UCLA Status & Plan

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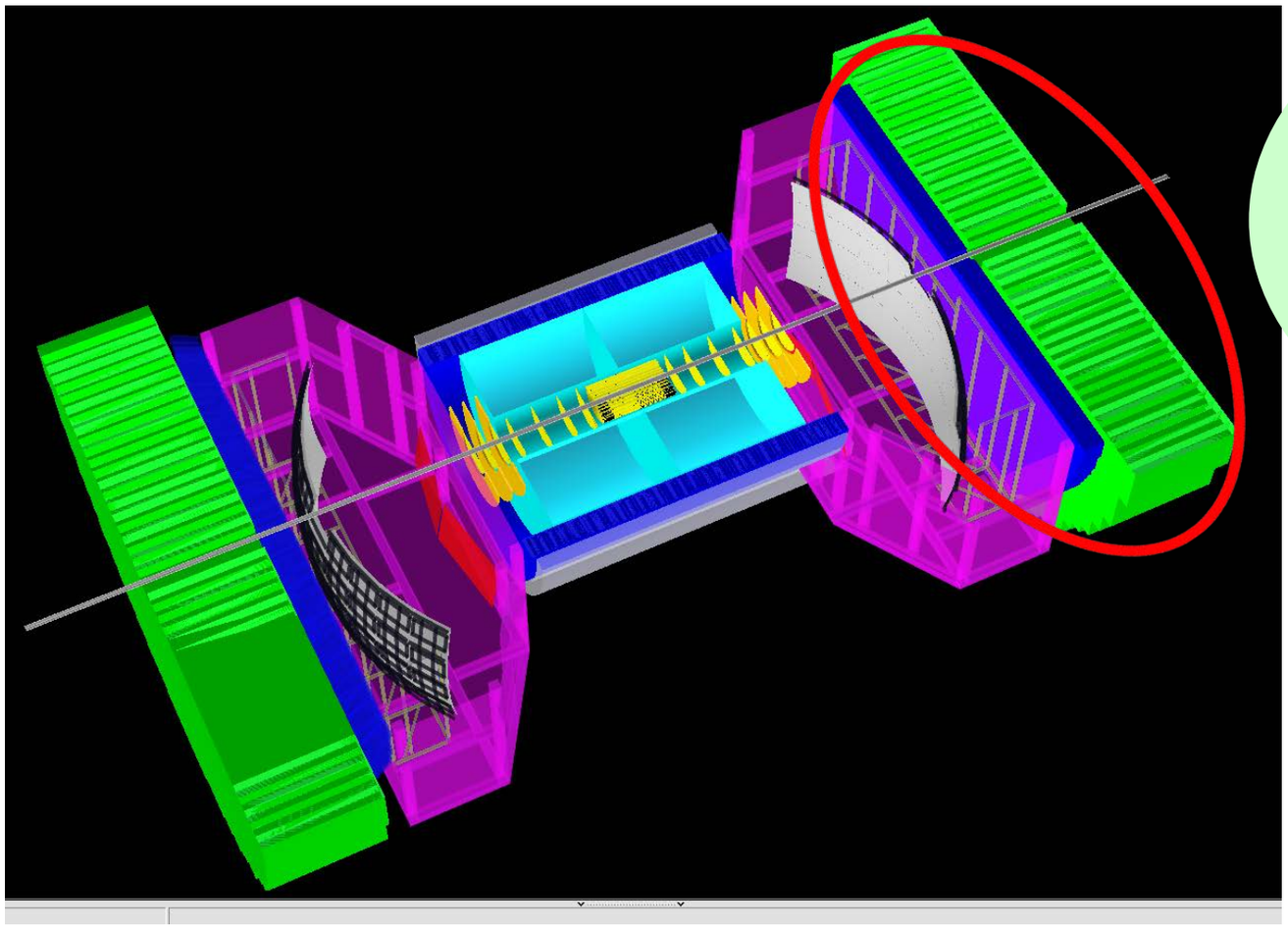
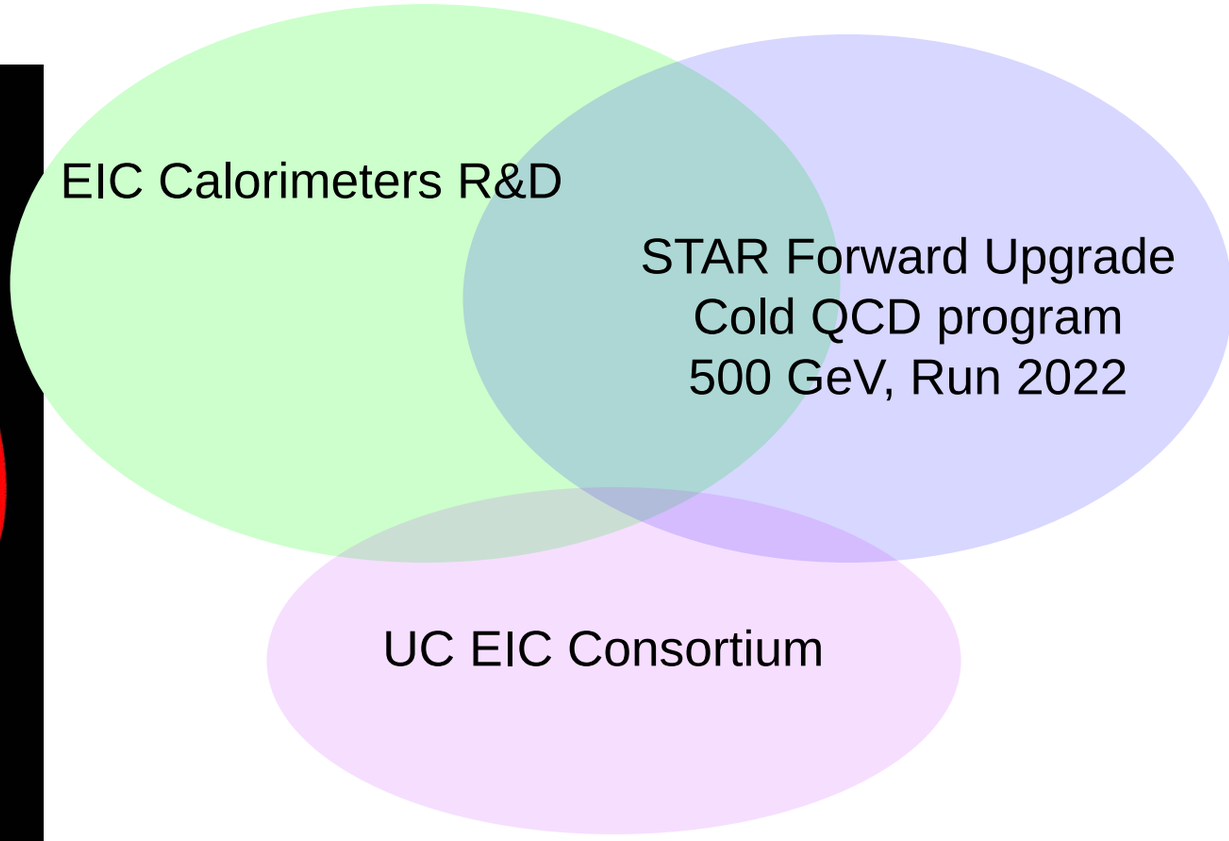
Forward Hadron Calorimeters, Central Detector and ZDC





