



University of Glasgow | Department of
Physics & Astronomy

Glasgow institute interests

Richard Bates,
University of Glasgow



4D tracking

- 4D silicon sensors
 - Using LGAD or “3D” technologies
 - Build on previous and on-going work in both areas
- Pixel electronics
 - TimePix4 and beyond
- Sensor design capability
 - TCAD
- Excellent contact with fabrication vendors
 - Micron Semiconductor Ltd
 - CNM Barcelona
- Testing expertise
 - Clean room with probe stations for sensors and chips
 - Electrical & source test
 - Timing, TCT, in-house focused X-ray facility
- Radiation testing
 - In-house X-ray irradiation
 - Long term irradiation with high energy gamma source
 - Experience of radiation hardness testing
- Device design and assembly expertise
 - Design expertise in PCBs and module mechanics
 - Wire bonders, glue robots, CMM

Interconnect

- In-house Flip-chip bonder
 - Concentrating on solder
 - SET 150 flip-chip machine with integrated solder reduction
 - Nikon X-ray inspection, CT-100 non-contact profilometer
 - Qualifying for ATLAS module build
 - Dedicated engineer
- UBM & Bumps
 - Limited access at GU for 6inch wafer processing
 - 8inch wafer processing at SMC
 - Good relationship.
 - Previous projects
 - CEA LETI with 300mm bump deposition
 - Advacam with 200mm bumps, sensor UBM and Flip-chip
- Interested in wafer-to-wafer direct bonding
 - CEA LETI has expertise and interest in working with us

CMOS

- Testing expertise in CMOS
- Worked on
- HEPAPS4 – circa 2006 – 2010
- MI3 consortium
 - 11 UK universities / laboratories develop CMOS active pixel sensors (APS) and apply these sensors to a range of imaging challenges:
 - Autoradiography, a gamma camera system, radiotherapy verification, tissue diffraction imaging, X-ray phase-contrast imaging, DNA sequencing and electron microscopy

Developed:

- On-Pixel Intelligent CMOS (OPIC)—designed for in-pixel intelligence;
- FPN—designed to develop novel techniques for reducing fixed pattern noise;
- HDR—designed to develop novel techniques for increasing dynamic range;
- Vanilla/PEAPS—with digital and analogue modes and regions of interest, which has also been back-thinned;
- Large Area Sensor (LAS)—a novel, stitched LAS;
- eLeNA—which develops a range of low noise pixels.
- CMOS for particle physics - 2 PhDs, 1 post doc, 2015 – 2021.
- Ongoing collaborations with CERN and research in UK / Europe.
- Technology demonstrators: MALTA, mini-MALTA, LFoundry-A, Tower Jazz demonstrator
- Characterisation and irradi capabilities: X-rays, Lasers, TCT, irradiations, UV, MIPS
- LHCb U-II
- 25+ publications in peer reviewed journals.



Thank you for your time

