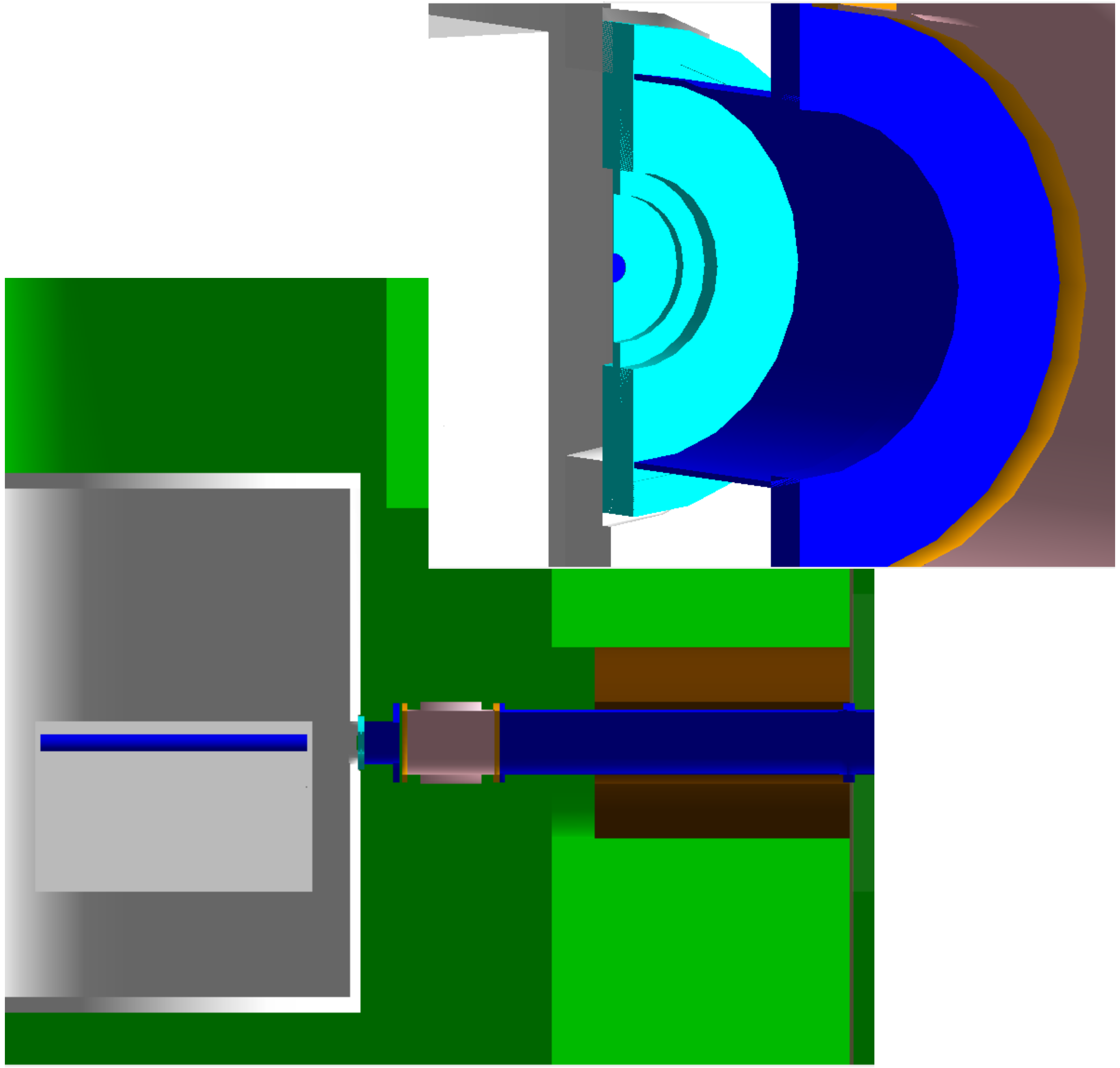
Technical Update

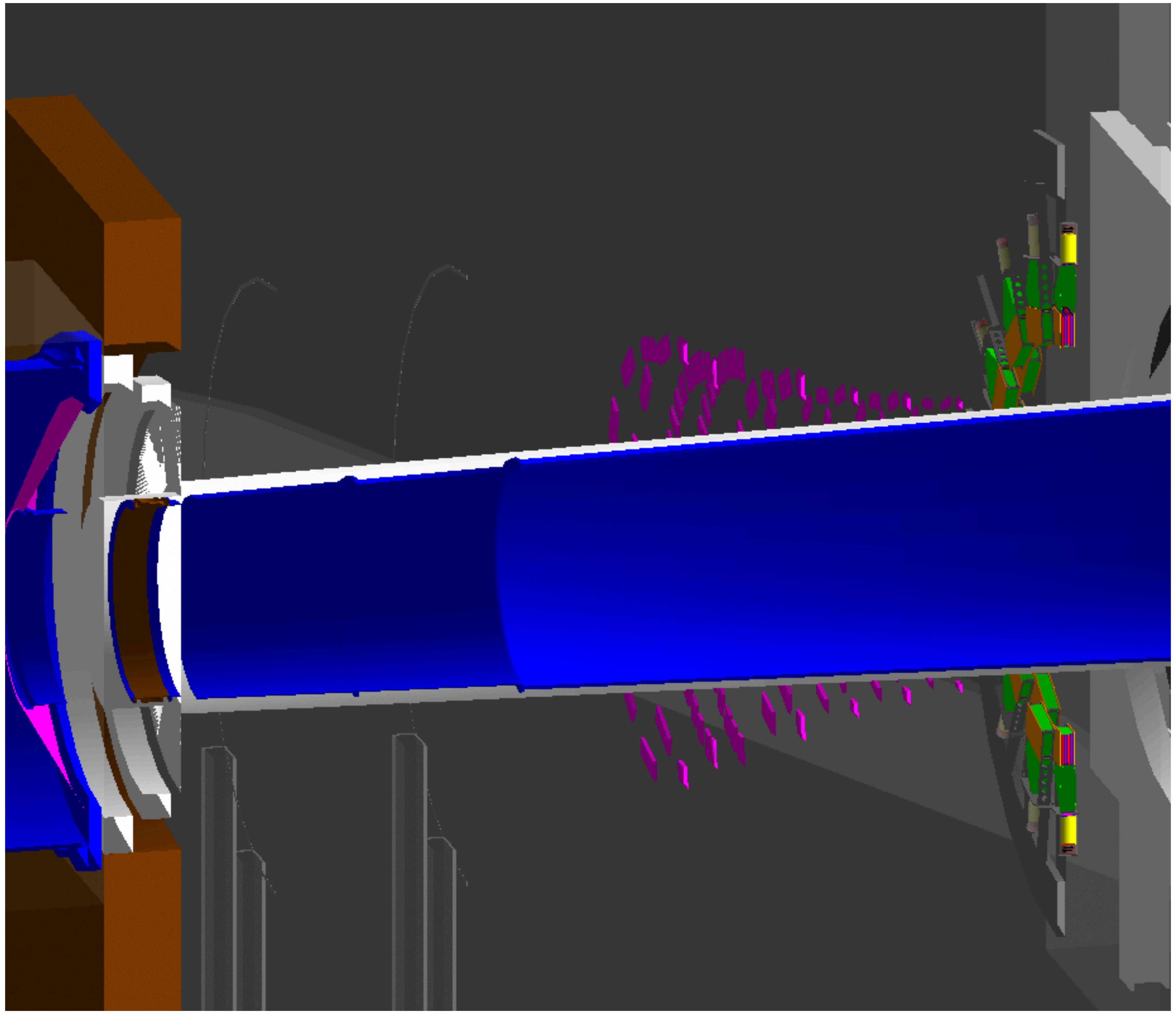
Kent Paschke

Progress

- Coil dose and shielding (JM, SR)
- Photon background investigation
- Beamline charged background optimization (PG)
- MD tiling verification / optimization (ZD, CG, MG)
- MOLLER GEMs prototyping
- Compton electron detector progress
- Ferrous material - fasteners, supports… (EK)
- Sieve design (VD,KE)
- Accelerator talk organization, PQB meeting coordination
- Injector upgrade (gun and booster)
- SAM and LAM designs (DA)

Simulation Fidelity





Two Bounce

The two-bounce code has been updated to match the CAD and verify (in a 2-d model) we aren't introducing 2-bounce line-of-sight backgrounds

