ATHENA HCals are based on ref. detector design. 20210514 -3T-BaseLineDimensions.pdf

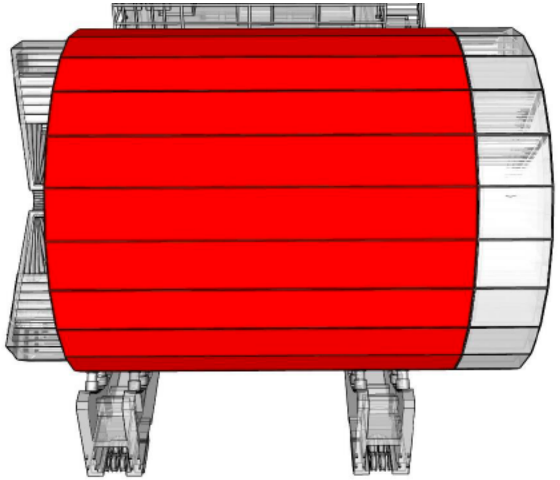


Figure 2: Barrel Hadron Calorimeter

bHcal

Weight Estimates

Element	Basis	Weight
3,167 ft³ of Iron	491 lb/ft³	1,554,913 lbs
842 ft³ of Plastic	59.90 lb/ft³	50,425 lbs
Cabling		
	Total:	1,605,337 lbs
		802.67 tons

eHcal

Weight Estimates

Element	Basis	Weight
824 ft³ of Iron	491 lb/ft³	404,486 lbs
219 ft³ of Iron	59.90 lb/ft³	13,117 lbs
Cabling		
	Total:	417,604 lbs
		208.80 tons

hHcal

Weight Estimates

Element	Basis	Weight
1,068 ft³ of Iron	491 lb/ft³	524,157 lbs
284 ft³ of Iron	59.90 lb/ft³	16,998 lbs
Cabling		
	Total:	541,155 lbs
		270.58 tons

- Absorber - Fe (only choice)
- Readout – Scintillator (first choice) Gaseous (second)

- hHcal and eHcal – traditional sampling calorimeters, i.e. energy measurement and pattern recognition.

- bHcal - is a sampling calorimeter, but likely will be used as a pattern recognition device only, due to thick SC 3T magnet between bECal and bHcal.

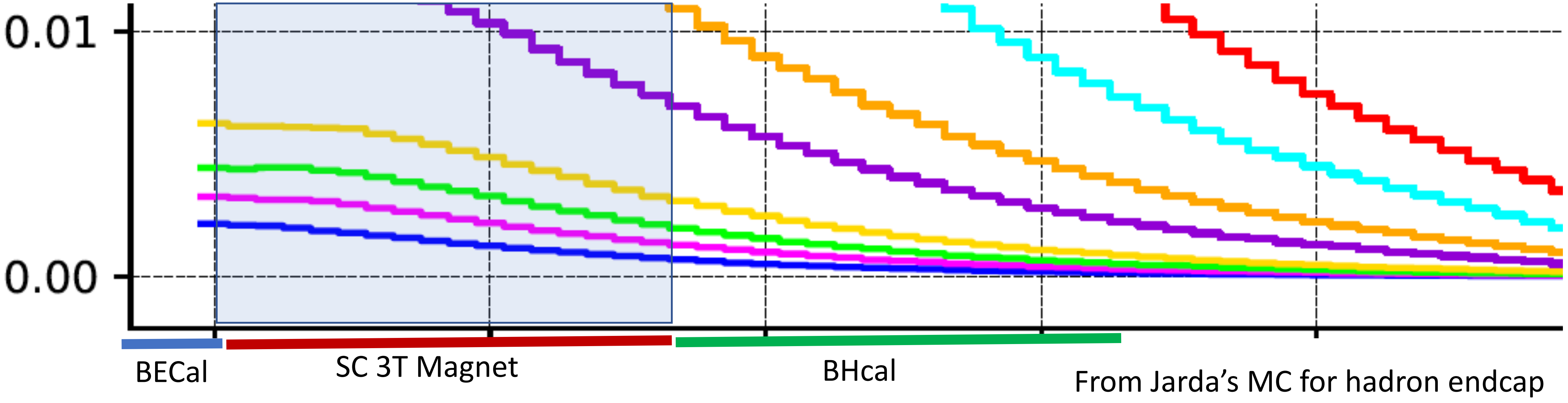
Optimization for the whole system (especially for barrel region) is needed, i.e. thick ECal option inside SC magnet and role of bHcal behind the coils.

