Challenge in software and simulations

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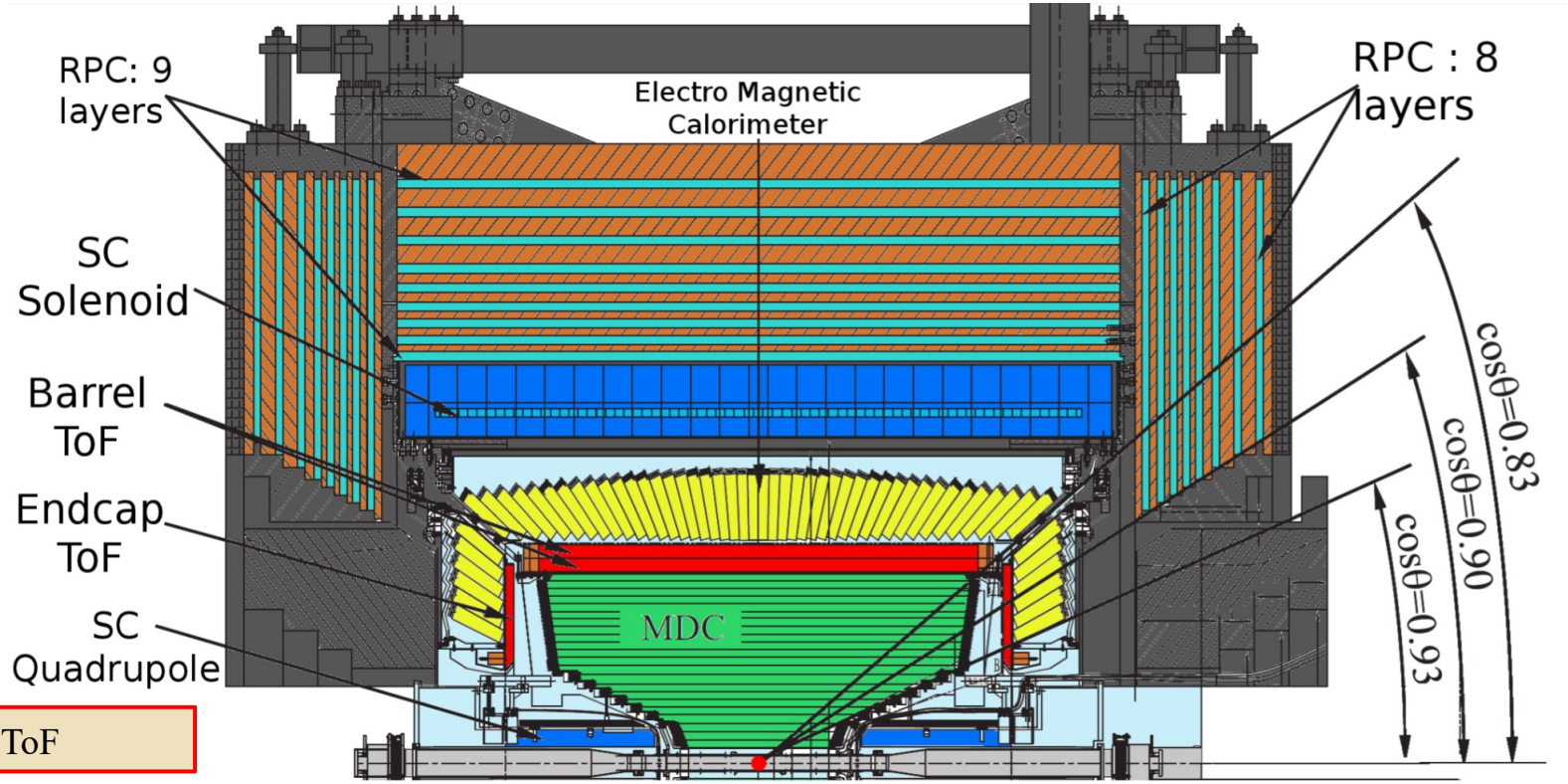
On behalf of the πFE working group

Istituto Nazionale di Fisica Nucleare
Università degli Studi di Ferrara

September 8, 2021
University of Ferrara

BESIII @ CGEMBOSS

Nucl. Instr. Meth. A614, 345 (2010)



