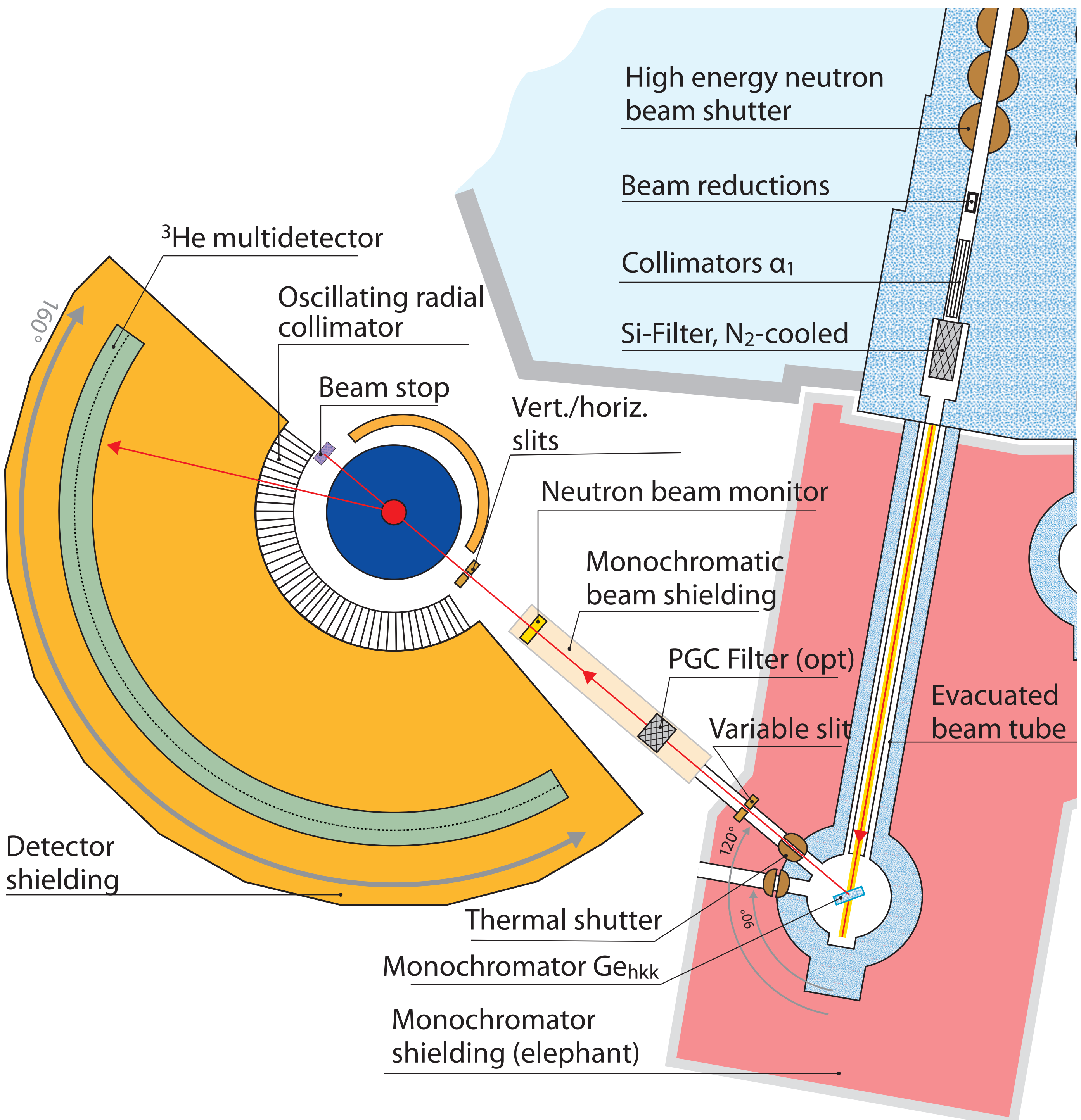
# High Resolution Powder Diffractometer for Thermal Neutrons

Vladimir Pomjakushin and Denis Sheptyakov




## Guidelines from Marc Janoschek

- Which parts of your instrument do have frequent technical problems?
- What parts of your instrument are outdated compared to other facilities?
- What is the percentage of user days you are not able to deliver due to …?
- Which components result in additional work for you that could be avoided by upgrading aspects of the instrument.
- When you report on components that need to be exchanged/repaired due to technical difficulties, please also consider how this change could be additionally used to improve your instruments scientific capabilities.
- Are there quick wins to technically improve your instrument or extend its science case?
- Are there scientific questions for which your type of instrument is ideal but technical difficulties prevent such measurements?
- Please consider budget and procurement of items above.
- possible internal and external funding avenues.

For example, which parts could be covered from internal LNS/LMU investment budget, which parts need additional funding.

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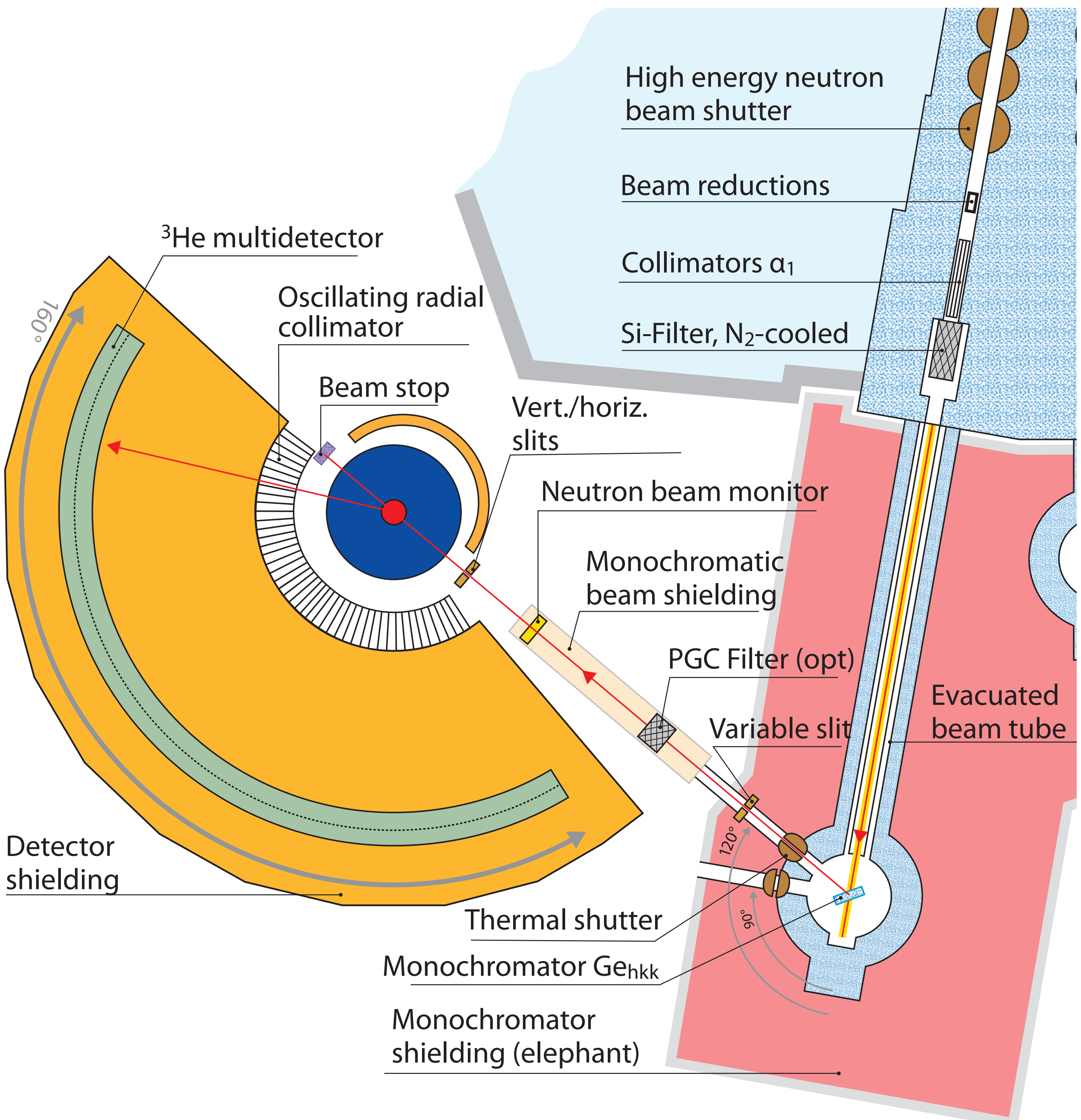


