Bandwidth studies on MIMOSIS for the CBM-MVD

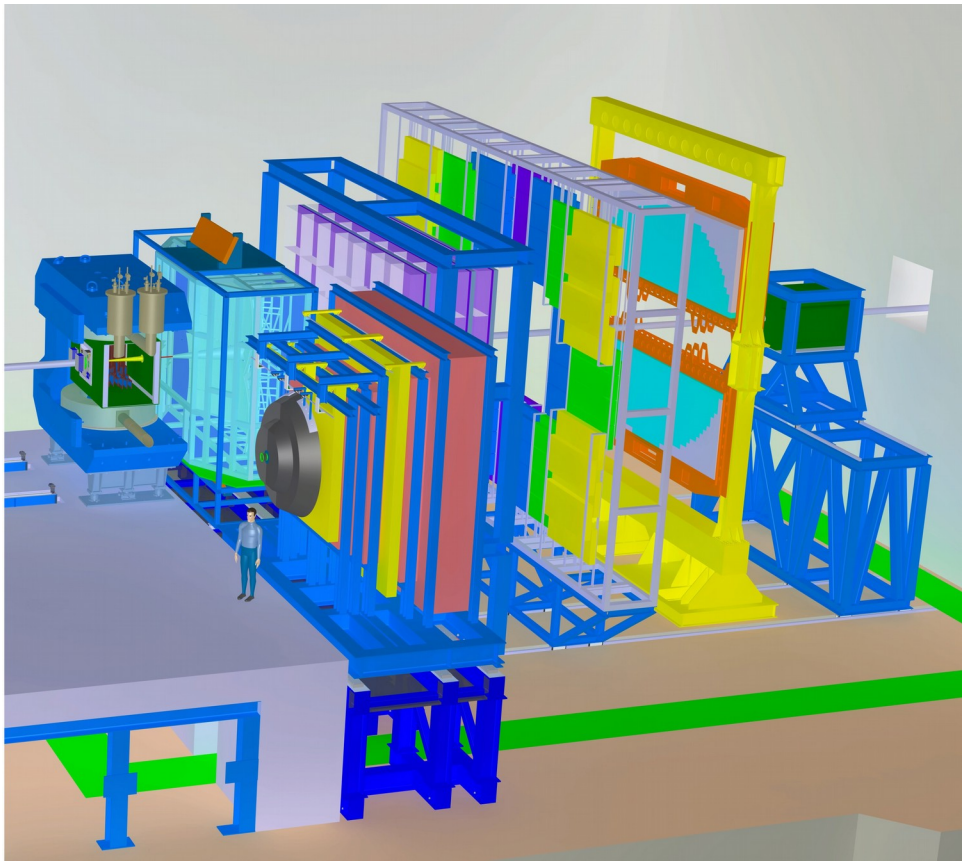
IKF Institut für Kernphysik Frankfurt

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

HIC for FAIR Helmholtz International Center

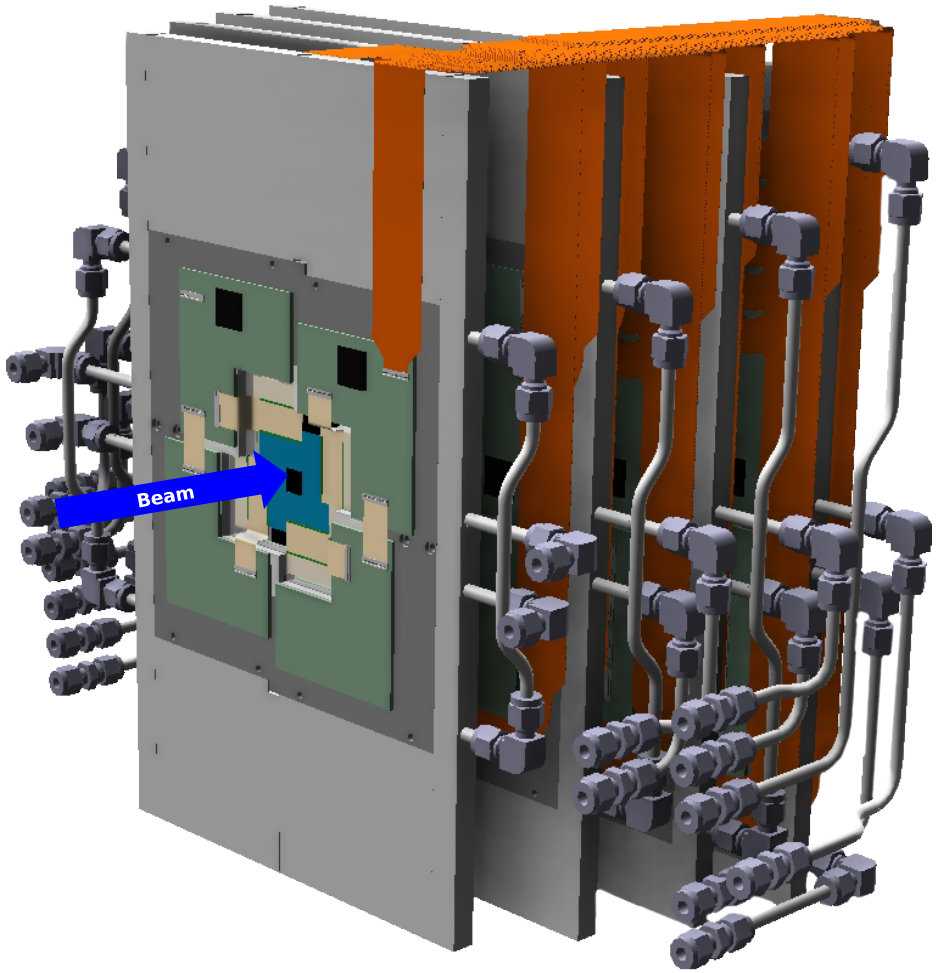
HGS-HIRe for FAIR Helmholtz Graduate School for Hadron and Ion Research

CBM @ FAIR



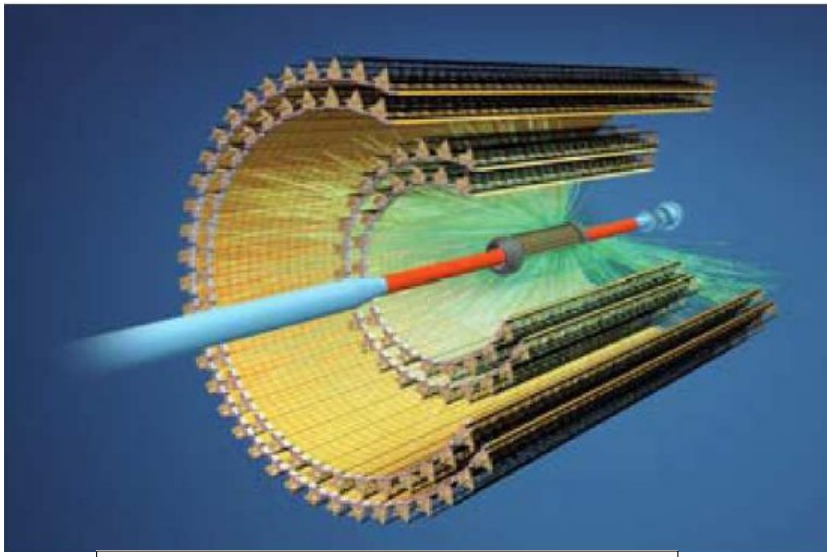
- **Fixed target heavy ion experiment**
- **High rates**
  - 100 kHz Au beam
  - 10 MHz Proton beam
  - 10x higher without MVD