ToF

Electromagnetic CsI(Tl) Calorimeter

RPC Muon Detector

Drift Chamber
$\sigma_{r\phi} \sim 130$ μm (single wire)
$\sigma_{pt}/p_t \sim 0.5$ % @ 1 GeV

BESIII @ CGEMBOSS

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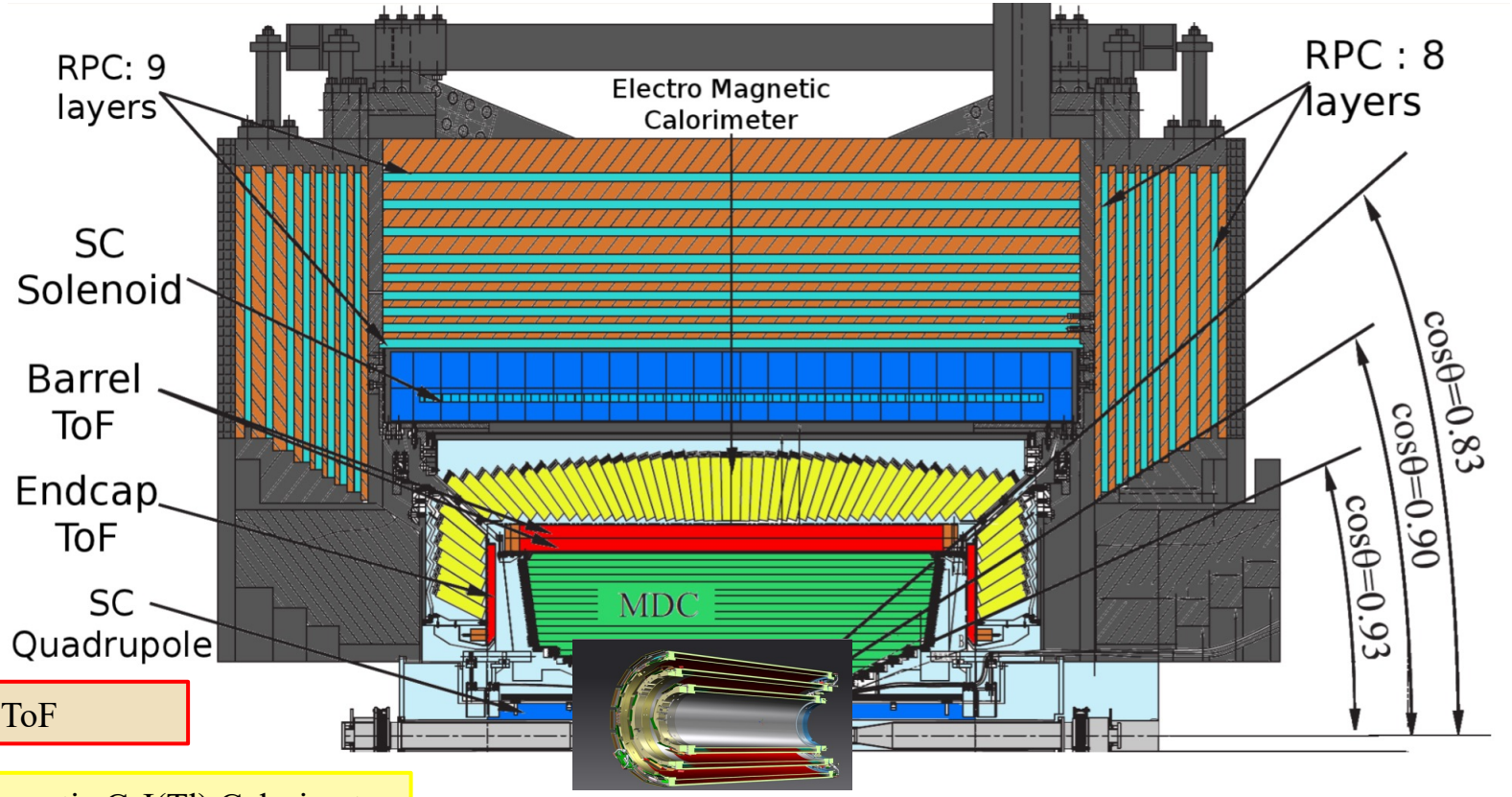


