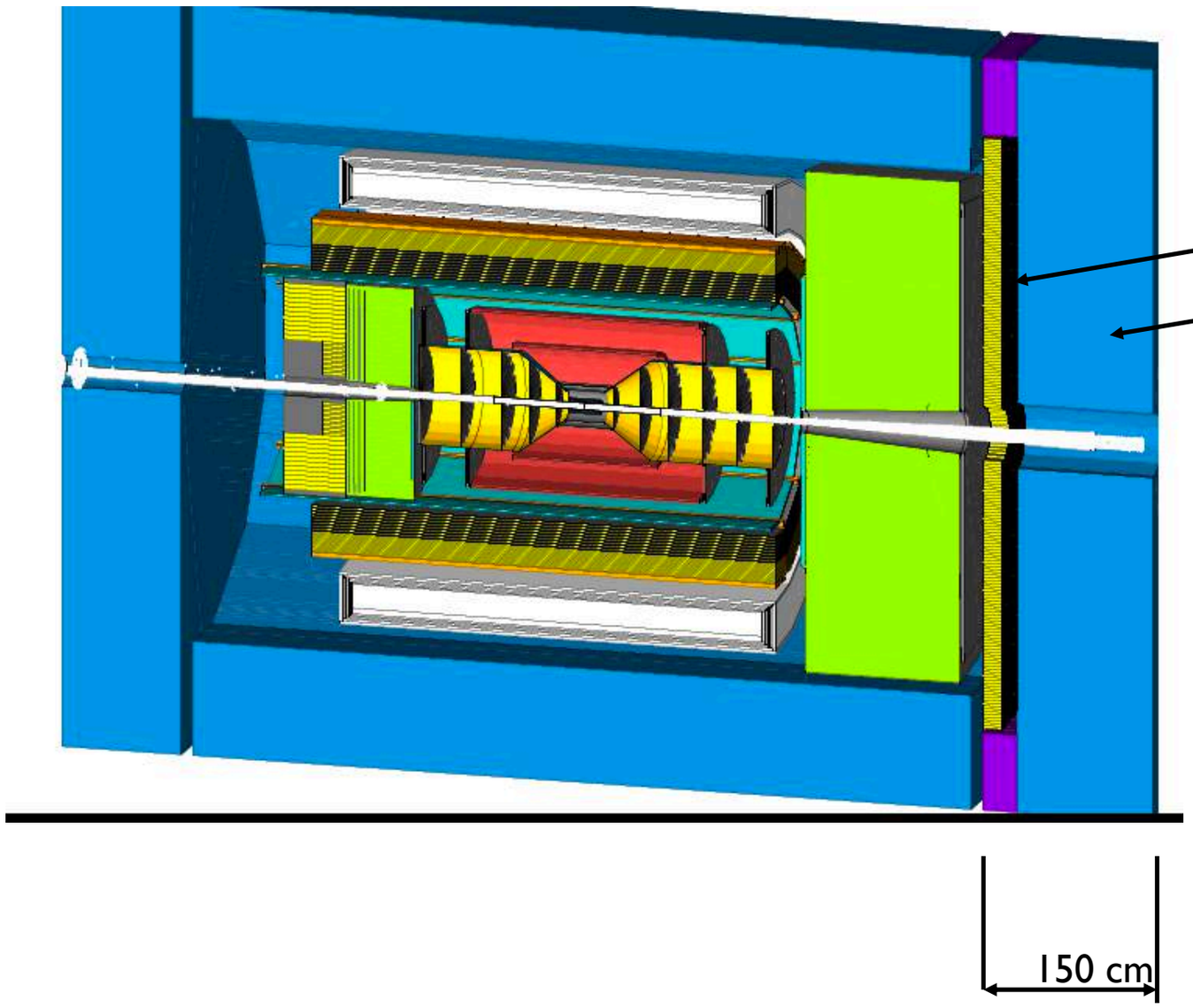


EIC R&D
Hadron EndCap
eRD106 (EMcal),
eRD107 (HCAL)

In context:

- Low rates
- Low occupancies
- No issues with rad damages
- Some concern with neutron fluxes (SiPM noise)

Challenges:

- Available space (150 cm integration envelope) for ~7 int. length (23 X0) system
- Hadronic + EM energy resolutions.