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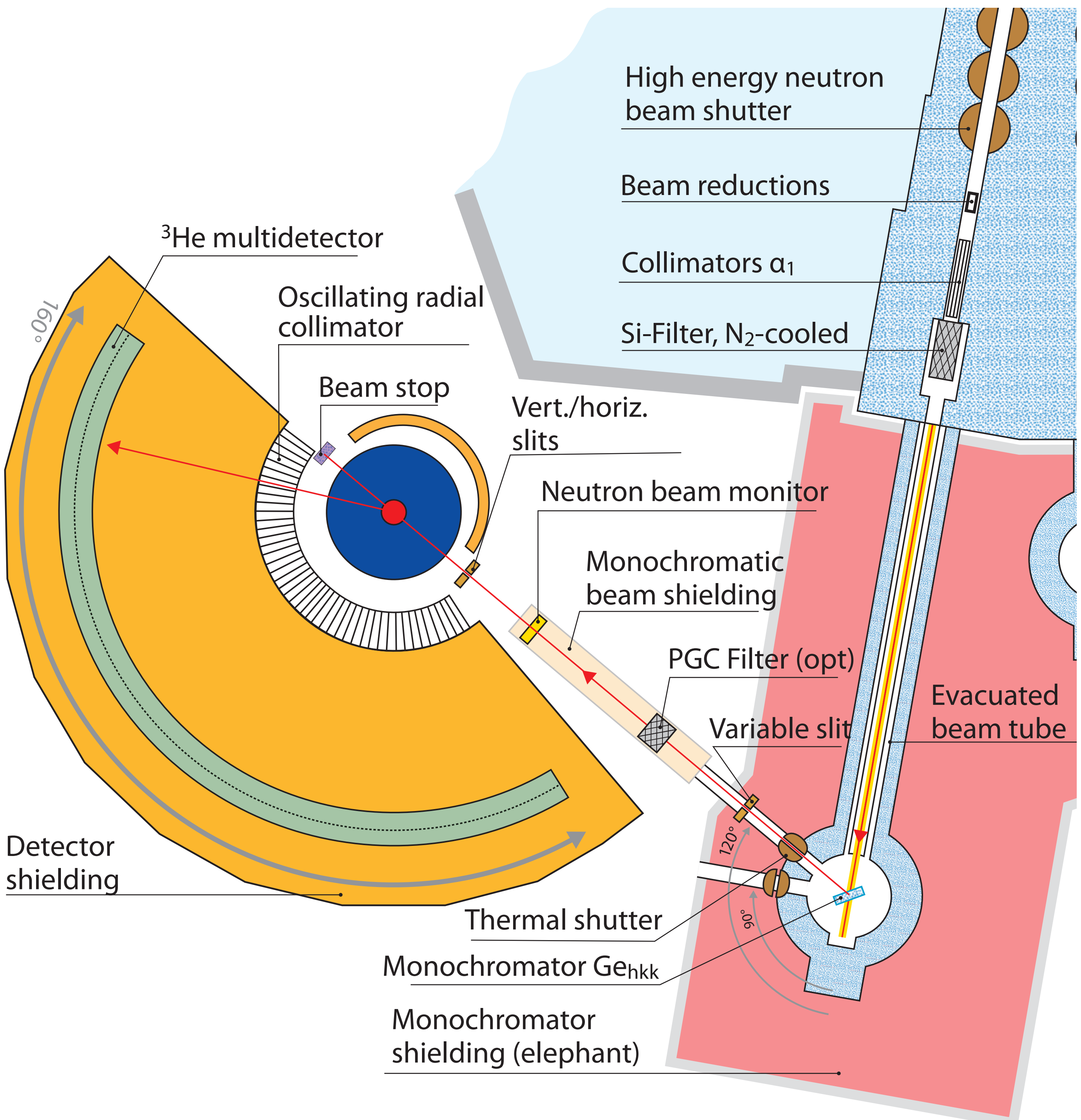


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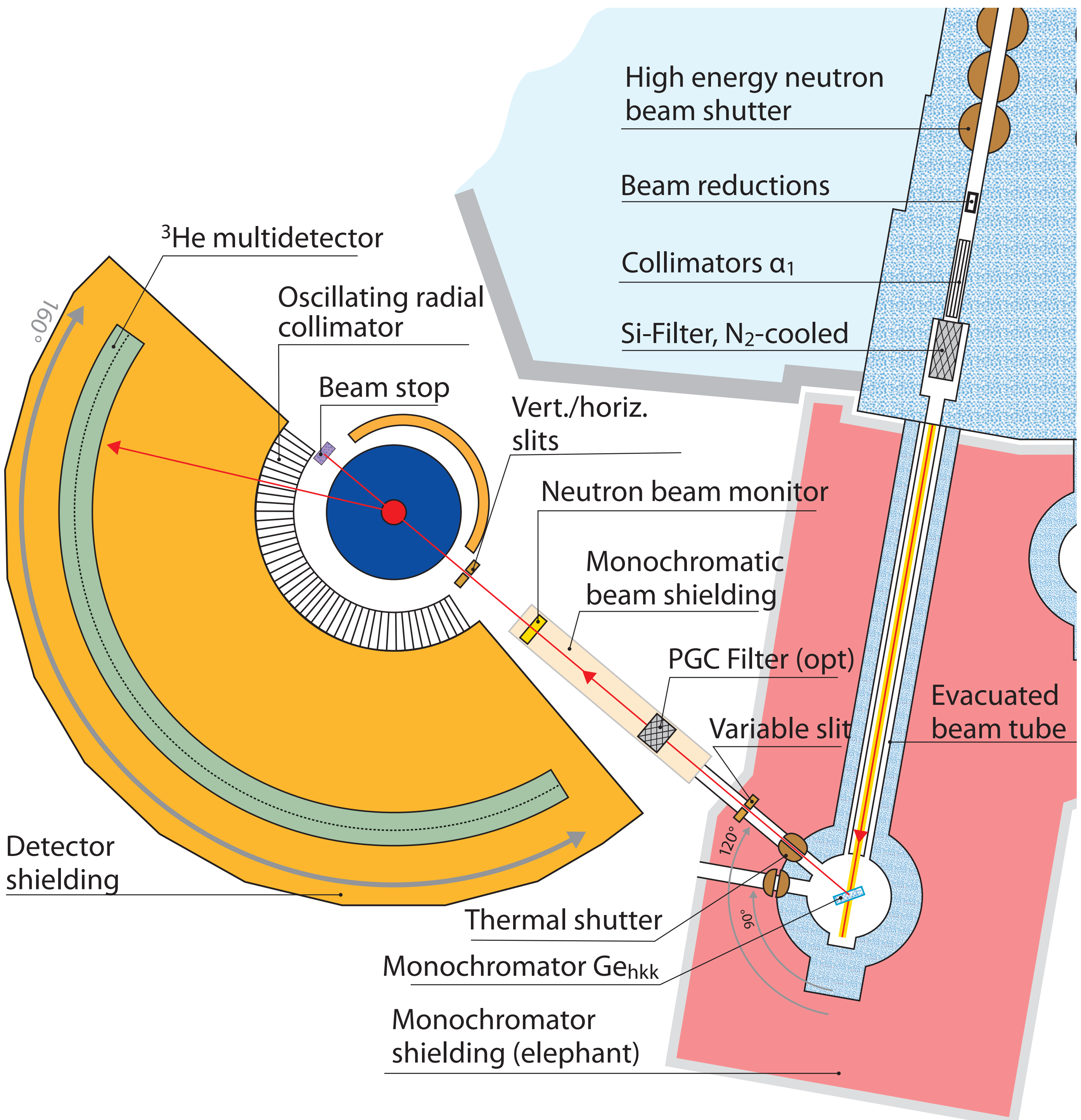


