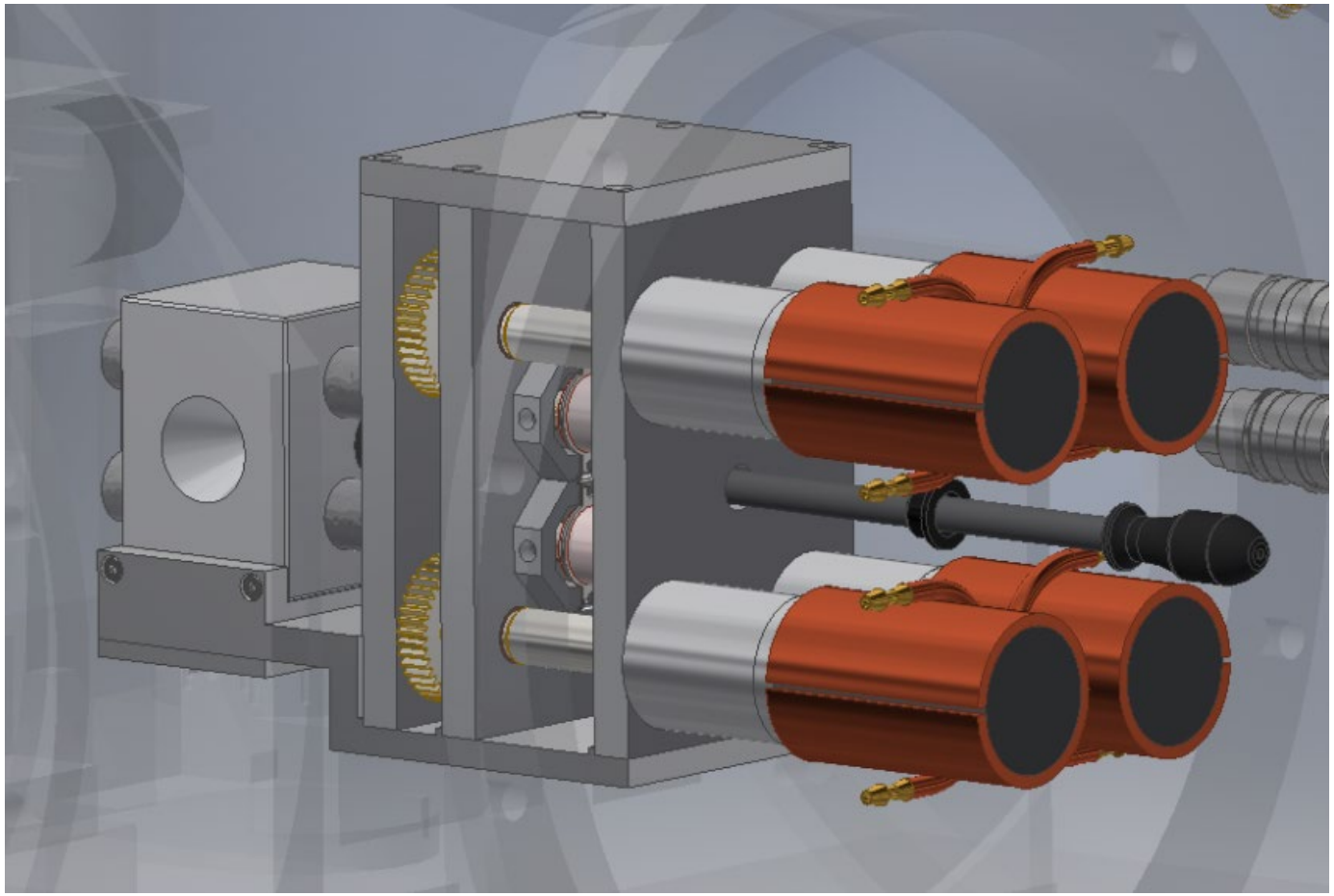


Z. Fu, et. al, Nanoscale 8, 43, (2016)

- Preferred orientation of ordered Structure of Nanoparticles
- Future Application on SANS Instrument manipulation of Spin Structure of ordered Nanoparticles