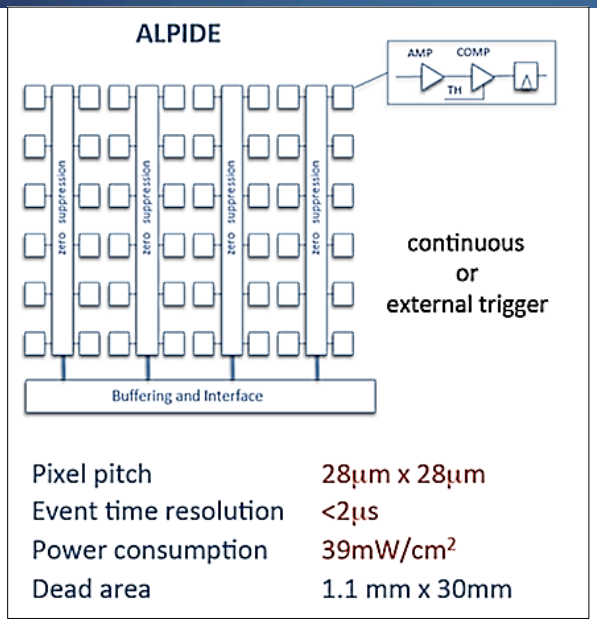
The Micro Vertex Detector for CBM



- **High resolution vertex detector**
- **physics goals**
  - Open charm off vertex decay
  - Near vertex tracking
    - Short tracks
    - Multi-strange hyperons
    - Dilepton background

MIMOSIS

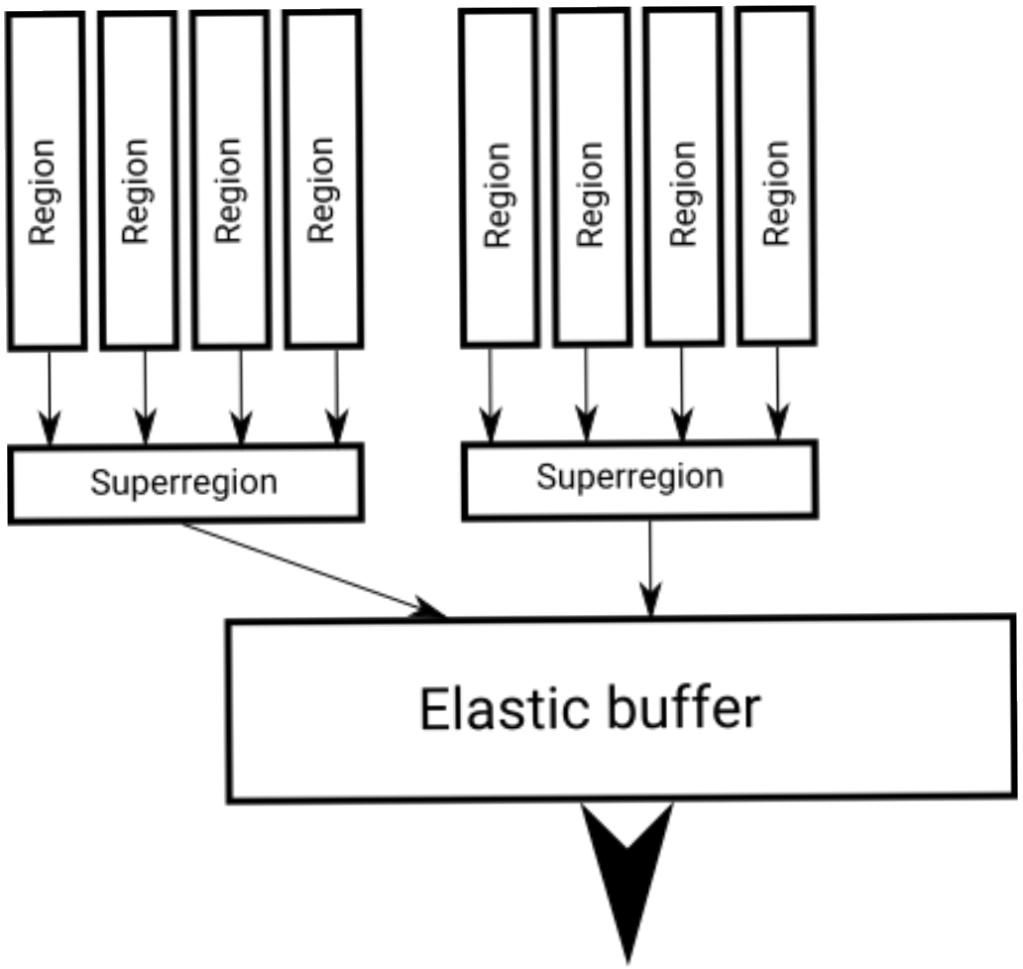




Pixel pitch	28μm x 28μm
Event time resolution	<2μs
Power consumption	39mW/cm^2
Dead area	1.1 mm x 30mm

- **ALPIDE like pixel**
- **Discriminator in pixel integrated**
- **Continuous readout**
- **Internal multi buffer structure**

New sensor readout design



64 Regions per sensor

16 Superregion per sensor

Flexible buffer to match r/o bus speed

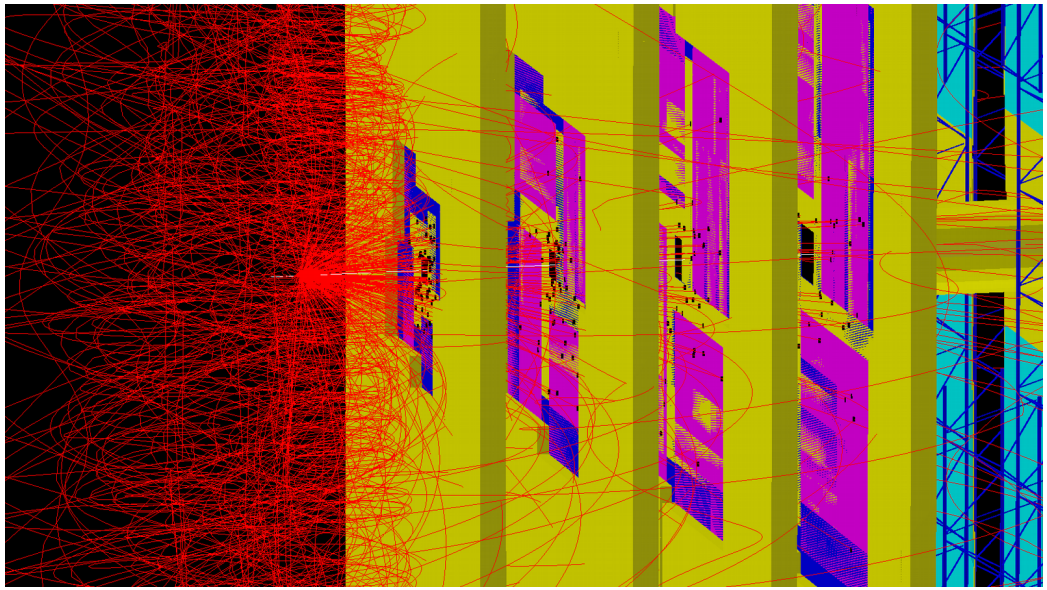
Bus with max r/o 2.5 Gbit/s.
Average of 800 words / frame