  < 50%/sqrt(E) +10% ~10%/sqrt(E) +2%

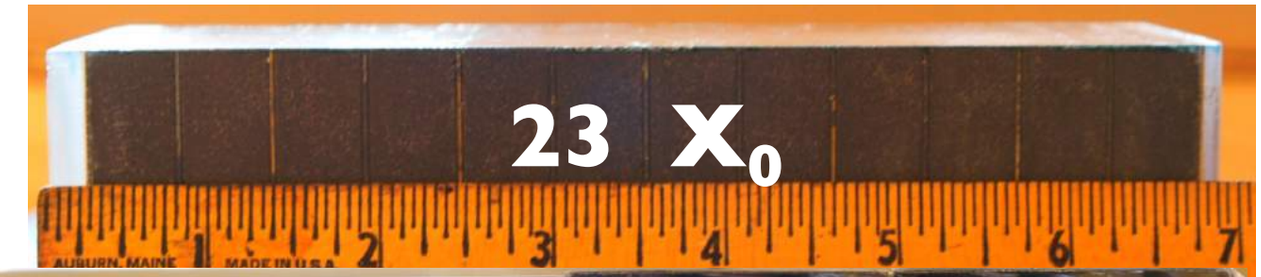
Calorimeters has to be very compact!

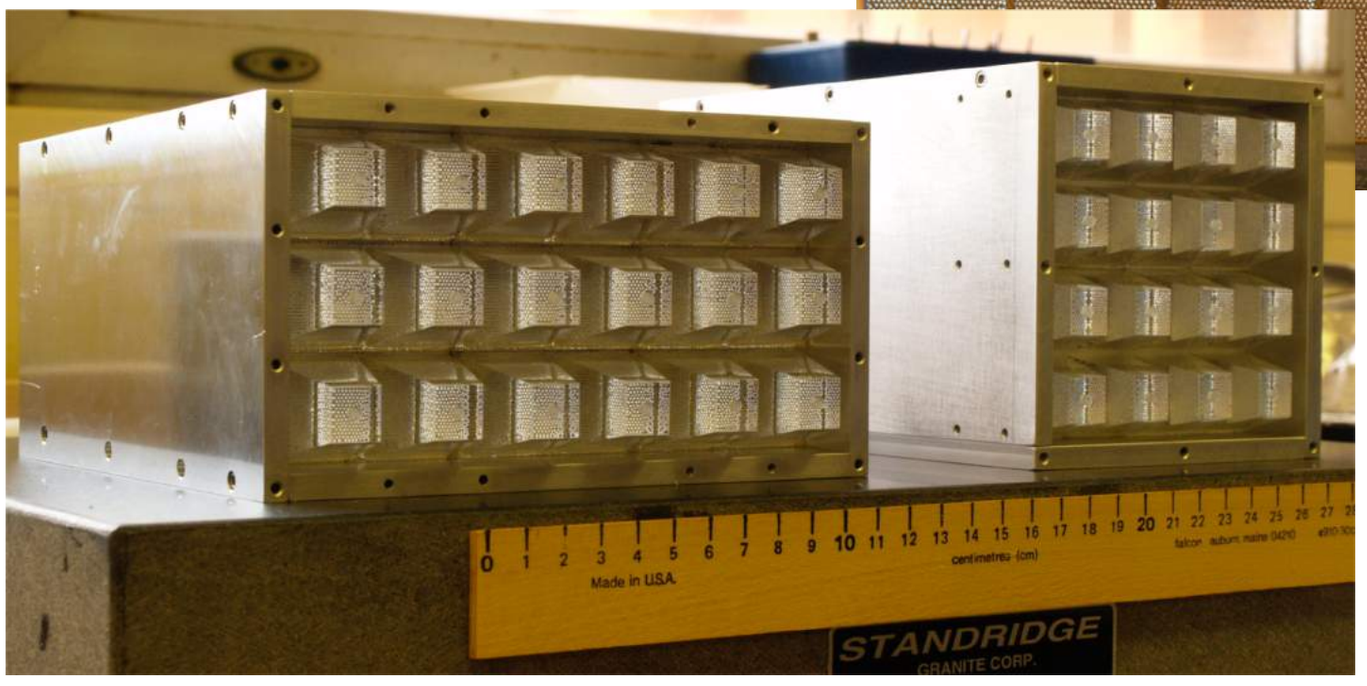
EM Section. W Powder + ScFi (EIC generic R&D)

Parameters:

Final Density - 10.17 g/cm^3,
X_0 ~ 7 mm, R_m ~ 2.3 cm,
S_f -2% (electrons),
Sc. Fibers -SCSF78 Ø 0.47 mm
Spacing 1 mm center-to-center.

Super-module 2x2 towers. Details:
Dimensions 16.6 × 5.33 ×5.33 cm^3
Weight of supermodules (4567, 4651, 4627,4630 g.)
Number of fibers -3120



