Towards improved measurements with the upgrade of the ALICE Inner Tracking System in LS3

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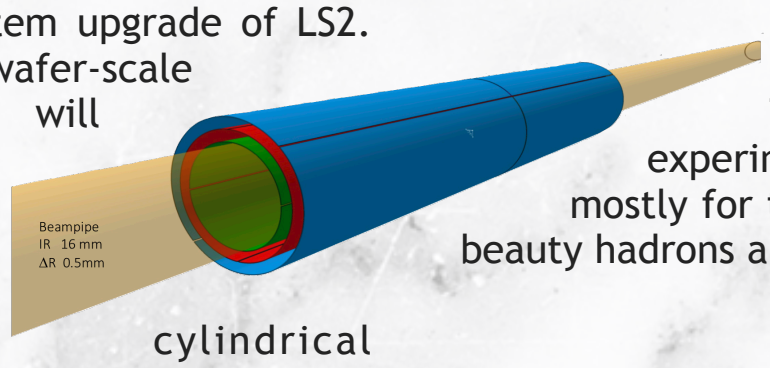
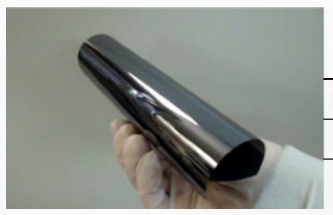
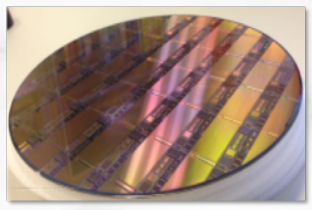
The ALICE experiment is planning the construction of a novel ultra light vertex detector during the next LHC LS3 (2024-2026). The latest innovations in the silicon imaging technology, offer the opportunity to further reduce the thickness and increase the area of the ALPIDE sensors developed for the Inner Tracking System upgrade of LS2. Through the process of stitching, wafer-scale Monolithic Active Pixel Sensors (MAPS) will be produced. The sensors will be thinned down to 20-40μm, a thickness at which the flexibility of silicon allows the bending of the sensor and the construction of cylindrical layers. The three innermost layers of the ITS will be replaced by three layers of curved silicon-only sensors. The new modifications will reduce the material budget from 0.3% X_0 to 0.05% X_0 per layer.



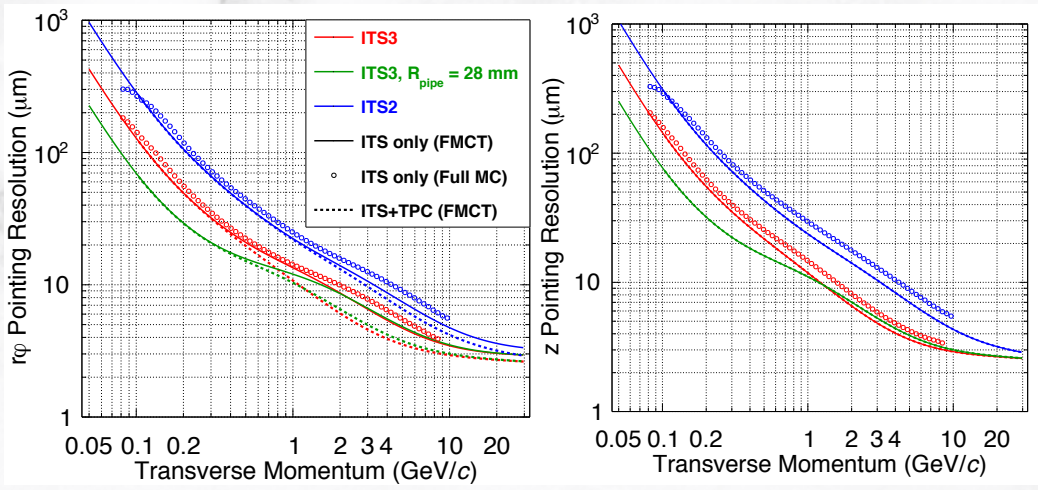




Beampipe inner/outer radius (mm)		16.0/16.5	
IB Layer parameters	Layer 0	Layer 1	Layer 2
Radial position (mm)	18.0	24.0	30.0
Length (sensitive area) (mm)	270	270	270
Pseudo-rapidity coverage[a]	± 2.5	± 2.3	± 2.0
Pixel sensor dimensions (mm²)	280 × 56.5	280 × 75.5	280 × 94.0
Number of pixel sensors/layer		2	
Pixel size (μm²)		$\mathcal{O}(15 \times 15)^b$	

The beam pipe will be replaced by a smaller one with Inner Radius (IR) 16mm and thickness 500μm. The reduction of the radial distance of the first layer to the interaction point from 23mm to 18mm along with all the above modifications will improve the pointing resolution and the tracking efficiency of low-momentum particles.

The physics program of the ALICE experiment will benefit from the ITS upgrade mostly for the low p_T measurements of charm and beauty hadrons and of low-mass dielectrons.