MIMOSIS design goals

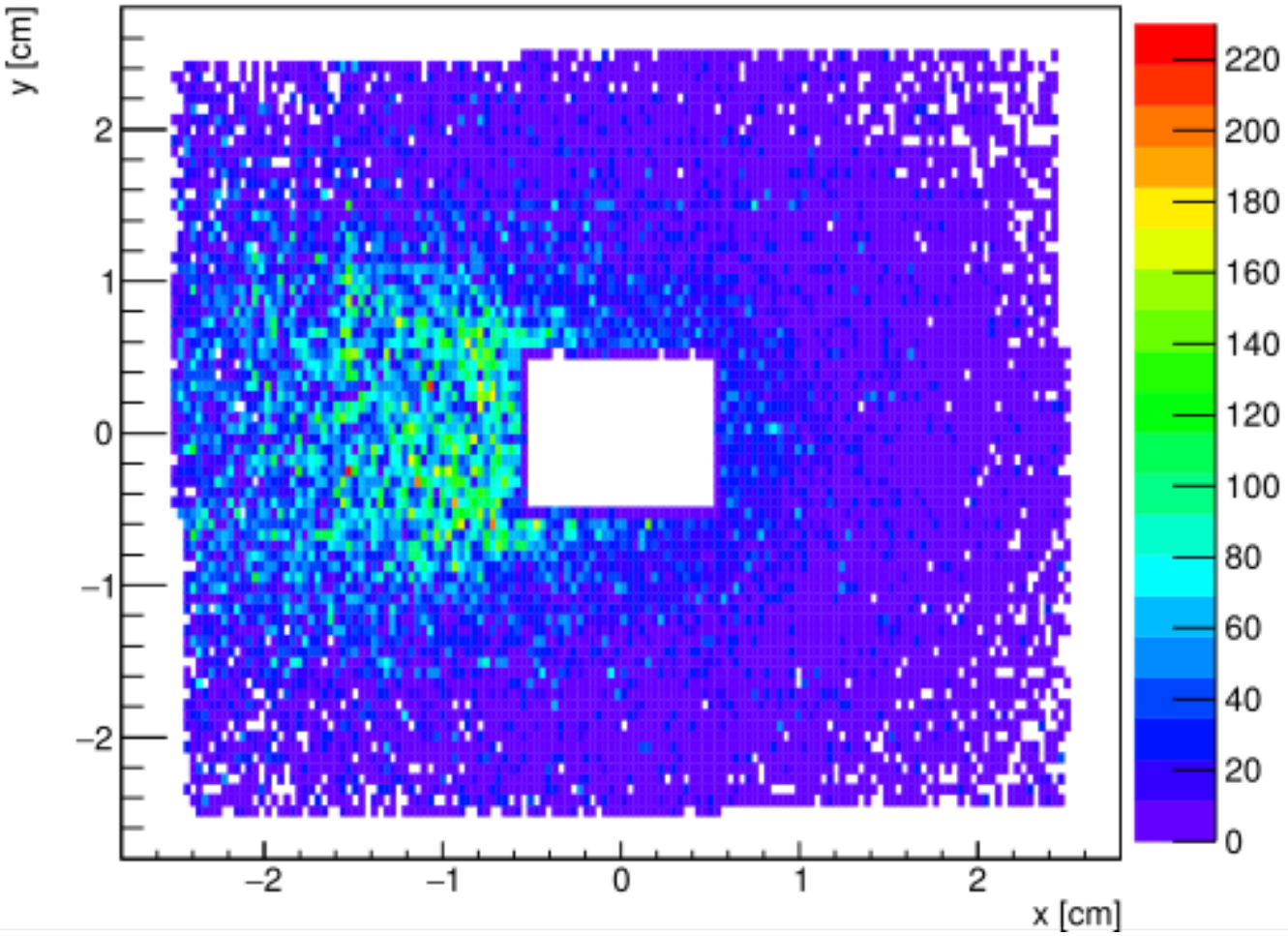
Design goals	MIMOSIS
Radiation tol. ionizing	3 Mrad, > 500krad/week
Radiation tol. non-ionizing	$> 3 \times 10^{13} n_{eq}/cm^2$
Rate capability (Au+Au)	100kHz + 3x margin
Rate capability (p+Au)	10 MHz + 3x margin
Time resolution	2.5µs – 10µs, likely 5µs
Data interface	Details to be discussed
Spatial resolution	< 5 µm
Depletion voltage	2-20V

Event input definitions

- **Au x Au 10 AGev @ 100 kHz**
  - 50 delta electron Events
  - (0.5 →) 1 centr urqmd Event
- **Au x Au 10 AGeV with beam fluctuations**
  - 150 delta electron Events
  - (1.5 →) 2 centr urqmd Events



