LHCb Upgrades

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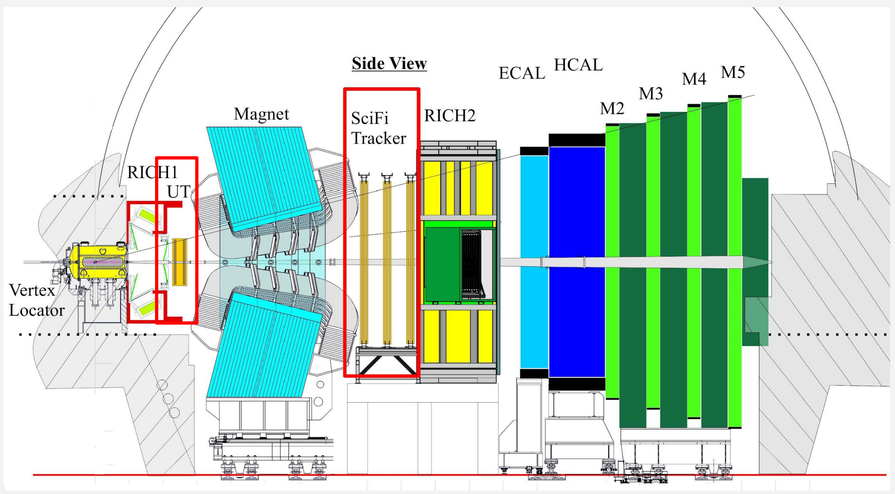
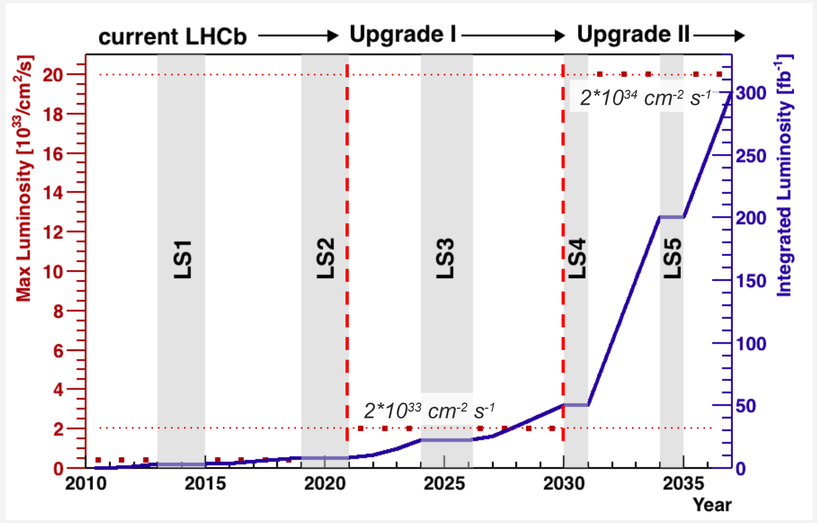
LHCb Detector at the Large Hadron Collider



LHCb detector, Upgrade I

- single arm spectrometer– designed for precision measurements in decays of particles containing heavy quarks
- fully instrumented in the forward region ($2 < \eta < 5$)
- momentum resolution: $\Delta p/p = 0.5\text{-}1\%$
- particle identification: excellent $K/\pi/p$ separation kaon ID
- very flexible trigger → able to trigger on low momentum objects