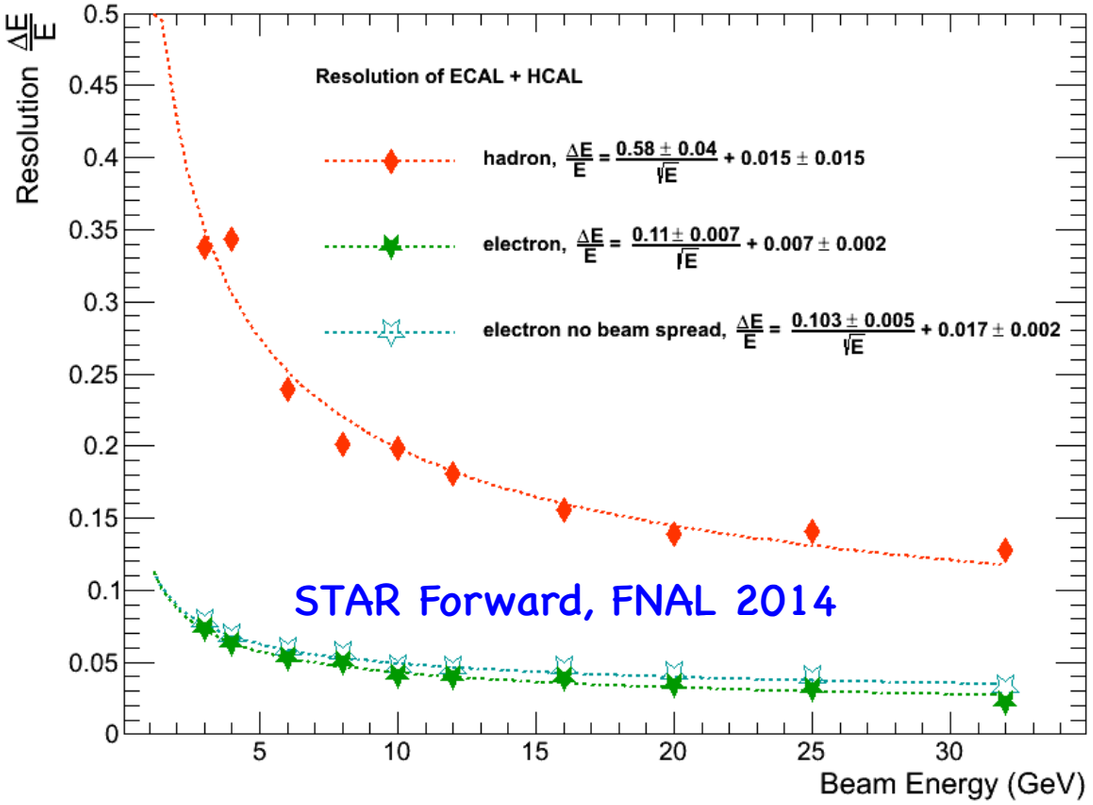


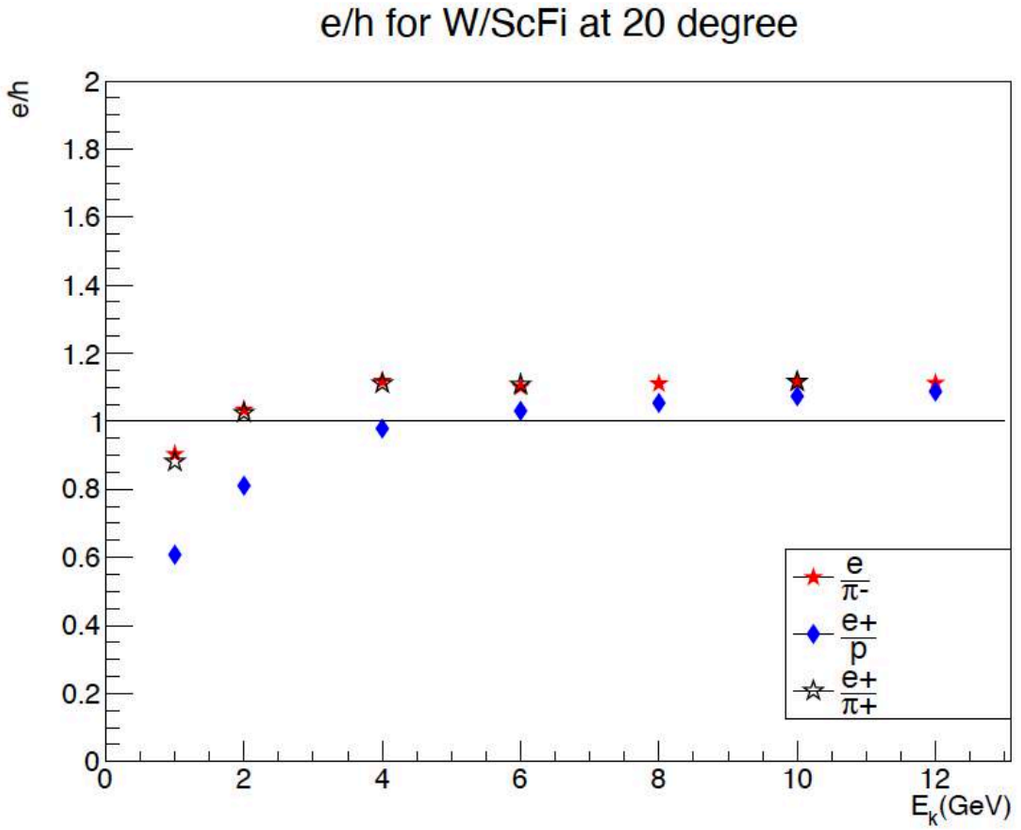
CALOR 2012, J.Phys.: Conf. Ser. 404 012023
CALOR 2014, J. Phys.: Conf. Ser. 587 012053

