4th LNF Workshop on Cylindrical GEM Detectors
Frascati, 17 November 2015

CGEM-IT Feasibility Studies of Hyperons Benchmark Channels

Giulio Mezzadri
On behalf of the BESIIICGEM Consortium

INFN Istituto Nazionale di Fisica Nucleare

UNIVERSITÀ DEGLI STUDI DI FERRARA
1391
"EX LABORE FRUCTUS"

BESIII

Outline

- CDR
- Softwares
- Bench tests

Approved!

BESIII

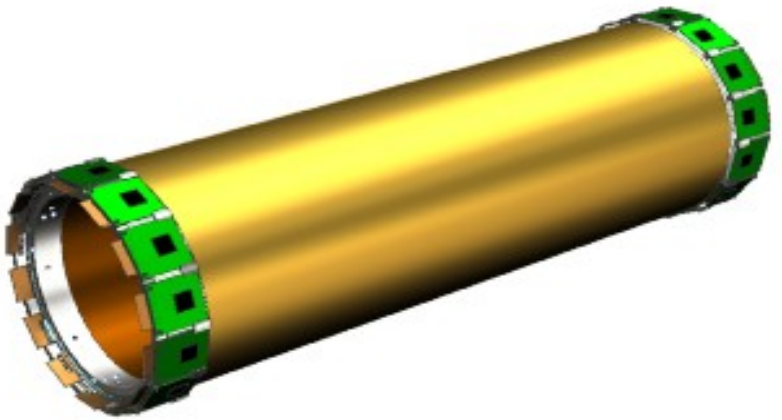
Conceptual Design Report

BESIII Cylindrical GEM Inner Tracker

BESIII Collaboration

May 28th, 2014

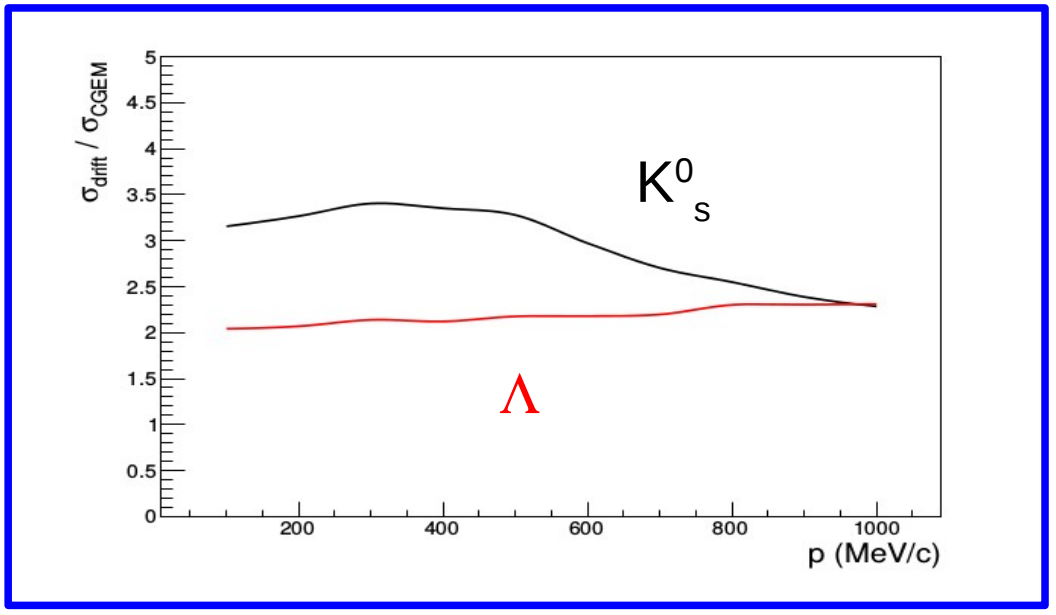
Ver. 1.0



In the CDR...

The benchmark channels to be considered are in particular those with final states including short living particles; better capabilities in secondary vertices reconstruction (in particular in the rz view) will be in fact a natural consequence of the layout foreseen for the CGEM-IT anode readout (see Sec 3.1).

A first preliminary evaluation of such an exploit has been performed by the mean of a toy Monte Carlo simulation including the main features of the DC-IT and of the CGEM-IT, and in particular their different layouts and their stereo angles.



TOY MC:
Ratio of the secondary vertex resolution wrt to particle momenta

In the CDR...