HALBACH ARRAY

Overview

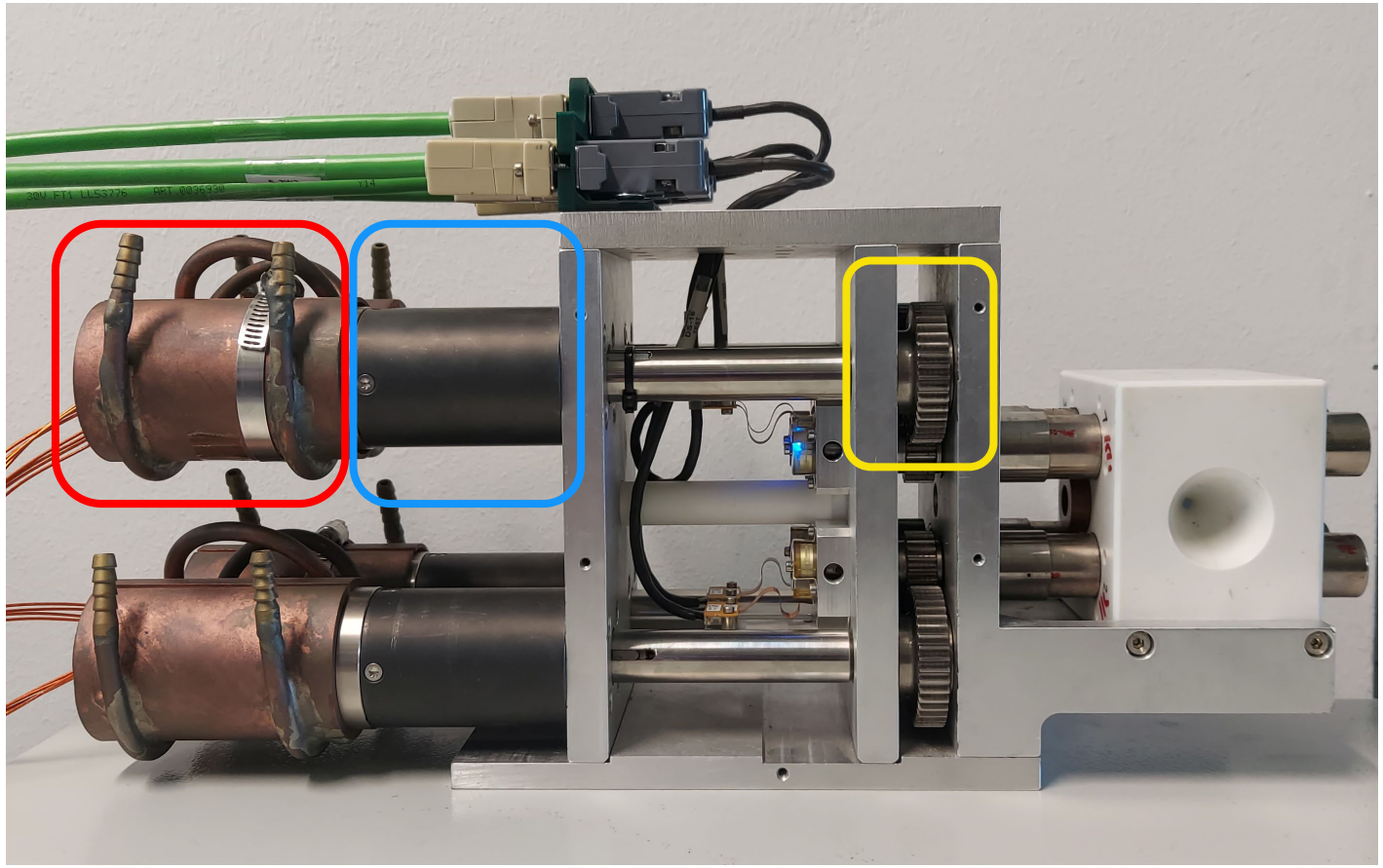


MECHANICS

Motor and Gearing

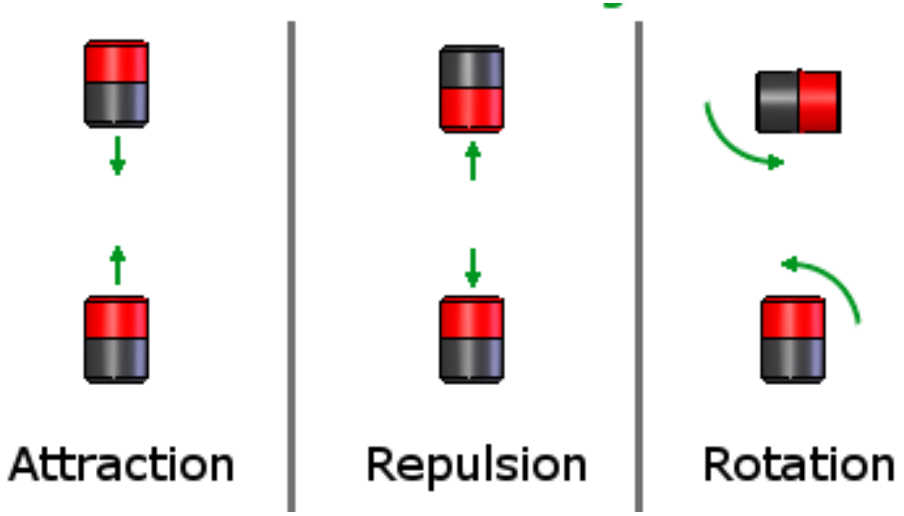
Motor and Gearing

- **Phytron VSS 43.200.2.5**
  - **2.5 A - 200 steps/rev**
- **Phytron VGPL42**
  - 293,89 / 1 Gear Ratio
- **Second Gearing**
  - 2 / 1 Ratio

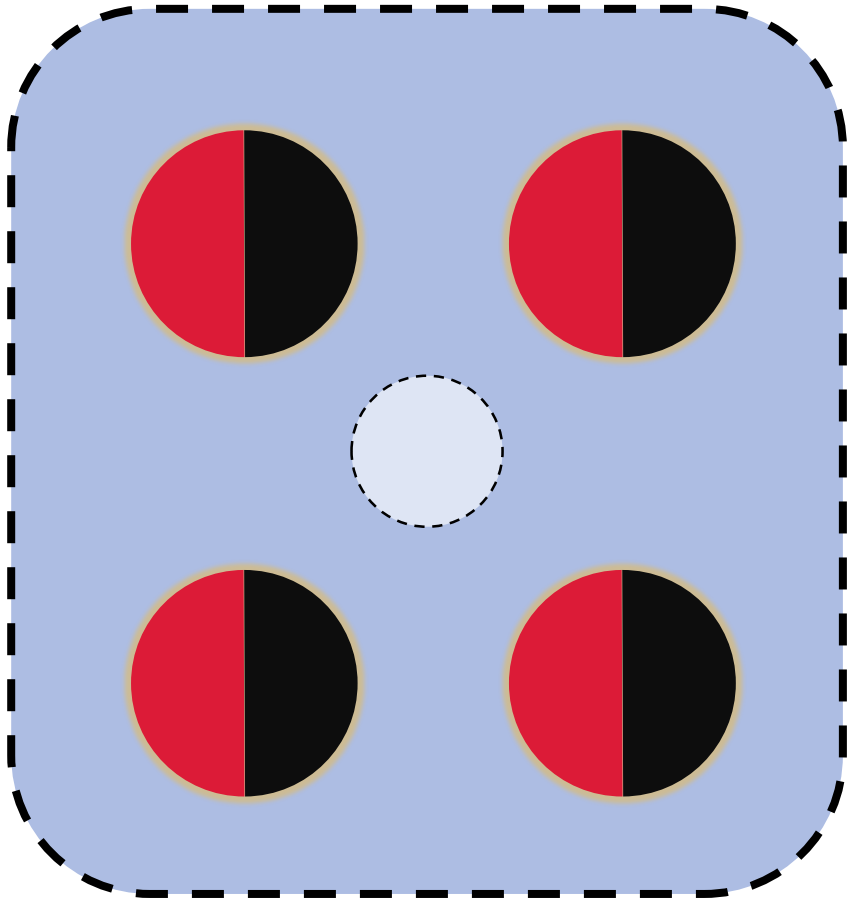


MAGNETIC FORCES

- Attraction and Repulsion during Rotation



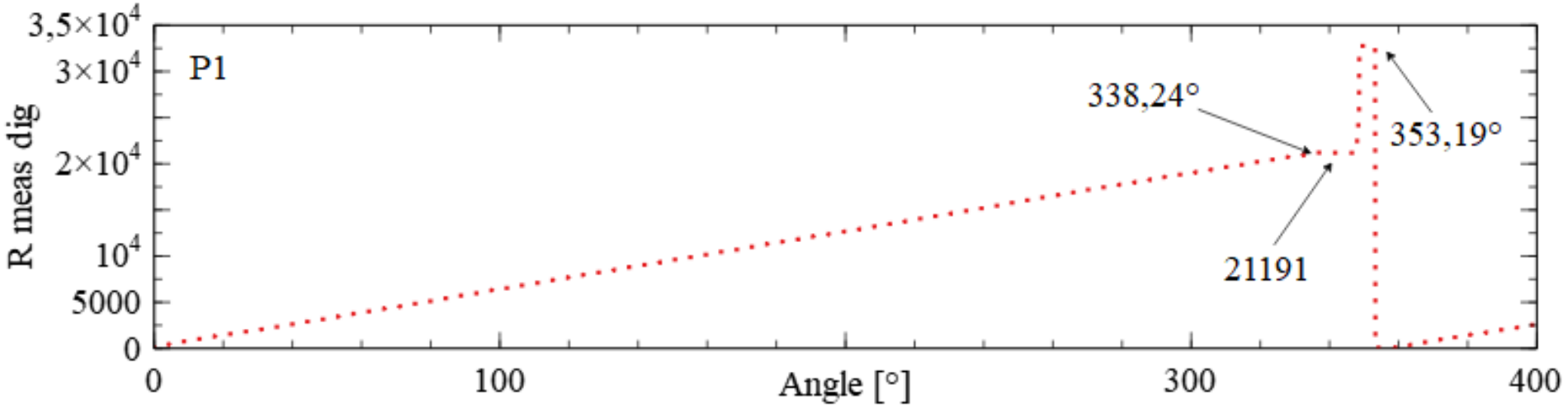
https://www.kjmagnetics.com/blog.asp?p=magnetic-forces



