

G. Iles et al. - Imperial College

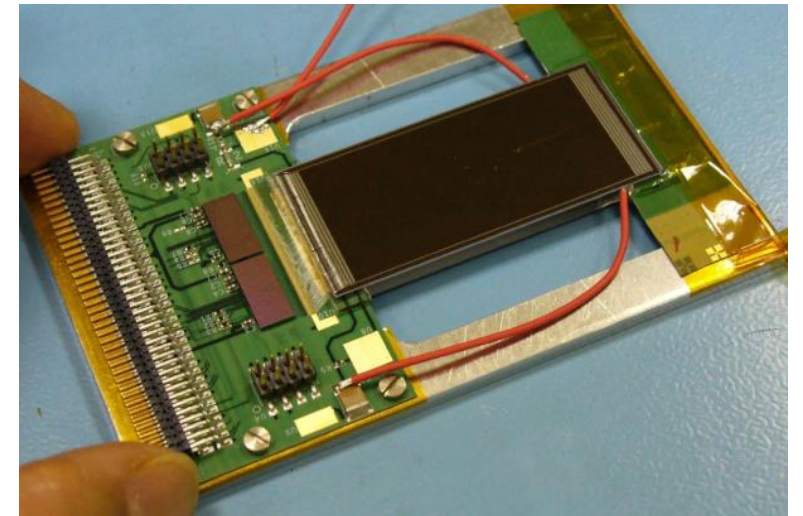
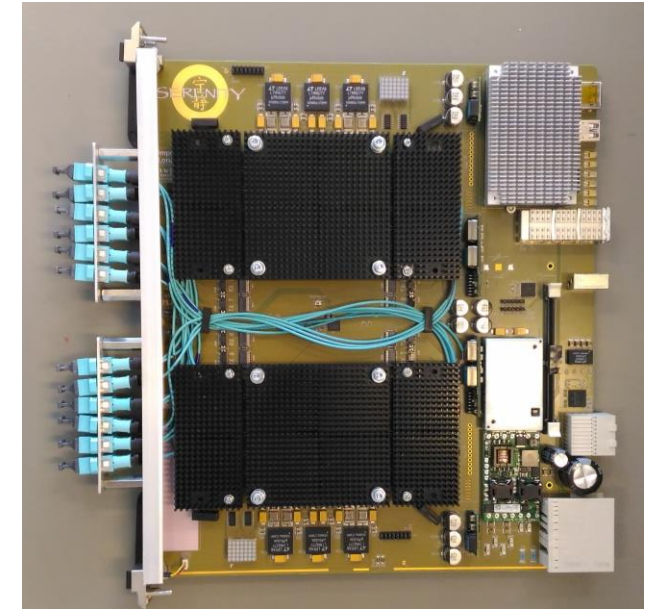
CMS Phase-2 Upgrade

- Back-End Electronics – FPGAs & Optics
 - Tracker, Trigger & ECAL & HGCal
 - Serenity Collaboration created to support activity across sub-detectors and across many institutes, including non-UK
- Tracker silicon sensor readout ASIC
 - CBC – Just started production

Dune

- HPgTPC and far detector firmware

Areas of R&D that I'm connected with



Key technical challenges for the UK in these R&D areas?

Availability of high-speed, multi-channel, low latency optics

- Commercial applications can tolerate high latency Forward Error Correction
- Fast moving field
- Practical knowledge of evolving standards and how they might be adapted
 - Likely to require good industrial links

Experienced firmware/software engineers are a scarce resource

- Not all tasks are suitable for High Level Synthesis
- Complex low-level stuff and dataflow "plumbing" best handled in HDL

Organisational & logistical barriers?

Lack of communication between engineers, which COVID has exacerbated.

- Only meet many UK colleagues at yearly conference
- Far from easy to create synergies between projects/people/institutes

Should we revisit our approach to design re-use?

- Very hard to make design re-use work well.
 - Needs very polished product
- We have many frameworks, but they sometimes require a steep learning curve.
 - Sometimes easier to start from scratch – at least initially.
- Consider more radical approach

Collaborations to efficiently use resources should form readily, but non-trivial

- Serenity Collaboration created to make best use of flexibility offered from FPGAs
- Could this be made easier in some way?

Relationship with industry and other research areas?

Difficult to engage with industry for some tasks when parameters may change as the detector requirements evolve

- CMS Upgrade is a large multi parameter optimization
- Specification not fixed, but must adapt to new information, particularly as engineering limits become apparent.
 - Physical limits from the detector itself
 - Firmware resources or optical links
- Long timescale

Good industrial connections for PCBs

- InCap, Norcott, etc

Lessons for the future

Scrupulous evaluation - not “testing”!

- Beam tests, full vertical slice, TID, large scale testing
- Special conditions - environmental chambers & probe stations
- Essential to work very closely with the designers during evaluation and following up as many small anomalies or discrepancies
 - Uncommon in our field.

Be cautious of over-relying on specification documents

- Not always comprehensive (e.g. operating temperature) and usually evolves.
- No substitute for working closely with colleagues to understand problems faced and resolve them.