R&D on Calorimeter readouts

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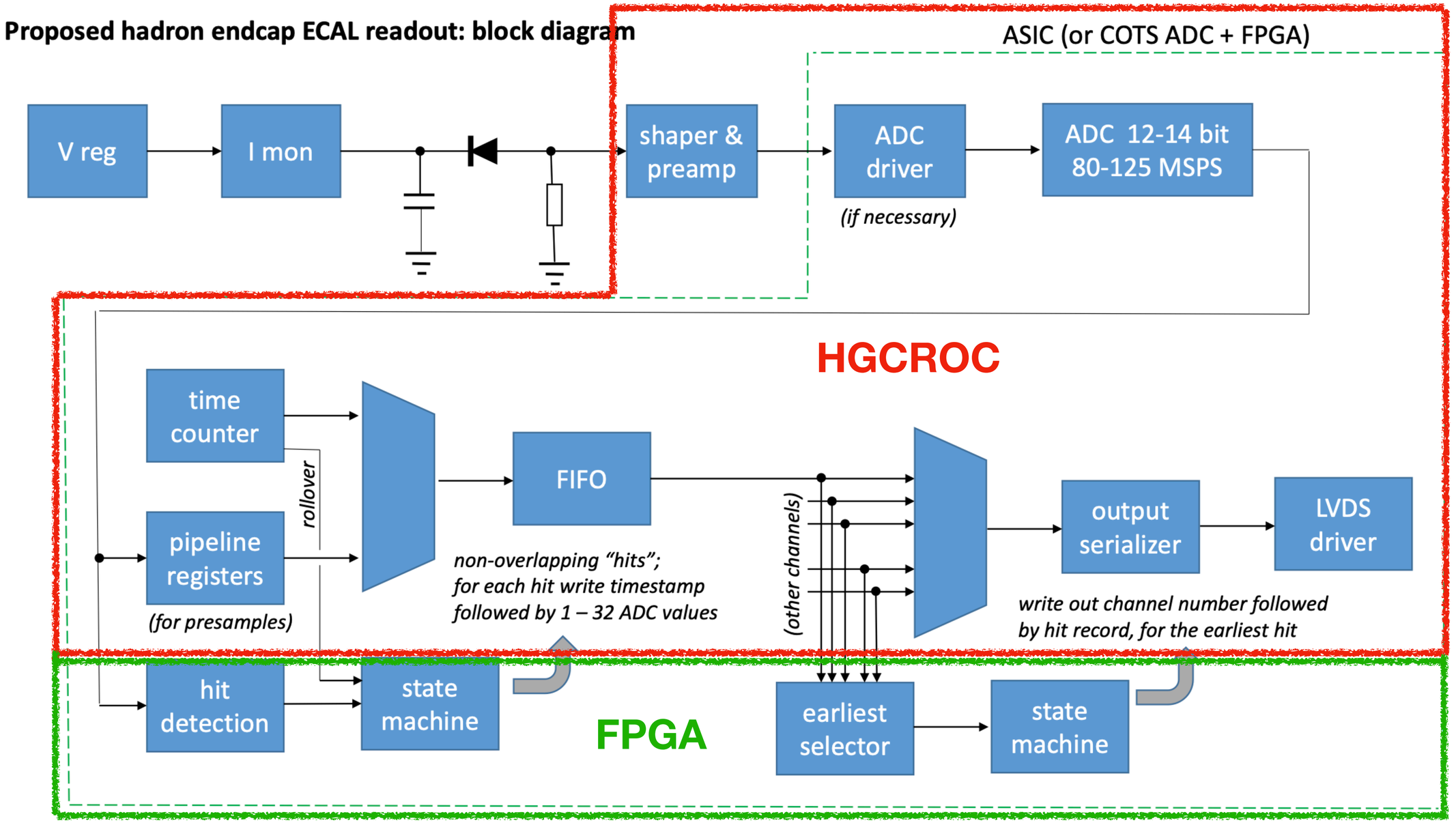
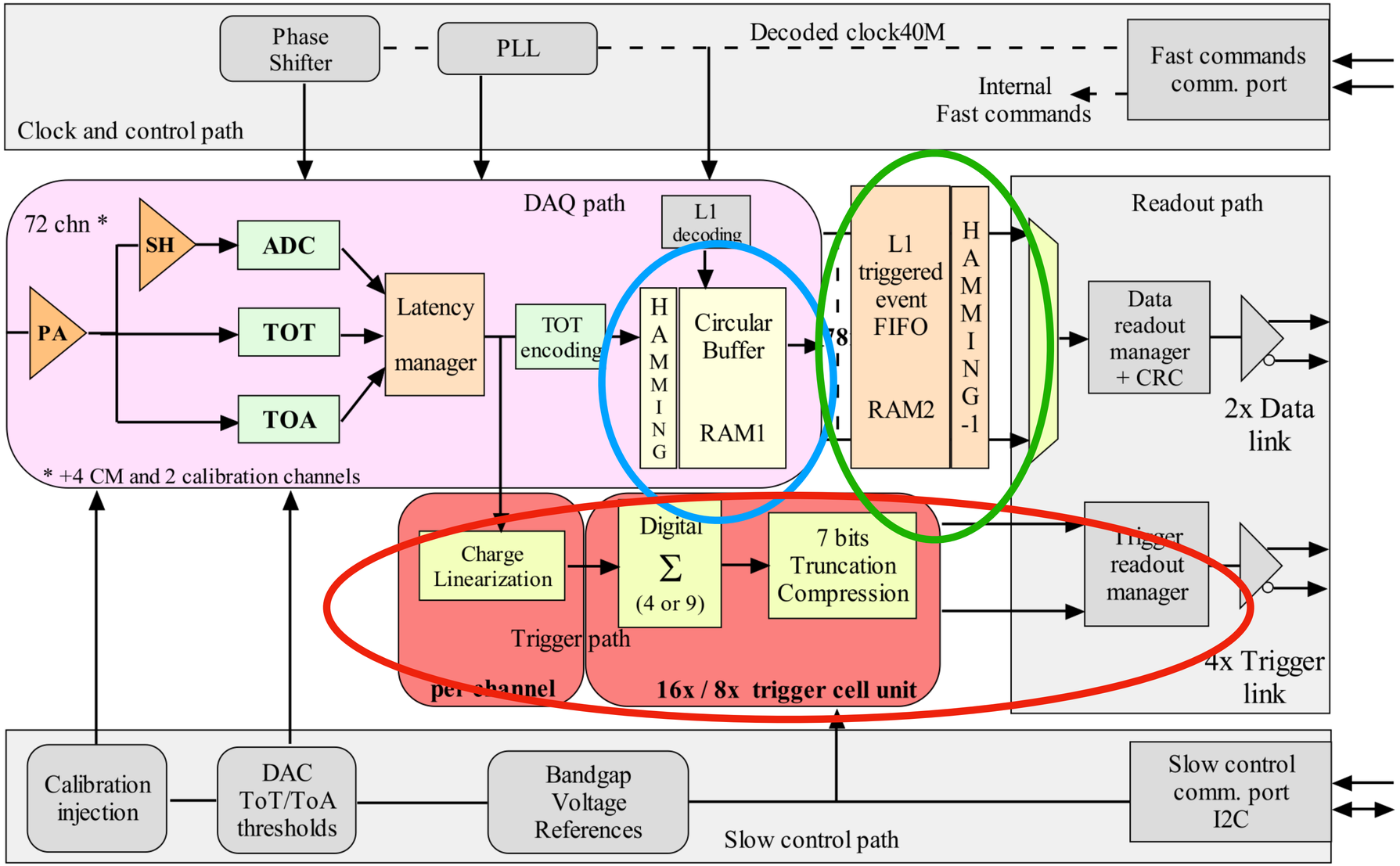
Calorimetry readout block diagram



