# DRD and SWIFT-HEP

Conor Fitzpatrick

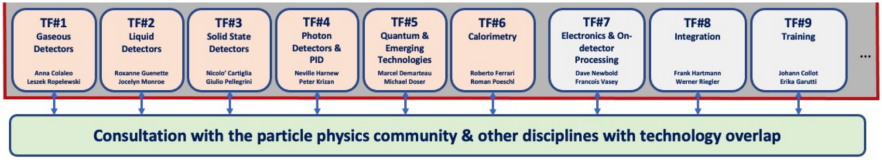
Swift HEP meeting 6
Bristol



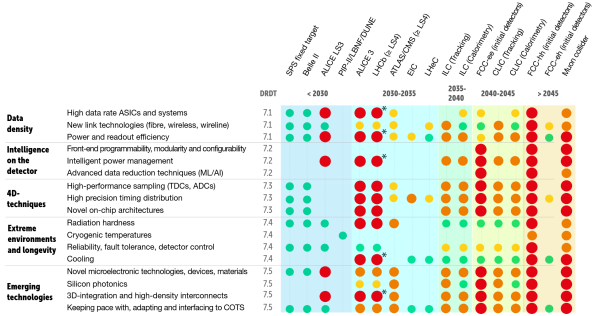



# What is DRD?

- The ECFA Detector Roadmap (2021) Covered nine technology domains soliciting input from Task Forces.




- The most urgent R&D topics in each Task Force area were identified as Detector R&D Themes (DRDTs). Eg: TF7, electronics, looks like this:




- Similar tables exist for the other themes.
- Since the Roadmap document, DRDTs have been meeting to determine how to R&D projects/collaborations within their theme areas

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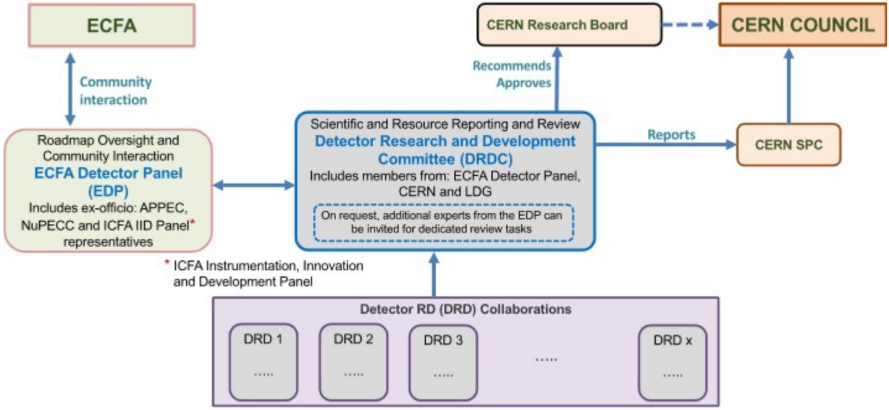
# Implementation of the roadmap

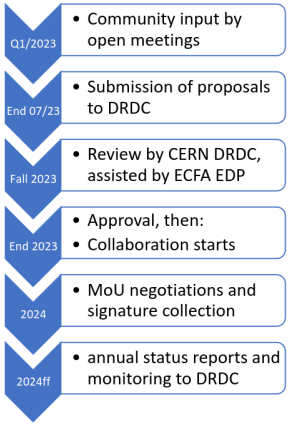
- Process approved by CERN SPC and Council in Autumn last year
- Two bodies will review and evaluate DRD proposals:
  - The `DRD Committee` (DRDC)
  - The ECFA `Detector Panel`