An investigation of the new experimental scenario, in which the Inner Tracker of the BESIII spectrometer has been upgraded with the CGEM-IT, will be possible only when the tough and long job of developing a specific simulation and reconstruction framework for the CGEM-IT will be completed, and the full pattern recognition and tracking will be included in BOSS.

About the toy MC

Simplified estimation:

- Generated isotropically inside BESIII fiducial volume
- Same multiple scattering effects

Results:

- Same rϕ resolution
- Improved rz

Overall vertex reconstrucion improves between a factor of 2 and a factor of 3

With this new study we want to go further, developing a full simulation inside the BESIII envoirment, with realistic condition of harware and software

Analysis Plan

- To develop a realistic simulation inside BESIII envoirment:
  - Test beam results to characterise the detector response
  - Full hardware description of the detector
  - Full software capabilities (simulation, reconstruction, analysis)
  - Set of benchmark channels

Analysis Plan

- To develop a realistic simulation inside BESIII envoirment:
  - Test beam results to characterise the detector response
  - Full hardware description of the detector
  - Full software capabilities (simulation, reconstruction, analysis)
  - Set of benchmark channels

Each benchmark channel has its own peculiarities to describe a detector features

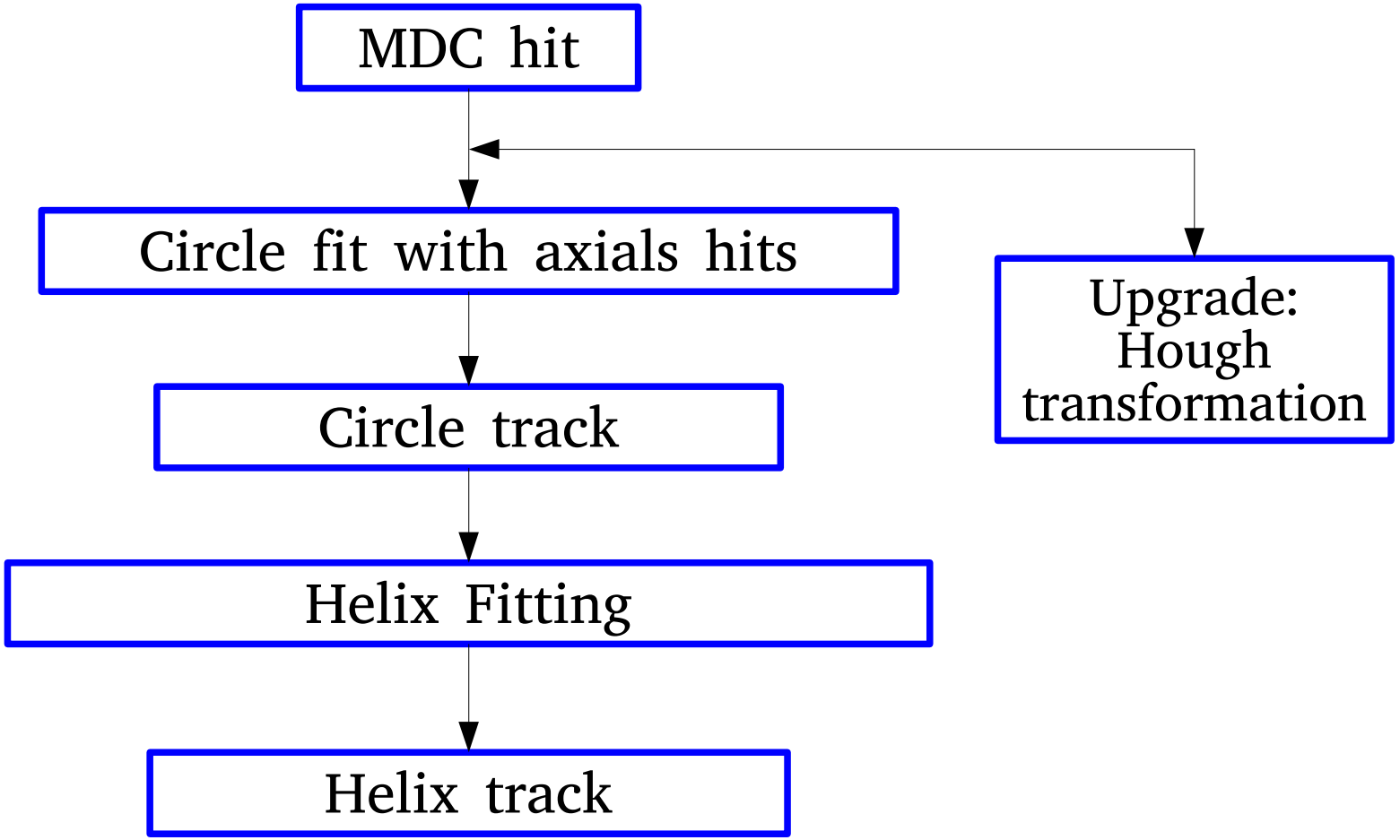
BOSS and CgemBOSS

- **B**es **O**ffline **S**oftware **S**ystem (BOSS):
  - Based on SLC
  - Version: 6.6.5.p01
  - C++, Gaudi framework
  - External libraries: CERNLIB, ROOT, CLHEP, GEANT4

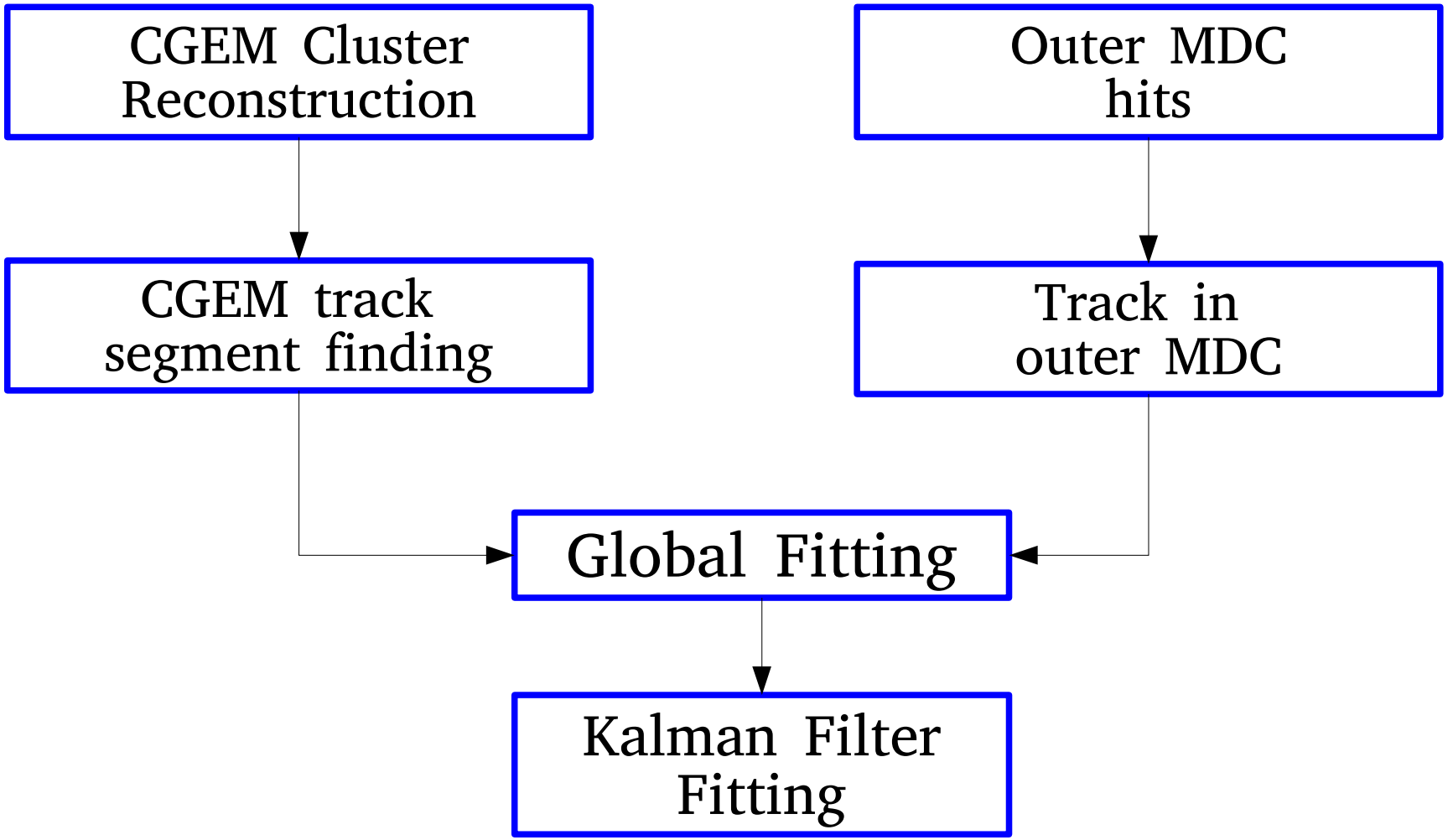
- CgemBOSS:
  - Based on BOSS 6.6.5
  - Version 6.6.5
  - Integration of the CGEM-IT code

For more informations refer to Wang LiangLiang's talk!