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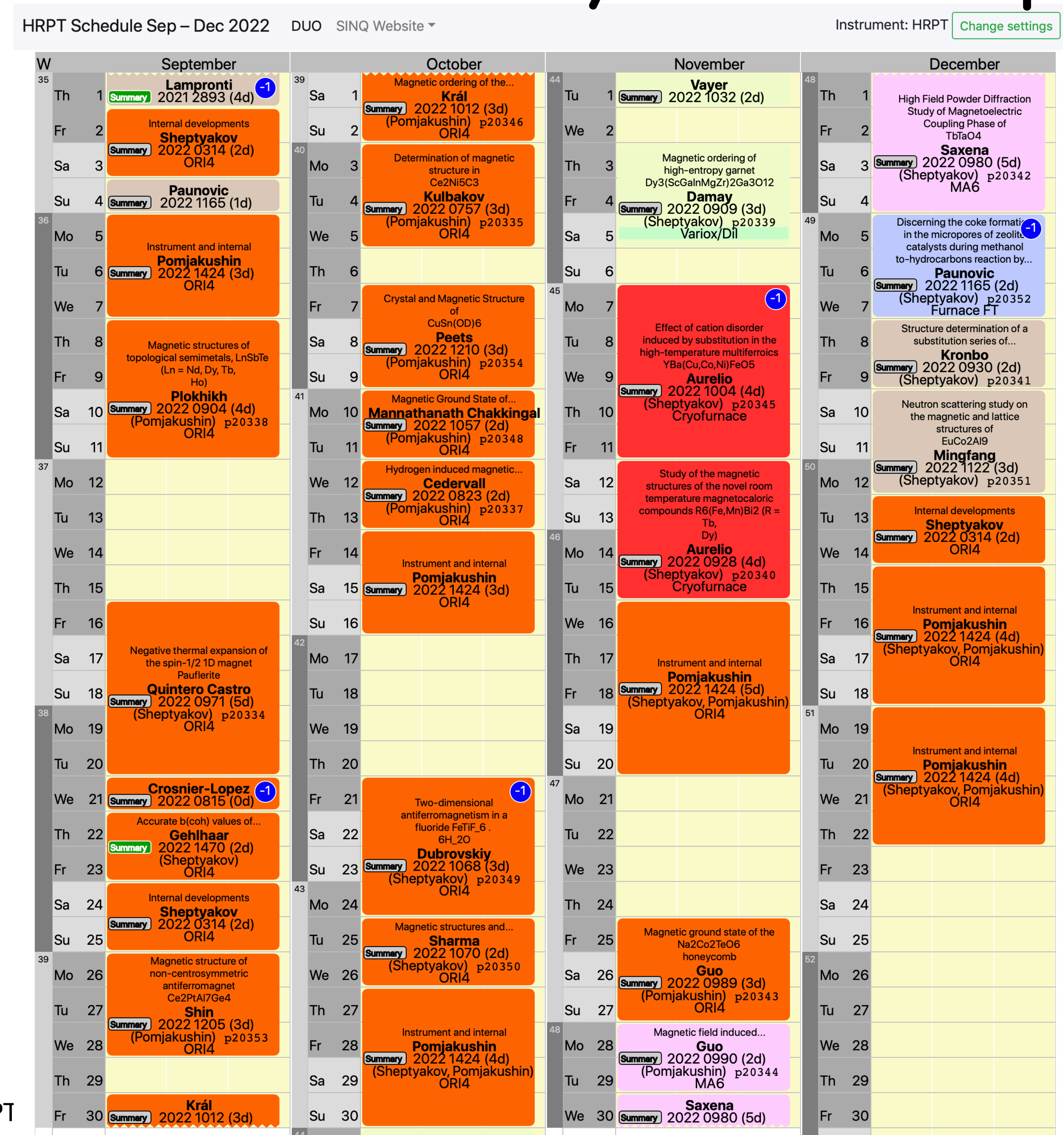
# HRPT schedule for one cycle 20-30 experiments




V. Pomjakushin, HRPT

https://www.psi.ch/en/sinq/hrpt/examples-of-results-and-publication-statistics

# Publication Statistics about 20 publications /year

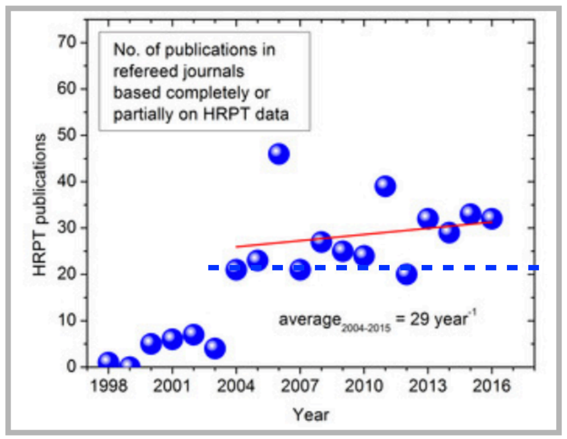
- Statistics of HRPT publications
- Examples of results
- References

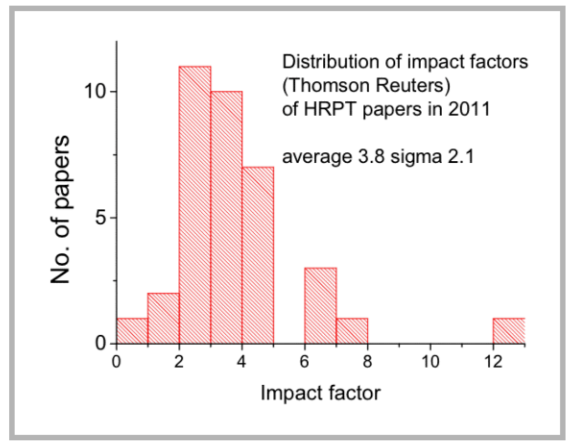
## Statistics of HRPT publications

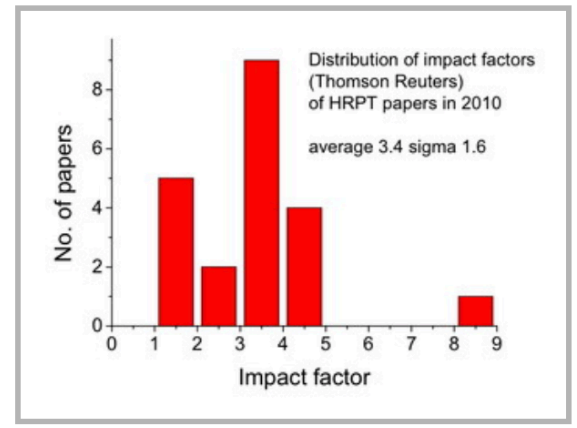
22, 18 publications in 2020, 2021

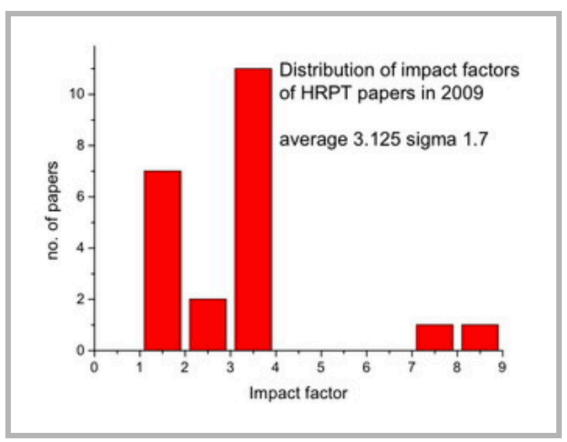
HRPT publications (automatically updated from DORA)

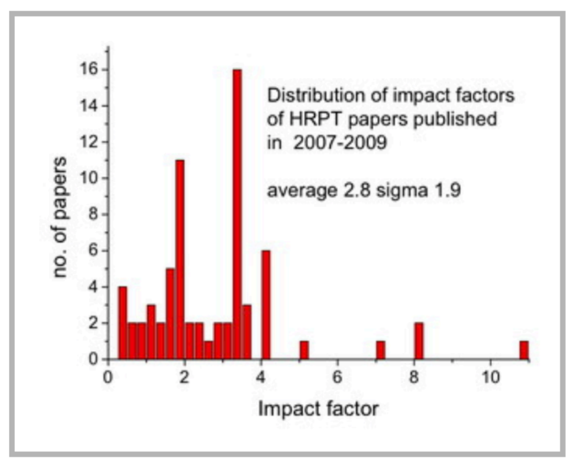
TOTAL SINQ: 118, 83 publications in 2020, 2021