Sakib and Luc Barrette
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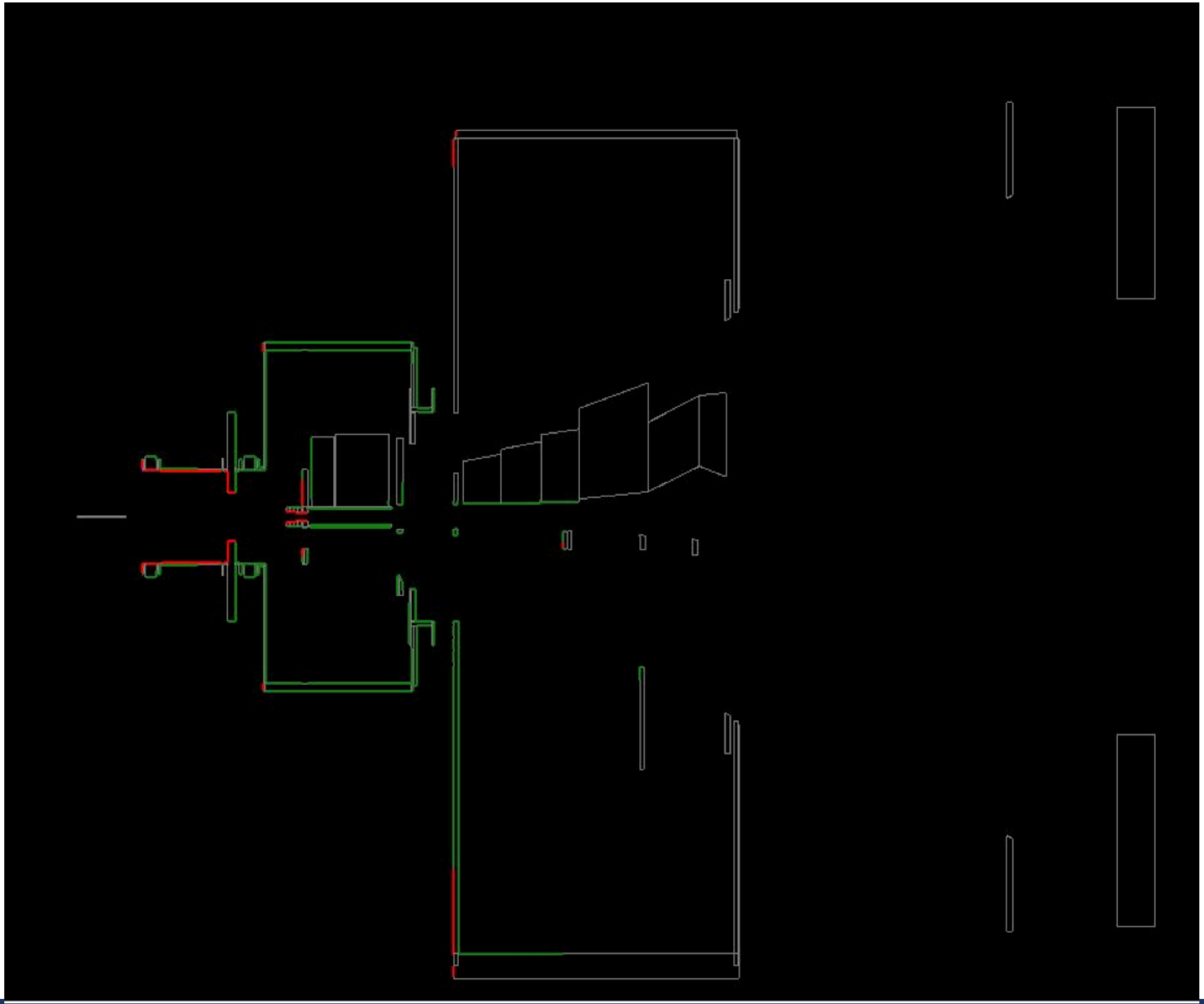
Photon background sources in remoll have been identified - these are due to charged particle interactions. Some reductions were sought there also.



Ferrous Materials Rule of Thumb

Eric King will discuss recent ferrous sim

Estimate false asymmetry A_f as

$$A_f = f_r P_e P_s A_n$$

f_r rate fraction of process
P_e incident electron polarization
P_s material electron polarization
A_n analyzing power

Goal: $A_f < 10^{-12}$

X_r	Example material	Spin polarization	Allowable f (per eot)	Allowable f (per Moller)
2000	Mild steel	1e-2	1e-11	1e-7
1	Stainless steel (worst case) e.g. 304	1e-5	1e-8	1e-4
0.01	Stainless steel (best case) e.g. 316	1e-7	1e-6	1e-2
0.001	Inconel 625 Bronze/brass(best case)	1e-8	1e-5	1e-1
0.0001	Aluminum, titanium	1e-9	1e-4	1

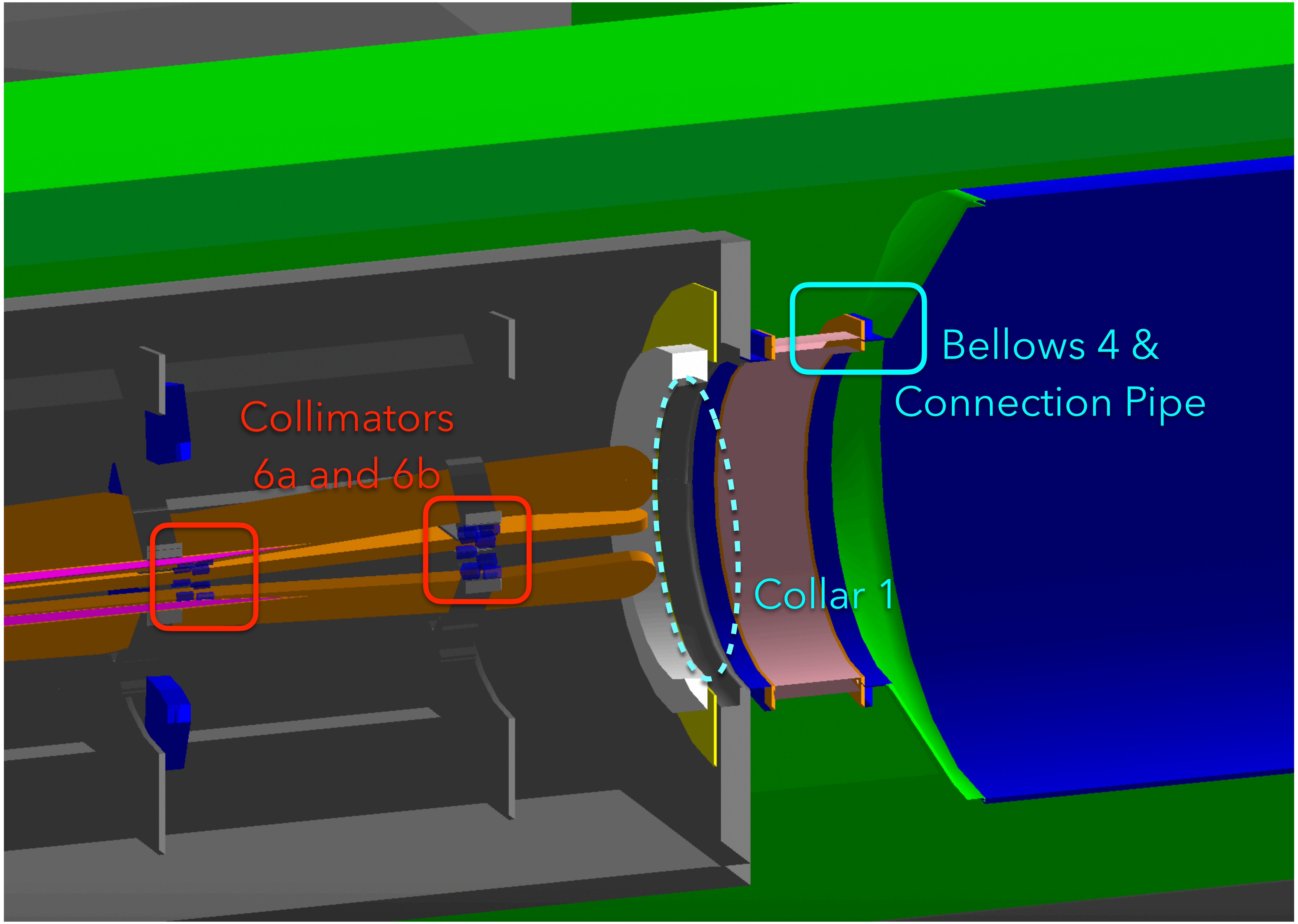
Assumptions: 1G ambient field, A_p = 1e-3, Moller rate 1e-4/eot.

In regions with applied field, we need very low scattering rates and/or very low relative susceptibility

In ambient field, one rarely needs to be better than (good) stainless. (Total rescattered background should be few 1e-3)

We get away with magnetic steel at low fields only when protected by shielding and/or field and/or distance from detector

