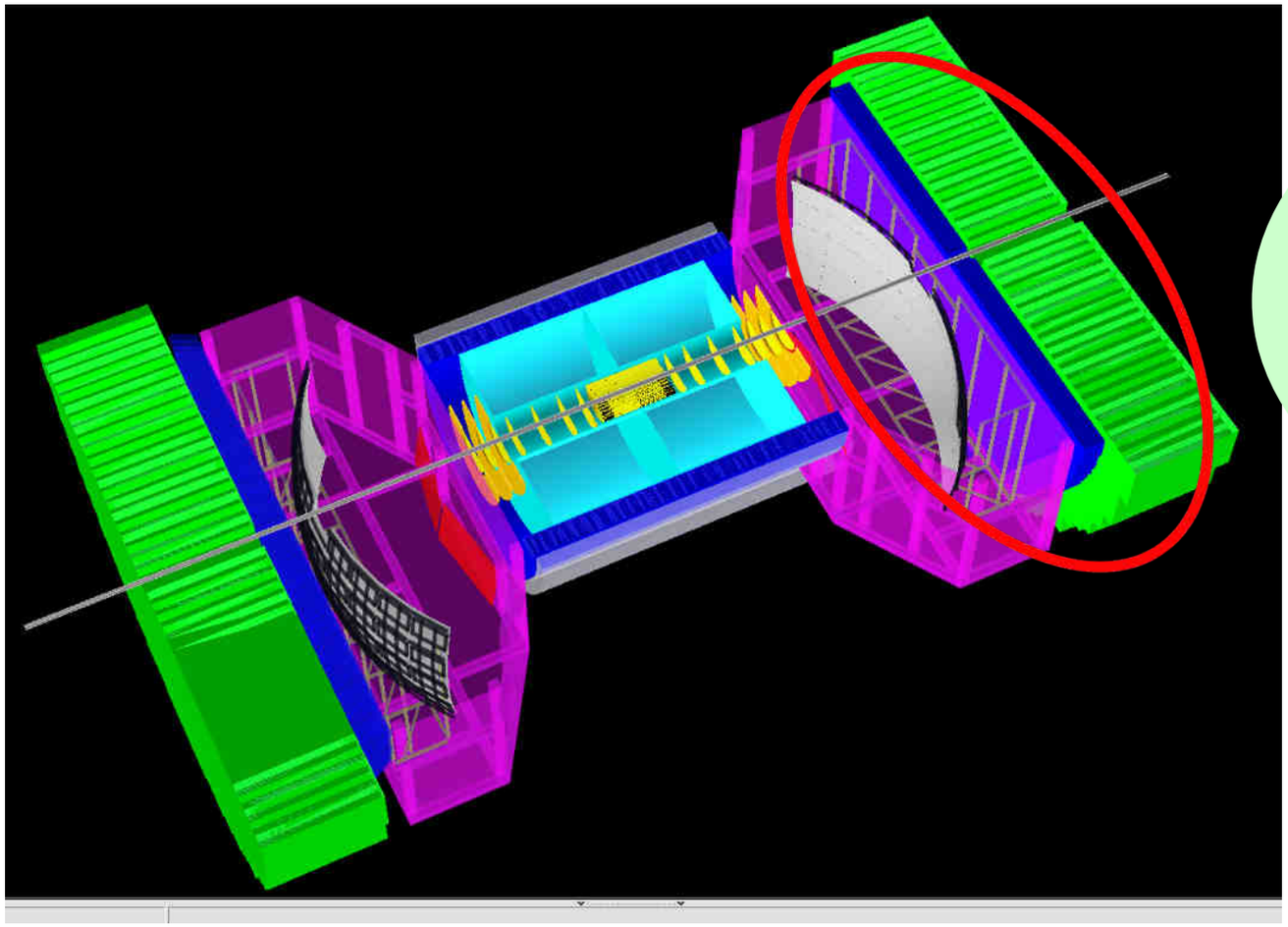
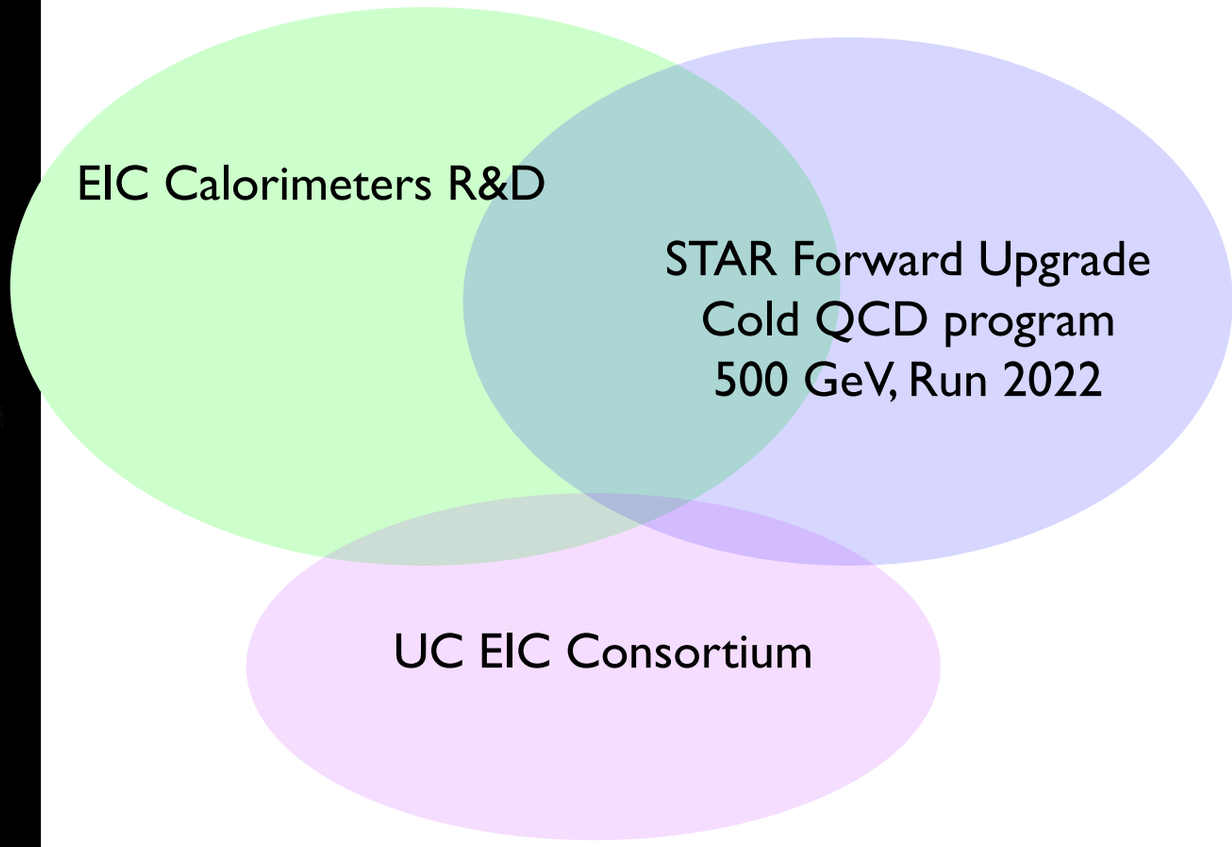
UCLA Report.
O.Tsai

Winter meeting of MRPI on Science of Dense Gluon Matter
UCR. Jan. 16, 2020

We will continue to concentrate efforts on forward Hadron Calorimeters. Central Detector. Targeted R&D.