ToF

Electromagnetic CsI(Tl) Calorimeter

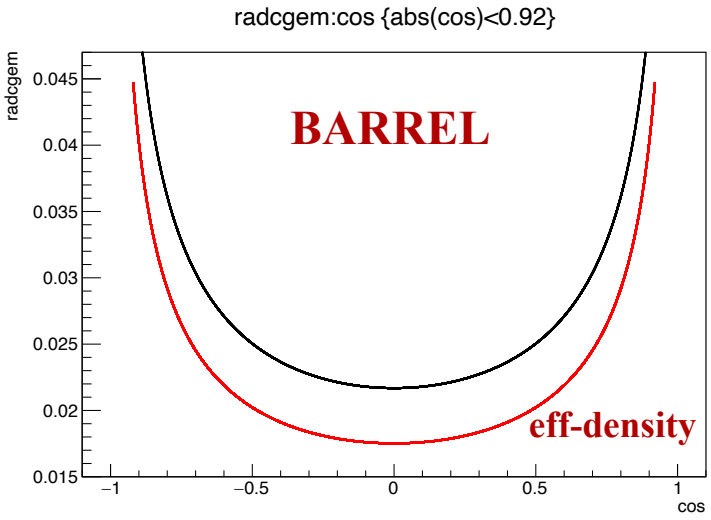
Outer Drift Chamber
$\sigma_{r\phi} \sim 130$ μm (single wire)
$\sigma_{pt}/p_t \sim 0.5$ % @ 1 GeV

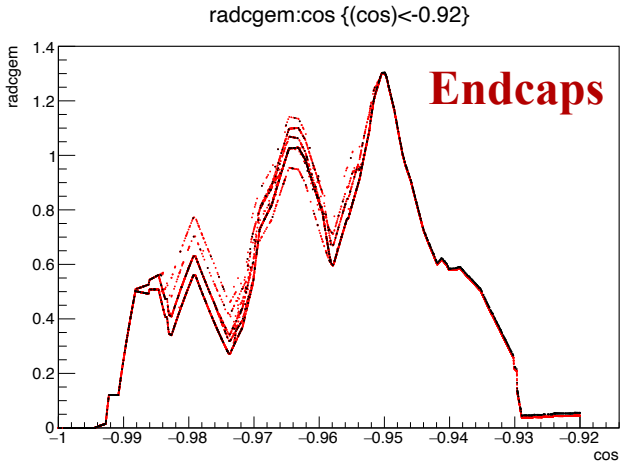
CGEM-IT
$\sigma_{r\phi} \sim 130$ μm
Materia budget ~ 0.5% for each layer

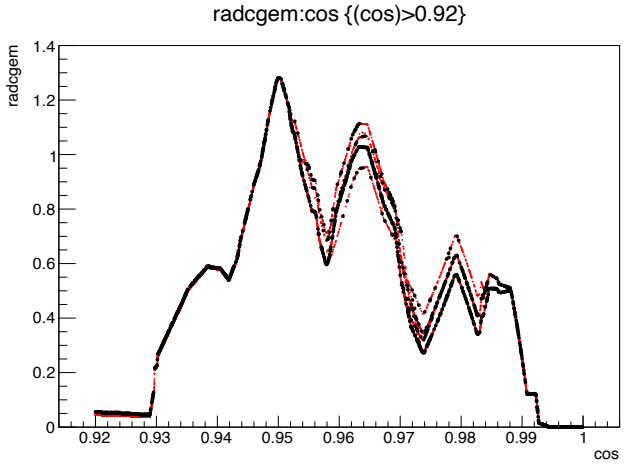
RPC Muon Detector

Works in Ferrara: status and plans

- Implementation of CGEM-IT geometry
  - new L3 updated
  - material budget study done







