fFEX Overview

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14/10/2020

& Uli

Motivation

- fFEX new addition to L0Calo (eFEX, gFEX, jFEX) trigger system
  - EM trigger ($|\eta|>2.5$): interesting for fwd. electrons (e.g. $\sin^2\theta_W$)
  - Jet trigger ($|\eta|>3.2$): interesting e.g. for VBF processes
- Advantage: finer granularity than jFEX (cell level vs. supercell level)

Specifications & Input

- Receiving **full** detector granularity (longitudinal + transversal) in |η|>2.5
  - 0.1 x 0.1 (ηxϕ) EMEC inner wheel, 2 layers
  - 0.2 x 0.2 (ηxϕ) HEC, 4 layers
  - Irregular in FCAL (x-y geometry), 3 layers
- First robust SLW-like EM algorithms studied (Link)

Specifications & Input

EM trigger (|η|>2.5)

- Baseline needs: energy & isolation (em./had.) calculation
  - Calculation of more sophisticated variables conceivable
- Efficient EM trigger needing ‘environment’ below |η|<2.5
  - Potential lower limit at |η|=2.4-2.2 (to be studied in detail)

Jet trigger (|η|>3.2)

- Baseline needs similar: Calculation of appropriate energy criteria
- Precise method to be studied
  - Starting point similar to Phase I, but cells instead of supercells
- Flexibility in jet definition (and jet size) - possible due to "environment" needed for EM trigger

Specifications & Input

- 4 modules planned for fFEX (2 each side)
- For efficient algorithms from |η|=2.5 information in |η|<2.5 needed
- Number of fibres per side needed* (with upstream duplication) for full granularity |η|>2.5 (+ summation to 0.1x0.1 (ηxϕ) for 2.2<|η|<2.5): **246**
- Using jFEX-inspired design with 2 FPGAs (each covering $\pi/2$ and 2.5<|η|<4.9)
  - Assuming constant no. of fibres per $\pi/2$
  - 62 fibres/FPGA (+ no inter-FPGA communication needed)

*courtesy A. Straessner

fFEX input data

Some initial discussions last year (Arno)

- Link speed 25(.65065/.78125 ?) Gbps
- 64/67bit encoding
- Link count : 3 options as of Oct. 16, 2019. Favourite option 2

„2) 0.1 x 0.1 E-Sums for 2.2<eta<2.5 separate per layer in EMEC and HEC; and all cells from eta>2.5: 492 fibres“

- Includes 100% duplication at source
  - Required for mapping sliding window type algorithms to a set of FPGA processors
  - Map a core plus an environment shared with neighbour onto given processor
  - Allows for getting full eta x $\pi/2$ core into a processor (phi quadrant)
  - With an environment of +/- $\pi/4$
  - Each processor covering full eta range per detector side

>> confirm link parameters and define data mapping << see below

fFEX Module

- Minimum eta,phi coverage per FPGA defined by required environment in jet algorithm, and data duplication at source
- Large numbers of high speed links per FPGA
- → large number of opto link devices
- Reasonable partitioning into modules
- **Two FPGAs** per module (phi quadrant each)
- Two modules covering each detector end
- **Four modules** in full fFEX system
- ATCA based

- … let's have a look →

fFEX… looking a bit like L1Topo

But just a bit:

MiniPOD → Firefly

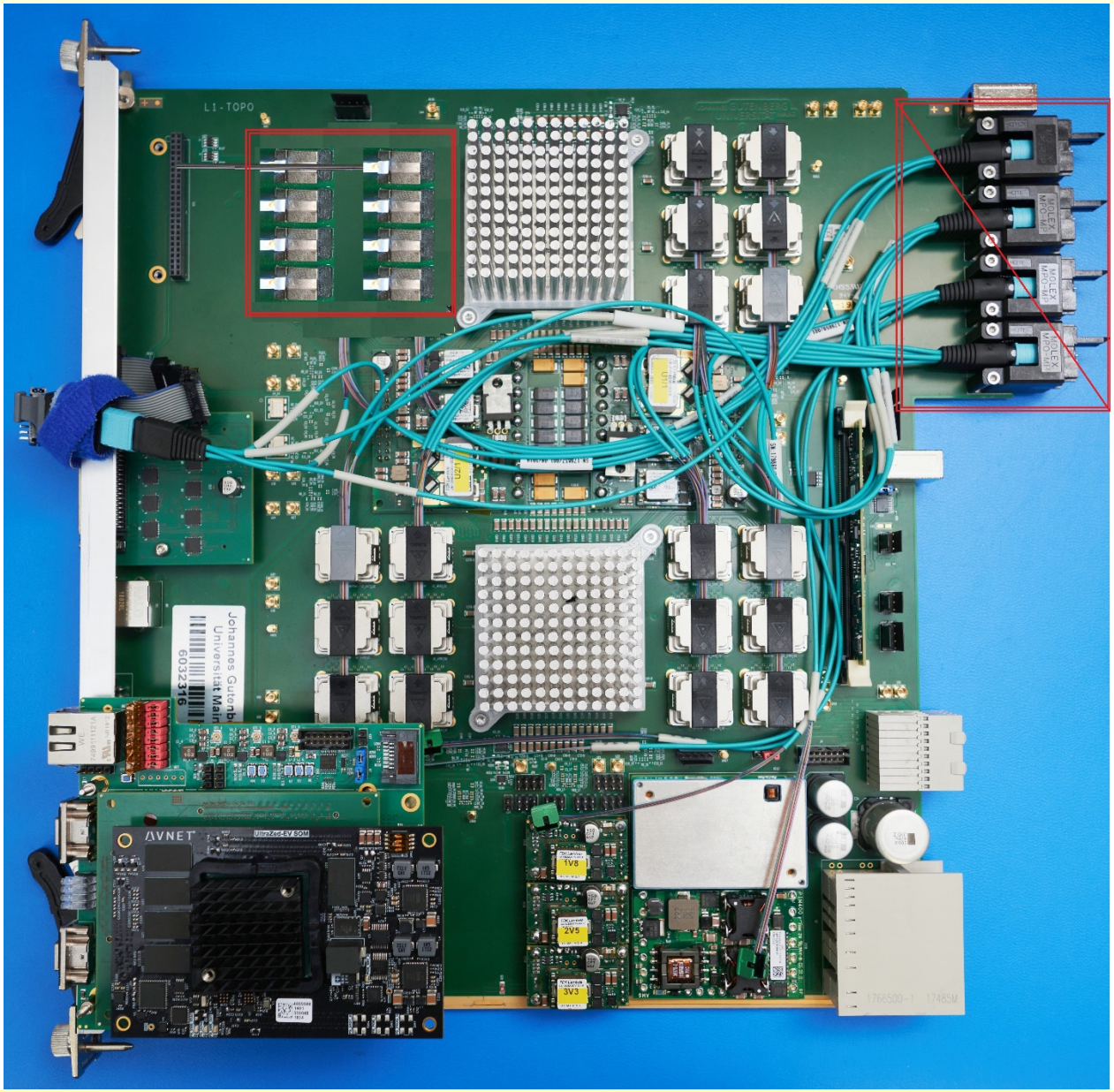
No solution for fibre aggregation from FireFly