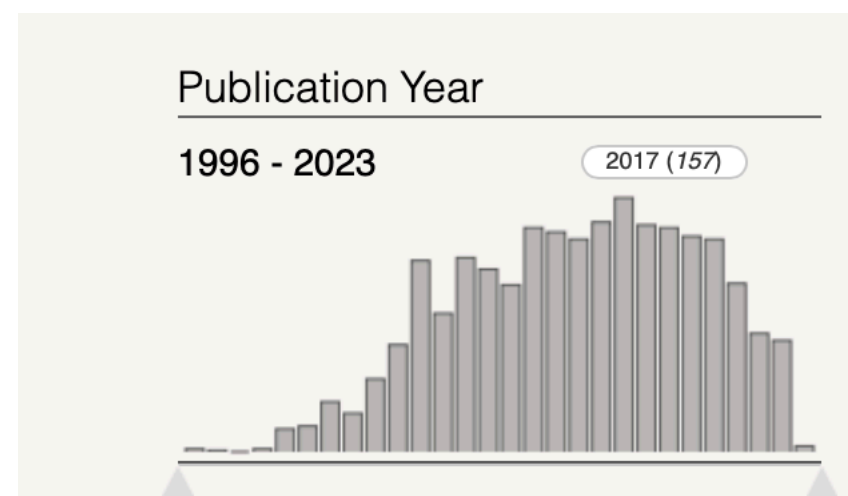


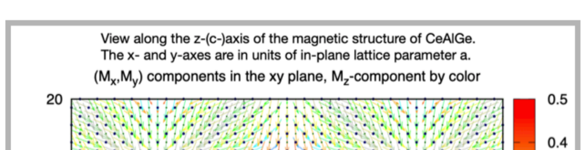



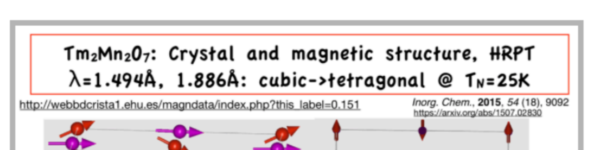



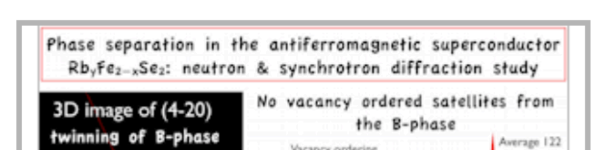




## Examples of results

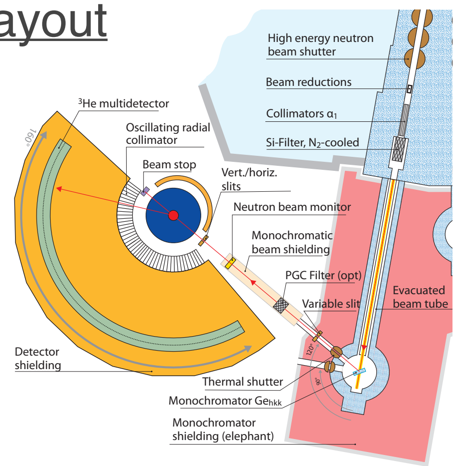


# Technical Specifications

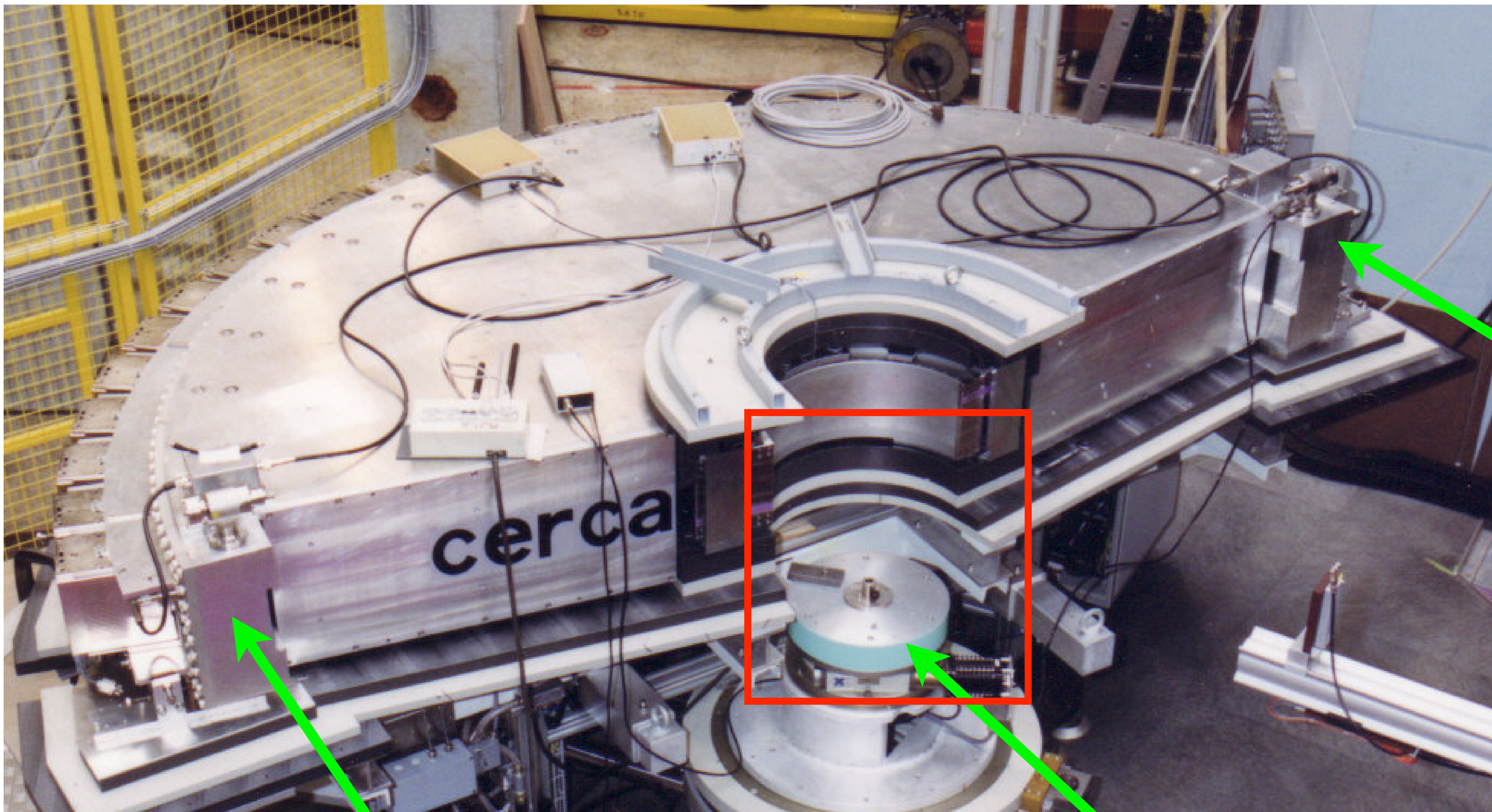
HRPT layout




https://www.psi.ch/en/sinq/hrpt/specifications

| | |
|---|---|
| Neutrons: | thermal (0.84-2.954Å) beam 1RNS41 from a water scatterer close to the SINQ target. |
| Primary collimation: | Gd-O Soller collimators with primary white beam collimations $\alpha_1$ = 6', 12', 24' (high resolution), - = approx. 40' (high intensity) |
| Liquid $N_2$ cooled Si | 20 cm length |
| Monochromator | Ge (hkk) of wafer type, 28 cm high, variable vertical focusing, total mosaic halfwidth 15' |
| Secondary collimation: | variable computer controlled slit system for monochromatic beam |
| Radial collimators: | Oscillating mylar-Gd-O collimators to eliminate Bragg peaks from sample environment such as from cryostat or |
| PSD detector: (LCP1600 from Cerca, F-26104 Romans) | $^3$He (3.6 bar + 1.1 bar $CF_4$), 25 x 64 = 1600 counters, step 0.1°, 15 cm high, radius 1.5 m, effective detection length 3.5 cm |
| HRPT gas mixture cleaning/adding system (more pictures) | cleaning of the gas mixture from (O2, H2O, etc) by a circulation of the gas mixture through the appropriate filters without pumping out the mixture. |
| Sample temperature: | 50 mK - 1800 K |
| Magnetic field: | superconducting magnet MAO6, field H vertical to scattering plane, H up to 6 T. |
| Zero matrix pressure cells: | up to 8, 15 kbar for full scattering angle range. Example of pattern, |
| Sample changers: | Room temperature sample changer for eight (8) samples, low temperature sample changer for four (4) samples (more pictures) , low temperature sample changer for five (5) samples with sample rotation |

# HRPT Detector and sample table



# HRPT short work list 2023-

HRPT 2017-18 to do list. 6.12.2017

1. • xyz sample table.

3. • Encoder on sample rotation for lt5, (2kFr) Feasibility is OK from Alex B. low-temperature sample changer

• Some channels in the detector are dying

by 2023: 15 ch. in total are bad. +8 (practically sequential) in 2023

Study: production of new analog cards/chan. for detector electronics.? This is a long term project.

