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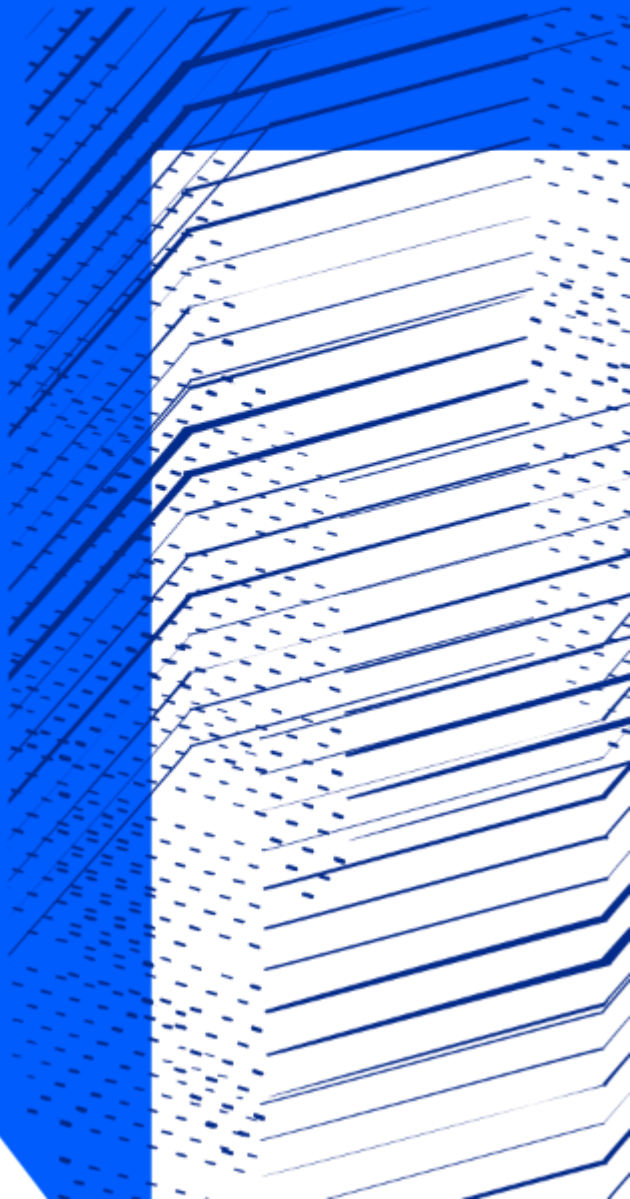
CMOS Sensor Development for Particle Physics in TD

26/04/2023



Agenda

1 CMOS Sensor Design Group

- 8 Designers, 1 Test Engineer
- Group Leader: Nicola Guerrini
- Share office with ASIC Design Group

2 Particle Physics Activities

- Electron Ion Collider/ITS3
- DECAL
- DRD Programme
- MALTA3

3 Other Activities

- Electron Microscopy: TEMAPS, QEM, C100
- Soft X-ray: PERCIVAL
- Raman Spectrometry: IRIS
- High Speed Imaging: KIRANA, TPM
- Large Area X-ray: LASSENA

