SoLID GEM Digitization

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02/24/2016

Preliminary Raw Occupancy for SIDIS GEM

- 100% background means we use 15uA current, so 25.74M electrons pass through the target cell in a 275ns time window

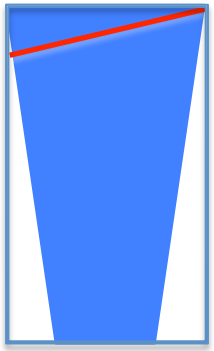
- Using Zhiwen's recent background simulation file, for each background particle, randomize the event time (same way as the previous study)

- For SIDIS, currently we consider only one sample (the one at 50ns). A strip is considered fired, if that sample is beyond certain threshold cut (ADC cut)

Preliminary Raw Occupancy for SIDIS GEM

- Only run a few hundred events now, very time-consuming (2 mins per event)
- Occupancy is defined as the # of strip beyond threshold over the total number of strip for a sector
- Total number of strips for a sector {453, 510, 583, 702, 520, 640} or {585, 711, 809, 971, 671, 817}.

First calculate the length of the red line, and divide it by the strip pitch. This give the first set of number



The second set of number comes from digitization. It calculates the number of strip based on the size of the bounding box

Preliminary Raw Occupancy for SIDIS GEM

The following results assume 0.45e5 mm^2/s gas diffusion speed, and on average 2 strips fired for a signal cluster

	ADC Cut 0	ADC Cut 80	ADC Cut 100	ADC Cut 120
Plane 1	3.7%	2.0%	1.8%	1.7%
Plane 2	12.0%	7.5%	6.8%	6.2%
Plane 3	6.2%	3.3%	2.9%	2.6%
Plane 4	3.3%	1.9%	1.7%	1.6%
Plane 5	2.8%	1.7%	1.5%	1.4%
Plane 6	2.9%	1.3%	1.1%	1.0%

Using only one sample, so no deconvolution, otherwise occupancy should drop by a factor of 2 to 3. # of strips based on the size of the bounding box

Preliminary Raw Occupancy for SIDIS GEM

The following results assume 0.45e5 mm^2/s gas diffusion speed, and on average 2 strips fired for a signal cluster

	ADC Cut 100
Plane 1	1.8%
Plane 2	6.8%
Plane 3	2.9%
Plane 4	1.7%
Plane 5	1.5%
Plane 6	1.1%

Plane	Raw Occupancy (%)	Occupancy w/noise cut (%)
u1	19.8	5.7
v1	15.0	4.6
u2	14.8	4.0
v2	11.7	3.2
u3	14.3	3.9
v3	11.3	3.2
u4	7.1	1.9
v4	5.7	1.5
u5	6.7	1.8
v5	5.5	1.4

Using only one sample, so no deconvolution, otherwise occupancy should drop by a factor of 2 to 3. # of strip based on size of the bounding box

Preliminary Raw Occupancy for SIDIS GEM

- A couple questions that I am thinking right now:
  - Cluster size on average 2, is it too small?
    - Cluster size is about 3 based on the PRad GEM cosmic test from Uva
  - Currently, digitization randomize background event time from 200ns before trigger time, and 75ns after. Is this long enough if we take only one sample?
    - If taking only one sample, out of time background suppression rely completing on the ADC threshold cut.
    - ADC threshold cut better not be higher than 150 based on current setting (~96% detection efficiency for signal particle based on 0% background digitization simulation)
    - What if the 150 ADC cut is not sufficient to cut away events appear 200ns before the trigger time? (due to long tail signal and pileup)

Preliminary Raw Occupancy for SIDIS GEM

The following results assume 1e5 mm^2/s gas diffusion speed, and on average 3 strips fired for a signal cluster (0.45e5mm^2/s and 2 strips used previously)

	ADC Cut 0	ADC Cut 80	ADC Cut 100	ADC Cut 120
Plane 1	4.23%	2.3%	2.0%	1.8%
Plane 2	13.0%	8.2%	7.4%	6.7%
Plane 3	7.0%	3.6%	3.2%	2.8%
Plane 4	3.9%	2.2%	1.9%	1.7%
Plane 5	4.3%	1.9%	1.7%	1.5%
Plane 6	3.5%	1.4%	1.2%	1.1%

Using only one sample, so no deconvolution, otherwise occupancy should drop by a factor of 2 to 3. # of strip based on the size of the bounding box

Conclusion

- Occupancy not terribly bad at least for now(except for the second GEM plane of course).

- Tracking should still work, even though it would be quite challenging (consider the second GEM plane, complex event topology and EC not always available)

- Maybe a slightly higher ADC cut is feasible, need to see how that affects the efficiency. And also see if hit amplitude matching before tracking is doable for SIDIS.