Au x Au @ 10 AGeV 100kHz



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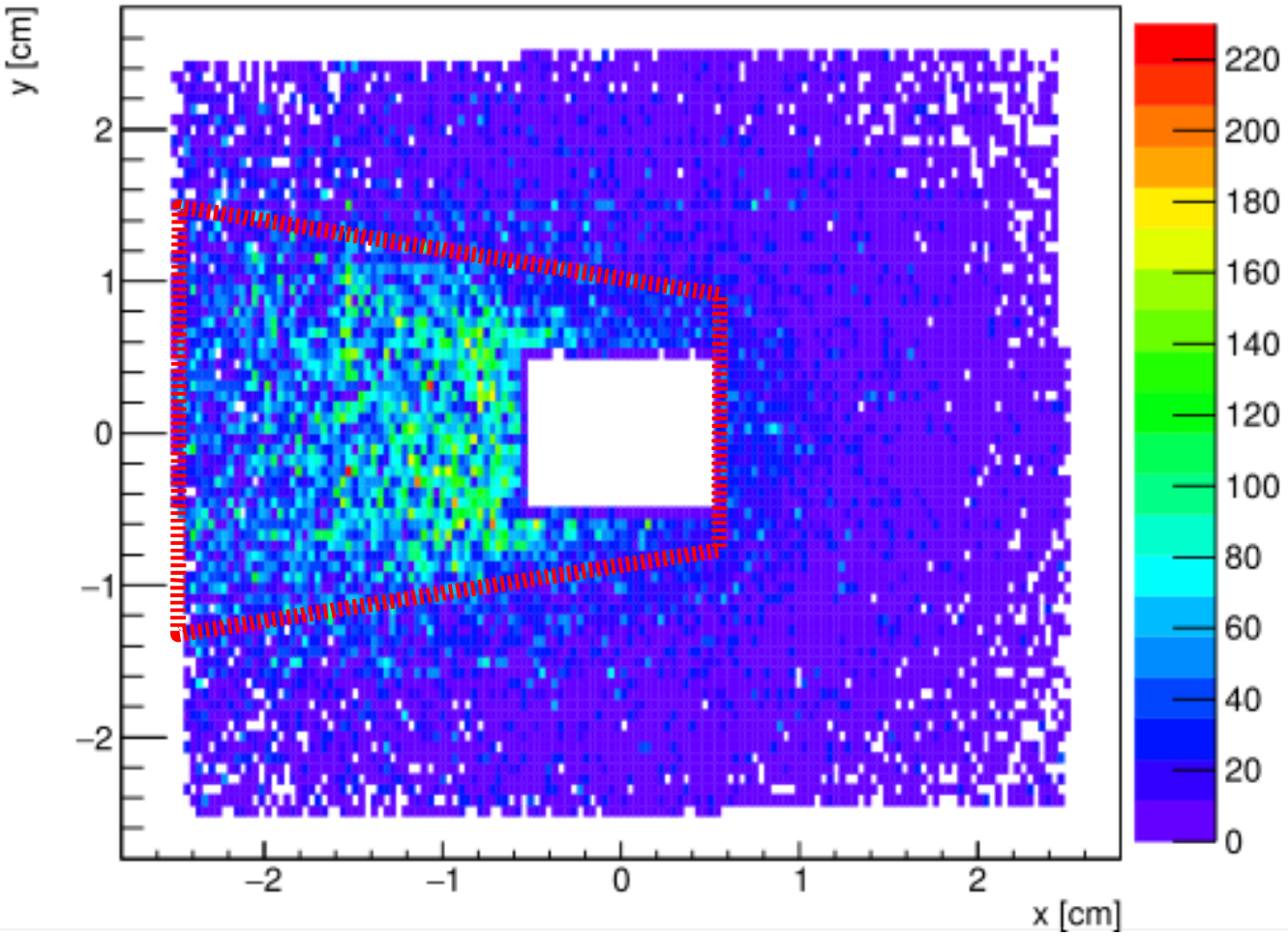
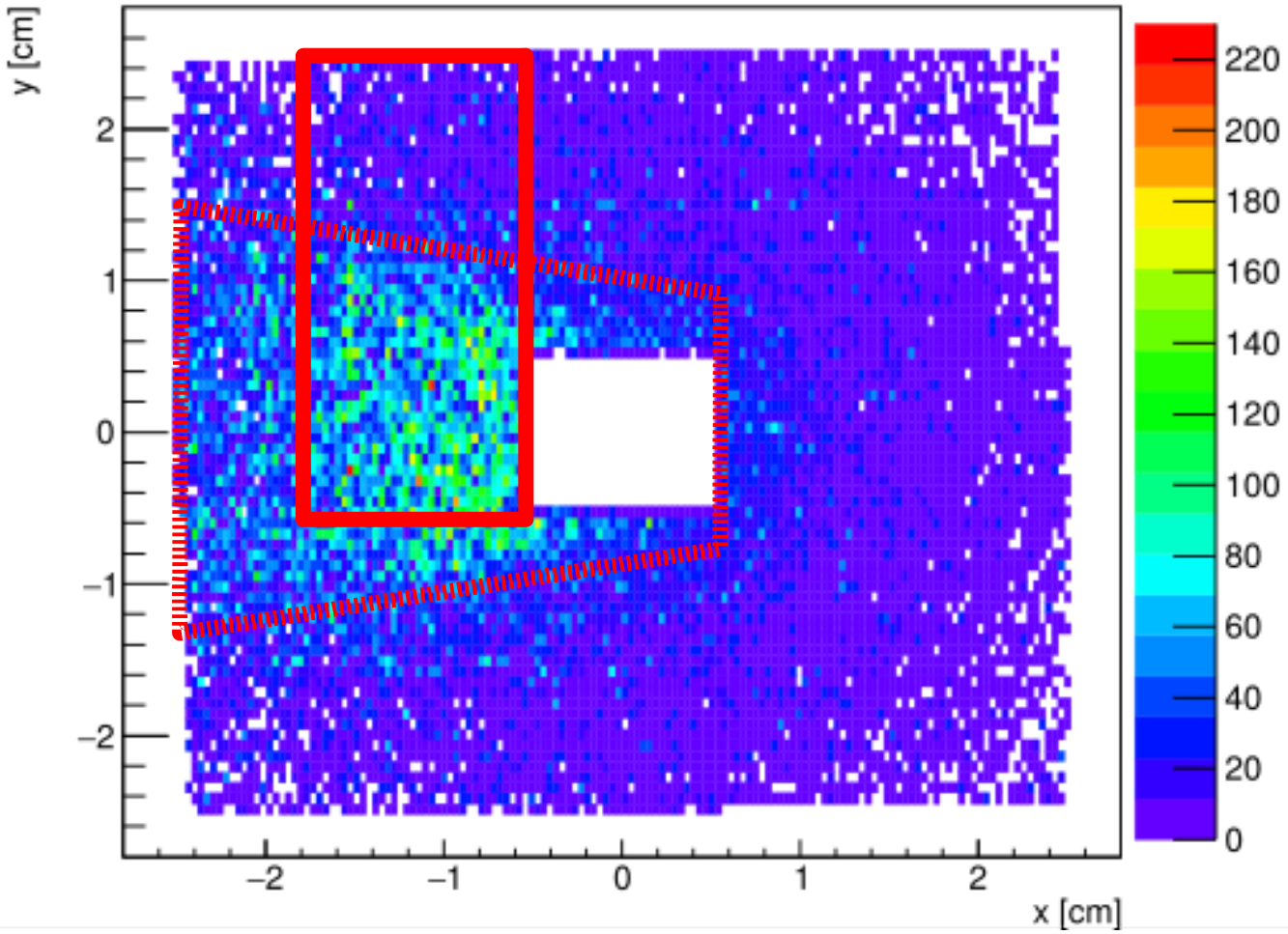


