dRICH space and requirements for readout and services

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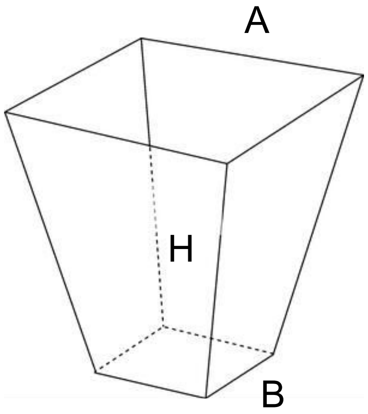
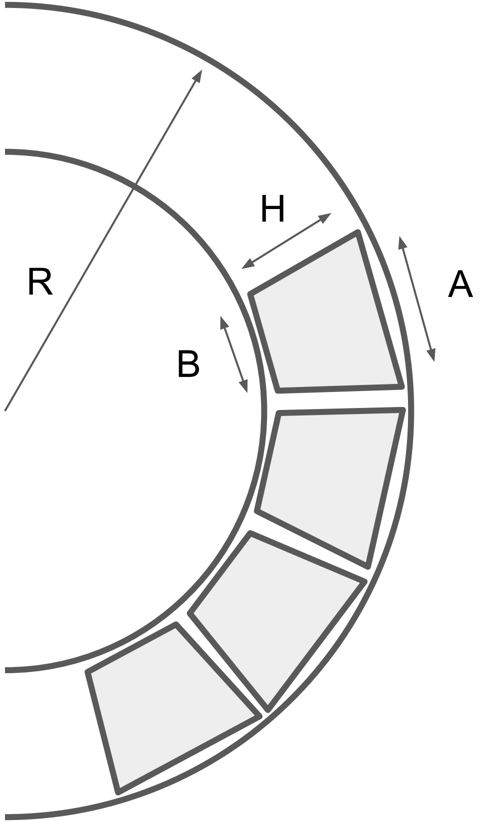
an approximately spherical surface can be achieved with single readout unit modules appropriately tilted one wrt. another



“envelope” of the readout unit module
256 SiPM channels
with cooling and FEBs
(perhaps also RDOs can fit)



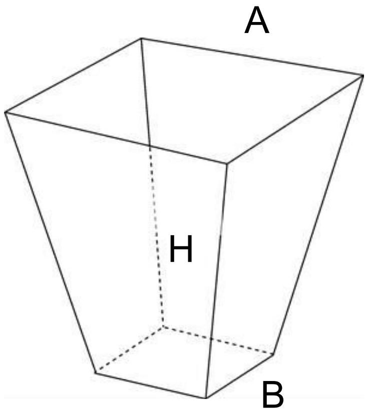
R = 100 cm
radius of sphere for sensor placement

A = 52 mm
width of the sensor surface

H = 15 cm
height of the readout unit

B = 44 mm
width of the bottom of readout unit

an approximately spherical surface can be achieved with single readout unit modules appropriately tilted one wrt. another



