Belle II.
First collisions

Jakub Kandra

- Performance @ Belle II

- First physics results

- Vertex detector alignment

- Summary

I) Vertexing:

- Time measurement
- Detector:
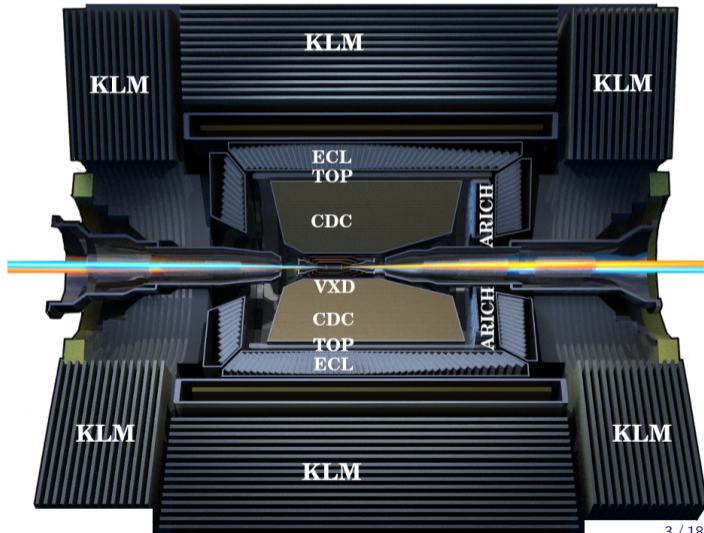 - Pixel detector
  - Strip detector

II) Tracking:

- Mass measurement
- Detector:
  - Pixel detector
  - Strip detector
  - Central drift chamber

III) Particle identification:

- Flavour tagging
- Detector:
  - Energy loss @ CDC
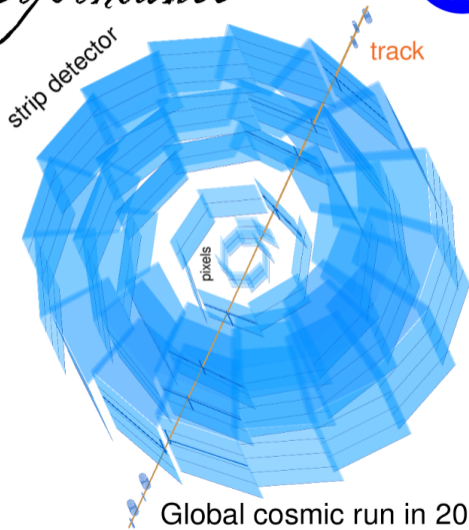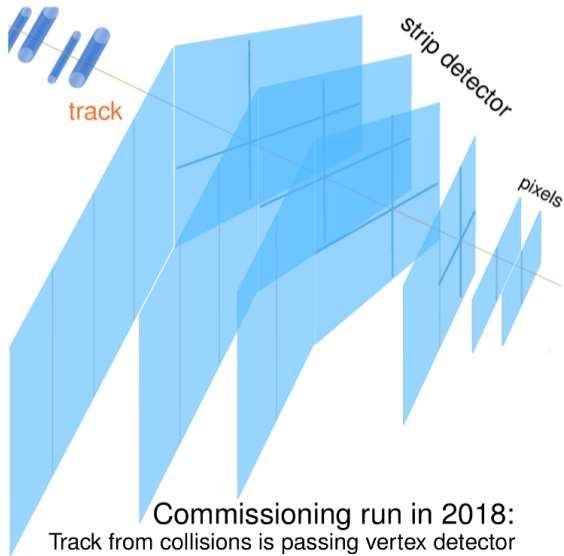 - Cherenkov radiation @ ARICH, TOP
  - KLong-muon system

IV) Neutrals reconstruction:

- Semileptonic decays
- Rare decays
- Dark matter
- Detector:
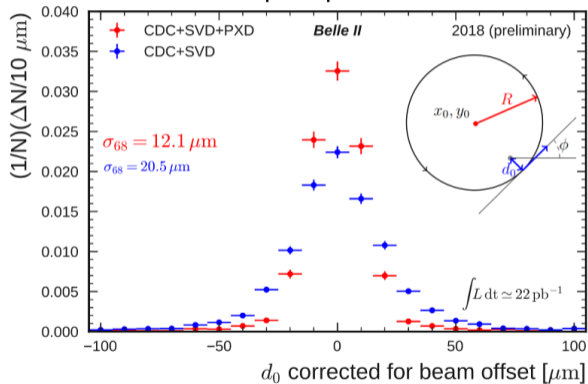 - Electromagnetic calorimeter
  - KLong-muon system
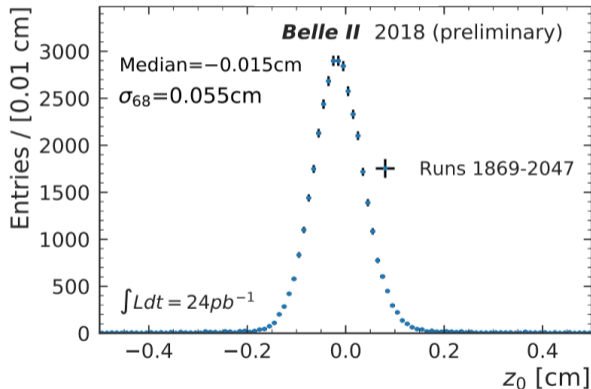
Vertex detector performance

strip detector

track

pixels

Commissioning run in 2018:
Track from collisions is passing vertex detector

strip detector

track

pixels

Global cosmic run in 2019:
Cosmic track is passing full vertex detector

Transverse impact parameter resolution

$\sigma_{68} = 12.1\,\mu m$
$\sigma_{68} = 20.5\,\mu m$

CDC+SVD+PXD
CDC+SVD

Belle II   2018 (preliminary)

x_0, y_0 R ϕ d_0

$\int L\,dt \simeq 22\,pb^{-1}$

$(1/N)(\Delta N / 10\,\mu m)$

d_0 corrected for beam offset $[\mu m]$

Vertex spread

Belle II   2018 (preliminary)

Median $= -0.015\,cm$
$\sigma_{68} = 0.055\,cm$
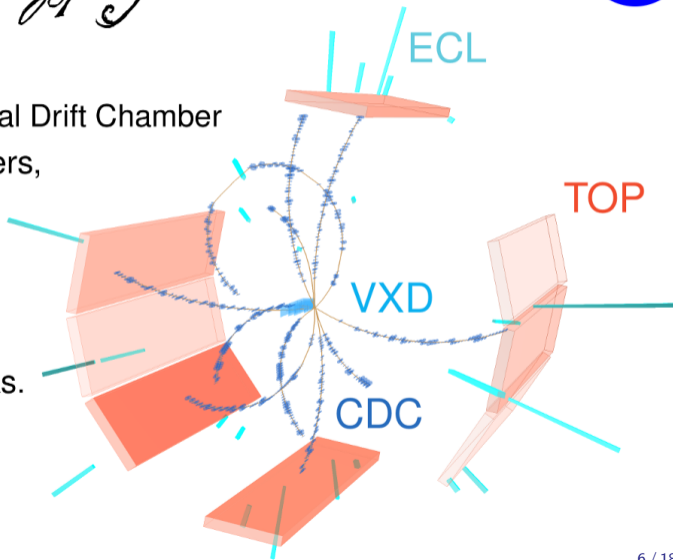
Runs 1869-2047

$\int L\,dt = 24\,pb^{-1}$

Entries / [0.01 cm]

z_0 [cm]

- The SuperKEKB on the road to Nano-Beam Scheme: Narrow interaction point comes from strong focusing and large crossing angle.