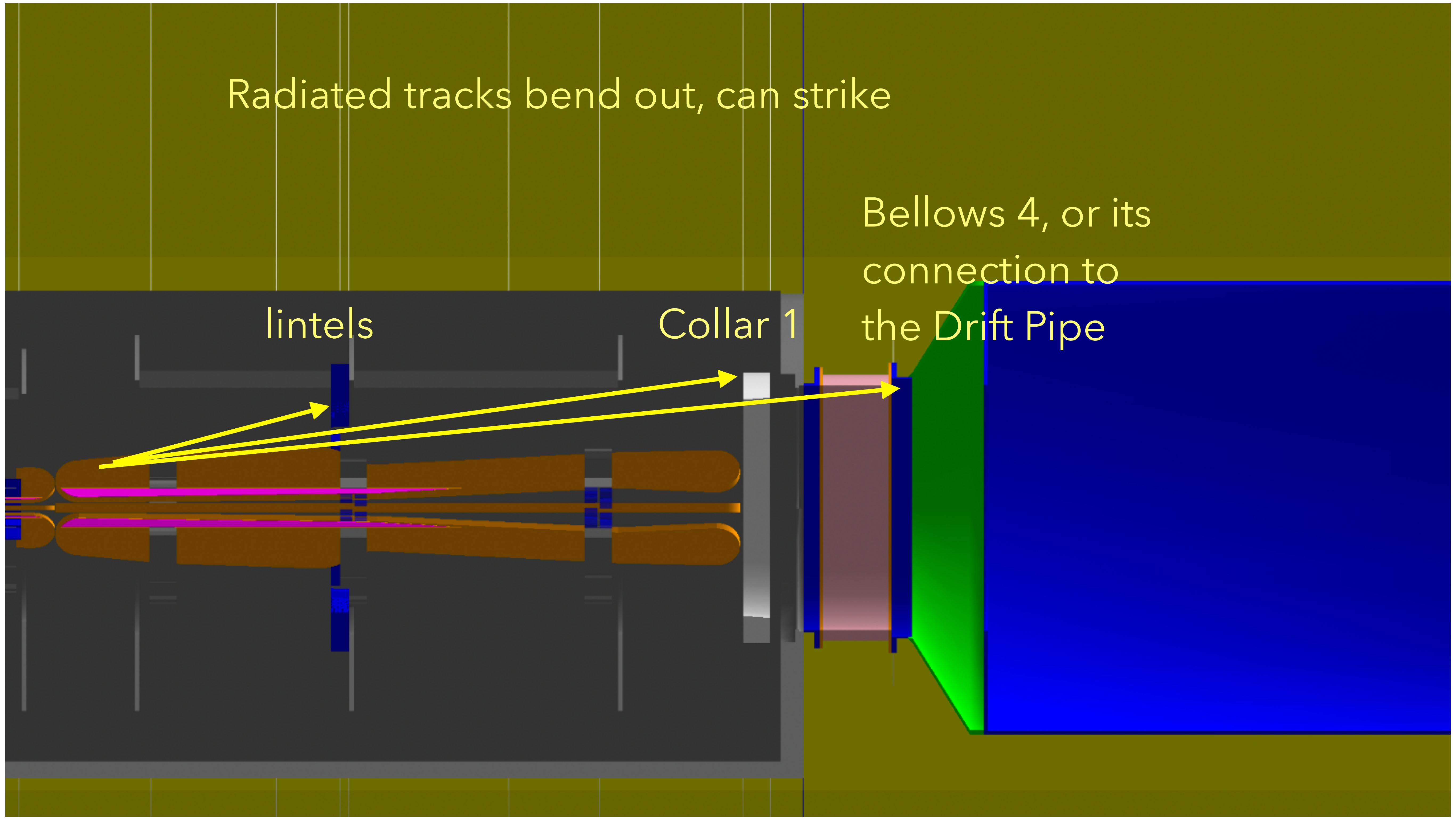
Backgrounds



Unexpected rescattering backgrounds were observed from two regions:

- Bellows 4 and its connection to the drift pipe, and Collar 1
- from Collimators 6a and 6b

Bellows 4 and Collar 1

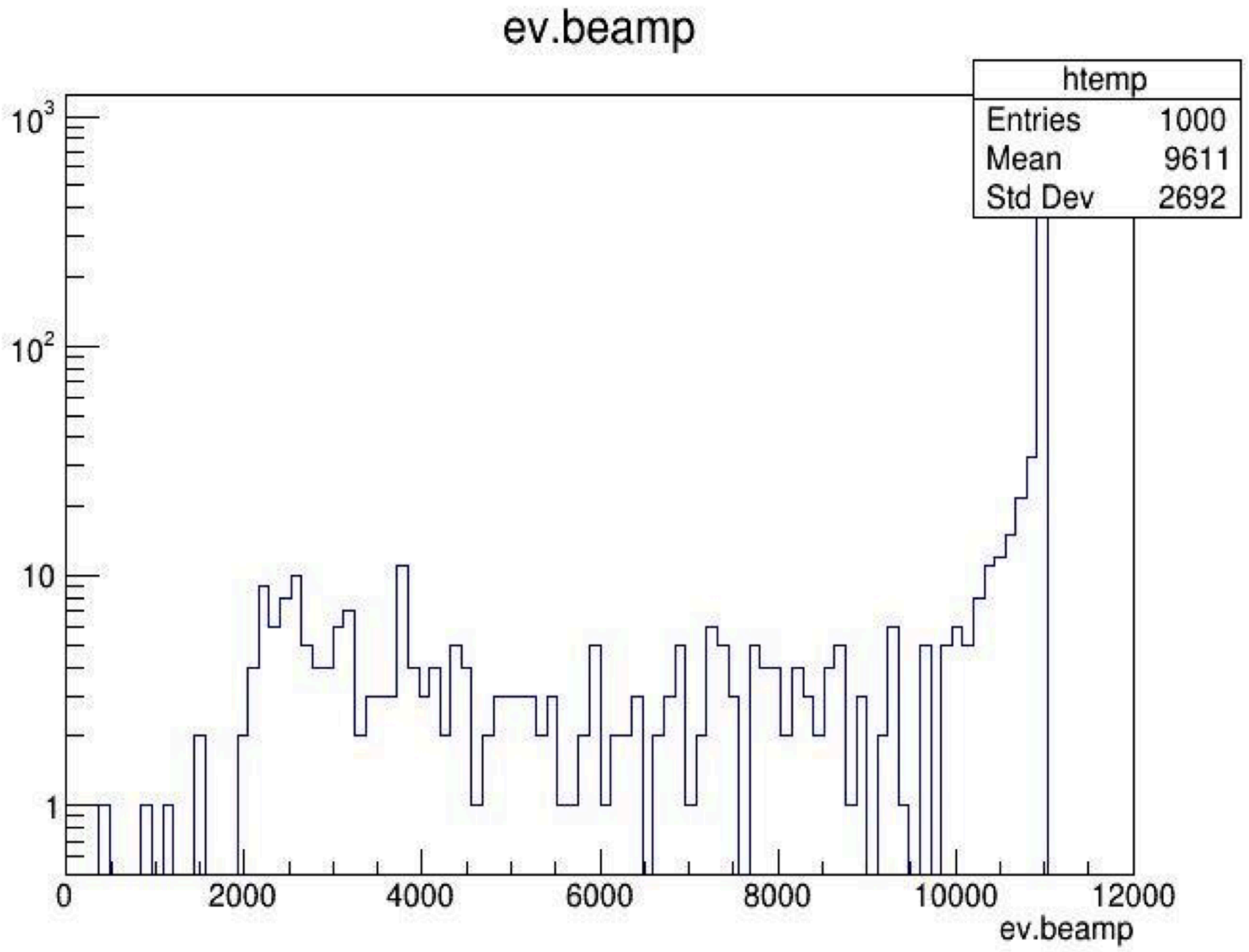


- Reduced length and maximized radius at bellows 4 / drift pipe connection
- Used Collar 1 to shield this connection
- Placed Collar 1 inner radius edge to minimize rescattering

Ryan Richards

Along the way, noticed something odd in the elastic generator

Simulation (elastic ep) Issue



In the elastic ep generator (and only for that generator) there were zero events with radiated beam momentum < 2 GeV

The radiative tail is what causes most of the rescattered background, so this is a significant issue

This was introduced when the carbon generator was added in Oct 2021(?). This shouldn't have changed anything! but inherited static data elements made defaults unreliable.