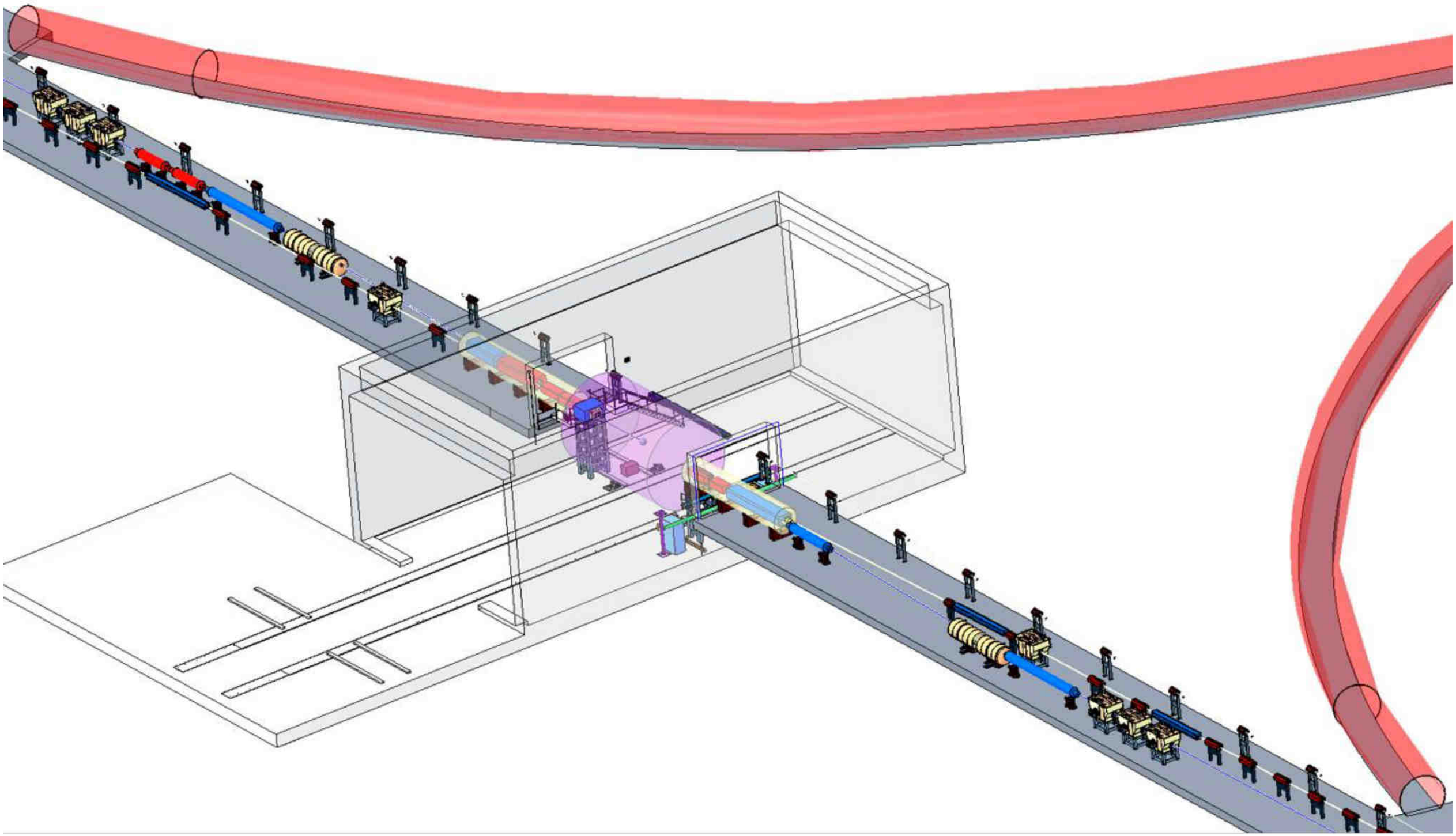
- People
- Similar desired system performance
- Observables
- Technical Challenges

Possible implementations for central detector:

- Shashlyk + Fe/Sc (STAR 2022)
- Shashlyk + Fe/Sc (finer sampling) – optimization via MC (Z. Xu/M.Sergeeva)
- W/ScFi + Pb/Sc (unlikely) (STAR 2014)
- W/ScFi + Fe/Sc – optimization via MC (Z. Xu/M.Sergeeva)
- W/ScFi + Pb/Fe/Sc (if timing will work) – optimization via MC (Z.Xu/M.Sergeeva/A.Kiselev)

Had to consider: IR design, space constrain, integration issues, cost, time scale

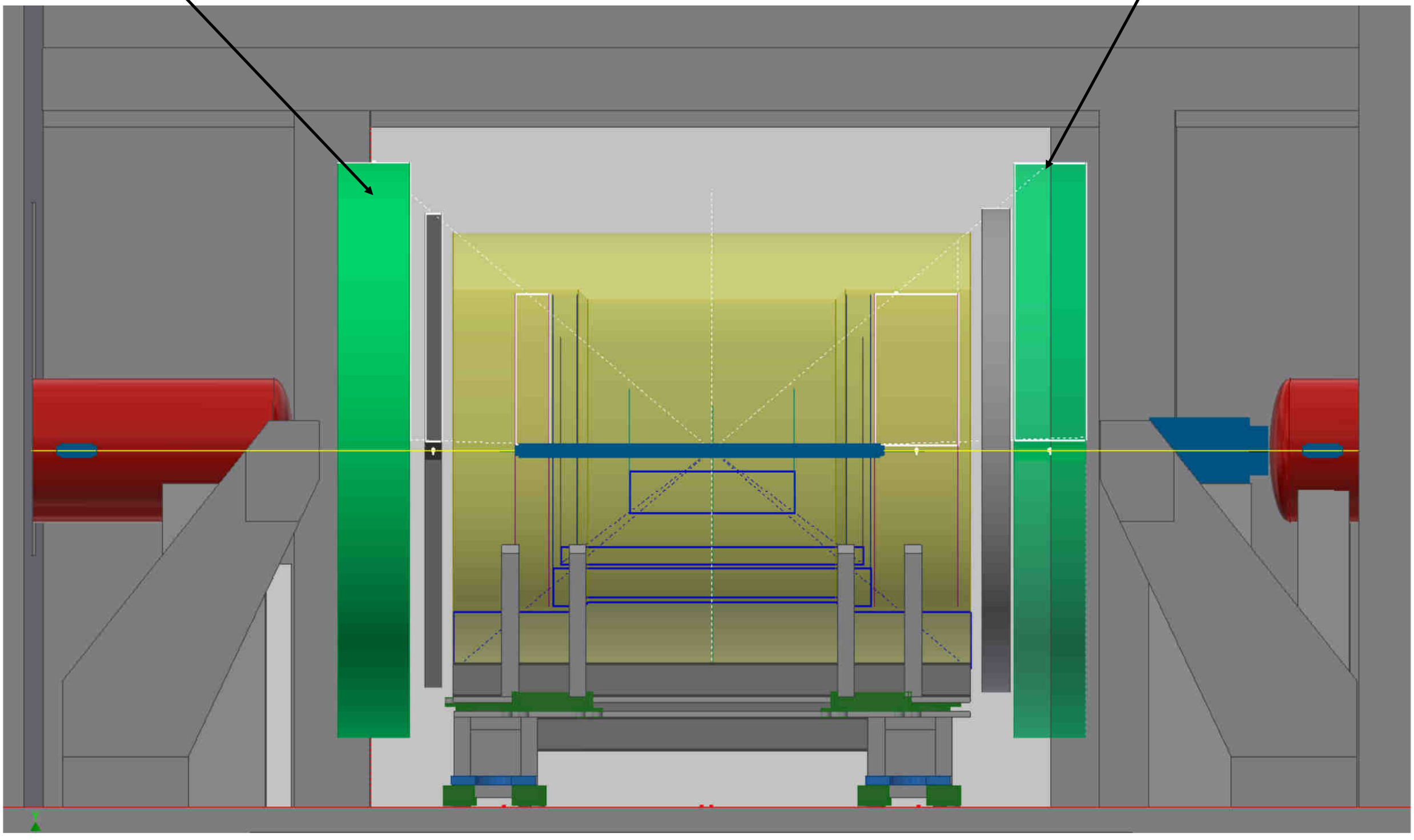
Considerations:



e-RHIC IR layout. BNL group, 3D drawings

Electron, EM/Hcal

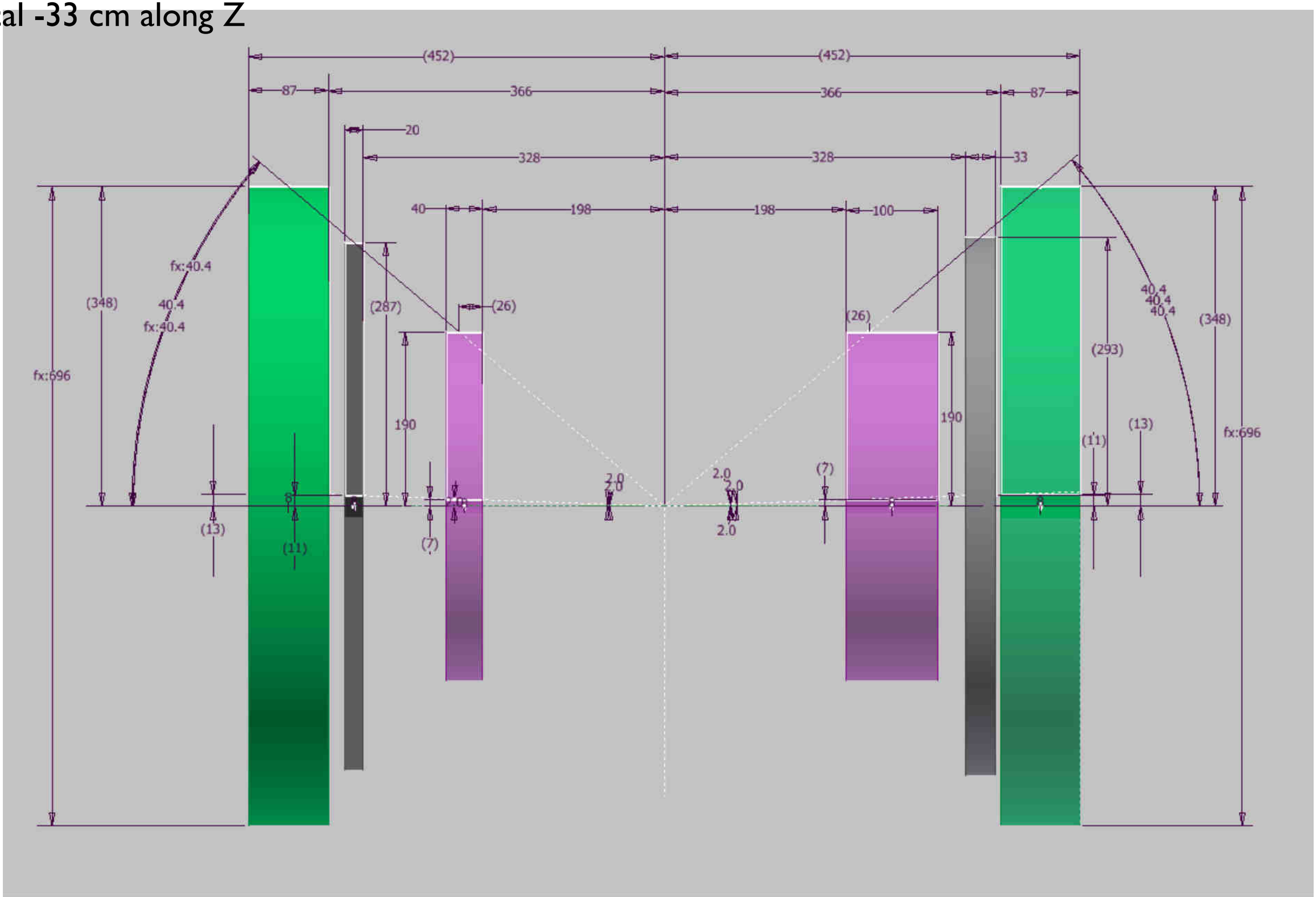
Hadron, EM/Hcal



e-RHIC IR layout. BNL group

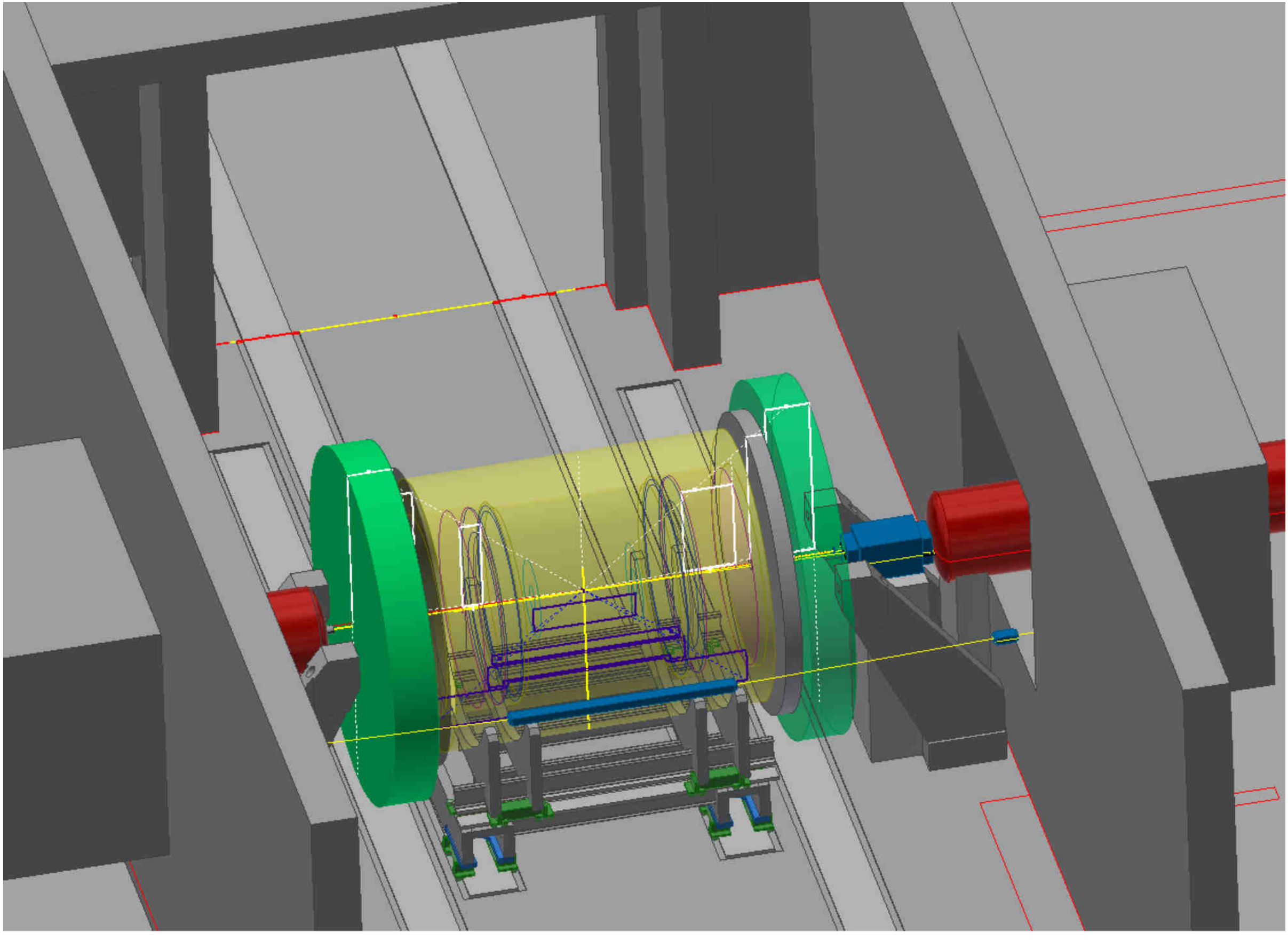
Current Integration Envelopes:

- Hcal – 87 cm along Z
- Ecal -33 cm along Z



e-RHIC IR layout. BNL group

IR Infrastructure



e-RHIC IR layout. BNL group

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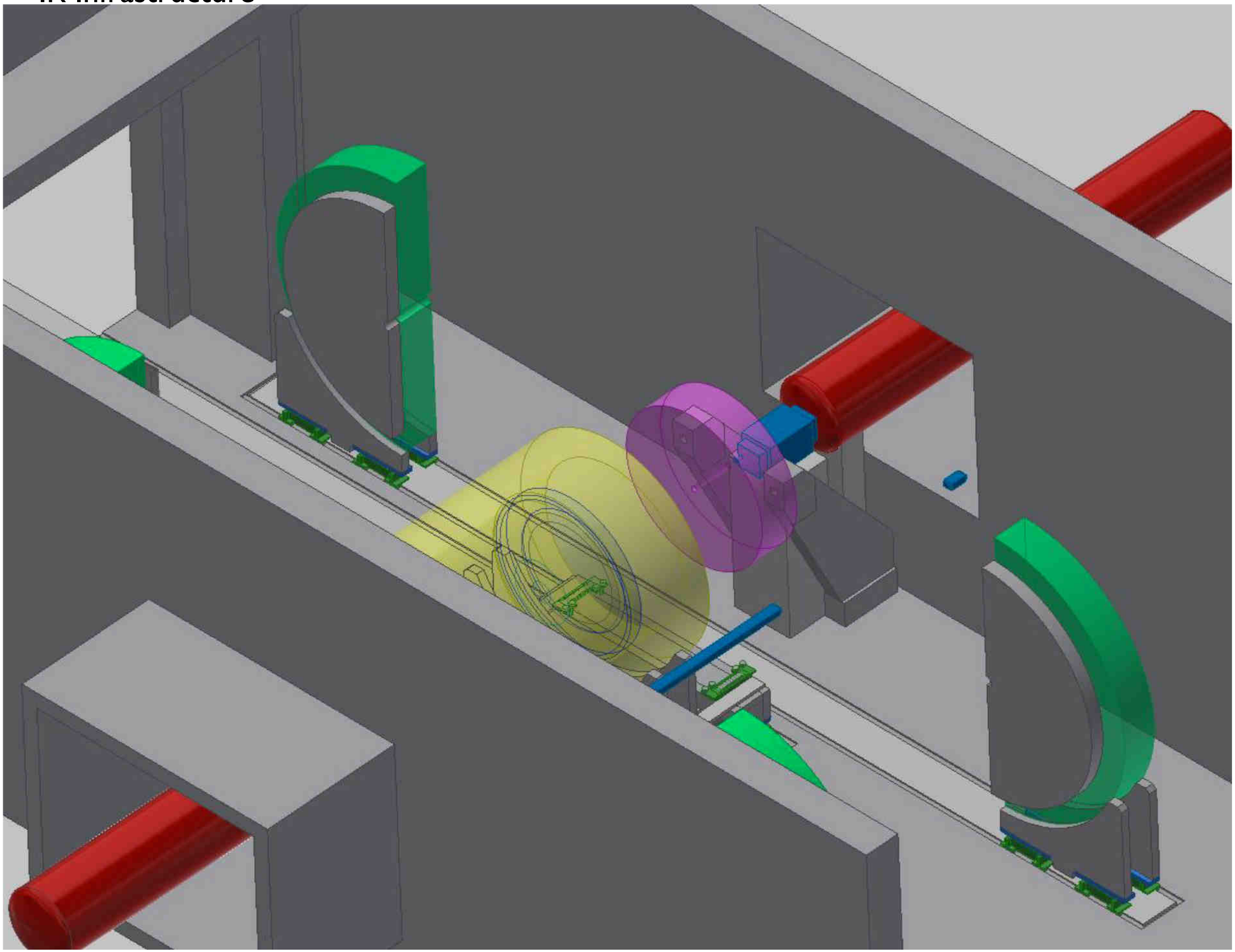

e-RHIC IR layout. BNL group

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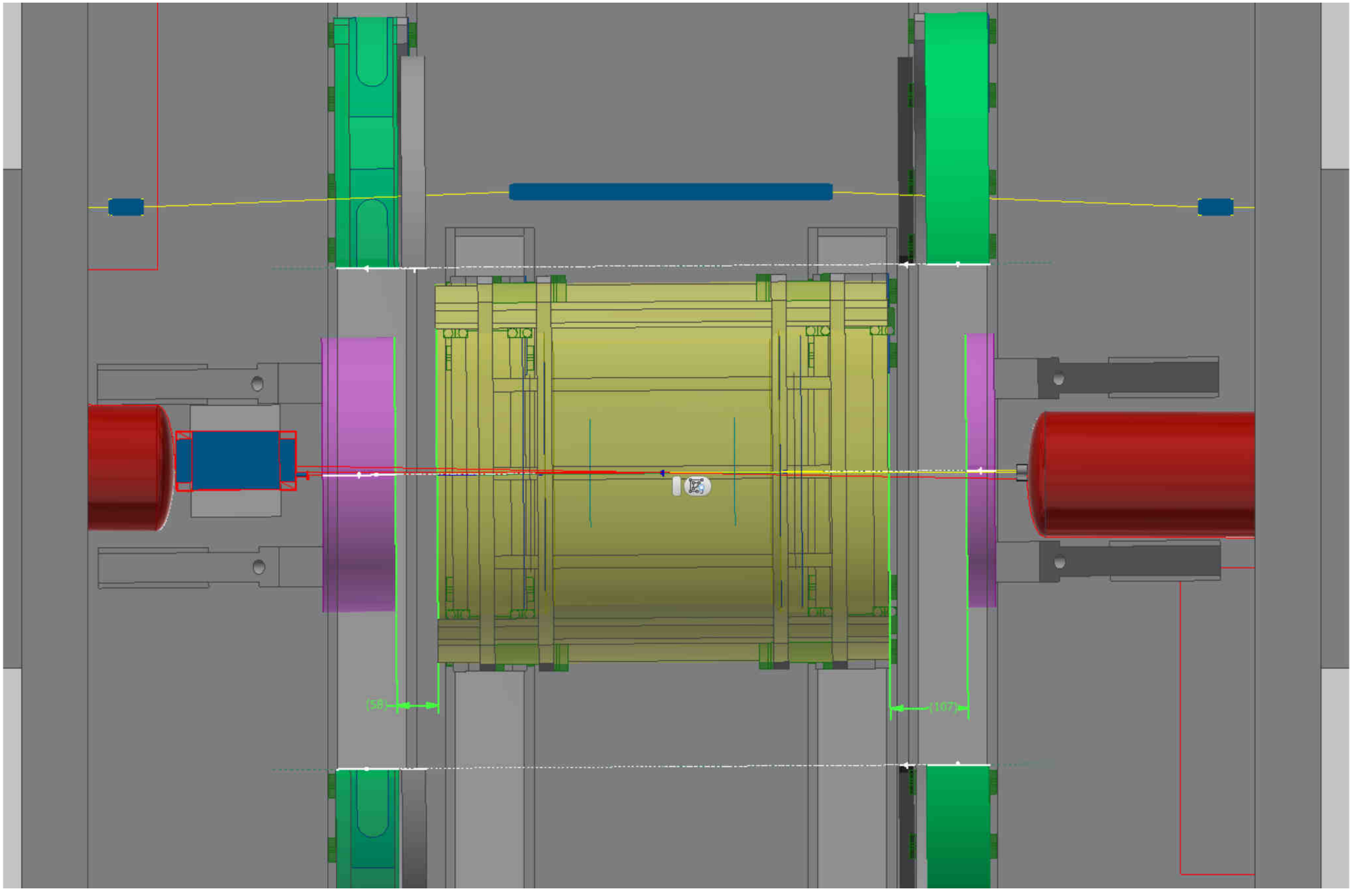