2. • motorised beam stop.

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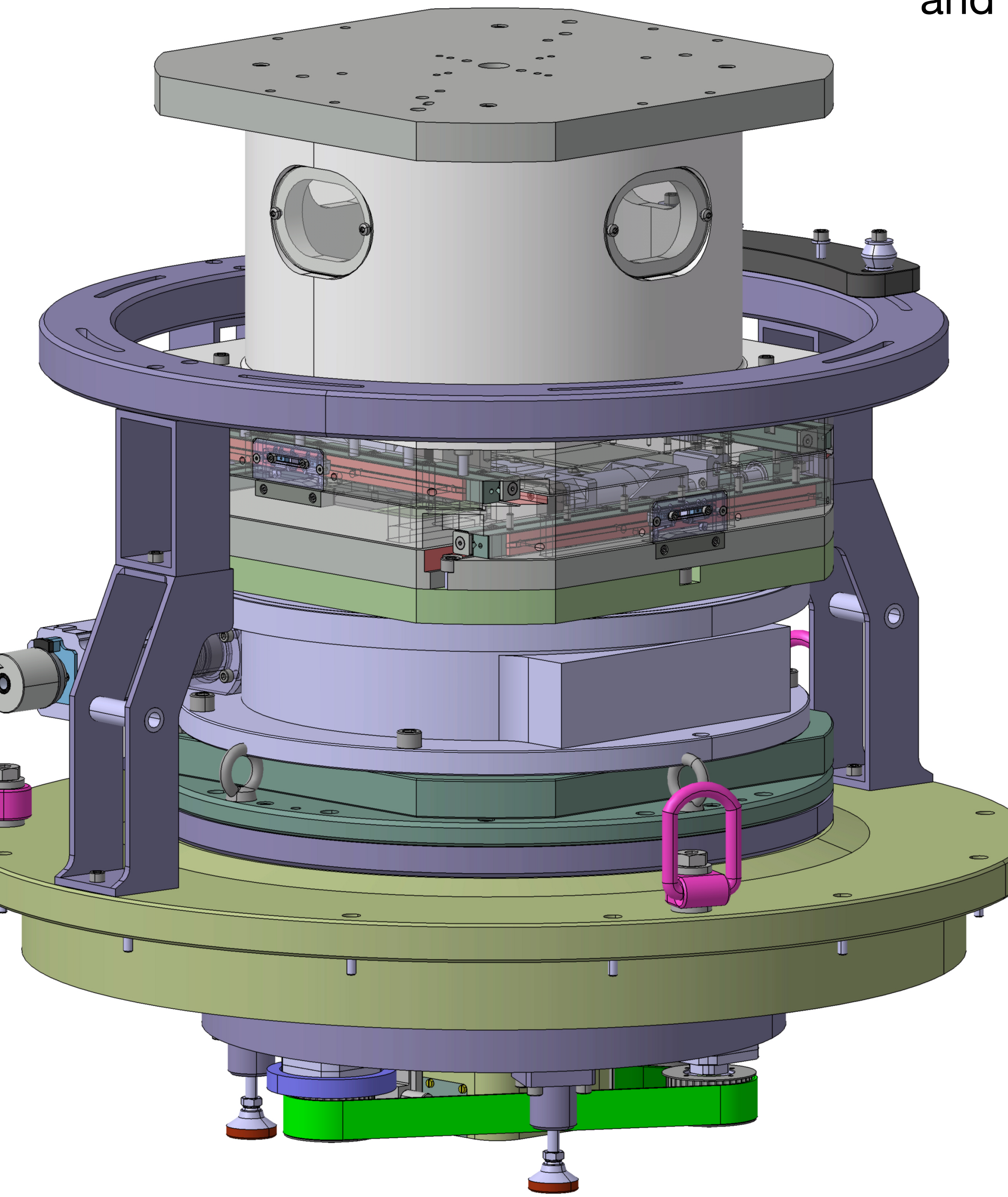
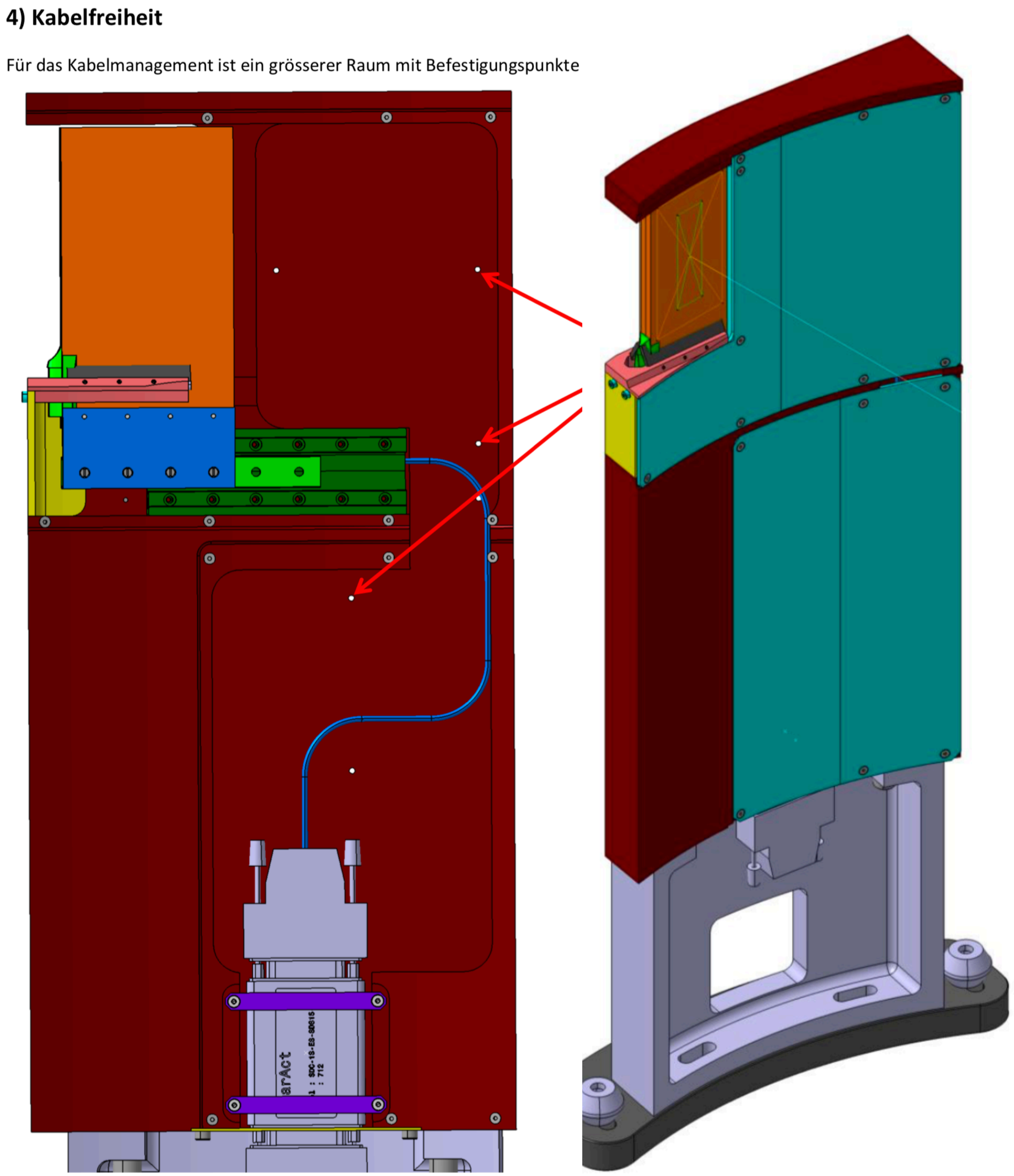
# “new” xyz sample table -hardware was ready and tested in 2017: Installation is still pending.

