

UCN handling components

R. Picker

2020-02-06



- Overview
- Design and status of components
- Summary

This talk will only marginally cover UCN run results.
⇒ Wolfgang Schreyer: Experiments with the vertical source

Florian Kuchler

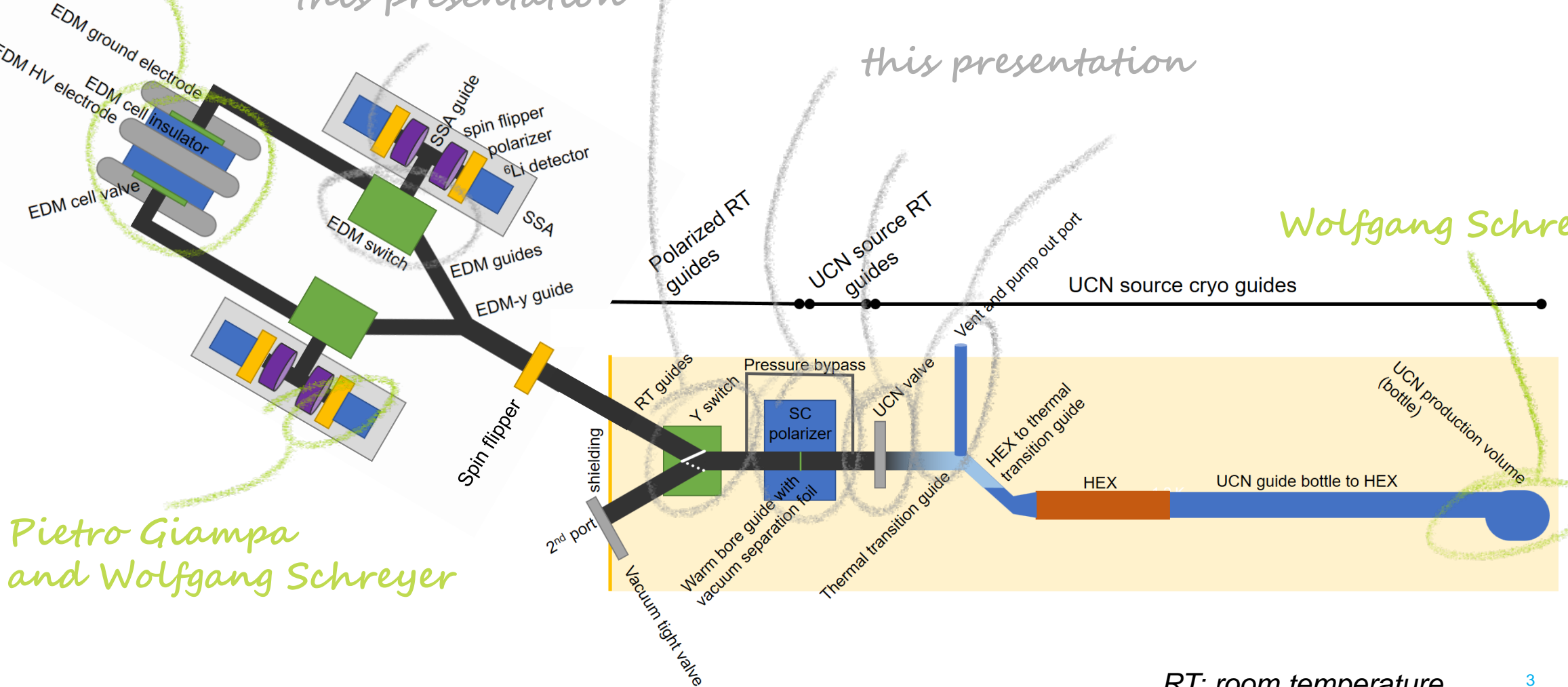
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+ UCN guide length adjuster

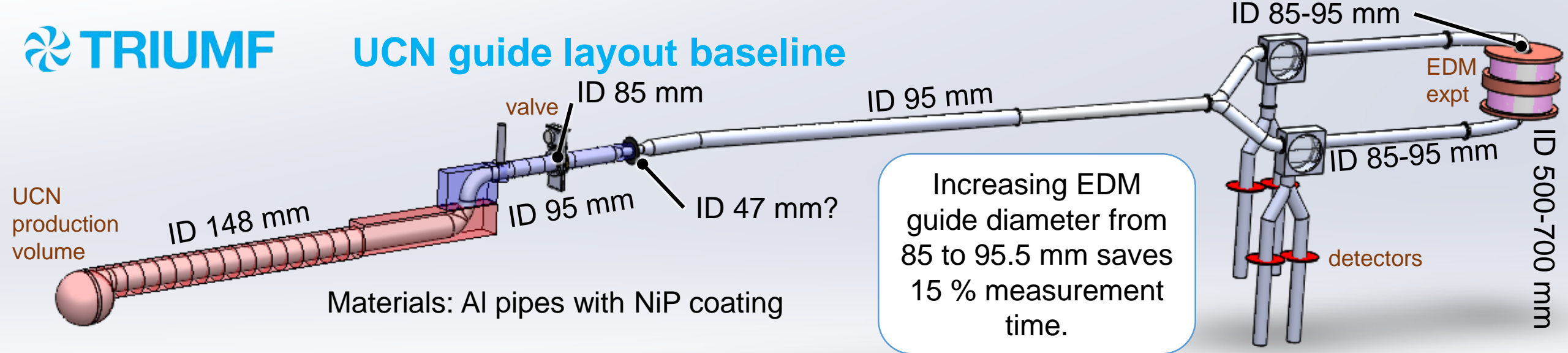
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Wolfgang Schreyer



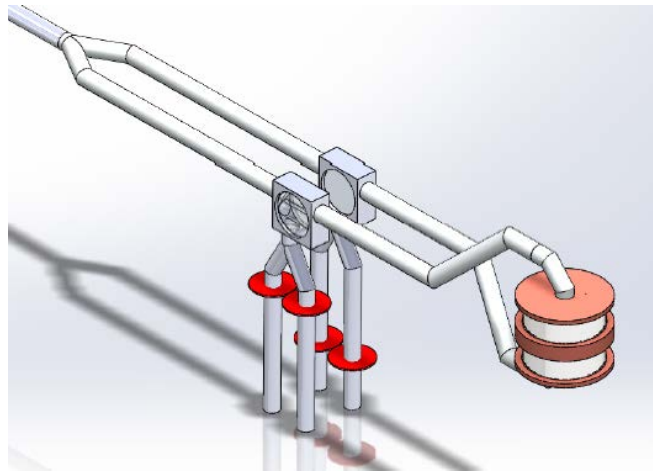
Pietro Giampa and Wolfgang Schreyer

UCN guide layout baseline



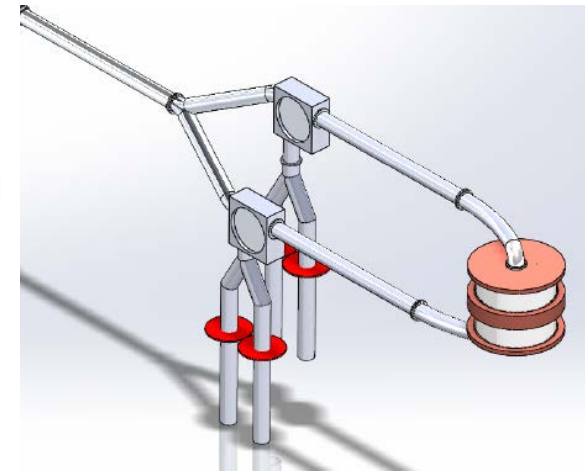
Version 1.0 of EDM cell feeders:

- Detectors can be on same height
- Energy spectra are different, so there is no real good reason for it.



Version 2.0 of EDM cell feeders:

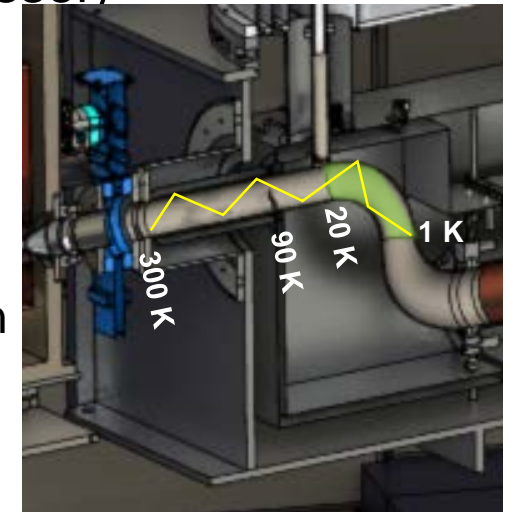
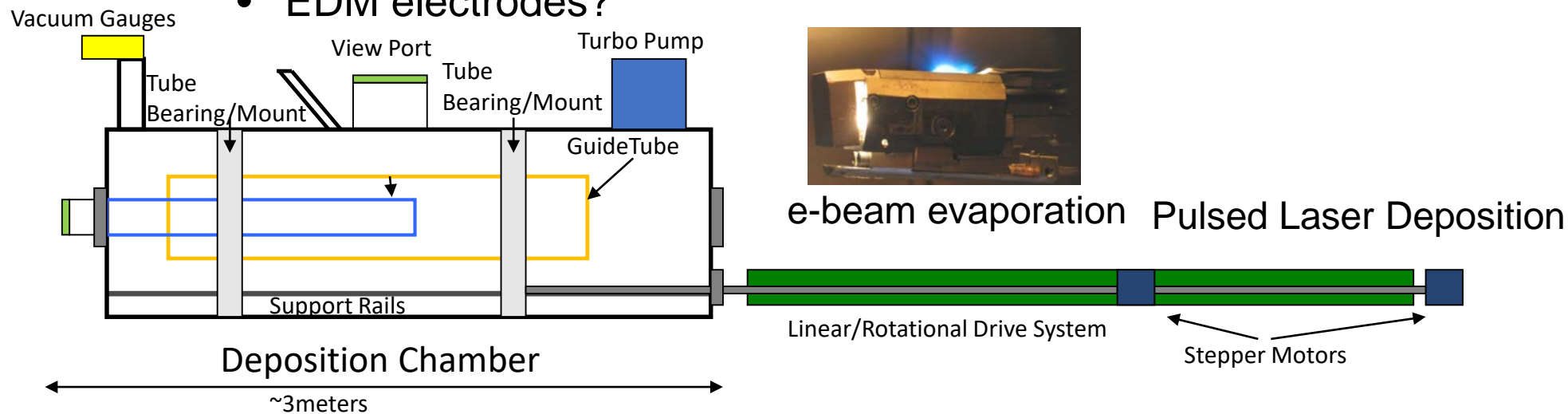
- Detectors on different levels
 - Less bends
- ⇒ 30% less measurement time required

