The Project | LHCb Mighty Tracker

- Hybrid tracker proposed for HiLumi LHCb [1]
- Mighty Tracker = SciFi + Silicon tracker
- Inner parts: HV-CMOS pixel chips [2] for radiation hardness and good granularity

The Chip | MightyPix1

- First prototype
- HV-CMOS pixel chip
- TSI 180 nm process
- In-pixel CMOS amplifier and CMOS comparator
- Digital interfaces: TFC, I2C, SR
- External 40 MHz and 640 MHz clocks
- Internal PLL
- Bias voltages applied externally or via integrated 10 bit VDACs

The Results | Simulated MightyPix1 Efficiency

- Data transmission ≤ 4 x 1.28 Gbit/s per chip
- Data size = 2 x 32 bits per hit
- Max hit rate that can be sent off-chip = 23.75 MHz/cm²
- Simulated efficiency drops at 21 MHz/cm²

The Results | Improvements for MightyPix2

- Additional FIFO to free up hit buffers faster
- Reduced data size: 1 x 48 bits per hit
- Max rate that can be sent off-chip = 31.66 MHz/cm²
- Simulated efficiency only drops at readout limit of 31.66 MHz/cm²

The Simulation | Goal and Method

Can MightyPix1 handle particle hit rates at the Mighty Tracker?

Data transformation
Chose settings, transform to pixel coordinates

Simulated hits

MightyPix Model

Measured hits

Data comparison
Get info on simulated, measured, missing hits

Results
Process results, create graphs

* Behavioural model, representing analogue pixel matrix with synthesised digital logic

Conclusion | MightyPix1 can handle Mighty Tracker rates

- New HV-CMOS chip MightyPix under development for LHCb Mighty Tracker → Expect hit rates up to 17 MHz/cm²
- Readout mechanism of MightyPix1 studied in simulations
- Simulated MightyPix1 efficiency over 99% for hits rates up to 20 MHz/cm²
- Simulations with new readout mechanism for MightyPix2 show efficiency over 99% for hit rates up to 31 MHz/cm²