Easy solution is to set the important parameters explicitly when using remoll

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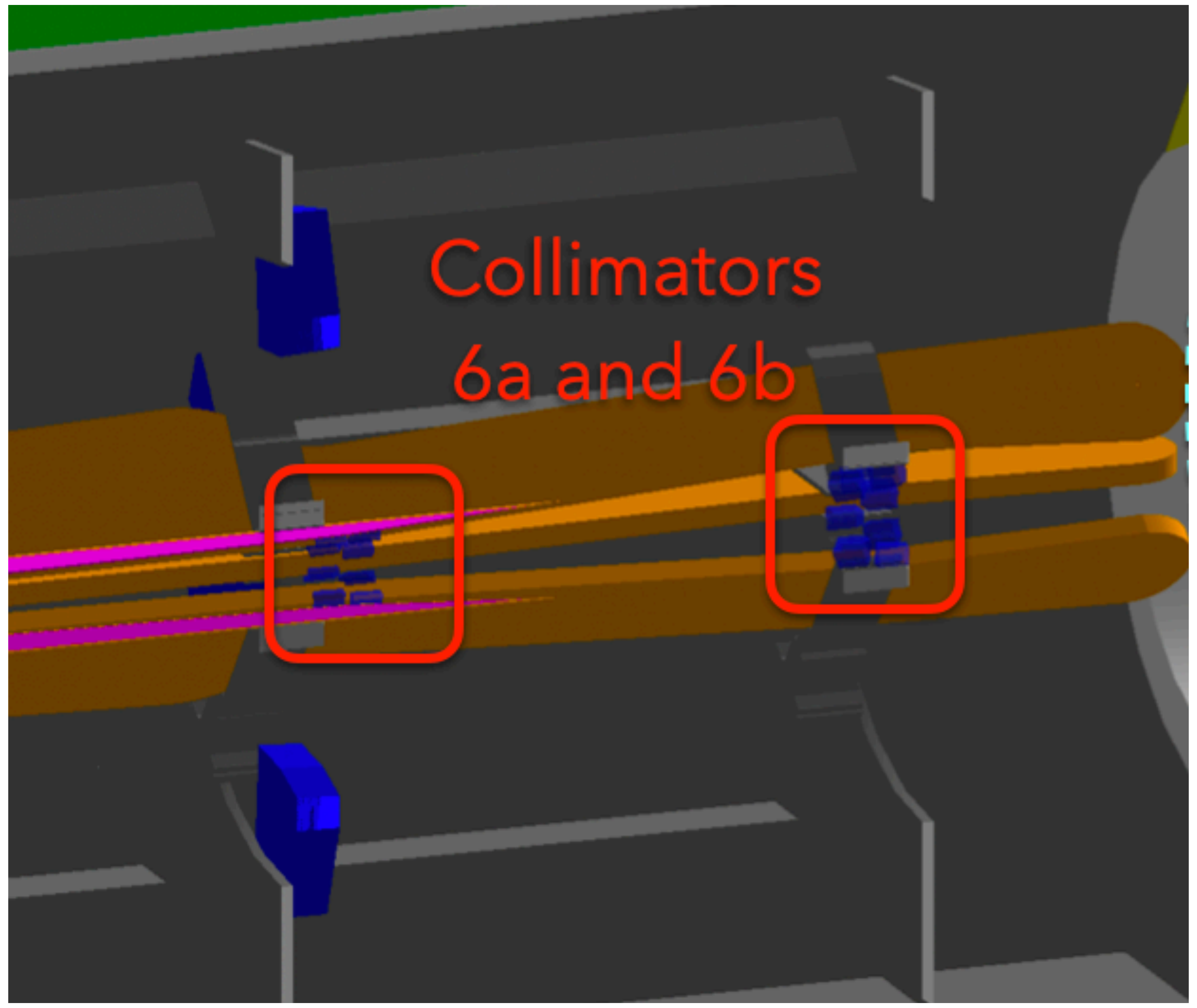
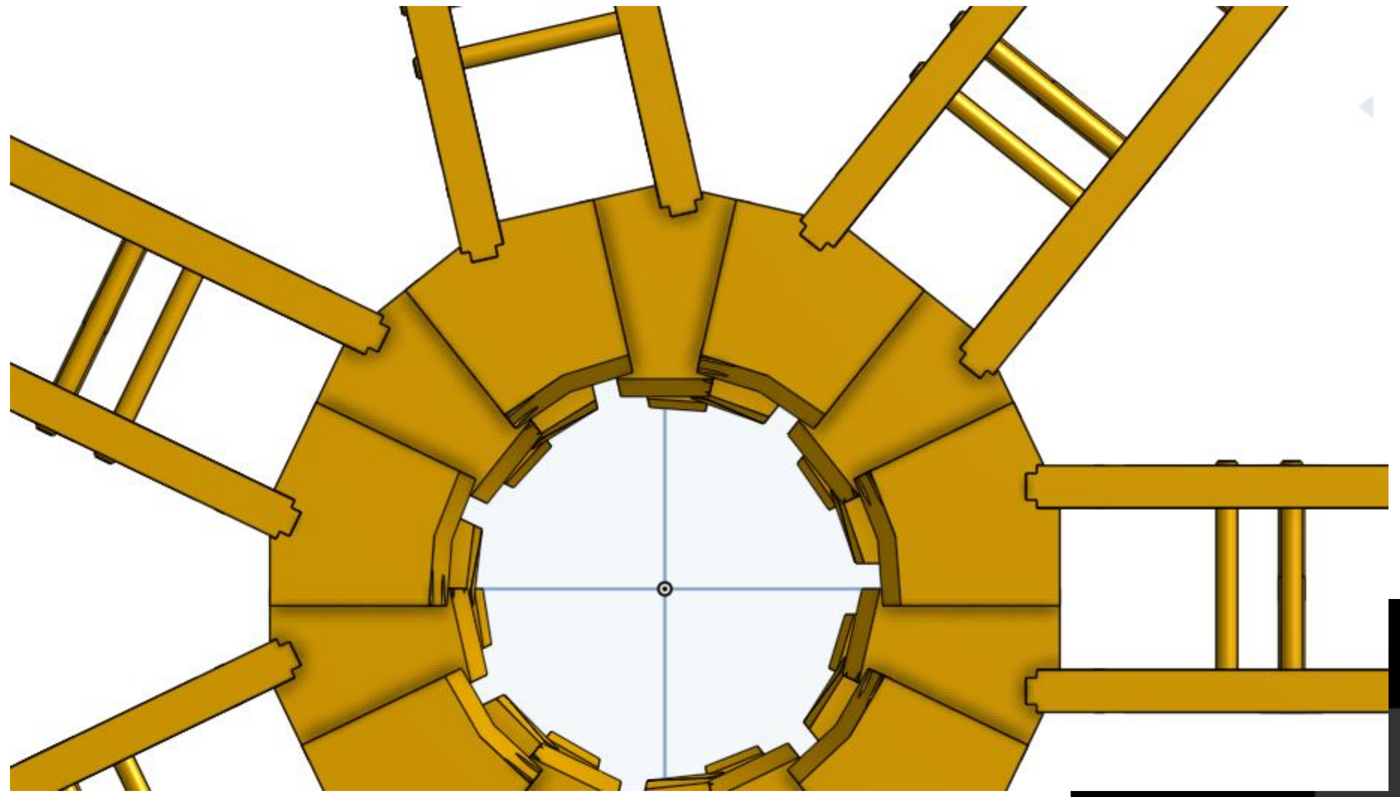
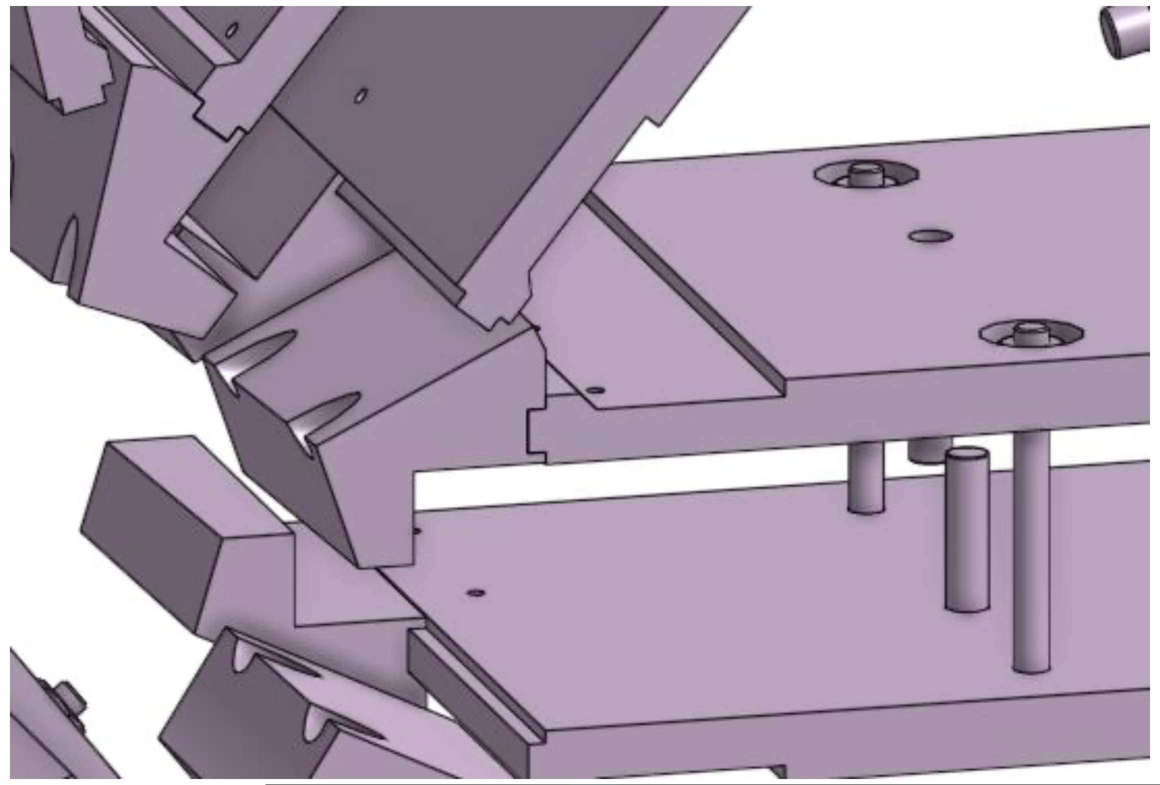
Sakib, Wouter, Sayak, + others…