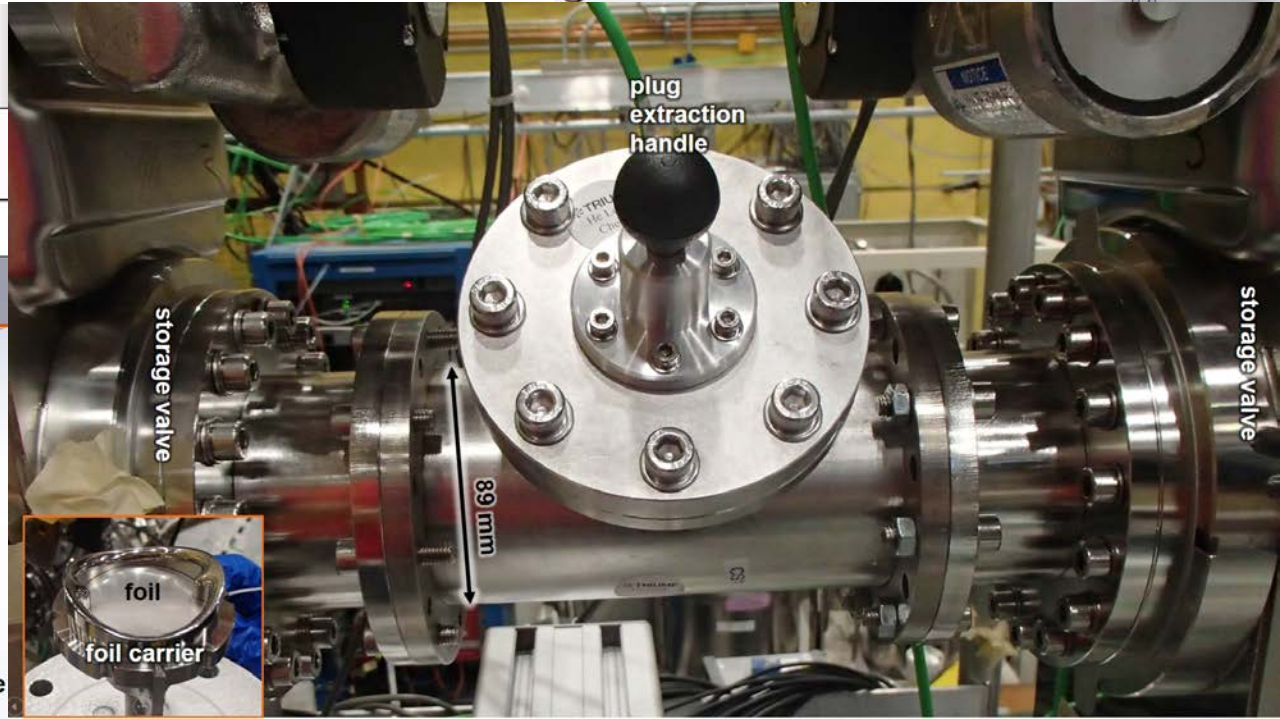
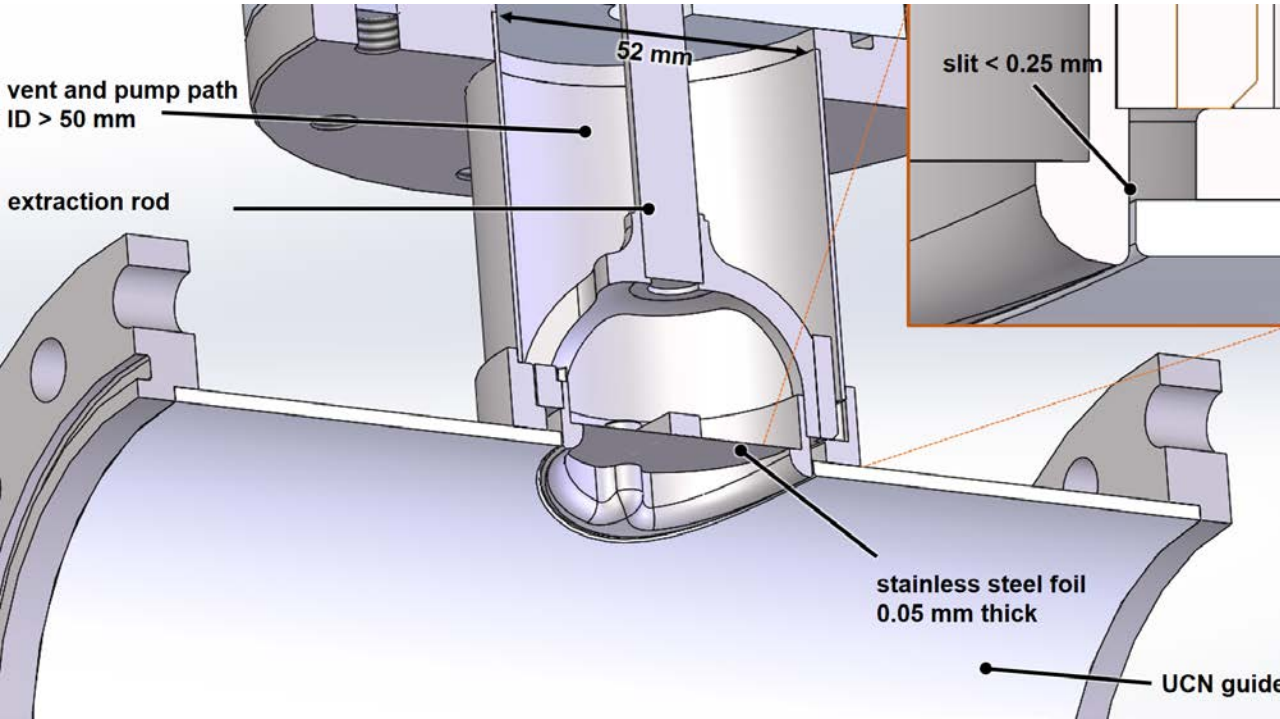


We are still interested in horizontal cell stacking....

