LHCb Tracker Turicensis

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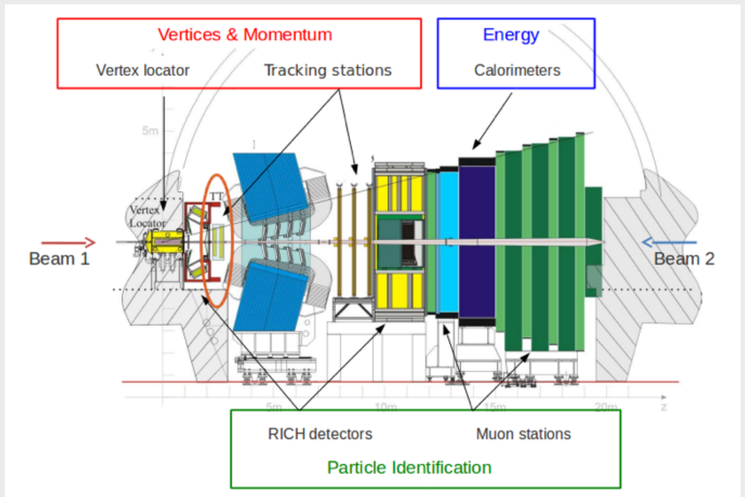
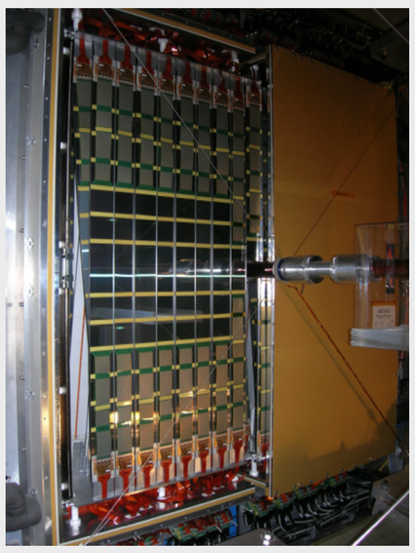
The LHCb detector

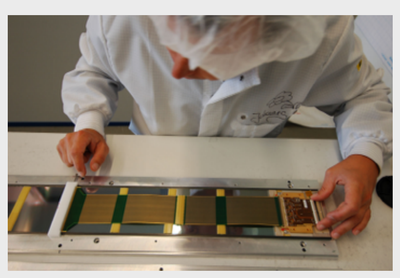


[JINST 3 (2008) S08005]

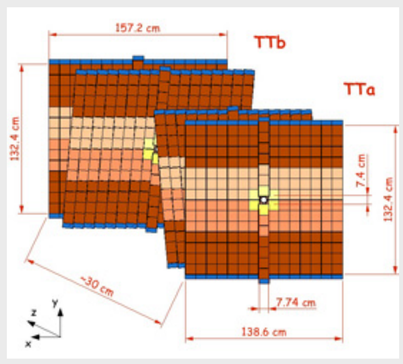
- single arm spectrometer – designed for precision measurements in decays of particles containing heavy quarks
- fully instrumented in the forward region ($2 < \eta < 5$)
- primary vertex resolution: $\sigma_{xy} \sim 15$ µm, $\sigma_z \sim 80$ µm
- momentum resolution: $\Delta p/p \sim 0.5 – 1\%$
- particle identification: excellent K/π/p separation
  eg. K identification ε = 90 % with < 5 % π mis-identification

The Tracker Turicensis





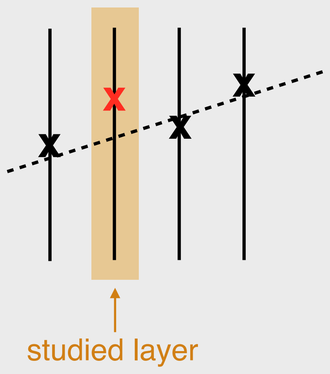
- silicon-microstrip detectors with 10 – 40 cm long readout strips, 500 μm strip pitch
- four detection layers, 128 detector modules, 896 silicon sensors, 143'360 readout channels
- improves momentum resolution for charged particles
- increases efficiency for reconstruction of long-lived neutral particles
- designed, built, commissioned, installed, operated by UZH group
- installed in LHCb in 2009, to be replaced by new Upstream Tracker during LHCb upgrade in 2019/2020