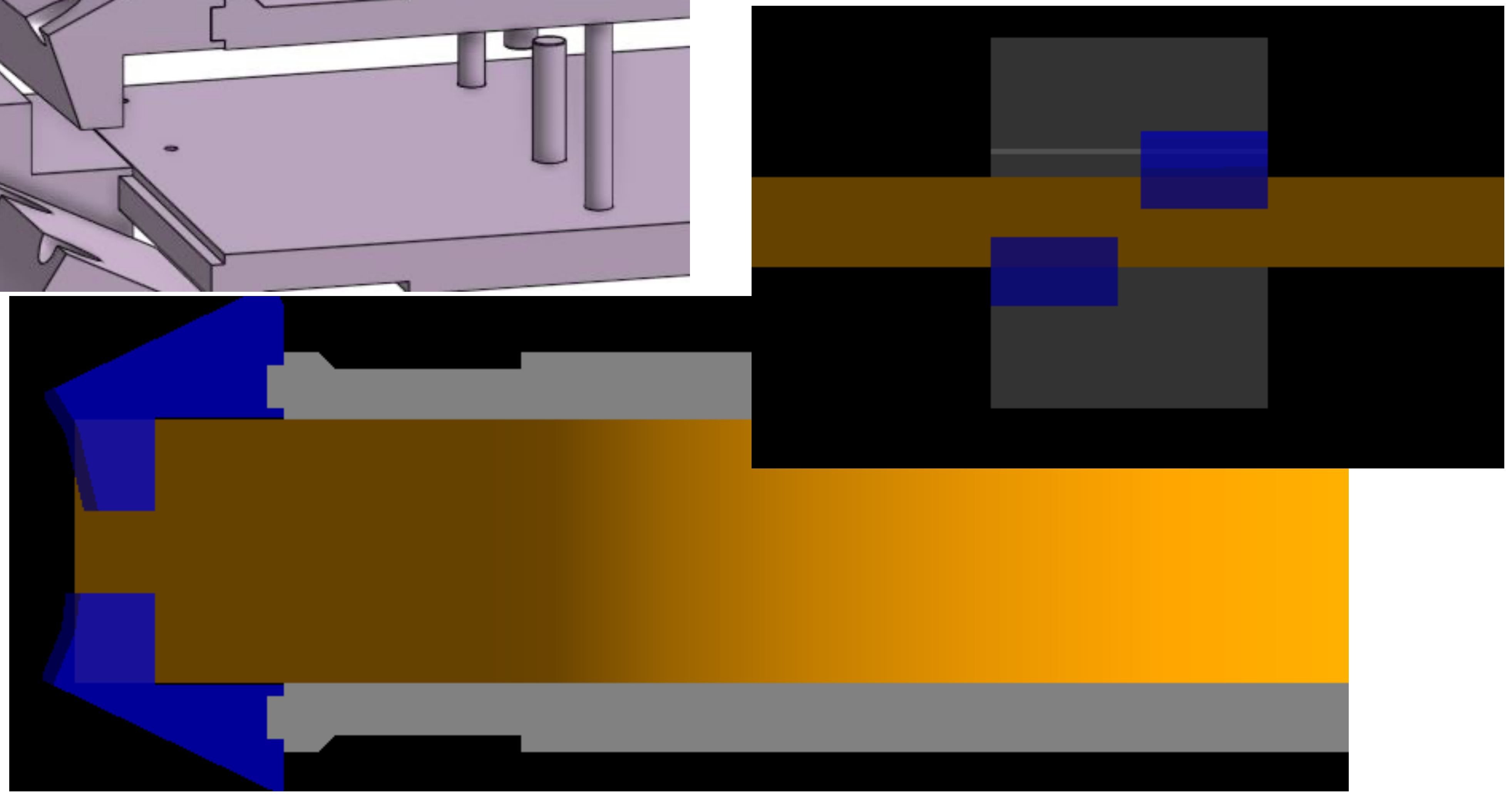
Collimator 6a and 6b



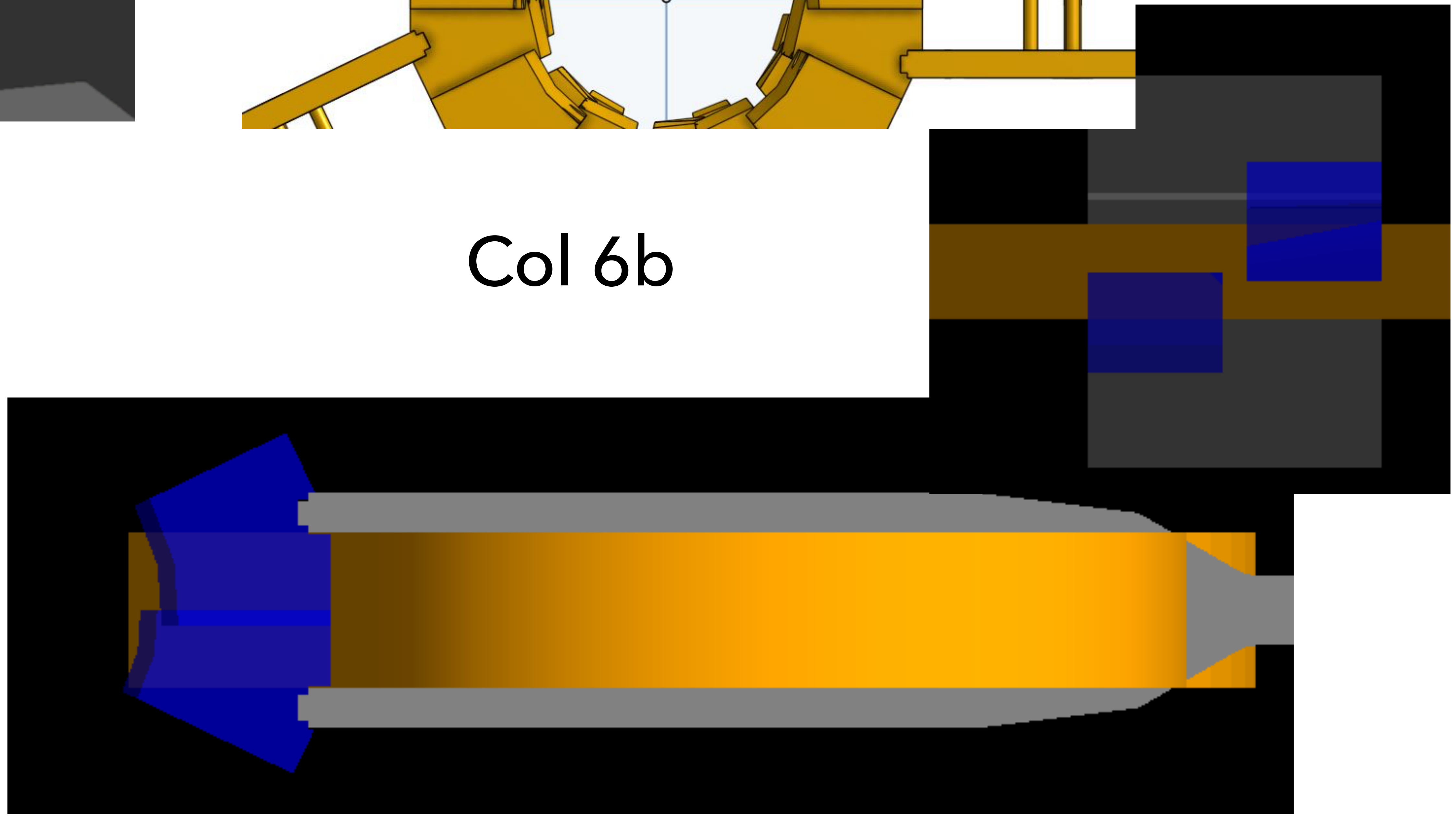




Col 6a



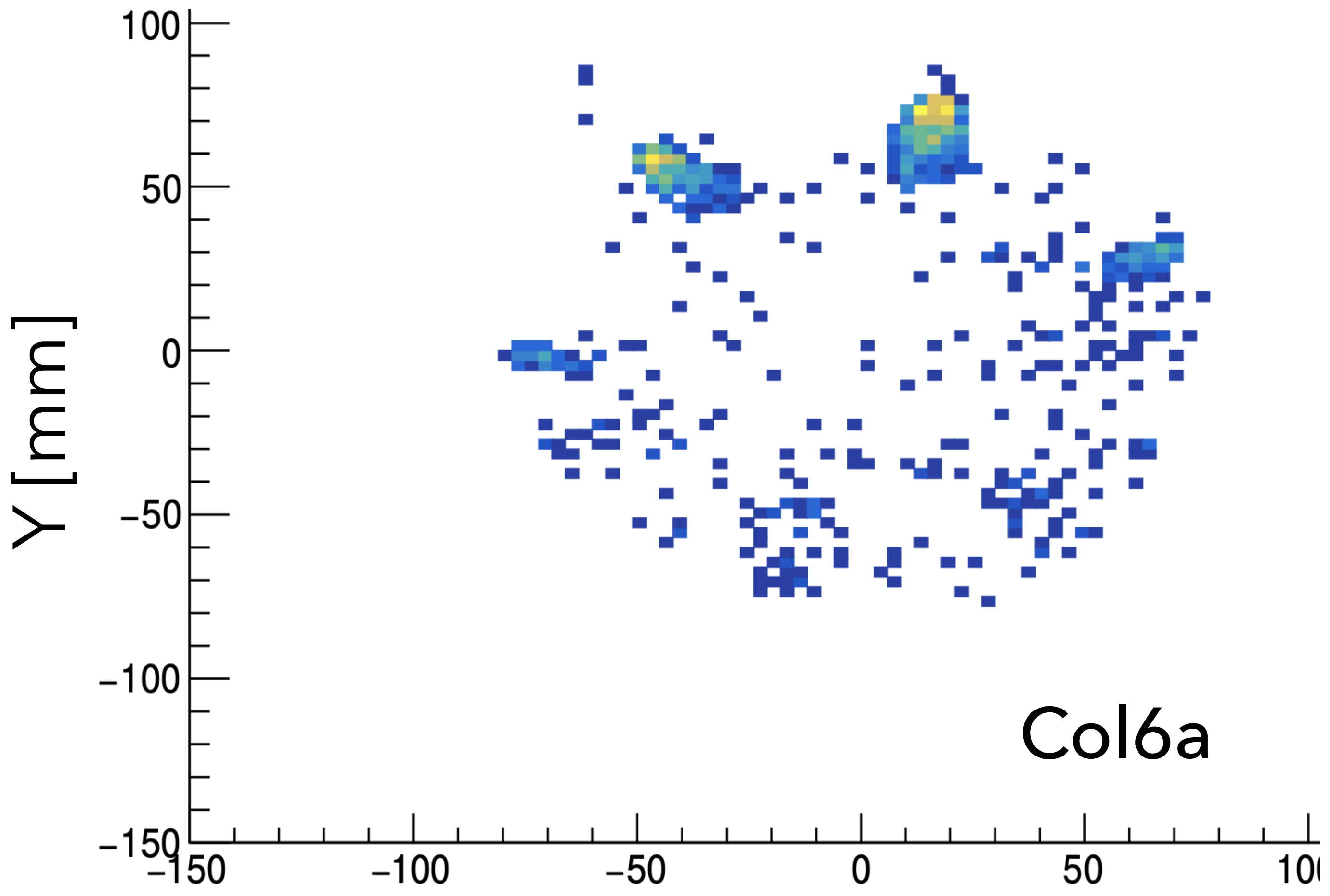
Col 6b

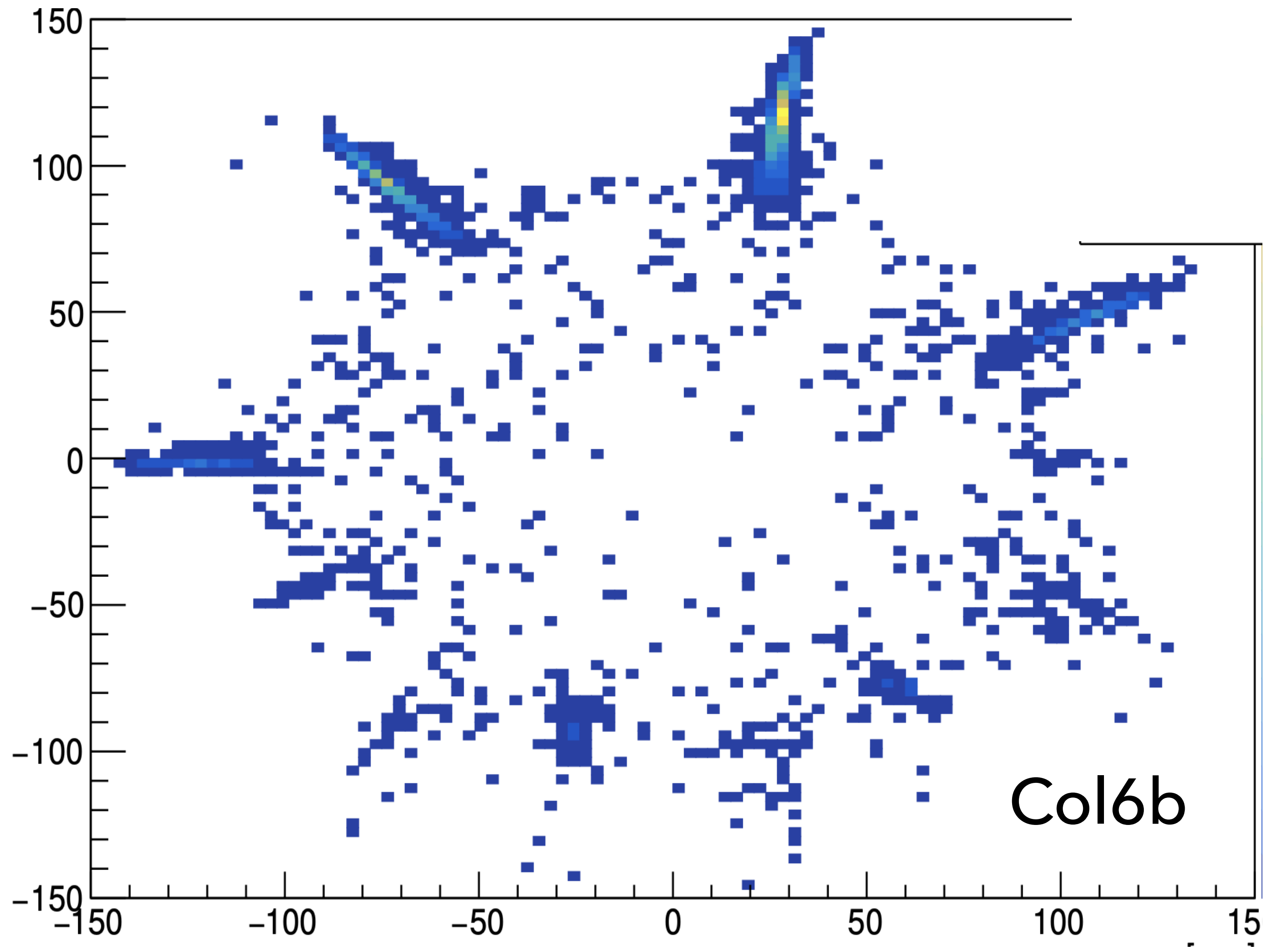


Collimator 6a and 6b

Fringe fields along the beamline pulls out flux between the coils