ECL

TOP

VXD

CDC

- Main tracking detector is the Central Drift Chamber
- It connects VXD with TOP counters, ECL clusters and KLM sectors.
- Tracks from the CDC were available since first collisions.
- Detector was aligned within few weeks mainly using cosmic tracks.
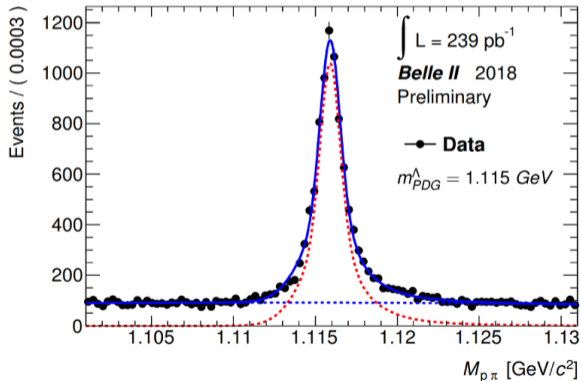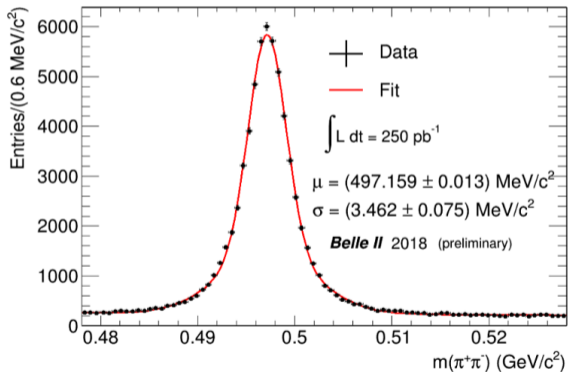- Magnetic field is measured to high accuracy.

$K_s \to \pi^+ \pi^-$

$\Lambda \to p\pi^-$

Data

Fit

$\int L\,dt = 250\ pb^{-1}$

$\mu = (497.159 \pm 0.013)\ MeV/c^2$

$\sigma = (3.462 \pm 0.075)\ MeV/c^2$

Belle II 2018 (preliminary)

$\int L = 239\ pb^{-1}$

Belle II 2018 Preliminary

Data

$m^{\Lambda}_{PDG} = 1.115\ GeV$

- Mass resolution is in good agreement with Monte Carlo predictions, on par with Belle.

$J/\psi \to e^+ e^-$

$J/\psi \to \mu^+ \mu^-$

Belle II
2018 preliminary

$\int L\, dt = 472\ pb^{-1}$

$\mu_x = 3.0901 \pm 0.0012$

nbkg $= 893 \pm 32$

nsig $= 198 \pm 19$

muonID>0.001

Belle II 2018
Preliminary

$\int L\, dt = 250\ pb^{-1}$
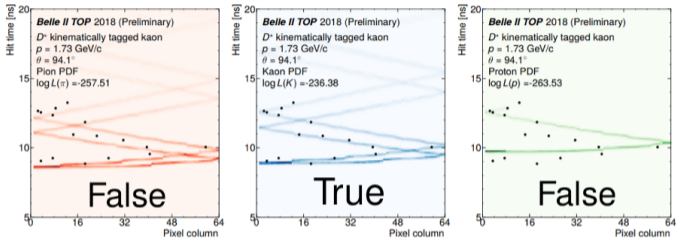
- Mass resolution is in good agreement with Monte Carlo predictions, on par with Belle.
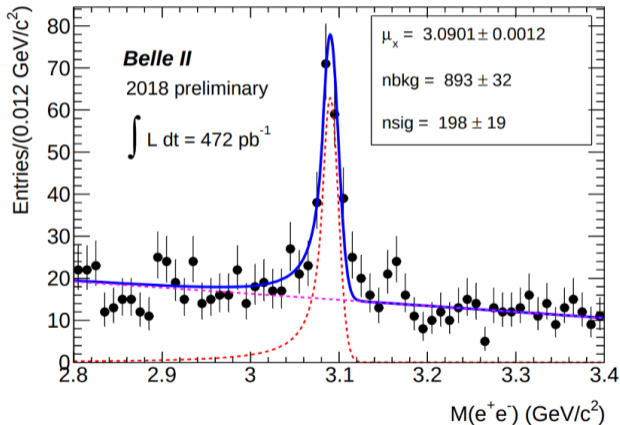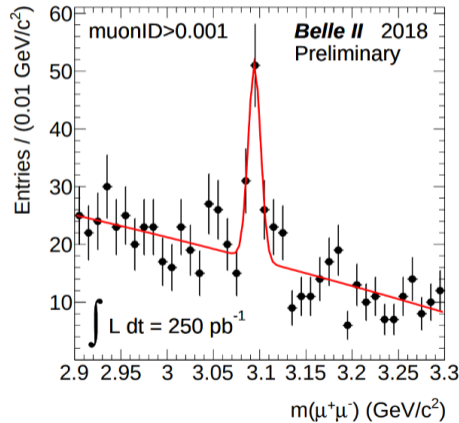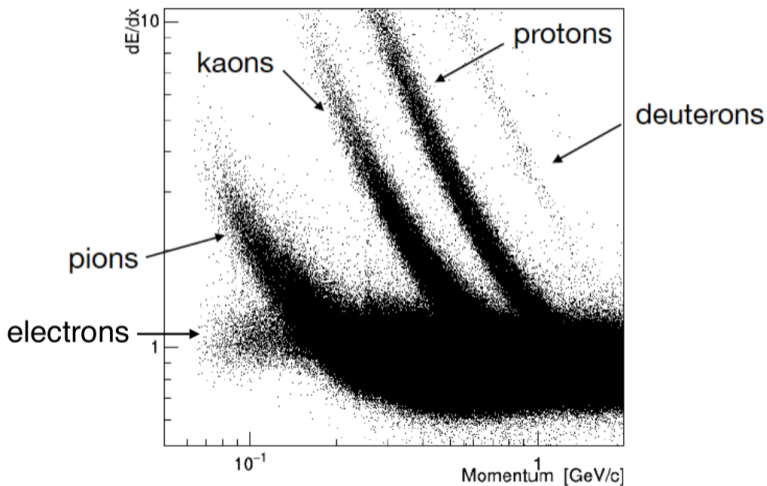
- Energy loss in Central Drift Chamber using hadronic event sample.