R. Mammei

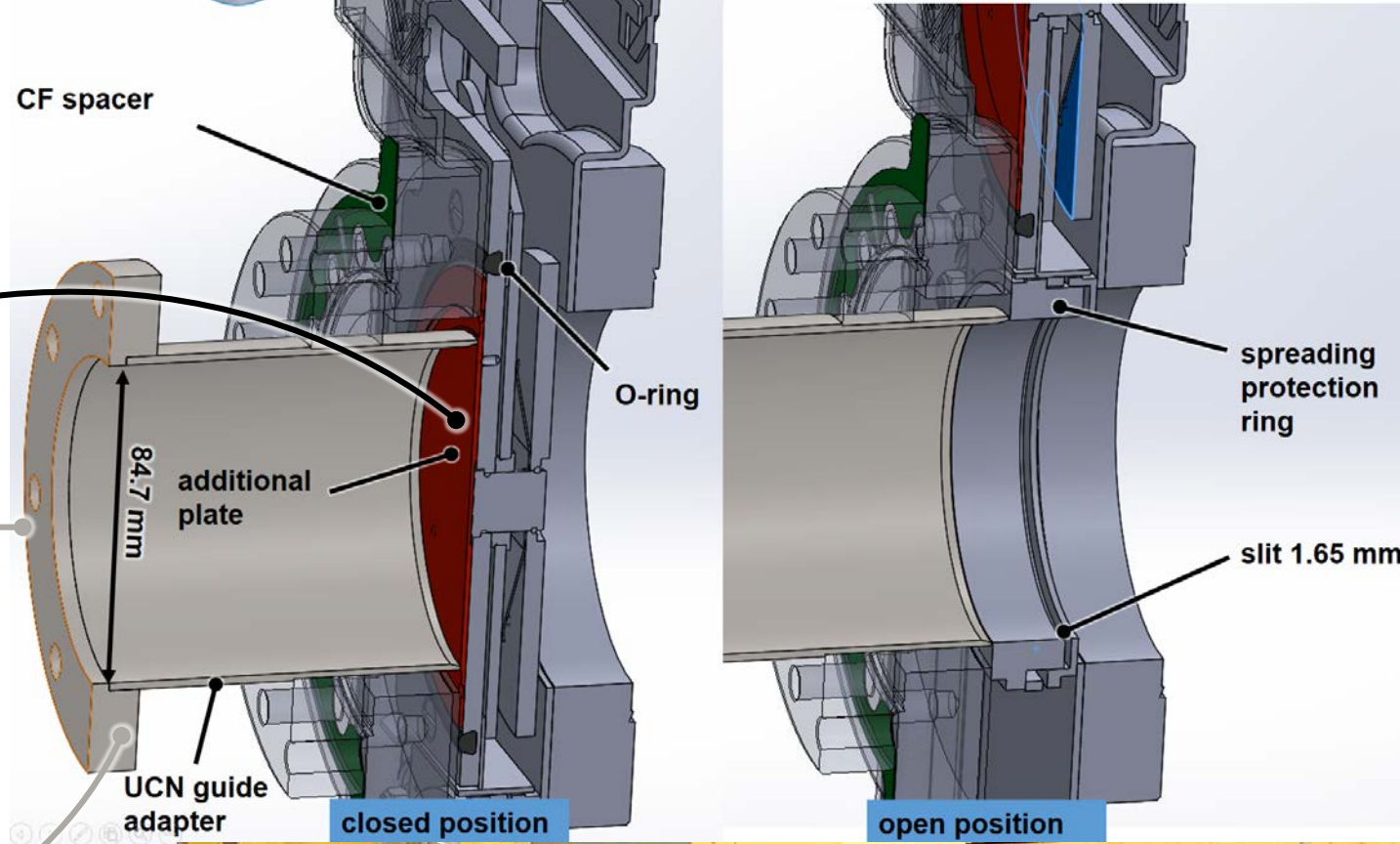
- Laser guide coating expertise in collaboration
- UCN Coating Facility at Virginia Tech will move to U Winnipeg (large savings)
 - Letter of Collaboration being drafted
 - Equipment includes: excimer Laser (to make DLC), the electron beam (to make Ni films), the guide coating chamber, the guide baking oven, + associated support hardware
- Expected move date spring to early summer 2020 (earlier coatings possible at VT)
- Operational at U Winnipeg fall of 2020
- Important for
 - “black” DLC coated guide for UCN source (thermal radiation suppressor)
 - EDM electrodes?



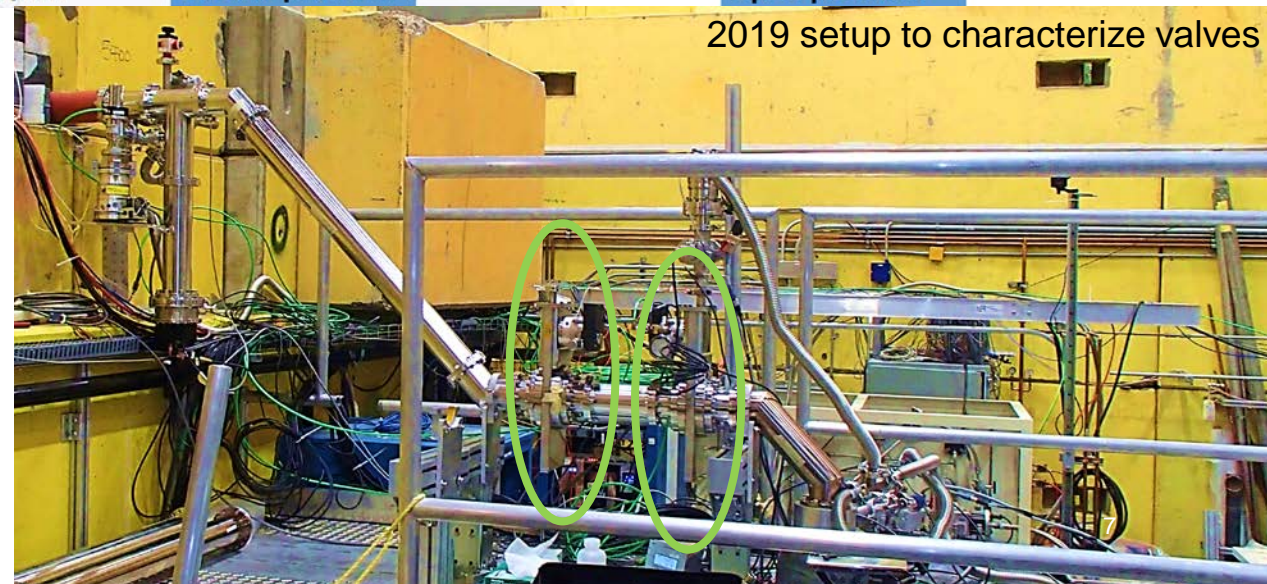


- Keeps pressure inside liquid helium filled UCN guide below 2 bar absolute in case of a full vacuum breakdown.
- Thin foil bends upwards at less than 10 mbar.

- Inside assembly is retractable so that it can be repaired or replaced.
- Also allows for pumping of the UCN guide.
- Tests show reduction of source storage lifetime $\approx 2.5\%$

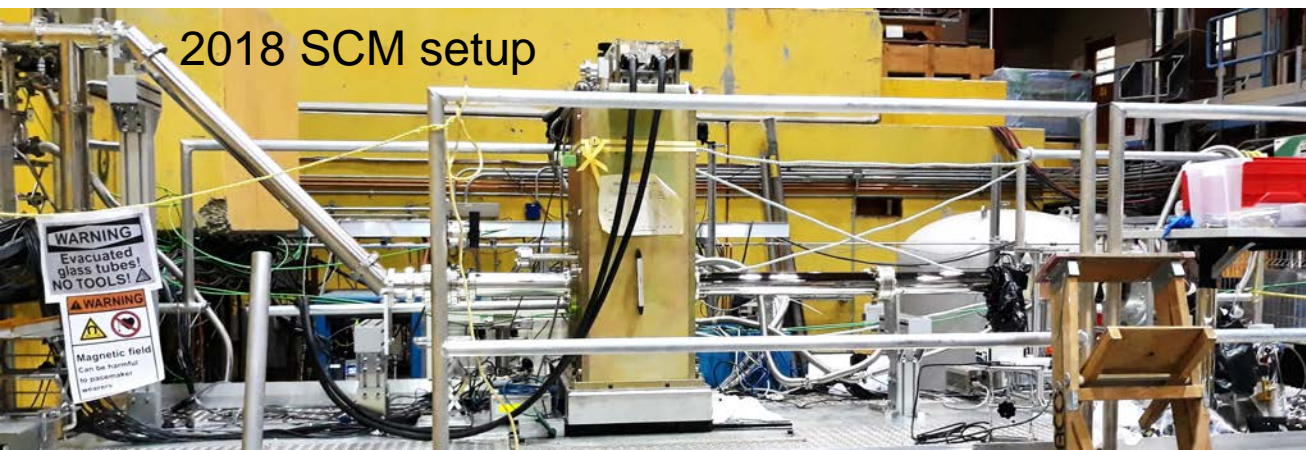
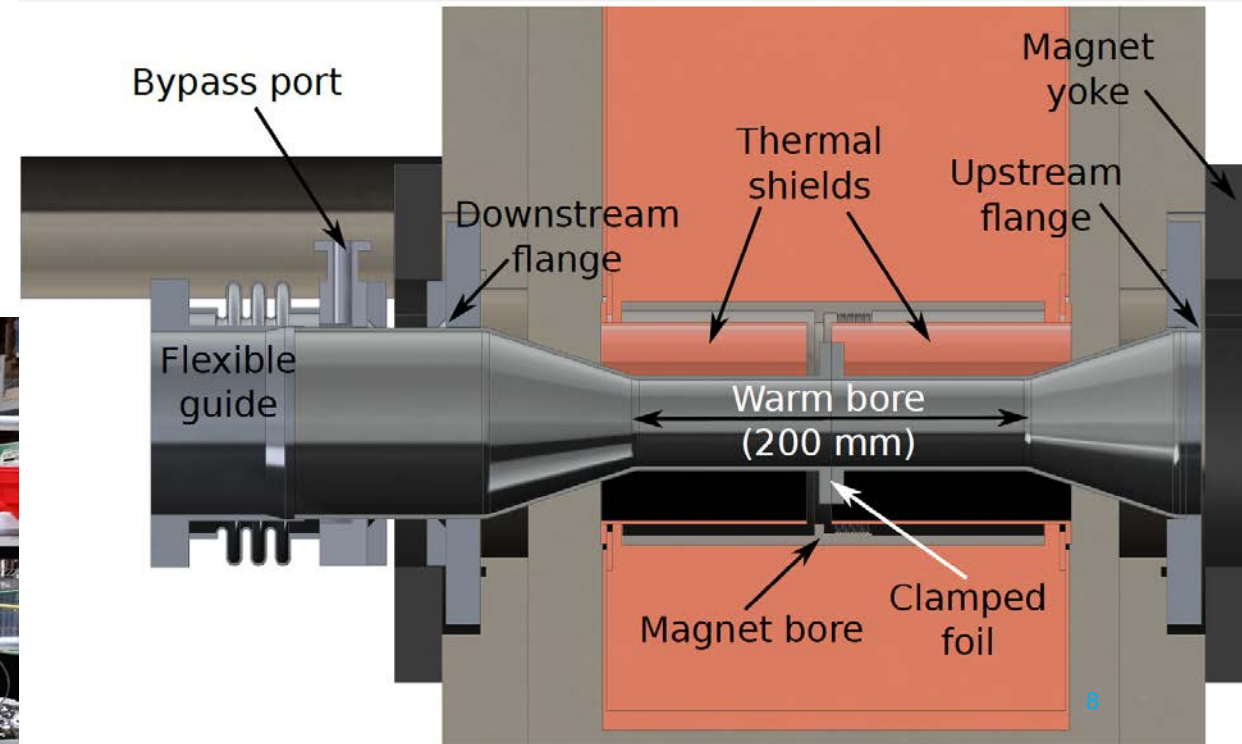
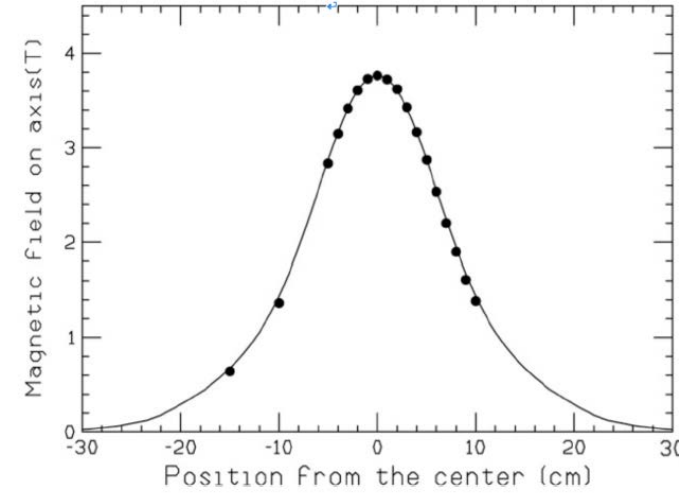