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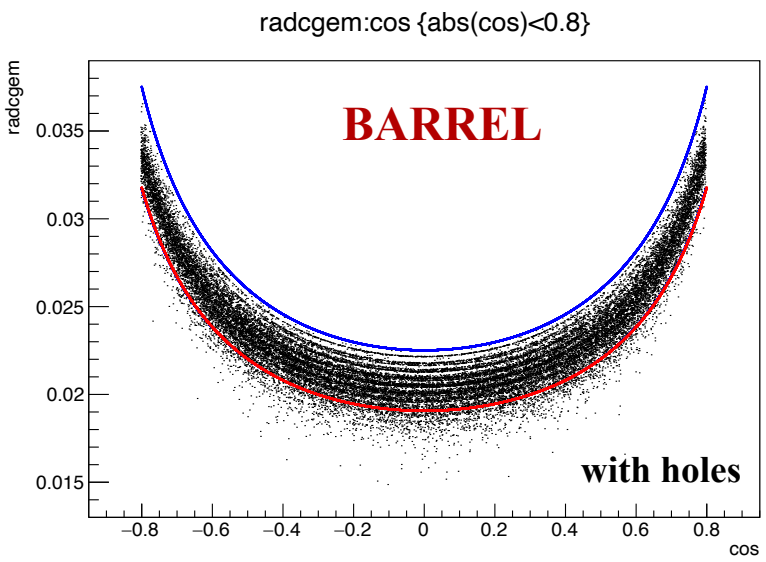

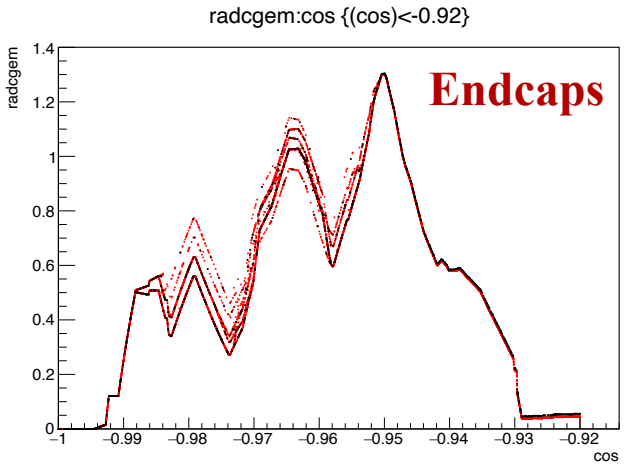

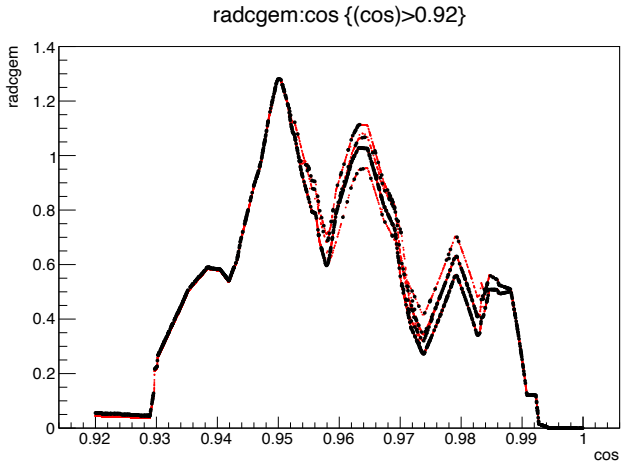

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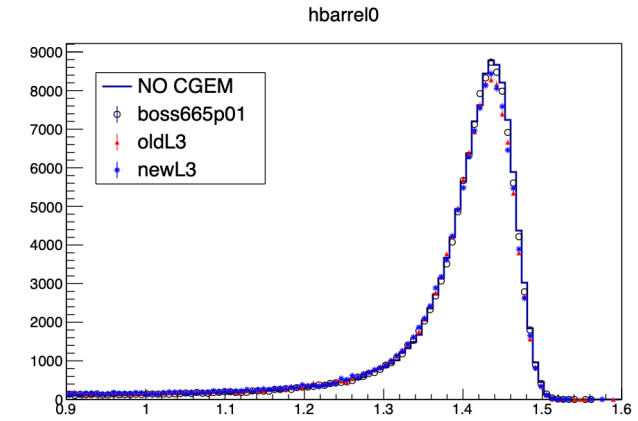
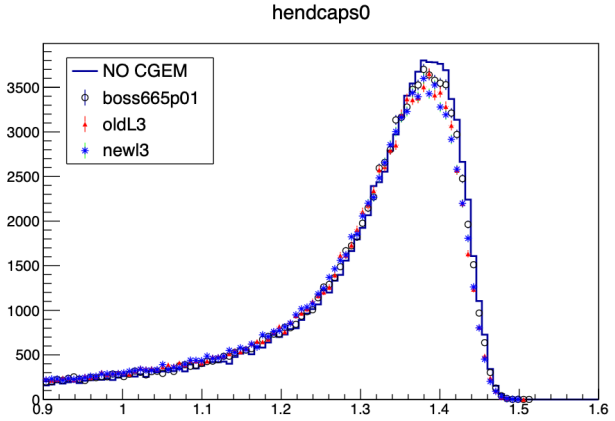
done