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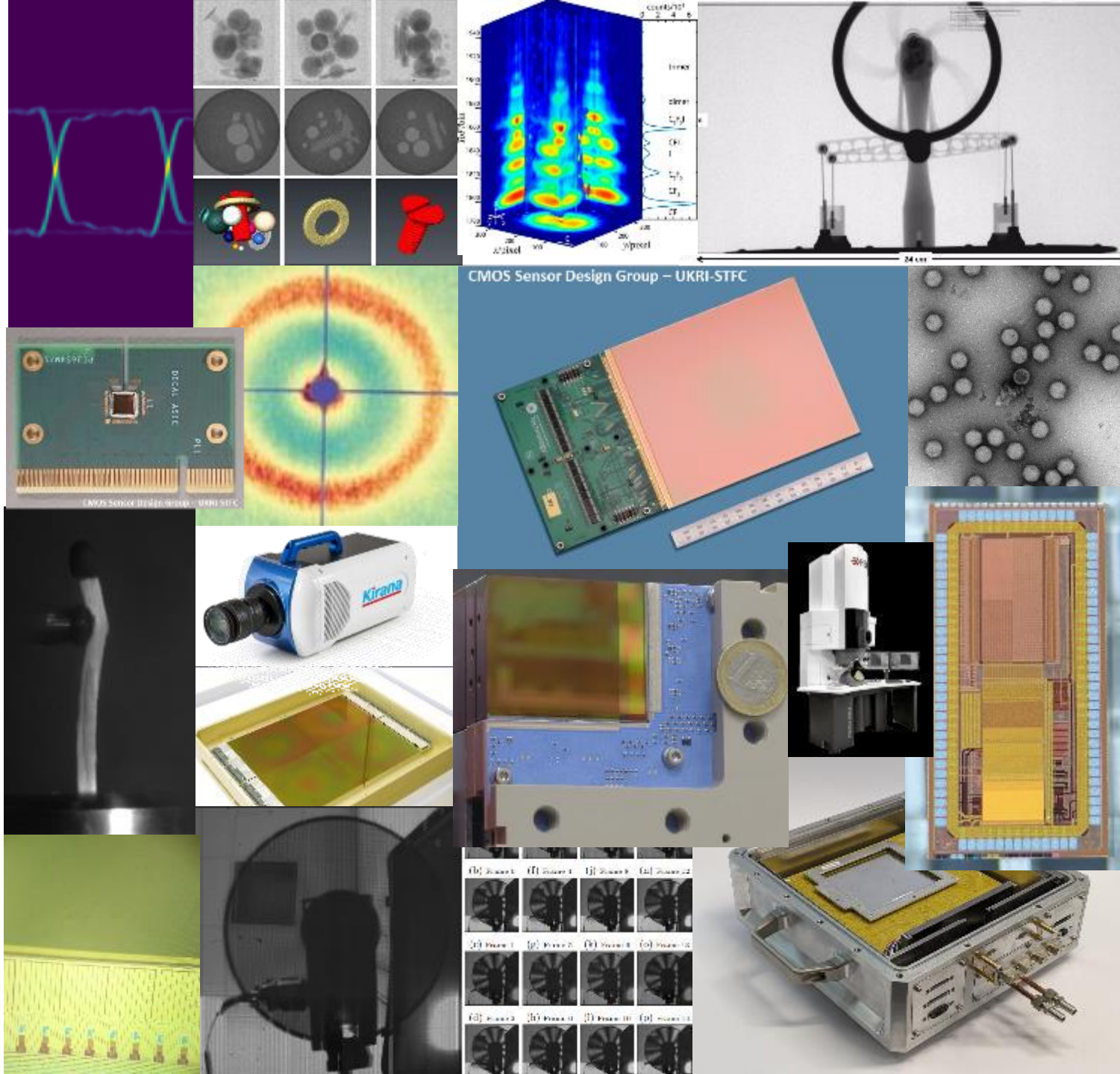

Electron Ion Collider/ALICE ITS3

What and Why?

- The EIC will be built at BNL to study role of quarks and gluons in proton structure.
- 65nm chip envisioned for the ALICE ITS3 upgrade has very similar specifications, so the goal is to use the same chip.
- Project is therefore also an opportunity to engage with CERN and work at a 65nm CIS node.

Other Personnel/Institutes Involved

- PPD, Brunel, Birmingham, Lancaster, Daresbury, Liverpool, Oxford

Schedule and Funding

- Machine operational ~2030
- UKRI Infrastructure Fund
  - Preliminary Activity
  - Full Proposal