e-RHIC IR layout. BNL group

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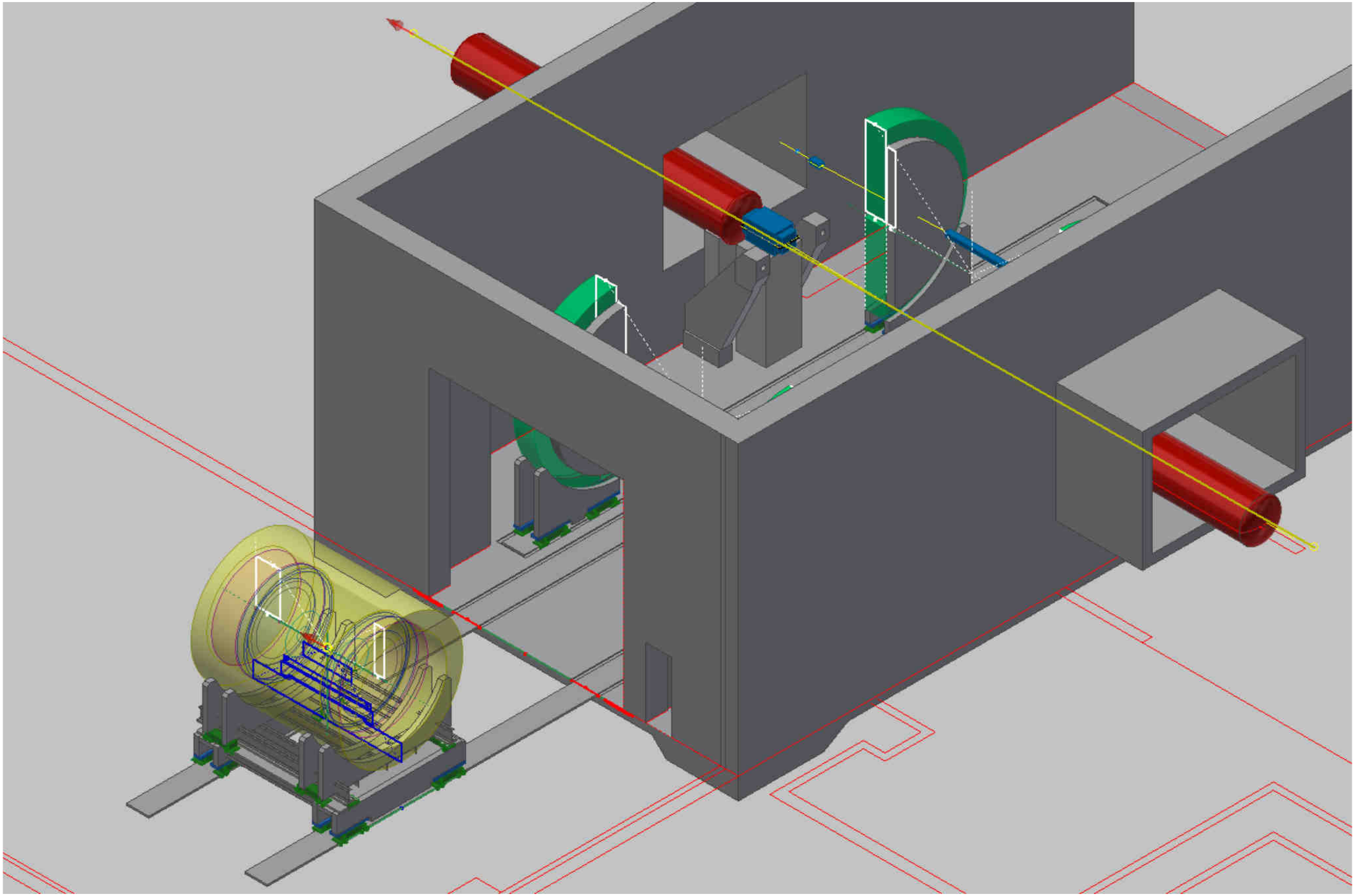


e-RHIC IR layout. BNL group

Constrains and consequences for central detector:

1. Space very limited –> consequence – leakages
2. Time scale. CD0->CD2 -> consequence – no time to develop new technology for HCal
3. Available EIC R&D funding (~ $30k/year)
4. Overall detector cost.

- What is realistic numbers for energy resolution?
- What is absolutely needed?
- Is this part of Yellow report exercise?

60%/sqrt(E) + ? (In The Handbook, assumed in White paper, and seemingly within reach with some efforts).

40%/sqrt(E) – unrealistic due to (1+2+3+4), IMHO

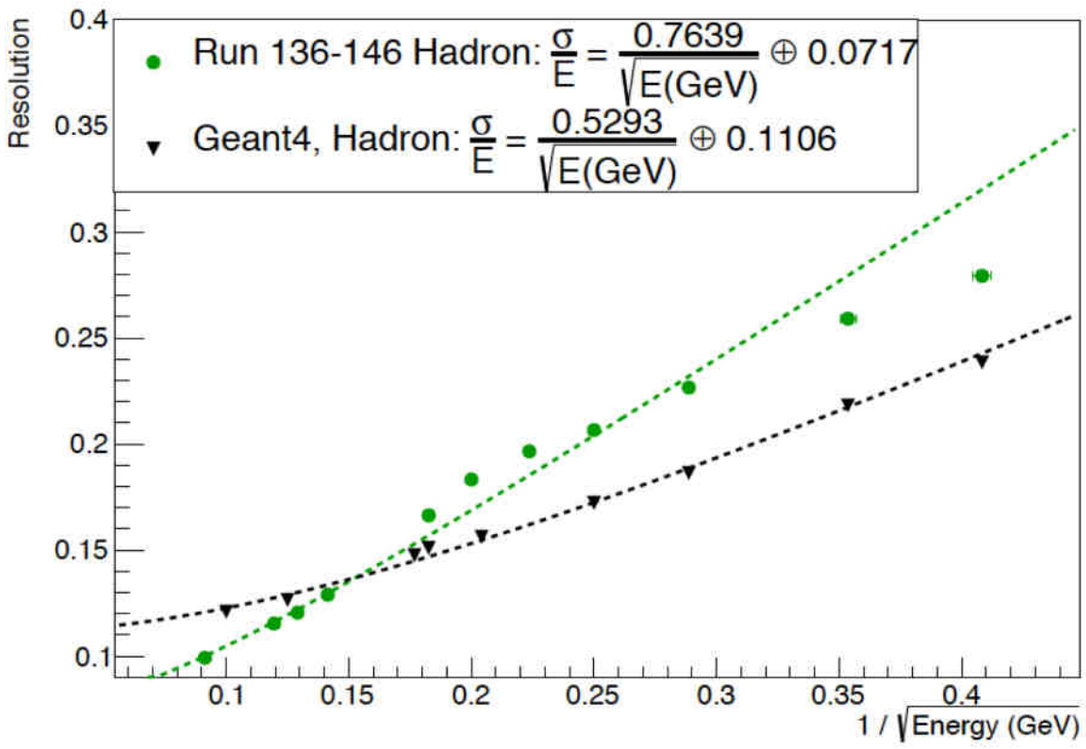
- Goal is to transition toward targeted R&D.
- Goal is to deliver best possible configuration within constrains.

Optimal configuration is probably - W/ScFi (ECAL) + Fe/Sc (HCAL)

MC Optimizations.

