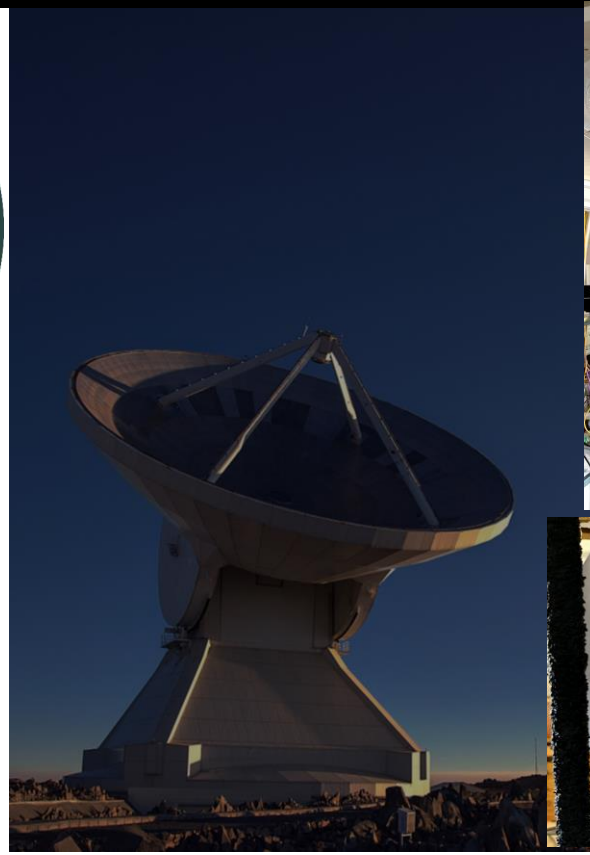
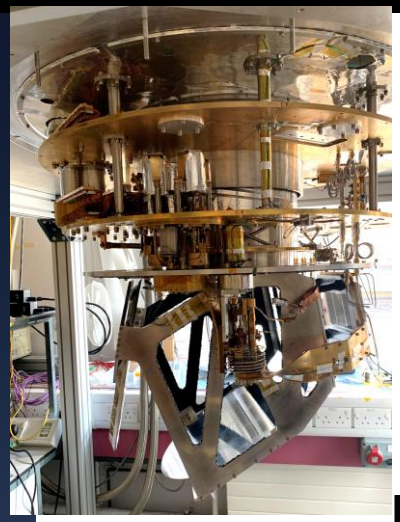
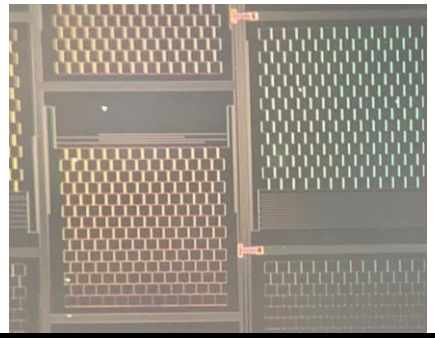
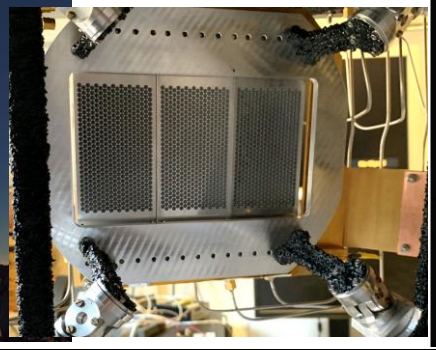
Development of next-generation LEKIDs and Instruments at Cardiff





Sequestim





Astronomical Instrument Development Meeting

Dublin, 2nd September 2019

CARDIFF UNIVERSITY

PRIFYSGOL CAERDYDD

The Cardiff AIG

Prof. Matt Griffin

Three main areas:

- **Quasi-optical filters & metamaterials**
- **Detectors**
- **Cryogenics**

Prof. Peter Ade

Dr Erminia Calabrese

Dr Simon Doyle

Prof. Pete Hargrave

Dr Giampaolo Pisano

Prof. Carole Tucker

6 post doctoral staff

5 PhD students

7 dedicated technical staff + 2 soon

2 dedicated administrative staff

The Cardiff AIG

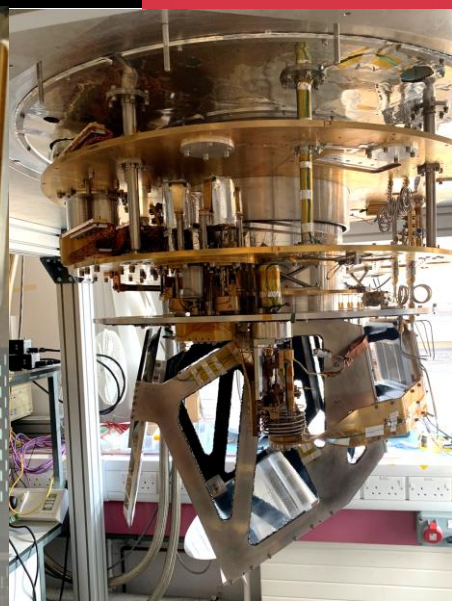
- **Science-driven approach to developing technology for astronomy.**
  - **We develop technology and instruments for studies of: the Early Universe; CMB science; Star Formation and Evolution.**
- **Enabling technology for IR-FIR/Sub-mm Instrumentation.**
  - **Hardware on virtually ALL astronomical satellite instruments working > 60μm**
  - **Earth-based, balloon-based and space-borne observatories.**
  - **'THz' technology**
- **Instrument-level system optical/cryogenic design & engineering.**
  - **Lead institute for *Herschel*-SPIRE, ISO-LWS.**
  - **Focal plane integration & testing for *Planck*-HFI**
- **Focal-plane characterisation and integration.**
  - **Cleanroom, semi-cleanroom facilities; spectroscopy lab (FTS + VNA); anechoic chamber – for detector and QO device characterisation.**
- **Instrumentation for Earth observation.**
  - **Met-Op SG; EU-MetSat – MWS; Chinese Meterological Feng-Yun 4.**
  - **Optical design for ESA FORUM instrument concept.**
  - **ICEMuSIC instrument concept for Climatology – to constrain the essential climate variables.**
- **Transfer of Technology to Industry for other applications.**

Detector Sub-Group: Current Main Projects

- MUSCAT
  - 1.1-mm receiver for LMT (Mexico) – Newton Fund
- Sequestim
  - Passive security scanner – Home Office & DfT + investment
- Multi-chroic antenna-coupled LEKIDs
  - Target application: CMB science – PhD/STFC
- TiN arrays
  - Target application: commercial (Sequestim); with Glasgow – EPSRC

MUSCAT

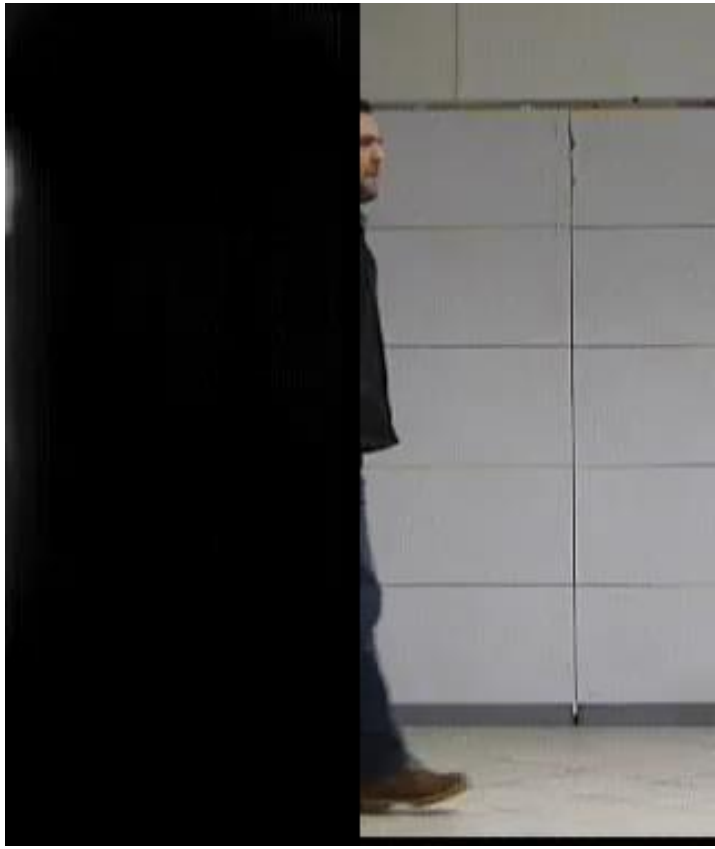
- Funded by STFC & CONACYT (Mexico) under Newton Fund
- First continuum instrument on 50-m LMT
- 1,500 single-color pixels
- Currently fully integrated and undergoing final-stage lab commissioning
- Novel He3-light cooling system down to approx. 100 mK



Brien et al., SPIE (2018) arXiv: 1807.08637
Brien et al., JLTP (2018) arXiv: 1801.07442
Castillo-Dominguez, JLTP (2018) arXiv: 1806.10400