Particle identification performance
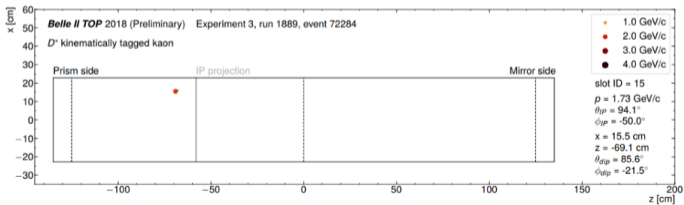
- Visualisation of the Cherenkov rings in the time-of-propagation counter

Particle identification performance

$$\phi \to K^+ K^-$$

No kaons identified

$m_{PDG}^{\phi} = 1.020 \; GeV$

Belle II 2018 Preliminary

$\int L \, dt = 356 \; pb^{-1}$

Both kaons identified

Combined PID

$m_{PDG}^{\phi} = 1.020 \; GeV$

Belle II 2018 Preliminary

$\int L \, dt = 356 \; pb^{-1}$
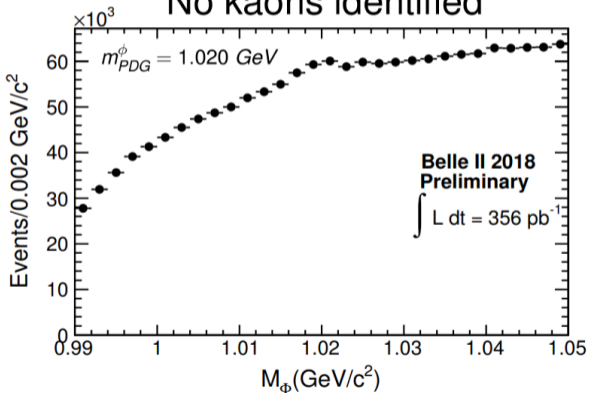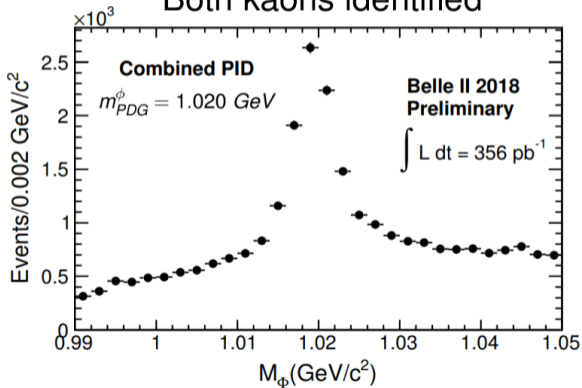
- An example of Kaon identification capabilities using combined information

