Fast timing silicon pixel detectors for new applications
⇒ Synchrotron and electron microscopy applications

25 Nov 2019, Diamond Light Source

Workshop Committee:

Richard Bates	(Glasgow)
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Marco Gersabeck	(UoM)
Dima Manueski	(Glasgow)
Alex Oh	(UoM)
Nicola Tartoni	(Diamond Light Source)
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THE ROYAL SOCIETY

MANCHESTER 1824
The University of Manchester

UKRI Science and Technology Facilities Council

University of Glasgow

Welcome!

Two workshops funded by **STFC Opportunities Grant**:

- Proton Therapy applications
  (Friday Nov 22, Manchester)
  https://indico.cern.ch/e/FastPixels4Imaging
- Synchrotron and electron microscopy applications (today!)

Purpose: The Opportunities Call is designed to support the STFC PPAN community by providing funding for 'pump-priming' activities. The call aims to allow the STFC community to do one or more of the following types of activity:

- Prepare for participation in **multi-disciplinary science programmes** that may be supported in the future by major UKRI or STFC funding schemes;
- Undertake **exploratory or proof-of-concept studies** that may have the potential to develop into new strategic PPAN programmes;
- **Develop and strengthen multi-disciplinary research collaborations and networks.**

https://stfc.ukri.org/funding/research-grants/funding-opportunities/2019-opportunities-call/

Background

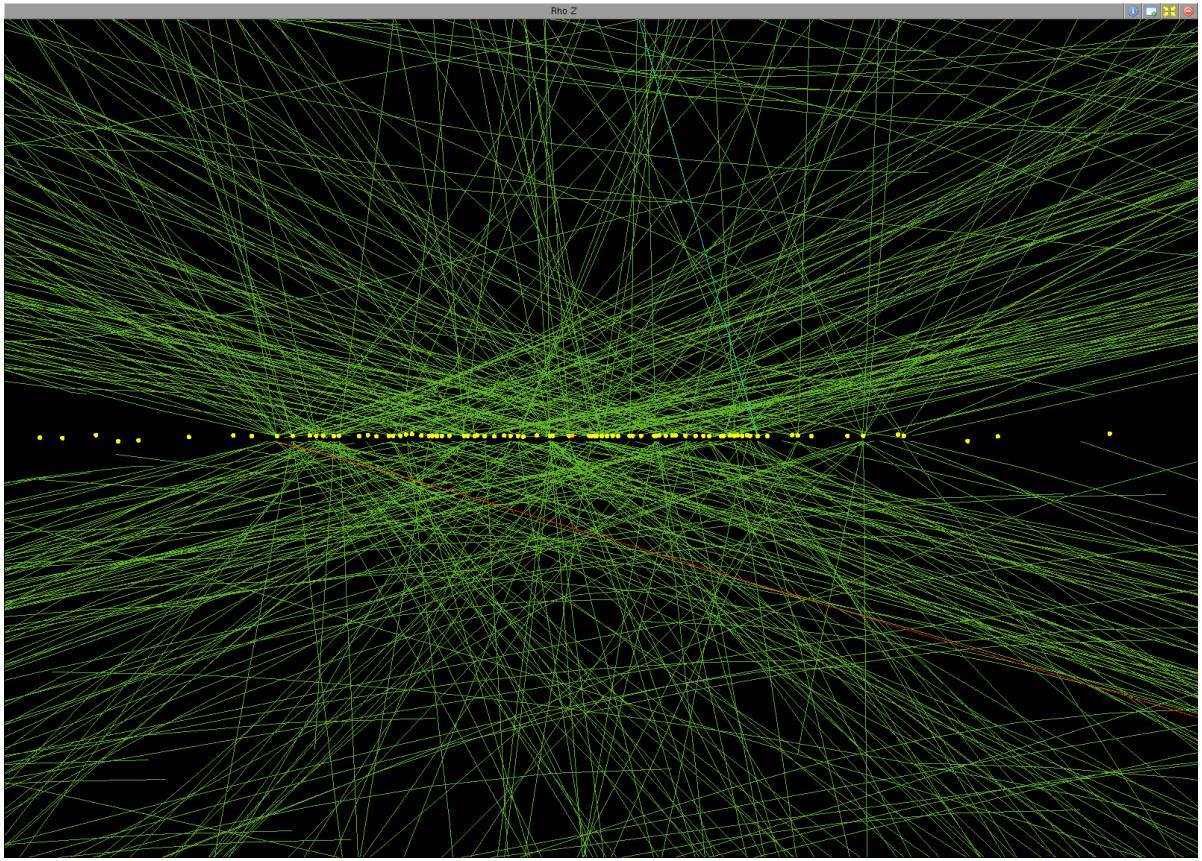
Investigate applications *beyond particle physics* for **small-pitch pixel (~50µm)** detectors with **precise timing (~50ps)** capabilities.

