LFHCal absorber material change

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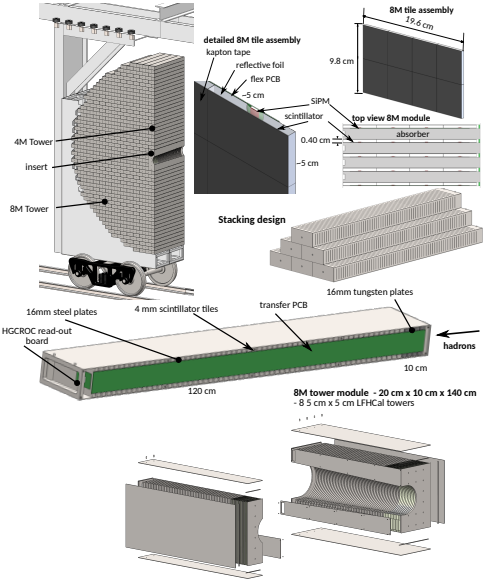
LFHCal



Current Design

- 4 layers of W (16 mm)-Sci plates (4mm)+ 61 layers of Steel (16 mm)-Sci plates (4mm)
- Multiple towers combined in one module to reduce dead areas, increase granularity
- Read-out:
  - SiPMs in each tile grouped in 7 signals per tower (signals combined from 10(5) Sci-plates)
  - readout position: after full HCal
- Modules of different sizes (8M, 4M) to maximize coverage & assembly efficiency

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deputy DSL: Miguel Arratia
Read-out expert: Norbert Novitzky
Participating institutes:
ORNL, BNL, FNAL, ISU, GSU, Yale, UCR, UTK, Valpo, UCLA, UTA, Indiana

Recommendation from FDR

Main recommendations to be adressed from absorber review:

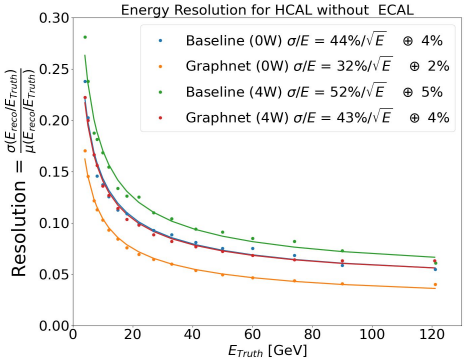
1. Charge 1
   - Use the power of the now existing full simulation for further understanding of detailed requirements
     - ⋆ Uniformity within segments
     - ⋆ **Tungsten vs. stainless steel**
     - ⋆ Dynamic range
     - ⋆ Cast and molded scintillator, small and large SiPMs
   - Use LFHCal simulation as integrated in overal ePIC simulation and study physics sensitivity to technical performance
2. Charge 2
   - **Implement software compensation as soon as possible and re-assess the benifits of the tungsten section**

Highlighted recommendations have direct impact on CD3-A procurement package
$\Rightarrow$ needed to be adressed urgently

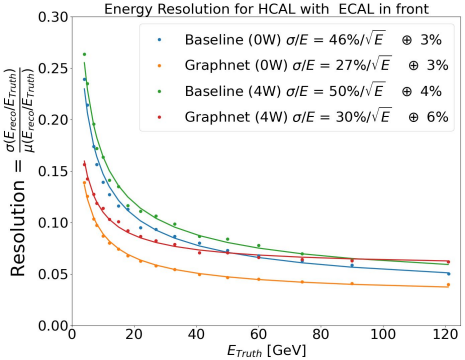
Tungsten vs. no Tungsten studies

- Several studies performed by UCR-Crew:
  - Initial study & methodology explanation
  - Updates for energy resolution
  - Update for position resolutions
- Focussing on combined energy and position resolution for single particles for forward Ecal and HCal with or without HCal tungsten layers
- Baseline simple sampling fraction weighted based average for energy resolutions
- Graphnet used for optimization and better software compensation

Energy resolution



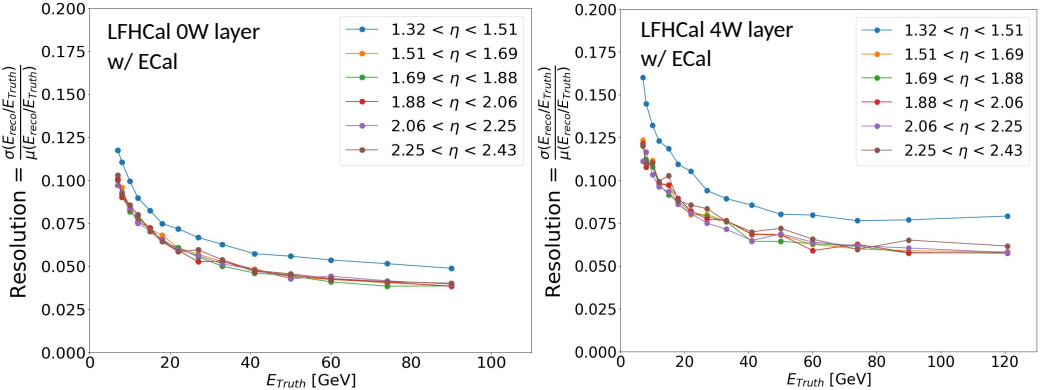
w/o ECal infront



w/ ECal infront

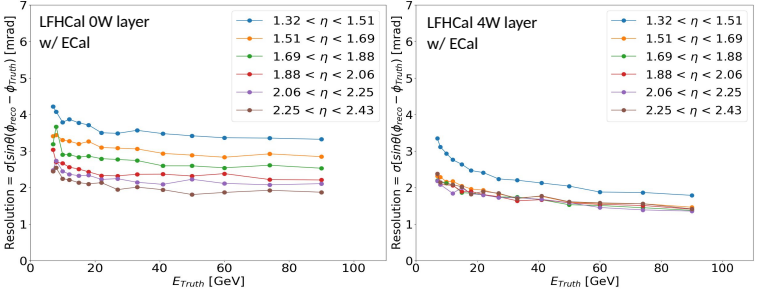
- Baseline w/o tungsten performs better than with tungsten (sub-optimal baseline assessment with unoptimized weights)
- Graphnet performance shows similar behavior: w/o tungsten performs siginificantly better than with tungsten
- Low energy performance siginificantly better with ECal infront, slightly worse constant term (might simply be fitting artefact)

Energy resolution vs η



- E-resolution as function of η shows similar behavior as global performance
- Not using tungsten with ECal infront seems favorable

Theta & Phi resolution vs η



- Angular resolutions in general very good, primarily derived from additional hit in ECal
- Slight deterioration without additional tungsten layers in θ

Summary

- Contrary to initial standalone LFHCal & insert studies tungsten layers in combination with WSciFi-ECal not benefitial
- After consultation with magent group tungsten layers replaced by 1020 steel as all other absorber components and casings, except the PCB convers which will be 304 stainless steel
- Results in significant cost savings & easier production of absorber structure
- Further multi-particle studies will be carried out to address remaining simulation comments from review

Suggested design change: Replace current tungsten layers with 1020 steel as rest of HCal