$$e^+ e^- \rightarrow \mu^+ \mu^- \gamma$$

$$\pi^0 \rightarrow \gamma\gamma$$

1.00 GeV < p(recoil) < 8.00 GeV

MC

Data

Belle II

2018 (Preliminary)

$\int L \, dt = 261 \, pb^{-1}$

E(ECL) / p(recoil)

$\times 10^3$

Belle II

2018 (Preliminary)

$m^\pi_{PDG} = 135.0 \, MeV$

$\int L \, dt = {\sim}5 \, pb^{-1}$

$E_\gamma > 0.15 \, GeV$

Data

Entries / (0.001 GeV/c^2)

$m_{\gamma\gamma}$ (GeV/c^2)
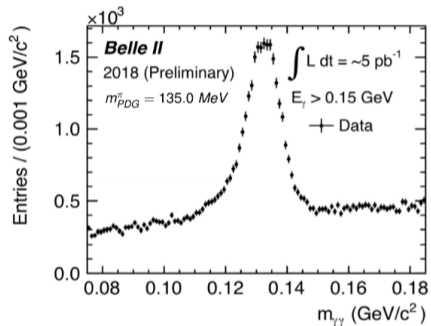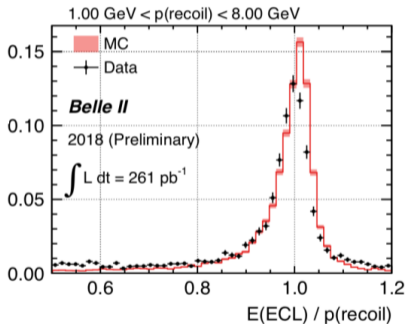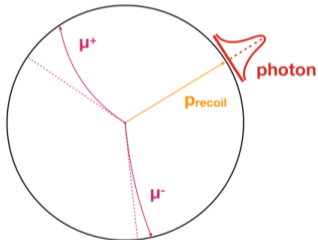
- Good reconstruction of a single photon and a pair of photons.