ELECTRONICS / CONTROL SYSTEM

Positioning

- Measuring Angle with analog Potentiometer



https://www.digikey.de/

ELECTRONICS / CONTROL SYSTEM

Positioning

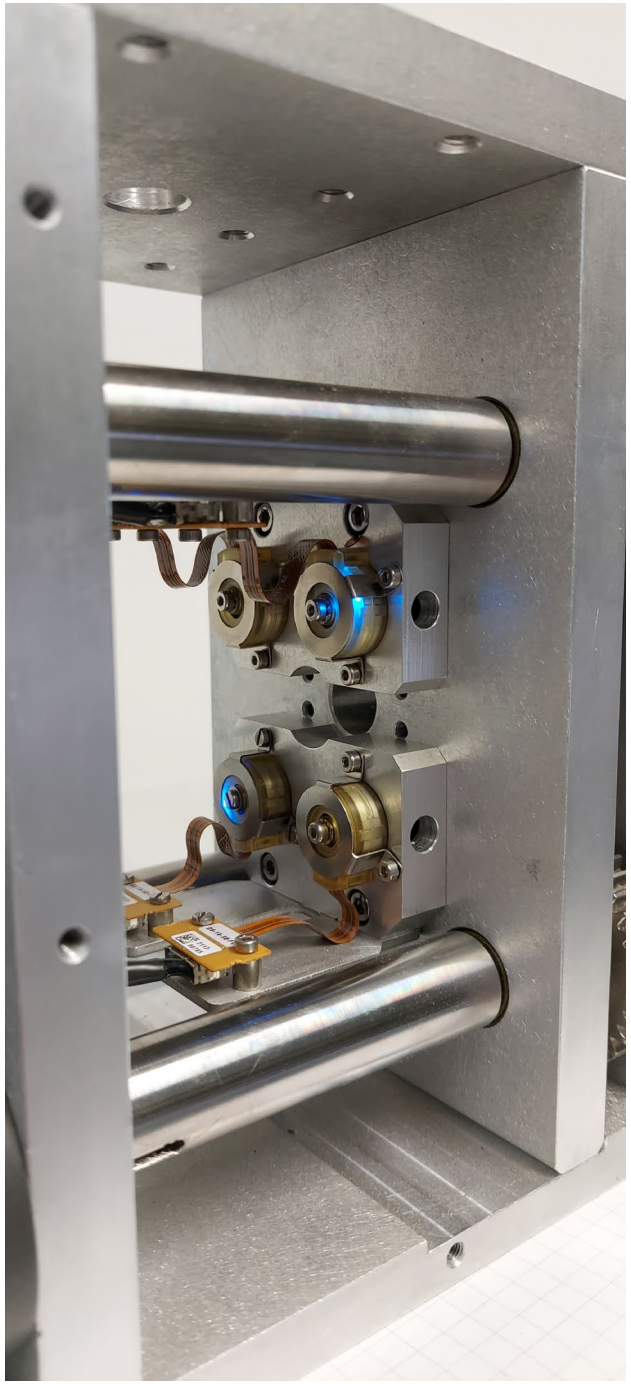
Netzer DS 16 (**16 mm OD**)	
Angular resolution	16 bit (SSI Interface)
Nominal position accuracy	±0.025°
Maximum operational speed	4,000 rpm

netzerprecision.com

ELECTRONICS / CONTROL SYSTEM

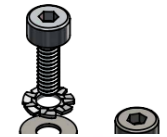
Positioning

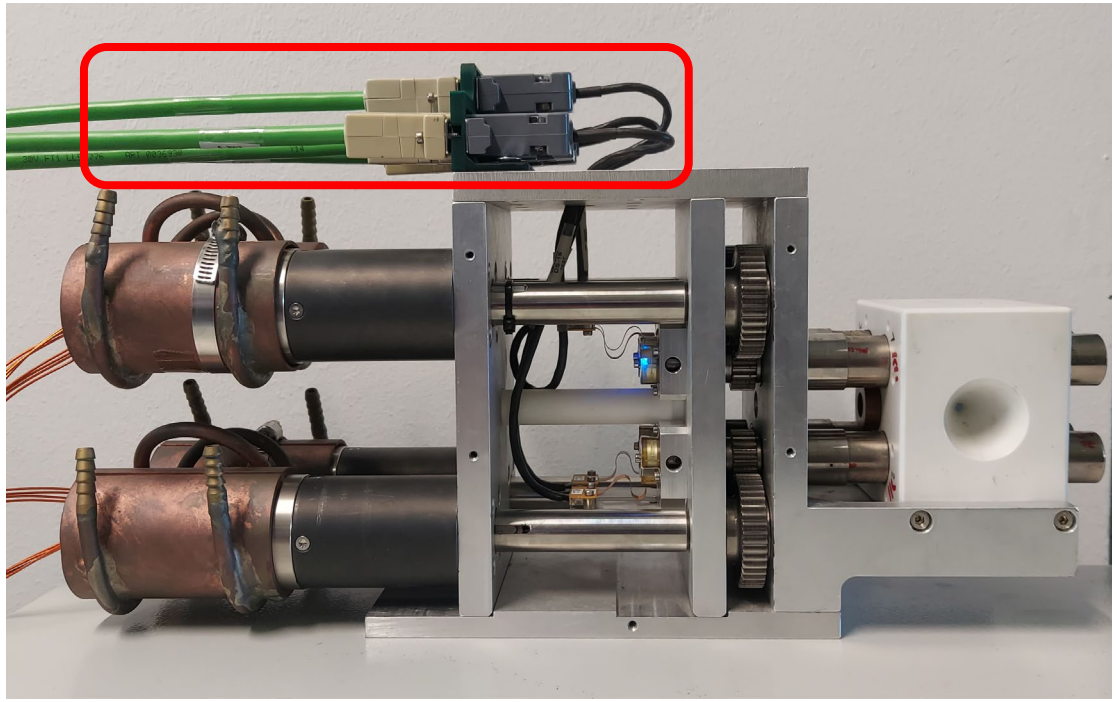
- Position Sensors mounted on Magnet Axis

