

# SIDIS Trigger Rate Update

Ye Tian

SIDIS Hadron Background Rate Update

- SIDIS windows rate update
- SIDIS target rate update

# Single e<sup>-</sup> Trigger Rates

Rate (kHz)	FAEC	FAEC+LGC	FAEC+LGC+S PD+up+down	e_FA+h_FA
	V1.2	V1.2	V1.2	
e <sup>-</sup>	70	64	59+1.1+1.8	
π <sup>0</sup>	558.6 (63)	23.3 (16.5)	17.1 (15.3)	2.5
π <sup>-</sup>	426	2.89	2.7	0.065
π <sup>+</sup>	513.5	2.3	2.1	0.04
ρ	161.3	0	0	0
All hadrons no e	2057.9	37.7	28.9+3.1+4.5	10.15+2.9+1.81
<b>FAEC total(e+background)</b>			<b>94.5kHz</b>	

Only primary particle in parenthesis

Rate (kHz)	LAEC	LAEC+SPD+up+d own	e_LA+h_FA
	V1.2	V1.2	V1.2
e-	4.5 2.4	4.1+3.6+2.6 2.3	
$\pi^0$	7.8	0.4	0
$\pi^-$	3.0	2.6	0.39
$\pi^+$	3.3	2.9	0.45
p	0.92	0.8	0.08
All hadrons no e-	20.7	8.5+8.4+5.1	2.3+2.46+1.07
LAEC total (e+background)		32.3	

Single e:  $94.5+32.3=126.8\text{kHz}$

# Hadron Trigger Rates

h_FA (kHz)	EC		EC+SPD+up+down	
	V1.2	V1.0	V1.2	V1.0
e	133 134	140	95.4+3.5+3.7 96	100+4+4
$\pi^0$	2417	4607	265	548
$\pi^-$	2829	4925	2493	3971
$\pi^+$	3502	5855	3103	5151
p	1928.9	3510	1802.16	3164
All hadrons no e-	10715 11083	17392	7982+2578+3859 8247.8	12805+4500 +6000
LAEC total (e+background)			14521	23413

# Hadron Trigger coincident Rates

Coin trigger rate(kHz) >=32.5cm		e_FA	h_FA	e_LA	e_FA & h_FA	e_LA & h_FA	E_FA & h_FA)+ (e_LA+h_F A)
e+ $\pi^+$	V1.0	36	127	4.5	9.1	1.2	10.3
	V1.2	50.2 49.5	77 81.7	5.5 5.2	7.7 8.9	1.1 1.15	8.8 10.05
e+ $\pi^-$	V1.0	27	99	3.3	6.3	0.76	7.06
	V1.2	43.7 40	67 65	4.3 4.3	6.5 6.7	0.81 0.86	7.3 7.56
e+ $\pi^0$	V1.0	27	42	2.6	0.6	0.05	0.65
	V1.2	47 45.3	58 59.2	2.8 4.7	2.9 2.2	0.09 0.24	2.99 2.44
e+p	V1.0	22	94	2.5	6.2	0.76	6.96
	V1.2	16 23.3	31 43.3	2.2 2.7	4.3 6.0	0.74 0.84	5.04 6.84

# Hadron Trigger coincident Rates

Coin trigger rate(kHz) >=32.5cm		e_FA	h_FA	e_LA	e_FA & h_FA	e_LA & h_FA	e_LA & h_FA)+ (e_LA+h_F A)
e+k <sup>+</sup>	V1.0	10	19	1	0.6	0.06	0.66
	V1.2	10.9 10.97	18 18	1.1 1.2	2.0 1.9	0.28 0.29	<b>2.28</b> <b>2.19</b>
e+k <sup>-</sup>	V1.0	1.3	6.8	0	0.11	0.002	0.112
	V1.2	2 2.1	3.6 3.7	0.12 0.14	0.46 0.44	0.035 0.036	<b>0.495</b> <b>0.476</b>
e+k <sup>0</sup>	V1.0	5.4	23	0.5	1.6	0.12	1.72
	V1.2	5.7 5.7	9.4 9.8	0.5 0.6	1.13 1.1	0.13 0.14	<b>1.26</b> <b>1.25</b>

Different kinematic cuts for V1.0 and V1.2

V1.2:  $0.9 < Q^2 < 10 \text{ GeV}^2$ ,  $0.03 < x < 0.99$ ,  $0.02 < z < 0.99$ , and  $0.0 < P_t < 1.8$