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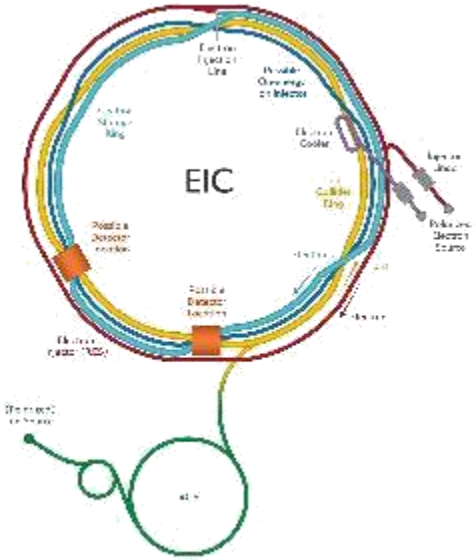
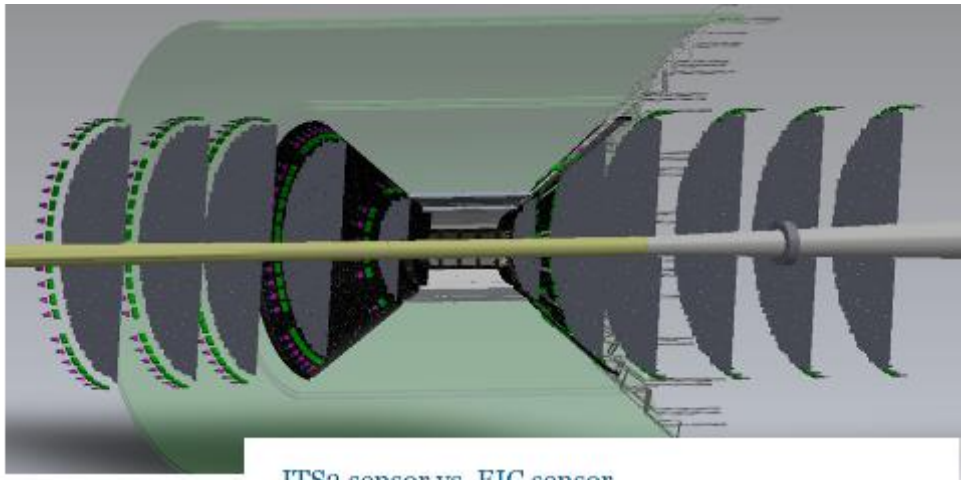
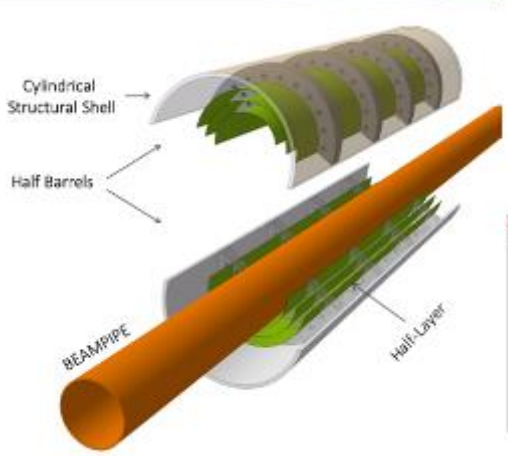
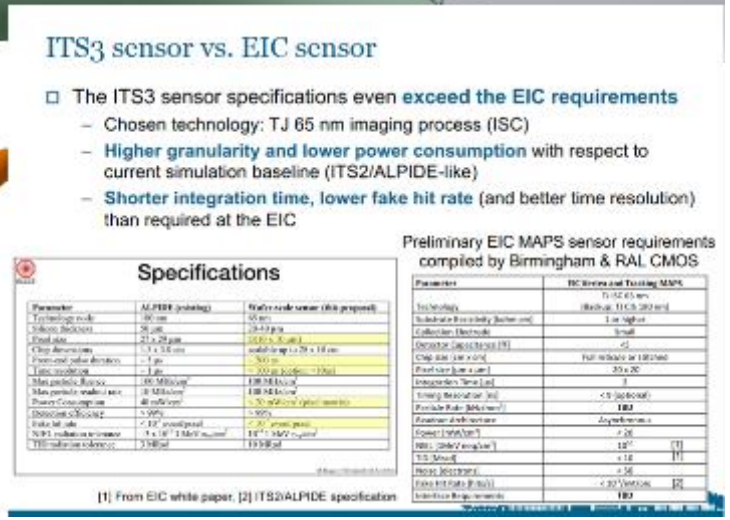




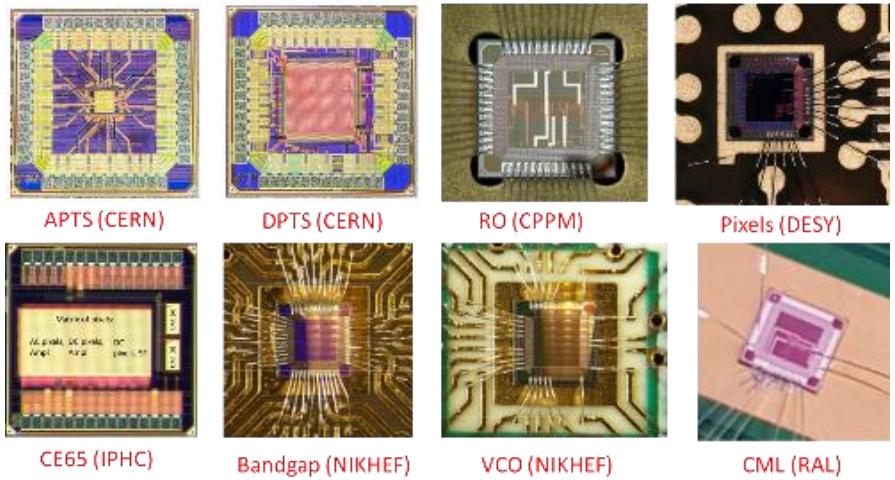


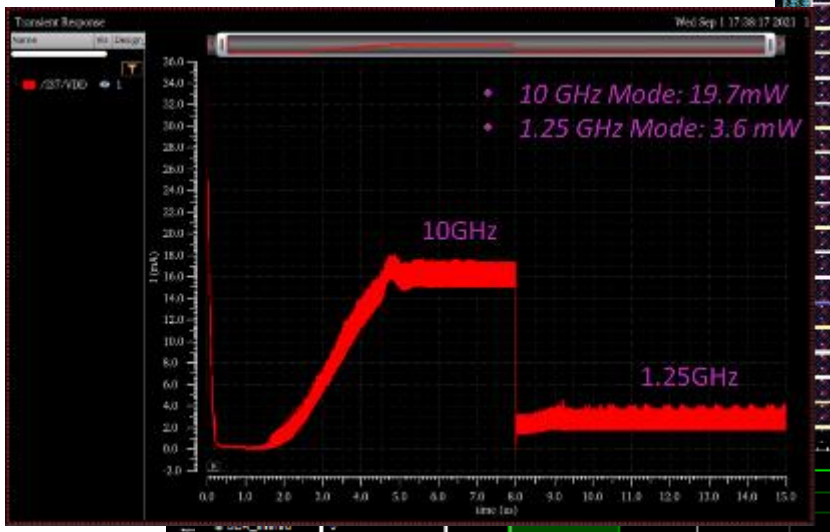


Electron Ion Collider/ALICE ITS3

Ongoing Work

- Submitted various circuit blocks in 65nm
  - LVDS-CML drivers and receivers
  - I2C block
  - PLL
- Support to development of high yield logic for MOSS
- Currently working on SLDO for serial powering and other 65nm IPs





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DECAL

What and Why?

