

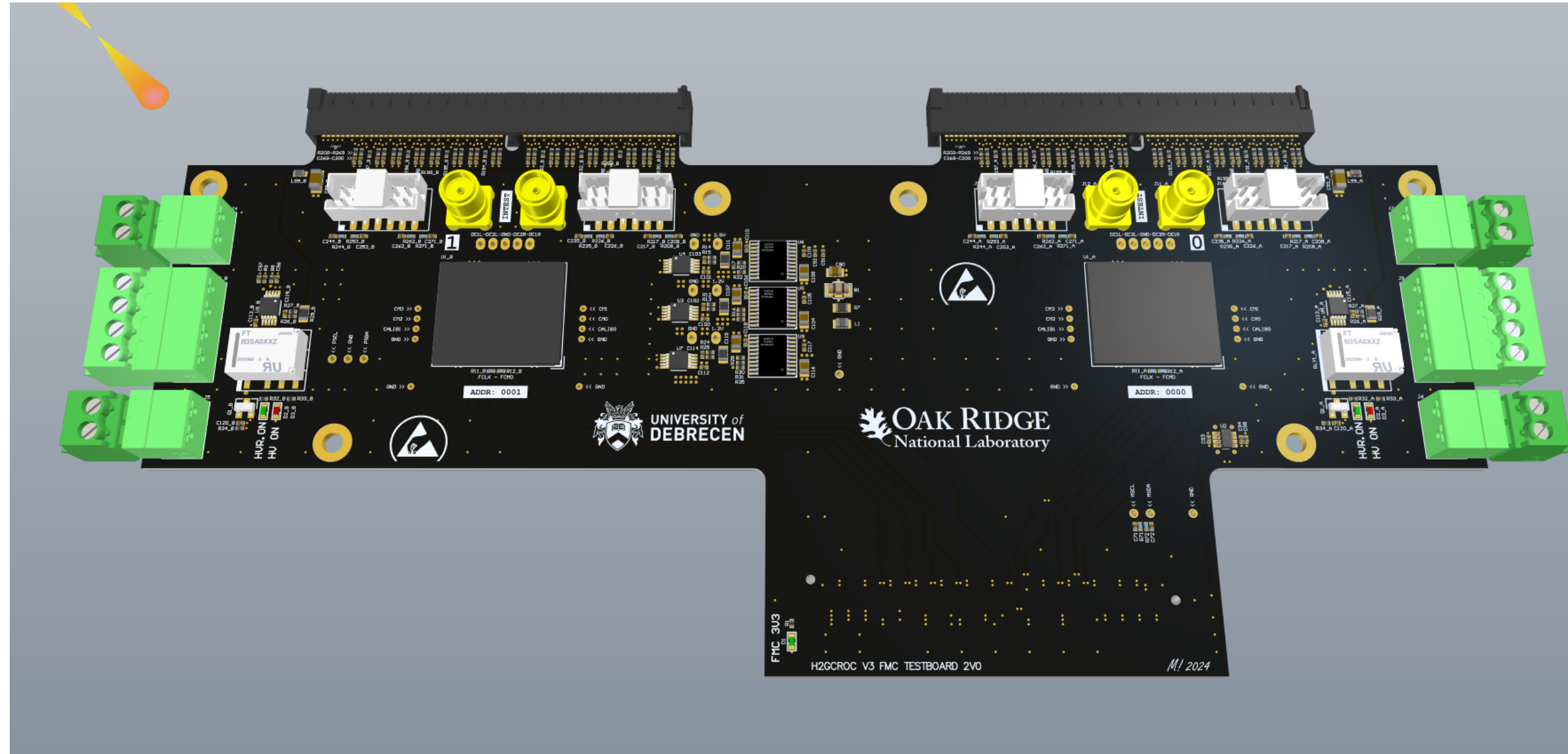
eRD109 – HGCROC/CALOROC

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03/07/2024
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HGCROC usage in different calorimeters