- We decided to go for an off-the shelf VAT valve and improve it.
- **Closed position:** **additional plate** on blade of valve and **precision machined adapter** \Rightarrow good storage lifetime (>30 s in 2 l storage volume).
- **Open position:** Spreading protection ring \Rightarrow transmission to about 90% compared to a straight guide.
- Valve is ready to go for new source (but new adapters have to be made)
- Slight guide restriction 95.5 mm ID to 85 mm \Rightarrow potential future upgrade

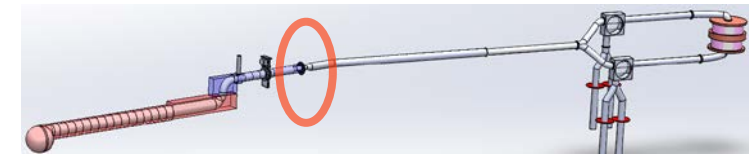
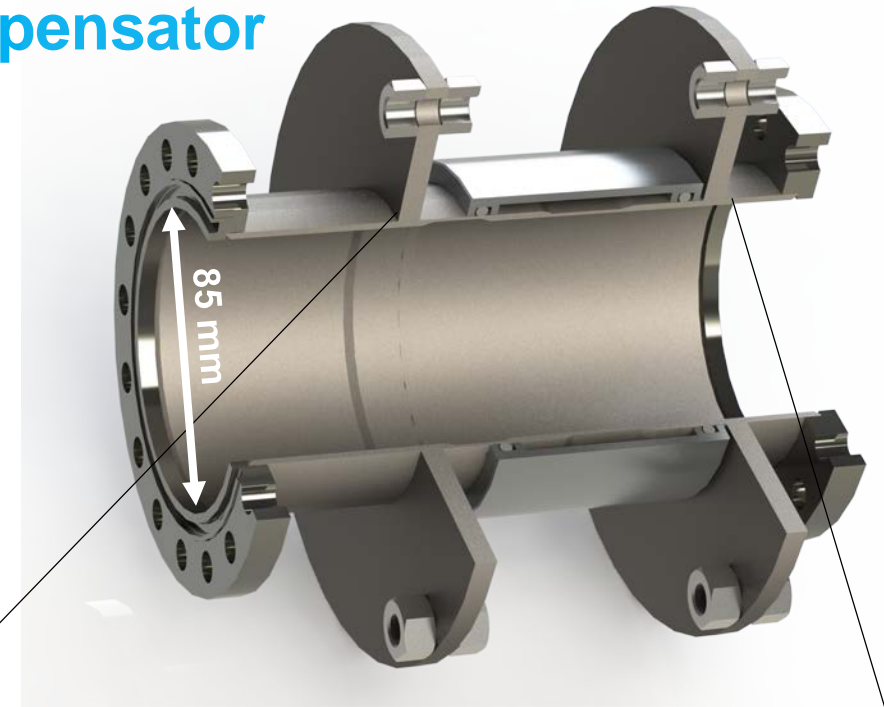


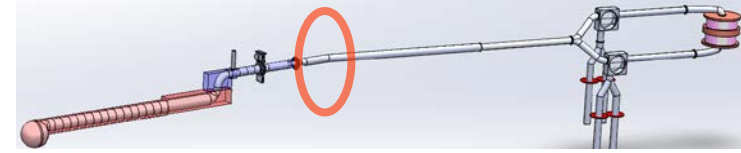


- 3.7 T dry SC magnet available from RCNP (no quenches, fast ramping, HTSC)
- Originally with cold bore, changing to warm bore for RT foil.
- Found solution for welding in Al foil after NiP coating.
- Smaller bore is preferred by simulations.
- UCN transmission measurement 45 mm ID vs 67 mm ID outstanding to confirm simulations \Rightarrow 2020 UCN run?

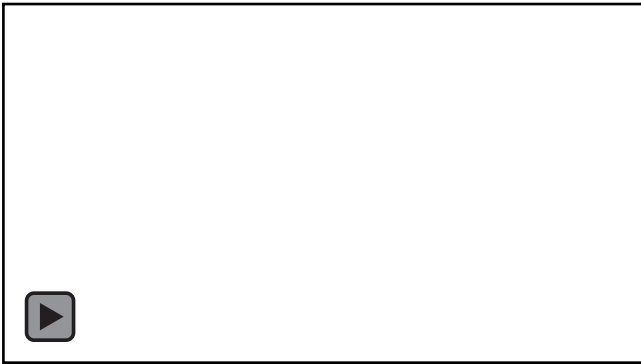
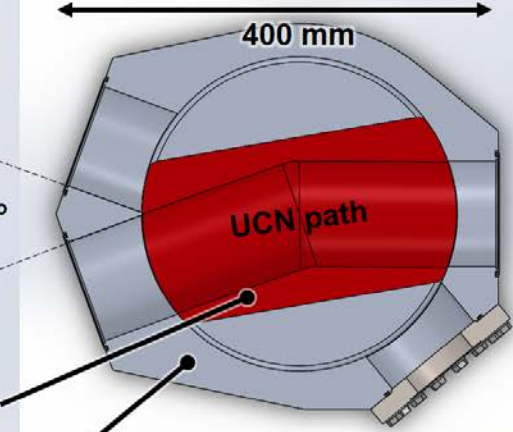
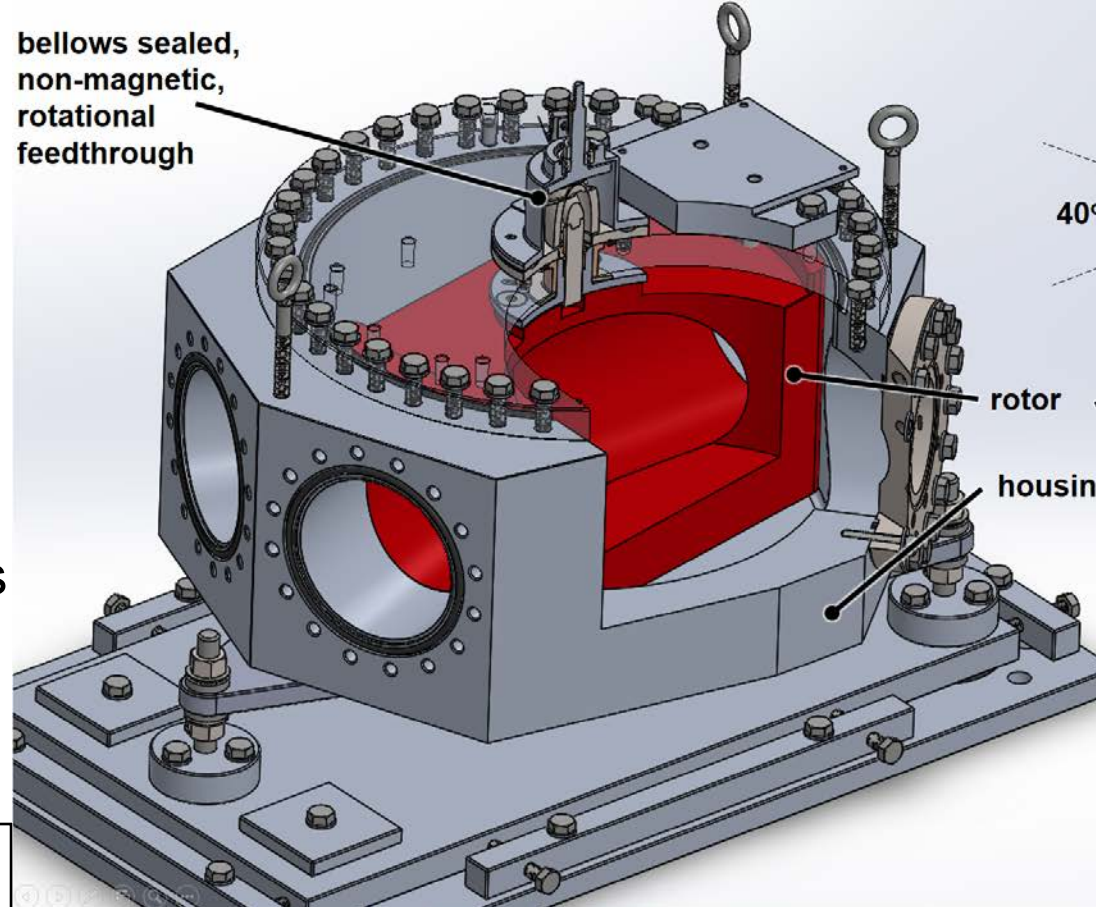


- Required to adjust to allow for some tolerance in assembly and also allow easier disassembly.
- Will probably be integrated in the SCM warm bore UCN guide adapter.
- Two sliding tubes with as little as possible slits and steps.
- Vacuum sealed by bellows.
- Prototype with O-ring seal ready for UCN





- **Non-magnetic** (NiP plated on Al), all-metal-sealed, very small tolerances
- 3 UCN, 1 pumping port.
- **< 50 μm slit** between rotor and housing (had to be increased from 10 μm since dust in clean room caused seizing)
- Bellows-sealed rotary feedthrough.
- Assembled, small actuation changes outstanding.
- Actual valve ready for a 2020 UCN run.