- Demonstrator chip for Digital Electromagnetic Calorimetry
- Re-configurable to operate as strip tracker
- Counts hits/chip (pad) or hits/column (strip)
- Goal is to reduce costs with re-configurable chip

Other Personnel/Institutes Involved

- PPD, Birmingham, DESY, UCL, Humboldt

Schedule and Funding

- Currently none
- Some idea to submit a proposal to DRD6

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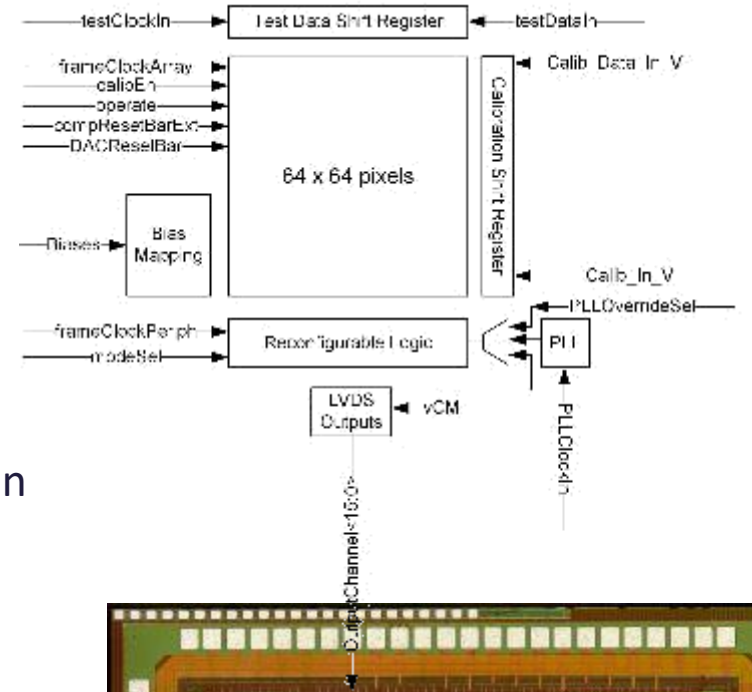