HGCROC overview



Trigger data:
- 4 or 9 channels are summed up
- Sent as a 64-bit word out on 4 trigger links

RAM1:
- Circular buffer of 512 samples
- 512 x 25 ns = 12.5 µs total
- L1 needed to shift to the RAM2
  - We can shift 3-4 samples

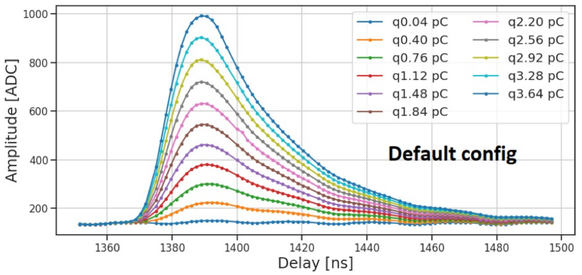
RAM2:
- Circular buffer of 32 samples
- Space for 8-10 events
- Max readout speed 960 kHz

Expected hit rate is 50kHz in forward region, with 4 samples it would be 200 kHz readout speed (1/4 of the capability)

Signal shape

Received the sample of the HGCROCv3

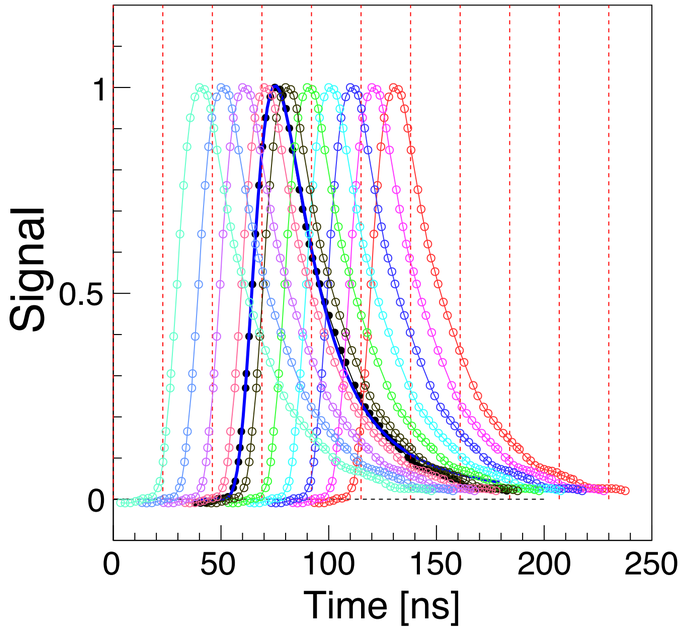
- Testboard
- 4 Chips



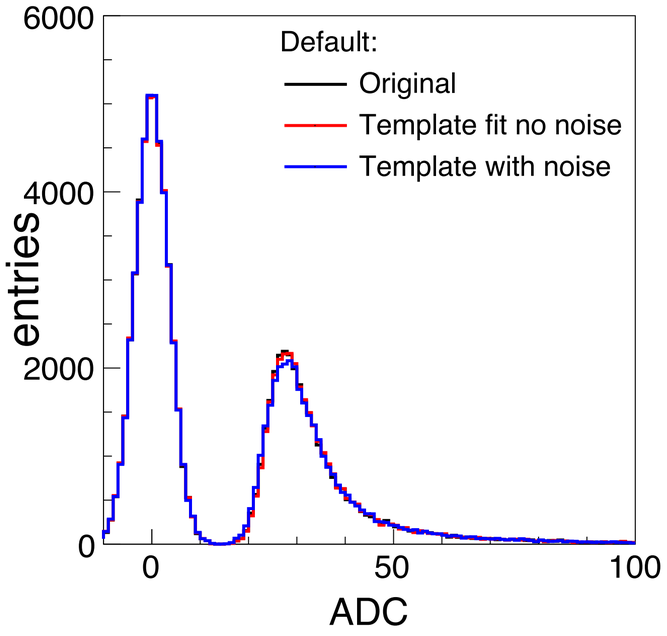
Collisions can happen every 10 ns:

- HGCROC samples at 40 MHz clock speed (25ns)
- Realistic noise added

Strategy is to collect 3-4 samples of the default shape

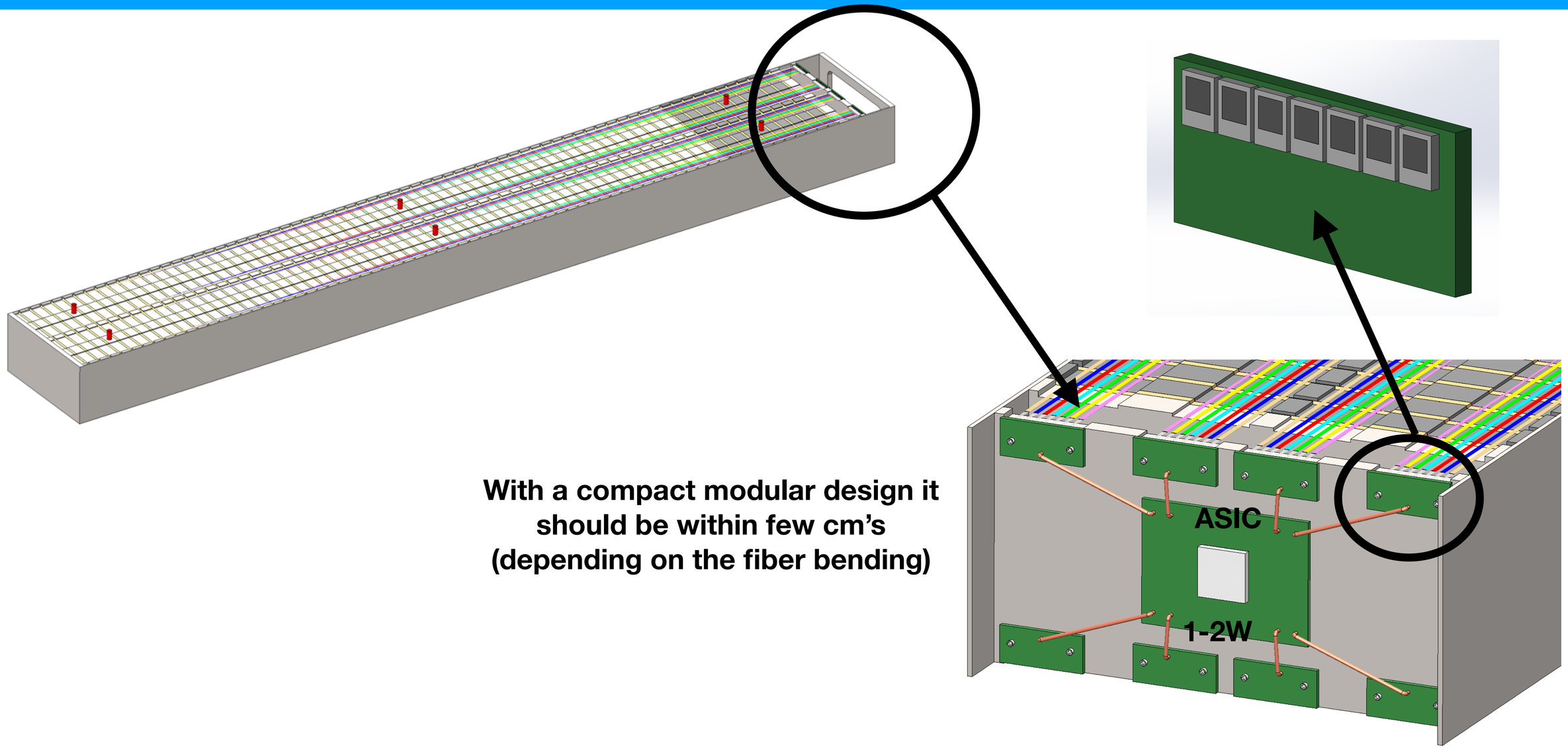


