



TASK 4: C+RWELL SIMULATION

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CREMLINplus WP5 General Meeting

■ 28 Sep 2020, 11:00 → 29 Sep 2020, 15:00 Europe/Rome

? Zoom



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C+RWELL SIMULATION GROUP

Newly established working group exploiting KLOE-2 and BESIII expertise and skills



C+RWELL SIMULATION: BENCHMARK & ACTIVITIES

Benchmarks agreed with the group of the Inner Tracker TPC option:

 \oplus Reconstruction efficiency of soft pions ($p_{\pi} < 100$ MeV) with background (Bhabha + 2 γ)

TPC

- Pions with momenta less than 50 MeV/c do not pass through the beampipe option/subsystem
- Three options of Inner Tracker are considered
 - $\circ~$ Si-strips reconstruction for p_{_{\rm T}} > 65 MeV/c
 - CGEM reconstruction for $p_{\pi} > 60 \text{ MeV/c}$ 0
 - TPC 0
 - Standard wall reconstruction for $p_{\pi} > 60 \text{ MeV/c}$
 - Thin wall reconstruction for $p_{\pi} > 55$ MeV/c





 \oplus Reconstruction efficiency and space resolution for vertices in Inner Tracker volume using Λ 's and K_s in FV

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Activities for μ **RWELL** Inner Tracker option:

- DD4HEP framework for SCTF detector simulation using more realistic material budget
- Detector Response parametrisation for fast simulation

I. DD4HEP FRAMEWORK

Insert updated detector configuration. Geometry & material budget inputs from mechanical group studies (see G. Bencivenni's talk)

 \oplus Use Geant4 hits to study soft pion reconstruction as a function of p_{π} momentum. Same scheme used to find p_{π} threshold in studies previously performed with Inner Tracker detector options.

✤ Insert detector response parametrisation for fast simulation.

Hands-on started on proxima server @ BINP/General Computing Facility using basic package version from Software Group and following wiki page https://ctd.inp.nsk.su/wiki/index.php/Workflow_quick_reference

First tutorial with Build and Run primary generators done

Eagerly awaiting to participate in periodic meetings on software activities

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Start with DATA/MC matching of well known detector configuration to get efficiencies and resolutions.



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 Calibrate MC @ θ = 0° and 0.5 kV/cm drift field with cluster size and charge distributions.
 Validate MC with angle and drift field scans.



Ar:CO₂:CF₄ 45:15:40, HV=600V, Gain ~5000

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- Calibrate MC @ θ = 0° and 0.5 kV/cm drift field with cluster size and charge distributions.
 Validate MC with angle and drift field scans.
- Extrapolate MC to new detector configuration



♦ Simulation software developed for BESIII triple-GEM detectors (GTS) → Adapted to µRWELL detector.
 ♦ Inputs from Garfield simulation of orthogonal tracks from 100 GeV muons in 6 mm gap with Ar:CO₂:CF₄
 45:15:40 and 0.5 kV/cm drift field

i. Primary clusters distribution



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htemp i. Primary clusters distribution 10⁵ 225334 Entries 31926 Entries 104 2.388 Mean 2.44 ii. Secondary electrons distribution 6.7 Std Dev 6.757 Std Dev 10 10^{3} 10 104 10 10 60 80 100 120 140 160 180 50 200 eCluster N Primary 100 150 #e

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 ϕ Check with reference DATA if Noise and ADC threshold are compatible with μ RWELL



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CONCLUSIONS & OUTLOOK (I)

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I) DD4HEP framework for SCTF detector simulation

Insert updated detector configuration as from mechanical group studies

Perform soft pion studies

↔ Vertex reconstruction efficiency and resolution

2) Detector Response Parametrisation for fast simulation

- ✤ Simulate resistive configuration
- ϕ Parameters tuning @ θ = 0° and 0.5 kV/cm drift field with μ RWELL reference data: threshold, noise, space and time resolutions
- \bigoplus Validation with drift fields > 0.5 kV/cm and track incident angle scan
- Insert DRP in DD4HEP framework

CONCLUSIONS & OUTLOOK (II)

Study possible layouts presented in G. Bencivenni's talk



- N. 4 independent C+layers \rightarrow 1.9÷2.5% X0
- 1 cm gas gap/layer
- 4 cm global sampling gas •



Possible layouts

- N.2 small gap B2B C+layers \rightarrow 1.5÷1.9% X0 •
- 2×1 cm gas gap/B2B device
- 4 cm global sampling gas •

- 10.1016/j Radial Time Projection Chamber for α detection in CLAS at Jlab, <mark>R. Dupré</mark> et al., 1.1016/j.nima.2018.04.052 N.1 large gap B2B C+layers → 0.75÷0.95% X0
- 2×5 cm gas gap/B2B device
- 10 cm global sampling gas •

Operation of large gas gap radial TPC to be verified

Material budget estimated taking into account different material choices for the mechanics, cathode and faraday cage. All these layouts require the design, construction and test of a C+RWELL prototype.

The prototype under discussion is based on the innovative concept of the **modular roof-tile shaped detector**.