- **Three-way switch** to connect (1) source to EDM cell, (2) EDM cell to detectors and (3) source to detectors.
- Original plan: vertical rotation
- Now investigating to re-use extensive engineering of Y-switch ⇒ horizontal rotation
- Ready for engineering design.

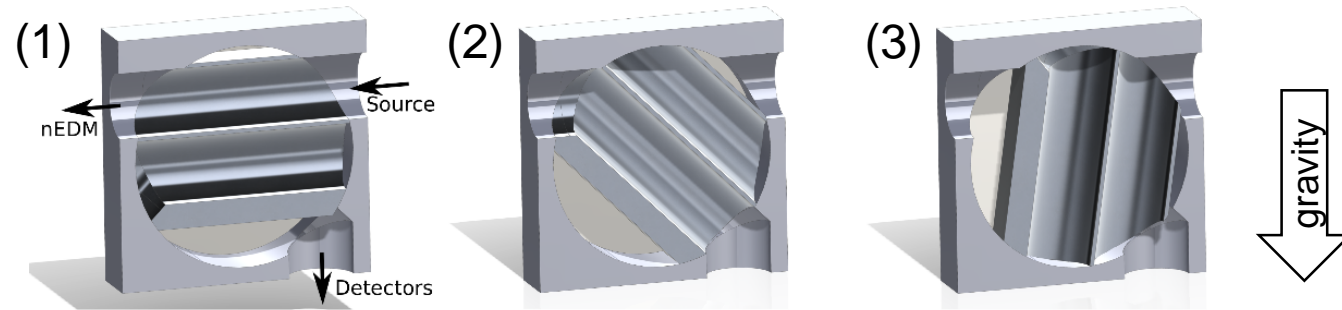


Figure 5.18: Concept for the EDM detector switches with three positions to transport UCN from the source to the nEDM cell (left), from the nEDM cell to the detectors (center), and directly from the source to the detectors (right).





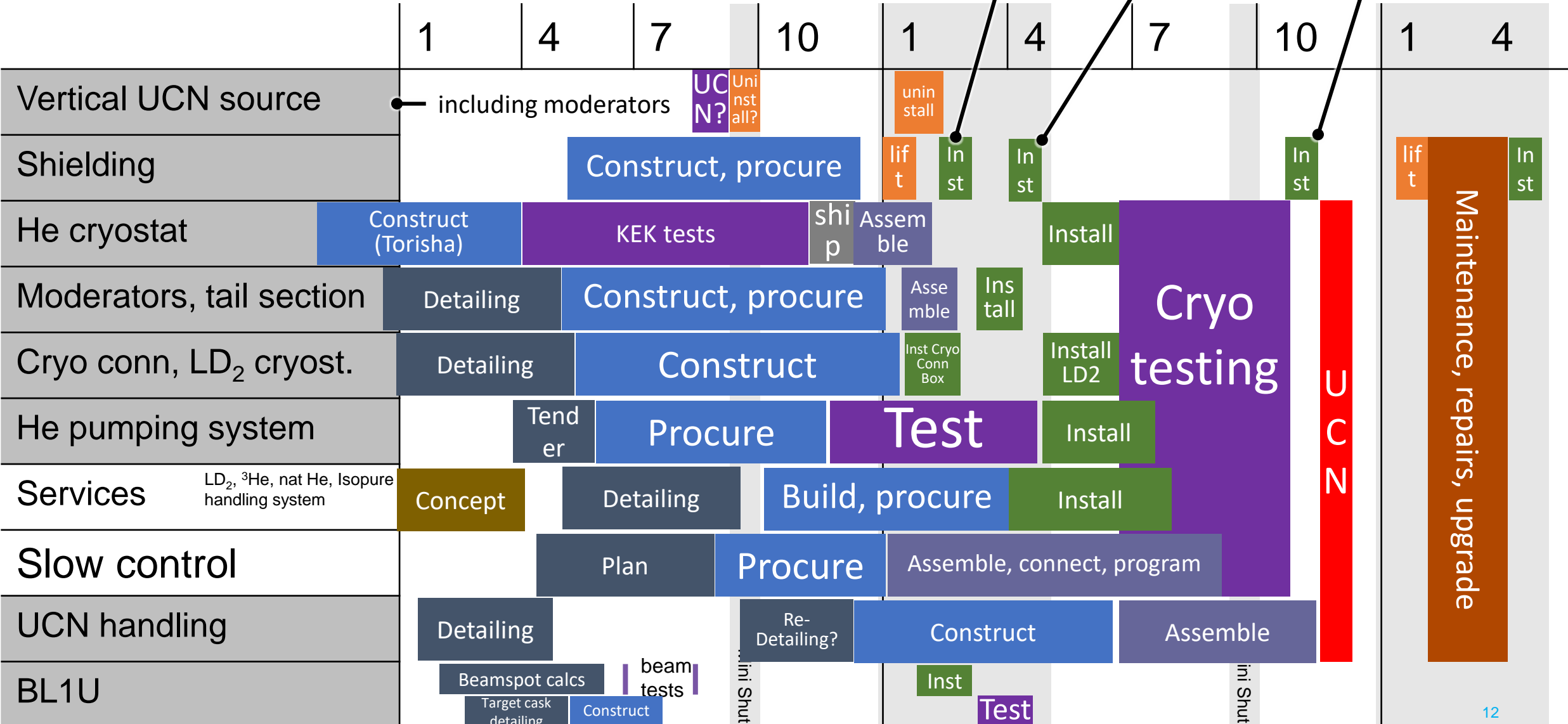
UCN source schedule

Calendar Year

2020

2021

2022



prepare moderator region

to allow BL1 operation

to allow BL1U operation

UCN

Maintenance, repairs, upgrade

Gray shaded systems are inside the biological shielding.

Main Shutdown

Main Shutdown

Main Shutdown

- We have a very solid baseline for the UCN guide elements of (source and) the EDM experiment.
- No showstoppers have been identified.
- UCN experimental runs have proven the effectiveness of many geometries and surfaces and indicated necessary improvements \Rightarrow Wolfgang Schreyer's talk
- Additional important items are ready for UCN tests \Rightarrow my later talk for discussion

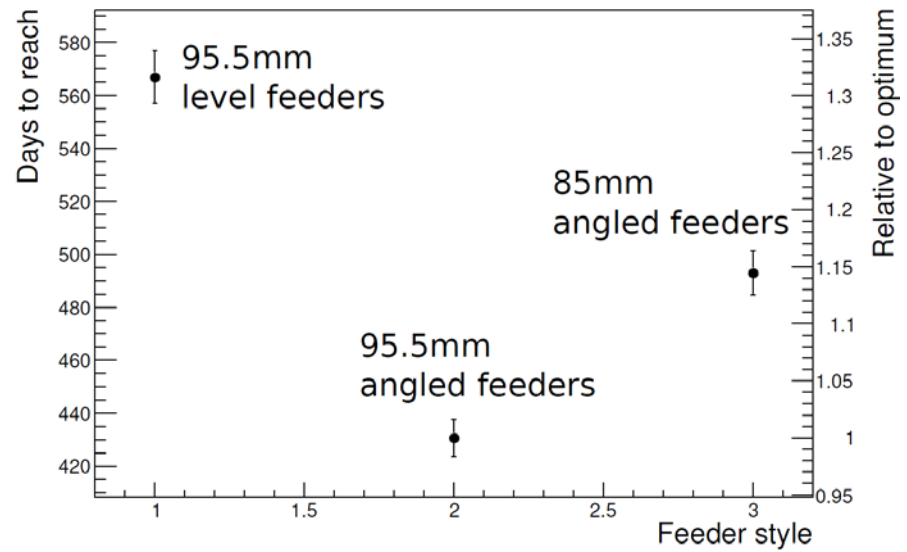
Thank you
Merci

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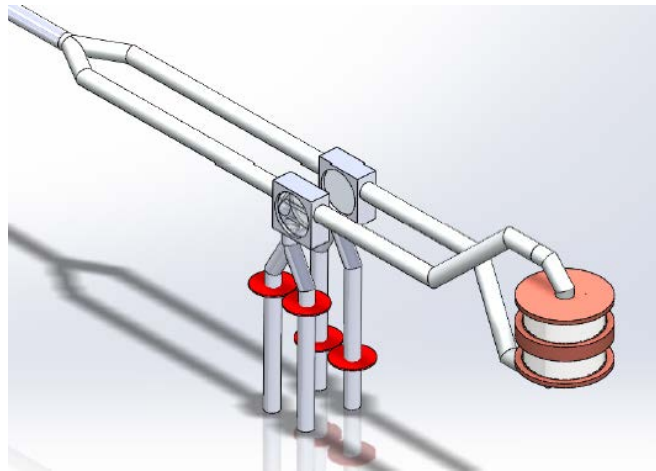