3 Samples could sufficiently reconstruct the MIP peak



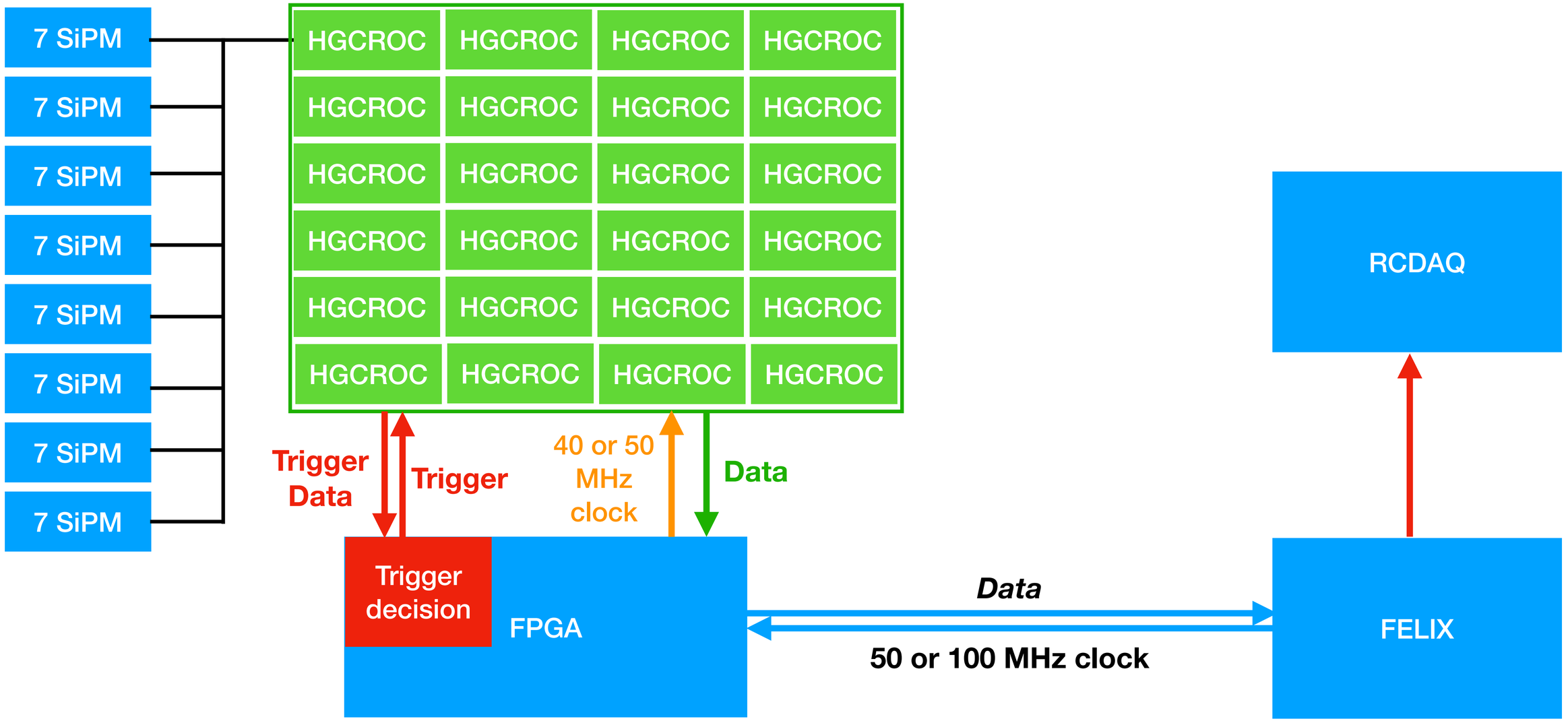
We will further investigate large signals