# The DRD timeframe

- Open meetings held for most themes throughout 2023.
- Most DRDTs have coordinated proposals and submitted these to the DRDC
- Review of DRD Proposals is happening now
- Some themes have a delayed process either as they emerged later (Quantum/Infrastructure) or to collect input from other themes (Electronics)

| Collab. | Topic | Initial Proposal Submission | Seeking approval | comment |
|---|---|---|---|---|
| DRD 1 | Development of Gaseous Detectors | July 2023 | Dec. 2023 | Former RD51 |
| DRD 2 | Liquid Detectors | July 2023 | Dec. 2023 | |
| DRD 3 | Solid State Detectors | 3 Oct. 2023 | Dec. 2023 | Former RD50 |
| DRD 4 | Photon Detectors and Particle Identification Techniques | July 2023 | Dec. 2023 | |
| DRD 6 | Calorimetry | July 2023 | Dec. 2023 | CALICE, CrystalClear |
| DRD 5 | Quantum and Emerging Technologies | | later | |
| DRD 7 | R&D Collaboration for Electronic Systems | LoI submitted | later | |
| TF 8 | Integration | - | later | Workshop on 6th Dec. |







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# After approval

- Approved DRD collaborations will start in 2024
  - Enables entry to CERN grey book, so that team leaders of each participating institute can be nominated and users registered
  - Collaborations will have kick-off meetings, elect spokespersons
  - MoU setup and collecting signatures from Funding Agencies
  - Later: Annual status reports to DRDC; monitoring of milestones and deliverables
- Contributing institutes will sign a lightweight MoU
  - MoU Template will be provided by CERN (currently being negotiated with legal office, KT, DRC,..)
  - Covers IP topics, how to handle industry involvement, common fund
  - No commitments on strategic funds in the MoU proper
  - Strategic funding will be agreed upon in annexes to this light- weight MoU
  - One Annex per Work Package, signed by the relevant Funding Agencies



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# How is the UK engaging with the DRD Process?

- There is a DRD-UK structure:
  - PI Chris Parkes (Manchester)
  - Steering Board Chair Daniela Bortoletto (Oxford), one rep per UK institute
  - Theme coordinators:

| Institution | Representative |
|---|---|
| DRD-1 [Gas] | BRANDT, Oleg; MAJEWSKI, Pawel; |
| DRD-2 [Liquid] | GUENETTE, Roxanne; MONROE, Jocelyn; SAAKYAN, Ruben; SCOVELL, Paul; |
| DRD-3 [Si] | DOPKE, Jens; GONELLA, Laura; HYNDS, Daniel; VILELLA FIGUERAS, Eva |
| DRD-4 [PID] | BLAKE, Thomas; ROMANO, Angela |
| DRD-5 [Quantum] | BUCHMULLER, Oliver; DAW, Ed |
| DRD-6 [Calo] | SALVATORE, Fabrizio; WATSON, Nigel |
| DRD-7 [Electronics] | FITZPATRICK, Conor; FRENCH, Marcus; POTAMIANOS, Karolos; PRYDDERCH, Mark; ROSE, Andrew |
| DRD-8 [Systems] | GOLDSTEIN Joel; VIEHHAUSER, Georg |
| Training | LAZZERONI, Cristina; BATES, Richard |
| Industry Engagement | FARROW, Richard; CASSE Gianluigi |



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# The Money

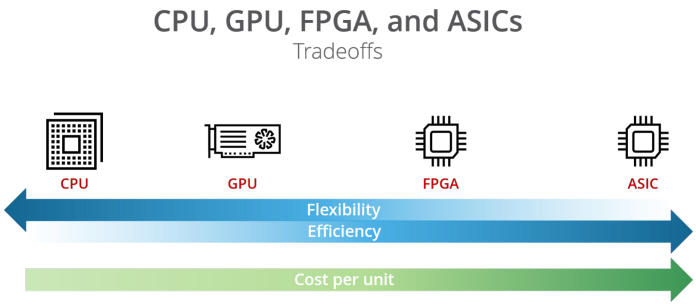
- Discussions ongoing with STFC about how funding might be made available for DRD activities
- Briefing document describes the aspirations in the UK and level of interest
- DRD-UK is making a CG submission, and institutes with DRD involvement will be requesting fractions of staff for DRD activities.
  - Expectation is mostly core, but possibly some responsive?
- In addition, DRD-UK is submitting $\sim 5$ projects for next Early Stage R&D call. These will be defined in the coming months.

