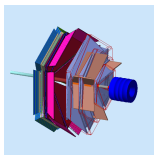


A Study of Simulated Background in CLAS12 Drift Chambers

David Riser

University of Connecticut

HUGS 2016



Overview

- Introduction to Hall-B, CLAS
- Luminosity & Background
- Simulation Procedure
- Results
- Conclusion

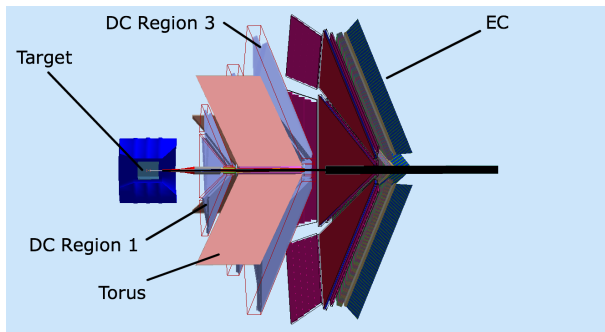
CEBAF Large Acceptance Spectrometer



Left: Overview of Jefferson lab, Right: View of experimental Hall-B.

CLAS12 (GEMC)

Base Beamline Configuration



$$\frac{dN_x}{dt} = L\sigma_x$$

Luminosity

- Higher luminosity, more interesting physics, more background

$$\frac{dN_x}{dt} = L\sigma_x$$

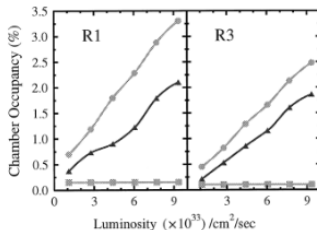
Luminosity

- Higher luminosity, more interesting physics, more background
- CLAS12 $\rightarrow L = 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$

$$\frac{dN_x}{dt} = L\sigma_x$$

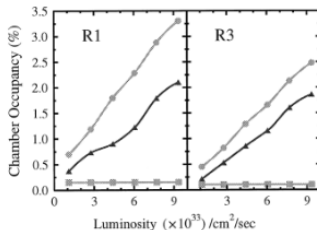
Luminosity

- Higher luminosity, more interesting physics, more background
- CLAS12 $\rightarrow L = 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$
- Luminosity limitation \rightarrow Drift Chambers, FC Rates



Drift Chamber Occupancies

- Probability DC wire gets at least 1 hit in detector response time window Δt



Drift Chamber Occupancies

- Probability DC wire gets at least 1 hit in detector response time window Δt
- Occupancies above few percent reduce tracking efficiency.

Tour of GEMC

- GEant4 Monte Carlo → built around GEANT4 libraries
- Many additional features

GEMC Luminosity Generator

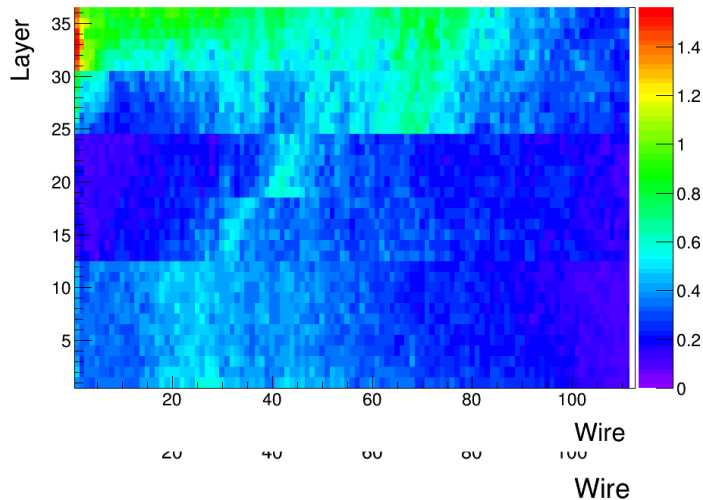
- Simulates 10^{35}
- 1 event simulates 250ns of beam time, 2ns bunches of about 1000 electrons each