# SIDIS trigger rates Update

## a) FAEC electron + LAEC electron

- **Single e (FA\_e[e,h]+LA\_e[e,h]):** 94.5+32.3=126.8kHz (win:27.3 kHz)
- **Hadron (FA\_h[e,h]):** 14521kHz (win: 6444.2 kHz)
- **Random coin:** assuming no correlation between electron and hadron trigger:

$$(FA\_e[e,h]+LA\_e[e,h]) * (FA\_h[e,h]) * \text{time window (30ns)}$$

# SIDIS trigger rates Update

## a) FAEC electron + LAEC electron

- Single e ( $FA\_e[e,h]+LA\_e[e,h]$ ):  $94.5+32.3=126.8\text{kHz}$  (win:  $27.3\text{ kHz}$ )
- Hadron ( $FA\_h[e,h]$ ):  $14521\text{kHz}$  (win:  $6444.2\text{ kHz}$ )
- Random coin: assuming no correlation between electron and hadron trigger:

$$(FA\_e[e,h]+LA\_e[e,h])*(FA\_h[e,h])*time\ window\ (30\text{ns})$$

## b) FAEC electron + FAEC hadron

## c) LAEC electron + FAEC hadron

- SIDIS coin (duke e-hadron) :  $b)+c)=31.2\text{kHz}$
- Background Hadron coin (all hadron no e<sup>-</sup>):  $b)+c)=20.69\text{kHz}$  (win:  $8.24\text{kHz}$ )



# SIDIS trigger rates Update

## a) FAEC electron + LAEC electron

- Single e (FA\_e[e,h]+LA\_e[e,h]):  $94.5+32.3=126.8\text{kHz}$  (win:27.3 kHz)
- Hadron (FA\_h[e,h]):  $14521\text{kHz}$  (win: 6444.2 kHz)
- Random coin: assuming no correlation between electron and hadron trigger:

$$(FA\_e[e,h]+LA\_e[e,h])*(FA\_h[e,h])*time\ window\ (30ns)$$

## b) FAEC electron + FAEC hadron

## c) LAEC electron + FAEC hadron

- SIDIS coin (duke e-hadron) :  $b)+c)=31.2\text{kHz}$
- Background Hadron coin (all hadron no e<sup>-</sup>):  $b)+c)=20.69\text{kHz}$  (win: 8.24kHz)

**Has overlap, how much?**

$$\text{Random Coin}=(126.8-31.2-20.69)*(14521)*30ns*\text{kHz}$$

# SIDS trigger rates Update

▣ **Single e:**  $94.5+32.3=126.8\text{kHz}$ (win:27.3 kHz)

▣ **Hadron :** 14521kHz (win: 6444.2 kHz)

▣ **Random coin:**

$$(126.8-31.2-20.69/2)*14521*1e^3*30e^{-9}=37.14\text{kHz}$$

▣ **SIDS coin:** 31.2kHz

▣ **Hadron coin:** 20.69kHz(win: 8.24kHz)

▣ **Prescale inclusive e trigger:** 126.8/10 kHz

Total (random + true coin): **Include both windows**

$$\text{Total}=37.14+31.2+20.69/2+126.8/10=91.4\text{ kHz}$$

$$(126.8-31.2-20.69/1)*14521*1e^3*30e^{-9}+31.2+20.69/1+126.8/10=97.2\text{kHz}$$

# SIDIS trigger rates Update

- • **EC,LGC,SPD trigger condition has no change**

- • **Use 30ns time window** (previous: 20ns)

- • **The collimator size is not changed:**

previous: enlarge upstream collimator to block 7-24 deg (reduce LA e trigger from 46 to 32)