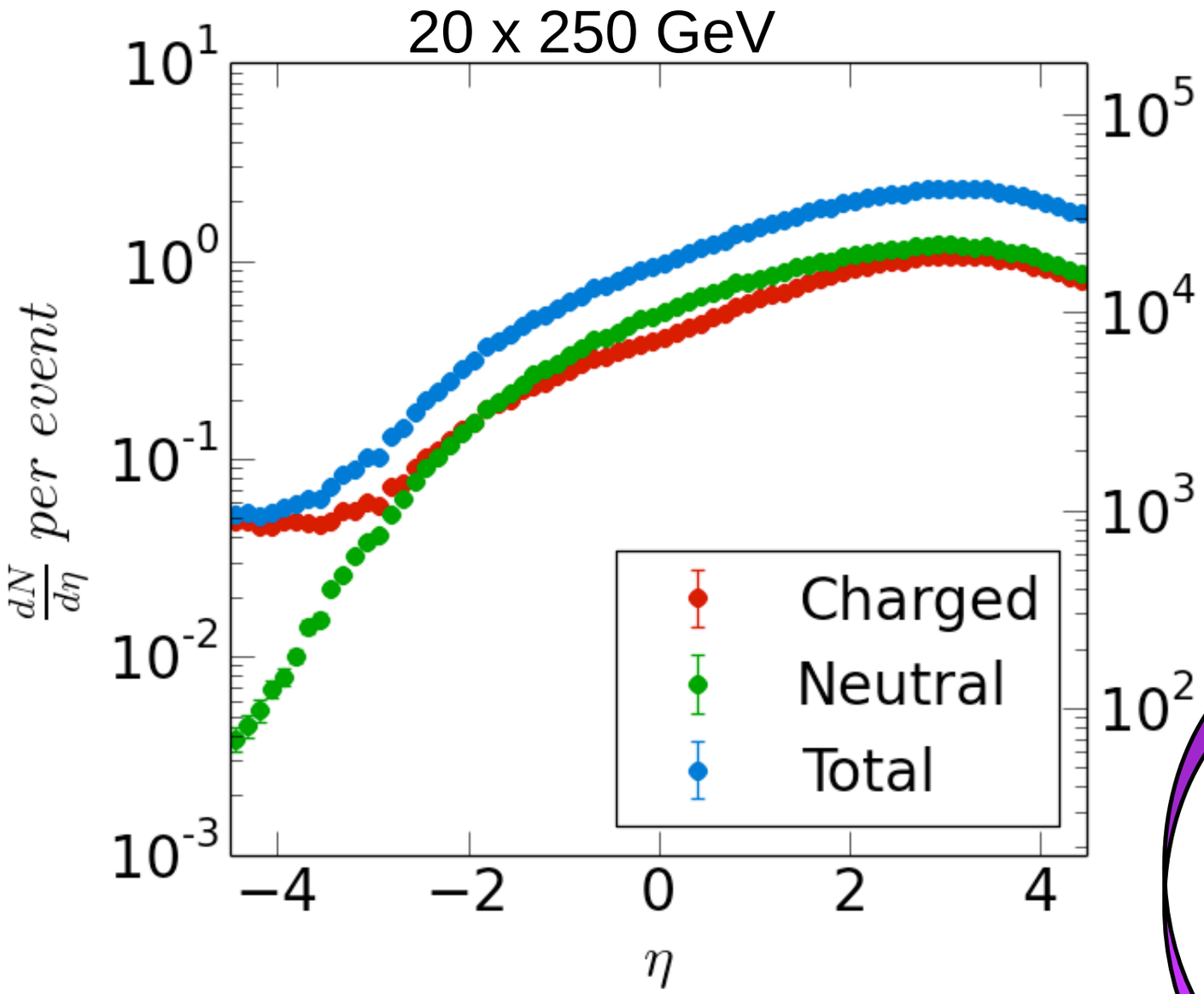
- People
- Similar desired system performance
- Observables
- Technical Challenges

