The LHCb Inner Tracker

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LHC Large Hadron Collider

LHCb beauty physics
- Precision CP measurements
- Rare B-decays
- Single-arm spectrometer

Search for new Physics!

- p – p collider
- High Energy 14 TeV
- High Luminosity $10^{34}$ cm$^{-2}$ s$^{-1}$
  (at LHCb $2 \times 10^{32}$ cm$^{-2}$ s$^{-1}$)

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LHCb sub-detectors

Tracking sub-detectors

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Ring Imaging Cerenkov
LHCb sub-detectors

Calorimeters

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LHCb sub-detectors

Muon Chambers
Inner Tracker: why?

IT is designed to keep OT occupancy below 10% while minimising Si surface.

- Cross shape around the beam pipe
- 1.3% of acceptance, 20% of the tracks
- approx. 4.3 m² of silicon
Inner Tracker: where?

A large part of the detector ‘dead material’ is within the acceptance

Use of light material
Mass reduced to minimum

Use of carbon- and glass-fiber
Metallic parts and cables shielding reduced to minimum
Inner Tracker: how?

4 detector boxes per station

2 boxes with two-sensors modules

2 boxes with one-sensor modules

4 silicon layers per box:
- 2 layers with vertical strips
- 2 layers with ± 5° rotated strips
IT module

- Hybrid and sensor glued on support
- Strips wire bonded

Front-End Hybrid with 3 radiation hard Beetle chips (0.25 µm CMOS)

Carbon fiber and foam sandwich structure with 25 µm kapton foil insulation

p+ on n bulk silicon detector
386 microstrips 198 µm pitch
320 and 410 µm thickness

168 one-sensor modules
168 two-sensors modules
Plus spares
IT module test

Burn-in test: 44 hours with 30 temperature cycles from -5°C to 40°C
Leakage current monitoring
Bad/open channel

IV curves

Sensor position metrology

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Tracking performance

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J. Borel, LPHE, EPFL
Two layers of modules are fixed on one cooling rod

Two Cooling rods fixed under the box cover

All the components are slid down in the box

And then:
• Readout check
• Survey
• Cooling circuit leaks

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IT and LHCb: when?

- Support frames are installed in the P8 pit
- The box assembly ongoing
- The commissioning of the first box soon
- Complete sub-detector in May

The Inner Tracker will be ready for the first collisions at the end of the year at injection energy
LHC Large Hadron Collider

ATLAS
- General purpose
- Higgs
- SUSY

- $p - p$ collider
- High Energy 14 TeV
- High Luminosity $10^{34}$ cm$^{-2}$ s$^{-1}$
- High Interaction rate 40 MHz
LHC Large Hadron Collider

CMS
- General purpose experiment
- Higgs boson
- SUSY evidences

- p – p collider
- High Energy 14 TeV
- High Luminosity $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
- High Interaction rate 40 MHz
LHC Large Hadron Collider

ALICE
- Pb-ions collision
- quark-gluon plasma

- Pb-Pb collider
- High Energy 1150 TeV
Outline

• LHCb at LHC

• The LHCb subdetectors

• Inner Tracker: why, where, how, when