

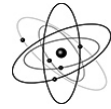
# Tracking system of the LHCb upgrade



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on behalf of the LHCb Collaboration

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## Upgraded detector

### Physics motivation:

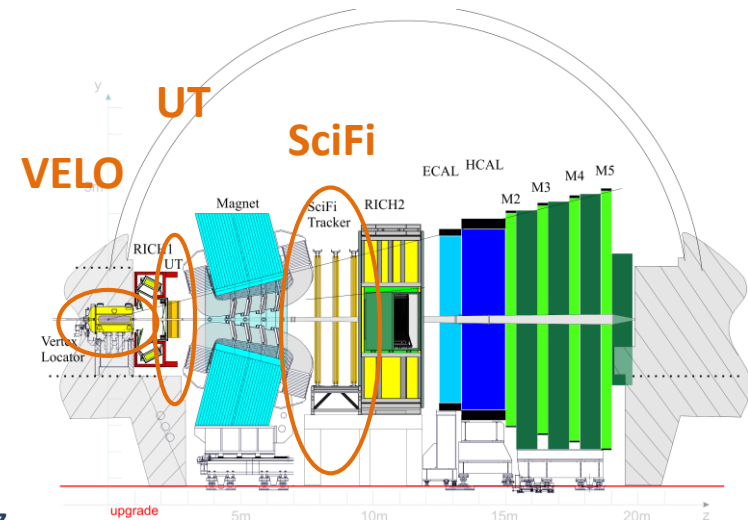
- experimental sensitivities close/better than theoretical ones (electroweak and gluonic penguins)
- expand scope to lepton flavour sector, electroweak physics, exotic searches and QCD,

### Installation is foreseen between 2018-19

- New **tracking system**.
- Full event readout at 40 MHz.
- Upgraded trigger (fully software).
- Increase of the output rate to 20-100 kHz
- New PID system.

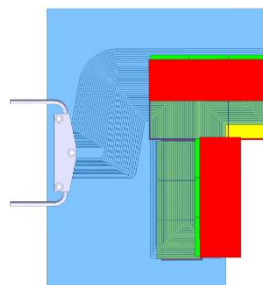
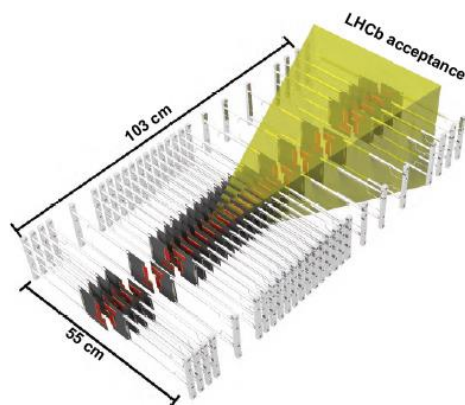
### Upgraded **NEW** tracking detector system:

- **VELO** – pixels,
- **UT** – silicon strips detector,
- **SciFi** – scintillating fibres



## Vetex Locator (VELO)

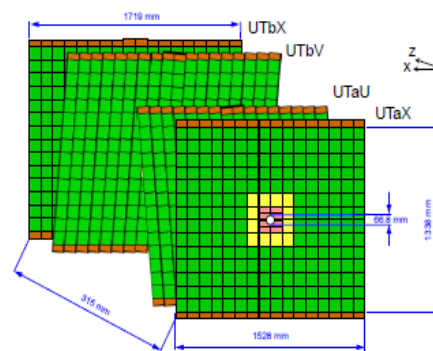
Covers full LHCb acceptance  
 Crucial role in tracking efficiency  
 Improved impact parameter resolution (first pixel - 5.1 mm from IP)



- L-shaped module, pixel sensors
- VeloPix ASIC,
- new L-shaped RF foil
- micro-channel cooling plates
- non-uniform radiation dose ( $0.2-8 \times 10^{15} n_{eq}/cm^2$ )
- $V_{dep} = 1000 \text{ V}$  after  $50 \text{ fb}^{-1}$

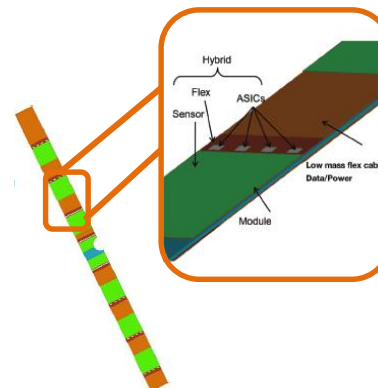
## Upstream Tracker (UT)

Essential for fast triggering.  
 Fast momentum measurement.  
 Crucial for  $V^0$  reconstruction.