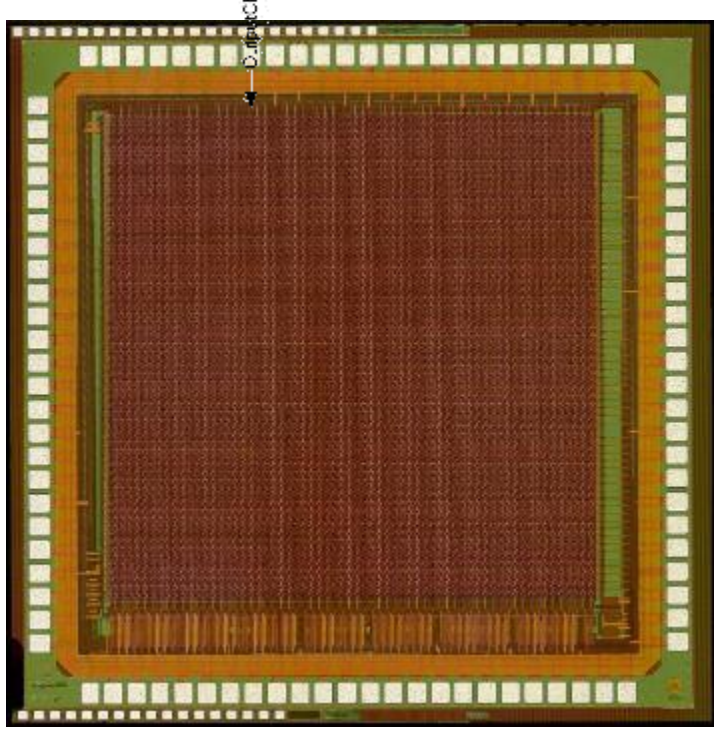

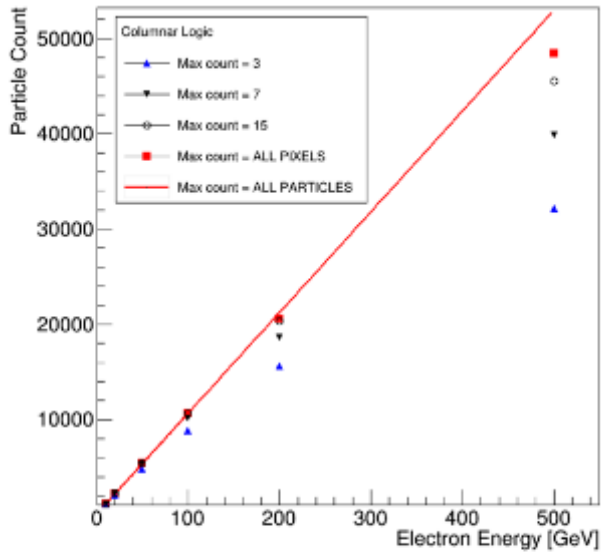

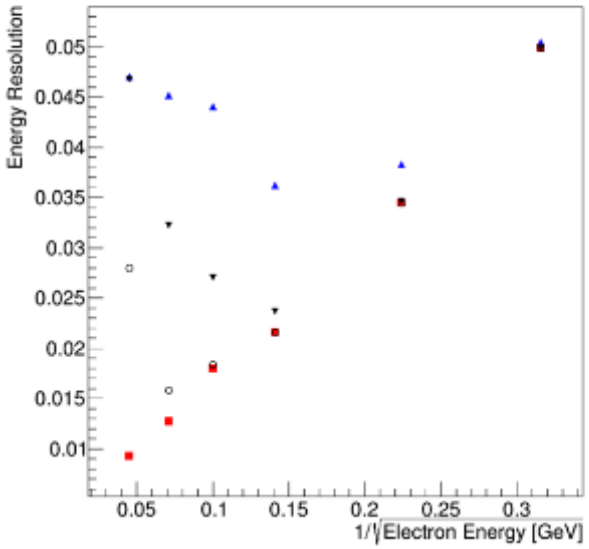

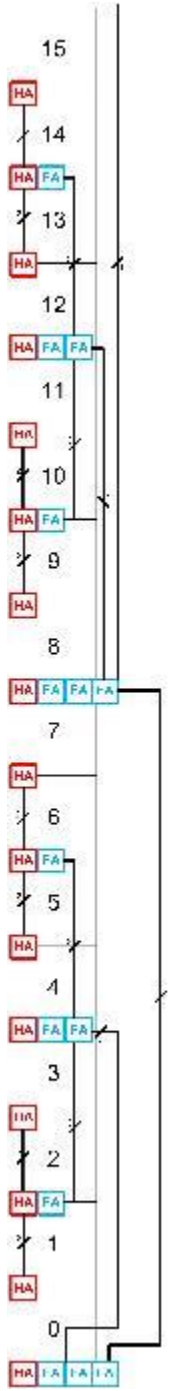

DRD Programme

What and Why?

- CERN's programme for Research and Development
- Currently starting up
- Aiming for Letter of Intent and collaboration forming later this year

Other Personnel/Institutes Involved

- Very many…
- In TD: Marcus French, Iain Sedgwick, Mark Willoughby (DRD7)…

Schedule and Funding

- Idea is that DRD approval will help release money from funding agencies

DRD1: Gaseous Detectors

DRD2: Liquid Detectors

DRD3: Solid State Detectors

DRD4: Photon Detectors and PID

DRD5: Quantum and Emerging Technologies

DRD6: Calorimetry

DRD7: Electronics and On-detector processing

DRD8: Integration

DRD9: Training

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MALTA3

What and Why?

- MALTA family is technology demonstrator for high granularity, high radiation hardness MAPS
- Approached about providing previously developed high speed serialiser to be used in the design

Other Personnel/Institutes Involved

- CERN

Schedule and Funding

- Currently none
- Some CfI last year, but difficult to respond rapidly to such requests