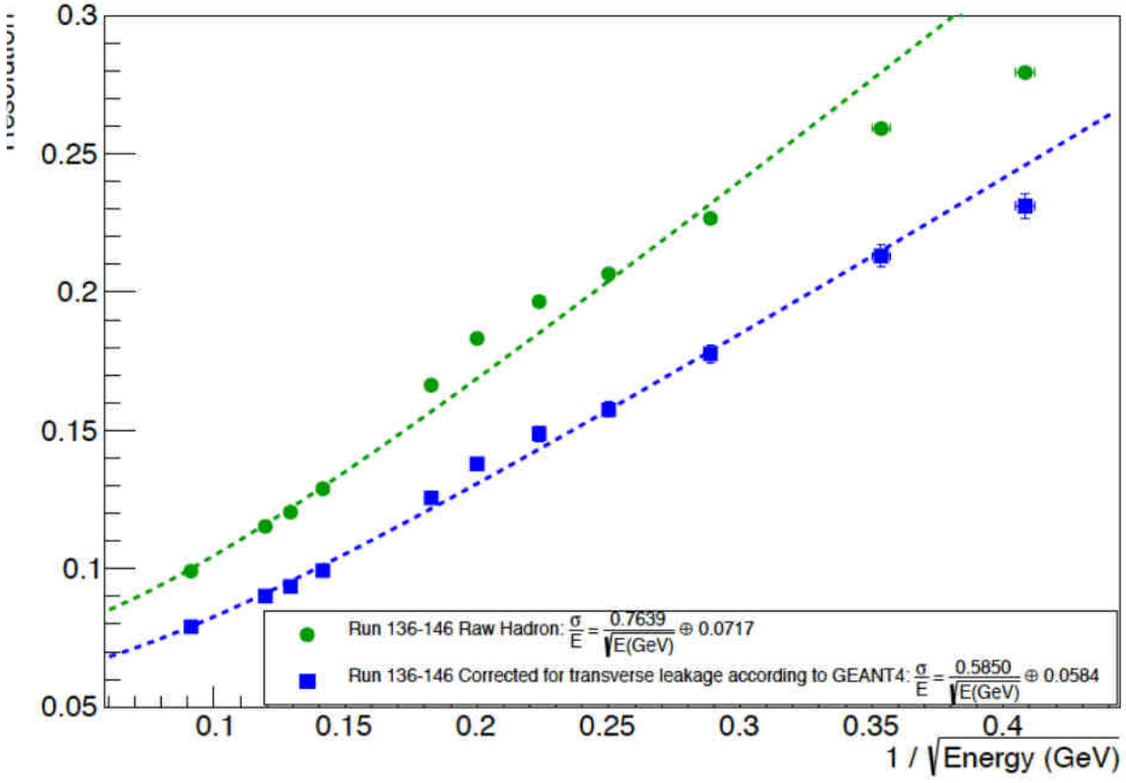
Path forward with re-aligned goals

1. Finish investigation of instrumental effects in connection with test beam results.
2. Optimization of W/ScFi+Fe/Sc system.



Why prototype underperformed?
Are we comparing apples to apples?

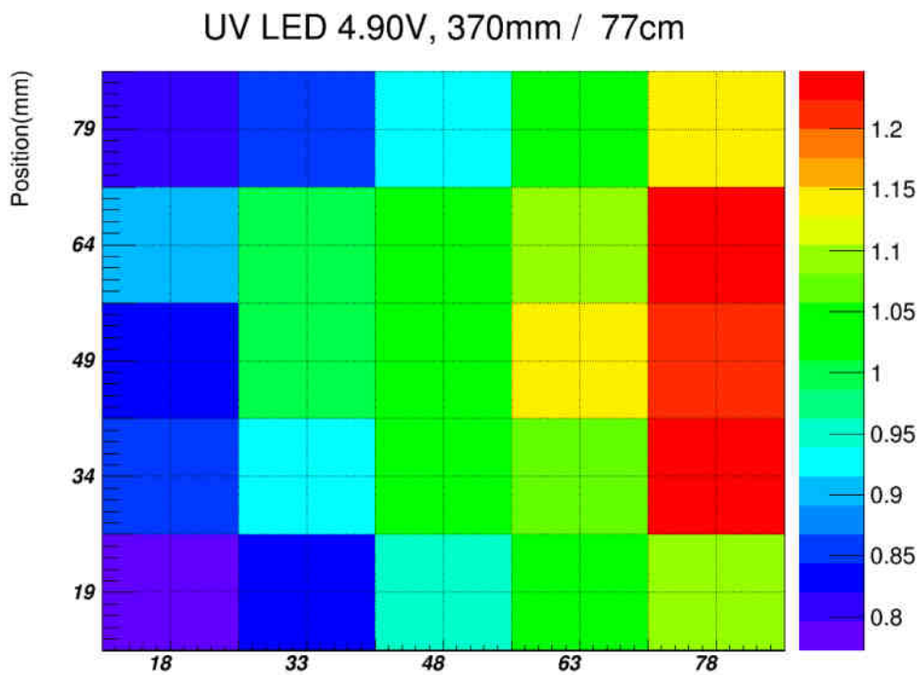
- Ideal vs detailed MC
- Instrumental effects (uniformities in light collection)



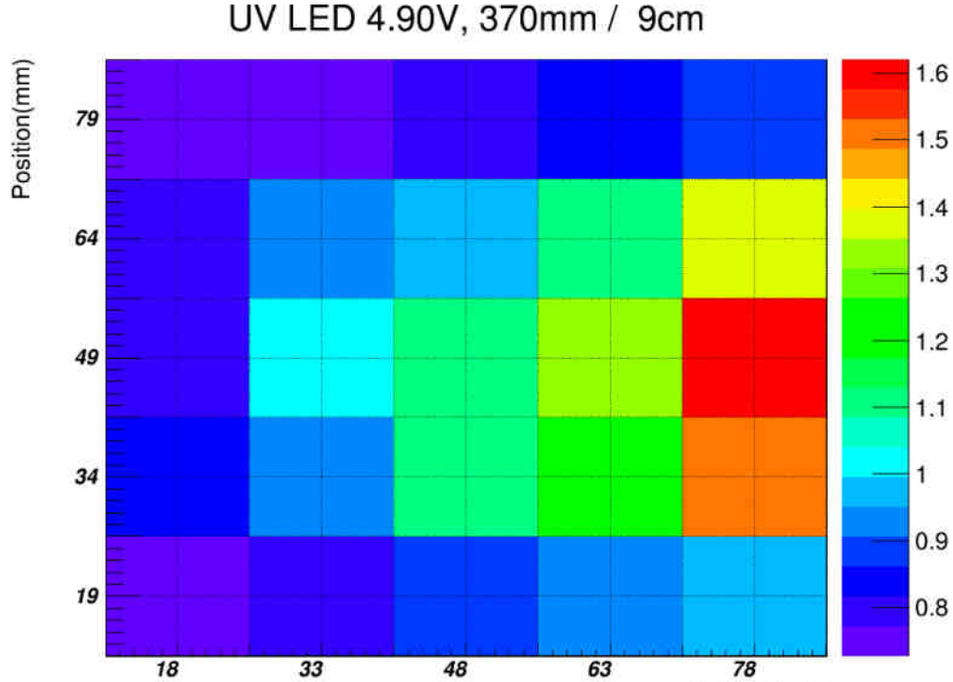
- Corrected for leakages, resolution in test run is close to 60%/sqrt(E).

- How much it can be improved?

Main motivation for reading Sc tiles from both sides to improve uniformity of light collection -> improve energy resolution by may be 20% to 30%. ???