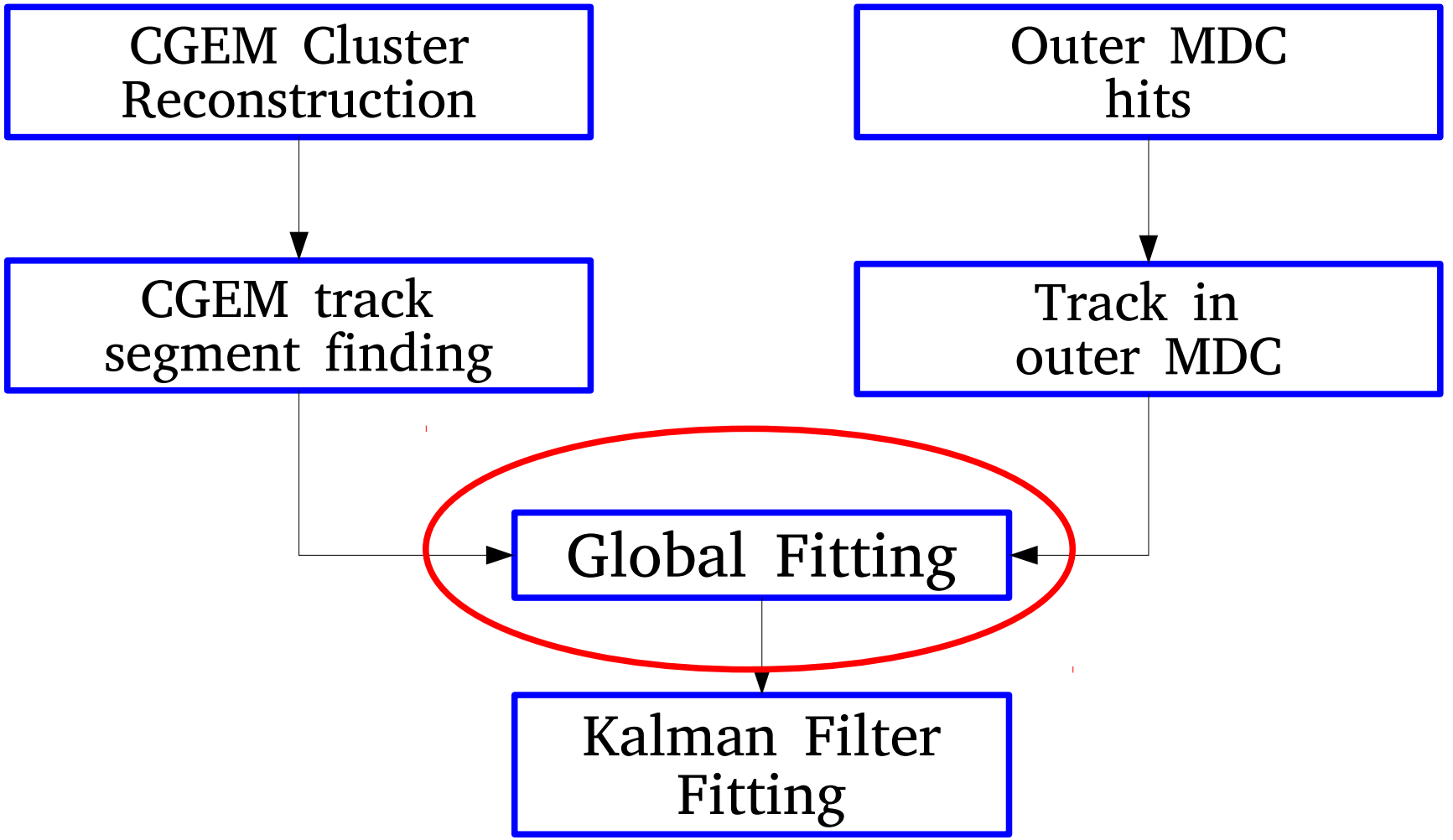
BOSS


MDC hit
Circle fit with axials hits
Upgrade: Hough transformation
Circle track
Helix Fitting
Helix track