"envelope" of the readout unit module 256 SiPM channels with cooling and FEBs
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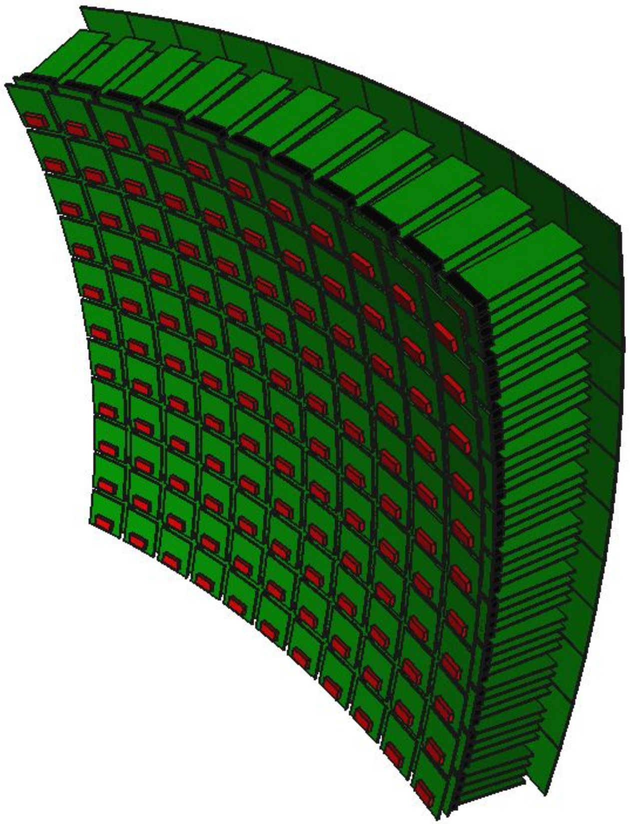
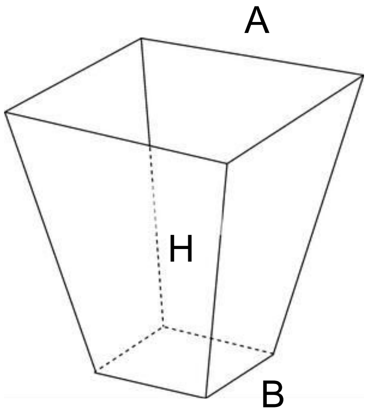


an approximately spherical surface can be achieved with single readout unit modules appropriately tilted one wrt. another



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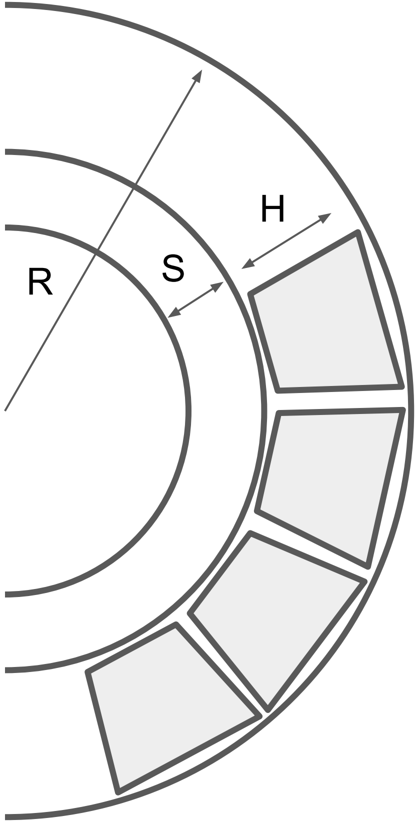


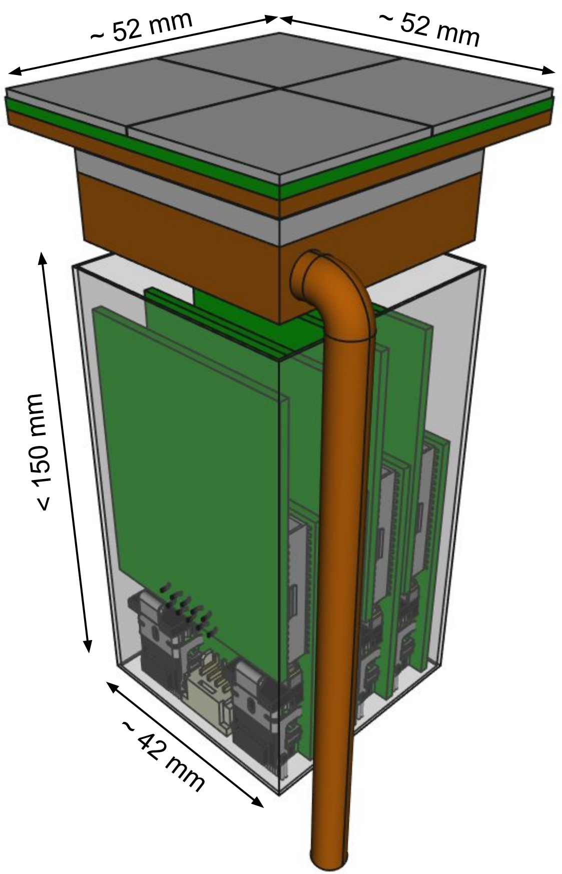
R = 100 cm
radius of sphere for sensor placement