In **particle physics**, obvious use-case for future experiments

⇒ reconstruct particles, and their origin vertices, from map of pixel hits

⇒ at high particle densities, spatial information no longer sufficient to reach required performance − need time information

e.g. Atlas/CMS (LGAD pads), LHCb upgrade-II Vertex Locator, Future Circular Collider, …



http://cdsweb.cern.ch/record/1479324

Background

Hosted exploratory IoP half-day meeting in October 2017

http://indico.hep.manchester.ac.uk/event/NewDimensions2017

A few ideas came from that meeting, leading to (successful and failed) grant applications to pursue them more closely.

Several potential technologies which might provide required time- and space resolution

- **Low Gain Avalanche Detectors (LGAD)**
- **3D silicon (and diamond)**
- **Planar hybrid silicon**
- **CMOS devices**

Our specific interest is in LGAD devices, but aim to be **technology-agnostic** when investigating applications.

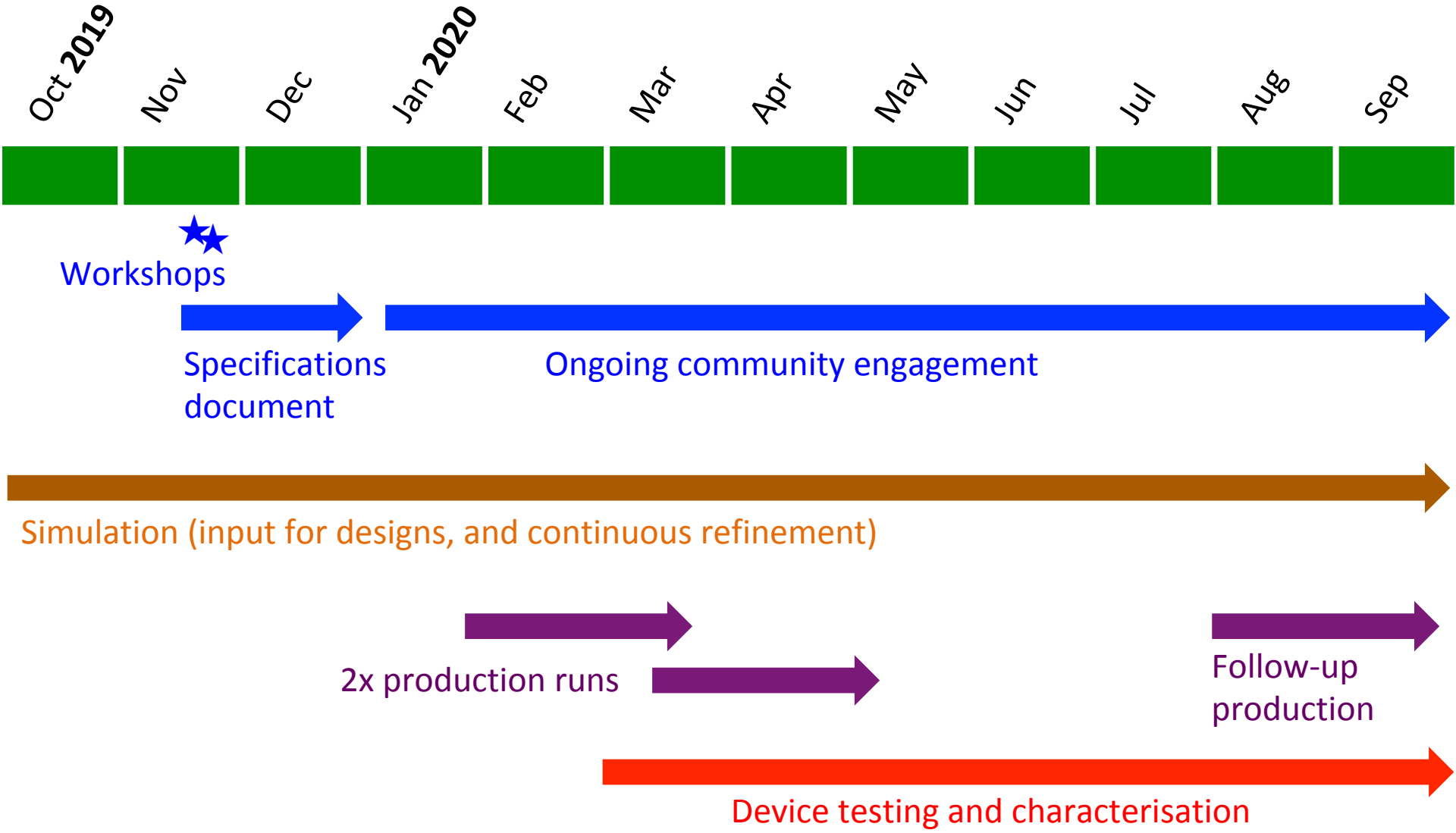
Aims of Workshops…

Objective: Develop a network of potential beneficiaries of the technology, and actively engage with these communities to define required device specifications, and explore future opportunities for societal and economic impact beyond those already identified.

> **Deliverable 1 — Specifications document**: Early in the project we will host two workshops targeting key beneficiaries of the technology. […] A specifications document will be generated from these workshops to ensure that the community needs are addressed.

> **Deliverable 5 — Future Beneficiary Network**: […] we will build a network of potential beneficiaries, within the particle physics community and in the other fields of materials science and medical science. We will use this network to identify potential funding opportunities to extend this work beyond the scope of this proposal.

Grant timeline



	Coffee *G54, Diamond House, Diamond Light Source*	10:30 - 11:00
11:00	**Welcome and introduction** *G54, Diamond House, Diamond Light Source*	11:00 - 11:10
	Technology overview *G54, Diamond House, Diamond Light Source* *G54, Diamond House, Diamond Light Source*	11:10 - 11:30 11:30 - 11:40
