

# SoLID SIDIS\_He3 trigger

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2016/10/06

2016/10/18

2016/10/25

2016/11/30

2016/12/13

# SIDIS He3 (gas only)

hallD generator & Jin's EC Wiser trigger

Whole detector matching only, No hit matching yet

<u>e FA (kHz)</u>	<b>EC</b>	<b>EC+LGC</b>	<b>EC+LGC+SPD</b>	<b>EC+LGC+SPD+MRPC</b>
electron	70 (56)	63.5(55)	63(55)	63(55)
Pim	531	3.8	3.8	3.8
Pip	696	4.3	4.2	4.2
Pi0	1024	57	54	52
Total:	2324	128	123	<b>123</b>

<u>e LA(kHz)</u>	<b>EC</b>	<b>EC+SPD</b>
electron	4.5	4.3
Pim	6.8	6.5
Pip	8.4	7.8
Pi0	13.7	1.3
Total:	33.4	<b>20</b>

<u>h FA(kHz)</u>	<b>EC</b>	<b>EC+SPD</b>	<b>EC+SPD+MRPC</b>
electron	216	184	174
Pim	5895	5838	5267
Pip	7662	6969	6863
Pi0	5006	1120	842
Total:	18779	14111	<b>13146</b>

# Trigger condition

- e\_FAEC: R(105-235)cm, Q2>=1, Jin's wiser trigger curve
- e\_LAEC: R(80-140)cm, P>3, Jin's wiser trigger curve
- h\_FAEC: R(105-235)cm, cut below MIP, Jin's wiser trigger curve
- e\_LGC: at least 2 PMT and each has at least 2 photons, similar to PVDIS
- e\_FASPD and h\_FASPD: Edep>0.5MeV
- e\_LASPD: Edep>1.5MeV
- e\_MRPC and h\_MRPC are not working yet, so not used

# Trigger logic

- e\_FA: e\_FAEC & e\_LGC & e\_FASPD  
e\_LA: e\_LAEC & e\_LASPD  
h\_FA: h\_FAEC & h\_FASPD
1. Starting from EC and record all hits pass trigger
  2. Then check matching LGC sectors and two neighboring sectors, if any sector passes, then LHC pass
  3. Then check matching SPD sector
  4. Finally we have individual triggers, we can count single trigger rate without double counting
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1. Then check coincidence trigger with all hits from single trigger
  2. Check e\_LA & h\_FA
  3. Check e\_FA & h\_FA and choose to cut on hit distance on FAEC

# single (gas(hallD), win up(wiser), win down(wiser))

## Jin's EC Wiser trigger hit matching

e FA(kHz)	EC	EC+LGC	EC+LGC+SPD
Electron	68 (57)	63(56)	58(52)+1+2
Pip	694(643)	4.2(3.3)	3.8(3.1)+2.5/2+1.6/2
Pim	537(492)	4.0(3.2)	3.6(3.0) +2.3/2+2.1/2
Pi0	1024(120)	43(31)	32(30) +1.1/2+5.8/2
P	202(185)	0(0)	0(0) +0/2+0/2
all hadrons, no electron	2692	62	47 +?+?
Total:			105+4+7=116

electron trigger self coin  
prescaled by 10

$$61/10=6\text{kHz}$$

Only primary particle  
in parenthesis,  
In case of pi0, only e+  
or e-

Pi0 before LGC 26(26)  
Pi0 before GEM 13(12)

e LA(kHz)	EC	EC+SPD
electron	4.5(4.3)	4.1(4)+3.6+2.6
Pip	8.6(8.5)	7.9(8.1)+8.4/2+5.6/2
Pim	6.4(6.0)	5.9(5.7) +6.1/2+3.7/2
Pi0	15.3(0.2)	0.6(0.2) +0.4/2+0.3/2
P	2.9(3.2)	2.8(3.0) +7.6/2+4.8/2
all hadrons, no electron	38	18 +?+?
Total:		22 +14+10=46

h FA(kHz)	EC	EC+SPD
electron	140(94)	100(87) +4+4
Pip	5855(4898)	5151(4447) +3405/2+4570/2
Pim	4925(3787)	3971(3435) +3300/2+4590/2
Pi0	4607(811)	548(468) +33/2+171/2
P	3510(3103)	3164(2831) +2243/2+2563/2
all hadrons, no electron	17392	12805 +?+?
Total:		12913 +4500+6000=23413

only primary particle in parenthesis

Wiser rate scaled down by 2

$$\text{Random coin } (116+46-10.3-7.06-6.96) * 23413 * 1e3 * 30e-9 = 97\text{kHz}$$

