STFC Centre for Instrumentation

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PPD seminar

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STFC Centre for Instrumentation (CfI)

- What is CfI?
- Medium-term projects (“Managed programs”).
- Short-term projects (“Responsive programs”).
- How to apply and get resources.
- (I’ll mostly talk about “responsive mode” projects.)

STFC Centre for Instrumentation

- “The Centre for Instrumentation (CfI) forms the backbone of core technology development for STFC's Facilities and Programmes. The CfI has developed strategic technology roadmaps to shape long term managed R&D programmes in areas such as CMOS sensors, Cryogenics and Advanced Optics.”
- What does that mean?
  - Part of TD’s budget is assigned to this program.
  - ~£800k/yr split over ~6 three-year “Managed Program” projects
    - £150k/yr for three years (+ 1 year extension)
    - As a project ends it may be extended for a year or new projects added.
      - e.g Quantum MP has just ended, ADVISE was extended for a year
  - ~£700k/yr split over ~14 one-year “Responsive Mode” projects
    - Up to £60k for one year
  - In general the funding pays for TD effort.
    - Some money can buy out other people’s time (rare)
    - Money for travel and consumables, if justified.
    - Each project managed by a TD person.

Managed Programs (MP) 2022

	Programme	Approved	Requested	
		2022	2023	2024
PB01	Data to information	£125k	£245k	£145k
PB02	Machine learning for Data processing	£120k	£123k	£99k
PB04	ADVISE extension (scintillators for EPAC)	£100k	£100k	End
PB05	Microelectronics development at 28nm	£118k	£224k	£168k
PB06	Supra-THz semiconductor devices	£68k	£81k	end
PB07	LGADS for Track Timing and x-ray science	£150k	£199	£107k

I'm not showing names of rejected projects

PB05: Microelectronics development at 28nm

- WP1 LGAD Front-End Electronics
  - In this work package we will specify and design suitable readout electronics for LGAD development, making use ofthe high speed performance offered by 28nm technology. In the first year we will develop a test structure for submission on a Mini@SIC run early in 2023, with test and evaluation to follow in year 2. Testing of high speed circuits will be non-trivial and will require the development of asuitable test system. Lessons learned from the first test structure will be used to refine the design and expand to a full readout channel for a more comprehensive test structure for manufacture in the third year.
- WP2 IP Development
  - This work package will establish a library of 28nm building blocks based on the expected common needs for future ASICs. Circuits such as Serialisers, Bandgaps, DACs will be designed and built as test structures on MPW shuttle runs for characterisation and confirmation of performance against simulation
- WP3 Circuit Evaluation with LGAD detectors and radiation
  - This work package will test the performance of the fast front-end test structure developed in work package 1 with available LGAD detectors and a suitable radiation source. A suitable test system will need to be developed. Further testing will follow in the final year for the complete front-end test structure.

PB07:LGADs for Tracker Timing and x-ray science

- WP1 LGAD wafer production
  - In this work package we propose to make a 6 inch wafer mask design to create a variety of detectors to cover thedifferent potential applications. We will make 4 thin (100um) wafers for optimum timing resolution for particle tracking and 4 thick (300um) wafers for X-ray detection in year 1 using doping isolation. After a review of performance of devices, the available readouts to test the LGADs and the scientific applications/landscape we will manufacture a second set of wafers.
- WP2 Uniformity and Timing Resolution
  - We will use the existing 15ps laser facility at the University of Oxford to measure timing resolution of the thick and thin Micron devices with 1.3mm pitch pixels to give a direct comparison to the Teledyne e2v devices. The laser system will also be used to map the gain with 10µm resolution and timing performance uniformity
- WP3 Low Energy X-ray Detectors
  - This work package will characterise HEXITEC, LPD and Timepix 3 LGAD detectors as a function of applied bias using an Fe-55 source and XRF foils covering the low energy X-ray range ~2-17.5keV. A collimated X-ray source in R65 with a Fe anode tube will be used to map the low energy X-ray performance at 30µm steps, complimenting the laser scans in WP2

Responsive Mode (RM) program 2022

	Responsive Mode bids	2022		Responsive Mode bids	2022
RB01	Ge Microstrip detector at high flux	£12k	RB10	Fibre positioner for Multi-Object Spectroscopy	23k
			RB11	Machine Learning for Adaptive Optics	£14k
RB03	Packet Acceleration and Data processing	27k	RB12	HEXITEC-MHz roadshow	50k
RB04	130/65nm ADCs for Next-Gen Image Sensors	63k	RB13	Cryogenic detector for Ge mm-pixels	17k
RB05	CERN-STFC Future High Luminosity colliders	25k			
RB06	High frequency pulse tube cooler	20k	RB15	Tileable Detector Systems	17k
			RB16	Zynq control systems	60k
RB08	DAQ system for neutron imaging	60k			
RB09	Miniature infrared photonics for gas spectroscopy	60k			