Motivation

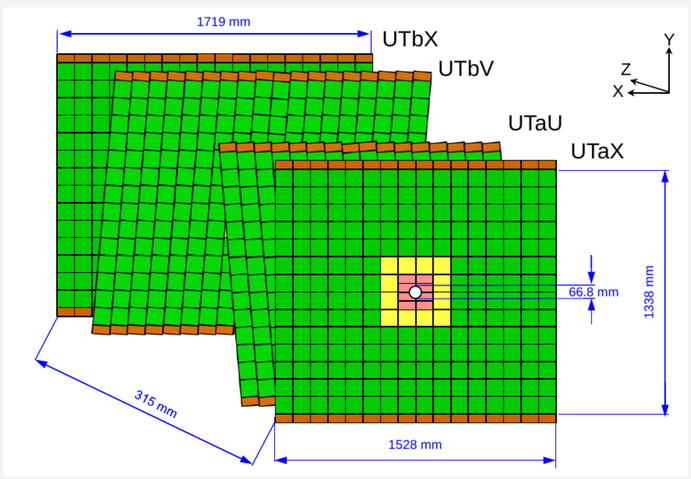


Planned LHCb Upgrade schedule

The **amount of data and the physics yield from data** recorded by the current LHCb experiment **is limited by its detector, readout technologies and hardware trigger**. The Phase-I & Phase-II Upgrades will allow to collect data at more than x10 higher rate.

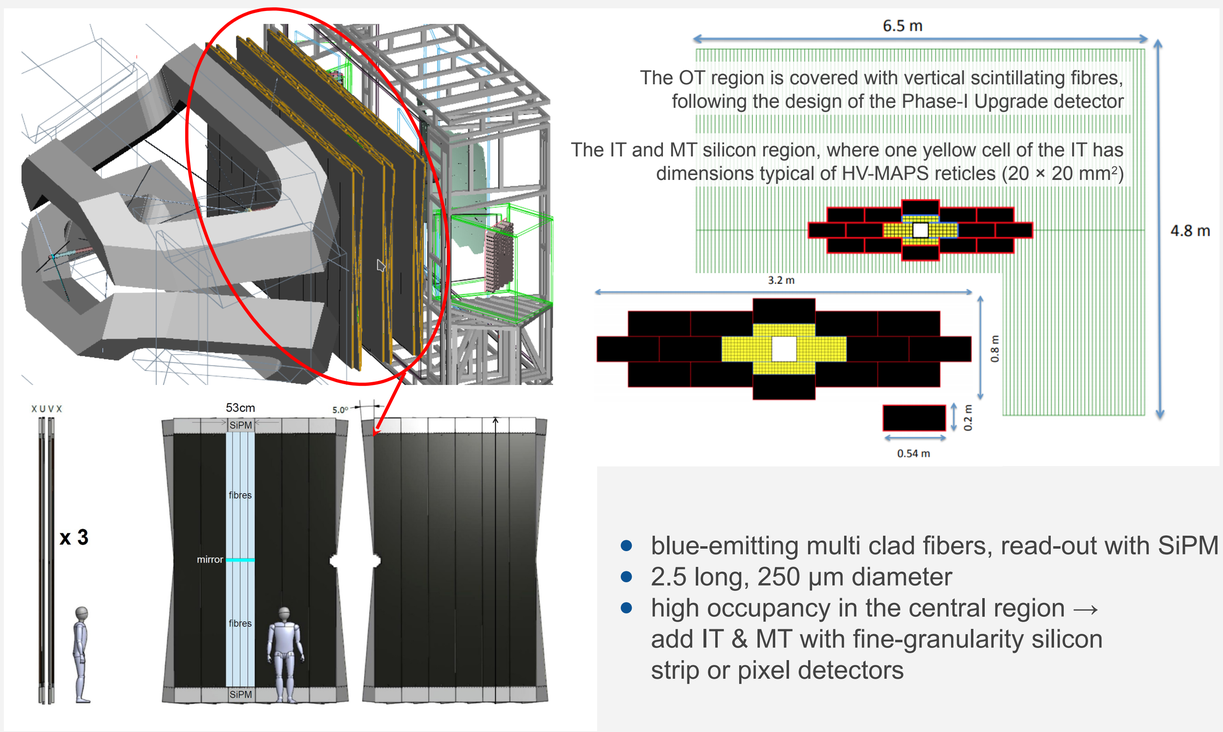
Upgrade I: New Upstream Tracker (UT)

- four planes of silicon strip sensors
- higher segmentation in the region surrounding the beam pipe
- electronics located near sensors to allow segmentation & improved signal/noise ratio