Space budget for EIC:

- 17 cm – 23 X0 WScFI
- 2.5 cm light guide
- 10 cm Readout

Total 30 cm along Z

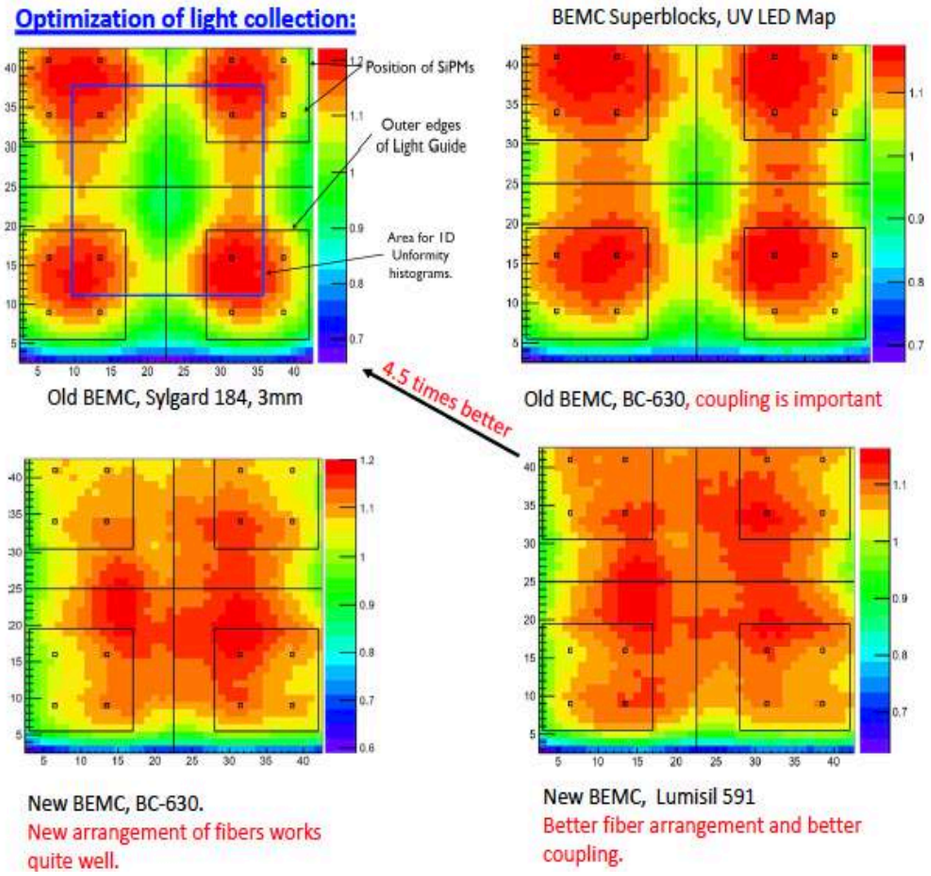




At present W/ScFi parameters tuned for:

a) required EM resolution

b) e/h ~ 1

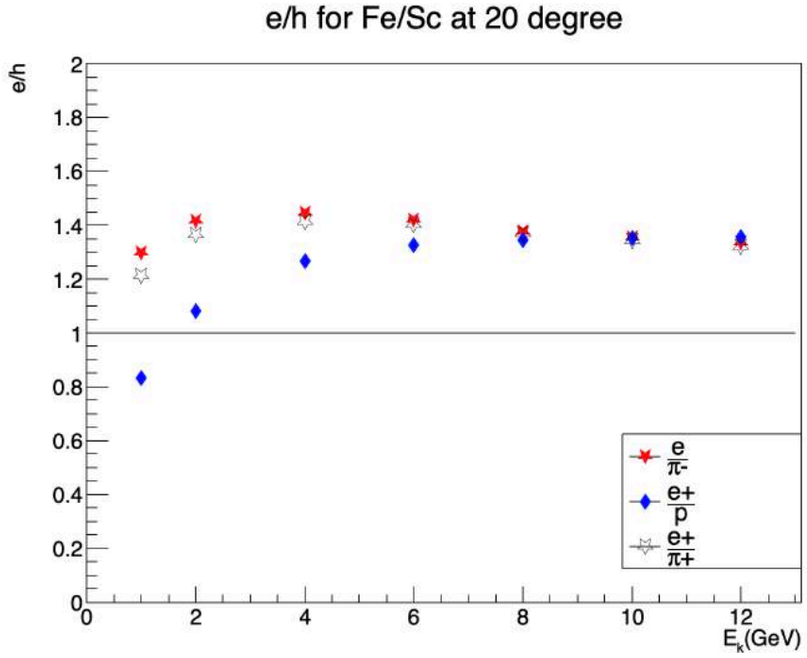


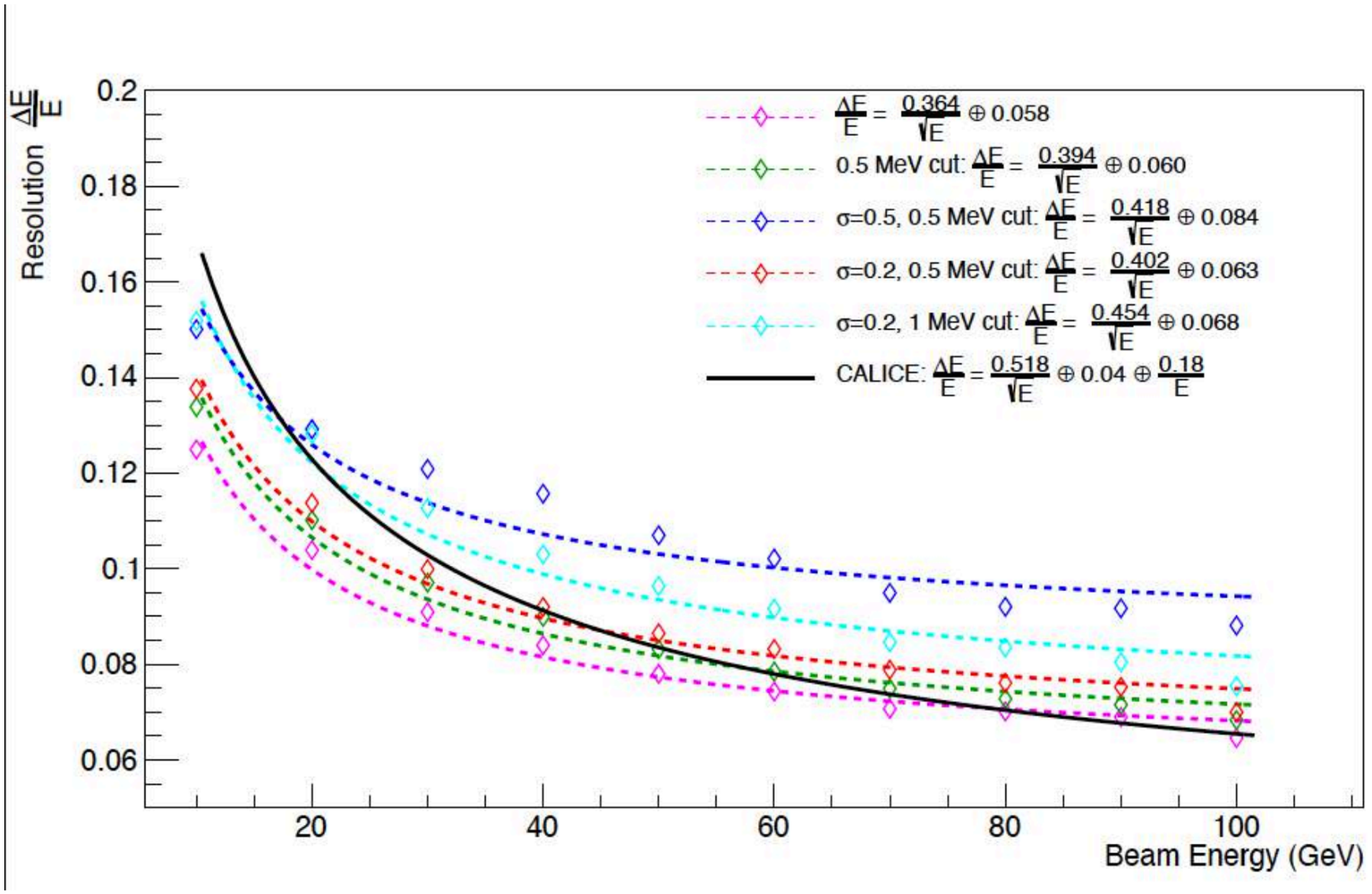
What is needed for EIC (eRD106):

1. Improve Light Collection Uniformity (x4)
2. Improve Light Collection Efficiency (x2.5, 1000 pe)

HCal Section parameters:

- Fe/Sc - 20/3 mm
- Transverse tower size 10 cm x 10 cm
- Number of Layers -51
- Gap for Sc tiles 3.5 mm
- Effective Interaction lengths 19.1 cm
  (Fe interaction length 16.8 cm)