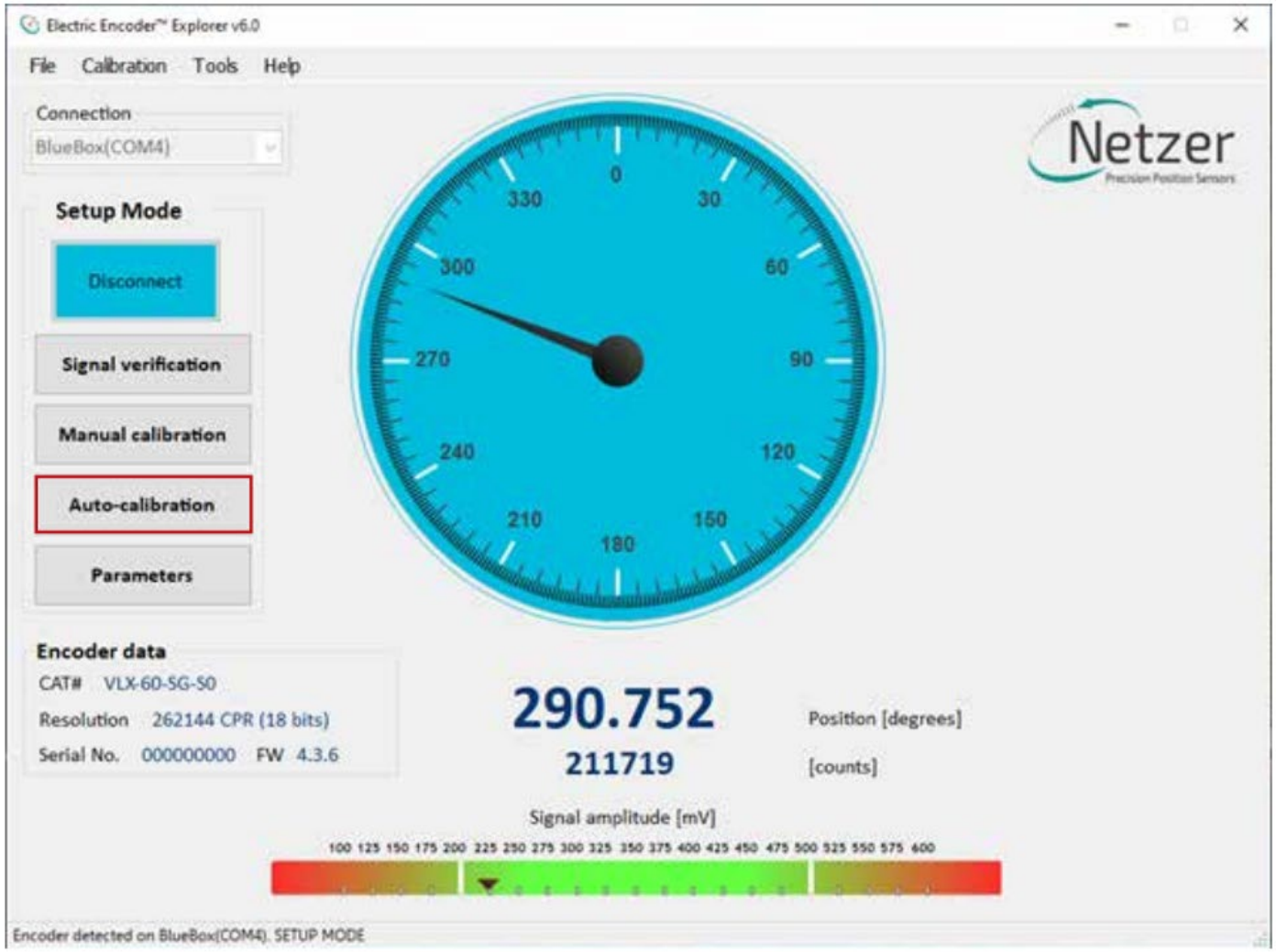


ELECTRONICS / CONTROL SYSTEM

Alignment Calibration





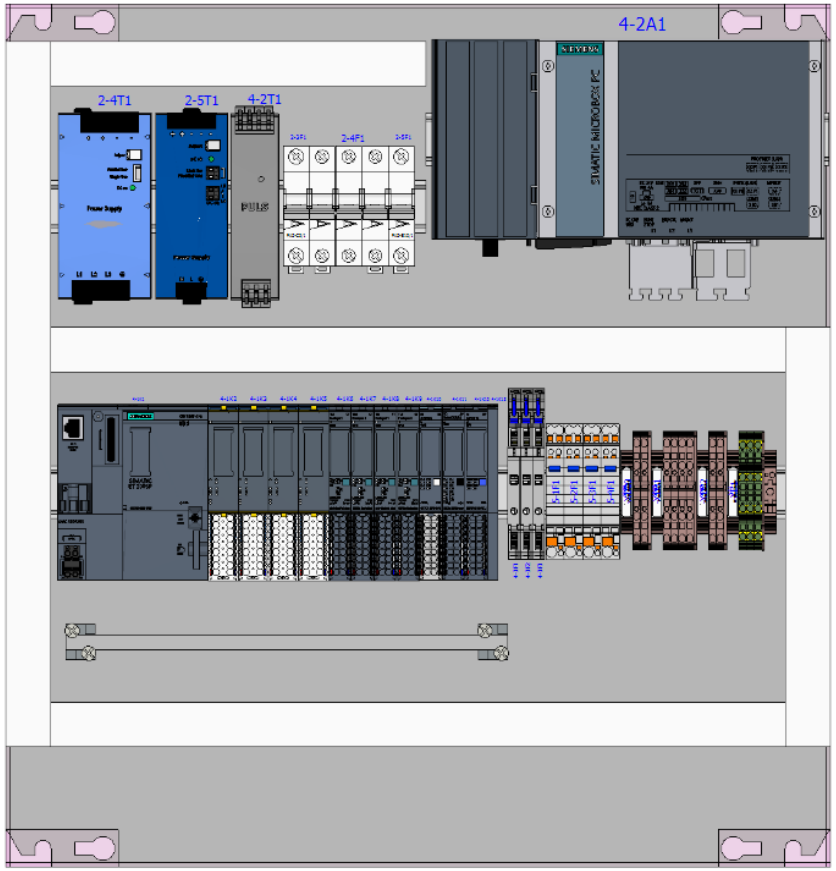


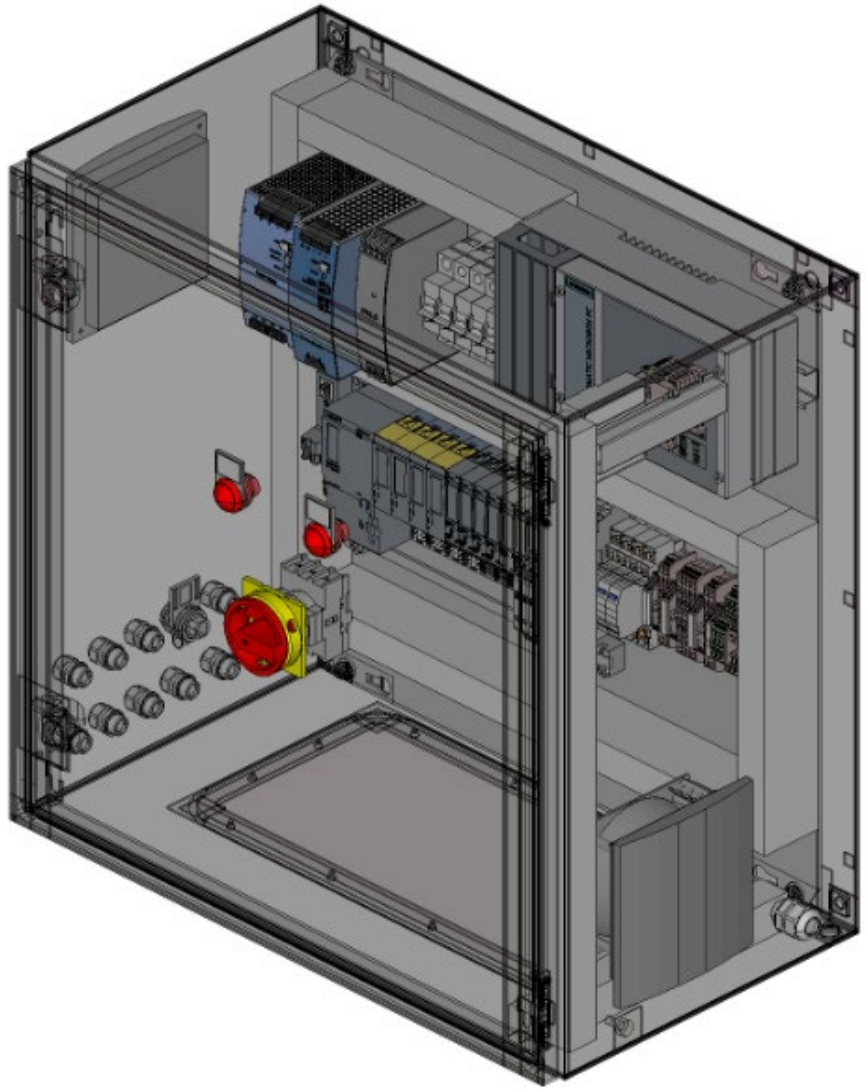
netzerprecision.com

ELECTRONICS / CONTROL SYSTEM

Control System

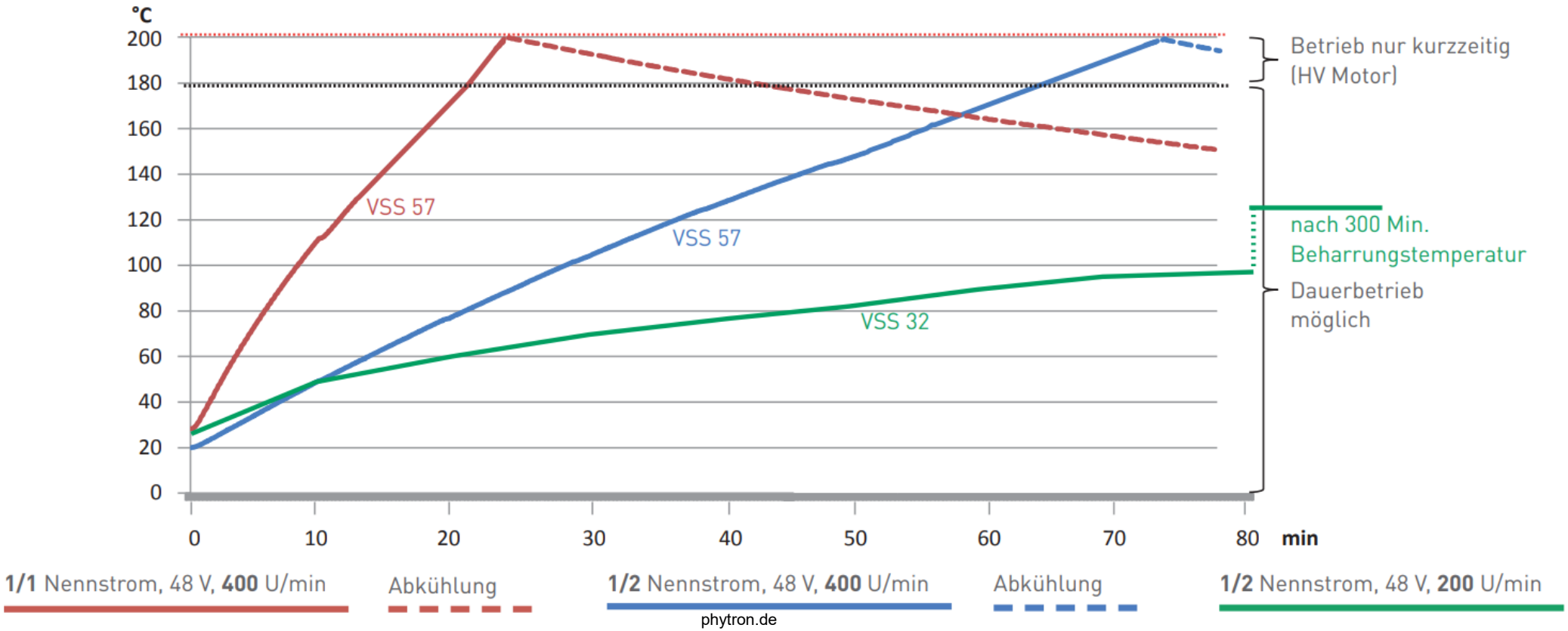
- S7-1500 (ET200SP)
- F-TM ServoDrive HF
- TM PosInput1





ELECTRONICS / CONTROL SYSTEM

Motor Temperature



CONTROL SYSTEM

SPHERES - guest at localhost:1301

Application Device commands Scan commands Other commands Script control History viewer Presets Tools Help

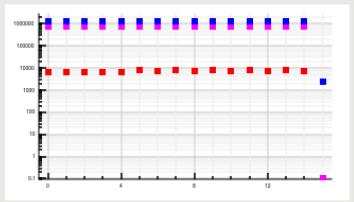
Connect Exit View Log Scale Auto scale X Y Reset Delete Fit Pick Line Fit arbitrary function

Experiment Info

Proposal
Title
Users
Local Contact
Setups mock_spheres
Samples
Environments
Detectors sis
Scans c_temperature, setpoint
Remark

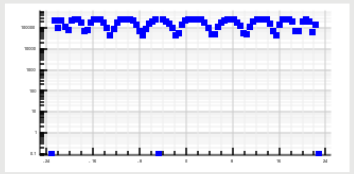
Sis Flux

direct	151641
elastic	215529
inelastic	127284



Sis Live

Timer 2.00
Latest files __empty__6083a15
__empty__6083u15



Instrument | Script Editor | SisLive | Scan Plotting | Device Plotting

>> Dry run Run

```
 1 | timeramp(target=300, time="3h:30m")
 2 | acquireInelasticTime(time="3h:30m", interval="50s", target="eta")
```

Estimated Finishing Time: **Donnerstag, 18:15**

All output | Errors/Warnings

Status: test.py :: Time scan :: Point 15 :: Counting

```
[14:45:44] >>> [guest 2019-08-29 14:45:44] ------------------- /data/nicos/2019/service/scripts/
timeramp(target=300, time="3h:30m")
acquireInelasticTime(time="3h:30m", interval="50s", target="eta")
--------------------------------------------------
[14:45:44] ================================================================================
[14:45:44] Starting scan:      atscan(12600.0000, target='eta', t=50.0)
[14:45:44] Started at:         2019-08-29 14:45:44
[14:45:44] Scan number:        6083
[14:45:44] Filename:           ascii/_00006083.dat
[14:45:44] --------------------------------------------------------------------------------
[14:45:44] #        etime    c_temperature setpoint sistimer total
[14:45:44]         s        K             K        s        cts
