Particle Physics Technology Centre

UK Particle Physics Technology Centre

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Summary

The invention and development of new particle detection and data-handling technologies underpins the entire STFC science programme. We propose a new model for such activities. Based on the success of ASTEC and UKATC, the UK PPTC will combine new investment in both facilities and people, with new initiatives in doctoral training, industrial and cross-disciplinary engagement, and international development. PPTC projects, led by scientists from across the UK field, will directly enable UK leadership in the next generation of particle physics experiments, beyond the LHC.

Context and need

Delivery of current and near-future detector systems for collider physics, dark matter discovery, and neutrino physics – for instance, ATLAS / CMS, LZ, and DUNE respectively – required a decades-long prior investment in R&D activities. Substantial support offered through STFC and

Perceived Need

- Detector R&D
  - Key component of the UK PP / PA research portfolio
  - Increased emphasis as new experiments start to be proposed
  - One of the most direct ways PP IP can enable other science / tech areas
    - e.g. use of PP silicon sensors in cry EM (Chem. Nobel Prize 2017)
  - Traditionally where 'small grants' / 'young researchers' make a difference
- Funding context
  - Formally-organised detector R&D has been 'minimal' for some time
  - PRD was suspended some time ago due to lack of funds
    - Recent 'Opportunities Call' occupies some of the same territory; evidence of pent-up demand
  - The work that is happening has largely been through EU programmes
- The 'Big Idea'
  - Repackage UK Detector R&D as a new programme outside the 'core'
    - Encompassing the (many) submissions to the 'big ideas' call on detector topics
  - Make a case based on {applications, training, industrial connection}
  - Seek substantial funding from UKRI to enable the programme

PPTC

- *"We propose a new model for the funding and coordination of detector development activities at a national scale…"*

- Five year project, with three planks:
  - Detector R&D research programme
  - Centre for Doctoral Training in detector systems
  - Focal point for industrial engagement

- What it is not
  - An attempt to steer 'top down' UK R&D activities
  - A shiny new building at the lab (but see later…)
  - A direct replacement for PRD
  - A source of funding for what we would have done anyway

- Science case – dismayingly obvious
  - All new facilities / experiments are currently too hard / too expensive
  - UK international leadership rests on practical contributions to facilities
  - UK ROI rests on a coherent industrial connection with UK science

Organisation and Resources

- Virtual organisation
  - Make use of existing facilities / expertise at institutes
  - Ensure that resources is distributed transparently
  - Measure outcomes / success over the course of the project
- Concrete leadership
  - Director and industrial engagement officer posts
  - Governance panel drawn from the community
- Resources
  - Direct project grants for PDRAs, consumables
    - Range of sizes: 'startup' (8 x £30k), 'small' (4 x £300k), 'large' (2 x £1M) *per annum*
  - UK-PPTC fellows: three per year?
    - Addressing the lack of career opportunity for detector-focussed physicists
  - CDT Students: five per year?
  - PPTC staff, events, facilities costs

