SIDIS trigger study

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Planned trigger detectors

- SIDIS electron trigger
  - ❑Forward angle: EC + LGC + SPD + MRPC
  - ❑Large angle: EC + SPD
- SIDIS hadron trigger
  - ❑EC + SPD + MRPC (could be different depending on further study)
- Working plan
  - ❑Get singles rate on each detectors for different particles
  - ❑Get total singles rate with detector coincidence
    - ✓ electron-like total rate
    - ✓ hadron-like total rate
  - ❑Estimate electron-like & hadron-like random coincidence rate
  - ❑Estimate Real physics SIDIS rate with SIDIS generator

Forward electron trigger

EC + LGC + SPD + MRPC

SPD threshold: 0.35 MeV

MRPC threshold: edep of 16eV in one gap and at least 5 gaps to be fired

SIDIS forward electron trigger

---Individual detectors

Using Wiser generator

Singles particle	EC Rate (kHz)	LGC Rate(KHz)	SPD Rate(MHz)	MRPC Rate(MHz)	All 4 fired Rate(KHz)
electron	82.8	169	3.3	1.9	64.4
Pim	861	82.4	15.5	14.4	6.2
Pip	1036	85.7	18.7	17.6	7.2
Pi0	2210	2045	10.8	7.6	88.1
Total:	4193	2382	49	41.5	166.5

Total electron-like trigger rate in forward angle: 166.5 KHz + random coincidence among detectors

Random coincidence: if track match is done with 10 segmentations in each detector, random coincidence rate=55Hz

Large angle electron trigger

EC + SPD

SPD threshold: 0.35 MeV

SIDIS large electron trigger

---Individual detectors Using Wiser generator

Singles particle	EC Rate (kHz)	SPD Rate(MHz)	Both fired Rate(KHz)
electron	4.47	2.3	4.3
Pim	9.8	17.7	9.1
Pip	10	21.8	10
Pi0	18.5	7.8	2.3
Total:	42.8	49.6	25.7

Total electron-like trigger rate in forward angle: 25.7KHz + random coincidence among detectors

Random coincidence: if track match is done with 10 segmentations in each detector, random coincidence rate=914Hz

- SIDIS hadron trigger
  - ❑ EC + SPD + MRPC

SIDIS hadron trigger

Wiser curve and wiser data

Singles particle	EC Rate (MHz)	SPD Rate(MHz)	MRPC Rate(MHz)	All 3 fired Rate(MHz)
electron	0.21	3.5	1.9	0.17
Pim	13.7	15.7	14.4	12.1
Pip	16.7	19.1	17.6	14.8
Pi0	17.5	10.8	7.6	2.5
Total:	48.1	49.1	41.5	29.6

Total hadron rate based on EC+SPD+MRPC = 29.6 MHz + random coincidence among detectors

Random coincidence: if track match is done with 10 segmentations in each detector, random coincidence rate=84KHz

Electron-like & hadron-like random coincidence ---assuming 30 ns window

- Forward angle electron trigger rate: 166.5KHz
- Large angle electron trigger rate: 25.7KHz
- Hadron trigger rate: 29.6MHz

❑e&h random coincidence rate:
(144KHz+29.8KHz)*29.58MHz*30ns=176KHz

No detector correlations study yet, should be taken into account

My concern for hadron trigger

- Forward electron trigger: EC(high threshold)+LGC+SPD+MRPC
- Forward hadron trigger: EC(low threshold) + SPD+MRPC
- Those particles passed electron trigger in the forward angle will also pass hadron trigger: will cause additional e&h coincidence rate by 144KHz in the forward angle

- ❖ VETO on LGC ??? Not practical, could have an electron in this sector
- ❖ Make judgement on hit position on EC??? Will have bias on phi_h
- ❖ Only inclusive triggers in forward angle??? A big project, not doable shortly

Hit position constraint to form hadron trigger ---5 cm away from electron trigger

Using singles particle to do a test

Pid	Pass electron trigger (kHz)	Pass electron trigger and hadron trigger without R constrain (kHz)	Pass electron trigger and hadron trigger with R constrain (kHz)
electron	42	42	11.3
pim	6.2	6.2	0.8
pip	8.1	8.1	1.3
pi0	89.7	89.7	37.6

Electron trigger and hadron trigger at forward angle has a correlation of about 35%

e&h trigger correlation in the forward angle will give additional 51kHz coincidence trigger rate

SIDIS trigger rate by using wiser

- e&h random coincidence:(144KHz+29.8KHz)*29.58MHz*30ns=154KHz
- e trigger and hadron trigger correlation in forward angle: 51KHz
- SIDIS physics rate: ~10KHz

- Detector correlations---impact on e or h rates---haven’t been studied yet

To-do list for SIDIS trigger rate estimation

- Update EC response using Hall D generator (Rakitha)
- Update SPD threshold (Sanghwa)
- Update MRPC threshold (Sanghwa)
- Hadron-like trigger rate estimation →done by using wiser based study
- Define how to do “track match” at trigger level to reduce random coincidence rate (among detectors)
  - → 10 segmentations in phi dimension (3 adjacent sectors)
- Efficiency study by combining all the individual detectors in the trigger design

Backups

SIDIS hadron trigger

Wiser curve and wiser data

Singles particle	EC Rate (MHz)	SPD Rate(MHz)	MRPC Rate(MHz)	All 3 fired Rate(MHz)	All 3 fired + lgc veto (MHz)
electron	0.14	2.0	1.16	0.11	0.047
Pim	13.7	15.7	14.4	12.1	12.06
Pip	16.7	19.1	17.6	14.8	14.76
Pi0	17.5	10.8	7.6	2.5	1.81
Total:	48	47.6	40.8	29.5	28.7

By putting a VETO on LGC for hadron trigger, we almost keep all the pi+/-

Forward electron trigger now doesn't have any overlap with hadron trigger

SIDIS forward electron trigger
---EC singles rate

Singles particle	Rate (kHz)
electron	53.9
Pim	864
Pip	1036
Pi0	2210
Total:	

Using Wiser generator

SIDIS forward electron trigger

---LGC singles rate with threshold=2 p.e & 2 pmts

Singles particle	Rate (kHz)
electron	77.2
Pim	82.4
Pip	85.7
Pi0	2045
Total:	

Using Wiser generator

SIDIS forward electron trigger
---SPD singles rate with threshold=0.35MeV

Singles particle	Rate (MHz)
electron	2.0
Pim	15.7
Pip	19.1
Pi0	10.8
Total:	

Using Wiser generator

60 pieces in phi dimension, 4 pieces in r dimension

SIDIS forward electron trigger

---MRPC singles rate with threshold=16eV and 5 laylers to be fired

Singles particle	Rate (MHz)
electron	1.16
Pim	14.4
Pip	17.6
Pi0	7.6
Total:	

Using Wiser generator

60 pieces in phi dimension, 4 pieces in r dimension, 10 gas layers