Delta Electrons dominate occupancy

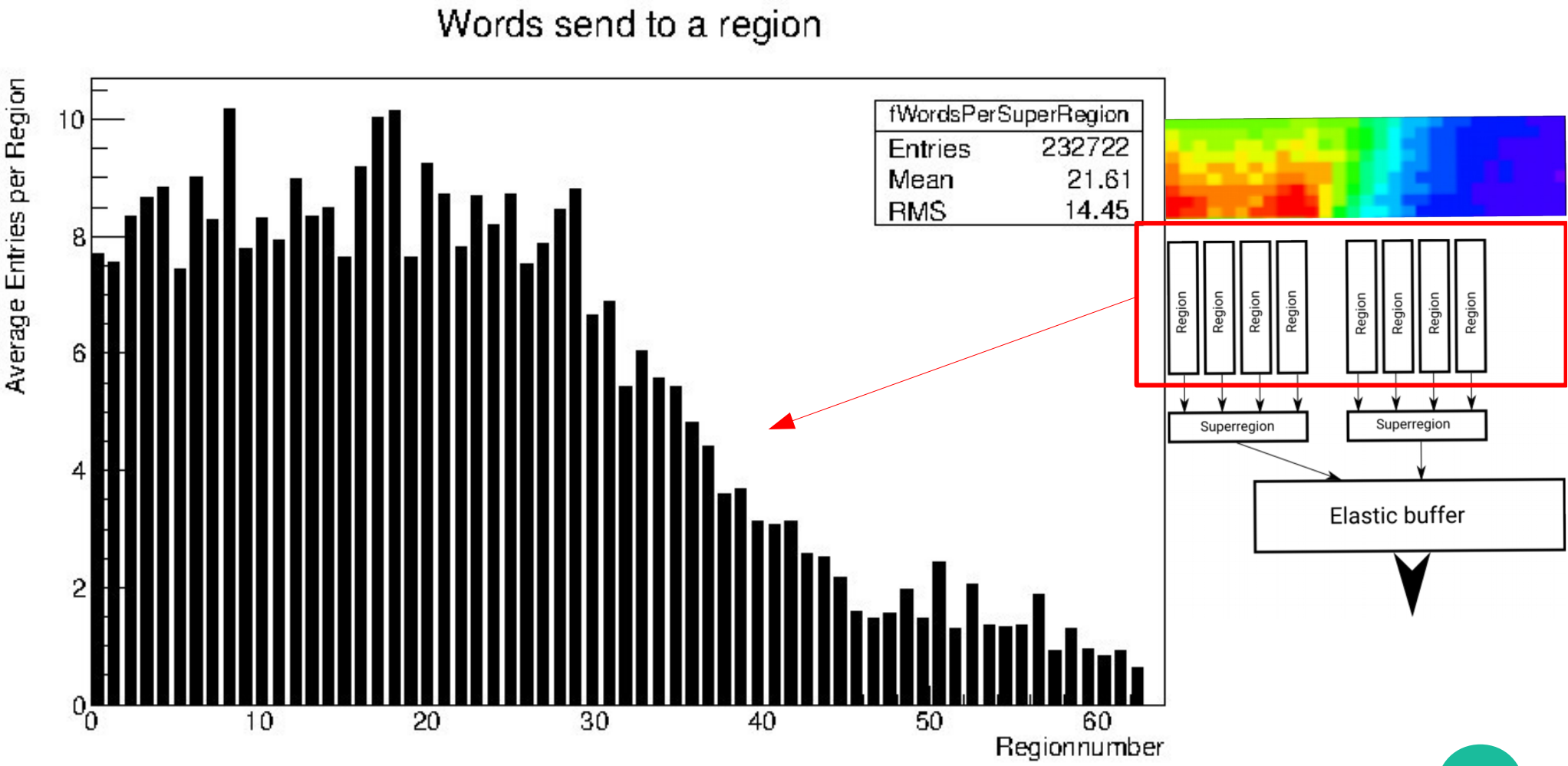
Au x Au @ 10 AGeV 100kHz



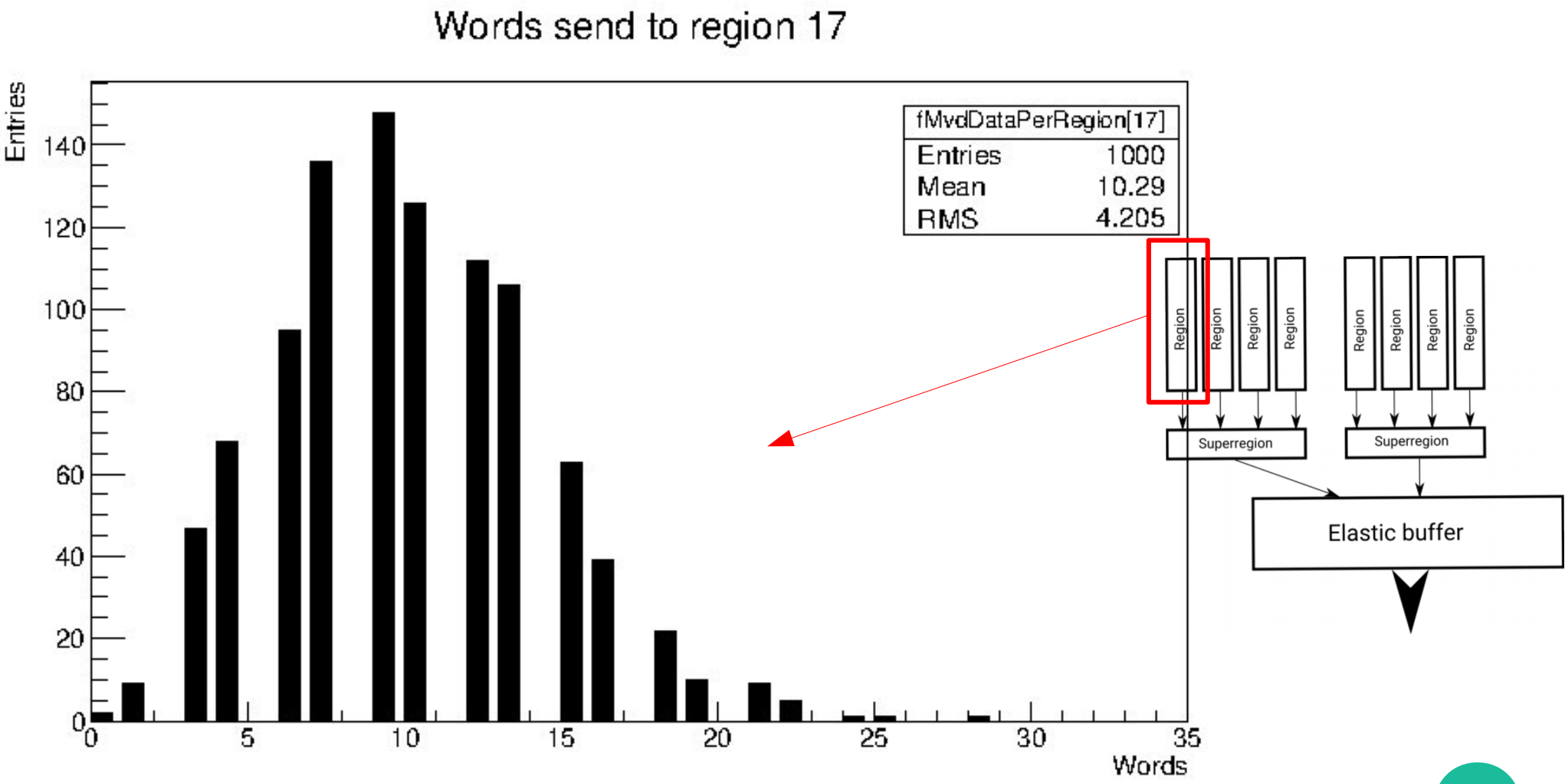
Delta Electrons dominate Occupancy

One sensor is critical

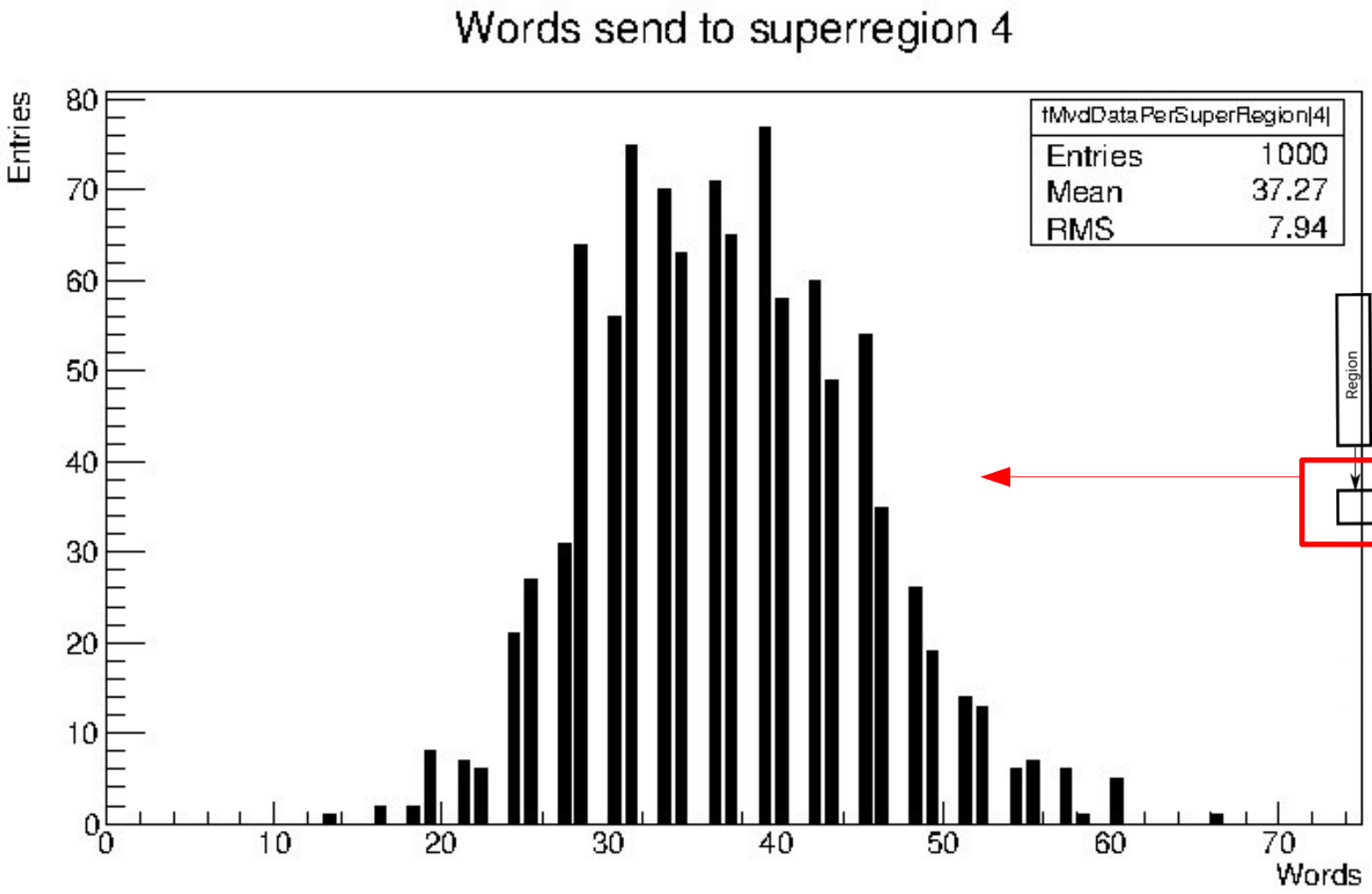
