# PVDIS Tigger Rates and Pile-up Study

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### Overview

• Electron Generators:

evgen\_inclusive\_e https://github.com/JeffersonLab/evgen\_inclusive\_e.git

- $\checkmark$  Compared with d2n and MARATHRON data
- Compare with Geant4

#### Hadron generator:

bggen <a href="https://github.com/JeffersonLab/evgen\_bggen">https://github.com/JeffersonLab/evgen\_bggen</a>

- ✓ Compared with MARATHRON data
- Compare with Geant4
- ✓ Got the neutron data----optimize bggen

#### • EC beam test simulation

✓ FTBF

#### • EC simulation study

- ✓ SIDIS LAEC ---add preshowers at the inner radius of LAEC
- ✓ PVDIS trigger rates and pile-up-----this talk

### $\pi$ - in EC



#### $\pi$ - in EC



#### PVDIS EC Shower Deposit Energy Maximum E6p1



## Pile-up Comparison @ 30ns TW

b/evgen bggen/ commit:

227c7

R=189.317module\_ID=196(x,y)=(-61.47,-179.06)

nTargetEM\*.root



#### Effects of pile-up

- **Energy Resolution**
- **Trigger rates**
- $\pi$ -/e- seperation

## Pile-up Comparison @ 30ns TW



#### EC Shower Deposit Energy Maximum 6p1



### PVDIS EC Trigger Rate with Pile-up (kHz)



#### PVDIS EC Trigger Rate with Pile-up (kHz)



### PVDIS EC +LGC Trigger Rate with Pile-up (kHz)



### PVDIS EC+LGC Trigger Rate with Pile-up (kHz)



Trigger Rate EC (MHz)				Trigger Rate EC+LGC (MHz)				
	Without pile-up	With Pile-up 15ns	With pile-up <mark>30ns</mark>	With Pile-up <mark>60ns</mark>	Without pile-up	With Pile-up 15ns	With pile-up <mark>30ns</mark>	With Pile-up <mark>60ns</mark>
e⁻	0.449	0.460	0.467	0.484	0.235	0.240	0.246	0.254
$\pi^-$	21.615	25.89	31.01	42.28	0.048	0.048	0.048	0.076
$\pi^+$	0.663	0.710	0.739	0.853	0.0095	0.0095	0.0095	0.0095
$\pi^0$	0.061	0.061	0.071	0.061	0.02	0.02	0.02	0.02
All pions	22.339	26.66	31.82 1	43.20	0.077	0.077	0.077	0.106

- electron with EC&LGC = 235 KHz = 7.8 KHz/sector=8.5kHz/sector @ 60ns TW
- pions with EC&LGC = 77KHz = 2.6 KHz/sector

DAQ <15kHZ/sector

• total rate = (7.8+2.6)KHz/sector = 10.4KHz/sector

= (12.1 KHz/sector with pile-up @ 60 ns TW)

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#### Some Thoughts about PVDIS Trigger Study

- $\succ \pi^{-}$  dominates the pile-up
- ≻ LGC coverage is smaller than EC---purpose?
- > DAQ can handle the trigger rates with pile-up
- → For large radius (R>2.3m), it triggers on  $\pi^-$  with very low e<sup>-</sup> rates.
- Re-check the offline PID performance with the latest configuration and simulation events.
- If we need to increase the EC trigger threshold to eliminate the pion backgrounds at R>2.3m, we have to study the physics influence on loosing high  $X_{jb}$  electrons.

#### $\pi$ –/e- Ratio



### $\pi$ –/e- Ratio



#### Generator level



p [GeV/c]

### Summary

- **PVDIS** trigger rate with pile-up is under DAQ limit 15kHZ/sector.
- On the trigger level, the pile-up mostly affect the larger radius.
- □ Need to understand the  $\pi^{-}/e^{-}$  ratio (*a*) the larger radius by consider the trigger condition
- The document of this study is under preparing, and will be uploaded to SoLID DocDB.

### Thanks!

# Backup



Baldini, A., Flaminio, V., Moorhead, W.G., & Morrison, D.R.O. Schopper, H. (Ed.). (1988). Total cross-sections for reactions of high energy particles (including elastic, topological, inclusive and exclusive reactions) Subvol b. Germany:

≻E<3GeV

 $\gamma$ +n-> $\pi^{-}p$  SAID  $\gamma$ +n-> $\pi^{0}n$  SAID  $\gamma$  n-> $p \pi^{0} \pi^{-}$  $\gamma$  n-> $n \pi^{+} \pi^{-}$ 

#### E>3GeV --PYTHIA

can use protons and neutrons for the target, and can be adapted to a light nuclear target by hand

- Provide the right mixture of interactions with protons and neutrons (approximately the same cross section)--- easy
- Apply the Fermi motion, or the nucleons spectral functions --relatively easy
- Consider re-scattering it may be small or unimportant--- not easy
  ----program FRITIOF

A word of caution: bggen (and PYTHIA in particular) can be used to describe a bulk

of the the photoproduced final states, but can hardly predict properly rai

#### $\pi^{-}$ cross section ratio





#### LAEC 1748 modules



+Al and prescintillator 45 inner modules +1/2 length 45 inner modules 45 inner modules

+1/4 length



Preshower 10MeV cut	1748 modules	1748+45 preshowe rs	1793	1748+45modul es 1/4 length	1748+45modul es 1/2 length
e-	14%	65%	60%	61%	62%
π—	20%	18%	24%	23%	24%

Etotal cut	1748 modules	1748+45 preshower s	1793	1748+45modul es 1/4 length	1748+45modul es 1/2 length
e-	22%	26%	86%	27%	50%
π—	0.3%	0.086%	0.82%	0.46%	0.17%

### Compare with Previous Resutls

P>1 GeVcurrent						
(MHz)	Total Rate	Trigger Rate	Trigger Rate with pile-up 30ns			
eAll e⁻	0.6	0.449				
$\pi^-$	124.0	2.711	3.261			
$\pi^+$	2.872	0.01	0.076			

Previous	P > 1 GeV			
PID	Total Rate	Trigger Rate		
	(MHz)	(MHz)		
Pi-	85.971	4.539		
Pi+	11.377	0.328		
DIS	0.437	0.26		
Total EC	AL Trigger	5.127		

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