Beamline collimators at the end of Hybrid-TM4 are needed to catch these

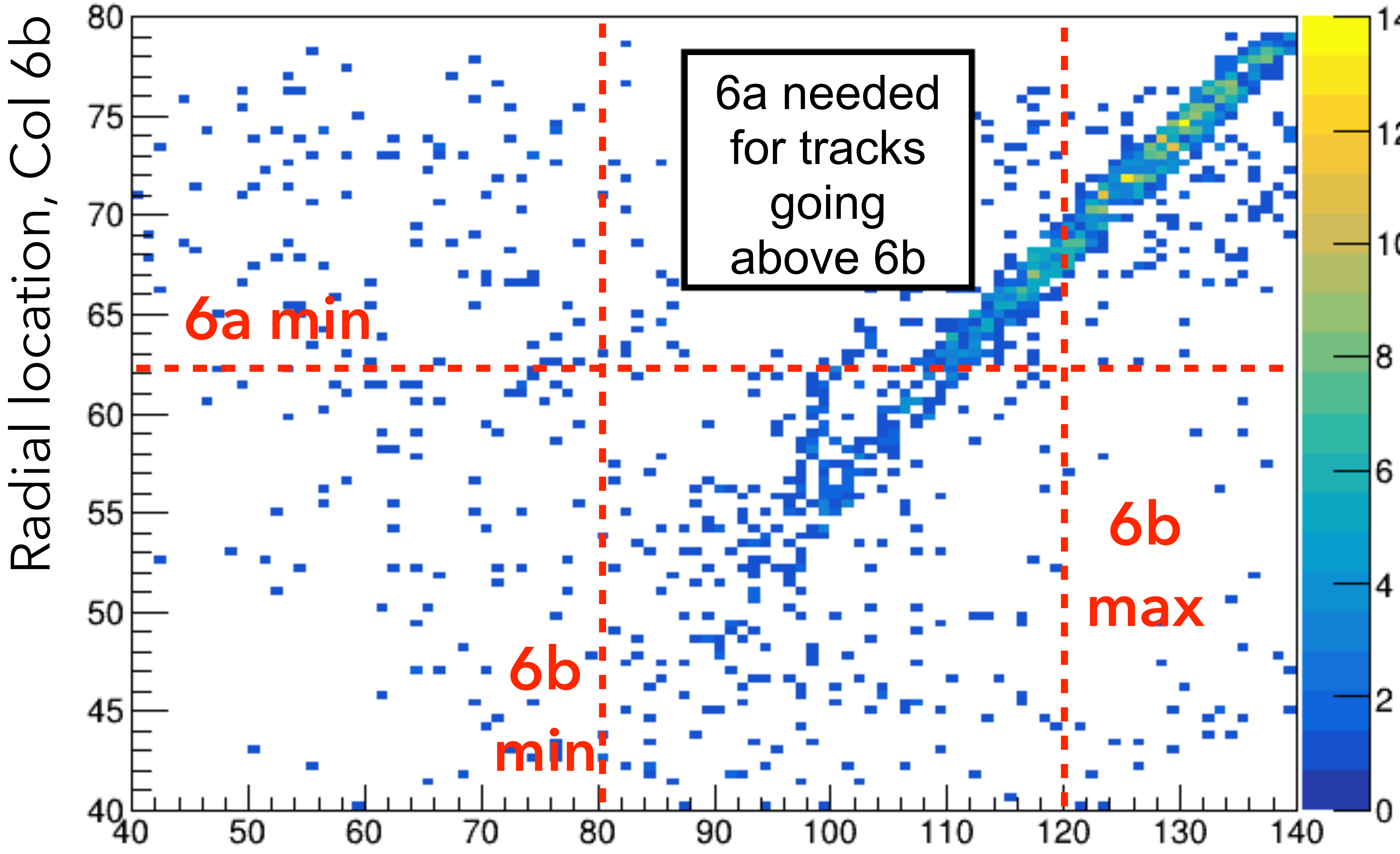
“real asymmetric” field





Tracks passing collimator location, go on to hit ring 5

Hit position correlation 6b and 6a (MD ring 5)