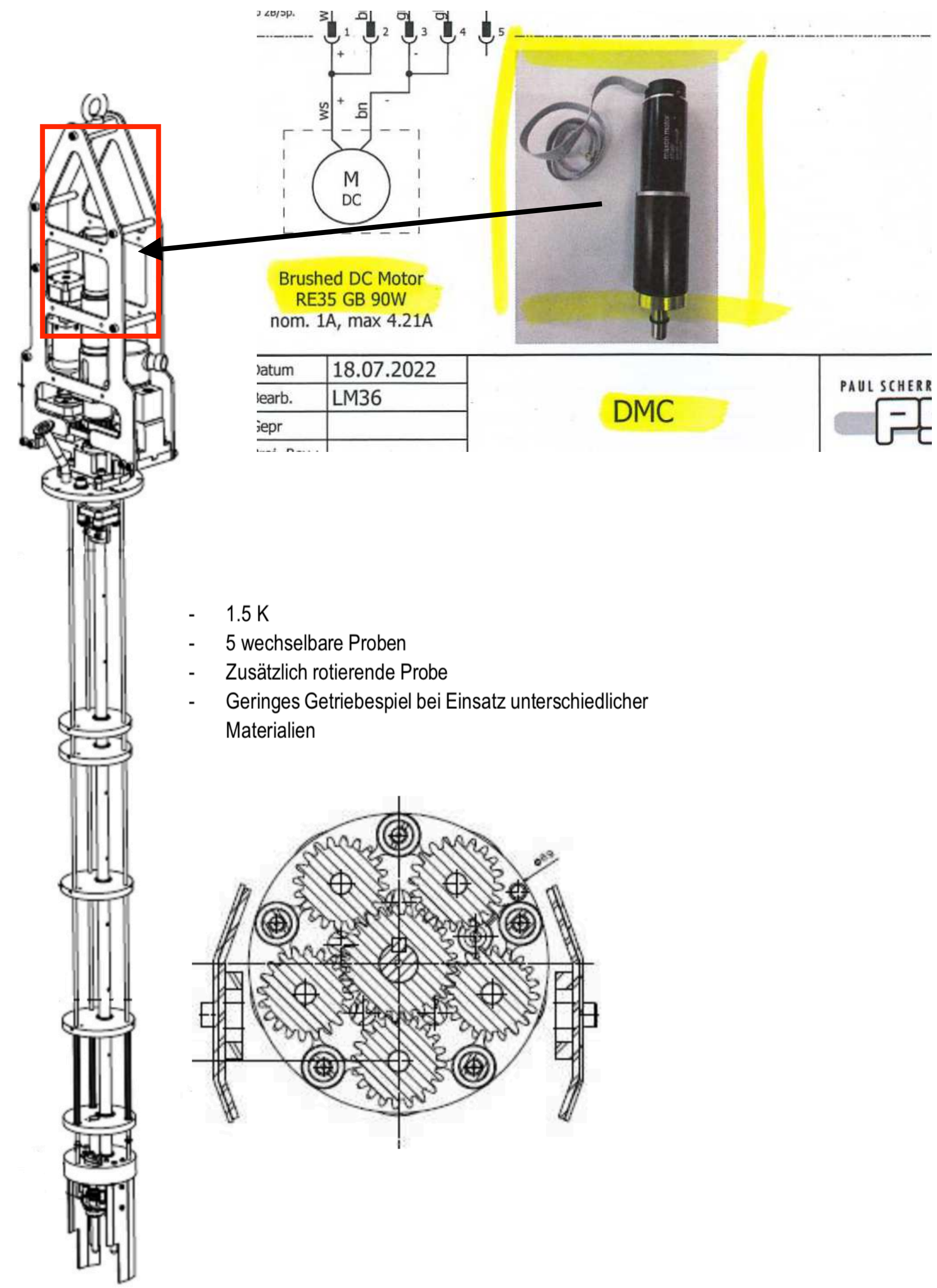
- The old sample table does not allow precise positioning along x,y-directions for some experiments, which is crucial to avoid aberration of diffraction patterns.
- Positioning along z-axis is needed for new low-T sample changer, and for some other special setups



## motorised beam-stop - ready 2018: Installation is still pending.

## encoder on sample rotation motor - design is done, Installation is still pending.




- fine position adjustment for SANS signals
- automatic measurements of muR absorption
- …

- measurements of single crystals in sample changer
- computer controlled rotation frequency

# Summary of the planned HRPT maintenance/ development for 2023-…

New xyz-sample table. Hardware, including electronics on the table, was ready in 2017. Installation is still pending.

Motorised, computer controlled beam stop with adjustable position. Hardware, including electronics on the table, was ready in 2018. It is in the finished state, installation is still pending.

Absolute encoder for the sample rotation axis for the LT5 cryogenic sample changer. This extension of the LT5's functions has already been designed by Alex B. It requires either no or only extremely minor mechanical adjustments, but the installation of an additional encoder and corresponding commissioning of an additional axis.

The front-end analog electronics of the detector. Some modules are already misbehaving, but at the moment we can live with this problem by software tricks/recalibrations. Some preliminary study of the problem is foreseen in 2024. By 2023: 15 ch. in total are bad. +8 (practically sequential) in 2023.

———————————————————————————

After the above list is done:

Power supply/UPS for the controls of resolvers (electronics cabinet at the elephant). - This is partially done. Otherwise, one day we risk losing the actual positions of very important motors that move our monochromator.

Controller of the refilling of the liquid nitrogen into the silicone filter. It fails from time to time.

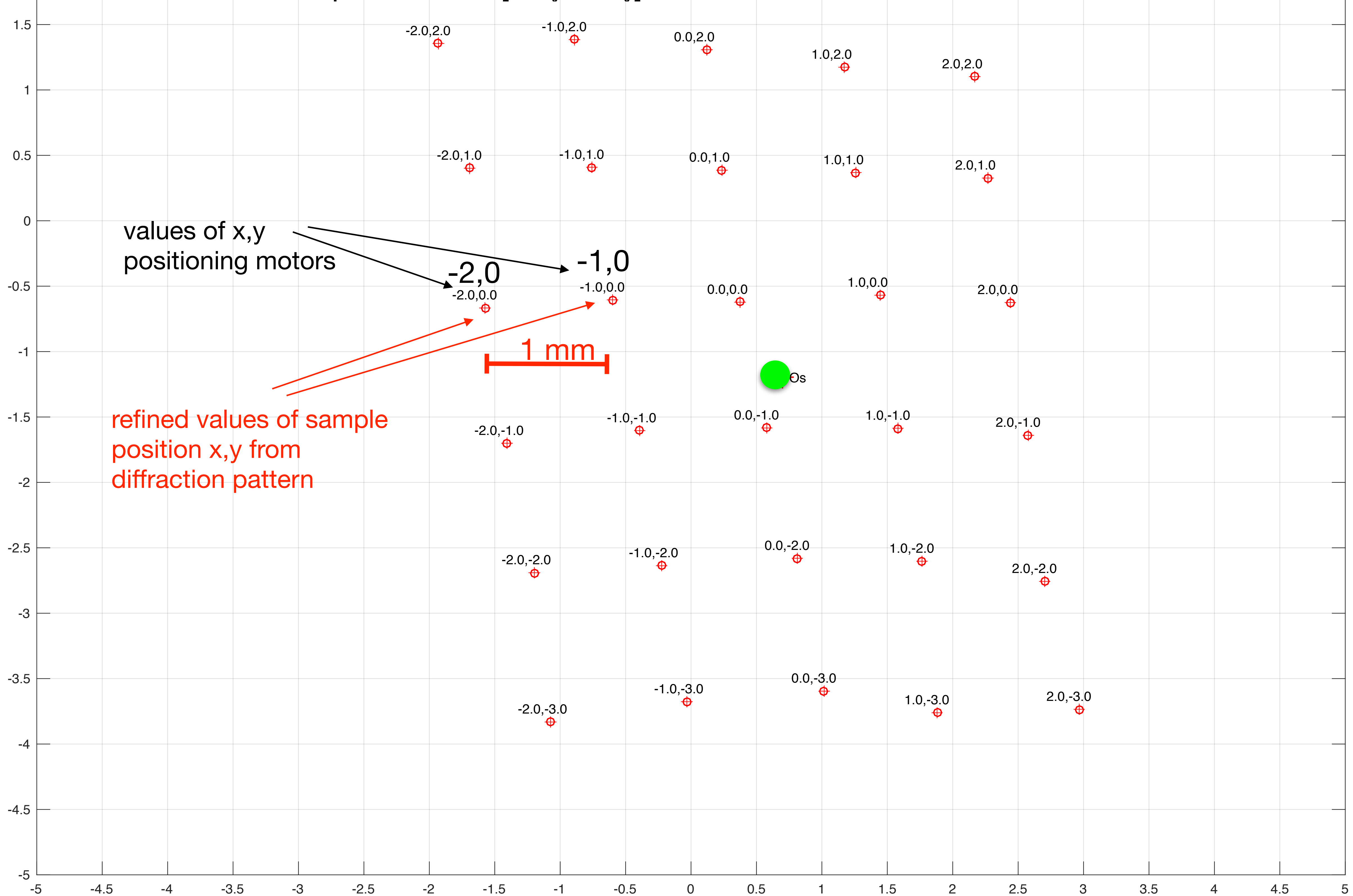
Check the electronics of the 3He cleaning system pump. Repeat the cleaning, and maybe pressurising.