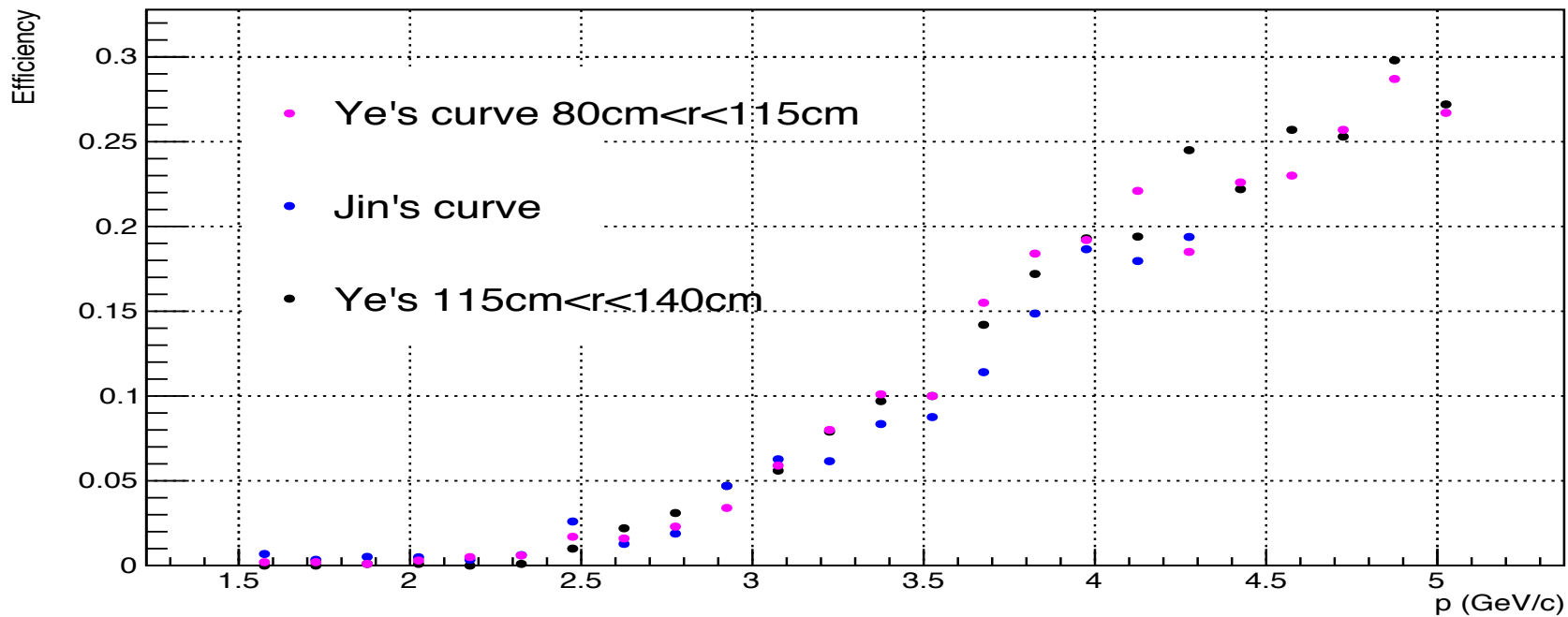
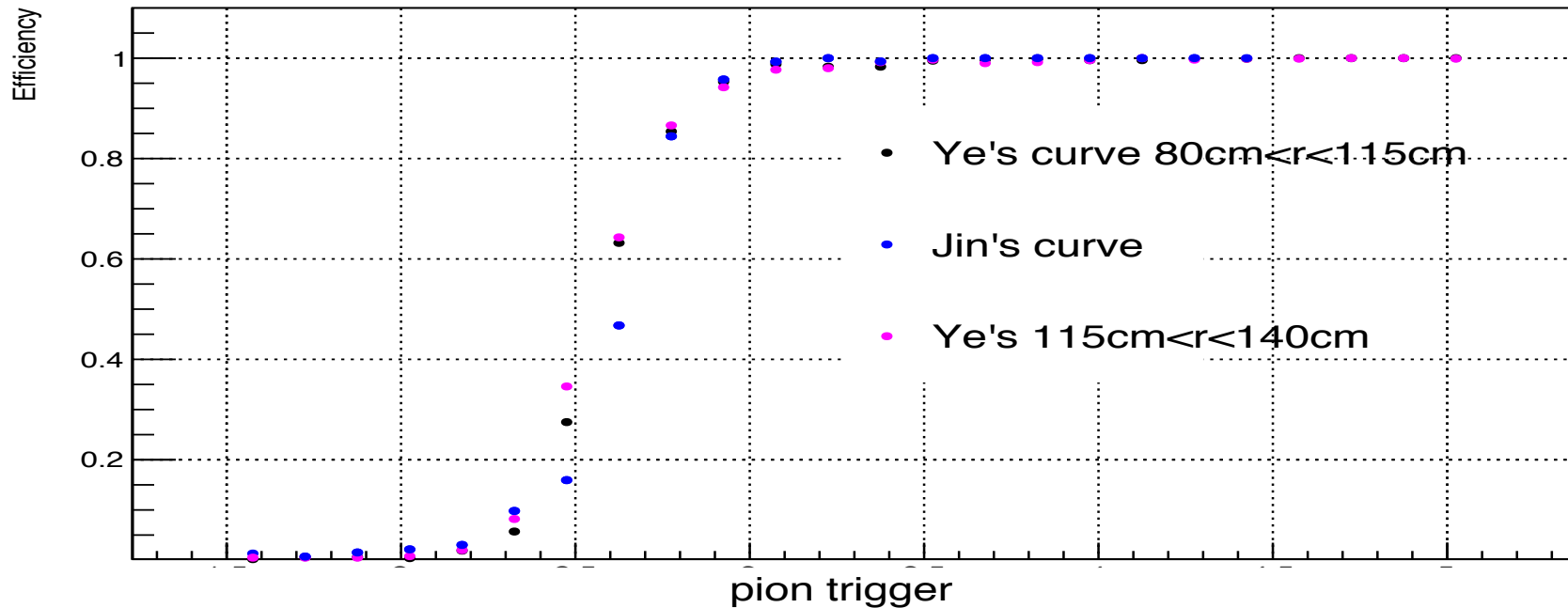
- • **Keep the collimator material**