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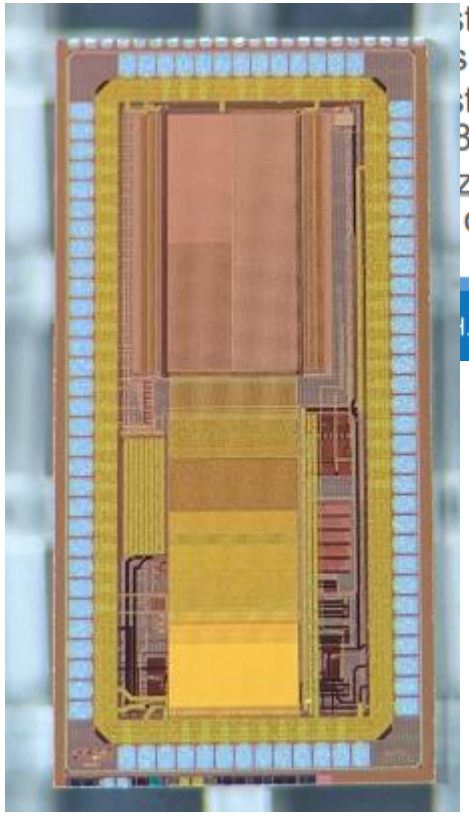
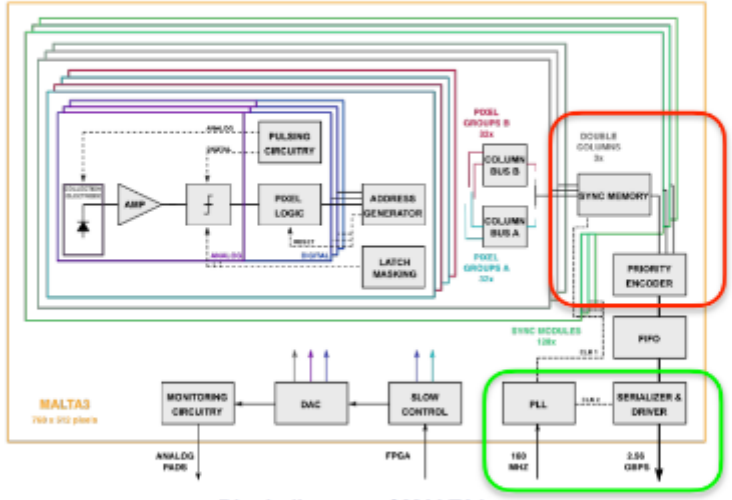


Outlook: MALTA3 with integrated hit time tagging

- Integrate time-stamping and data serialiser directly on sensor in periphery
- Developed in same TJ180 process as MPW chip (submission 2023)

- Modular 24-column block design to scale to desired sensors matrix size up to full-reticle size (2x3 cm)
- Improved timing reference pulse and masking
- tamping of on-chip tamping logic 3GHz zed high- output



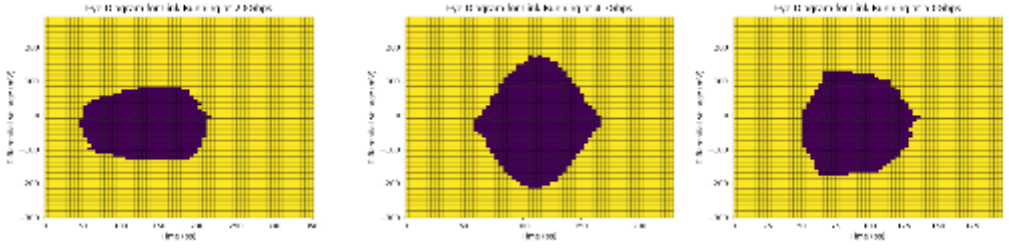
Block diagram of MALTA3

New for MALTA3 5-bit fine time synchronisation memory & readout logic

STFC "Precise" chip (PLL & serialiser already demonstrated on silicon)