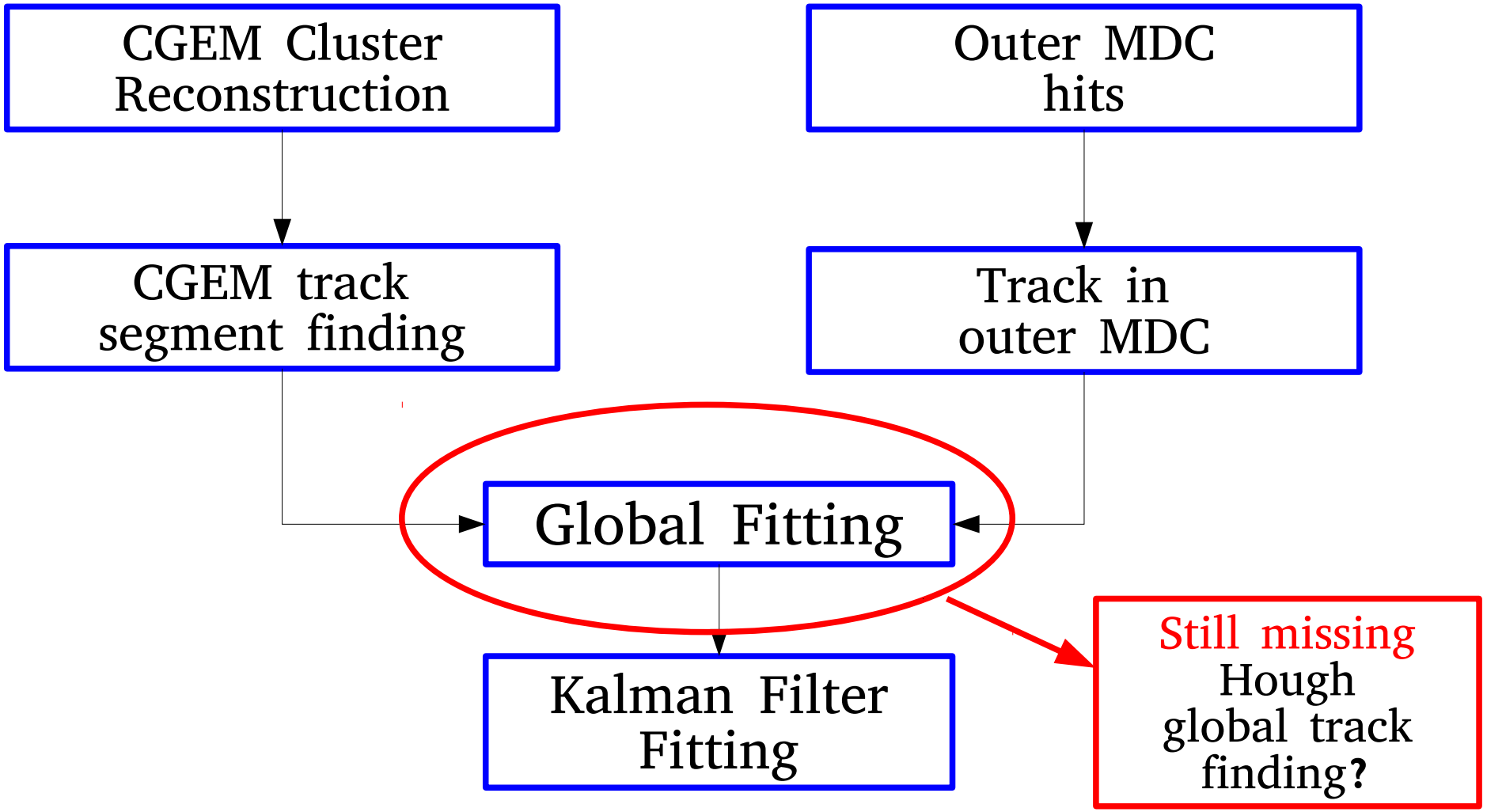
CgemBOSS Status



CgemBOSS Status



CgemBOSS Status



Study of Benchmark Channel

- Short-lived neutral particles
  - → Reconstruct the secondary vertex position
- High reconstruction efficiency
- Analyse processes already studied:
  - → Spot for any inconsistency