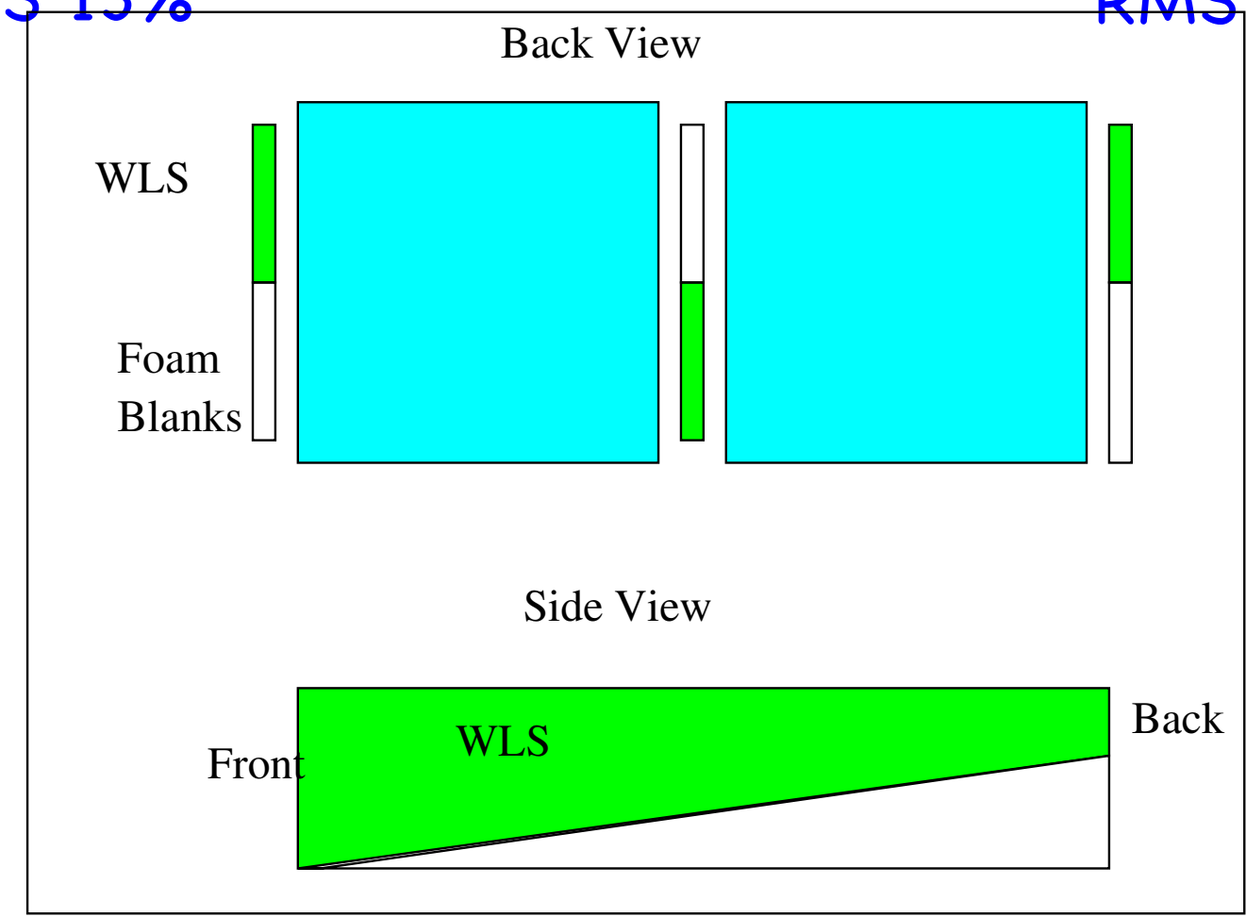


RMS 13%

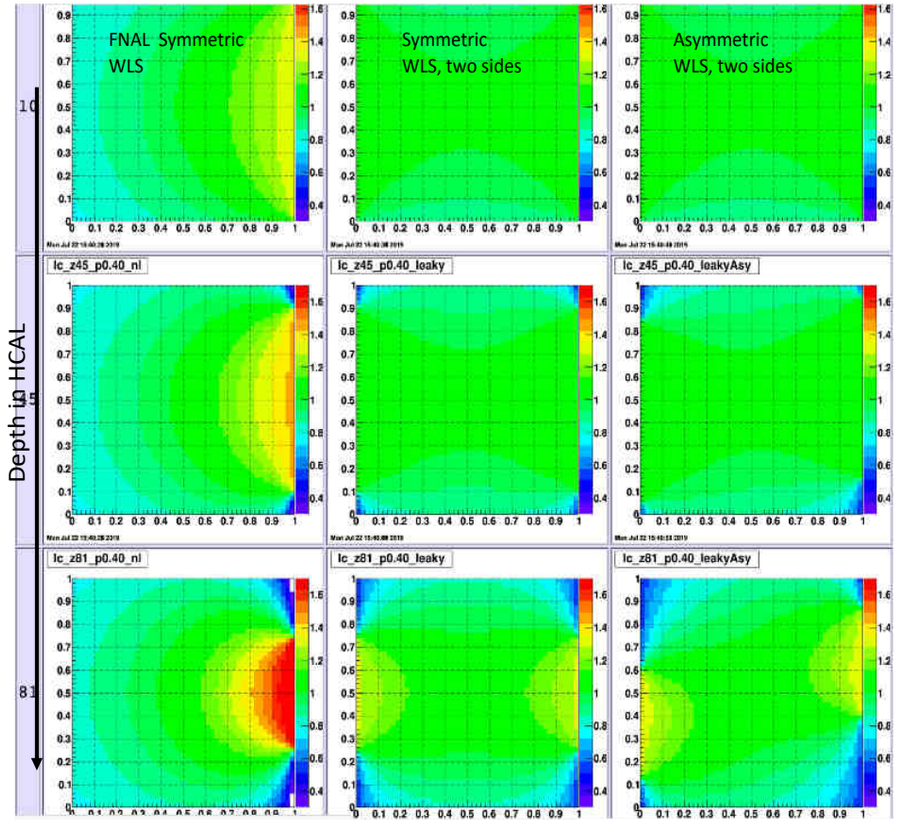


RMS 18%

It was believed that due to wide hadronic shower such large transverse non-uniformities will have little effect.



New Light Collection Scheme



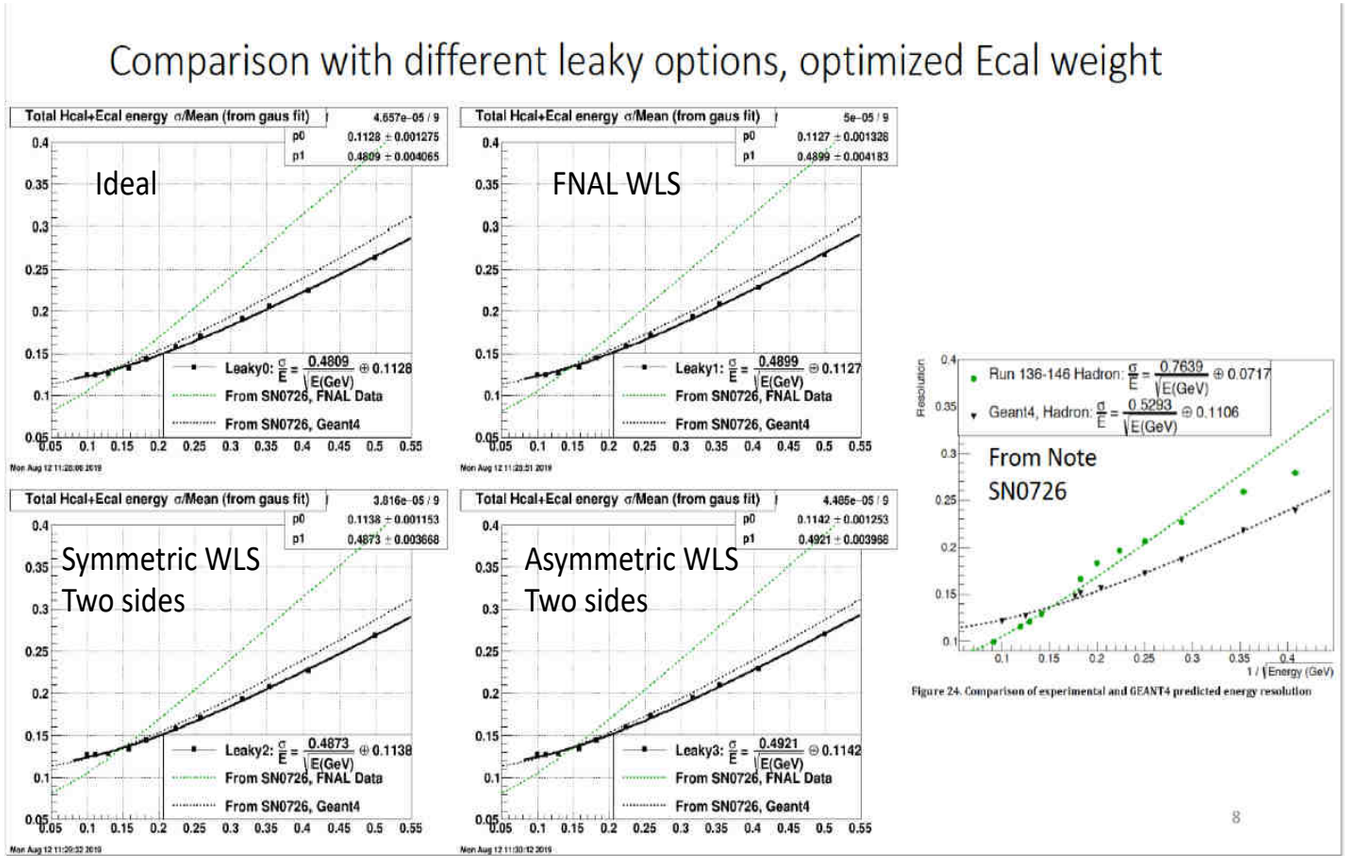
Tested three different schemes of light collection from Sc tiles.