- **Hadron Calorimeters:**
 - **LFHCal:**
 - Main user, >60k channels
 - Larger dynamic range because of the forward region, but also requirement for MIP (e.g. muon)
 - 1.3x1.3 mm² SiPM's and 3x3 mm² SiPM's:
 - Grouping (summing) in groups of 5 and 10 for input signal
 - Insert:
 - 3x3 mm² on tile, single SiPM readout
 - **Barrel HCal:**
 - 3x3 mm² SiPM on tile
 - Cable to the FEB (up to 2-3 m)
 - **Backward HCal:**
 - Work in progress, following LFHCal
- **Electromagnetic Calorimeters:**
 - **Barrel ECal:**
 - 4x4 Array of 3x3 mm² SiPM's
 - Timing will translate to position (100-150 μsec requirement)
 - Small signal requirement for MIP detection

Ongoing work



ProtoBoard2.0:

- Design is ready
- Sent to production, finished time end-of-March:
 - Price is ~1000\$, working on quotes
 - eRD109 money is coming in April, the manufacturer trusted us that we will pay for it

Modification list:

- Simplified communication with the KCU board (cheaper components)
- Extra connector for the 8 channels (72/hgcroc/-64/caen connector/ = 8)
- Two LED pulser with SMA connectors
- Monitoring of low/bias voltages

Should be compatible with Tonko's effort on RDO

SiPM signal summing

Received the 4x4 array from Argonne:

- 3x3 mm² SiPM's, 16 in total
- Modular design to approach the summing systematically:
 - Compatible the CAEN unit (red board)
 - Purple one is only the SiPM array
 - Extra summing board we will add in-between:
 - Try different methods of summing from serial connector to more complicated designs
 - Easily interchangeable:
 - We can readout 16 channels (as on picture)
 - We can add 2, 2x2, 3x3, 4x4 SiPM's gradually

Also important for LFHCaI prototype



HCal progress

LFHCal:

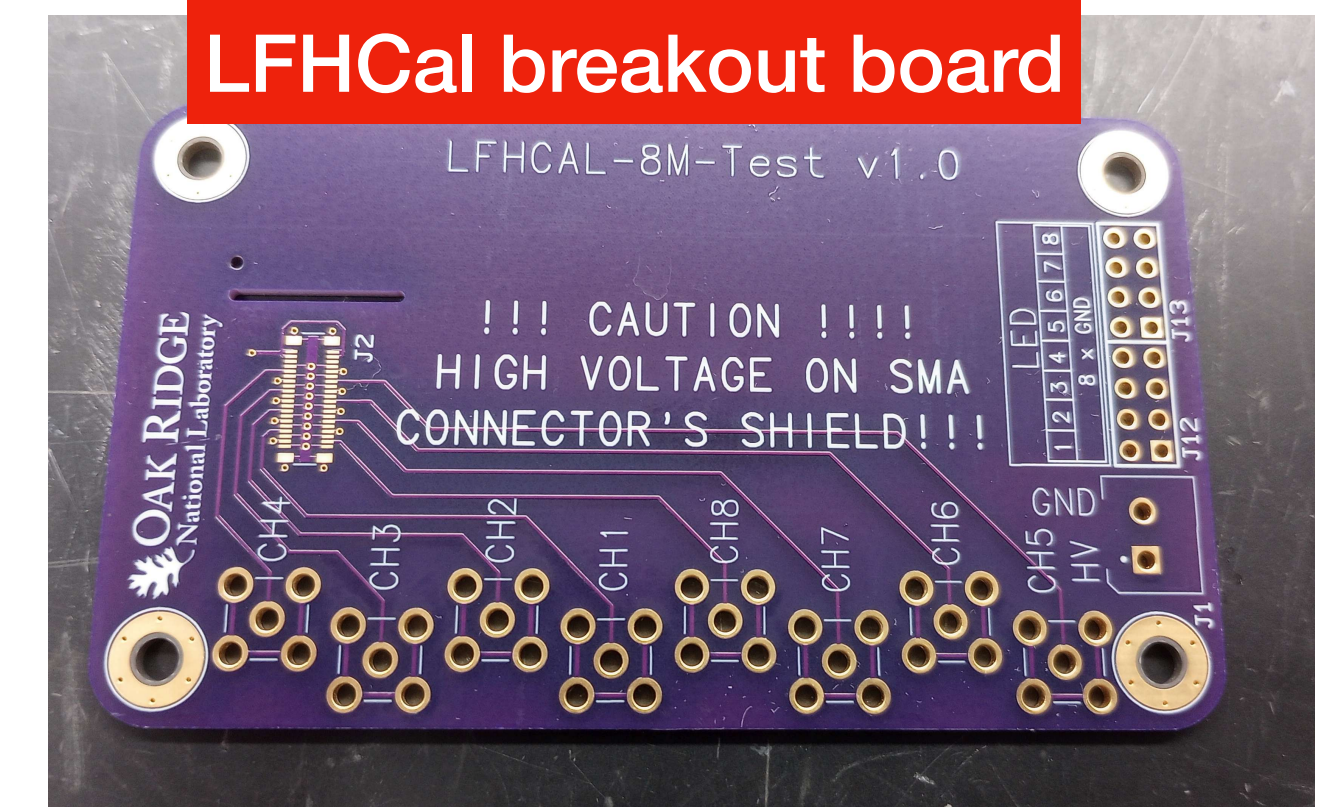
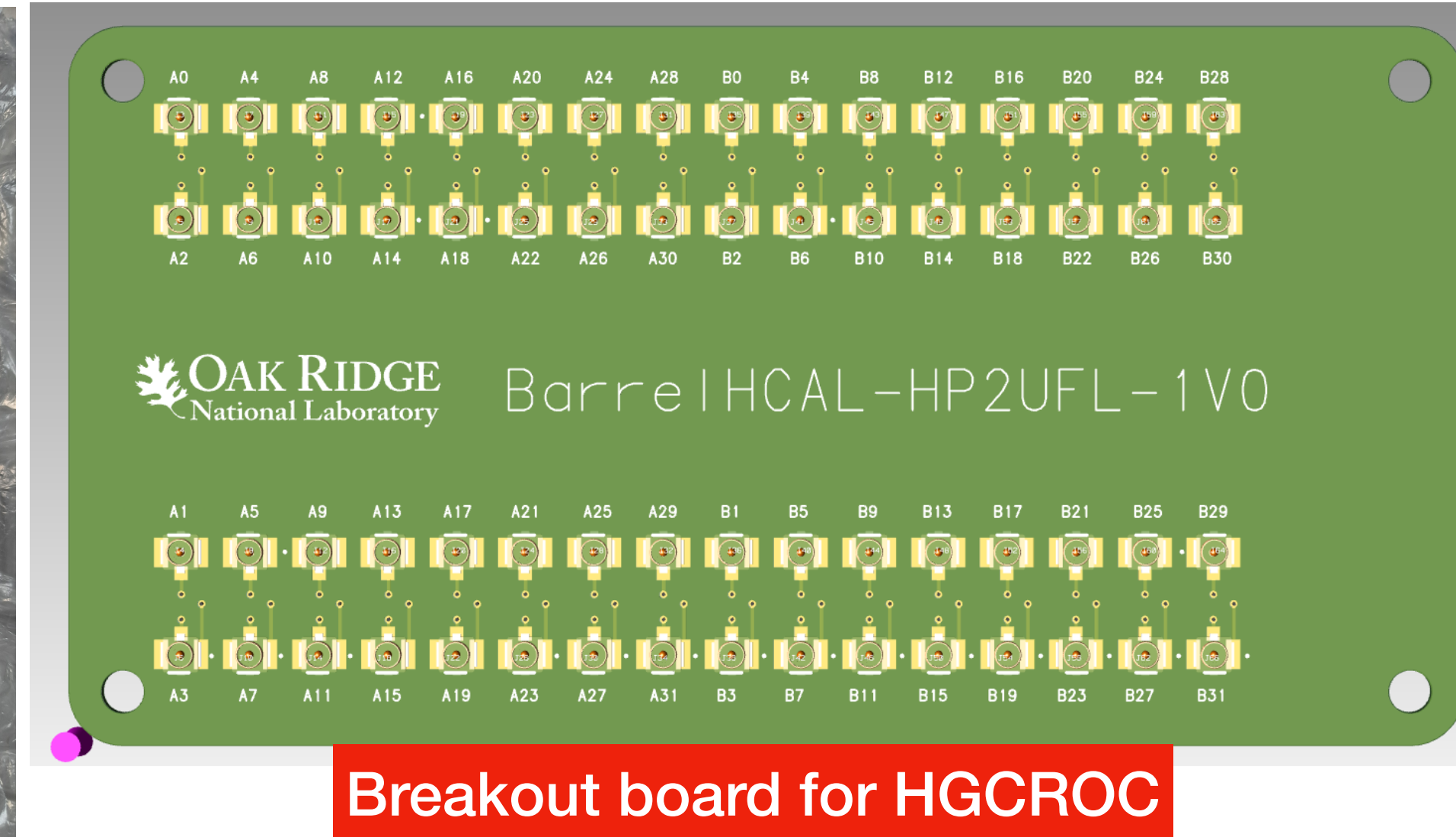
- Testbeam planned in CERN May 15-22:
 - One full 8M module (65 layers, 2x4 array)
 - 520 individual channels for readout