Further study of the decrease in the gas amplification ratio after cleaning and pressurising the gas mixture in the detector.

Thank you

# precise sample positioning with respect to calibration

We can determine by diffraction the (x,y) position of sample with the accuracy better than 0.1mm! by the detector (radius 1500mm) from systematic diffraction peaks shifts [sin() cos()]



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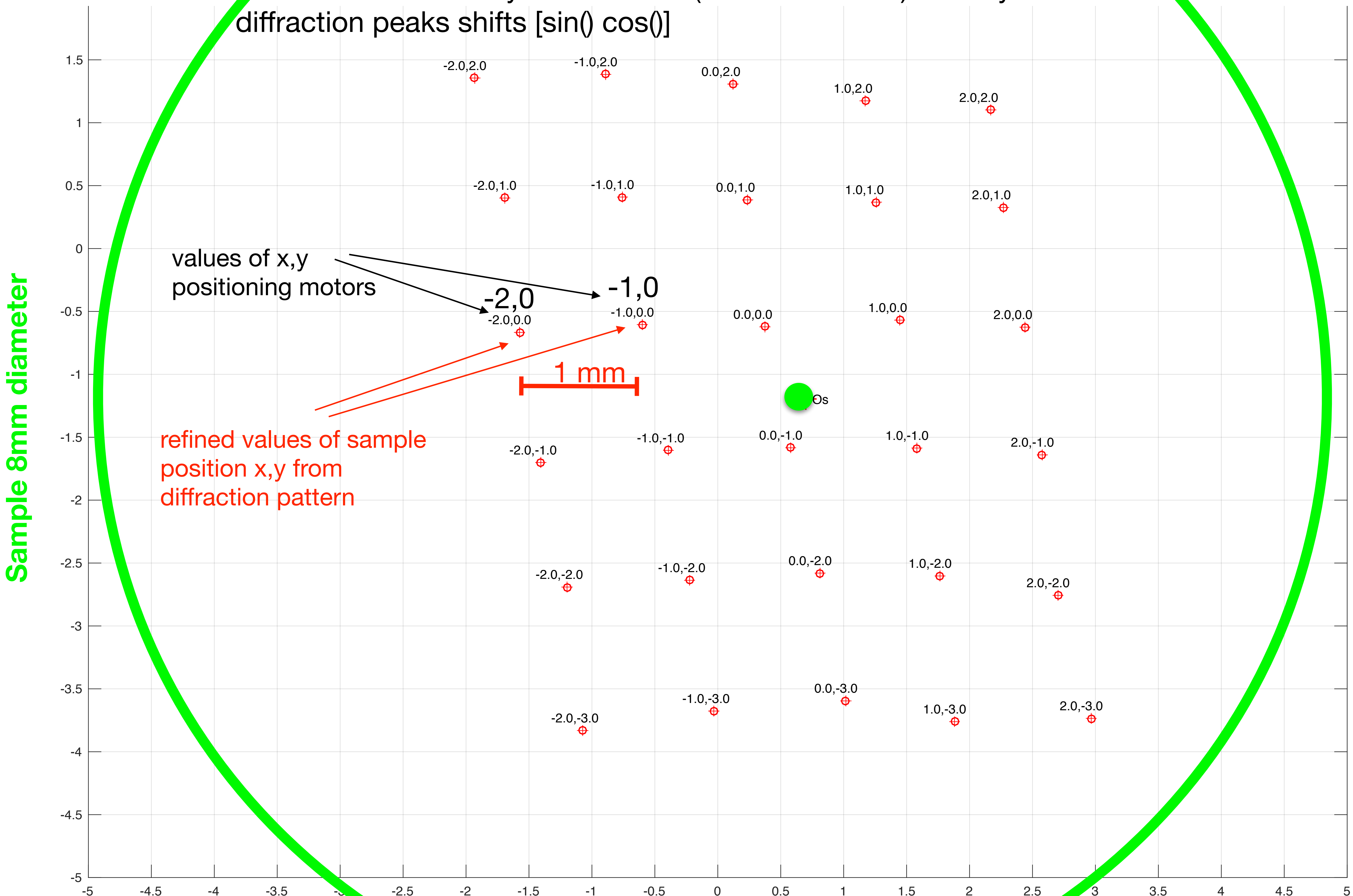
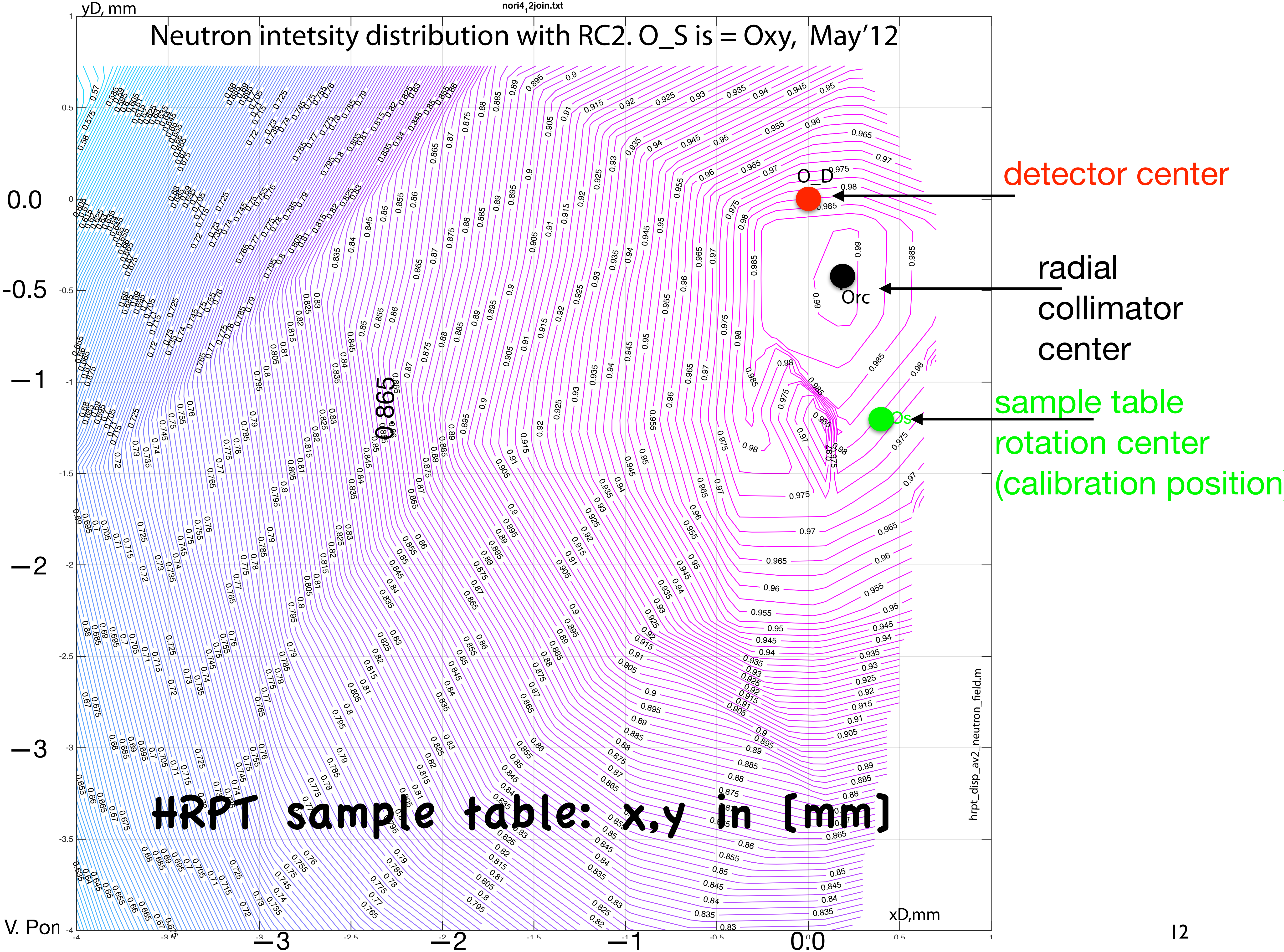
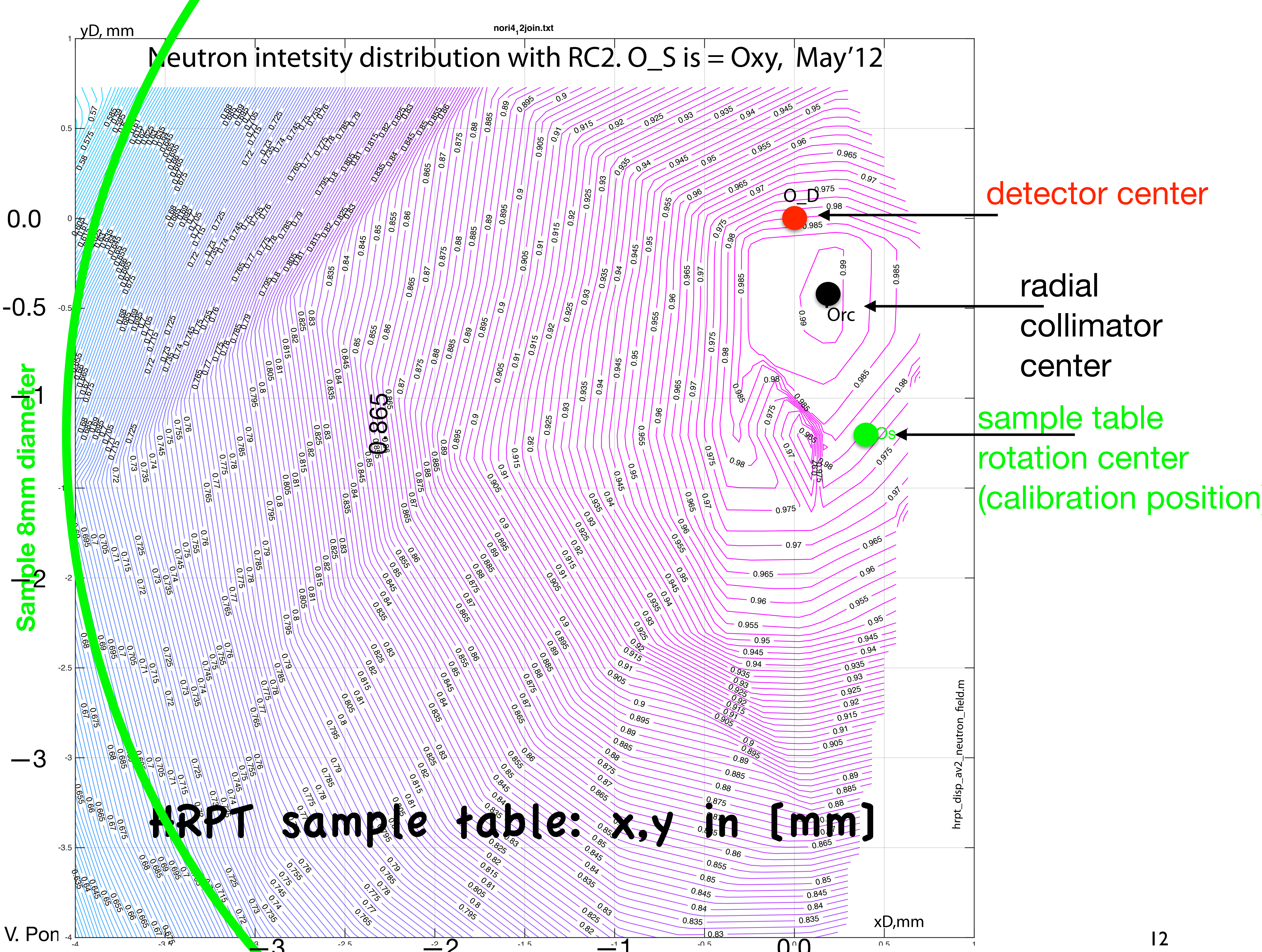