First physics results

Charm physics

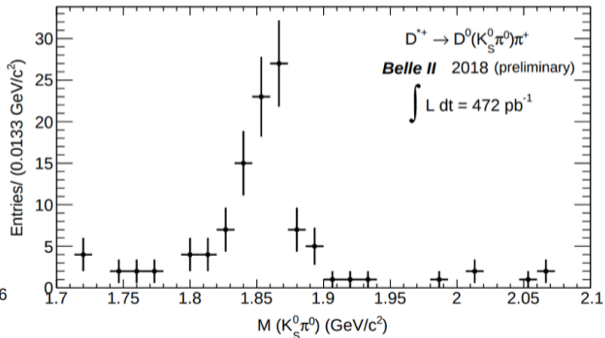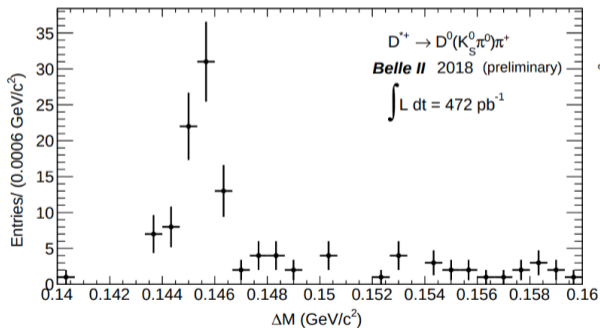$D^{*\pm} \to D\,(K^-\,\pi^+)\,\pi^\pm$ $D^{*\pm} \to D\,(K^-\,\pi^+\pi^0)\,\pi^\pm$ $D^{*\pm} \to D\,(K^-\,\pi^+\pi^-\pi^+)\,\pi^\pm$
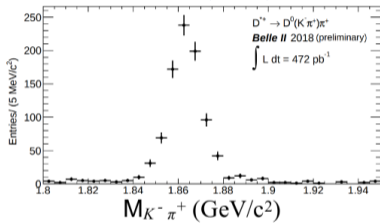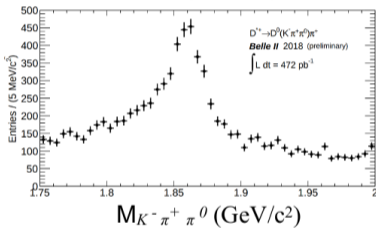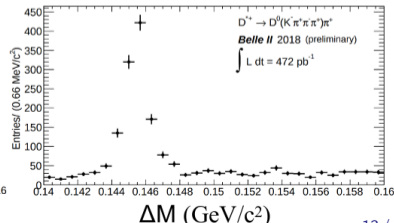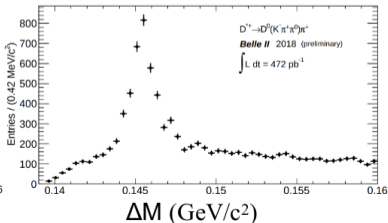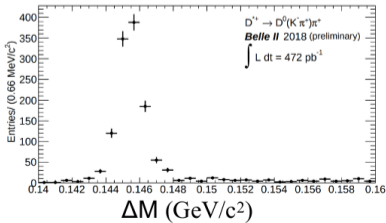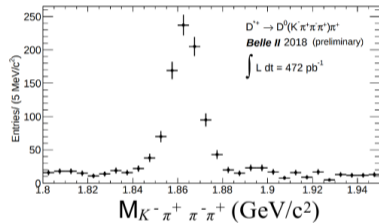
- Unique capabilities of Belle II detector using channel of all neutral states

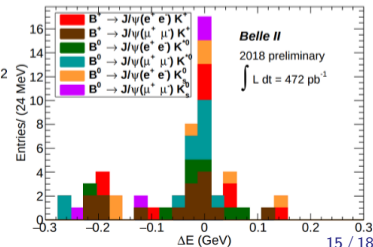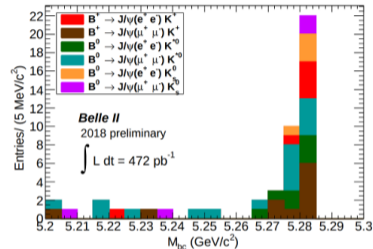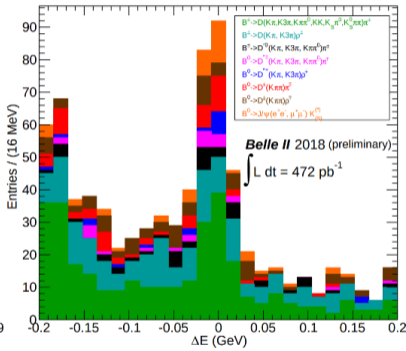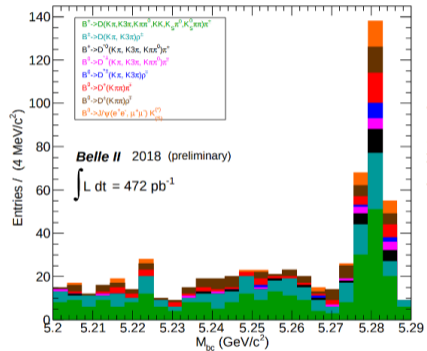- D^0 decaying to CP eigenstates: $D^{*+} \to D^0(K_S\pi^0)\pi^+$

- A pair of pions with a displaced vertex and two photons measured with good resolution and low background.