D. Dobrijevic TWEPP 2022

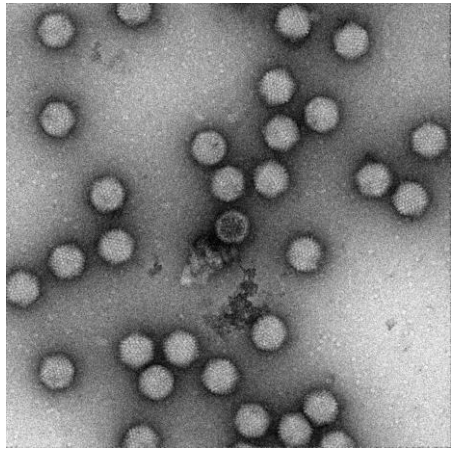
.Pernegger (CERN) Vertex2022 workshop

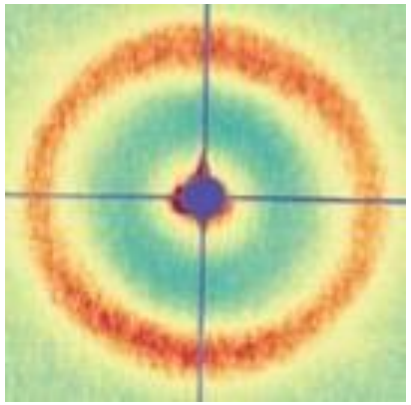


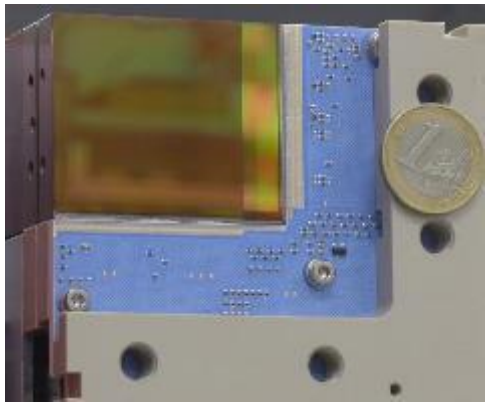
Other Activities

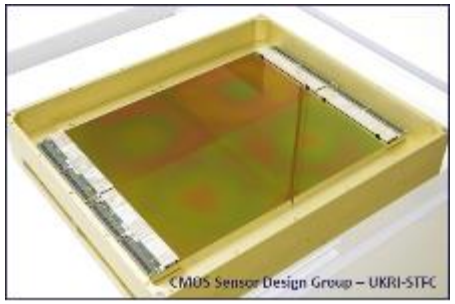
Also active in other fields

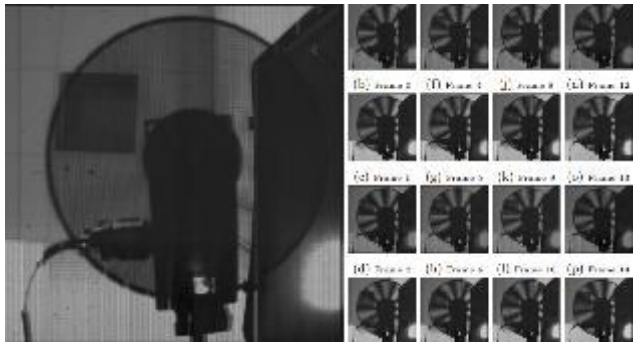
- Electron Microscopy: TEMAPS, QEM, C100
- Soft X-ray: PERCIVAL
- Spectrometry: PImMS, IRIS
- High Speed Imaging: KIRANA, TPM
- Large Area X-ray: LASSENA