$$Occupancy = \frac{N_{hits}}{N_{events}} \frac{\Delta t}{t_{sim}}$$

Results

Baseline Configuration

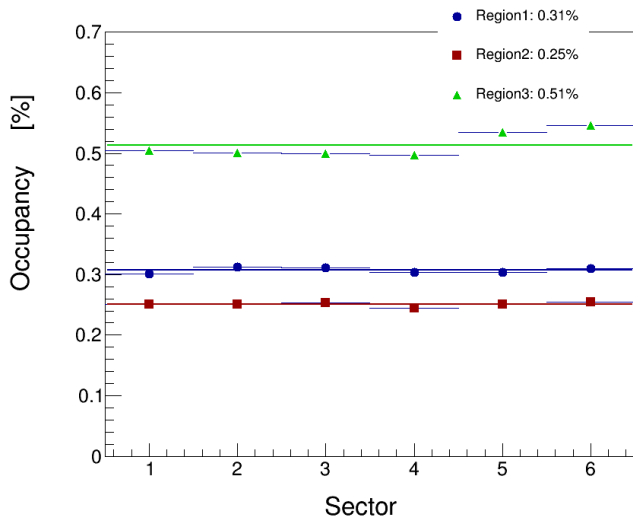
Hit Probability for Sector 1 for baseline



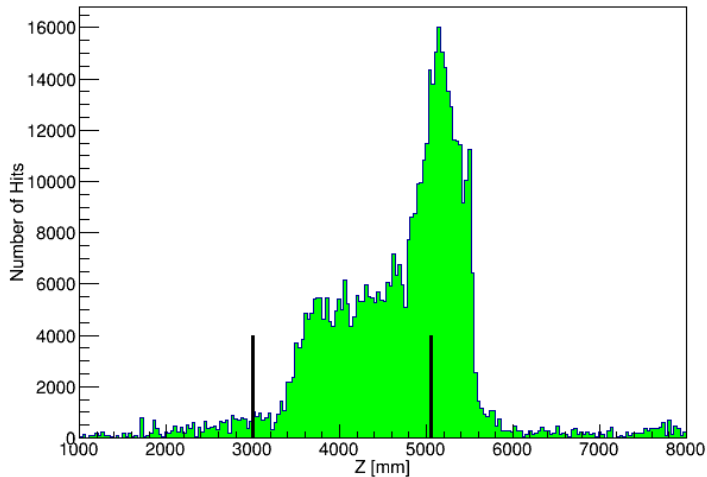
Results

Baseline Configuration

Drift Chamber Occupancy for baseline

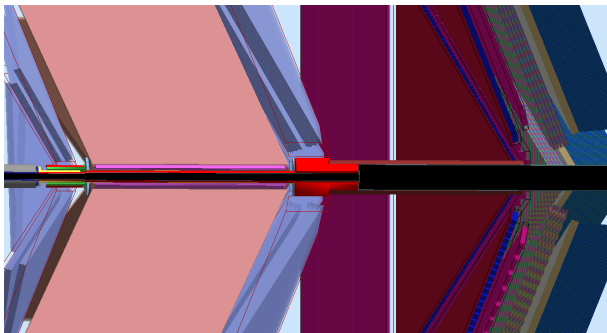


Z-Vertex Position For Region 3 Hits



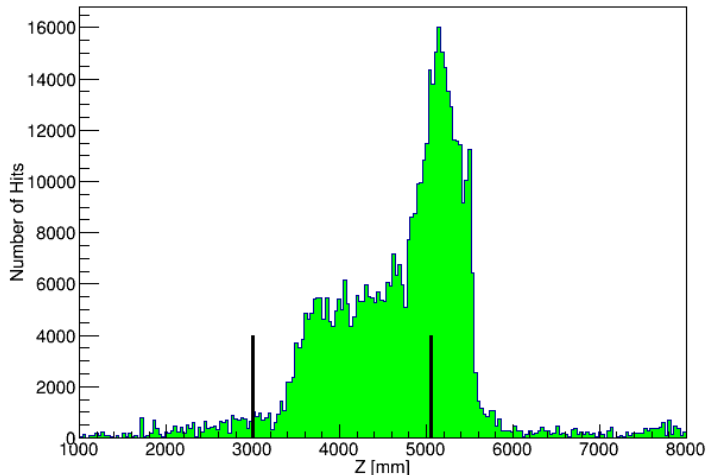
Results

Modified Configuration



- Added tungsten nose downstream of torus (shown in center - red)