First physics results

B mesons rediscoveries

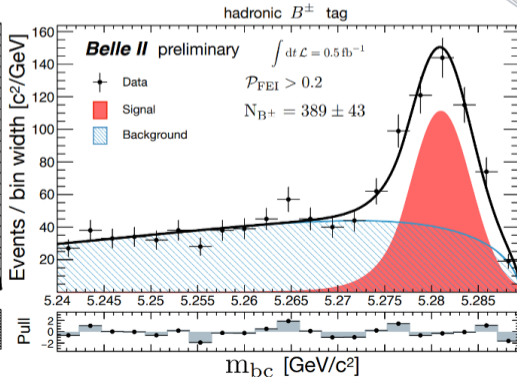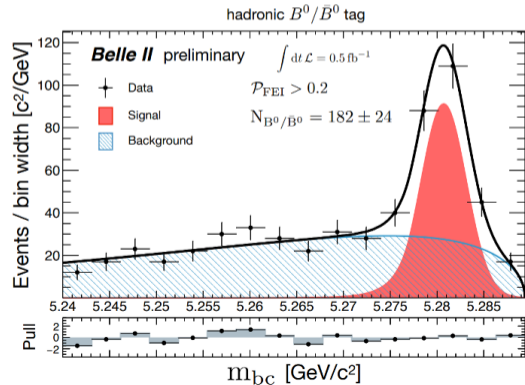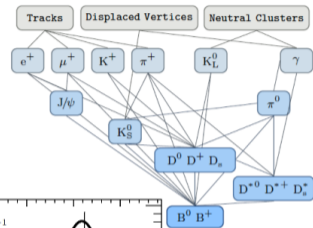- More than 250 B meson candidates in hadronic and leptonic modes
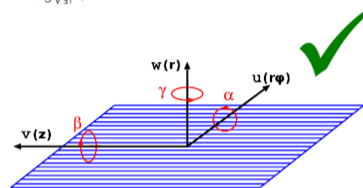
Full event reconstruction

- Boosted decision tree classifier
- Recursive reconstruction algorithm with more 5000 B decay modes.
- It allows to increase performance in B meson reconstruction.
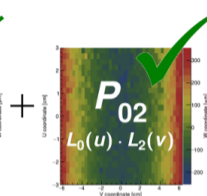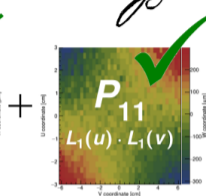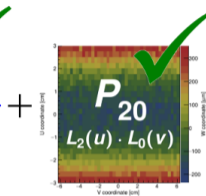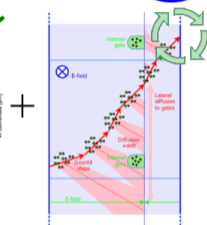- It is essential for studying of B decays with missing energy.

Vertex detector alignment

Rigid body parameters
($3 \times$ shift + $3 \times$ rotation)

P_{20}
$L_2(u) \cdot L_0(v)$

P_{11}
$L_1(u) \cdot L_1(v)$

P_{02}
$L_0(u) \cdot L_2(v)$

$3 \times$ surface deformation parameter

$2 \times$ Hall coefficient

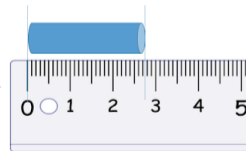The Great Alignment

Determination alignment parameters

NEW
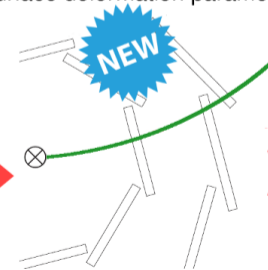
Validation and systematic uncertainty estimation
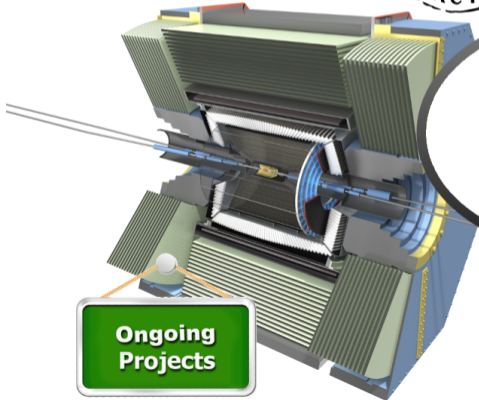
Physical measurement

THE NEW GENERATION of FABRIQUE B B FACTORY is READY to THE NEW PHYSICS

FIRE ALARM

Ongoing Projects

"thank you for your ATTENTION :)"