Possible implementations for central detector:

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

Better Cost-Effective HCal

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



https://wiki.bnl.gov/eic/index.php/Detector_Design_Requirements

eRHIC L =10^{33} $cm^{-2}s^{-1}$

No hope for central detector
Test Run 2019 at FNAL

Conditions in Central Detector:

- Low multiplicity.
- Low Rates.

Detector Parameters:

- HCal, signal integration over large detector volume is possible
- HCal, signal inegration over long time is possible

Techniques for High Resolution HCals:

- Compensation (2014).
- Dual Readout using timing (2018).

As an example. Containment. Longitudinal.

Shower depth:

$t_{max} \simeq 0.2 \ln E(GeV) + 0.7$

95% of energy in $L_{95} = t_{max} + \lambda_{att}$

where $\lambda_{att} \simeq E^{0.3}$ (E in GeV, λ_{att} in units of λ_A)

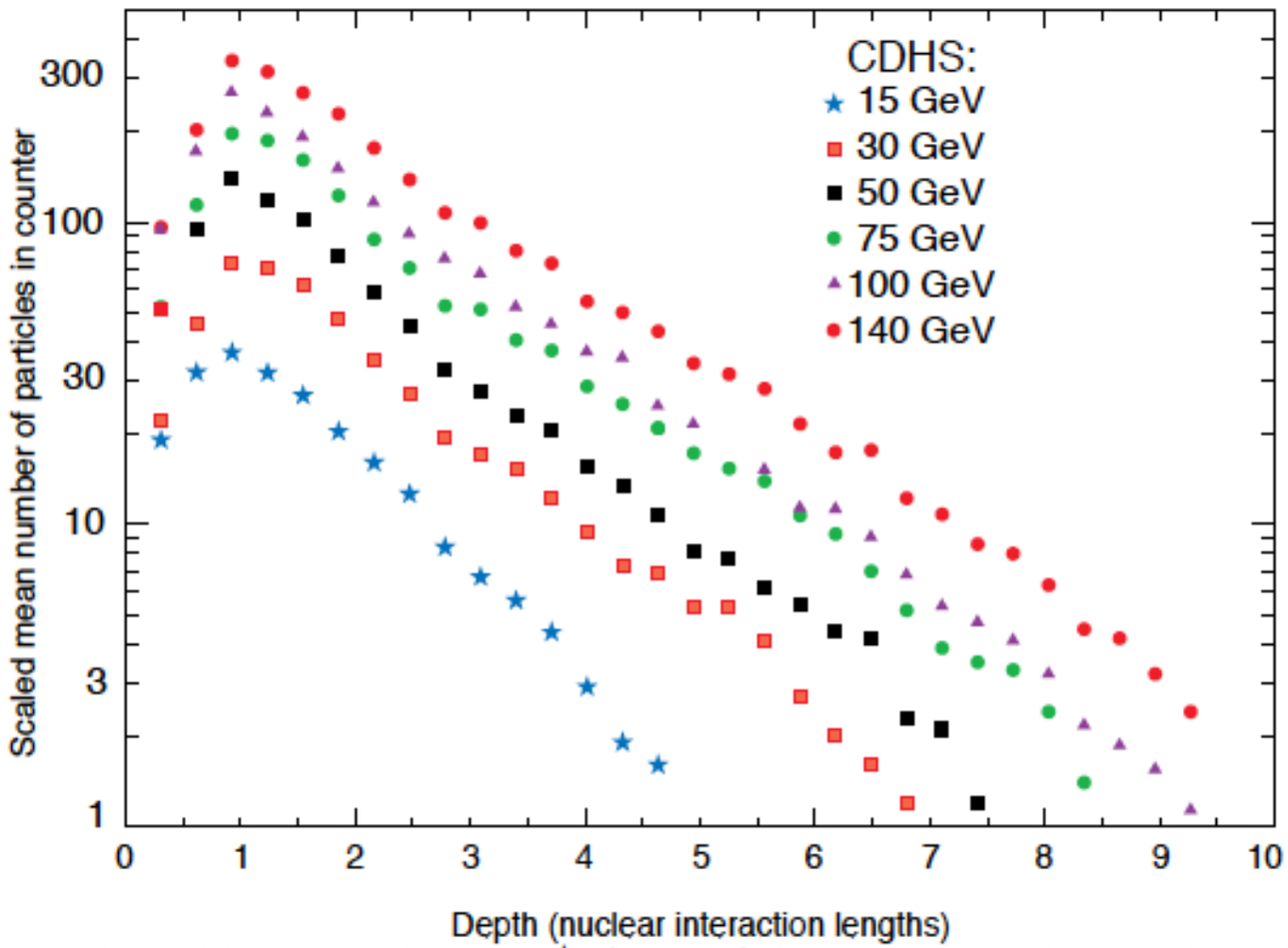
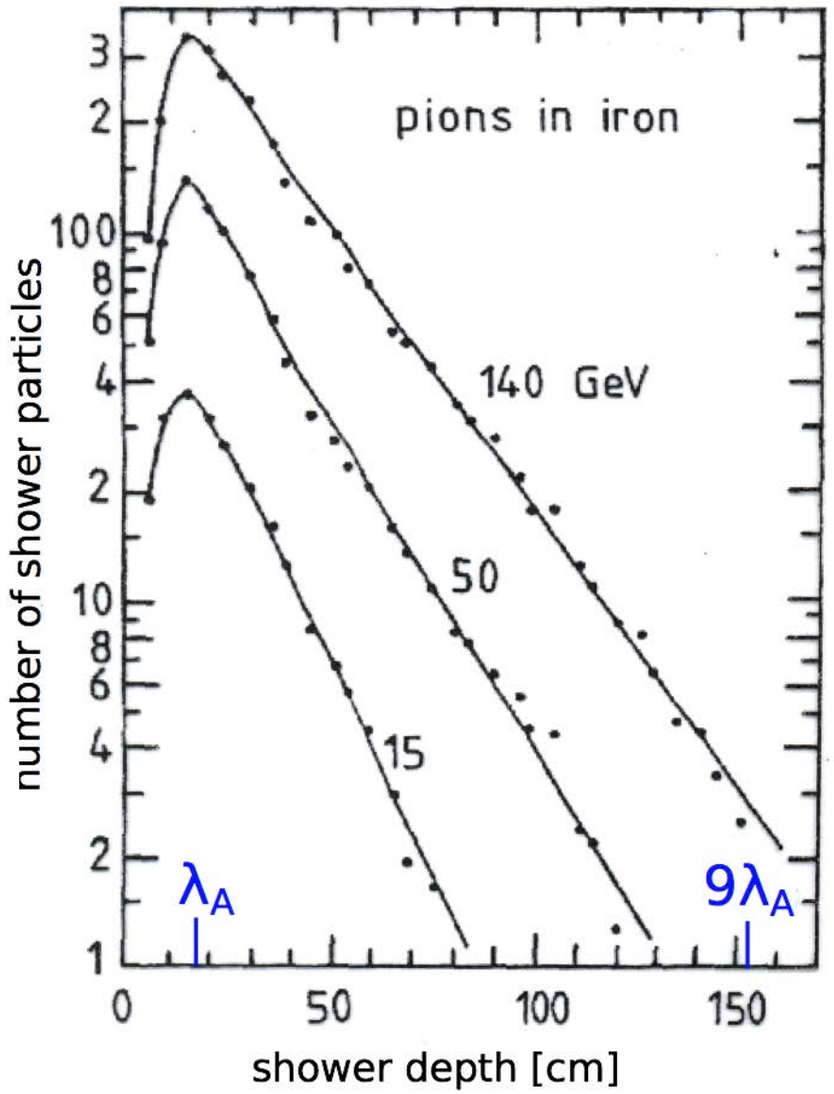


Figure 33.24: Mean profiles of π^+ (mostly) induced cascades in the CDHS neutrino detector [172]. Corresponding results for the ATLAS tile calorimeter can be found in Ref. 165.