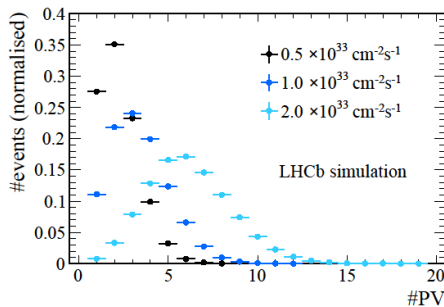
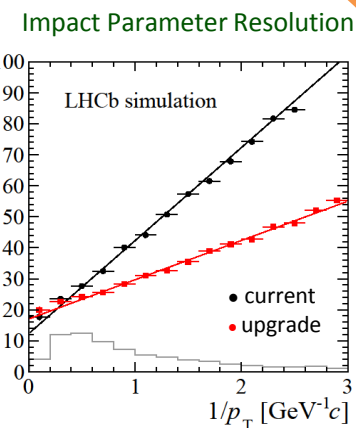
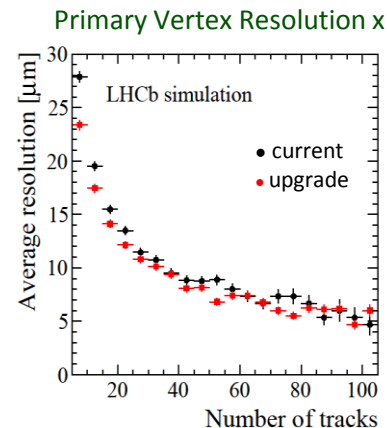
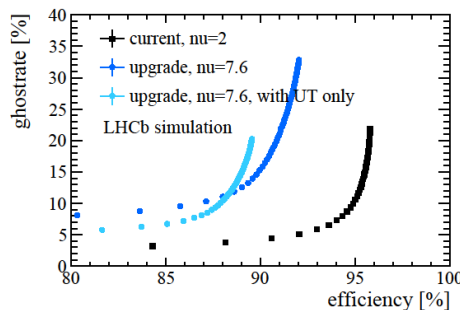
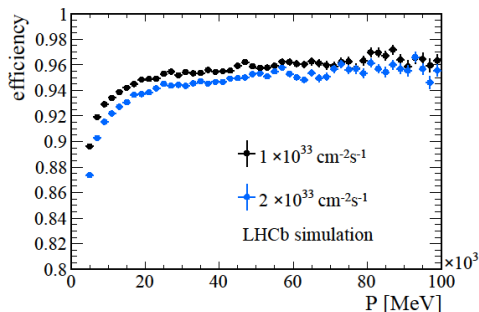
98 mm 190 $\mu\text{m}$ 512 strips	98 mm 95 $\mu\text{m}$ 1024 strips	49 mm 95 $\mu\text{m}$ 49 mm 95 $\mu\text{m}$
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250  $\mu\text{m}$  thick

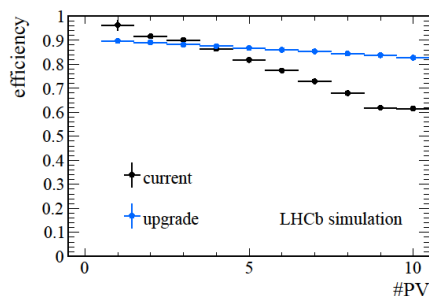
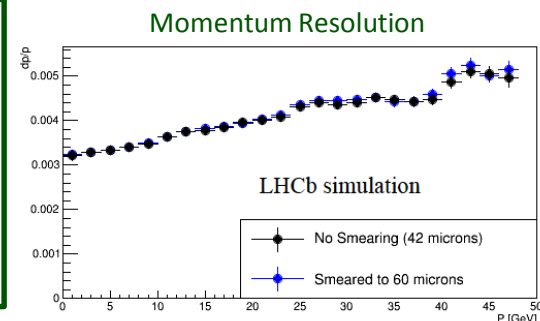


- Finer granularity, full acceptance coverage.
- New front-end electronics.
- Improved radiation hardness.
- Four planes of single side silicon microstrip sensors,
- 10x10 cm,
- arranged in staves,
- sensors cooled below  $-5^\circ\text{C}$

## Forward Tracking (long tracks)



**Tracking for upgraded LHCb**  
 Expected performance of the new tracking system is not much degraded despite much larger luminosity (higher multiplicity, more PVs etc.) wrt the current one.



$\nu=7.6$ B hadron, $P > 3$ GeV, $p_t > 0.5$ GeV	VELO-Forward	VELO-UT-Forward
Ghost rate [%]	40.6	12.3
Reconstruction efficiency [%]	94.7	93.4