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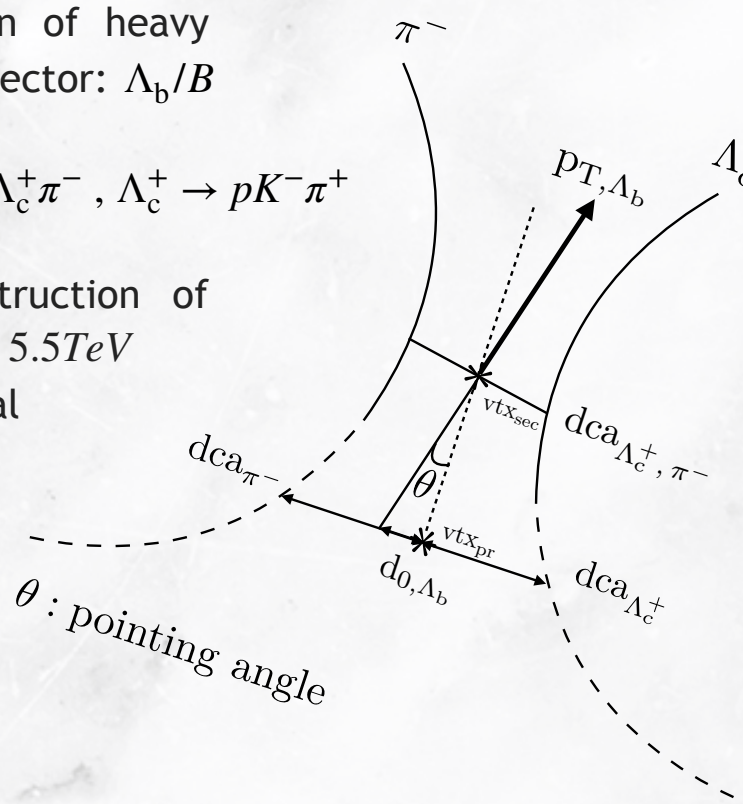
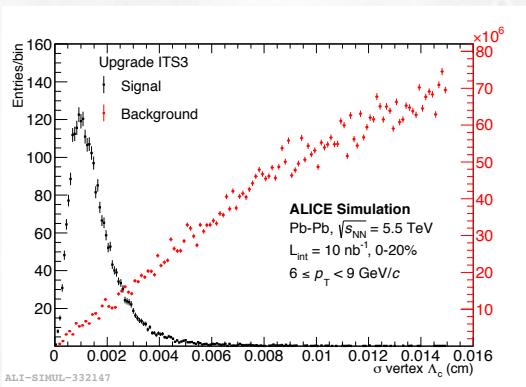
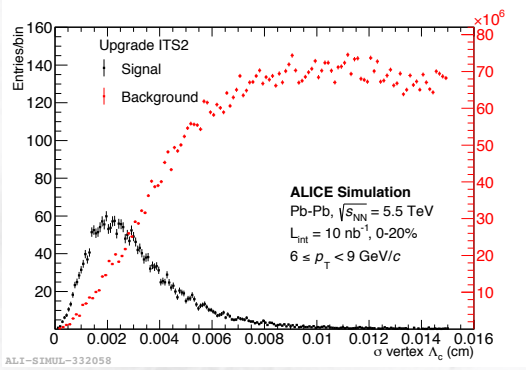
Λ_b^0 Beauty measurements with the new ITS

Particle Reconstruction

- Thermalisation and hadronization of heavy quarks in medium, in the beauty sector: Λ_b/B
- Decay length: 417 μm
- Decay channel considered: $\Lambda_b^0 \to \Lambda_c^+\pi^-$, $\Lambda_c^+ \to pK^-\pi^+$
- Combined B.R.= 0.49% x 6.28%
- MC full simulation and reconstruction of ITS2, 10^6 Pb—Pb events at $\sqrt{s_{NN}} = 5.5TeV$
- Hijing background + Injected signal

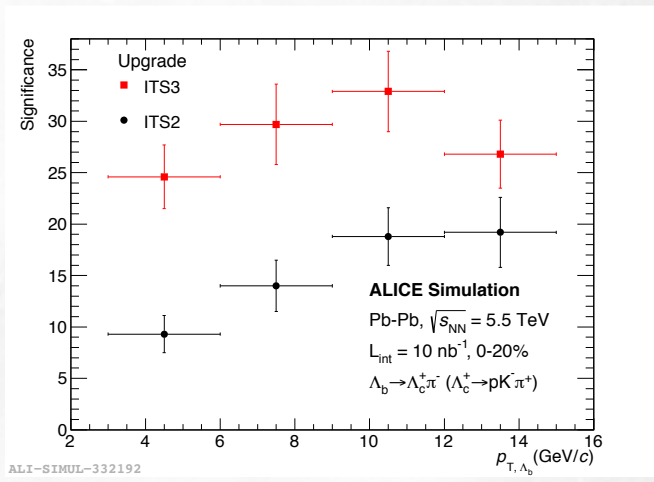






- Selection with particle identification and topological cuts
- Multiple rotation method (pion track) for increased background statistics

Significance measurement



$$Significance = \frac{Signal}{\sqrt{Signal + B(3\sigma)}}$$

- Significance calculation for ITS2
- Track smearing, updated MC with ITS3 resolutions
- Significance calculation for ITS3
- Central events 0-20% for luminosity $L_{int} = 10nb^{-1}$
- Improved measurements with ITS Upgrade

Expression of Interest for an ALICE ITS Upgrade in LS3