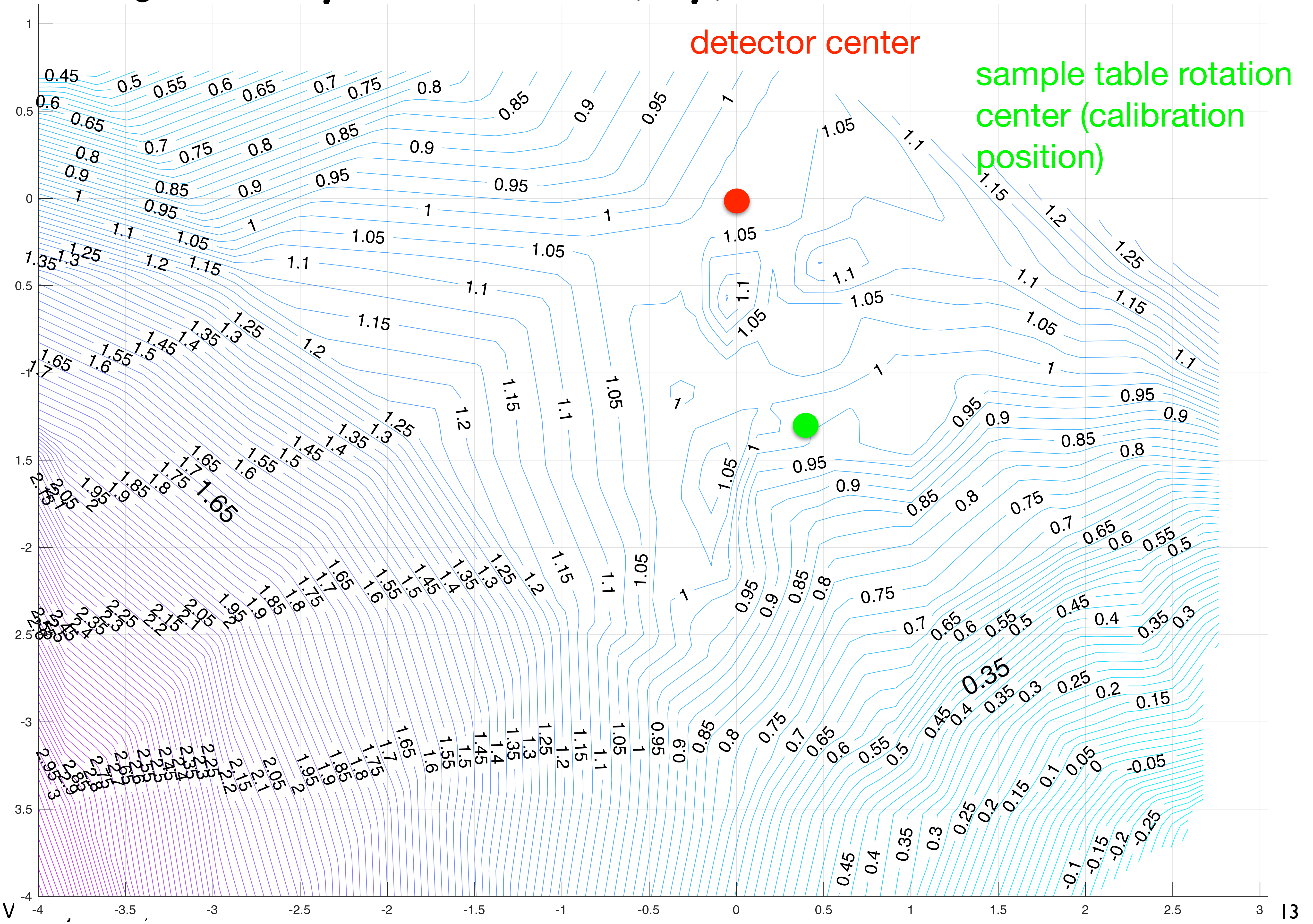


nori4_2join.txt
Neutron intetsity distribution with RC2. O_S is = Oxy, May'12
yD, mm
xD,mm
0.0
-0.5
−1
−2
−3
−3
−2
−1
0.0
O_D
Orc
Os
detector center
radial collimator center
sample table rotation center (calibration position)
HRPT sample table: x,y in [mm]
hrpt_disp_av2_neutron_field.m
V. Pon



Neutron intetsity distribution with RC2. O_S is = Oxy, May'12
nori4_1_2join.txt
yD, mm
xD,mm
detector center
O_D
radial collimator center
Orc
sample table rotation center (calibration position)
Os
Sample 8mm diameter
HRPT sample table: x,y in [mm]
hrpt_disp_av2_neutron_field.m
0.0
-0.5
−1
−2
−3
−3
−2
−1
0.0
0.865
V. Pon

# average Debay-Waller ADP(x,y) of Na2Ca3Al2F14 at 1.9A




V