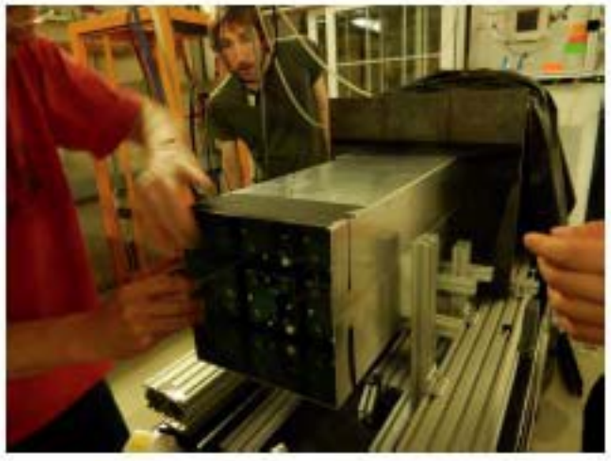
- For Central Detector longitudinal containment is one of few limiting factors.
- High Resolution System is not possible. Rely on tracking.

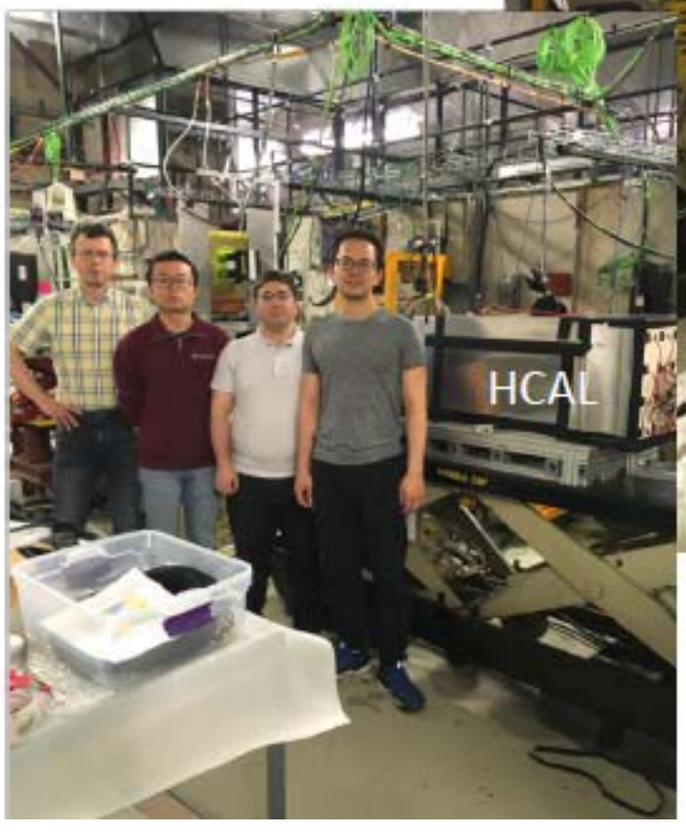
Constant Term in energy resolution > 5%

First Test Run for UC EIC Consortium.

- Re-used cold QCD Forward Calorimeter parts (Fe/Sc, 20mm/3mm),
- Changed readout from SiPM to PMTs added (thanks to Y. Goto for help).
- 1 GHz WFD DAQ (thanks to M. Putchke for help).

FCS, April 2019
FNAL Test Beam
4x4 Ecal, 4x4 HCal





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O. Tsai (UCLA)

D. Neff (UCLA)
M.Sergeeva (UCLA)
B. Chan (UCLA)

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For EIC R&D goal was to measure timing properties of signals from Hcal.

STAR Forward Upgrade/EIC/UC Consortium

1. Synergy between STAR Forward and EIC R&D was very productive, now UC EIC Consortia will add to that (two talks from UCR students)

2. MC machinery for optimizations and detailed timing simulation of shower development is being developed and partially in place.

3. Z. Xu (UCLA) partially supported from UC EIC Consortia will lead efforts with initial help from M.Sergeeva (UCLA) and A. Kiselev (BNL) to continue detailed MC studies.

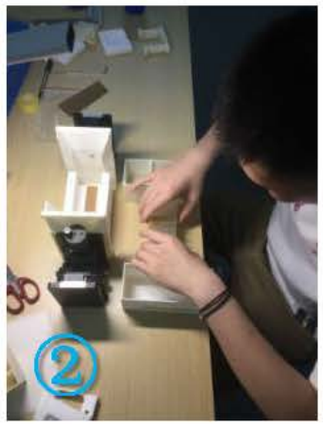
4. 2019 short test run at FNAL showed that there is no hope to use timing for dual readout method for Fe/Sc structures. (Central detector). Even with improved timing properties (fast WLS/Sc), signal will be too small for e-by-e corrections.