[14:45:44] --------------------------------------------------------------------------------
[14:46:34] 1        50.1     150.536       150.536  50.00    78822840 raw/__empty__6083a1 user/
[14:47:24] 2        100.0    151.131       151.131  50.00    79186680 raw/__empty__6083a2 user/
[14:48:14] 3        150.1    151.726       151.726  50.00    78974085 raw/__empty__6083a3 user/
[14:49:04] 4        200.0    152.321       152.321  50.00    78978210 raw/__empty__6083a4 user/
[14:49:54] 5        250.0    152.917       152.917  50.00    79186275 raw/__empty__6083a5 user/
[14:50:44] 6        300.0    153.512       153.512  50.00    78974955 raw/__empty__6083a6 user/
[14:51:34] 7        350.0    154.107       154.107  50.00    78968520 raw/__empty__6083a7 user/
[14:52:24] 8        400.0    154.702       154.702  50.00    78975285 raw/__empty__6083a8 user/
[14:53:14] 9        450.0    155.298       155.298  50.00    79186950 raw/__empty__6083a9 user/
[14:54:04] 10       500.1    155.893       155.893  50.00    78973800 raw/__empty__6083a10 user/
[14:54:54] 11       550.0    156.488       156.488  50.00    78976470 raw/__empty__6083a11 user/
[14:55:44] 12       600.0    157.083       157.083  50.00    78966135 raw/__empty__6083a12 user/
[14:56:34] 13       650.0    157.679       157.679  50.00    79194765 raw/__empty__6083a13 user/
[14:57:24] 14       700.1    158.274       158.274  50.00    78968910 raw/__empty__6083a14 user/
```

NICOS devices

Enter search expression

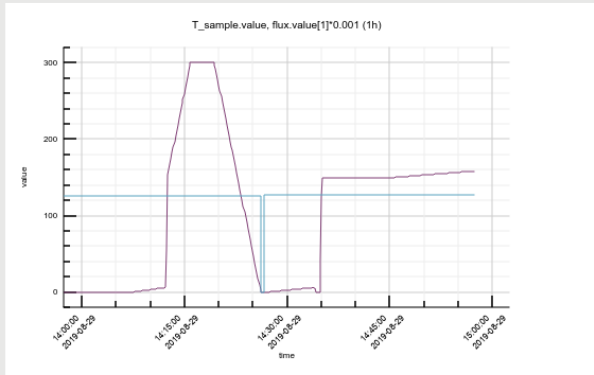
Name	Value	Status
c_pressure	49.586 mbar	
c_temperature	158.333 K	target not yet reached
pressure	49.586	
setpoint	158.333 K	
mock_shutter		
shutter	open	
mock_sis		
sis	sistimer = 2.00, total = 30...	sistimer=counting, sisimg
sisimg	3067485.000 cts	counting
sistimer	2.00 s	counting
sps		
nguide_he	55.127 percent	

shutter **open** pst_chopper **118.515** Hz
doppler **3.4** m/s bck_chopper **0** Hz

Target **158.33** K Pressure **49.59** mbar

	Value	Setpoint	Ramp	Heater
Sample	158.33 K	158.33 K	0.71 K/min	0.00 %
Tube	157.33 K	157.33 K	0.71 K/min	0.00 %