previous: change collimator from W powder to pure W, FA hadron trigger change from 23413 to 20413)

- • **Reduce hadron coin rate 20.69 kHz by factor 2(?)** to remove overlap with SIDIS coin

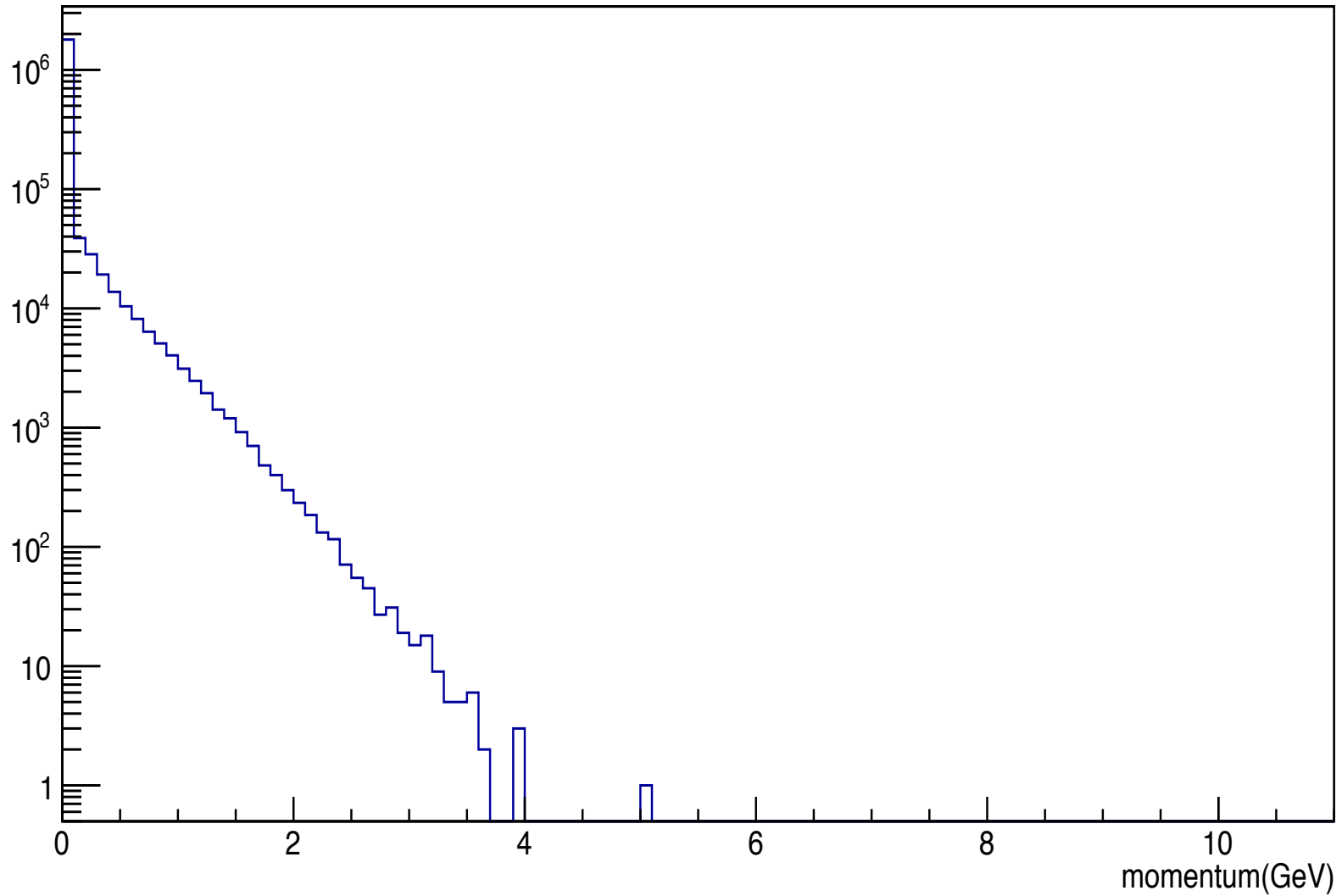
# Backup

# electron trigger



# Hadron momentum

Momentum



# Problem check

Compare two methods for the following setups:

<b>Target</b>	<b>Density g/cm<sup>3</sup></b>	<b>Radiation Length g/cm<sup>2</sup></b>	<b>Length cm</b>	<b>X<sub>0</sub></b>
<b>PVDIS LH</b>	<b>0.071</b>	<b>63.22</b>	<b>40</b>	<b>4.5e-2</b>
<b>PVDIS LD</b>	<b>0.169</b>	<b>125.97</b>	<b>40</b>	<b>5.4e-2</b>
<b>SIDIS 3He</b>	<b>1.345e-3</b>	<b>67.42</b>	<b>40</b>	<b>0.8e-3</b>
<b>SIDIS Up/ Down Window</b>	<b>2.76</b>	<b>19.42</b>	<b>0.012</b>	<b>1.7e-3</b>
<b>JPsi</b>	<b>0.071</b>	<b>63.22</b>	<b>15</b>	<b>1.7e-2</b>

# HallD hadron generator (SoLID-Bggen)

- **SoLID\_Bggen-v1.0**

SOLID-Bggen event generator (HallD) -----modified by Rakitha

- $E > 3$  GeV: PYTHIA is used
- $0.15 < E < 3$  GeV: a mixture of 10 dominating exclusive processes ( $\gamma + p$ ) is used. For the single pion production differential cross sections, the SAID code is used.

- **SoLID\_Bggen-v1.1**-----modified by Jixie Zhang