# Coin

Direct estimation: using SIDIS generator, EC&GEM acceptance histogram and 8deg cut with or without vertex angle>2.5deg

hit matching

Coin trigger rate (kHz) (EC distance cut for e_FA & h_FA)		e_FA	h_FA	e_LA	e_FA & h_FA	e_LA & h_FA	(e_FA & h_FA) + (e_LA & h_FA)	Direct estimation
e+pip	>= 0cm	36(32)	127(74)	4.5(3.5)	[80]36(6.3)	[1.3]1.2(0.71)	[81.3]37.2(7.0)	(7.54)
	>= 0.1cm	same	same	same	[18]13(6.3)	Same	[19.3]14.2(7.0)	(7.54)
	>= 32.5cm	same	same	same	[11]9.1(6.3)	same	[12.2]10.3(7.0)	(7.45)
e+pim	>= 0cm	27(25)	99(58)	3.3(2.8)	[58]27(4.7)	[1]0.76(0.53)	[59]27.76(5.2)	(5.51)
	>= 0.1cm	same	same	same	[13]9(4.7)	same	[14]9.76(5.2)	(5.51)
	>= 32.5cm	same	same	same	[7.5]6.3(4.7)	Same	[8.4]7.06(5.2)	(5.44)
e+pi0	>= 0cm	27	42	2.6	27	0.05	27.05	
	>= 0.1cm	same	same	same	3.8	same	3.85	
	>= 32.5cm	same	same	same	0.6	same	0.65	
e+p	>= 0cm	22	94	2.5	22	0.76	22.76	
	>= 0.1cm	same	same	same	7.9	same	8.66	
	>= 32.5cm	same	same	same	6.2	same	6.96	

SIDIS coin  $(9.1+6.3+0.6+6.2)+(36+27+27+22)/10+(1.2+0.76+0.05+0.76)=36\text{kHz}$

only primary particle in parenthesis,  
double counting NOT removed in square bracket

# Coin

Direct estimation: using SIDIS generator, EC&GEM acceptance histogram and 8deg cut  
with or without vertex angle>2.5deg

hit matching

Coin trigger rate (kHz) (EC distance cut for e_FA & h_FA)		e_FA	h_FA	e_LA	e_FA & h_FA	e_LA & h_FA	(e_FA & h_FA) + (e_LA & h_FA)	Direct estimation
e+kp	>= 0cm	10	19	1	10	0.06	10.06	
	>= 0.1cm	same	same	same	1.7	same	1.76	
	>= 32.5cm	same	same	same	0.6	same	0.66	
e+km	>= 0cm	1.3	6.8	0	1.3	0.002	1.302	
	>= 0.1cm	same	same	same	0.23	same	0.232	
	>= 32.5cm	same	same	same	0.11	same	0.112	
e+k0	>= 0cm	5.4	23	0.5	5.4	0.12	5.52	
	>= 0.1cm	same	same	same	1.9	same	2.02	
	>= 32.5cm	same	same	same	1.6	same	1.72	
all hadrons, no electron	>= 0cm	47	18	12805	47	5.9	53	
	>= 0.1cm	same	same	same	22	same	28	
	>= 32.5cm	same	same	same	17	same	23	

only primary particle in parenthesis,  
double counting NOT removed in square bracket

hadron coin (17)+(47)/10+(5.9)=28kHz

# SIDIS\_He3 trigger rate summary (2016/12/2)

- Single e  $116+46=162\text{kHz}$
- Random coin  $97\text{kHz}$
- True coin rate  $<70\text{kHz}$ 
  - electron trigger self coin  $6\text{kHz}$
  - coin from SIDIS  $36\text{kHz}$
  - coin from hadrons  $28\text{kHz}$  (still missing window)

All three true coin rate has overlaps but can't know how much without a complete generator!

Total coin rate  $167\text{kHz}$  + from hadrons of windows

# SIDIS He3 total coin trigger (2016/12/13)

- EC,LGC,SPD trigger condition has no change
- Use 20ns time window
- enlarge upstream collimator to block 7-24 deg, reduce LA e trigger from 46 to 32
- Change collimator from W powder to pure W, FA hadron trigger change from 23413 to 20413
- Reduce hadron coin rate 23 by factor 2(?) to remove overlap with SIDIS coin
  
- Random coin  
 $45.5=(116+32-10.3-7.06-0.65-6.96-11.5)*20413*1e3*20e-9$
- SIDIS coin 27
- Hadron coin 11.5
- Prescale FA inclusive e trigger 116/10
  
- Total  $45.5+27+11.5+11.6=96\text{kHz}$



# Todo

- Update EC trigger curve and work on EC simulation in general
- Update MRPC simulation for trigger
  
- Use halld generator for He3 window
- Modify halld generator including e and hadrons
  
- Add low energy EM better
  
- Add elastic, quasi-elastic?
- Add radiative correction?