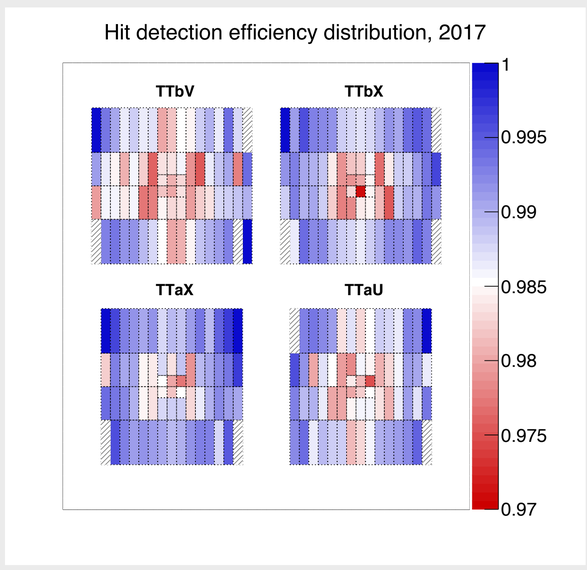
Efficiency

Algorithm:

1. mask the layer under study
2. run the pattern recognition & track fit
3. reuse the removed cluster to calculate the performance in that sector



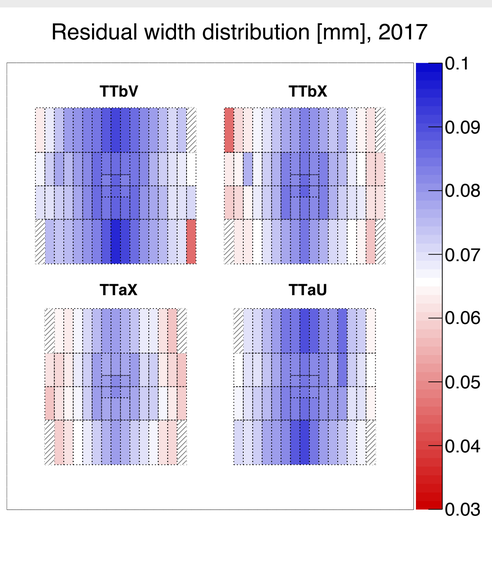
- hit efficiency: fraction of found hits in a search window of 240 µm