- Check overlaps done
- Study of the new radiation length: done
- BhaBha simulation: done





Works in Ferrara: status and plans

- Implementation of CGEM-IT geometry
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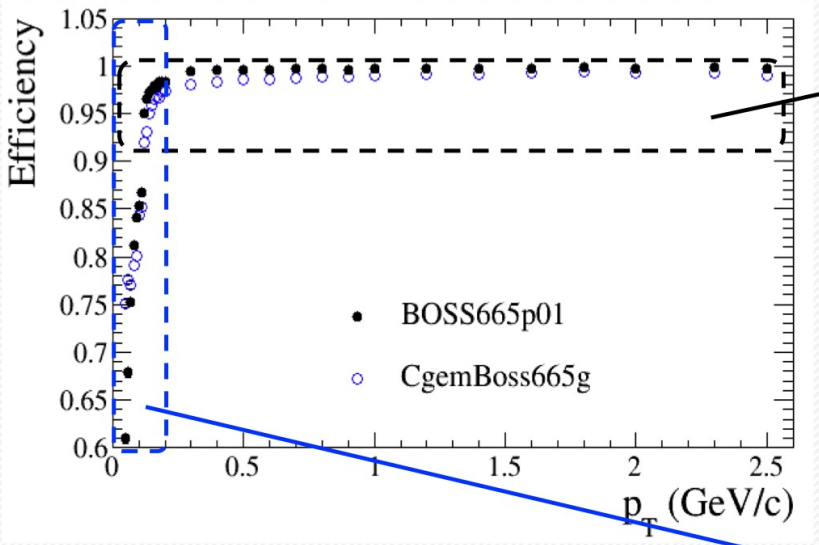
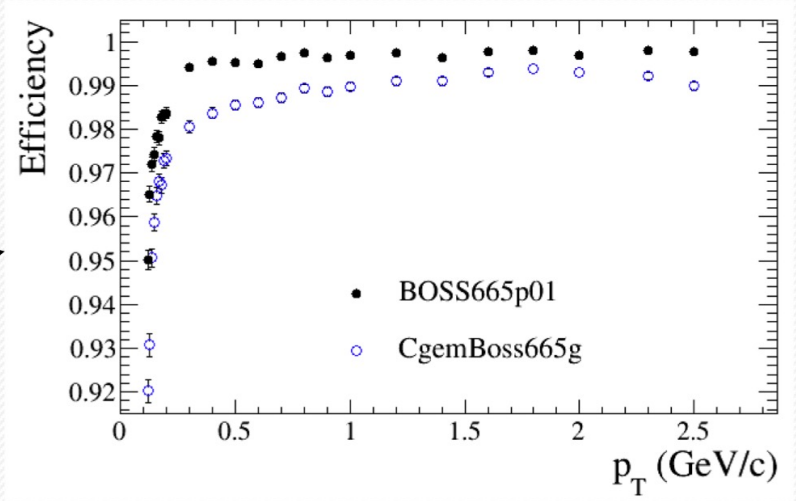
- Reconstruction: test/debug/implementation of Hough transform