For HCals Very little detector R&D will be required before construction will start.

Integrating readout and utilities should not be an issue. These will not interfere with other sub-systems (not in their acceptance, so no problem with detector performance validation).

All mechanical aspects obviously are big engineering job.

Example, Complications for calorimeters in barrel region



Estimated number of ‘MIP’ equivalents per layer:

10 GeV in shower max position ~ 5 MeV energy deposited in 3 mm thick scintillator, 5 / (0.6) ~ 10 particles,

Usually scale with energy so 1 MIP eq/GeV per layer

After coils average become 0.5 MIP eq/GeV per layer

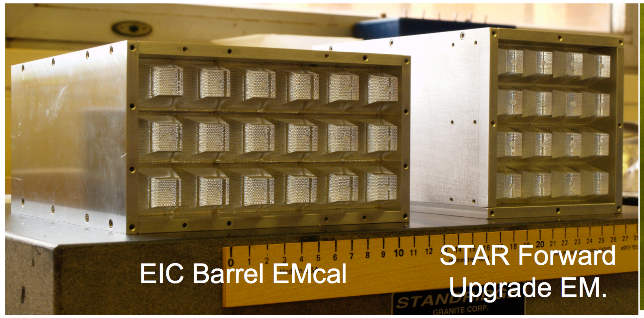
Pattern recognition (‘showers’ separation) ??? Looks like very tough task.

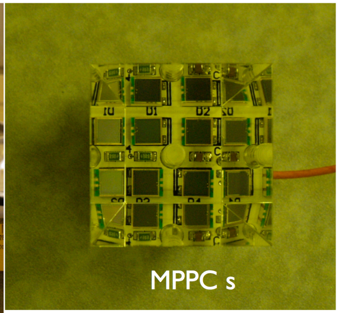
Discussions on role of bHCal and configuration of bECal continues (last two meetings).