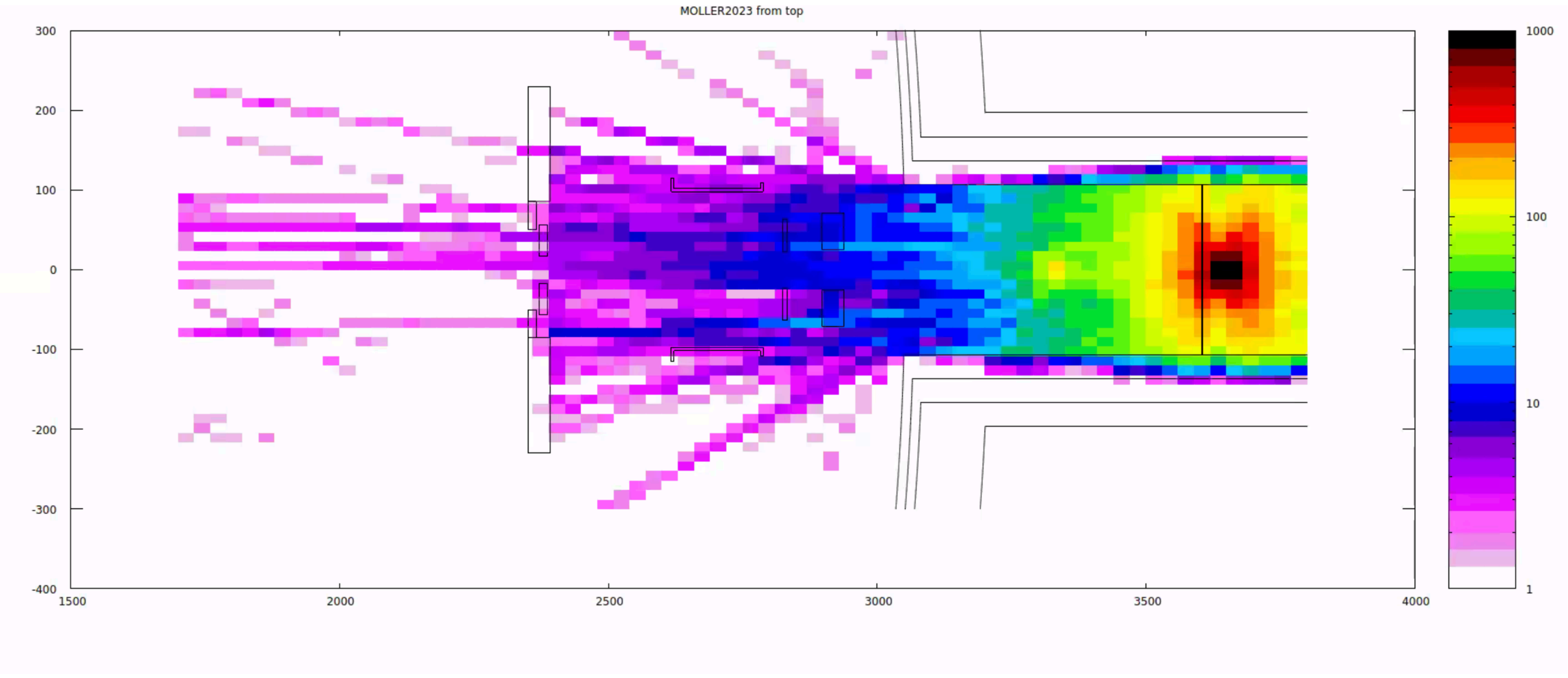


Balance: protecting all MD rings, and the drift pipe (to avoid rescattering) with avoiding excessive rescattering from 6a/6b themselves