Readout of the LFHCal



With a compact modular design it should be within few cm's (depending on the fiber bending)

Proposed hierarchy

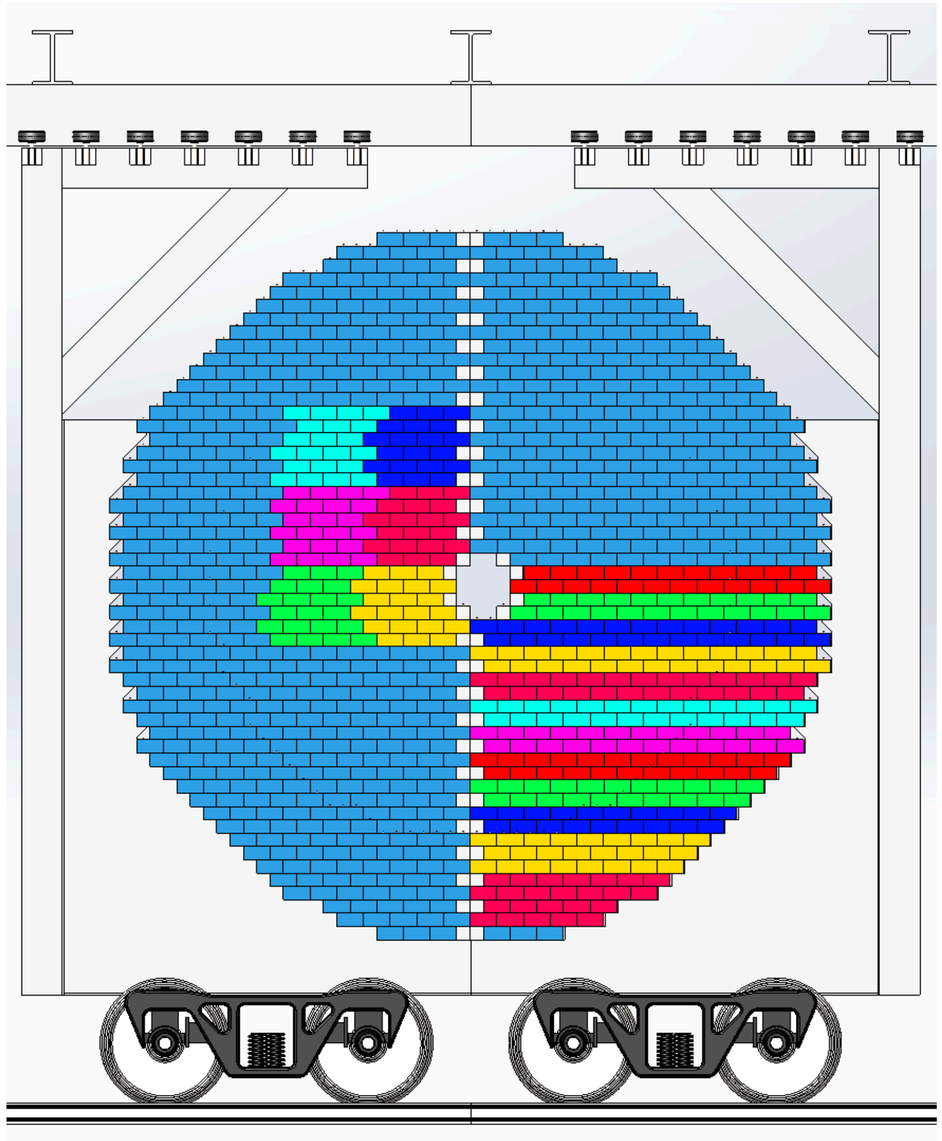


Possible placements of the FPGA board

Option A:

1 meter away from the beam pipe

Spider web design towards the FPGA



Option B:

On the side of the calorimeters

Snake design of the cables

Summary

ADC solution	ASIC solution
Streaming	(Virtual) Streaming
60 mW/ch (ADC) + FPGA	4-20 mW/ch
6-10$/ch (ADC)	1-2$/ch (Hgc), 40$/ch (PacC)
1000 small FPGA	~80 FPGA
Is it RadHard? 15 year?	RadHard, PacChip?
What cables are needed?	What cables are needed?

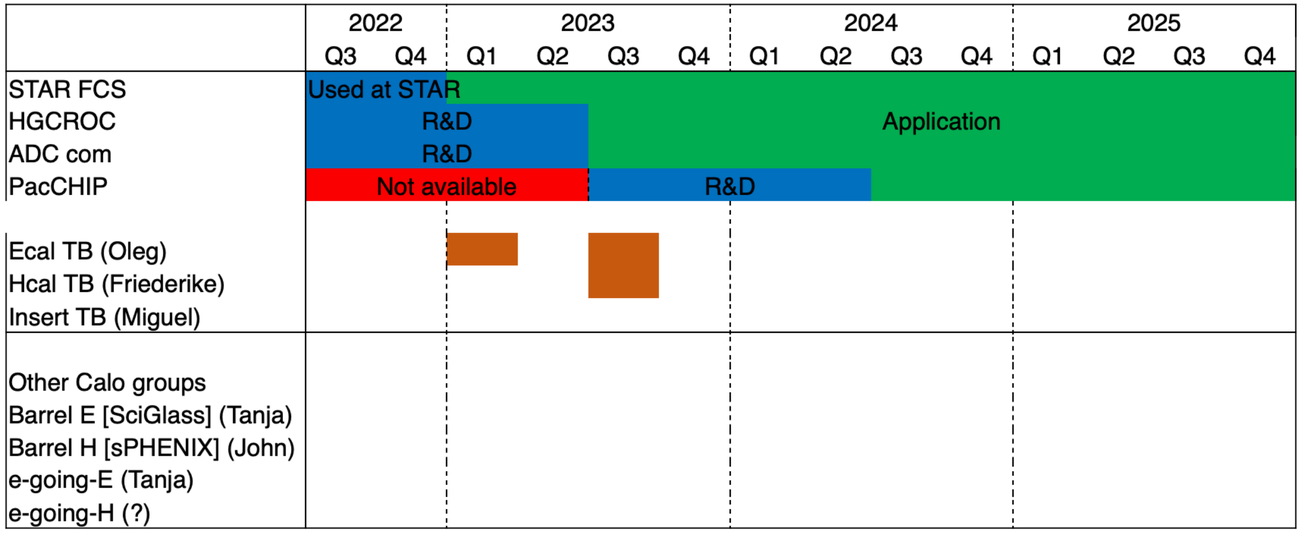
We probably need two parallel R&D developments in the RD109:

- ADC + FPGA on a small board on detector:
  - Cooling
  - RadHard
- HGCROC + FPGA:
  - 40 MHz clock
  - Shaper setup if needed
- PacChip:
  - Availability
  - Modifications, additions

We further investigate other ASIC possibilities, VMM, from Panda, etc.

Possibility to have also outside readout card solution for calorimeters

We will collect the needs and wishes for other calorimeters readouts also



https://docs.google.com/spreadsheets/d/18Cl2xWAC8HqhZmD1MT8JZWSVGm_WZQN2PT92f5KjNaE/edit#gid=2090491516