Temperature/Flux



nicos-controls.org

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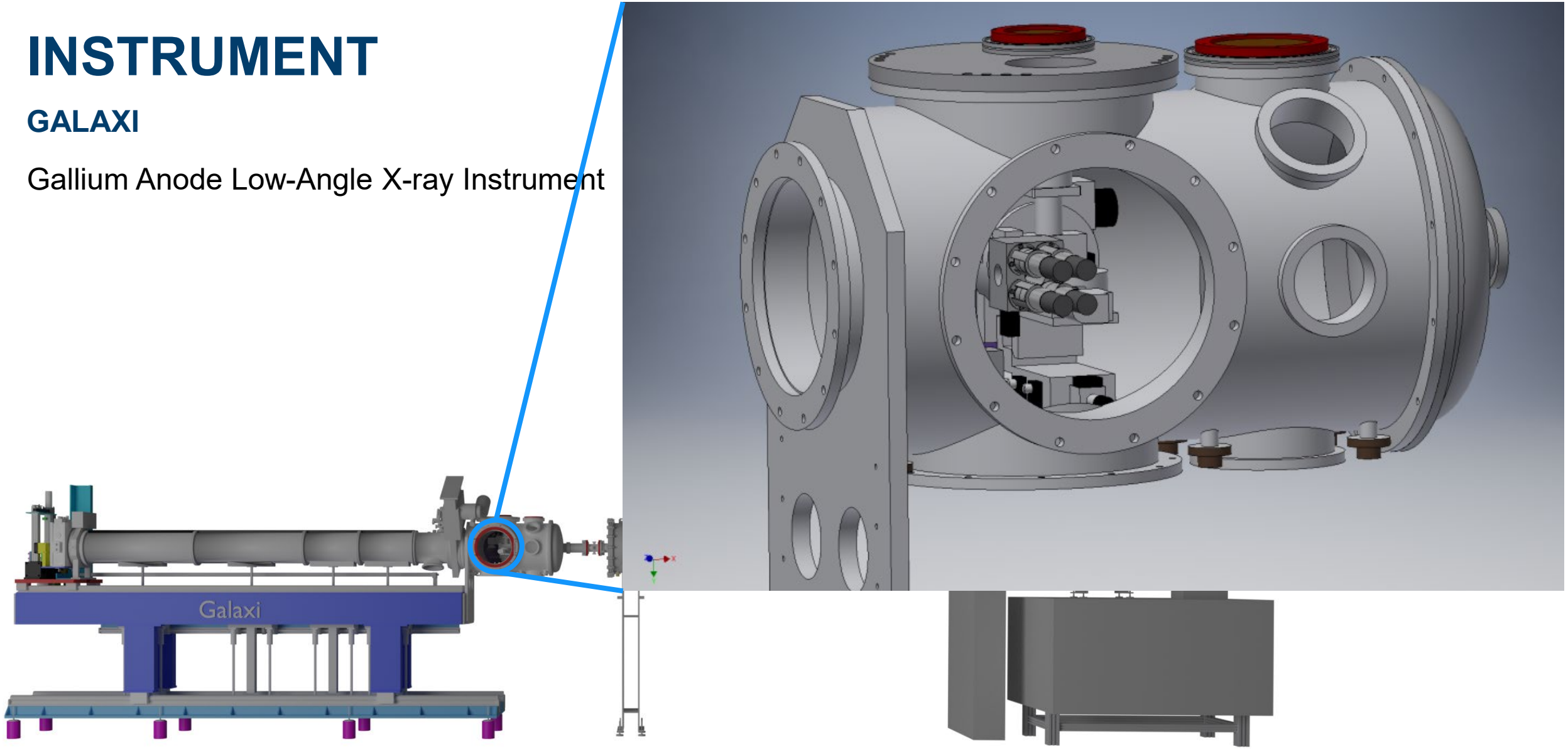
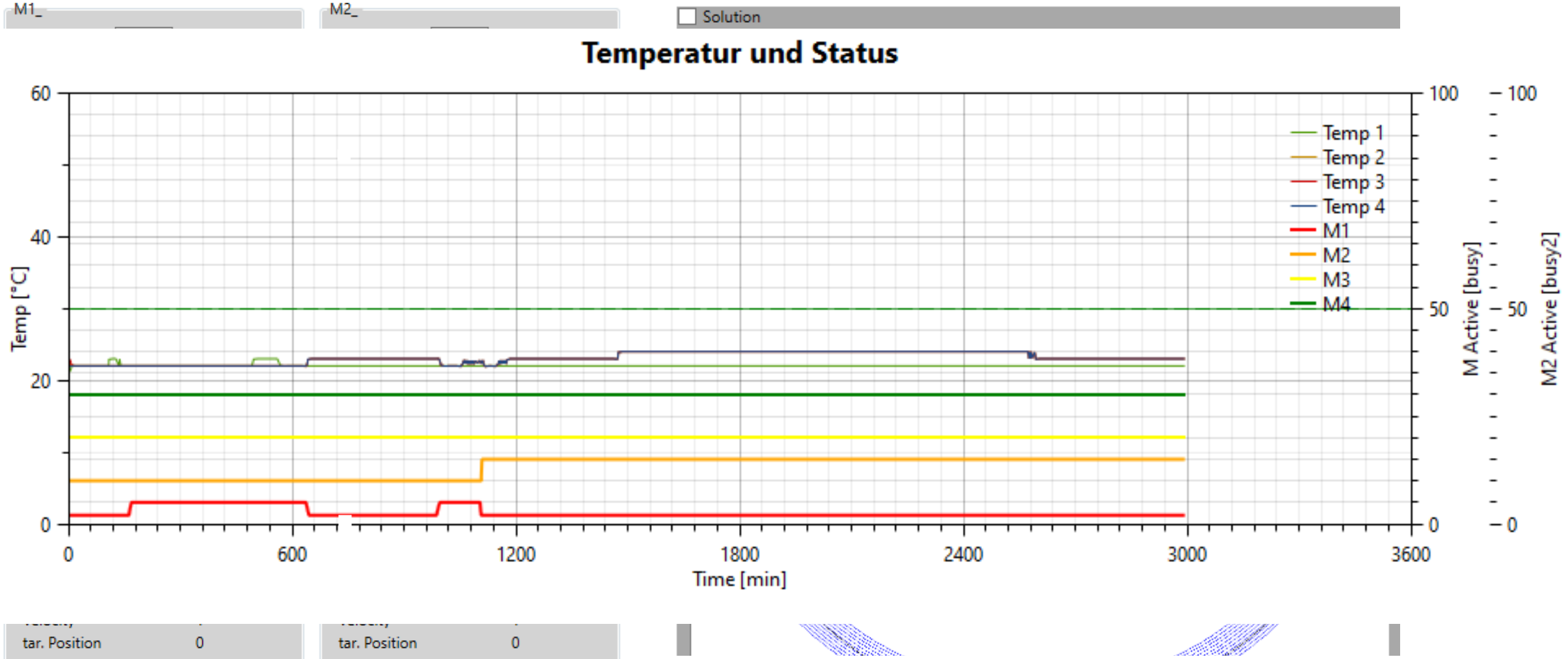
INSTRUMENT