Hyperons in J/psi energy regime

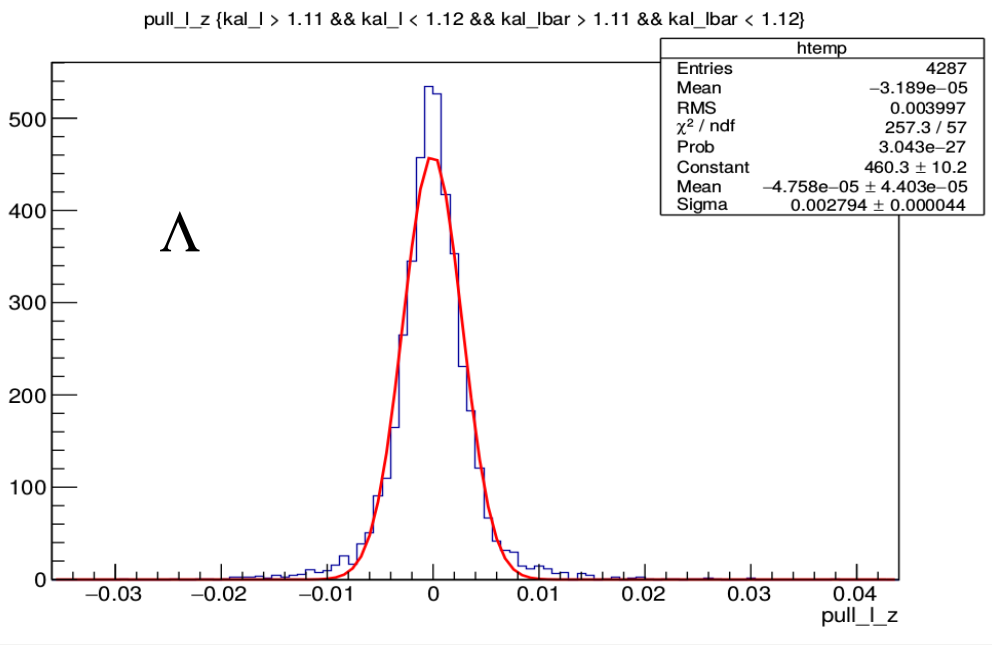
Study of Benchmark Channel

- Test bench:
  - 10000 J/psi → $\Lambda\overline{\Lambda}$ phase space decay
    - $\Lambda \rightarrow p\ \pi^-$
    - $\overline{\Lambda} \rightarrow \bar{p}\ \pi^+$

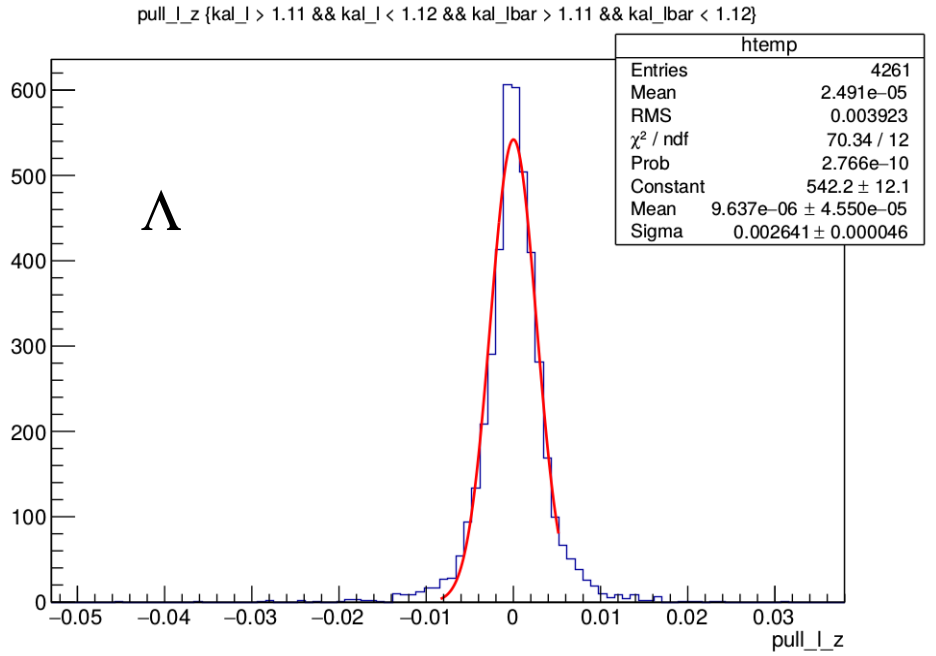
- Different test:
  - Compatibility of DC code: CgemBoss vs Boss
  - Signals in CGEM-IT+outerMDC code