→
MTP-CPI → front MTP

R/O, timing → FELIX

Module controller TBD

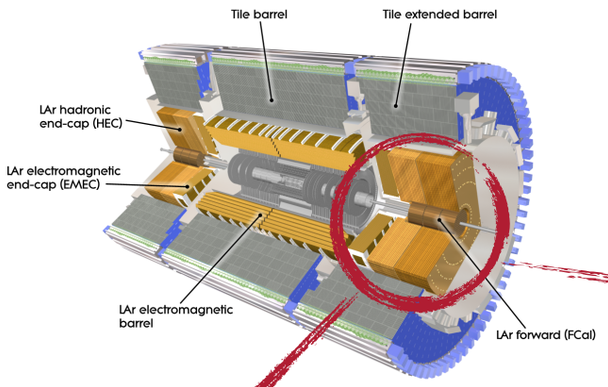
Real-time output TBD



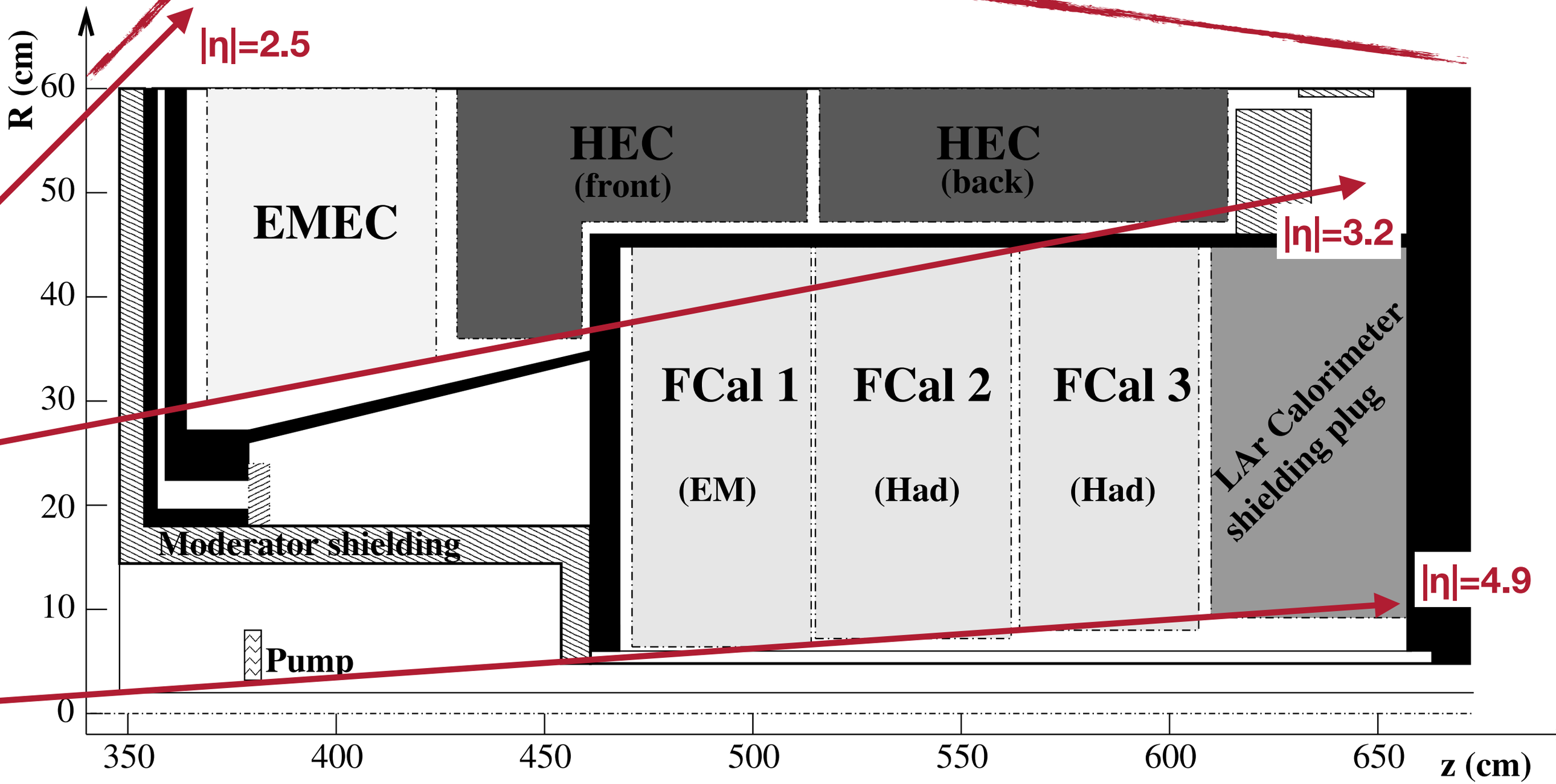
Urgent: Input link specification

- Upstream duplication: each data link sent twice
- Link speed to be confirmed
- Encoding to be confirmed
- (Calo data granularity to be agreed on) →
- Data volume to be confirmed
- Data format to be defined
  - Payload
    - bit count per channel
      - Can we gain from higher resolution?
    - Non? Linear? Encoding
    - Channel count per link
    - Channel mapping
  - Trailer
- Choice of FPGA/MGT type should be transparent: Xilinx, Intel
- Choice of opto link type should be transparent, but should probably be discussed: baseline FireFly

Backup


Tile barrel
Tile extended barrel
LAr hadronic
end-cap (HEC)
LAr electromagnetic
end-cap (EMEC)
LAr electromagnetic
barrel
LAr forward (FCal)

ATLAS


|η|=2.5
|η|=3.2
|η|=4.9
R (cm)
z (cm)
EMEC
HEC
(front)
HEC
(back)
FCal 1
(EM)
FCal 2
(Had)
FCal 3
(Had)
LAr Calorimeter
shielding plug
Moderator shielding
Pump
0
10
20
30
40
50
60
350
400
450
500
550
600
650