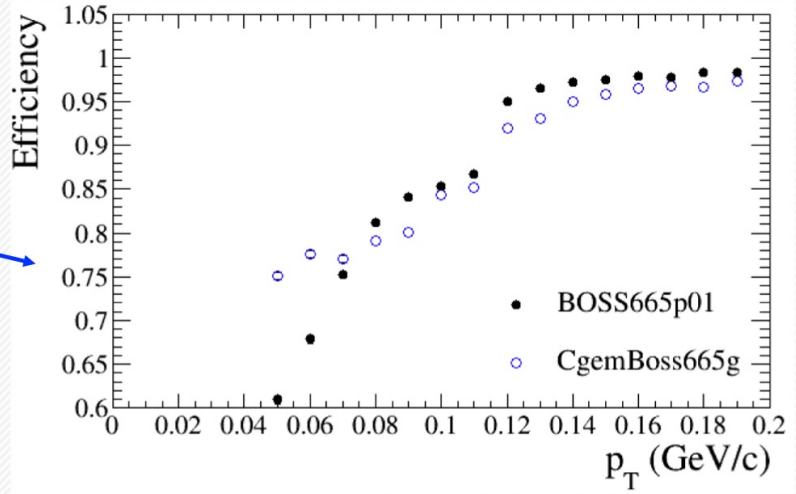
done

CGEMBOSS-665g

Tracking efficiency for single e⁻







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- Reconstruction: test/debug/implementation of Hough transform
  - test the efficiency for other particles
  - multipion efficiency studies
  - code validation

ongoing

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- QA (Quality Assurance) (Marco)

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ongoing

- Time calibration, μTPC and CC- μTPC Merge (Riccardo)

ongoing

- QA (Quality Assurance) (Marco)
- Benchmark physics channel studies

ongoing

to be done

CGEMBOSS-665g

Single tracks (e, m, p, K)
(Isabella Garzia, Zhen Huang, L.L. Wang)

$\psi(3686) \to \pi^+\pi^- J/\psi$
(Zhen Huang, L.L. Wang)

$e^+e^- \to p\bar{p}$
(Christoph Rosner)

$e^+e^- \to \pi^+\pi^-\gamma_{ISR}$
(Yasemin Schelhaas)

$e^+e^- \to \pi^+ D^0 D^{*-}$
(Andreas Pitka)

$e^+e^- \to \Lambda\bar{\Lambda}$
(Viktor Thorén)

$D^0 \to K_S^0 K^- K^+$
(Peter Weidenkaff)

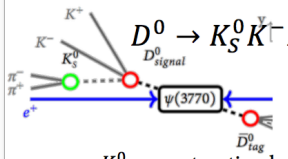
TO BE UPDATED

Displaced vertex - Λ and K_S^0 decays

Viktor Thorén

$e^+e^- \to \Lambda\bar{\Lambda}$
$\to (p\pi^-)(\bar{p}\pi^+)$

Particle	6.6.5.b	6.6.5.c	7.0.3-1
p	50.4 % %	49.3 %	60.6 %
$\bar{p}$	48.6 %	47.5 %	58.5 %
π^+	22.6 % %	18.6 %	35.0 %
π^-	23.4 %	19.4 %	35.5 %

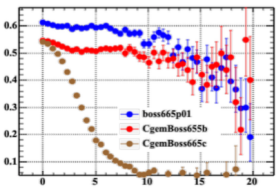


$D^0 \to K_S^0 K^- K^+$

- K_S^0 reconstruction by VeeVertexAlg

[%]	boss665p01	CgemBoss665b	CgemBoss665c
K^-	85.3	79.4	76.8
K^+	85.3	79.7	77.6
π^-	90.9	85.6	78.5
π^+	91.1	85.9	79.0
K_S^0	60.0	52.9	43.7

K_S^0 efficiency



24 Nov. 2018 | P. Weidenkaff

Expected due to missing 3D track finding

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Other activities/opportunities

- Neural Network for tracking (Stefano Spataro – infn TO) **recently started**
- Multivariate Analysis (MVA) for PID at BESIII
- MPGD simulation and calibration (Riccardo)