Au x Au 10 AGeV 100kHz

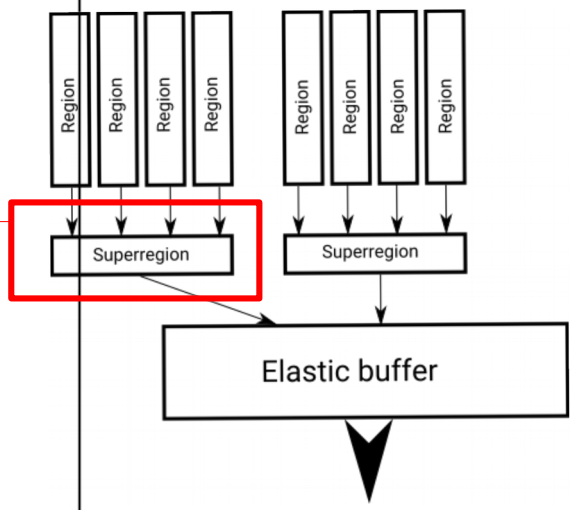


Au x Au 10 AGeV 100kHz

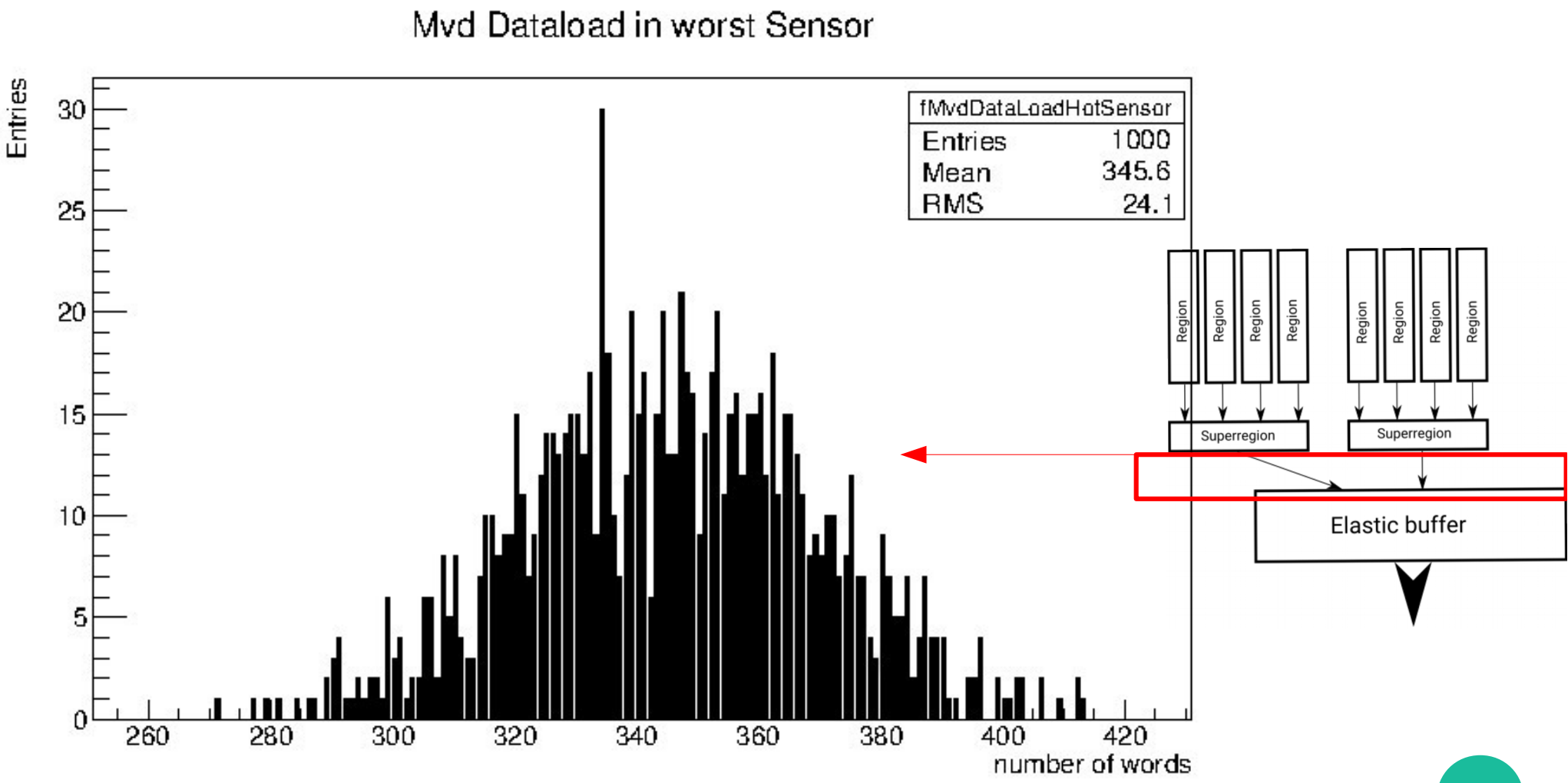


Au x Au 10 AGeV 100kHz



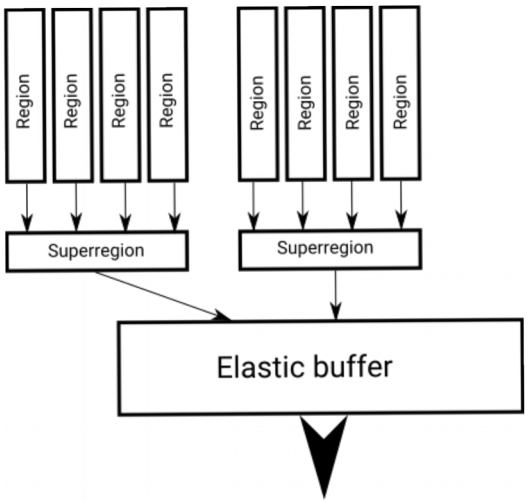


Au x Au 10 AGeV 100kHz

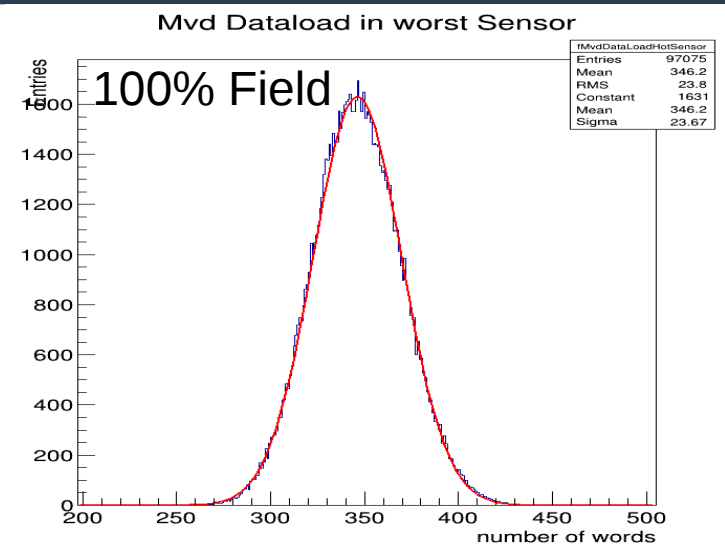