MDC preliminary studies
Pull distributions

BOSS 6.6.5



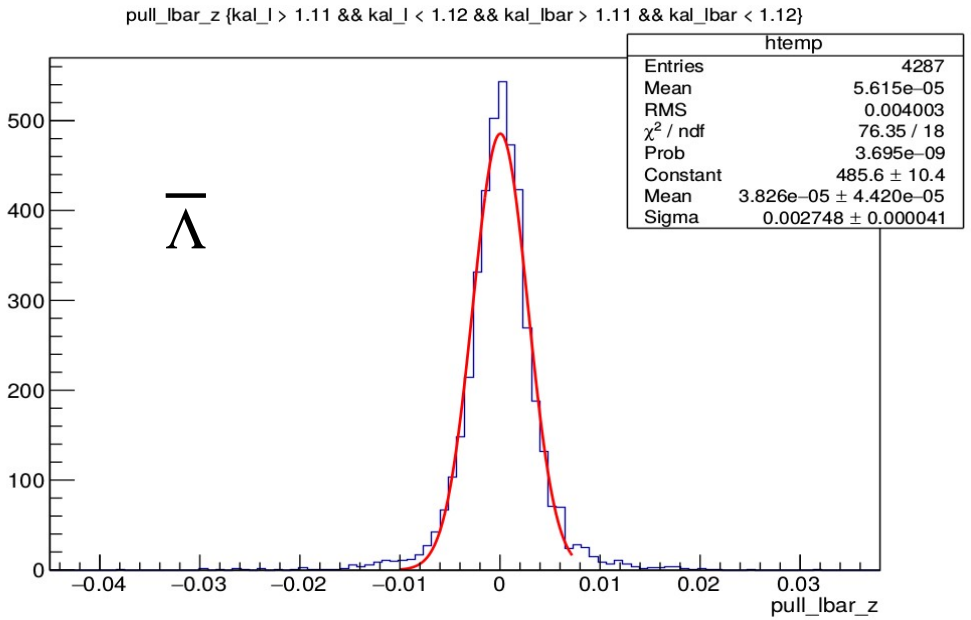
CgemBOSS 6.6.5



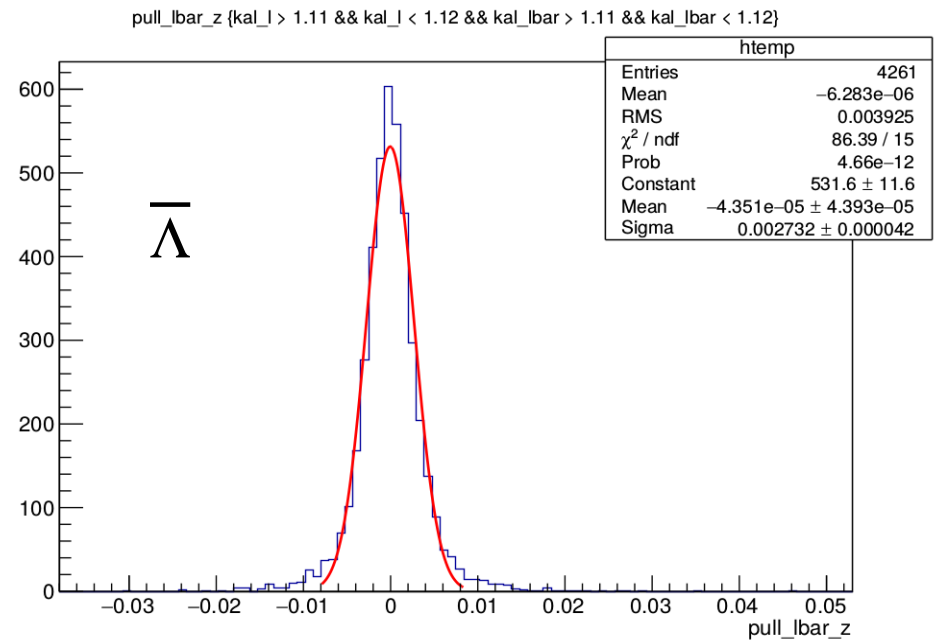
Consistency

MDC preliminary studies
Pull distributions

BOSS 6.6.5



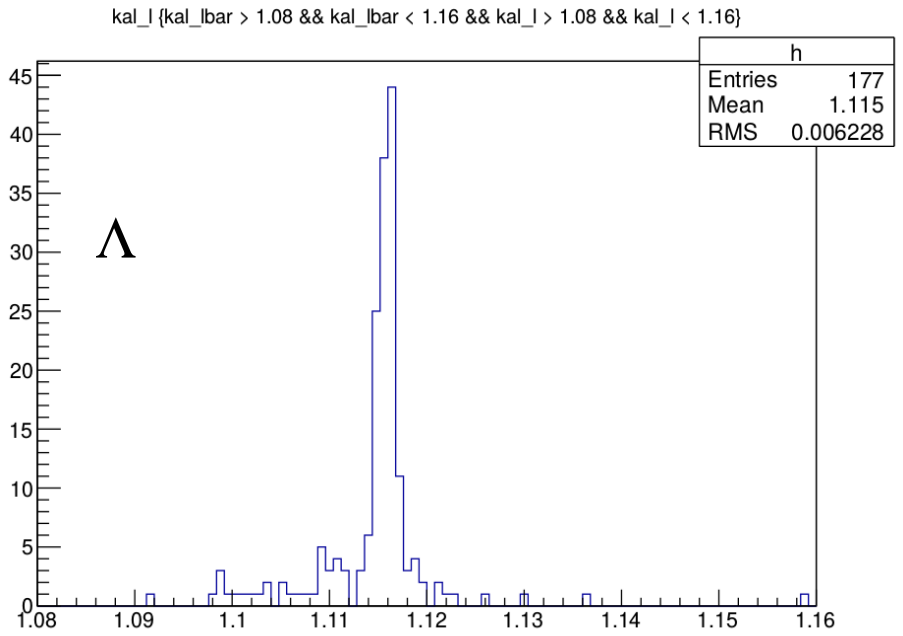
CgemBOSS 6.6.5

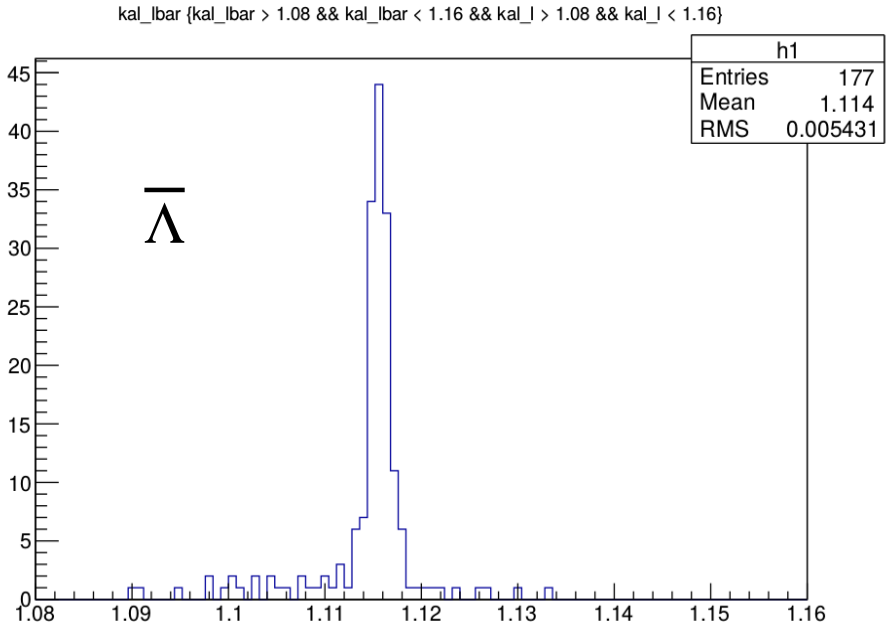


Consistency

CGEM-IT + outerDC

Reconstructed Λ ($\overline{\Lambda}$) signals





CAVEAT: generated 110000 events

CGEM-IT + outerDC

- Established a signal
  - but (for now) very low efficiency!

- Start the understanding process of the global impact of the new CGEM-IT in the BESIII physics analysis:
  - Which is the resolution that match the actual performances?
  - Which will be the performances with a given resolution?

How to prove how it works

Relevant variables:

- Global reconstruction efficiency on single track
- rϕ resolution
- rz resolution
- Momentum resolution

Single track

- Efficiency and resolution of secondary vertexes reconstruction
- Efficiency and resolution of primary vertex reconstruction

Multi track

To be compared with the MDC performances

Outlook

- The tough and hard job continues
  - Digitization needs to be upgraded
  - Global tracking needed

- Several questions still open
  - Low reconstruction efficiency
  - Final results from the test beams

Outlook

- Still, first signals emerges

Start of the study of the impact of the CGEM-IT detector in the BESIII envoirment

THANKS!

Comments and/or questions?