H = 15 cm
height of the readout unit

S = 5 cm
clearance for services

- distribution of LV for FEB/RDO
- distribution of HV to SiPM
- cooling

dRICH SiPM optical readout unit (prototype)



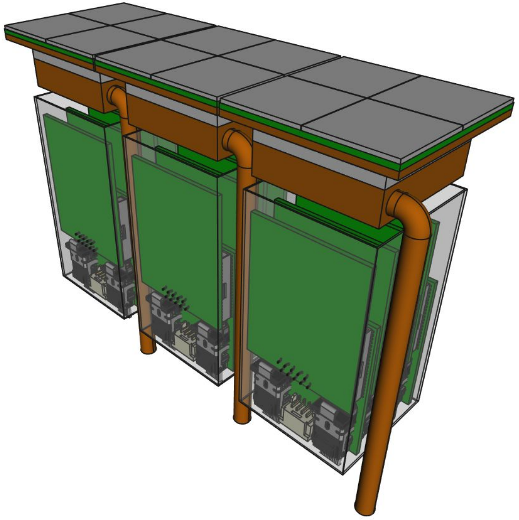
initial design concept

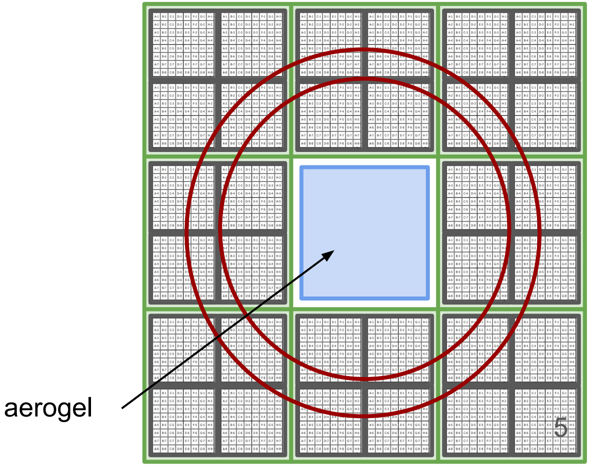
concept developed for the dRICH prototype

electronics engineers working on implementation of the electronics

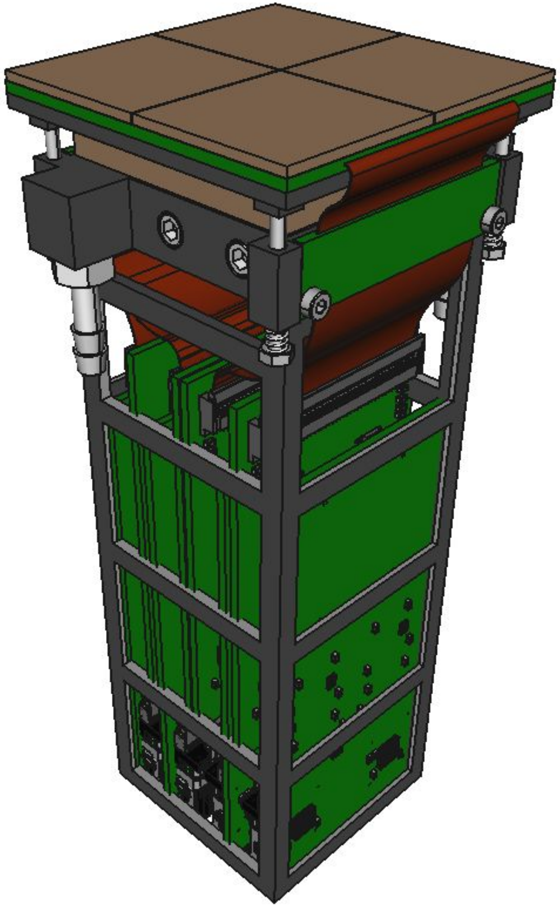
mechanical design will progress with the help of mechanical engineers