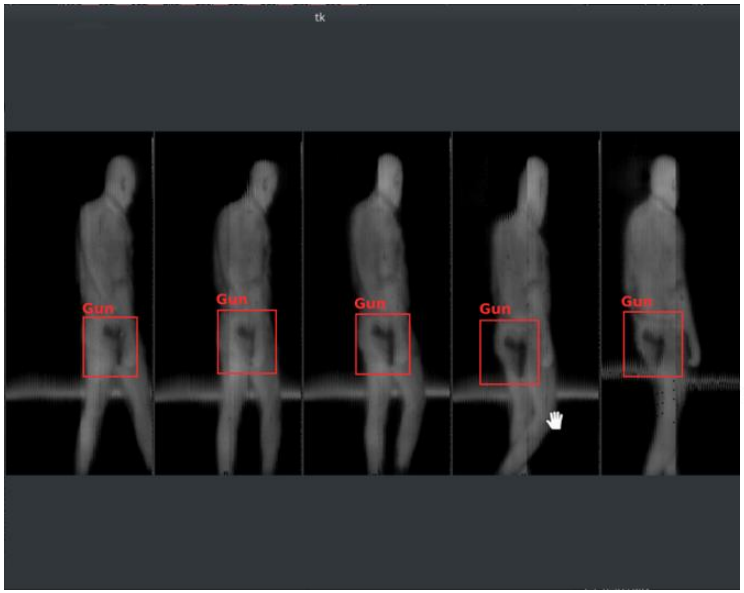
SEQUESTIM

- Passive security scanning
- Applications in airport security and maritime truck screening
- Non-public demo at Cardiff Airport
- AI analytics for threat identification
- Currently pursuing funding to upgrade and continue commercialisation and explore SoC (no new ROACH-II from next year)
- Also pursuing private investment



Rowe et al., Rev. Sci. Inst. (2015), arXiv: 1511.06011
Rowe, PhD Thesis (2015)
BBC and other news outlets, see: sequestim.com

SEQUESTIM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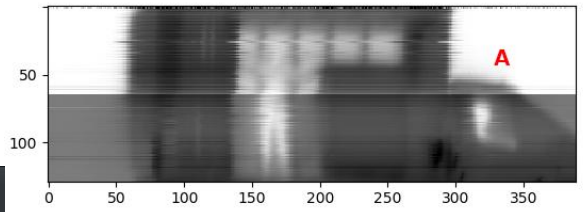
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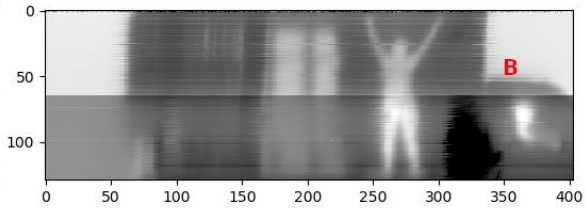
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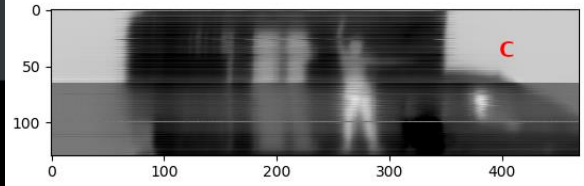
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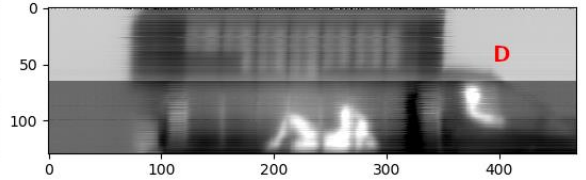
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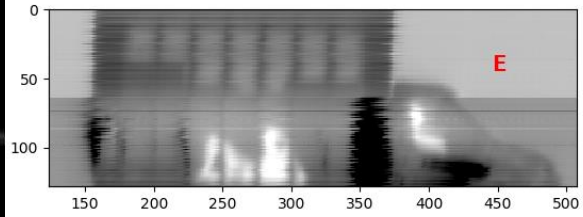
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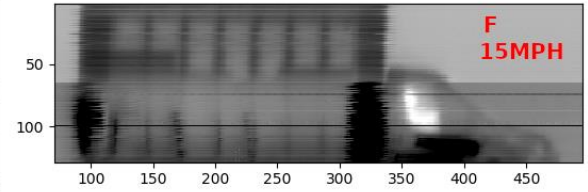
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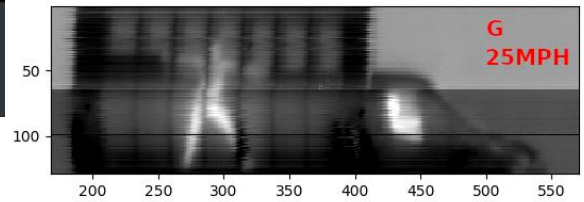
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Detector Development

- Development of multi-chroic pixels for CMB science
  - *Hornsby et al., JLTP (in review)*
- Array uniformity and yield improvements
  - *In prep.*
- Higher T_C materials (TiN)
  - *Morozov & Brien et al., JLTP (2018)*