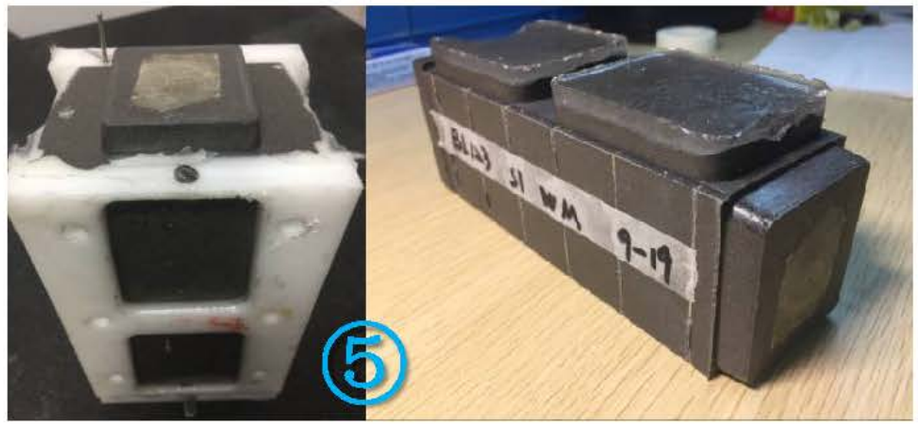
5. For Pb/Sc it may work. There is opportunity to check it by borrowing about 2k needed scintillation tiles from construction of FCS and using existing Pb absorber plates at FNAL, and reusing same PMT readout and DAQ used in test run 2019. (has to be done in spring 2020). Goal is to get definitive Yes/No for any future timing type developments for ZDC, or Pb/Fe/Sc central HCal. Requested funding from EIC R&D and waiting for decision.

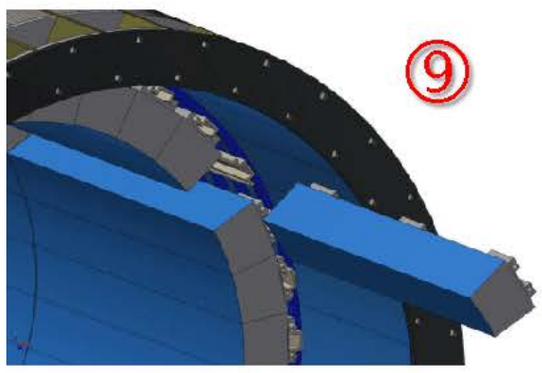
Progress at Fudan

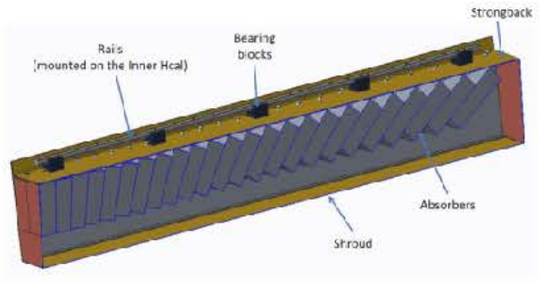
Production flow for making blocks:

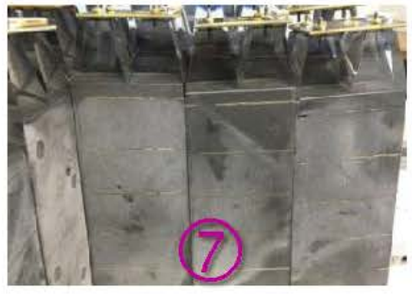
- Fudan has fully mastered the EMCal module construction technology and QA.
- At present, five blocks have been manufactured and related tests (dimension, density, light transmission test, etc.) have been completed, which meet the design requirements.







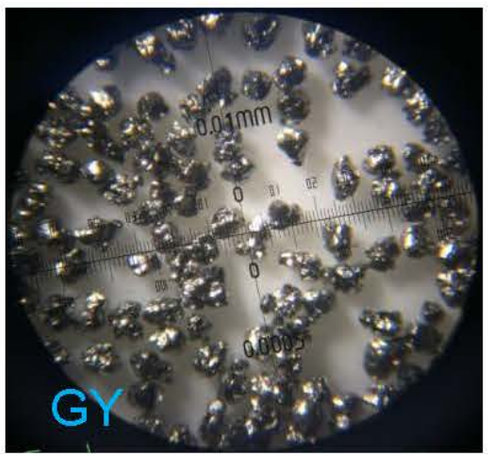


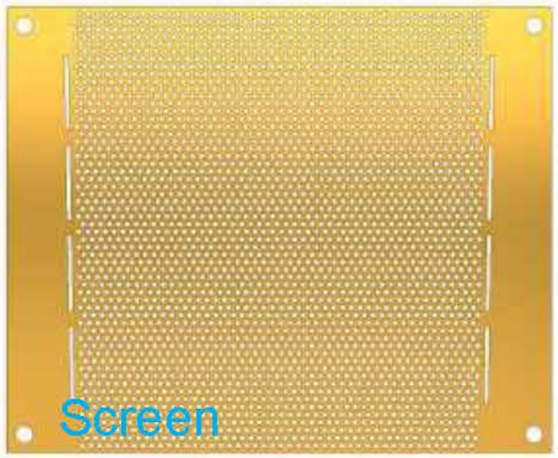


Progress at Fudan

Material readiness:

The key raw materials for EMCal (tungsten powder, scintillating fibers, molds, Epoxy, etc.) are ready.