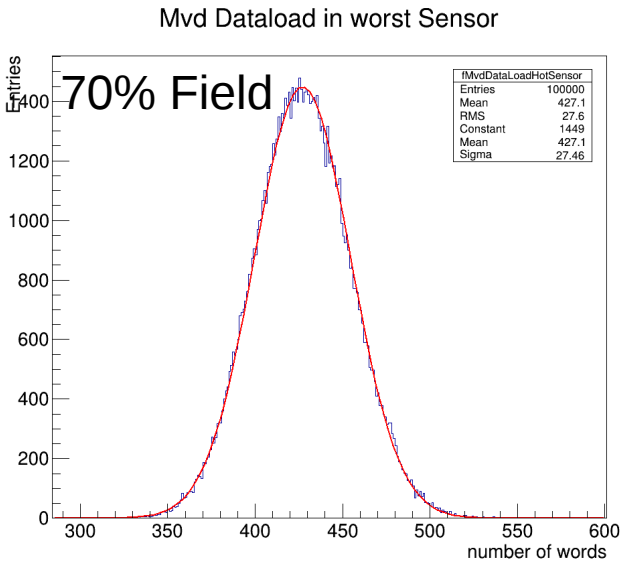
Overview

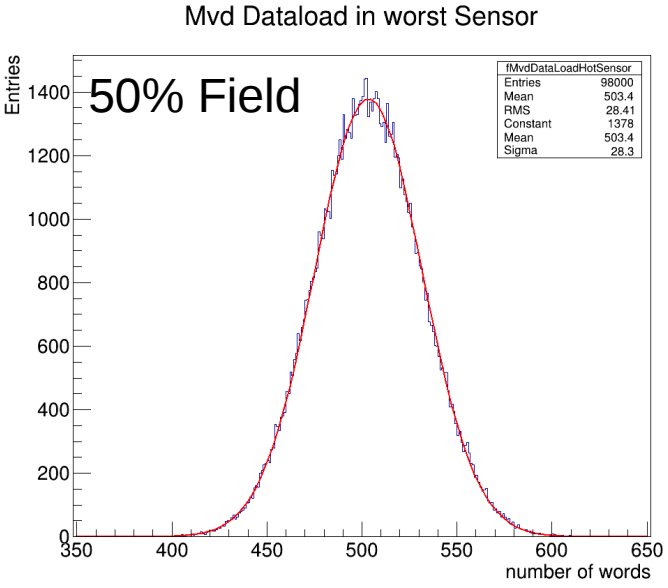
Component	average	Maximum (3x avarage + stat. fluctuations)
Region	10 words	55 words
Superregion	37 words	135 words
Elastic-Buffer input	345 words	1070 words