Days to reach vs FeederStyle



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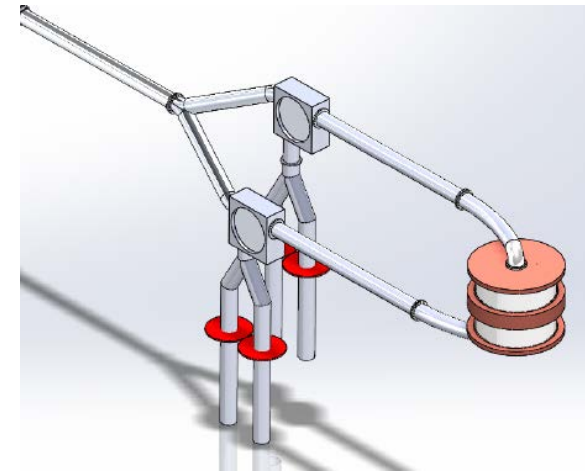
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Version 2.0 of EDM cell feeders:

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Increasing guide diameter from 85 to 95.5 mm saves 15 % measurement time.



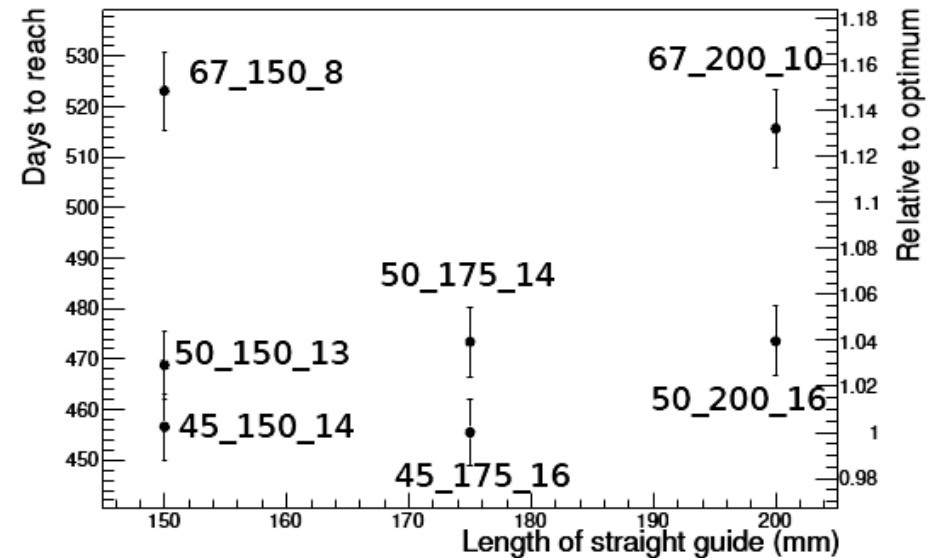
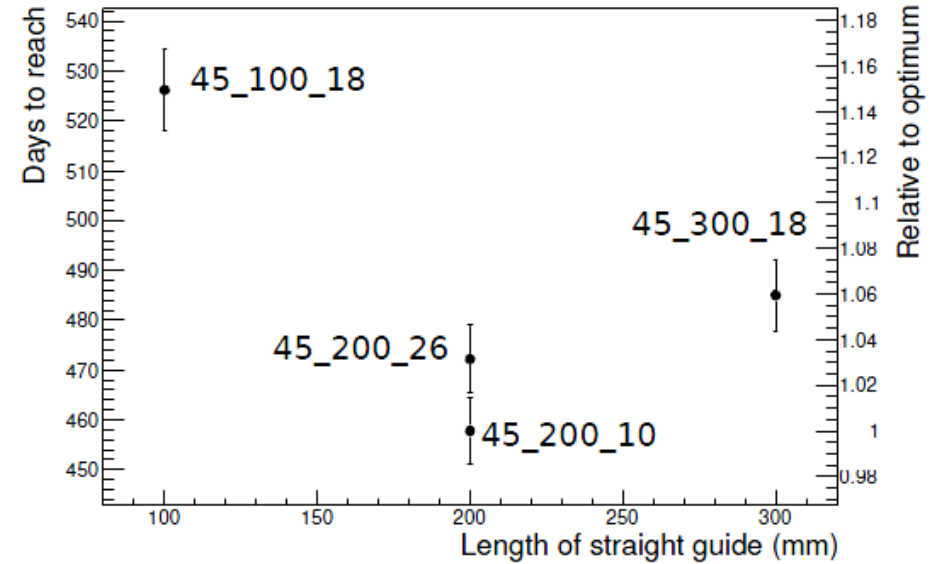
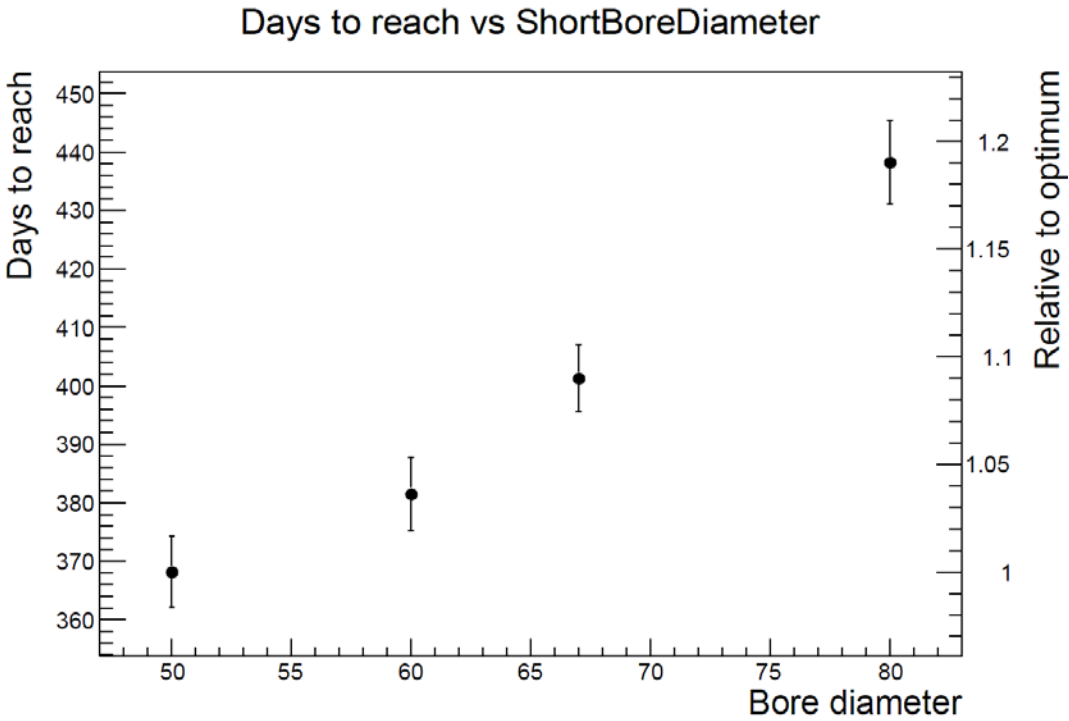


Figure 5.15: Days-to-reach sensitivity vs length straight guide. Labels indicate boreGuideDiameter_lengthOfBoreGuide_funnelAngle.