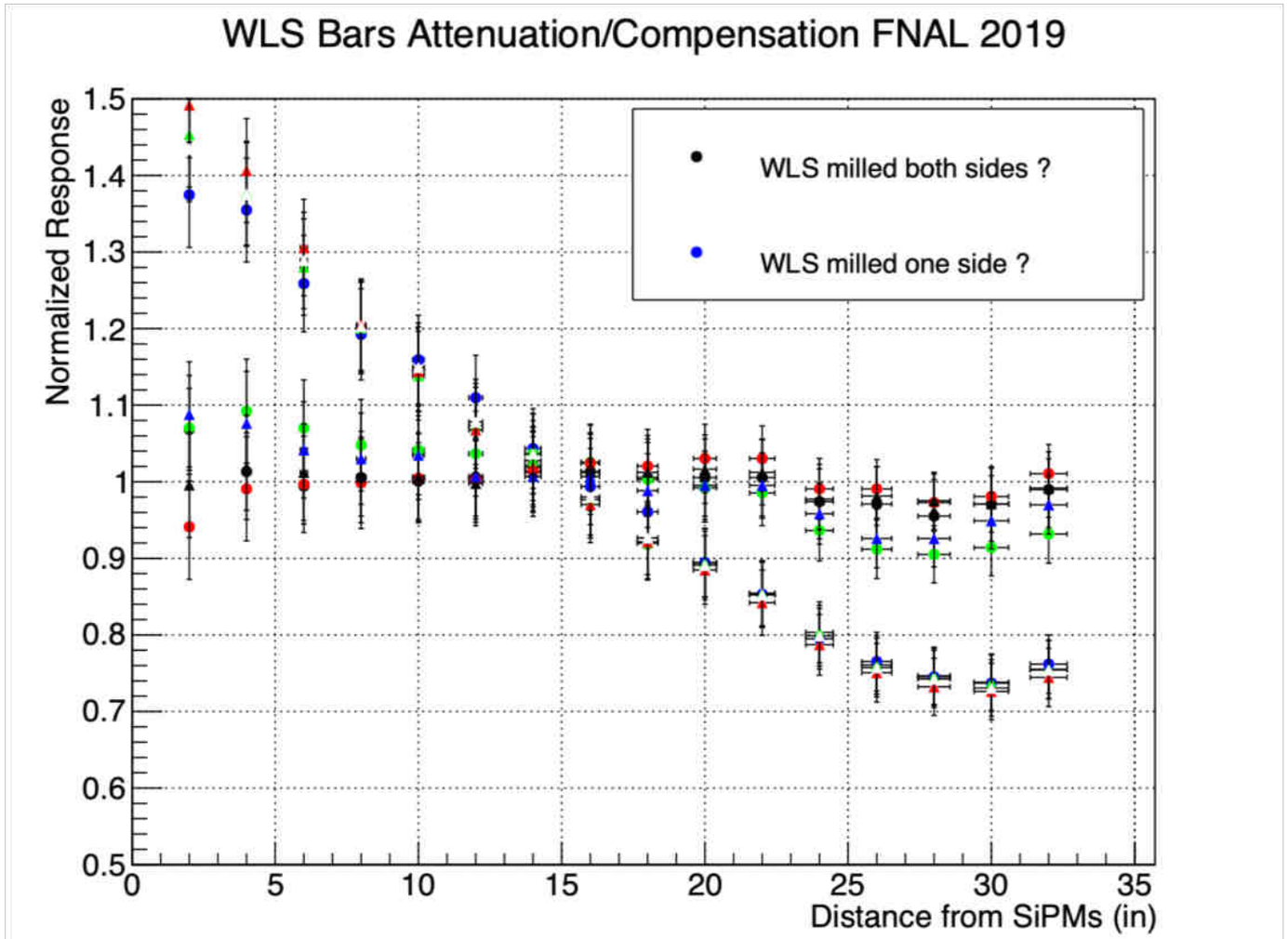
- Very little impact on resolution.
- GEANT3 (gSTAR, A.Ogawa (BNL) + T.Lin (TAMU)).

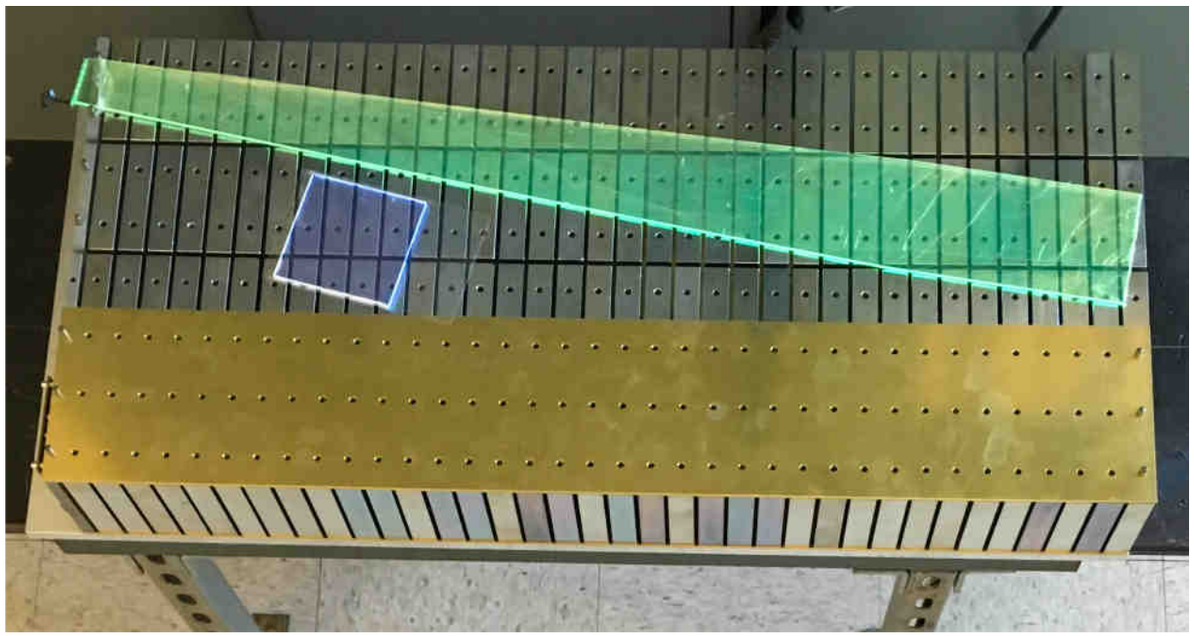
Had to be done fast, impacted construction of STAR FCS.

This study opened interesting direction for EIC hadron endcap system. Make it 4D.

We realized that with asymmetric WLS bars it will be relatively easy to implement longitudinally separated readout for Hcal (Full + tile catcher (~ 30% of tiles at the back side) -> correct for leakages.







Ongoing investigations:

Turned out that in FNAL prototypes we had mixed set of WLS bars.

Which lead to a different type of non-uniformities, along the length of the towers.

In pervious MC we learned that this type of non-uniformities degraded resolution substantially.

WLS bars from test run were mapped.

Currently, new G4 data sets generated.

Once Z.Xu will be back to UCLA we expect to finish this part of analysis quickly (hopefully by the end of January).

Summary and Plans:

1. We are re-adjusting our goals toward targeted R&D. eRHIC schedule is quite aggressive.

2. Synergy between STAR Forward and EIC R&D and now with UC EIC Consortia is productive.

3. UC EIC consortia need to work very closely with BNL colleagues working on IP and central detector design.

4. MC machinery for optimizations and detailed timing simulation of shower development is being developed and partially in place at BNL (A.Kiselev), but it may not be needed. Timing is very tricky part and results from Test Run is not encouraging (signal from neutrons is very low, corrections for invisible energy in Fe/Sc structures not practical).

5. MC machinery for stand alone optimization is in place, supported by M.Sergeeva.

6. In next six month we want to finish optimization for Pb/Sc+Fe/Sc and W/ScFi+Fe/Sc (4D system).

7. W/ScFi+Fe/Sc is more expensive, but integration and performance is better, so may be it is what we need to push for.

8. There is an option for Hadron endcap with high resolution hcal insert (small angles) and associated R&D program (W/ScFi blocks + timing, resolution at ~ 30%/sqrt(E)). This has not been thought through in details yet.