Hadron EndCap

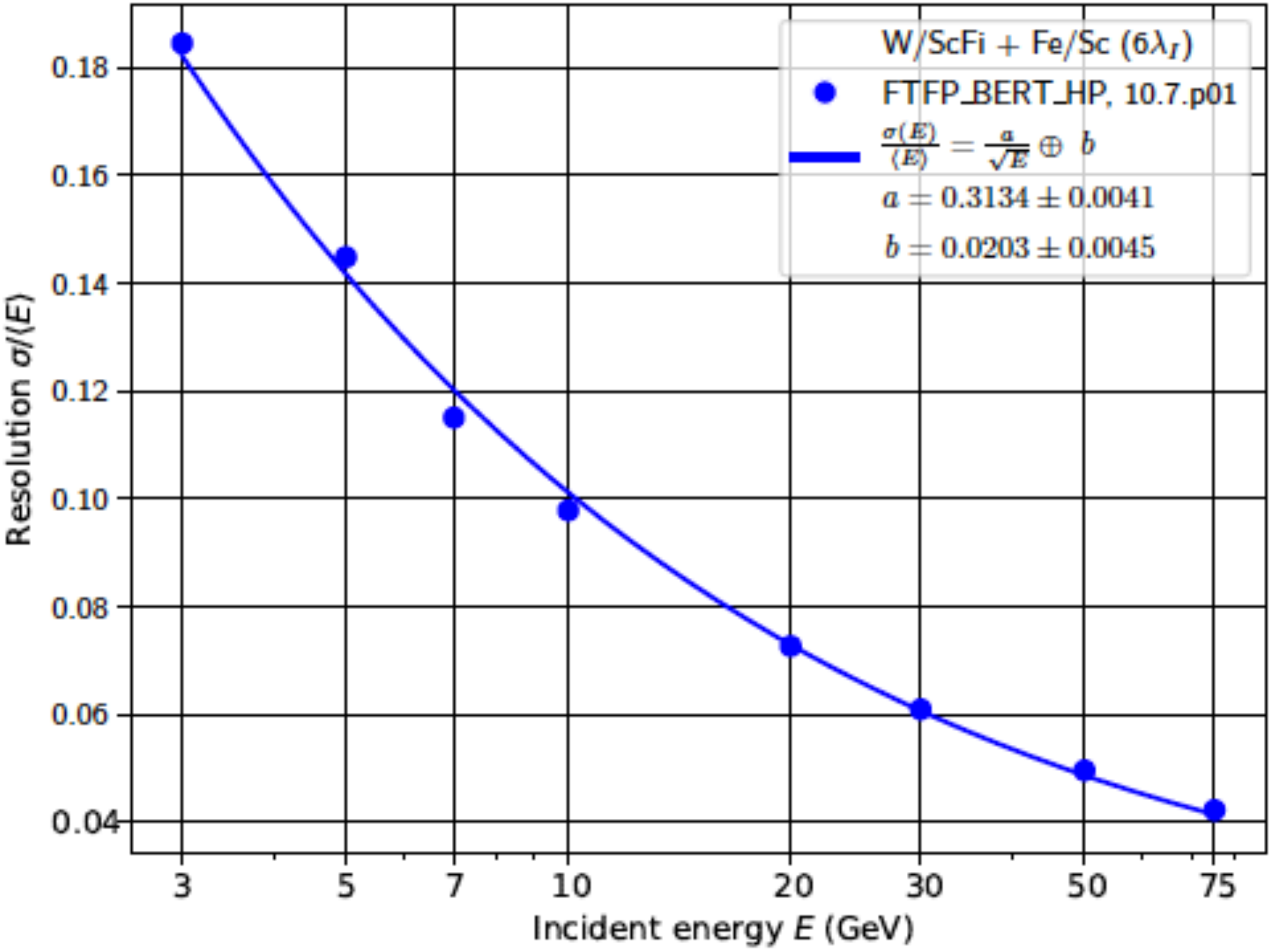
- Very High Resolution. (too good to be true?)
- Technologies developed during EIC generic detector R&D. Well established and spread in the EIC users community.
- Large scale prototype is desired. Cost.
- Approached ECCE to jointly build high resolution Hcal prototype.

(ECCE – ATHENA steering group may be need to talk)





- WScFI EM section of Hadron EndCap.
- Technology pioneered at UCLA.
- Very Compact with good EM resolution.
- Compactness very beneficial for detector integration (endcap to barrel integration)



Expected performance of ATHENA hadron endcap (improved version of STAR FCS)

eECal (Large Consortia, same for ATHENA and ECCE)

1) Lead tungstate crystal inner part (first and probably only choice)

PWO crystals, mature technology. Inner section requires ~1800 crystals including spares,

from 2nd EIC PM meeting: few 100 crystals (2.05 x 2.05 x 20cm) available from JLab/CUA/OU

SiPM readout: R&D ongoing, beam tests with different SiPM readout architecture options at JLab HallD this fall.

2) Glass outer part:

2.1 (reference) **SciGlass (eRD1 calorimeters consortia detector R&D in past few years)** timeline for completing R&D: within one year (eRD1 March 2021 progress report), beam test this fall with new generation of glass samples. Well funded program via EIC detector R&D and second phase of SBIR.

2.2 (alternative) **LeadGlas**

technology exists, from 2nd EIC PM meeting: ~10k PbGl blocks (4x4x40 cm or similar) available at BNL+JLab; few 100 PbGl blocks (5.8x5.8x60cm) available BNL . SiPM readout: same as for PWO, need to scale for 4x4cm^2 glass surface <- R&D needed.

Since we were pre-occupied with the barrel region, both EndCaps have not been discussed in calorimetry regular meetings. This will happen during June. Barrel region still will be the main focus.