- Run on the current ifarm environment.
- Beam current, target  $X_0$ ,  $\rho$ , and L for different target.

- **SoLID\_Bggen-v1.2**-----modified by Jixie Zhang

- Add window thickness to include more bremsstrahlung photons



# Rate Comparison

- Old Duke epim Weighted rate:  $1.017e5$  Hz
- New Duke epim Weighted rate:  $1.725e5$  Hz
- New Duke epim normalized rate:  $1.67e5$  Hz

# Hadron Trigger coincident Rates

Coin trigger rate(kHz) >=32.5cm		e_FA	h_FA	e_LA	e_FA & h_FA	e_LA & h_FA	e_LA & h_FA)+ (e_LA+h_F A)
e+ k <sup>+</sup>	V1.0	10	19	1	0.6	0.06	0.66
	V1.2	11.4	18.11	0.66	2.09	0.16	2.25
e+k <sup>-</sup>	V1.0	1.3	6.8	0	0.11	0.002	0.112
	V1.2	2.0	3.6	0.07	0.45	0.01	0.46
e+k <sup>0</sup>	V1.0	5.4	23	0.5	1.6	0.12	1.72
	V1.2	5.7	9.33	0.33	1.14	0.07	1.21
No hadron	V1.0	47	18	12805	17	5.9	23
	V1.2	12	18.1	0.7	2.13	0.15	2.28

# Hadron Trigger coincident Rates

Coin trigger rate(kHz) >=32.5cm		e_FA	h_FA	e_LA	e_FA & h_FA	e_LA & h_FA	e_LA & h_FA)+ (e_LA+h_F A)
e+ $\pi^+$	V1.0	36	127	4.5	9.1	1.2	10.3
	V1.2	49	78	5.4	7.7	1.2	8.9
e+ $\pi^-$	V1.0	27	99	3.3	6.3	0.76	7.06
	V1.2	43.7	67	4.5	6.5	0.84	7.34
e+ $\pi^0$	V1.0	27	42	2.6	0.6	0.05	0.65
	V1.2	46	58	4.9	2.6	0.29	2.89
e+p	V1.0	22	94	2.5	6.2	0.76	6.96
	V1.2	11	18.1	1.1	2.07	0.28	2.35