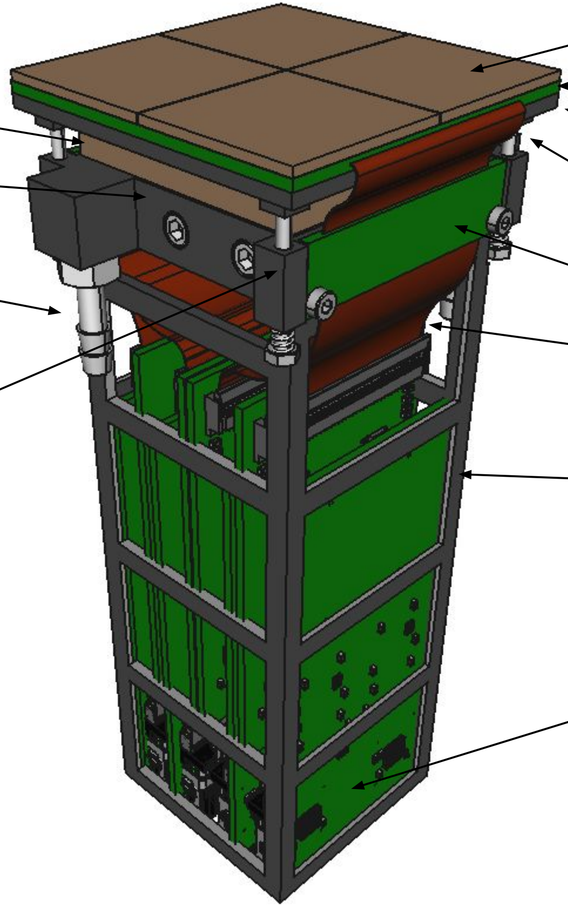
arrangement in beam test 2023





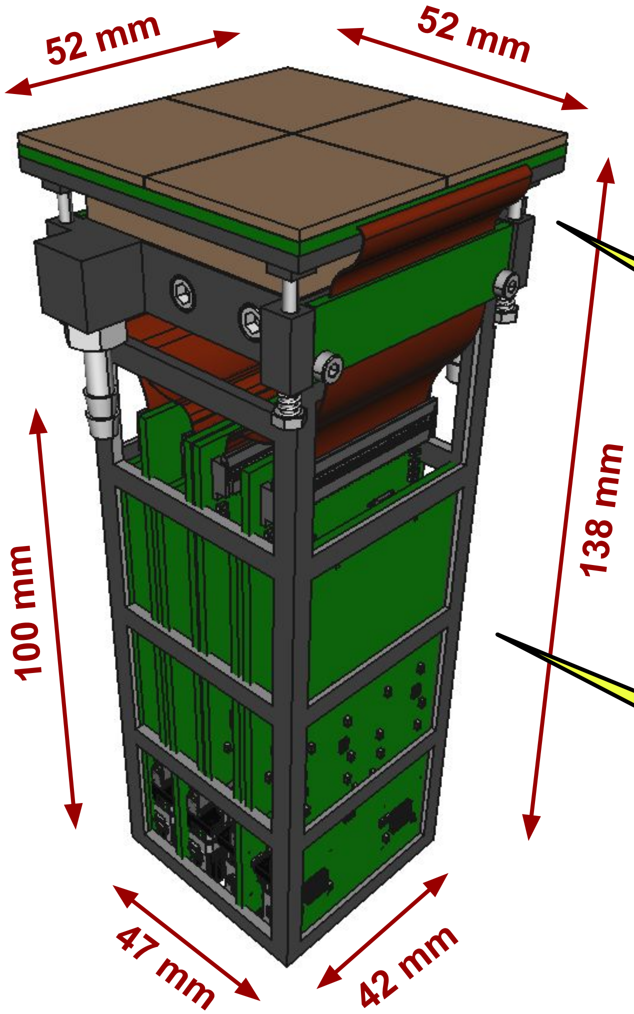
current status





CAD design being inspected / improved by engineers in BO

advanced design concept



includes 7 mm of Peltier modules
likely not for the future

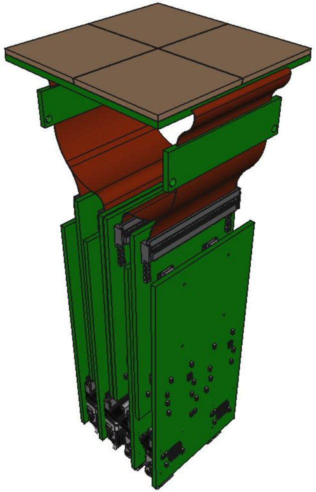
4x proto-FEBs made of 2 mated boards
unite them in a single board might save something more

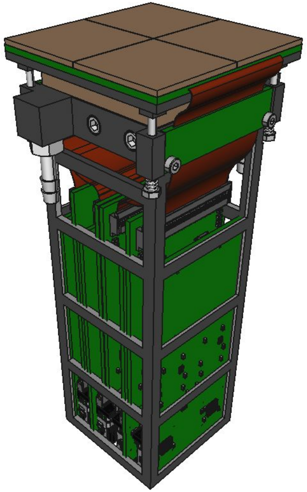
dimensions might slightly change

outstanding job to keep electronics within very small envelope

advanced design concept

ideas for the mechanical support of the dRICH prototype SiPM-based optical readout





Additional DAQ considerations

with impacts on space and other issues relevant for GDI

- A full presentation given recently at DAQ WG last 16 March (see link: 20230216-DAQ.pdf)

- Throughput estimates adjusted (with respect to ATHENA estimates) assuming different scenarios + more updated information (beam cycle gap, DCR, ecc.)

- We assume conservatively 500 kHz sensor max now (damage at 10^9 neq without annealing and V_{over}=4 V)
- We assume we can implement in ALCOR a shutter at 1 ns (timing reduction factor = 10, instead of 3) → ALCOR v3 [eRD109]
- We take into account 8% reduction due to machine cycle / bunch gap (1.015 us/12.789 us)
- We now know (not a surprise) we need TOT → 1 hit = 64 bit

Scenario	DCR rate	RDO	Fibers	DAM	DAQ link throughput	Total trhoughput	Notes
A	270	310	310	14	5.8 Gbps	1830 Gbps	timing reduction factor = 3
B	500	310	310	14	2.94 Gbps	935 Gbps	Timing reduction factor – 10 / machine cycle accounted

Optimizaton under way on FEB/RDO scheme can have impact on

a) Bandwidth used per RDO link → Number of DAM → costs

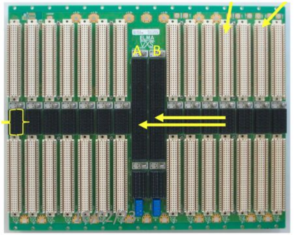
b) Request of additional space close to the detector and/or in racks in experimental hall