# How might SWIFT-HEP participate?

| No. | Primary area of interest | Relative UK interest |
|---|---|---|
| DRD-1 | Gaseous detectors | 4% |
| DRD-2 | Liquid detectors | 14% |
| DRD-3 | Semiconductors | 29% |
| DRD-4 | PID and Photon Detectors | 10% |
| DRD-5 | Quantum and emerging technologies | 7% |
| DRD-6 | Calorimeters | 5% |
| DRD-7 | Electronics & Data Processing | 22% |
| DRD-8 | Large scale detector systems - infrastructure | 8% |

- The DRD themes are Detector R&D oriented. That doesn't mean the projects don't need software
  - (My opinion): Simulation, data acquisition, analysis tools all necessary components of any R&D work that is planned in themes 1-6.
  - Theme 7 (Electronics) will cover both self-contained R&D and transversal content to the other themes.
  - I can see good opportunities to align activities with projects here, and there is considerable UK interest.
    - Obvious area: Keeping pace with COTs technologies (N. Neufeld, CF coordinating)
    - Two proposals submitted in this area: 'No Backend' and 'DAQOverflow'

# DRD 7.5a DAQOverflow (1)




- DAQ evolution in recent years has become increasingly COTs based where possible

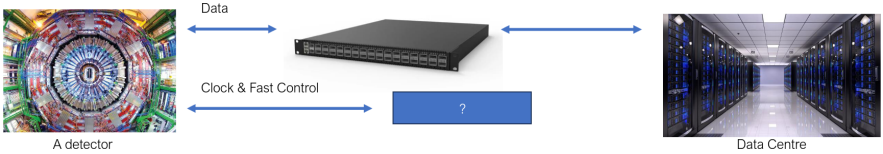
- Benefits:
  - economy of scale
  - standardisation
  - usually good support and upgrade pathways

- Caveats:
  - We're (usually) not the target market
  - It takes training and effort to develop for COTs
  - Technology evolution is fast and hard to predict
  - Choosing the right technology needs extensive R&D.

# DRD 7.5a DAQOverflow (2)

- DAQOverflow aims to:
  - Identify & Benchmark common TDAQ algorithms/workflows on existing and new (FPGA/GPU/CPU/XPU) architectures as they become available
  - Develop optimised 'reference' implementations of these algorithms/workflows
  - Maintain a community-led repository of these implementations and their benchmarks
- Think `Stack Overflow` for TDAQ development
- Aim is to provide COTs TDAQ software implementations for COTs hardware and maintain knowledge of what is cheap to do where.
- Pilot project underway at Manchester testing zero suppression implementations on FPGA (HLS + VHDL), GPU and CPU for the mu2e daq testbed.

# DRD 7.5b NoBackend




- Similar idea to DAQOverflow but for network/links:
  - Write 100GbE straight from the frontend
  - Use COTs or nearly-COTs network switching as a commodity DAQ.
- Two 'sub-projects':
  - using COTS switches to handle data-streams from the Front-End to Network Interface Cards (NICs) or even DAQ processors (the "No backend" approach)
  - design a COTS-based high-density switch bridging the detector environment to the COTS/DAQ world (the "Smart Switch" approach)
- These are coupled with ASIC IP development to implement 100Gb Ethernet cores for future frontends.



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# Conclusions

- The DRD process is beginning to move from hat factory to more concrete R&D collaborations
- The UK has signed up to quite a few projects, with Silicon and Electronics in particular being popular themes, but leadership in PID & Liquid detectors as well.
- In terms of research goals, SWIFT HEP fills a gap the DRDs currently do not
  - I see this as a good thing- It may be an opportunity to contribute to the UK DRD aspirations without competing for funds.
- There could be some nice overlap with DRD 7.5a in developing DAQ tools/software and shared training.
- More generally, given the number of UK institutes in DRD themes and SWIFT-HEP, it might be worth asking themes what their software needs are and if we could help.



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