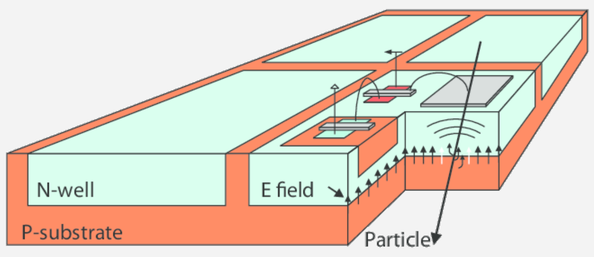
Overview of UT geometry looking downstream: the different sensor geometries are colour coded

Upgrade Ib/II: The Mighty Tracker



- blue-emitting multi clad fibers, read-out with SiPM
- 2.5 long, 250 µm diameter
- high occupancy in the central region → add IT & MT with fine-granularity silicon strip or pixel detectors

HV-MAPS pixel detectors

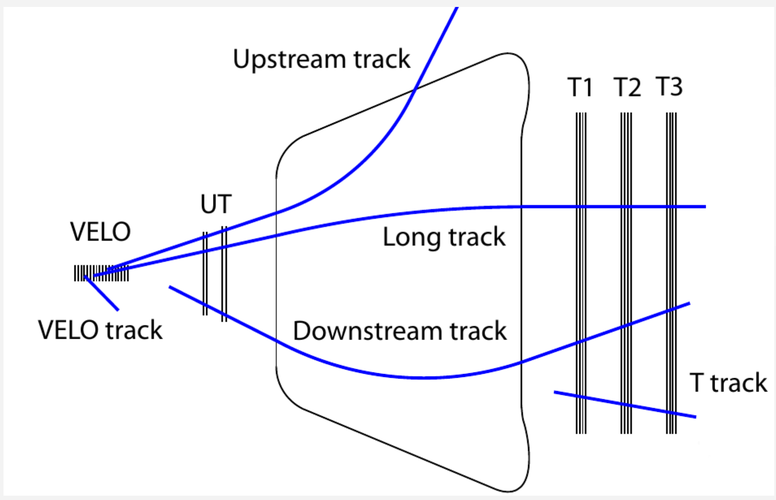


One of the options for the **inner region of the Mighty Tracker**:

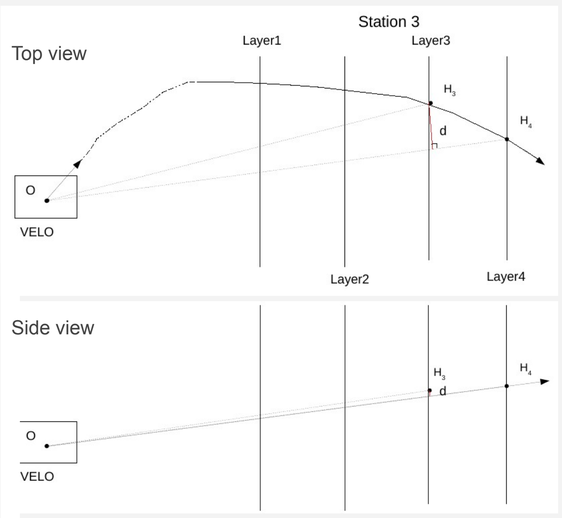
- active sensor → hit finding + digitisation + zero suppression + readout
- high precision → pixels 80 x 80 µm²
- standard HV-CMOS process, 60 - 90 V → low production costs
- front-end electronics in HV-CMOS process, embedded inside silicon detector substrate

*For more information go to **The Mu3e Experiment and its Pixel Detector** poster

Pattern recognition



Reconstructed track types for the LHCb upgrade tracking system



Determining a search window

- T-tracks finding: stand-alone track reconstruction in T-station
- Long-tracks finding:
  - Extension of Velo-UT segments
  - Matching of Velo-UT segments and T-station segments(T-tracks)
- Evaluate perfomance at high track density expected in Upgrade II: **efficiency, purity, timing**
- Explore novel pattern recognition algorithms, e.g. using **machine learning** techniques