Barrel HCal:

- Received 4 sPHENIX SiPM boards, couple more components which can be made to SiPM boards also
- We also have some tiles from sPHENIX to test on
- Breakout board is already designed and sent to production

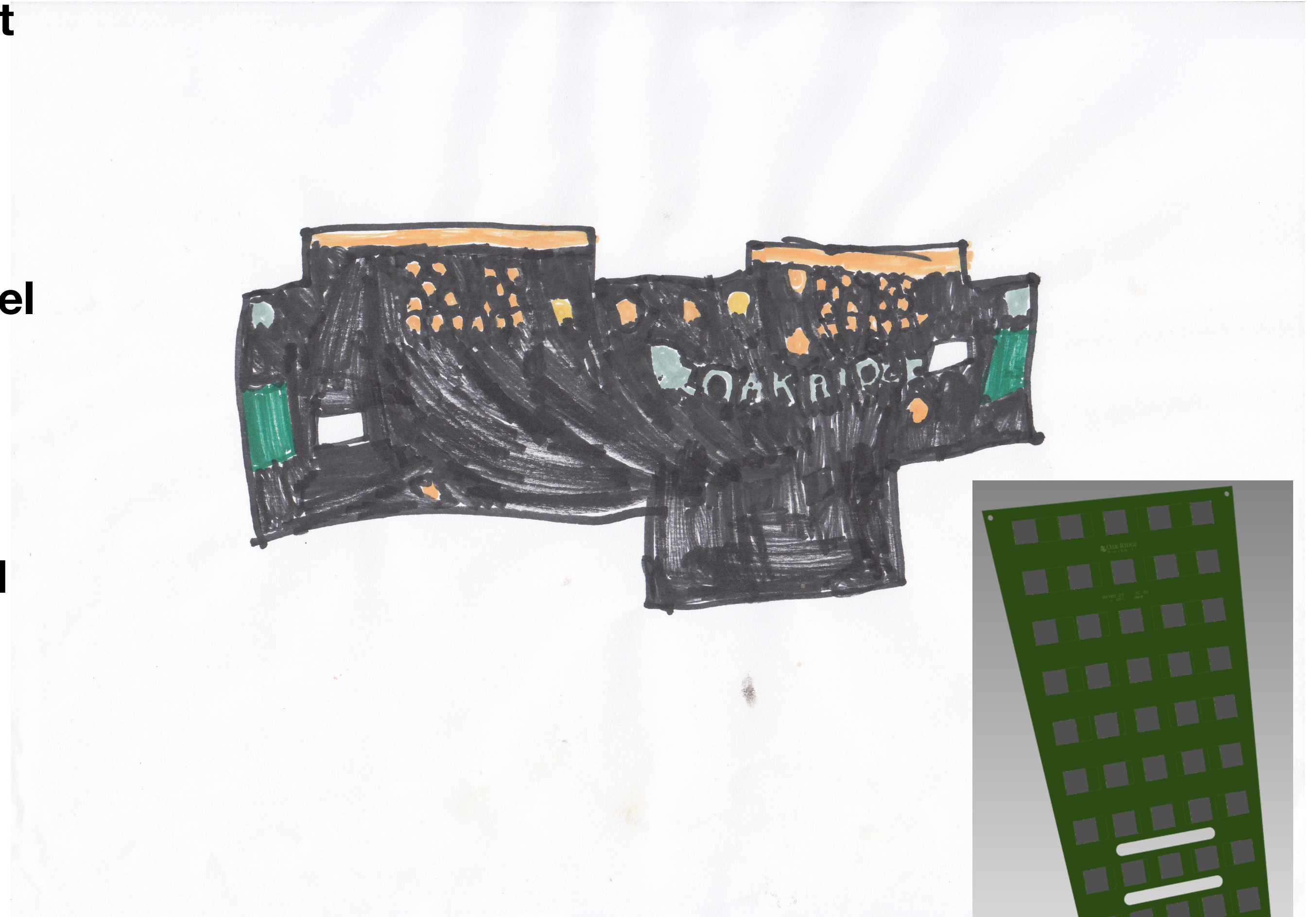
Backward HCal:

- Very similar path as the LFHCal, no summing is expected



Summary

- **Work ongoing with focus on the CERN PS test beam with LFHCal**
- **Preparing the summing scheme with the Barrel ECal SiPM array - first step is done**
- **Progress in designing the FEB for LFHCal and BarrelECal, BarrelHCal**
- **Also close communication with the Omega team about the CALOROC design and schedule**



eRD109 – Barrel TOF Kapton Flex R&D Update

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03/07/2024

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Barrel TOF Flex PCB

- Connect 64 ASICs (+X) along stave to RDO at end of stave
 - Low voltage, bias (HV), ground
 - Differential e-links, **clocks**, slowcontrol/I²C?
 - Individual ASIC output data rate is only ~Mbit/s (based on Tonko's initial estimates)
- Low mass: 1% X/X₀ total barrel material budget
- Needs to fit barrel TOF geometry
 - ~1.3m length
- Kapton flex PCB:
 - Custom geometry "sandwich" of thin kapton and conductor layers
 - Used in other tracking detectors already

PID-TOF	3M-50M	240-500	6Gb/sec	12	EICROC / AC-LGAD	Channel / Fiber counts depend on sensor geometry. Considering pitches of: .5mm x 1cm, .5mm x .3cm, .5mm x .5mm
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Towards a TOF Barrel Flex Prototype for the TDR

- TDR should be 70-90% design maturity.
 - We won't have a 70-90% mature ASIC.
 - The ASIC (largely) defines the actual requirements of the flex: number of conductors, e-link speed, power requirements...
- All we can really do is demonstrate we master the technology to 70-90% design maturity
 - Reading out a similar ASIC over a “long” flex with a prototype TOF RDO would be reasonable
- Plan made in Argonne: will demonstrate readout of ETROC (CMS endcap TOF ASIC) over “long” flex with TOF prototype RDO board

Update

- Found capable engineering support at Debrecen
- In the meantime: produced flex PCBs test boards with different vendors
 - Evaluated LV, HV characteristics
 - LFHCAL flex boards in production in three different processes, including super thin state of the art layup, will evaluate yield and impedance
- Looking into low profile high density e-link connectors
 - Unsolved: high density connector that includes HV bias capability... Likely requires second connector or even separate distribution