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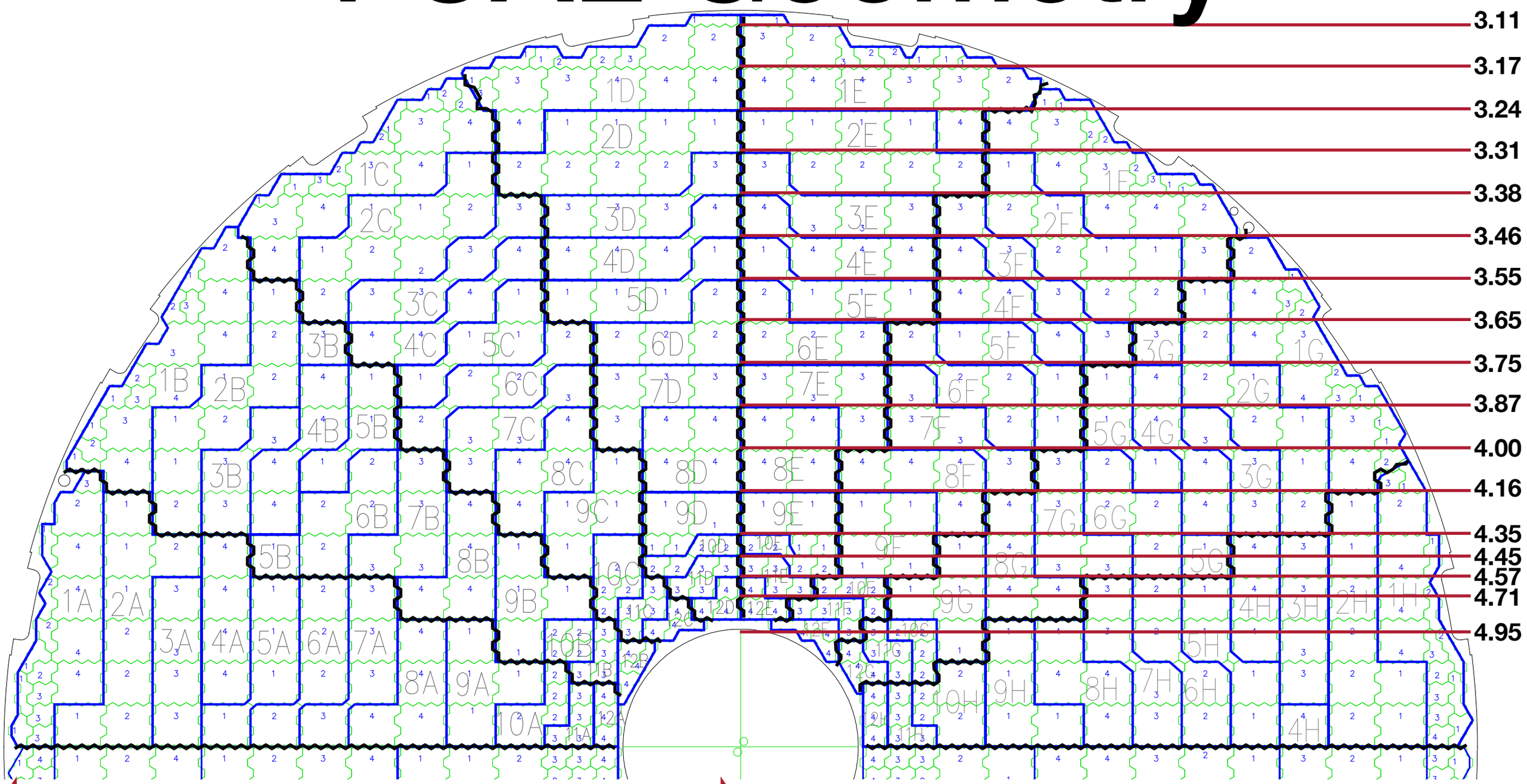
FCAL Geometry



AZ-FCAL-01-05RevB-2013Edit
J. Rutherford, Arizona

One cell: 3.0 cm x 2.6 cm

FCAL1

Geometry

Layer 1 cell centres*
FCAL
EMEC (Inner Wheel)
HEC

***projected onto FCAL1**