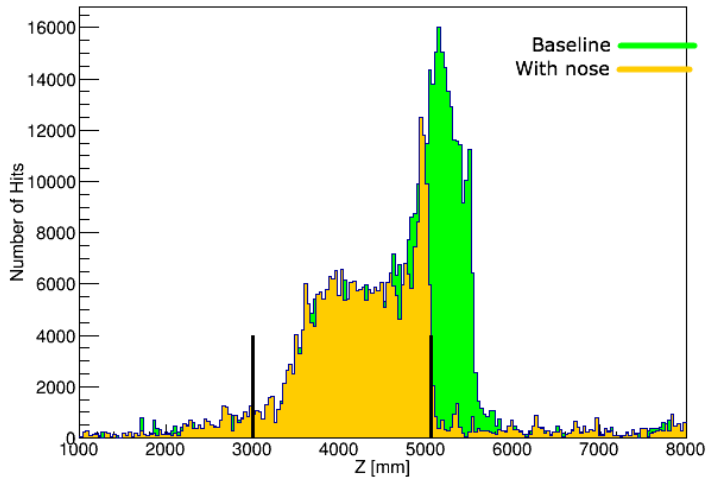
Z-Vertex Position For Region 3 Hits



Results

Modified Configuration

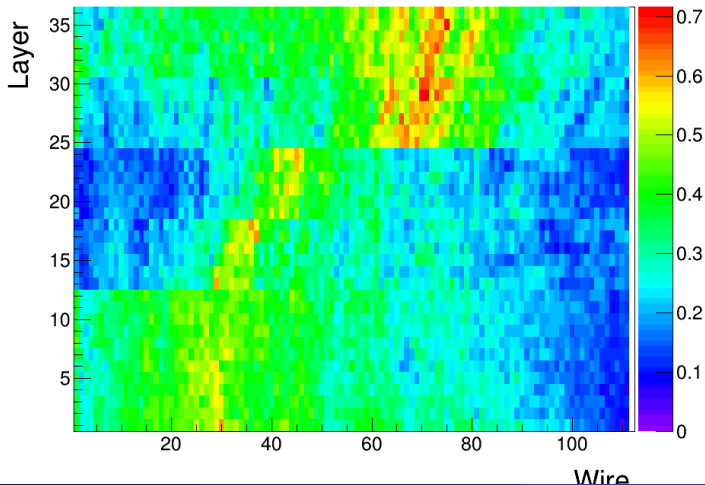
Z-Vertex Position For Region 3 Hits



Results

Modified Configuration

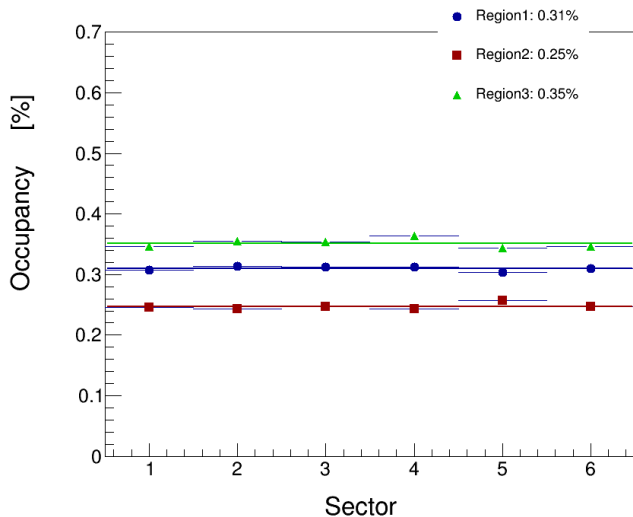
Hit Probability for Sector 1 for noft-l254-r195.4



Results

Modified Configuration

Drift Chamber Occupancy for noft-l254-r195.4



- Our group has simulated with/without additional beamline shielding

Summary

- Our group has simulated with/without additional beamline shielding
- Beamline shielding lowers region 3 occupancy by 30%

Summary

- Our group has simulated with/without additional beamline shielding
- Beamline shielding lowers region 3 occupancy by 30%
- With shielding in place it may be possible to run at several times the designed luminosity, while staying below 1% occupancy

Thanks to the people who have contributed to this work

- HUGS Chair (Alberto), Speakers, and all who helped
- Maurizio Ungaro, Latifa Elouadrhiri, Francois-Xavier Gird
- Kyungseon Joo, Nick Markov

End of Slides

Thank you.