Scenario	DCR rate	RDO	Fibers	DAM	Link/ DAM	DAQ link throughput	Total trhoughput	Notes
A	270	310	310	14	24	5.8 Gbps	1830 Gbps	timing reduction factor = 3
B	500	310	310	14	24	2.94 Gbps	935 Gbps	Timing reduction factor – 10 / machine cycle accounted
C	500	1240	1240	56	24	0.75 Gbps	935 Gbps	**Costs up:** more fibers, more PCB, more FPGA, more DAM
D	500	1240	1240	28	48	0.75 Gbps	935 Gbps	Assuming FELIX2 can reach 48 links per DAM

However the costs of DAM can be curbed, **if it is confirmed FELIX2 has 48 links** (scenario D)

Observation: the foreseen bandwidth of the DAQ link (RDO-DAM) in C and D would be seriously unused (14 Gbps available)

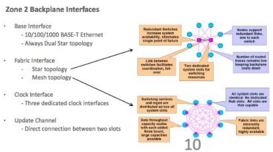
At this point we could decide to curb the cost of DAM making a **private dRICH-DAM system**, à la JLab concentrating data first in a crate using mesh topology (µTCA or VXS), moving then data to DAM. There are also potentially COTS options



David @DAQ group 2 Feb

CAEN FERS concentrator DT5215
https://www.caen.it/products/dt5215/

µTCA®



Scenarios and GDI…

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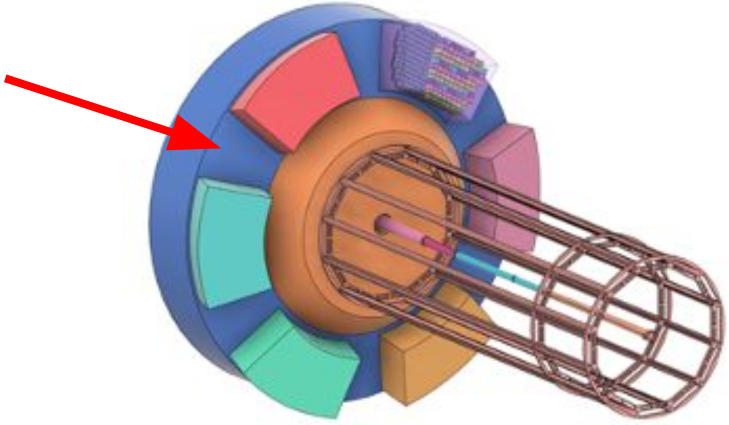
D	500	1240	1240	28	48	0.75 Gbps	935 Gbps	Assuming FELIX2 can reach 48 links per DAM
E	500	1240	1240 → 62	2	48	75 Mbps	4.65 Gbps	**Costs up**: minicrates, cards, fibers, FPGA… **Costs down:** from 28 to 2 FELIX2 **Throughput down**
F	500	1240	1240	28	48	3.75 Mbps	4.65 Gbps	**Requires an interaction tagger** Internal buffers implemented at ALCORv3 level or at RDO level

C, D, F: much more fibers in/out detector, less space in the front-end
E requires use of crates in the racks in the Hall (it saves 690 K$ in DAM but cost to be quantifed)
F: data reduction via an interaction tagger would be very effective (mentioned also by DPAP and ECCE/ATHENA proposal). Self solution and/or via LGAD TOF?
G see next slide

- Given the very small bandwidth of the RDO link we might think about a private DAM-dRICH system much cheaper than scenario E and closer to the detector, but still reducing by a factor 10 the number of DAM/FELIX2 cards (note that with a interaction tagger scenario each sector would have a modest throughput: 48 links == 1 DAM would be certainly enough).

Space between sectors in current design is “free”

We could have a scenario F+ saving money for
DAM and crates in the racks



Conclusions/message (DAQ - side)

- Optimization of space (FEB+RDO) is not “neutral” with respect to costs and “other” spaces (including occupied by cables/fibres

- Coordination at GDI level is needed to think seriously about an interaction tagger, even involving other sub-detectors. Steps?

BE AWARE: optimization and design are under way. This is a non linear process and we don’t have solutions and numbers for the moment!