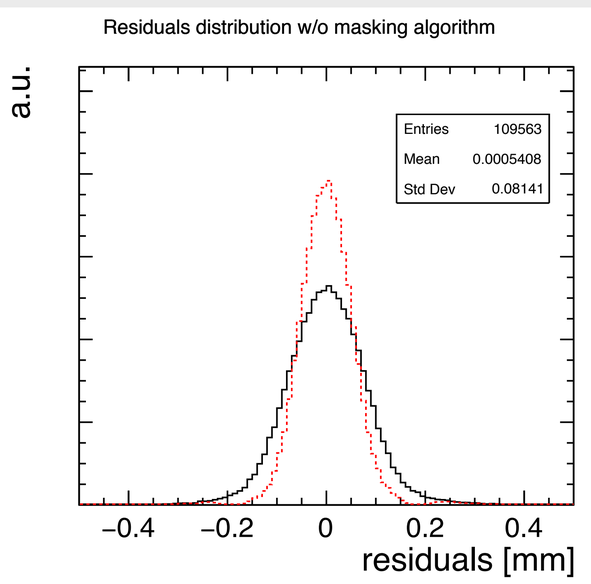


99.3 % of 143'360 readout channels fully operational

Resolution

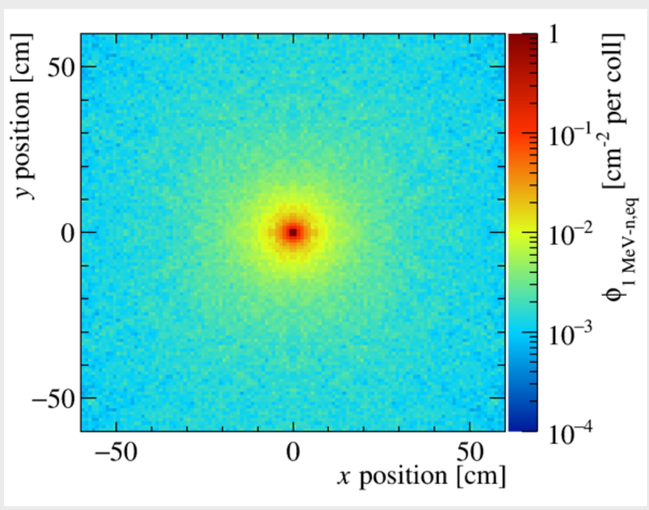
- hit resolution: width of the residual distribution



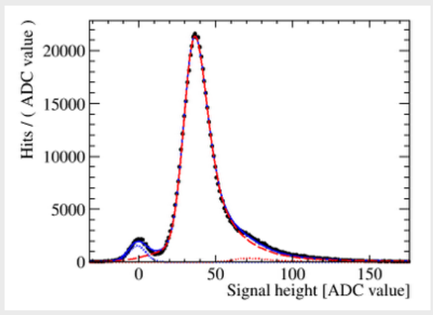


High radiation environment

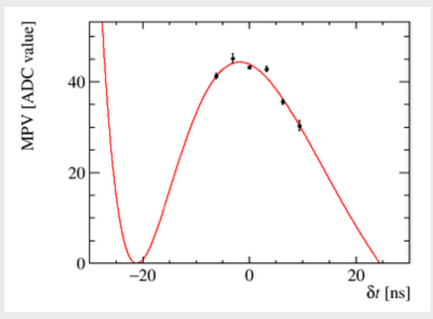
- we expect $\phi \sim 7\ 10^{14}$ cm^{-2} over the lifetime of the experiment
- fundamental to monitor radiation damage of the detector

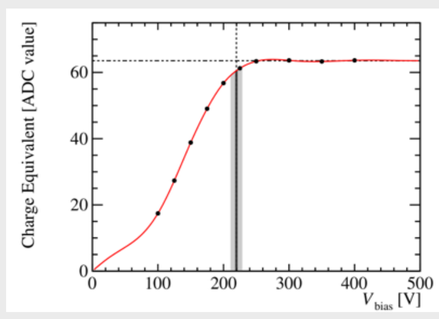


Monitoring radiation damage



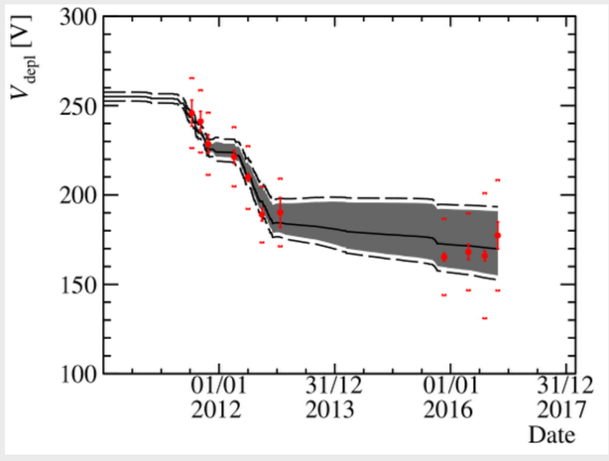
- $V_{depl} = q/2\varepsilon\varepsilon_0\, n_{eff}\, D^2$
- n_{eff} changes with radiation damage
- charge collection efficiency as a function of V_{bias} allows to estimate V_{depl}





Time evolution

- variations of V_{depl} are monitored as a function of time
- results in agreement with "Hamburg model" predictions [1]
- no limitation due to radiation damage is expected until the end of 2018



[1] M. Moll, Radiation damage in silicon particle detectors: Microscopic defects and macroscopic properties

http://www.physik.uzh.ch/en/researcharea/lhcb.html