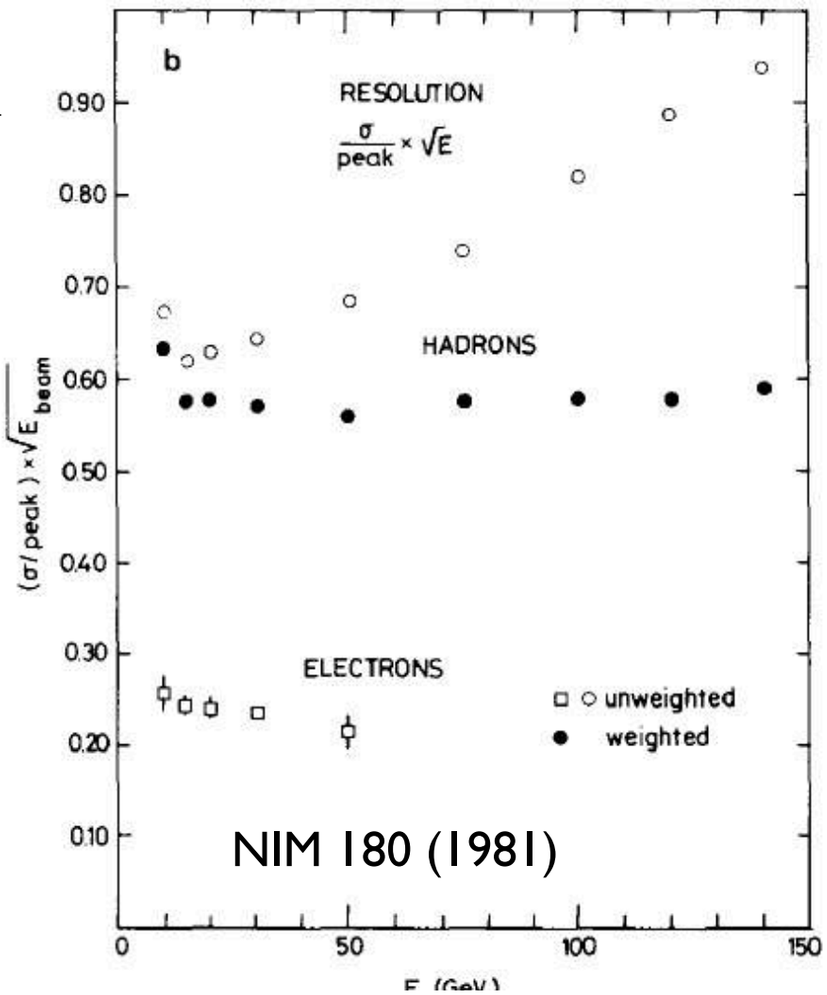


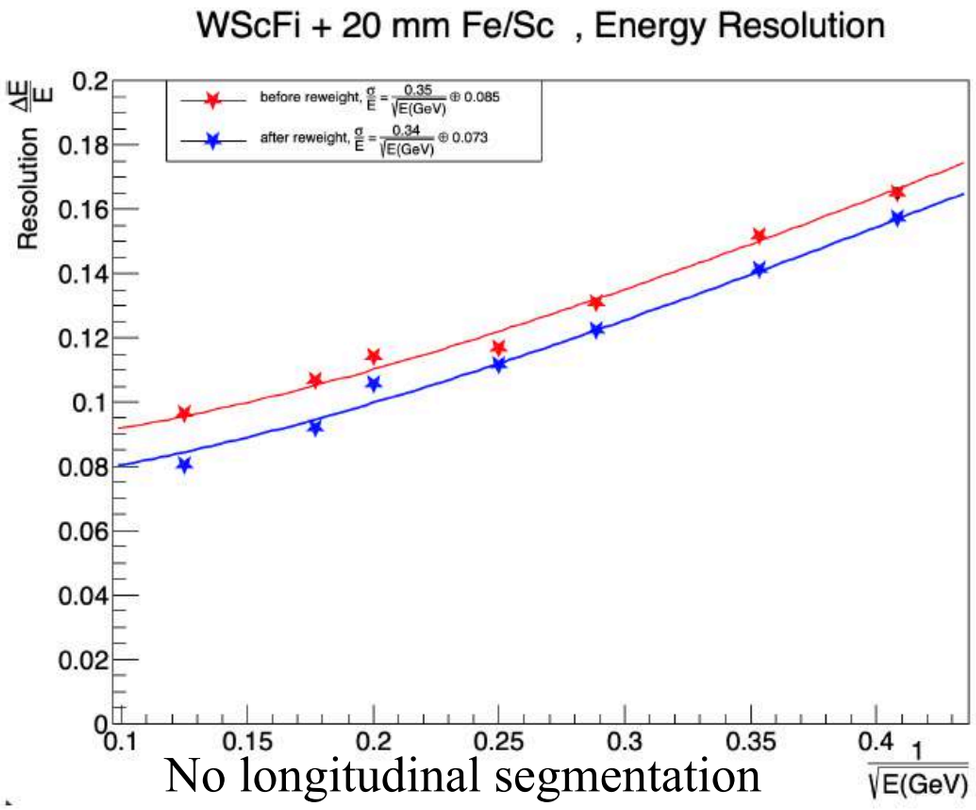
Energy resolution with some of the cuts used by the CALICE. Is it too good?