GALAXI

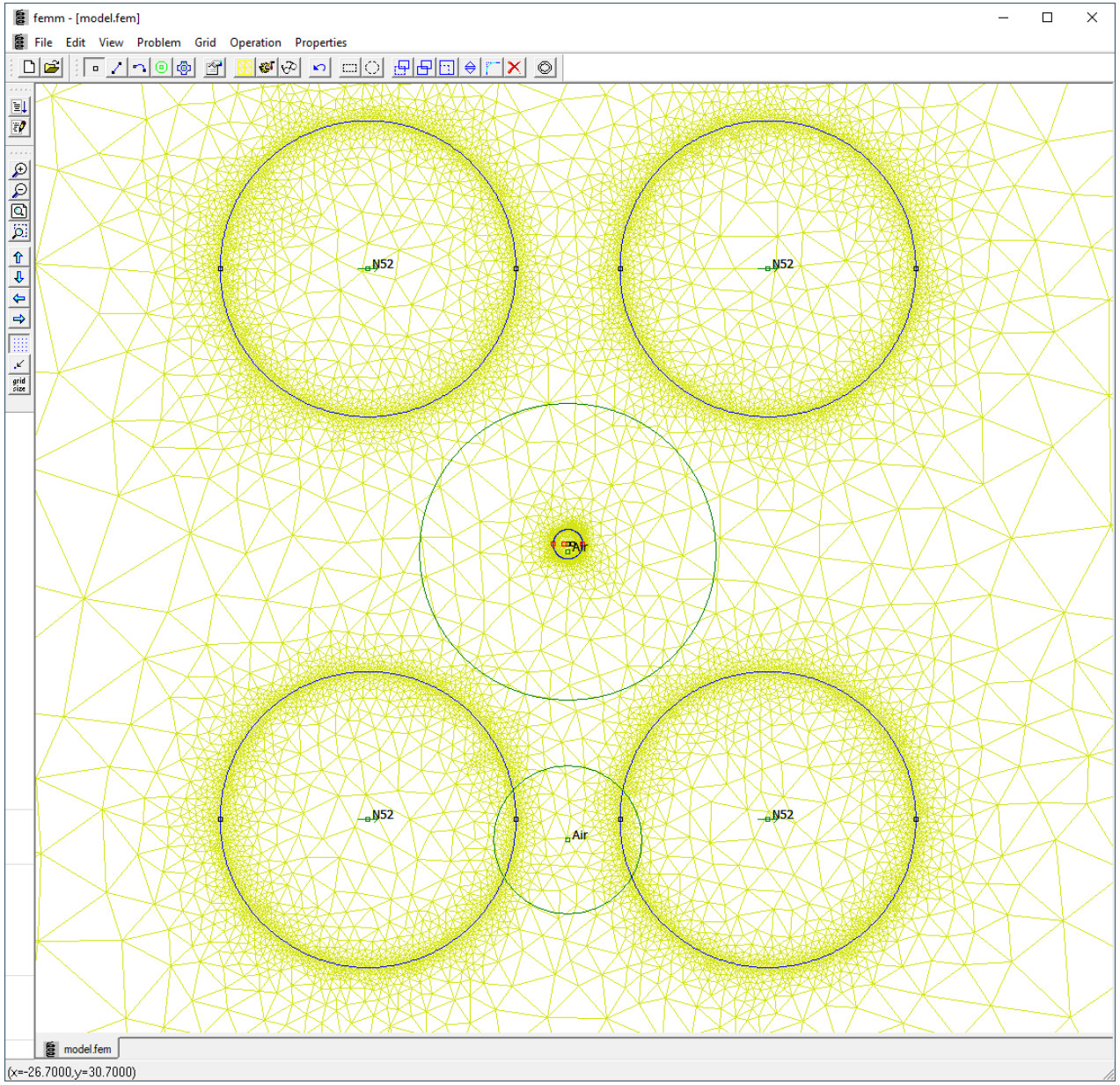
Gallium Anode Low-Angle X-ray Instrument

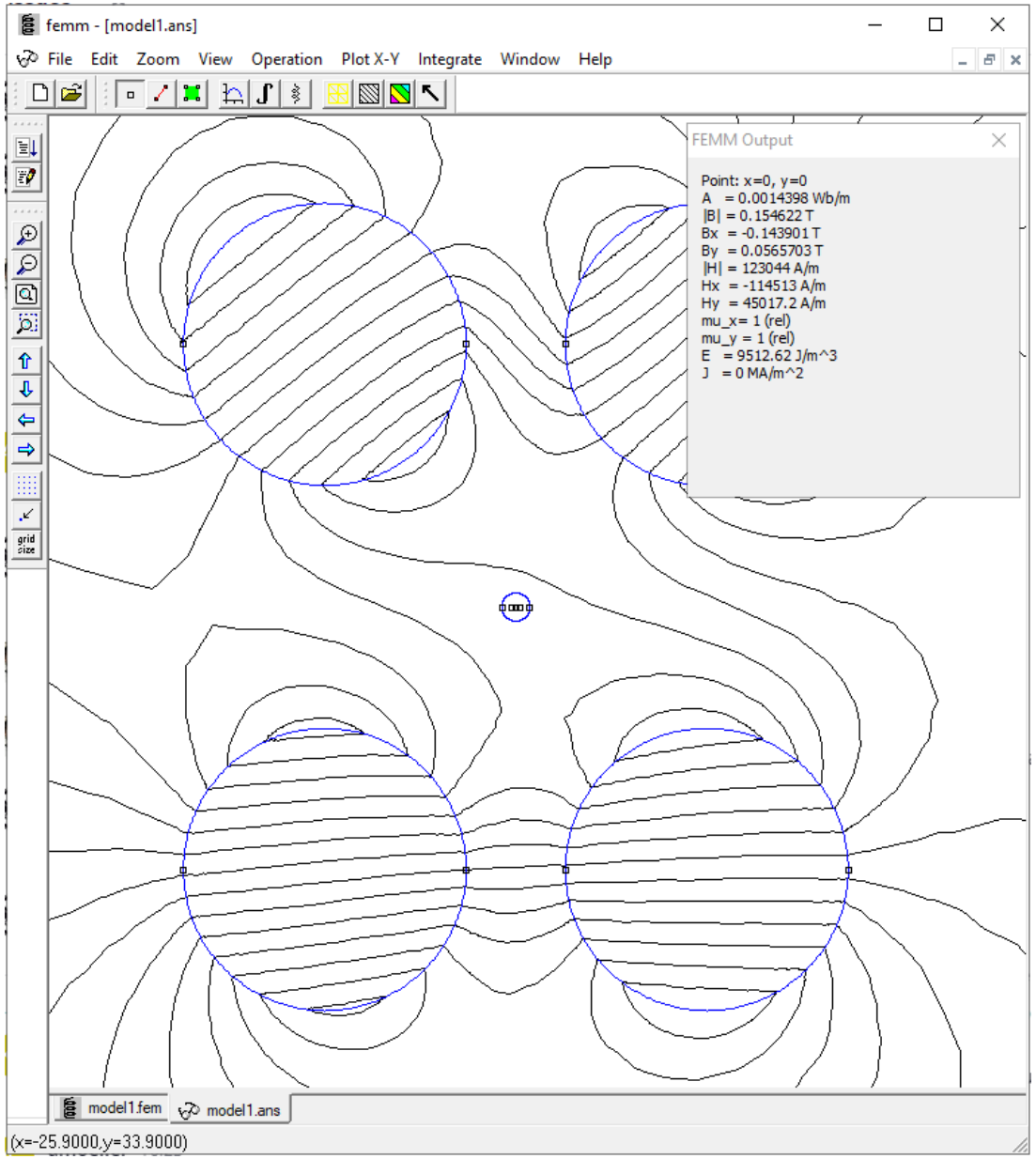


SOFTWARE


M1_
M2_
Solution
Temperatur und Status
Temp [°C]
Time [min]
M Active [busy]
M2 Active [busy2]
Temp 1
Temp 2
Temp 3
Temp 4
M1
M2
M3
M4
0
20
40
60
0
600
1200
1800
2400
3000
3600
50
100
tar. Position
0
act. Position
146,66967
tar. Position
0
act. Position
25,917125

