MALTA monolithic CMOS pixel sensors in Tower 180 nm technology

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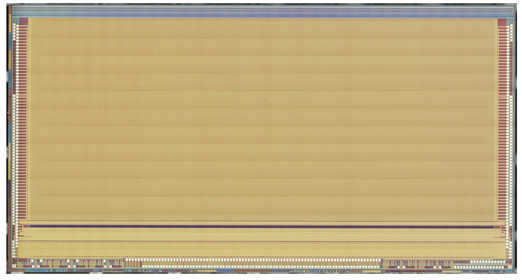
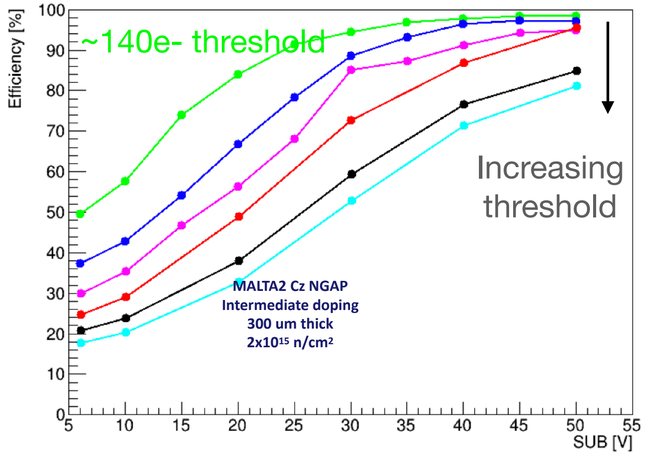
MALTA = Radiation hard small pixel CMOS sensor for tracking

MALTA sensor parameters and performance

- Pixel Pitch pixel size 36.4x36.4μm^2
- Matrix size 512 x 512 pixel (MALTA1) and 512 x 224 pixel (MALTA2)
- Asynchronous readout architecture to stream all hit data to output (trigger-less operation)
- Sensors data daisy-chain for sensors-to-sensor data transmission
- sensor thickness optimised to application 50μm to 300μm on Cz-substrate
- full efficiency (>98%) 2 x$10^{15} n_{eq}/cm^2$
- TID radiation hardness tested OK to 100Mrad
- time-resolution <2ns
- threshold after irradiation 120 e-



MALTA2 efficiency >98% after 2 x$10^{15} n_{eq}/cm^2$ irradiation



- Good performance of Cz samples at 2x10^{15} n/cm^2
- Expected uniformity at lowest threshold setting
- Cluster size increases with substrate voltage
  - Maximum at ~1.9 at 50 V at 120 e-
- Efficiency better than 98% at 50 V bias at 120 e-

MALTA2 time resolution in beam tests ~2ns

- Time of arrival of leading hit in the cluster w.r.t. scintillator reference
  - Included scintillator jitter : 0.5 ns
  - Signal latching at FPGA: 3.125/sqrt(12) = 0.9 ns
- Timing distribution integrated on full chip after correction in X and Y direction:
  - Y correction due to time propagation across the column (linear behaviour)
  - X correction compensates for non-uniformities in chip response