Need good test beam data.

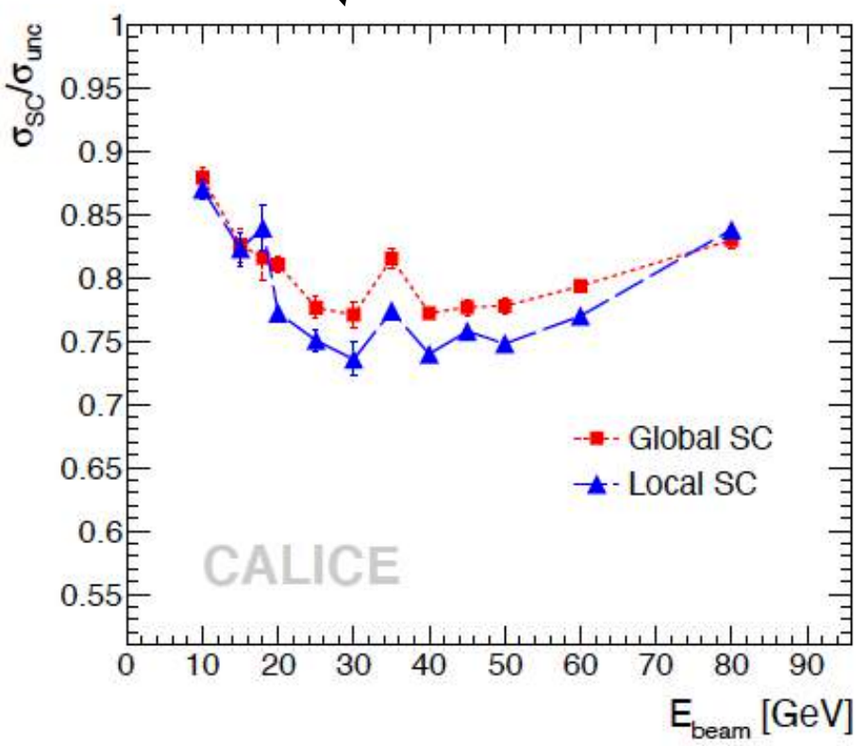
HCal Longitudinal segmentation.

- "Software compensation"
- Control for longitudinal leakages
- **ML/AI algorithms, 3D shower imaging**
- Calibration
- Complicated mechanical design
- Number of readout channels





No longitudinal segmentation



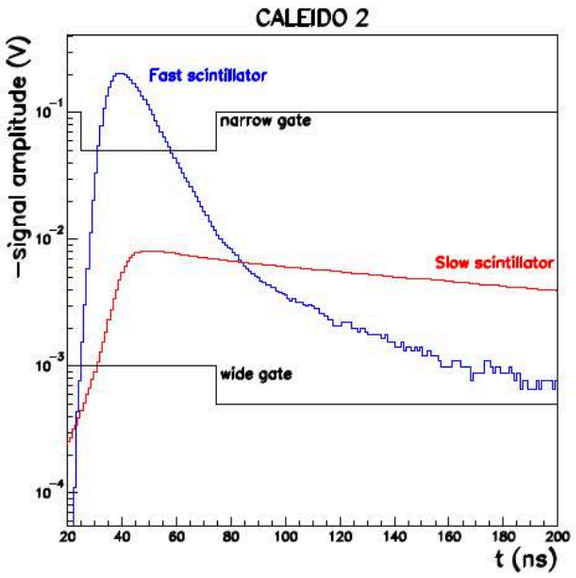
Longitudinal segmentation to improve energy resolution helps, but not dramatically.

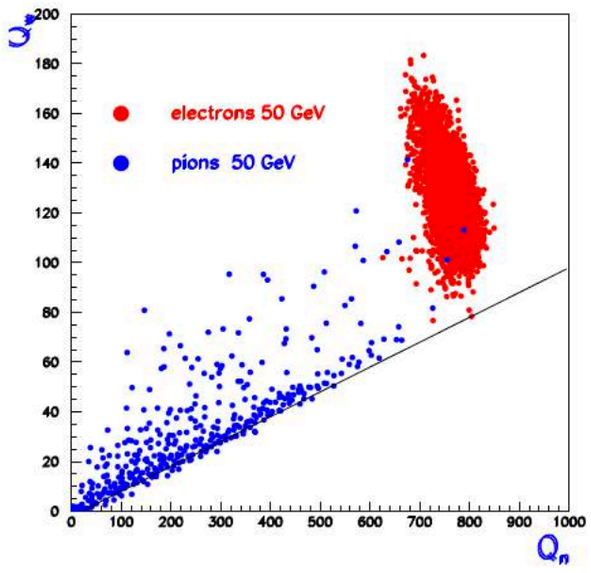
STAR Forward Calorimeter System 520 towers, 30 tons, SiPM readout, assembled in Nov-Dec 2020 at BNL