UCN potential $\mu \times B$ for HFS

16/Jul/2019 11:07:20

Map contours: $-B^*60$

-1.580671E+01

-5.000000E+01

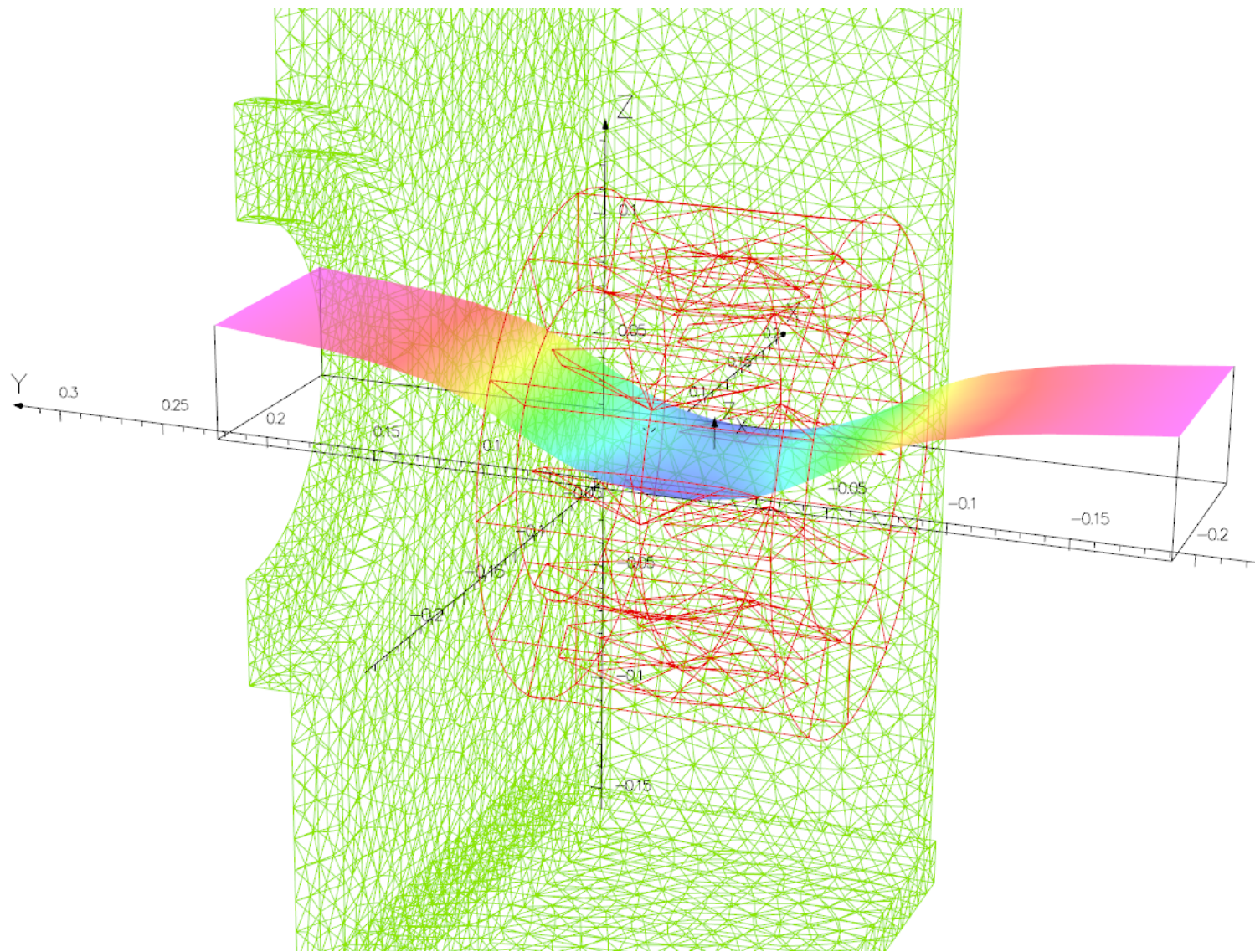
-1.000000E+02

-1.500000E+02

-2.000000E+02

-2.330498E+02

Integral = -4.154075E+00



UNITS

Length	m
Magn Flux Density	T
Magnetic Field	A/m
Magn Scalar Pot	A
Current Density	A/m ²
Power	W
Force	N

MODEL DATA

scmSafetyReport09-2018.op3
 Magnetostatic (TOSCA)
 Nonlinear materials
 Simulation No 1 of 1
 173595 elements
 83171 nodes
 1 conductor
 Nodally interpolated fields
 Activated in global coordinates
 Reflection in YZ plane (X field=0)
 Reflection in ZX plane (Z+X fields=0)

Field Point Local Coordinates

Local = Global

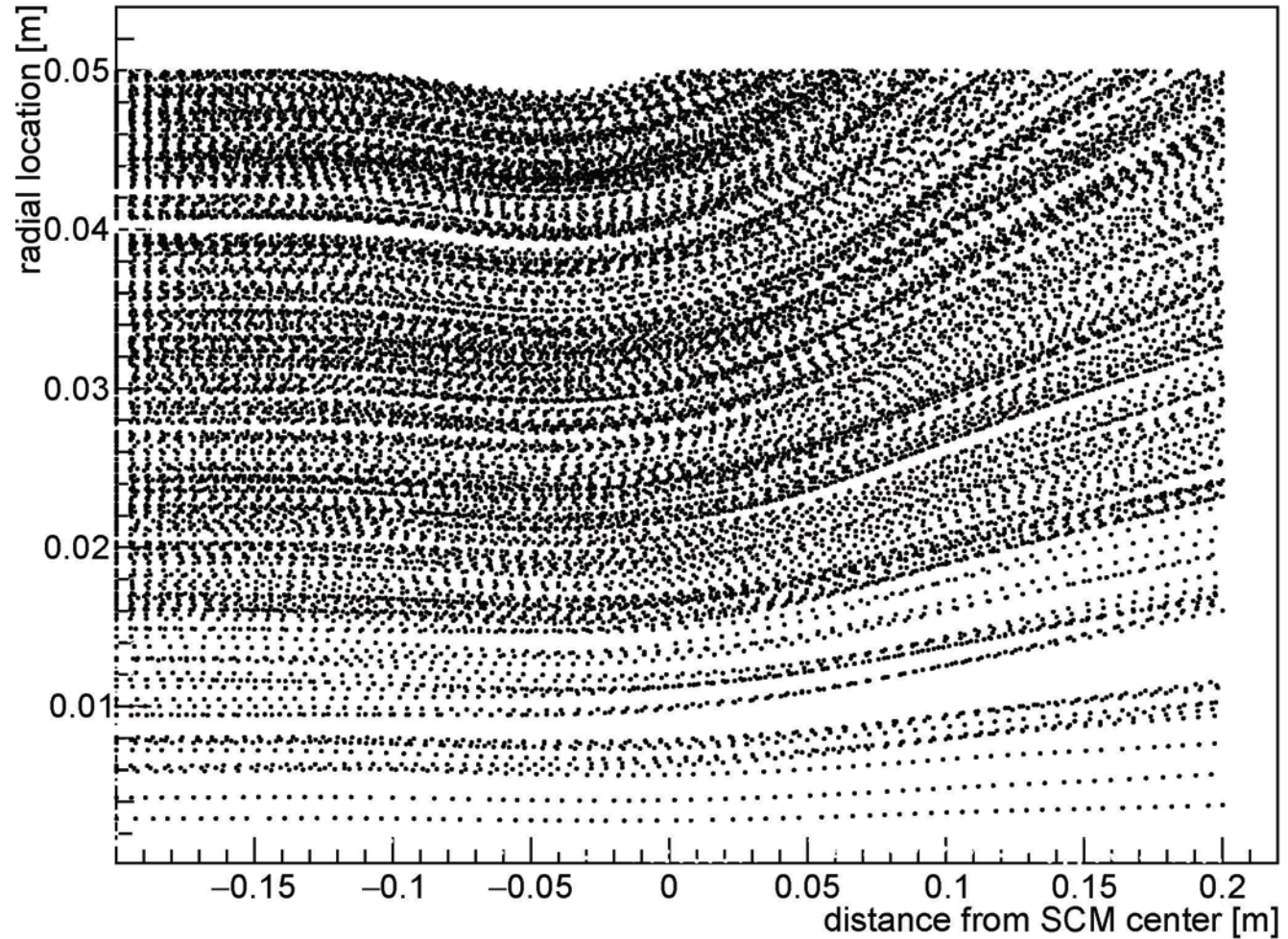
FIELD EVALUATIONS

Cartesian CARTESIAN (nodal) 100x100 Cartesian
 x=-0.05 to 0.05 y=-0.2 to 0.2 z=0.0

- all UCN start at -0.2 m from SCM centre
- all in x direction
- energies up to 200 neV