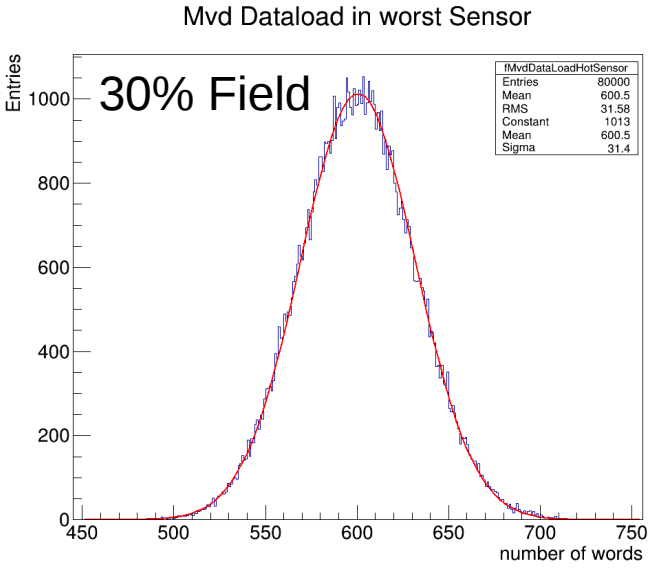


reduced field studies, average beam



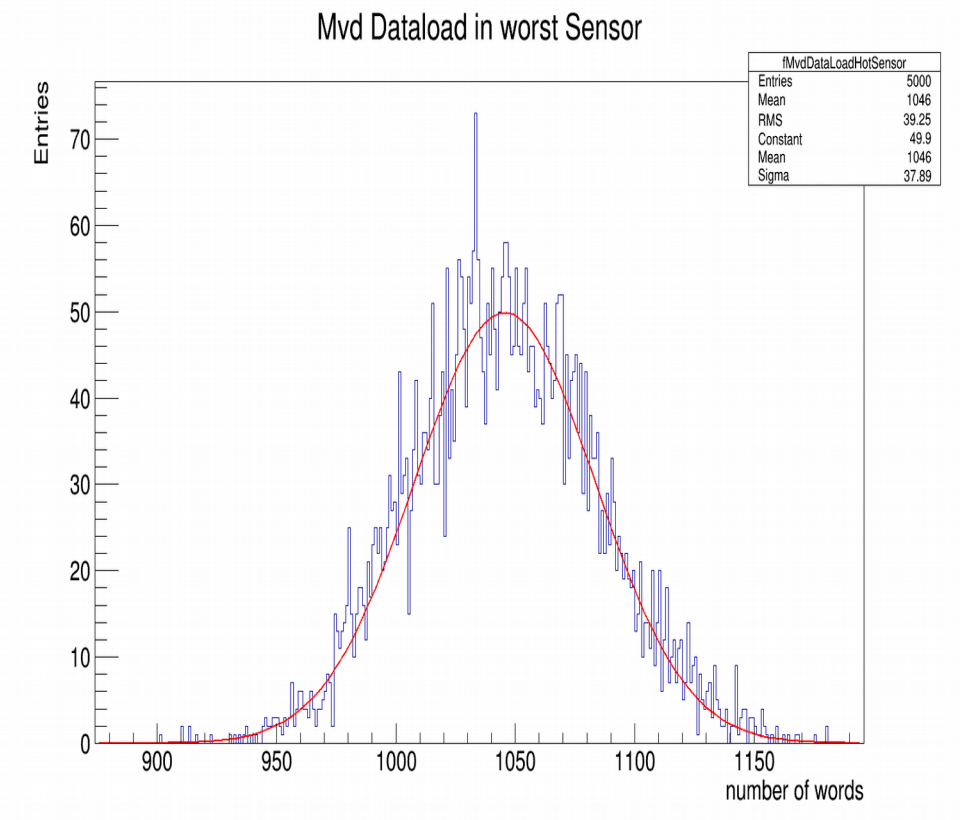




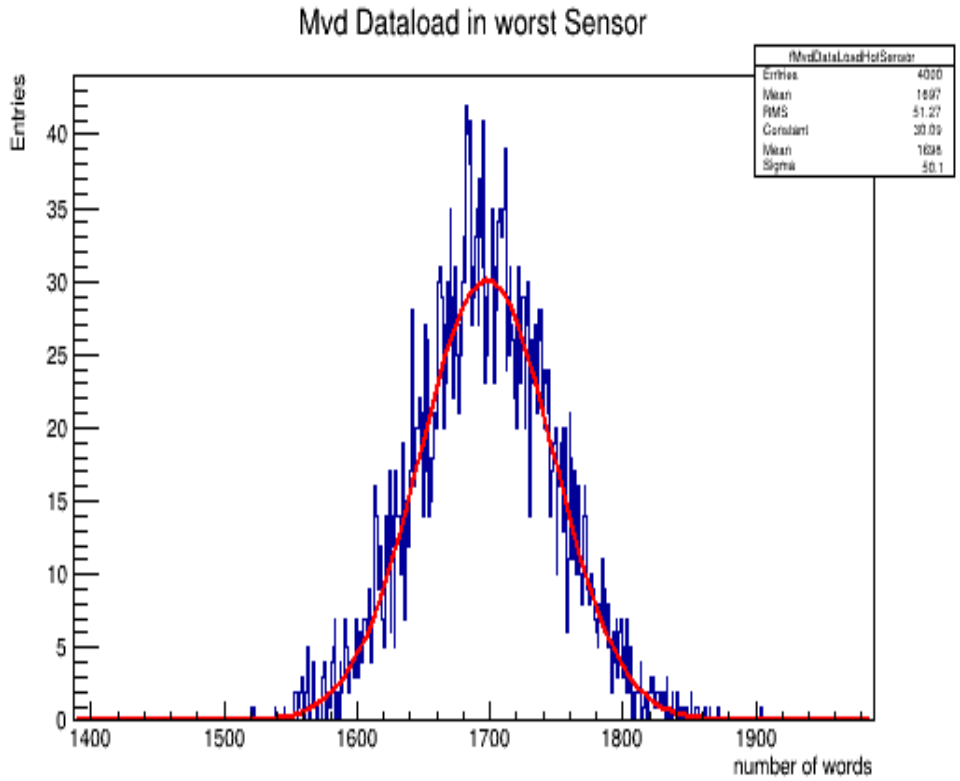


reduced field studies, beam fluctuations

100 % Field



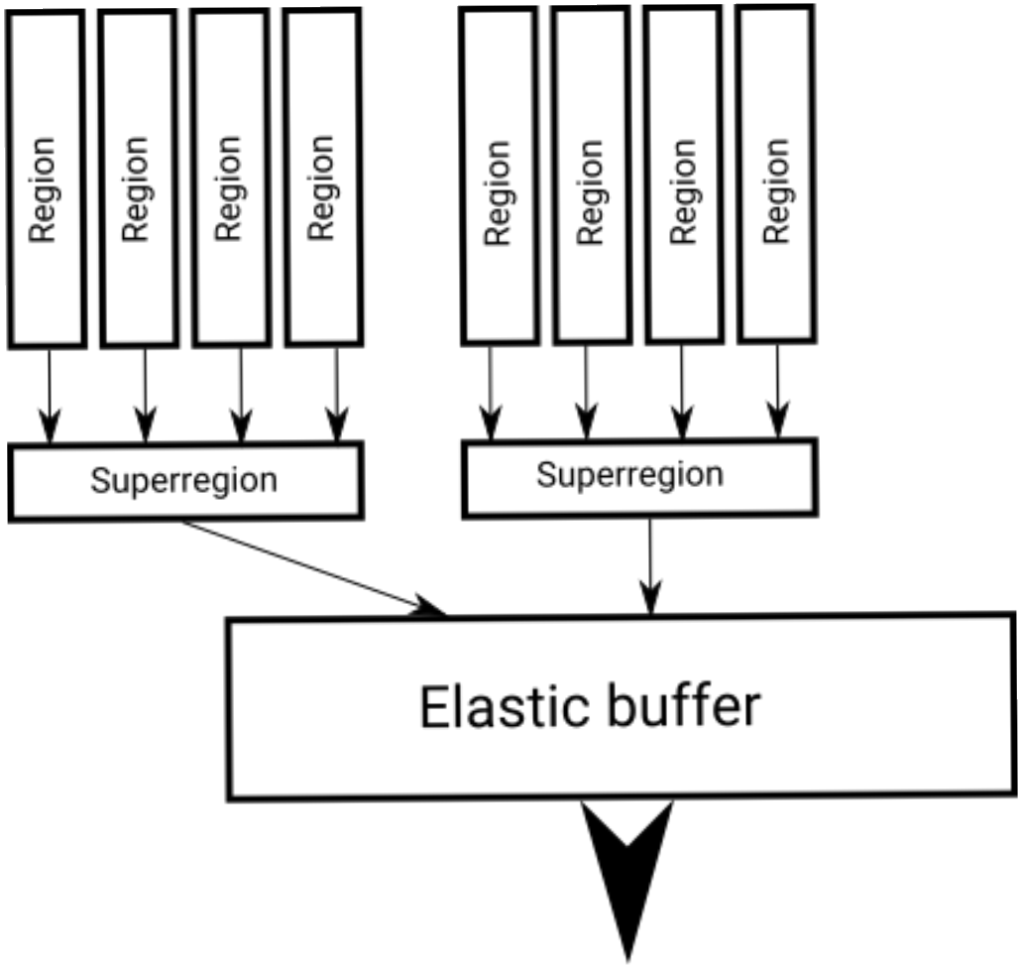
30 % Field



Overview

Component	average	Maximum (3x avarage + stat. fluctuations)	Maximum @ 30% field (3x avarage + stat. fluctuations)
Region	10 words	55 words	70 words
Superregion	37 words	135 words	230 words
Elastic-Buffer input	345 words	1070 words	1790 words

New sensor readout design ✔



64 Regions per sensor
→ 100 words

16 Superregion per sensor
4x Region → 400 words

Flexible buffer to match r/o bus speed. → 3200 words

Bus with max r/o 2.5 Gbit/s.
Average of 800 words / frame