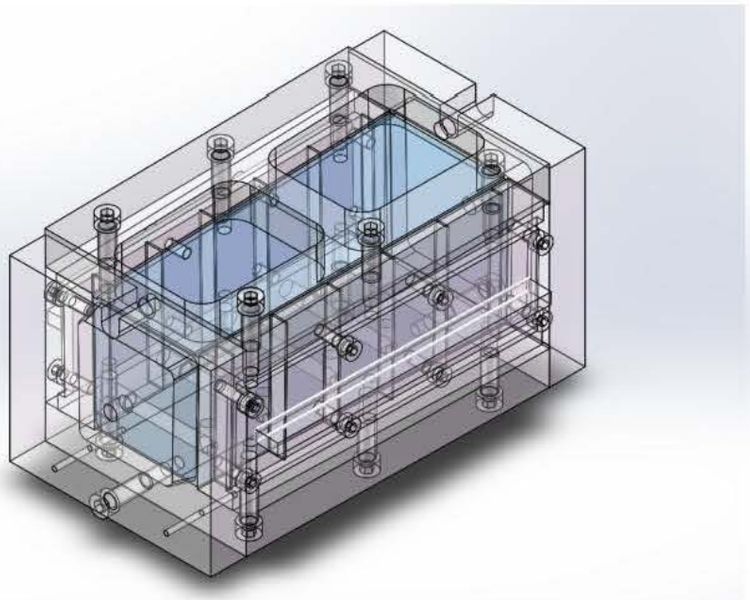


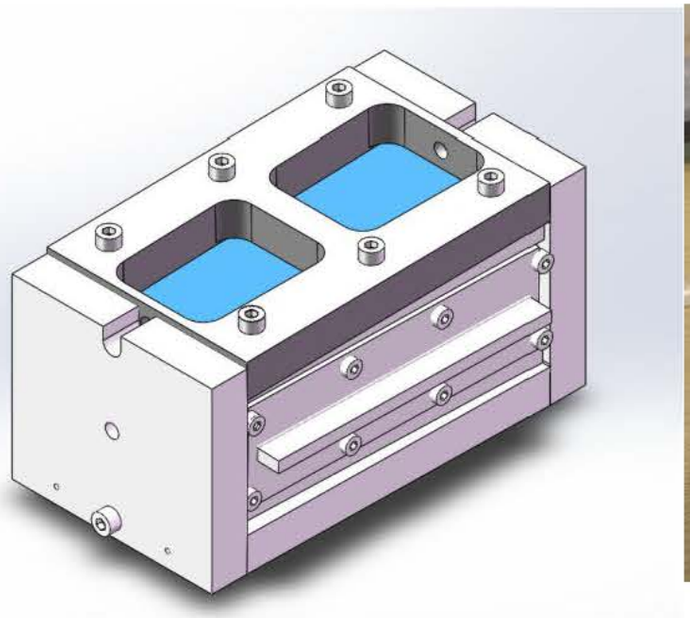


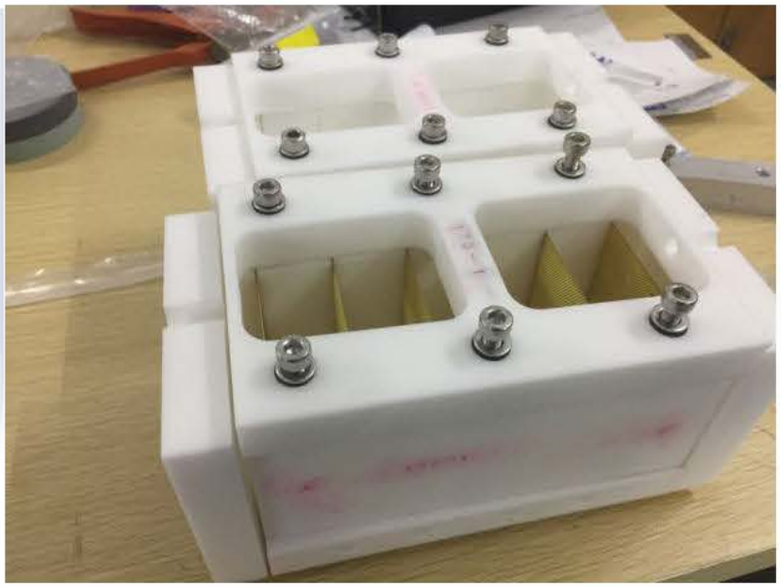
Progress at Fudan

Material readiness:

Molds



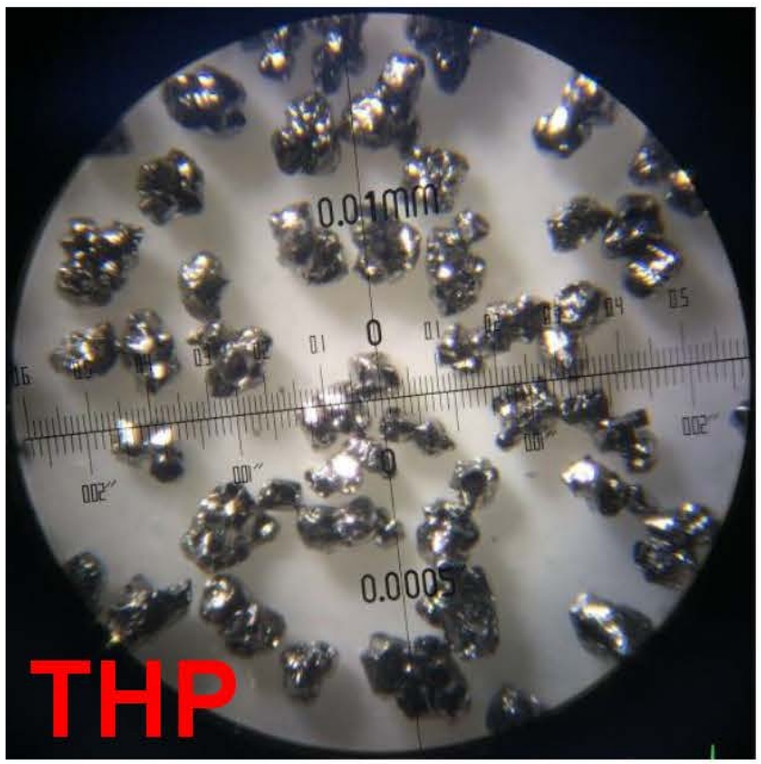


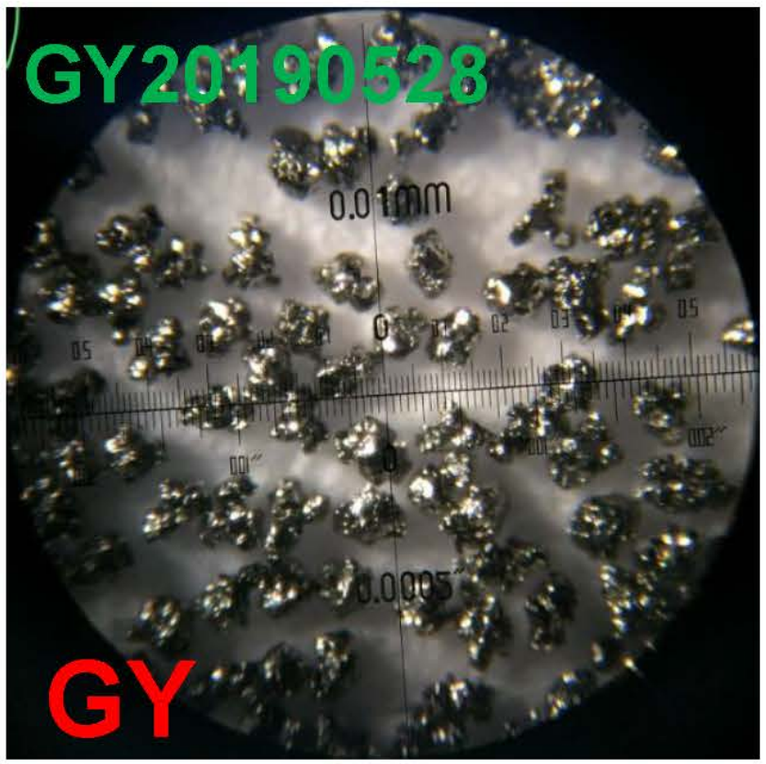


Progress at Fudan

Material readiness:

Tungsten Powder

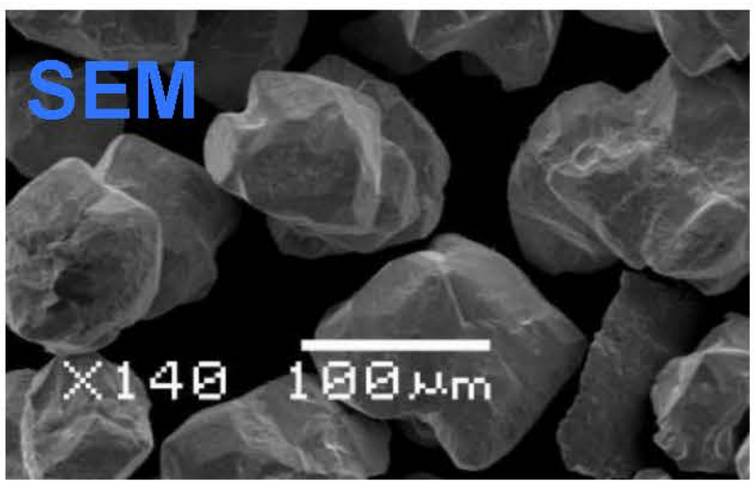




Tap density: **11.2-11.7 g/cm^3** **11.5 g/cm^3**

10.8-11.4 g/cm^3 (UIUC);

HC Starck:10.5g/cm^3 (UIUC)



Purity ~99.9%, Fe, Co, Ni <100 ppm

EMCal block desity: 9.0-10.0 g/cm^3

Facing Major Uncertainty in US-China Scientific Collaboration Now