LHCb

Measurement of CP violation in B decays

The aim of the LHCb experiment is to fully investigate CP violation in the B_d and B_s systems, and to possibly reveal new physics beyond the Standard model. The key detector requirements are:

- efficient trigger for many B-decay topologies

- excellent particle identification for π-K separation in a wide momentum range

- good decay-time resolution in particular to resolve fast B_s oscillations

- good mass resolution to efficiently suppress background

Trigger System

The Trigger System consists of 4 levels, designed to be very flexible and robust.

Muon System

selects events containing muons with high transverse momentum of about 1 GeV/c

Calorimeter System

selects events containing hadrons, electrons or photons with high transverse energy in the range of 2 to 4 GeV depending on the particle type

Pile-Up Vertex Detector

rejects events with multiple interactions in one bunch crossing

(40 MHz input rate)
Level-0 decision unit

Vertex Locator

identifies displaced vertices (a signature of b-hadron decays) via stand-alone three-dimensional track finding to reject minimum bias events that have passed the L0 trigger

(1 MHz input rate)
Level-1 trigger unit

Momentum Information

refines secondary vertices

Offline Algorithms

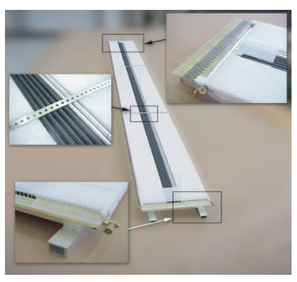
complete final state reconstruction

(40 KHz input rate)
Level-2 trigger

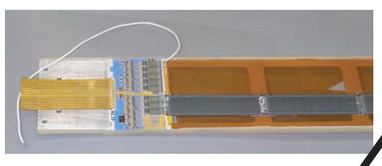
Level-3 trigger
(200 Hz output rate)

Tracking System

The Tracking System is split into Inner (around beampipe) and Outer Tracker. Tracks are reconstructed with a momentum resolution of $\Delta p/p = 0.3\%$-0.5% for momenta between 5 GeV and 200 GeV. The mass resolution is e.g. ~15 MeV for B -> ππ events.



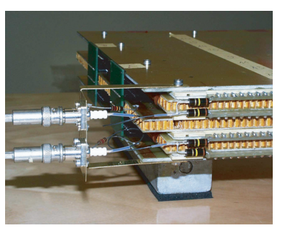
Prototype of Outer Tracker 'Straw Tubes'



Prototype of Inner Tracker 'Silicon Detector' with Readout Chips

Muon System

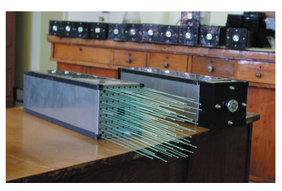
The Muon System consists of MWPCs in the region of high, and of RPCs in the region of lower occupancy. It provides information for the first level (L0) high-P_t trigger.



Prototype of 'Multi-Wire Proportional Chamber'

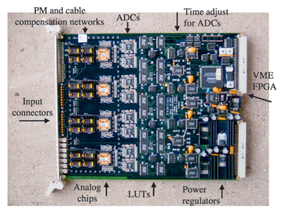
Calorimeters

The Calorimeter System consists of three sub-detectors (Preshower, Electromagnetic and Hadronic Calorimeter) that provide information for the first trigger level (L0) within 25 ns. The energy resolution of ECAL and HCAL are $10\% / \sqrt{E(GeV)} \oplus 1.5\%$ and $80\% / \sqrt{E(GeV)} \oplus 10\%$, respectively.

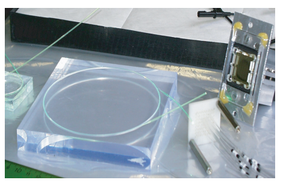


'Shashlik modules' from pre-production of Electromagnetic Calorimeter

Module 0 production of 'Iron/Scintillator Tile' Hadron Calorimeter

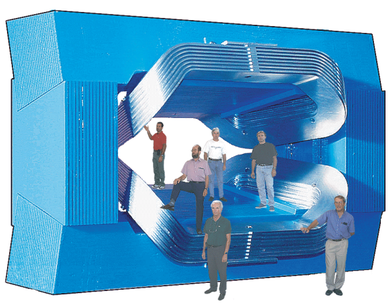


Prototype of ECAL and HCAL 40 MHz Readout and L0 Electronics



Prototype of Scintillating tile with single fibre readout of 'Lead/Scintillator' Preshower Detector

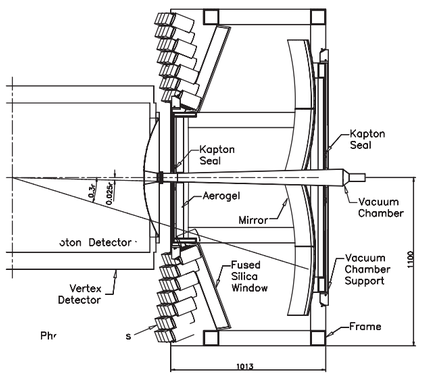
Magnet



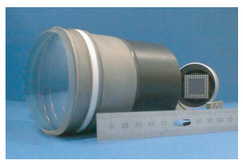
Model of Warm Dipole with Aluminium Conductor and 4 Tm integrated field

RICH detectors

Two RICH Detectors provide particle identification in the momentum range of 3-100 GeV.
This guarantees excellent B flavour tagging with kaons, and efficient background suppression for two-body B-decays.



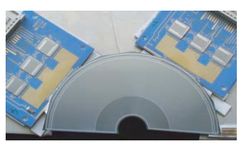
Mechanical Design of RICH1 with combined Aerogel/Gas Radiators



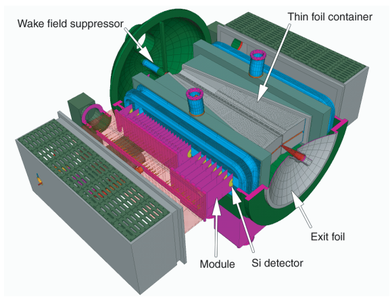
Prototype of 'Hybrid Photo Detector' with 61 Silicon Pixels Readout

Vertex Locator

The Vertex Locator provides data to the second trigger level (L1).
It surrounds the interaction point and consists of 25 r- and ϕ-measuring silicon stations that are housed inside a vacuum tank. The stations are retractable from the beam during injection. A primary vertex resolution of 40 microns is expected to be achieved.



Prototype of 300 micron n-on-n Silicon Wafer with Readout Electronics



Design of Vertex Tank

European Organization for Nuclear Research

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