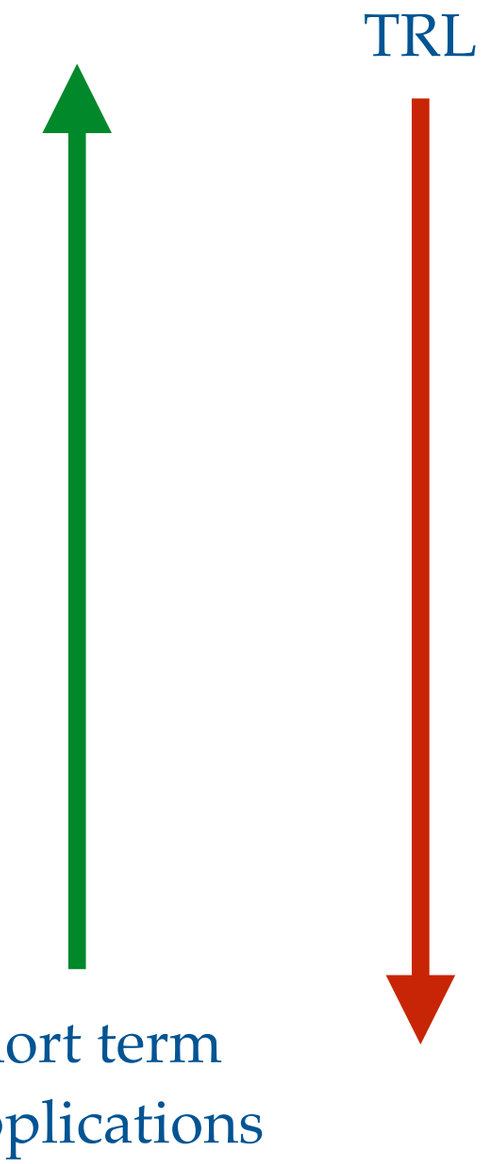
Resource Summary

Item	Number	Unit cost	Annual cost
UK-PPTC Fellows	10	£100k	£1M
Students	20	£30k	£600k
Large project costs	2	£1M	£2M
Small project costs	4	£300k	£1.2M
Startup project costs	8	£30k	£240k
PPTC staff			£200k
Facility costs / support			£200k
Events / industrial engagement			£100k
Total			£5.54M

- Five year initial project would be ~£28M
  - Probably a little small for ‘stategic’ funds, too large for responsive
- No element of capital infrastructure investment

Exemplar Projects

- These were simply harvested from the big ideas proposals
  - Or in corridor conversation…
  - Please do not get hung up on this, they are *examples*
- MAPS development with industry
  - Systems level work fornext generation tracking,
  - Industrial medical applications
- Real-time machine learning for TDAQ
  - Academic collaboration with data scientists
- Large area photon detectors for neutrino / DM
  - Basic development and testing
- Advanced short haul links (wireless, photonic)
  - Early stage R&D and ‘invention’, testing of technologies
- Quantum sensors
  - Starting from scratch in most cases!



The Other Side of the Coin

- Somewhere in a parallel Universe (RAL TD)…
  - 'Detector Systems Centre' – M. French, N. Geddes
  - £60M request for new infrastructure at national labs
  - Clearly addresses (much) more than PP / PA
  - Also on the 'big ideas' list – has not escaped people's attention
- The national context
  - Biggest (resourced) and shortest-term 'customers' are large facilities
  - Clear (indirect) route to support EPSRC / NERC / BBSRC / MRC science
  - They speak our language, but do not often speak to us…
- Conclusion
  - Makes little sense to have competing detector centre bids on the list
  - Emphasis for DSC / PPTC is capital / resource respectively
  - Downside: put together, this looks like a O(£90M) bid

What Happened Since 2018?

- PPTC made it to the 'big ideas' list ✔
  - We were rapidly required to produce a write-up, with minimum consultation time: http://tiny.cc/pptc
- PPTC and DSC proposals were merged ✔
  - Denoted '3S' - Sensors for Science and Society, ~£50M three-year project
  - Combined proposal was approved by STFC for submission to SPF
- Proposal not currently expected to be funded via SPF ✘
  - Formal announcements have not yet been made on successful projects
- Where are we now?
  - The case is still relevant and (I believe) strong – view shared across STFC
  - We need to work harder to explain the societal / industrial relevance
  - Need to attract explicit support from other UKRI entities
  - Q: Why would EPSRC / MRC support this bid?
    - £50M+ is a very large ask unless we have cast-iron evidence of a national need

What Next?

- Does the community still think this is a 'priority project'?
- How can we improve the science / business case?
- What can we learn from other (successful) large-scale bids?
- Tentative proposal
  - Determine if we / STFC executive want to take this forward
  - Put together a steering group including PP, N. labs, STFC PD
  - Confirm / revise our list of example projects
  - Seek ways to make explicit contact with users / collaborators
    - Other academic communities
    - Industry
    - Government departments
  - Get ready to respond to future calls at short notice

- I think it may still be all to play for – but much work to do
- Comments (now / offline) welcome