18 bids submitted, 13 accepted

RB0: CERN-STFC Future High Lumi colliders

1. Provide support to CERN in integration of TD serialiser into MALTA3 (advice, supporting simulation etc.)
2. Design a small PCB to support the existing serialiser for radiation testing
    1. the existing camera system is too large to be used for radiation testing. A small PCB, which could be plugged into an FPGA development board, would simplify this task. An additional advantage of such a development would be that several commercial partners have expressed interest in a sensor containing such a serialiser but would like to test it with their camera designs before committing to a project. Such a small PCB would be ideal for this purpose, and might lead to further projects in future

RB04: 130/65nm ADCs for Next-Gen Image Sensors

- **Milestone Completion Date**
- Complete review report and architecture selection May-22
- Complete schematic 180nm Aug-22
- Complete layout 180nm Oct-22
- Complete schematic 65nm Jan-22
- Complete layout 65nm Mar-22

RB12:HEXITEC-MHz roadshow

- **WP 1: Module Assembly and Test**
  - Delivery of at least one off of CdZnTe, GaAs:Cr and p-type Si modules to provide a selection of sensor energy ranges and resolutions for the different application areas.
  - A report on the characterisation of these modules that will be presented at the IWORID conference in July 2022 to further promote the technology
- **WP 2: Application of HEXITEC-MHz at Light Sources**
  - Beam Time at ID-19 @ ESRF: A study of the dynamics of the formation of additive manufacturing samples
  - Beam Time @ I-12: Mapping of multi-elements during melting and solidification using synchrotron X-rays and pixel-based spectroscopy
  - Demonstration of the HEXITEC-MHz camera at the FXE beam line @ XFEL
- **WP 3: Lab-Based Application of HEXITEC-MHz**
  - Experiment at Royal Marsden: Comparing the feasibility of emission and attenuation spectral x-ray imaging for detecting elemental composition changes associated with breast cancer diagnosis
  - Experiment at the NXCT: Dynamic Colour X-ray Computed Tomography
  - An oral presentation at the IEEE NSS/MIC/RTSD of the HEXITEC-MHz technology and results from it's use in different applications

How to apply

- Request for responsive mode bids comes out late December, early January
  - You can put in a managed bid if you like
- Applications due end of January
- Up to £60k can be requested for responsive mode (£150k/yr for MP).
  - You can ask for less or, sometimes, more.
- Decision made in March.
  - Mainly a proposal from Neil Geddes and Marcus French, which the CFi board usually accepts with minor tweaks.
    - CfI Board members: facilities, BID, external
- Project starts 1st April for one-year (RM bids), three years (MP bids)
- Reviews: mid-term and at end.
  - Progress and spending report

Neil Geddes	Chair
Anna Orlowska	Director Technology
Marcus French	CfI Manager
Andy Dent	DLS
Nigel Rhodes	ISIS
Mike Towrie	CLF
Nick Waltham	RAL Space
Fergus Wilson	PPD
Liz Bain	BID
Sarah Clements	Secretary
Apologies	
Liz Kirby	BID
Paul Sellin	University of Surrey

Proposal outline

- Three pages. Not too onerous.

Section	Description	Comment
1	Project outline	Page and a half
2	Previous CfI work	Paragraph (if relevant)
3	Deliverables	List/paragraph
4	Milestones	List/Table
5	Staff	List/Table
6	Benefits to STFC	List/paragraph
7	links to other projects	List/paragraph
8	Impacts arising	List/paragraph
9	External partners	List/paragraph
10	Appendix	Spend forecast, in-kind effort, web presence

Comments

- Talk to TD now:
  - Find out if they are interested
  - Identify a named TD person(s) to work on project
- Budget:
  - £60k is mainly for TD effort. Option to ask for more but rare.
  - Bids are usually rejected rather than cut.
  - Can ask for equipment, travel etc.
- Considerations:
  - Must be doable in one year.
  - Must align with strategy.
  - Must be of interest to other facilities.
  - Must explain why it's important.
  - Good to have outside interest and/or letter or support.
  - Project outline section is key. Adding a few images helps if you have space.

Project Review procedure

- The project gets reviewed by up to three STFC people in February
- You'll see the comments and have a chance to respond.
- Criteria:
  - Impact
  - Credibility
  - Methodology
  - Overall Assessment (accept/reject/cut)
- Typical rejection/cut comments:
  - Too vague; no specific target performance values; change in deliverables when extended; not cutting edge enough; too cutting edge; competing proposals; proposal too closely linked to a specific project; no science justification; work packages are disjoint;
- Typical acceptance comments:
  - Links to external bodies; links to strategy; replaces bespoke hardware with cheaper COTS hardware; addresses needs of multiple facilities; potential to be used at facilities; new opportunities;

Conclusion

- Application is easy.
- We have been and are successful.
- Important way to flag up PPD R&D interest to STFC and TD.
- Deepens collaboration with TD.
- Free money (well, resource at least) !
- The pot of TD resource for CfI could be increasing in future years.