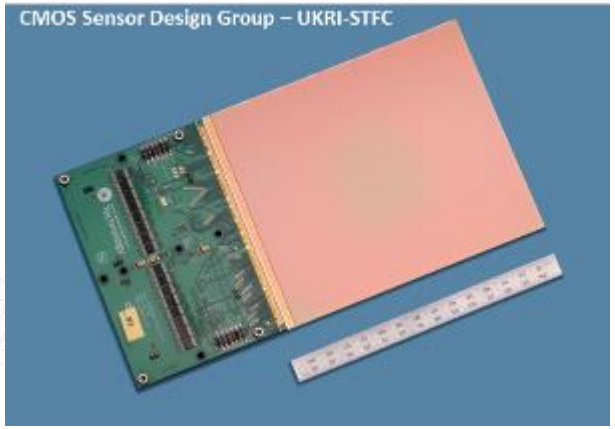


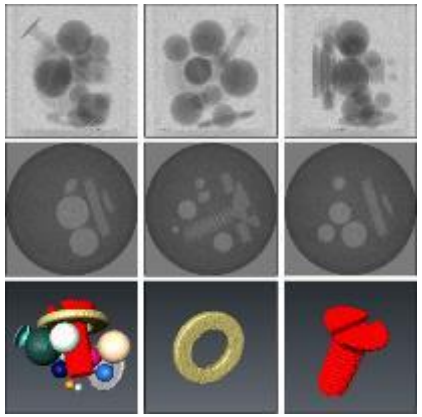


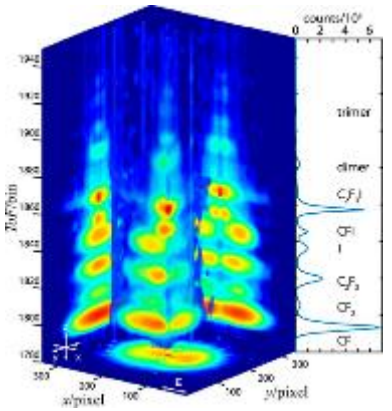












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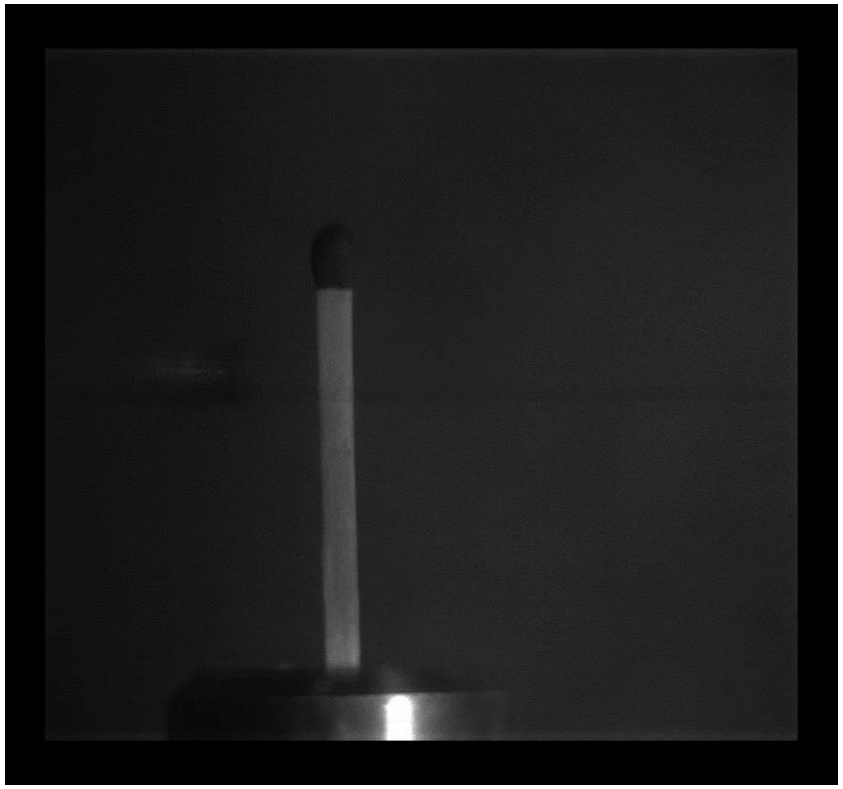
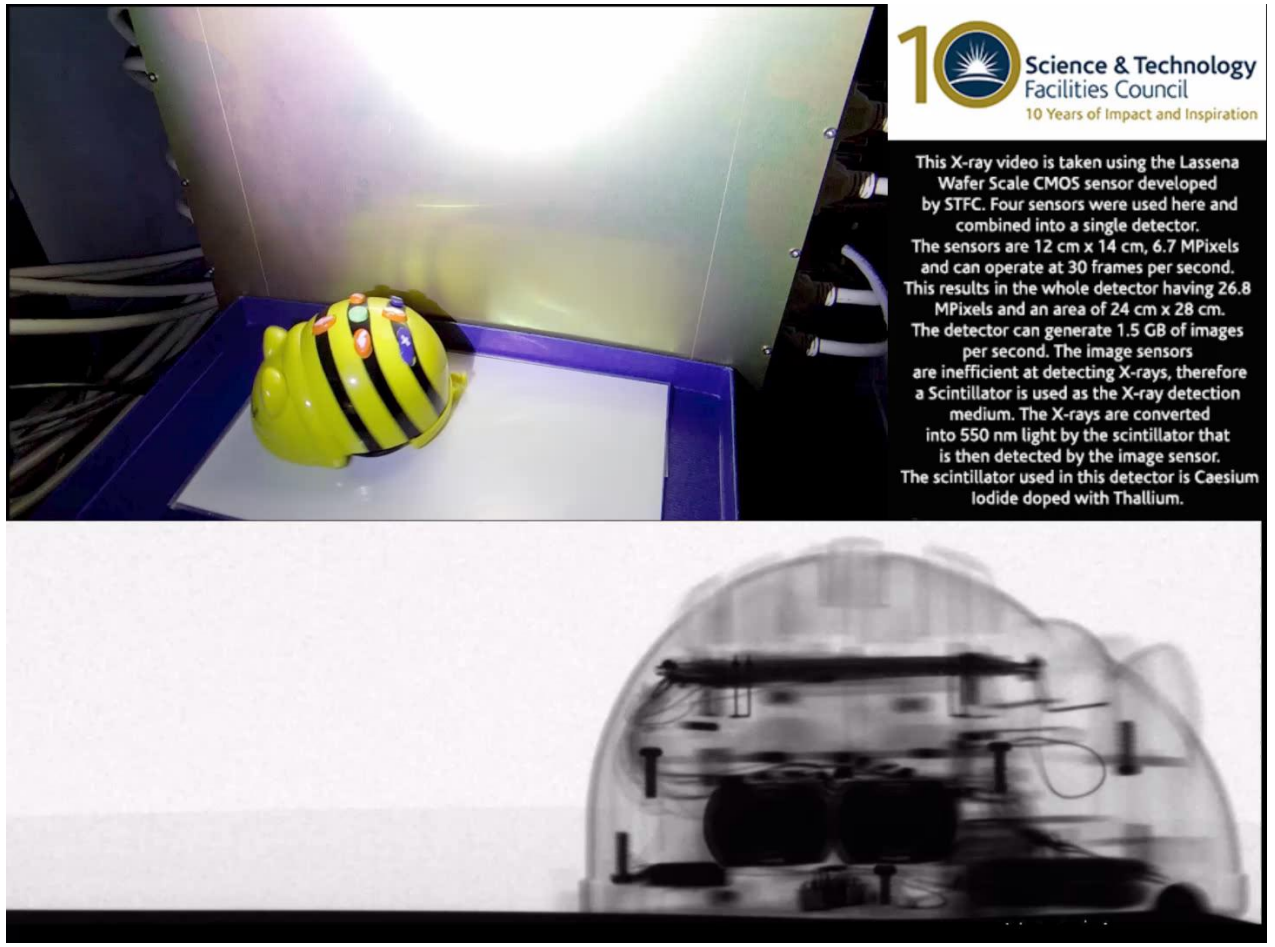
Thanks for your attention!





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Questions?

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Thank you