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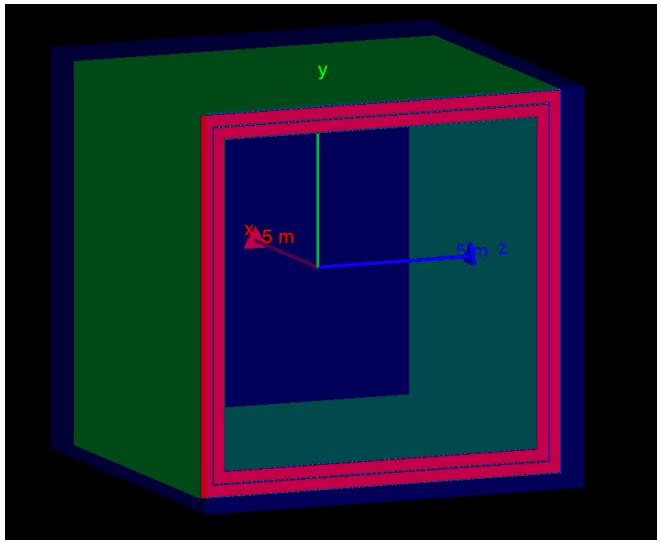
- FCC-ee: muon detector geometry implementation
  - standalone GEANT4 implementation done (simplified version) → Silvia Ghirelli (bachelor thesis)



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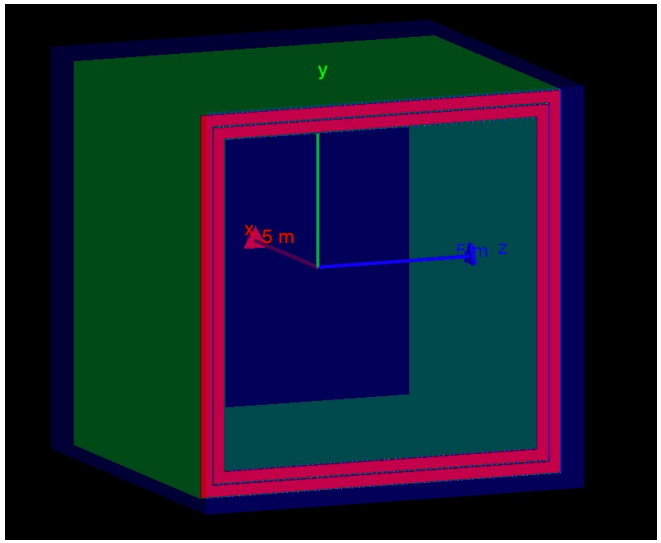
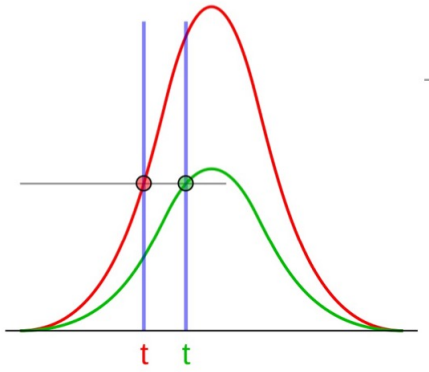
- FCC-ee: muon detector geometry implementation
  - standalone GEANT4 implementation done (simplified version) → Silvia Ghirelli (bachelor thesis)
  - import the code in the official release (stating soon)
  - overlaps check
  - performances studies
  - ….



BK slides

Time calibration summary

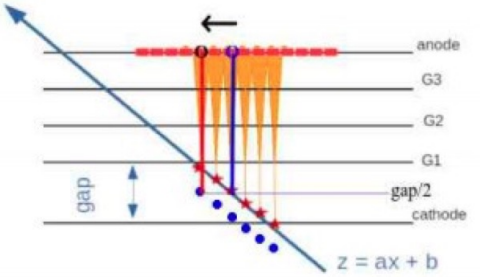


Time-walk: the signal amplitude affects the time measurement. The correlation between charge and time is studied as a function of the threshold levels

0-80 ns contributions

Time-reference: Tiger chip are synchronized but the time measurement of the same event can differ due to geometrical differences (i.e. routing, strip length, etc)

$$t'_{hit} = t_{hit} - t_0$$
$$z_{hit} = t'_{hit} \cdot v_{drift}$$
$$x_{\mu TPC} = \frac{gap/2 - b}{a}$$



0-40 ns contributions

Time-propagation: The signal propagation from the induction point on the strip and the electronic channel affects the time measurements

	Strip X	Strip V
Layer 2	0.51c	0.59c
Layer 3	0.35c	0.57c

0-5 ns contributions

- Implementation of CGEM-IT geometry
  - new L3 updated
  - material budget study done
- Reconstruction: test/debug/implementation of Hough method (lia)
- calibration and Alignment (riccardo)
- benchmark test (tutti + mainz group)