$E_{\text{kin}} > 150 \text{ neV}$

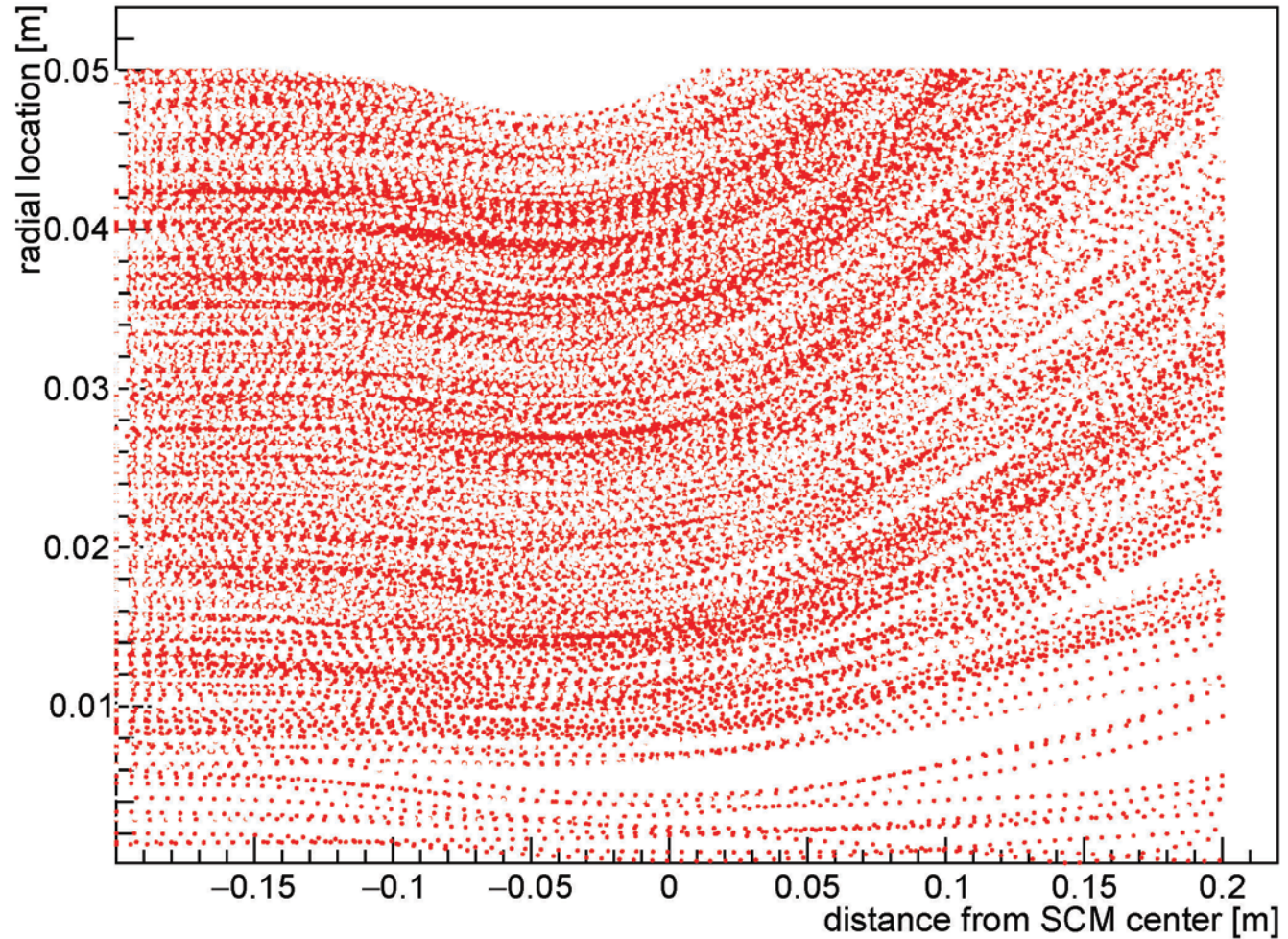
$\text{sqrt}(z*z+y*y):x \{H<50e-9\}$



- all UCN start at -0.2 m from SCM centre
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$E_{kin} < 50 \text{ neV}$

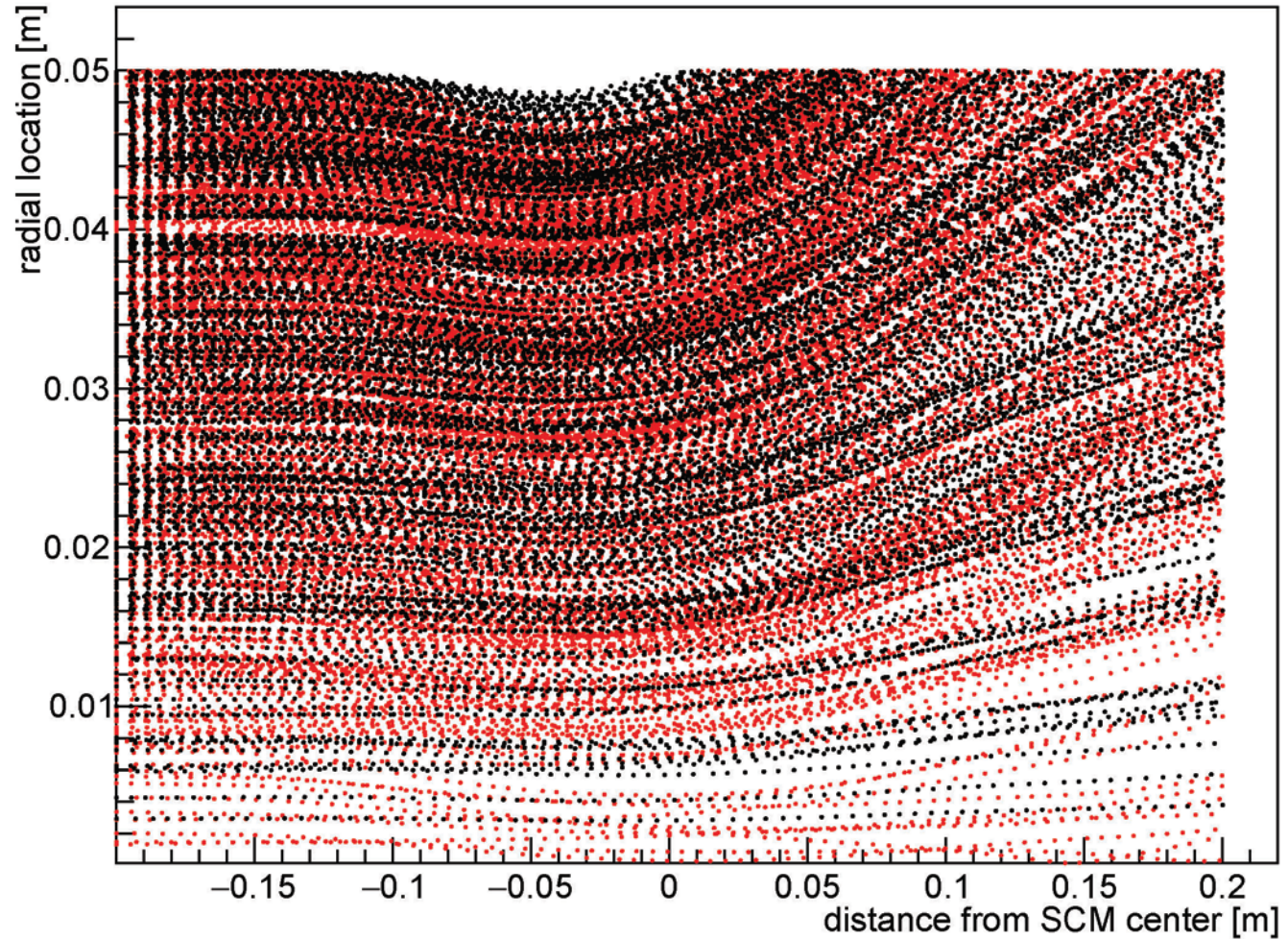
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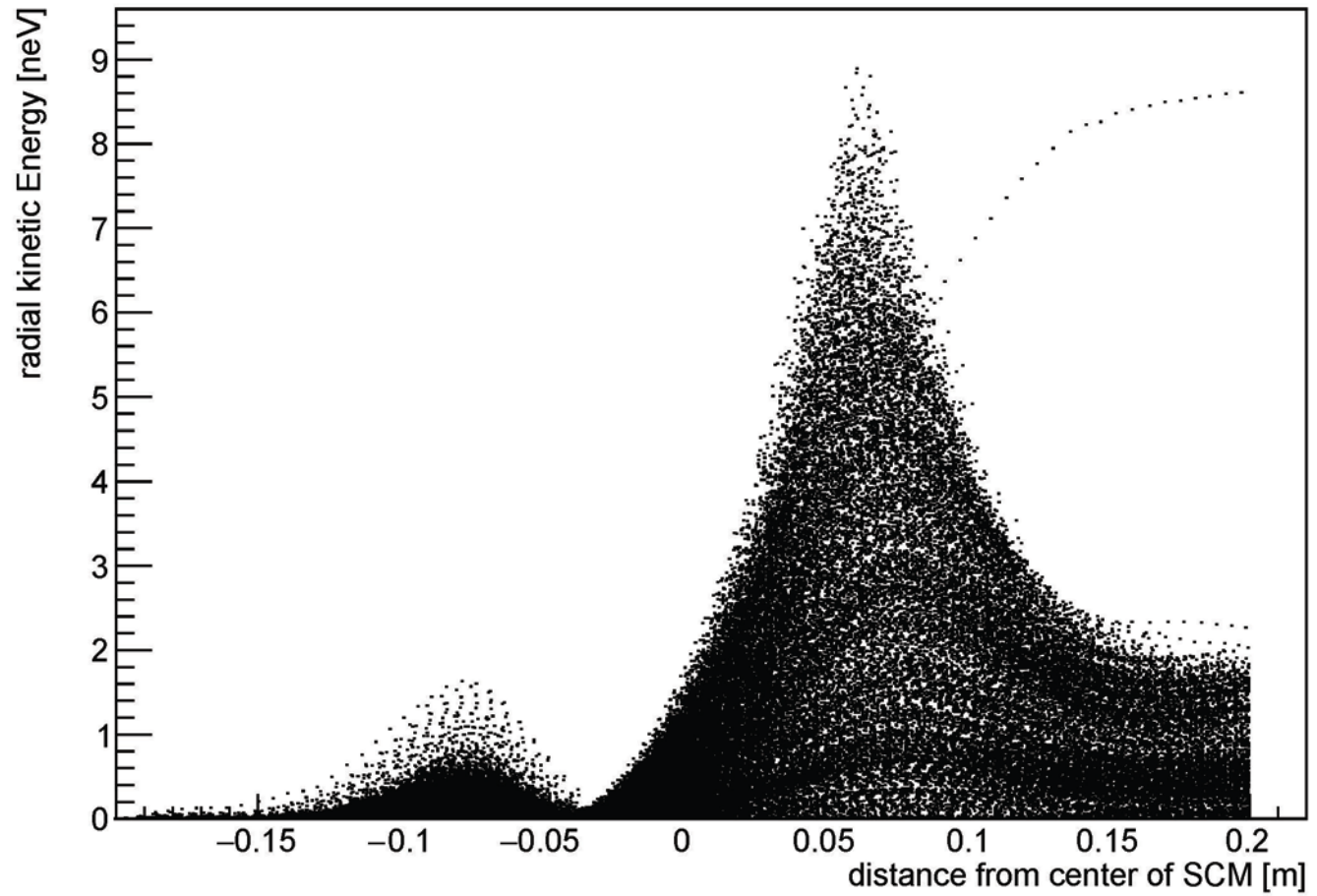
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$$(v_z^2 + v_y^2) * 5.23 : x$$



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- energies up to 200 neV