	Synchrotron applications at Diamond *Nicola Tartoni* *G54, Diamond House, Diamond Light Source*	11:40 - 12:00
12:00	**Synchrotron applications at DESY** *Jonathan Correa Magdalena* *G54, Diamond House, Diamond Light Source*	12:00 - 12:20
	Synchrotron applications at PSI *Anna Bergamaschi* *G54, Diamond House, Diamond Light Source*	12:20 - 12:40
	Lunch *Diamond Atrium, Diamond Light Source*	12:40 - 13:40
13:00	**Electron microscopy applications - material science** *Carol Trager-Cowan* *G54, Diamond House, Diamond Light Source*	13:40 - 14:00
14:00	**Electron microscopy applications - material science** *Mark Stewart* *G54, Diamond House, Diamond Light Source*	14:00 - 14:20
	Electron microscopy applications - biological applications *Andrew Howe* *G54, Diamond House, Diamond Light Source*	14:20 - 14:40
	Electron microscopy applications - biological applications *McMullan Greg* *G54, Diamond House, Diamond Light Source*	14:40 - 15:00
15:00	**Coffee** *G54, Diamond House, Diamond Light Source*	15:00 - 15:15
	Description of the aim of the discussion *G54, Diamond House, Diamond Light Source*	15:15 - 15:20
	Discussion and input to the specification document *G54, Diamond House, Diamond Light Source*	15:20 - 15:50
	Wrap up and thanks *G54, Diamond House, Diamond Light Source*	15:50 - 16:00
16:00		

Today's Agenda

Discussion-driven

Well-defined deliverable (specifications document):

- Updated in real time during workshop
- Discussed and updated in final session
- Open to all contributors

Specifications document

What are the required (desired) device specifications for each application?

- Pixel size
- Time resolution
- Radiation tolerance
- Sensor thickness
- Sensor dimensions
- Read-out rate/bandwidth
- Other requirements

Are there ways to stage the technology for an application,
e.g. gradually increasing time precision?

If the technology were available today, could it be used? Or, are there other limitations to address? (In which case what are required steps and timeframe?)

We will also collect contact information (with permission) of relevant people in each area.