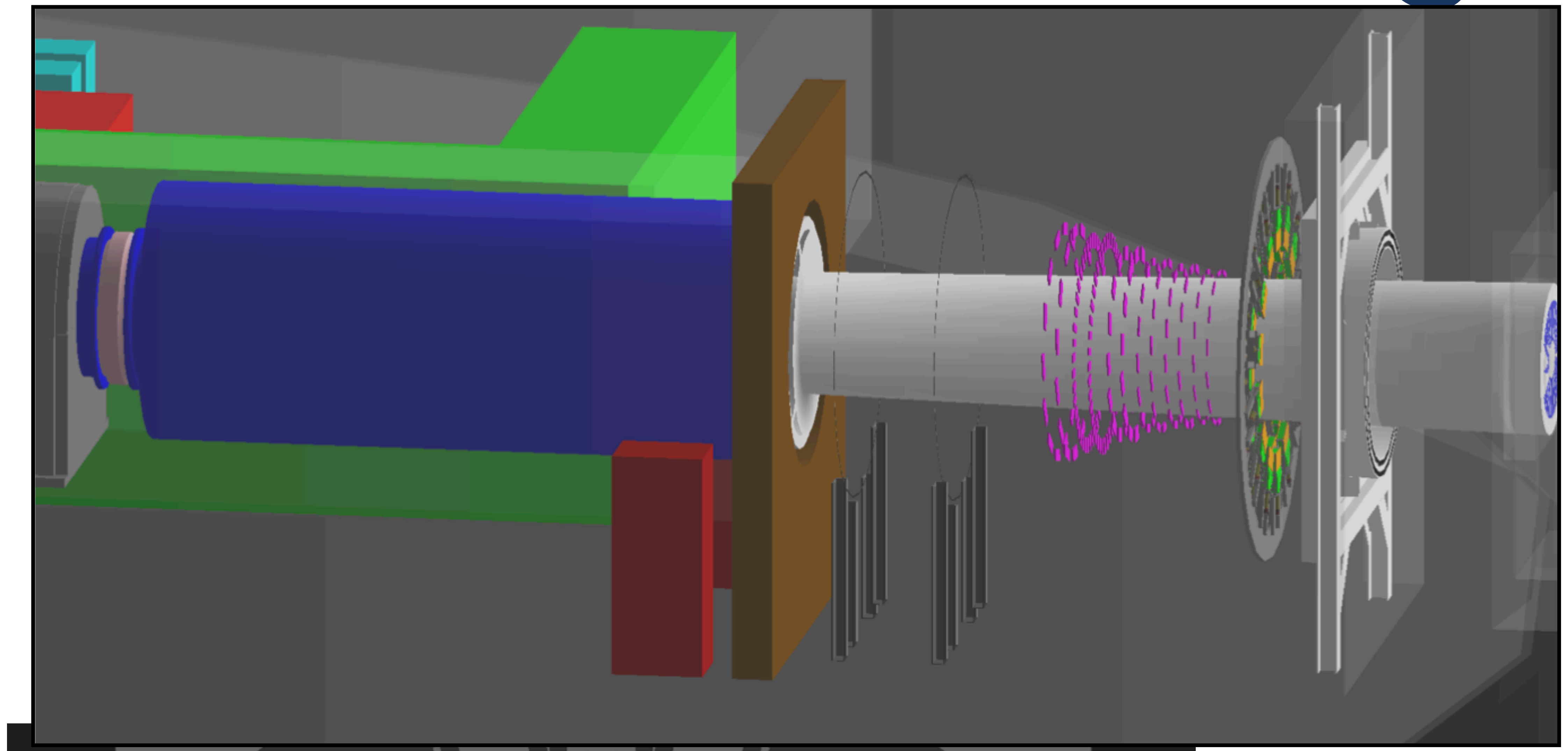
Prakash Gautam

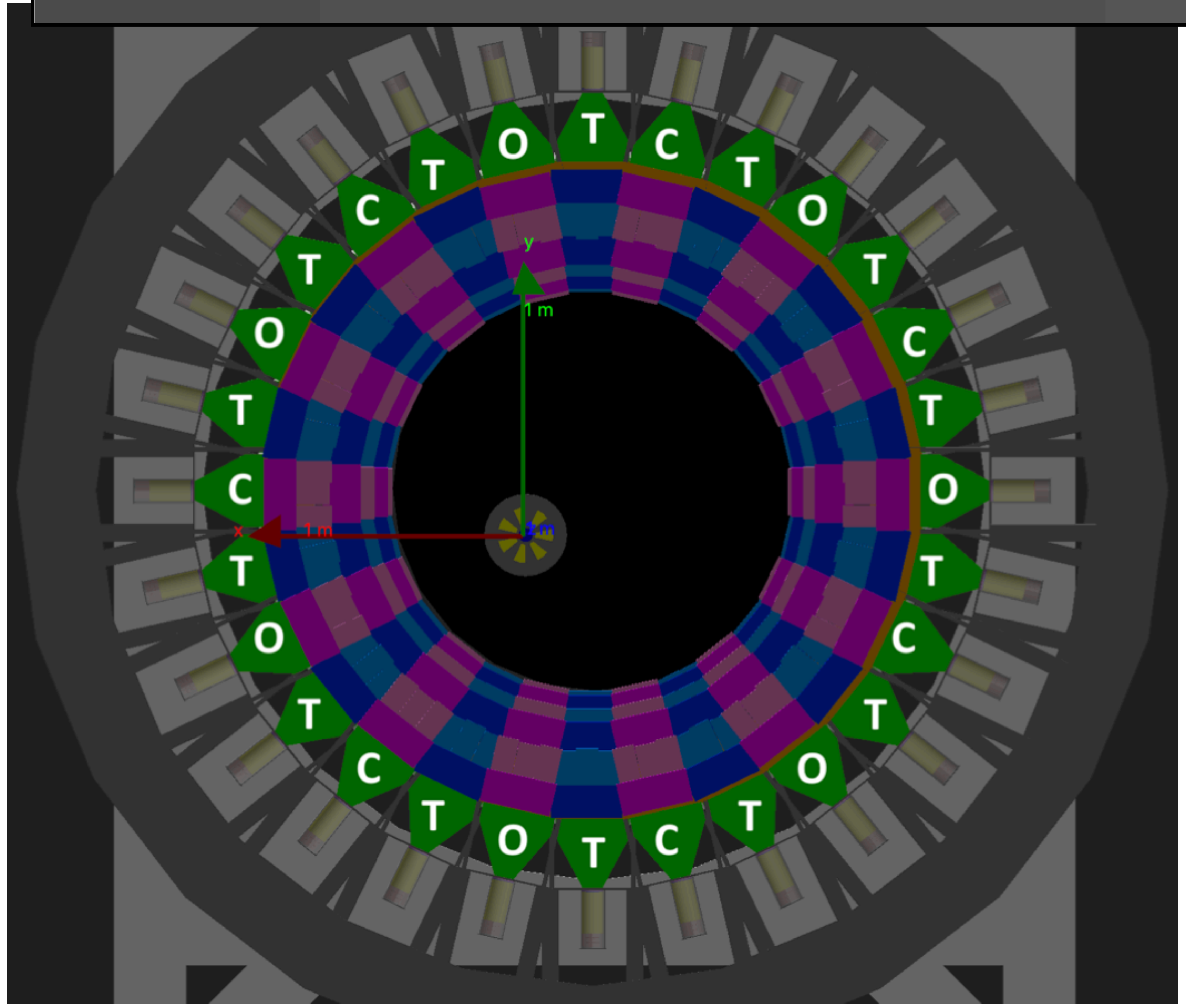
FLUKA

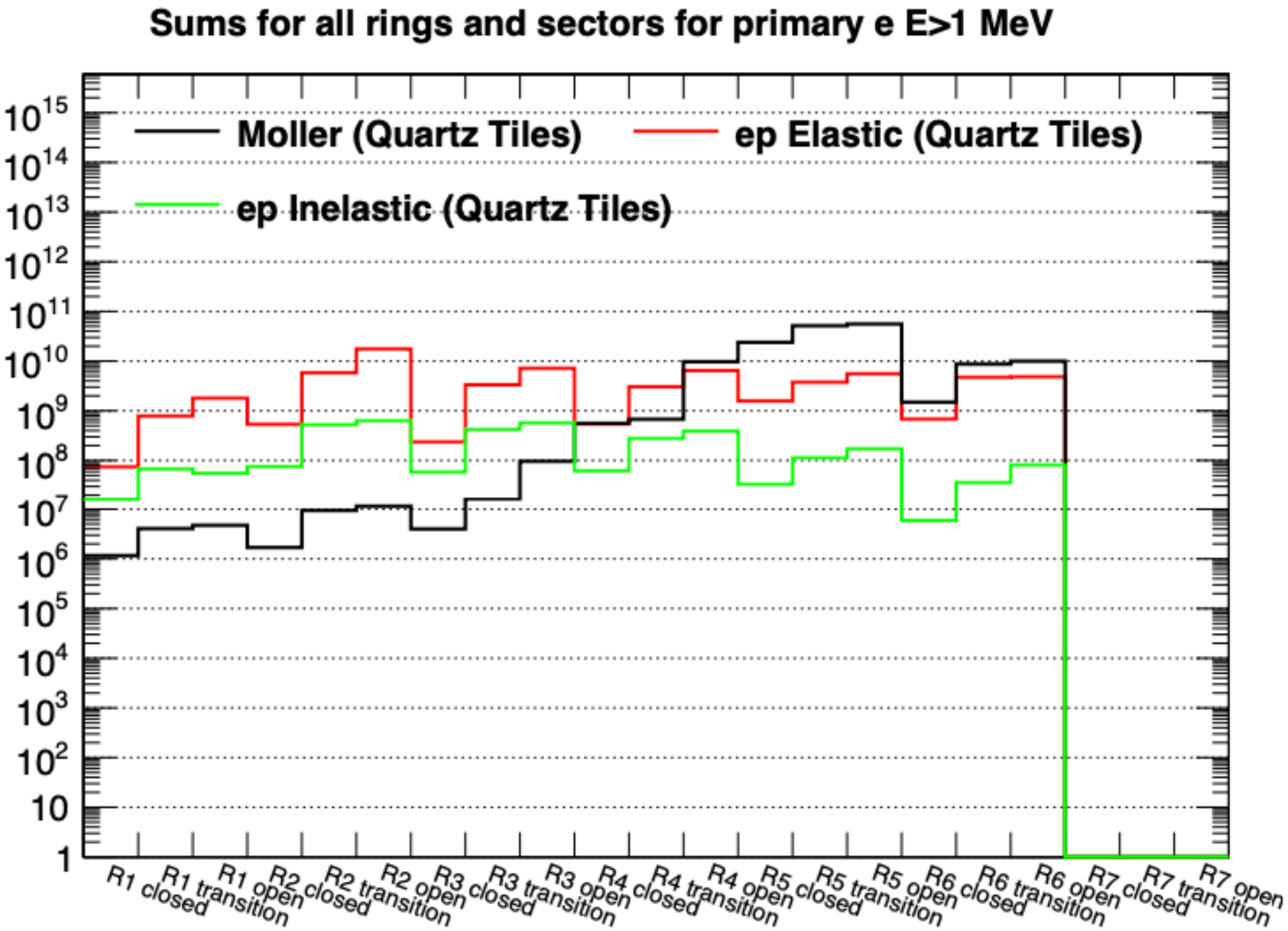
- Jhih-Ying has implemented the geometry of the barite wall, collar 2, MD PMT shielding, shower max, and pion donut
- The initial results don't have a proper implementation of the magnetic field and we are investigating ways to improve it
- The dump diffuser is a clear source, but that will have to be compared to the activation of the tungsten inside the shower max and the lead in the pion donut



MD Tiling and Deconvoution







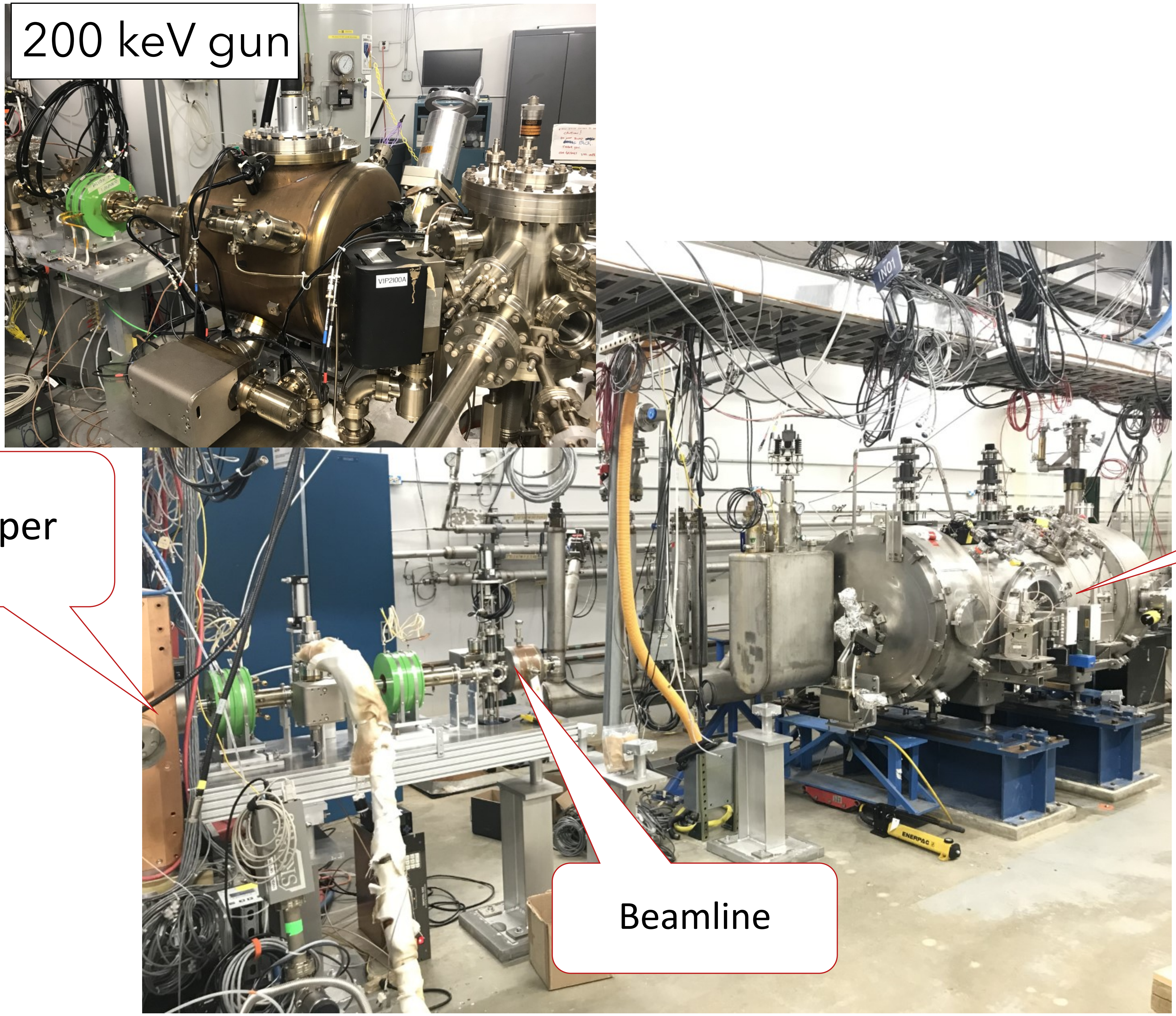
Michael Gericke has provided quartz geometry for remoll

Zuhal has been evaluating this in the deconvolution to verify the design geometry

Injector Upgrade

- New 200 kV (instead of 130 kV)
- New Booster
- Additional BPMS

Testing with parity DAQ in June/July



Technical Design Report

Goal: a concise but comprehensive description of the technical design demonstrating it will meet the physics goals

Section leads: Krishna Kumar, KDP, Mark Pitt, Caryn Palatchi, Silviu Covrig, Juliette Mammei, Michael Gericke, David Armstrong, Paul King, Don Jones, Ciprian Gal, Jim Fast

TDR-Draft got us through the CD3A review.

The document is essentially complete. Some readability editing remains.

Collaboration review at the end of this month, final publication in mid-June.

Continuing work

Complete final checks and get CD3a elements out ASAP

Quality Assurance is a project responsibility, but the physicists need to stay engaged. Encourage vigilance, and support with rapid, agile simulation or analysis to determine best path forward for non-compliant components

Beyond that: still no time for redesign, but a little more time to check and detail elements

Examples:

- Collar 2
- Barite wall structure
- Detector tiling

Next steps

Revive half-day collaboration “Forums” for in-depth coverage of individual subystems or topics

As design is finalized and we move to procurement, we can (must!) spend more time on achieving the physics goals with the hardware we have designed

- Simulations don’t stop when the parts are ordered
  - continue to refine optics calibration and alignment plans
  - continued background studies, including deconvolution and failure mode testing
  - beam parameter sensitivities
  - activation studies
- Polarized beam and beam monitor test plans.
- Polarimetry - design for use / optimization, testing, analysis code, maybe even analysis of data?
- Designing and writing analysis code, online and offline