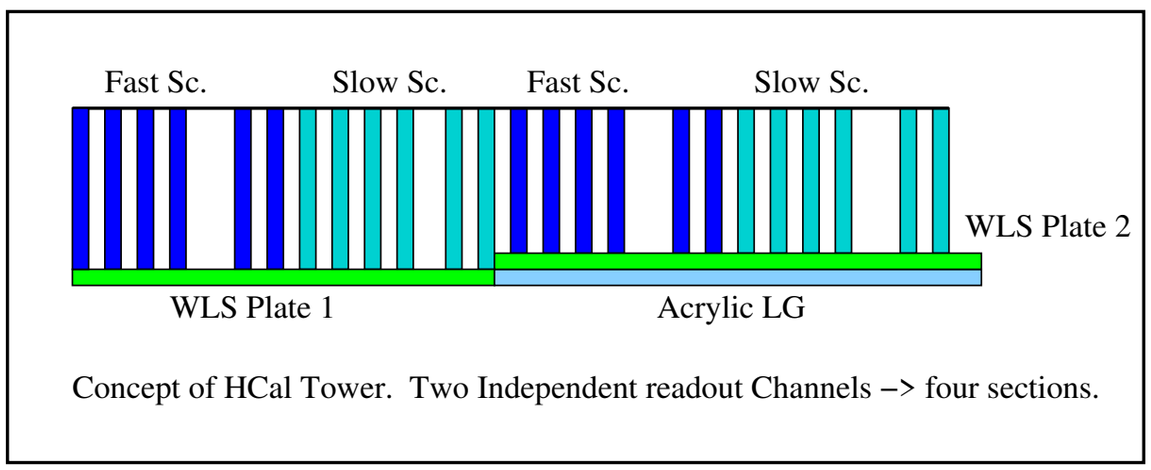
Very efficient construction method (LEGO type assembly) allows:

- High transverse granularity.
- Small effective interaction length. (no wasted space)

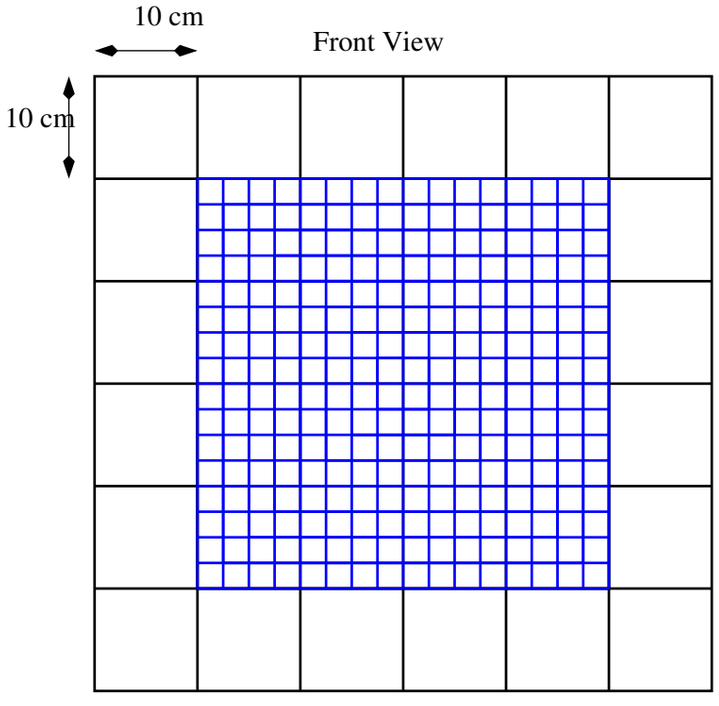
Can we add longitudinal segmentation, keeping all good things of simple STAR FCS design?







Concept of HCal Tower. Two Independent readout Channels –> four sections.



HCal 36 Ch.
51 layer Fe/Sc (20/3)
Tower size 10 cm x 10 cm

ECal 256 Ch.
WScFi 23 X0
Tower size 2.5 cm x 2.5 c

Use CALEIDO 2 (SHASHLYK EMcal) method with two types of scintillator in calorimeter stack.

EJ-212 2.4 ns decay time
EJ-240 240 ns decay time

Practical implementation seems simple, not that different from STAR FCS.

eRD107/106, next two years:

- Optimize length of hcal sections.
- Build large prototype 0.6 m x 0.6 m transvers size.
- Test at FNAL.
- In parallel, UC EIC consortium will be doing ML/AI optimizations.

Make decision on segmentation before CD2.

Thanks!