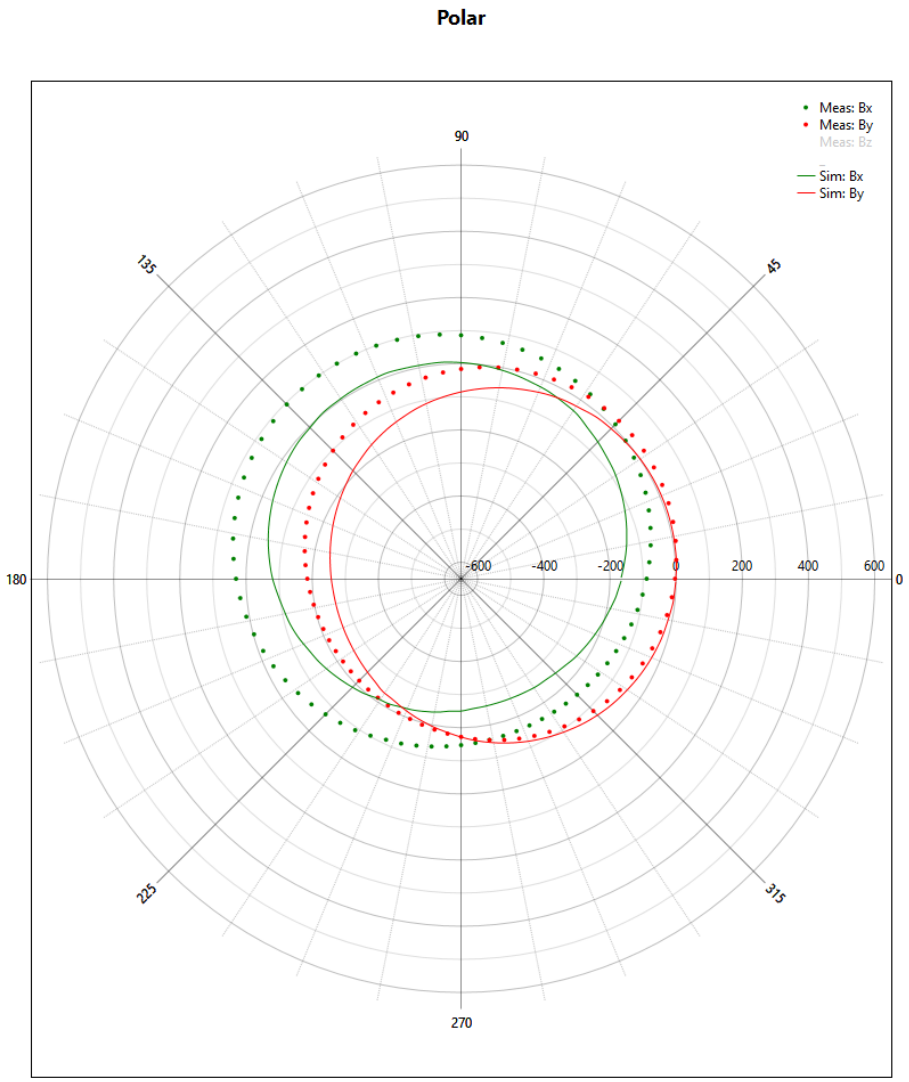
SIMULATION

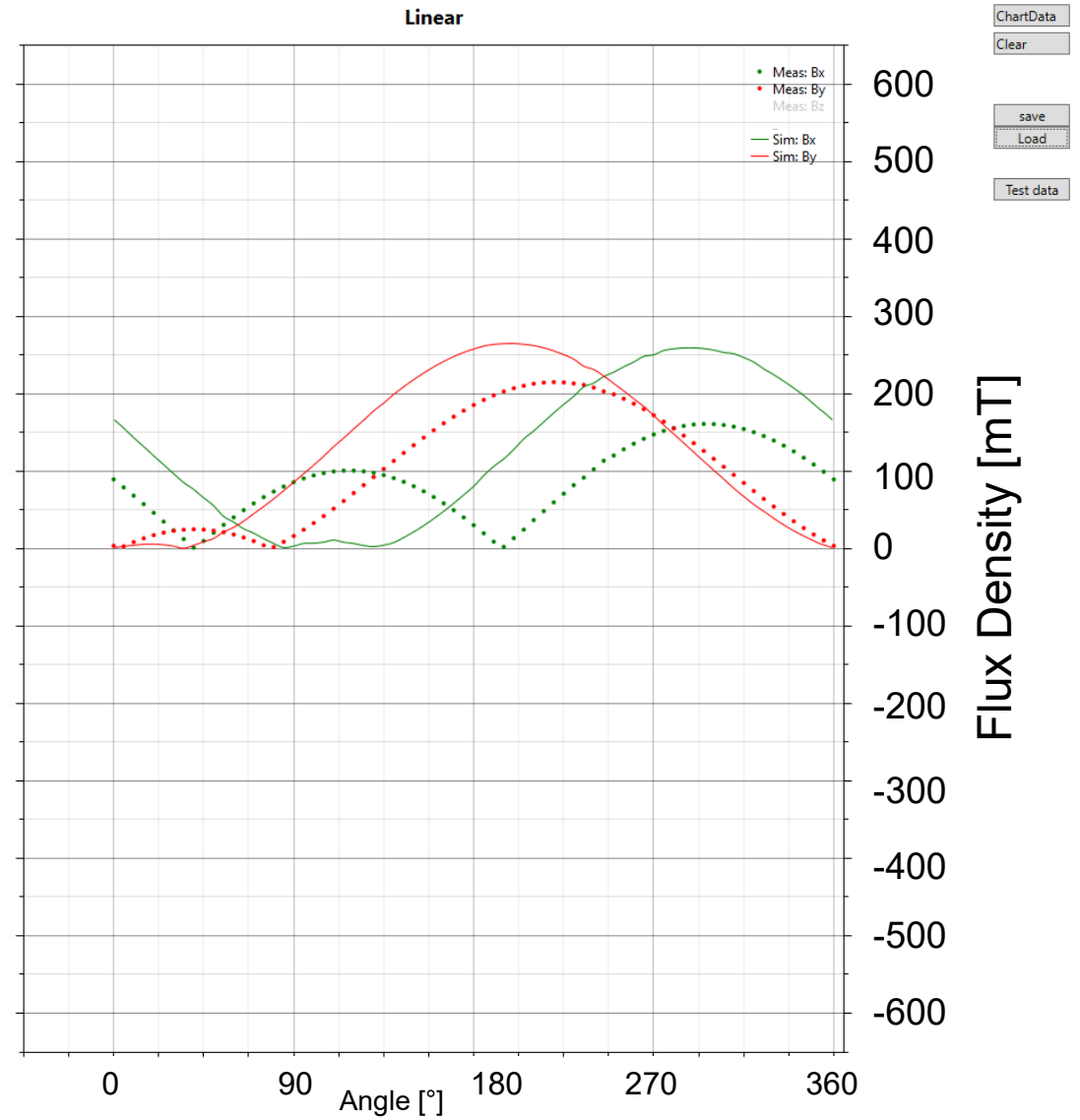

femm - [model.fem]
File Edit View Problem Grid Operation Properties
N52
N52
Air
N52
Air
N52
model.fem
(x=-26.7000,y=30.7000)


femm - [model1.ans]
File Edit Zoom View Operation Plot X-Y Integrate Window Help
FEMM Output
Point: x=0, y=0
A = 0.0014398 Wb/m
|B| = 0.154622 T
Bx = -0.143901 T
By = 0.0565703 T
|H| = 123044 A/m
Hx = -114513 A/m
Hy = 45017.2 A/m
mu_x= 1 (rel)
mu_y = 1 (rel)
E = 9512.62 J/m^3
J = 0 MA/m^2
model1.fem
model1.ans
(x=-25.9000,y=33.9000)

VALIDATION

with e.g. FW BELL 8030 Teslameter





CONCLUSION

- Individual Angle control for all (four) Magnets

- Next:
  - Calibration and Validation
  - Program of algorithm to reach a desired magnetic field

THANK YOU

Acknowledgements

Georg Brandl
Herbert Feilbach
Robert Swaczyna

Lester Barnsley