

Sub-micron Pixels (Particam)

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Particam Intro

- A novel concept for a fully digital particle detector.
- Enables pixel sizes with better spatial resolution below 1um.
- Advantages of power consumption, readout speed and reduced thickness.
- Two sensor types; Particam 1 and Particam 2.



Particam 1

- Inspired by the memory cell technology (0 & 1).
- No analogue frontend.
- No analogue amplification means tens of nm improvement of spatial resolution range.
- Direct conversion of ionization trail to a digital signal (a single bit).
- Very high probability of a state change induced by crossing ionising particles.
- Threshold Charge (Q_{crit}) toggling the circuit.







First Attempt

Current

Particam 1 for Neutron sensing

- Device coated with a neutron converter boron carbide.
- Samples coated successfully.
- For use as neutron sensors.

Particam 1 Measurements

- Laser measurements at the atom interferometry lab.
- Reconstruct the beam spot by integrating over multiple frames.
- Fitted beam centres for the different pulse lengths, agree within 3 pixels (1pixel = 2um) in one and 4 pixels in the other direction.





Particam 1 Measurements

- Fitted beam centres for the different pulse lengths, agree within 3 pixels (1pixel = 2um) in one and 4 pixels in the other direction.
- Thanks to the atom interferometry group for the support.









Alpha Measurements

• In collaboration with the CTL.

Hit Count (log)

- Source characterization by the nuclear structure group.
- Hits for different source distances, r (mm).



Particam 2

- Not fully digital.
- Bigger structures than Particam 1. Particam1 was 65nm UMC, Particam2 is 110nm Lfoundry.
- Particam2 has 4 TCT structures implemented on the top of the chip. Chip designed by FBK, test structures by Liverpool.

Particam 2

• IV measurements with a significant HV and depletion.





Particam 2 TCT Measurements

Confirms the IV results.

31122

341.2

313.9

160.3

145.8

100

200

300

Entries

Mean x

Mean y

RMS x

RMS v

y [μm]

500

400

300

200

100

- Performed at the University of Manchester.
- The metal traces are 1.5um wide.



Next Steps

- Measurements using coated Particam 1.
- Commissioning of Particam 2.
- **Particam 3** at 22nm GlobalFoundries FD-SOI and/or 65nm TPSCo (submission organised by CERN). Design will be led by Liverpool.
- Thanks.....