UK Strategic Detector R&D programme

DMN, v3, 2/4/23

Context

An outline proposal for a UK programme in Strategic Detector R&D was submitted to STFC via PPAP in September 2023. The proposal is intended to provide a platform for UK participation in the European Detector R&D Roadmap, and specifically to provide:

- Funding and organisation of a coherent UK participation in the DRD collaborations
- Routes for student training and skills development
- Mechanisms for interaction with industry

The recent actions taken by the ECFA Detector Panel to begin the process of implementing the Roadmap, now require further steps in organising the UK contribution. The PP programme manager has indicated that the submission of a Statement of Interest to STFC Science Board in September 2023 would be possible, with the potential for initial funding from FY 2024/25.

Kick-off meeting

A kick-off meeting was held in February 2023, with participation by the original proponents of the R&D proposal, plus a number of other UK community members who have organised technical discussions in the various work areas. The agenda and presentations at this meeting can be found here: https://indico.stfc.ac.uk/event/719.

After discussions of the broad context of the Roadmap and the content of the UK proposal, reports were received of activity and initial plans in each of the detector technology areas covered by the roadmap, plus the electronics area. Finally, a discussion resulted in general agreement to proceed along the lines of the proposal, identified the next steps required to set up a UK programme in this area, and generated a number of actions to be carried out.

Following the workshop, further expressions of interest were received in assisting the setup of the programme, and are noted below.

Discussions on structure and scope

The concept of a ‘matrix’ approach to the UK work plan was discussed, comprising a number of significant demonstrator projects combining detector, electronics, and software work, and potentially corresponding to R&D topics in more than one DRD. An example would be the development of a prototype 4D tracking stave, involving multiple topics across DRD3 and DRD7; similar developments could be considered in DRD2 and DRD6. In other areas, the UK may choose to focus on specific aspects of the DRD scope, and / or to seek investment in new facilities.

The danger of spreading the UK effort too widely was discussed, recognising the importance of attaining critical mass and leadership in key areas if future funding is to be secured. It was noted that the UK interests should tie into the future science roadmap. It was agreed that a coherent rather than competitive approach would be needed. The SoI should be at an ambitious funding level (£5M per year) but with clear priorities allowing a ramp-up to full scope if needed.

It was agreed that the overall structure of the programme should resemble a standard STFC project, with clearly-defined work packages, deliverables, and responsibilities. A fully resource-loaded plan is not necessary for the SoI, but confirmation of the overall size and scope of the project will be; this will not be known until the community has decided its priorities. A leadership team for the project will need to be identified.

It was recognised that, given the financial and practical tension with current detector construction projects, the project should probably proceed through a three-to-five-year ramp-up phase, providing opportunities for experts ramping down from LHC GPD developments. The importance of students during the ramp-up, as the workforce of the future but also benefiting from participation in the LHC GPD construction, was emphasised.

The potential tension with new construction projects (e.g. LHCb, EIC) was noted, and it was agreed that a clear separation between the deliverables of those projects and the R&D deliverables is necessary, to avoid perceptions of ‘double-dipping’, but also to prevent leakage of effort from one to the other.

The need for corresponding capital investment from non-core funds at the national labs was discussed, along with the possibility of acquiring and developing physical space for large-scale developments or specialised facilities (test facilities, laboratories, cryostats, magnets, irradiation facilities, etc), This may be a future target for infrastructure fund or other capital funds. The facilities and capabilities already built up at UK institutes (e.g. for ATLAS, DUNE) should be preserved.

An outline timeline for the next steps was discussed. The important of making UK decisions coherently with the DRD setup process was agreed, noting that: DRD7 is currently proceeding on a (deliberately) delayed schedule compared to the other DRDs; that a DRD8 on detector magnets may exist, but probably without strong UK interest; and that there may be additional elements for the UK programme not corresponding directly to items in the European roadmap (e.g. low-background materials).

Subsequent inputs from the community

The importance of re-building and sustaining an ‘end-to-end’ capability to delivery systems within UK institutes has been emphasised. This includes engineering and integration aspects not explicitly included in the DRD programme, though obviously necessary as an underpinning element.

Based upon the indicated plans of the DRDs, as discussed at the recent implementation workshops, the £5M per year nominal UK funding level would cover somewhat less work than might be expected given the UK's rough fractional contribution to CERN and European particle physics (~15%). This means that focus and tensioning will be needed both in the UK and in Europe, and it will be important to understand the plans of other national communities and funding agencies.

Actions

1. Summarise the outcome of the meeting and distribute widely to the UK community (D. Newbold / P. Allport)
2. Convenors in each of the work areas to continue their efforts to bring together a viable UK community and to identify areas of common interest that will form the basis of a proposal. The initial set of convenors was identified as:
    a. DRD1 (gaseous detectors): P. Majewski / TBD
    b. DRD2 (liquid detectors): R. Guenette / J. Monroe
    c. DRD3 (silicon detectors): J. Dopke / L. Gonella / D. Hynds / E. Villela
    d. DRD4 (PID): G. WIlkinson / TBD
    e. DRD5 (Quantum sensors): TBD
    f. DRD6 (Calorimetry): I. Vivarelli / N. Watson
    g. DRD7 (Electronics): C. Fitzpatrick / K. Potamianos / M. French / TBD
    h. Low-background materials: P. Scovell / R. Saakyan (proposed, TBD)
3. Since the programme must provide opportunities for all UK HEP institutes, a steering board should be set up to oversee the next steps in organisation, consisting of a nominee from each group (action: D. Newbold / P. Allport to contact group leaders).
4. A working group on the development of a doctoral training centre / training network for detector-focussed PhD students should be set up (action: D. Hynds / C. Lazzeroni / Y. Ramachers), and managers of the current STFC-funded CDTs co-opted if possible.
5. A working group on industry interaction should be set up (action: A. Bevan / R. Farrow)
6. A UK nominee to the LDG-ECFA working group on facilities for R&D should be identified (action: D. Bortoletto as UK RECFA delegate – completed, and I. Vivarelli invited to join the working group)
7. UK groups to participate in the DRD proposal preparation stage, ensuring that our plans are included in the programme presented to the DRDC and to identify any potential conflict / overlap with non-UK participants (action: all)

Timeline

1. February 2023 onwards: Continue to develop plans in each area for UK participation, based around a prioritised set of common deliverables, and with a rough idea of costs, and in parallel with the work plan development of the DRDs
2. March 2023: Participate in the DRD kick-off workshops in order to understand and influence the plans of the DRD collaborations – complete
3. April 2023 (at IoP HEPP meeting): inaugurate the steering board to confirm plans towards an SoI in September

4. June 2023: Bring together the plans from different areas to understand the potential scope of UK participation and define the initial scope of the programme. Form the working group to construct the SoI.
5. July 2023: DRD proposals submitted (except DRD7) to DRDC
6. September 2023: submit SoI to SB / STFC Visions
7. October 2023: DRD7 proposal submitted to DRDC
8. November 2023: (if approved): submit PPRP proposal
9. April 2024 (if approved): Project ‘soft’ start (noting that this is an ambitious time scale given the need to agree funding arrangements and recruit where necessary)
10. October 2024 (if approved): Project ‘full’ start, i.e. first tranche of new students / PDRAs in place.