

Energy overlaps between TAGH counters: effects of 2016-2017 resurvey

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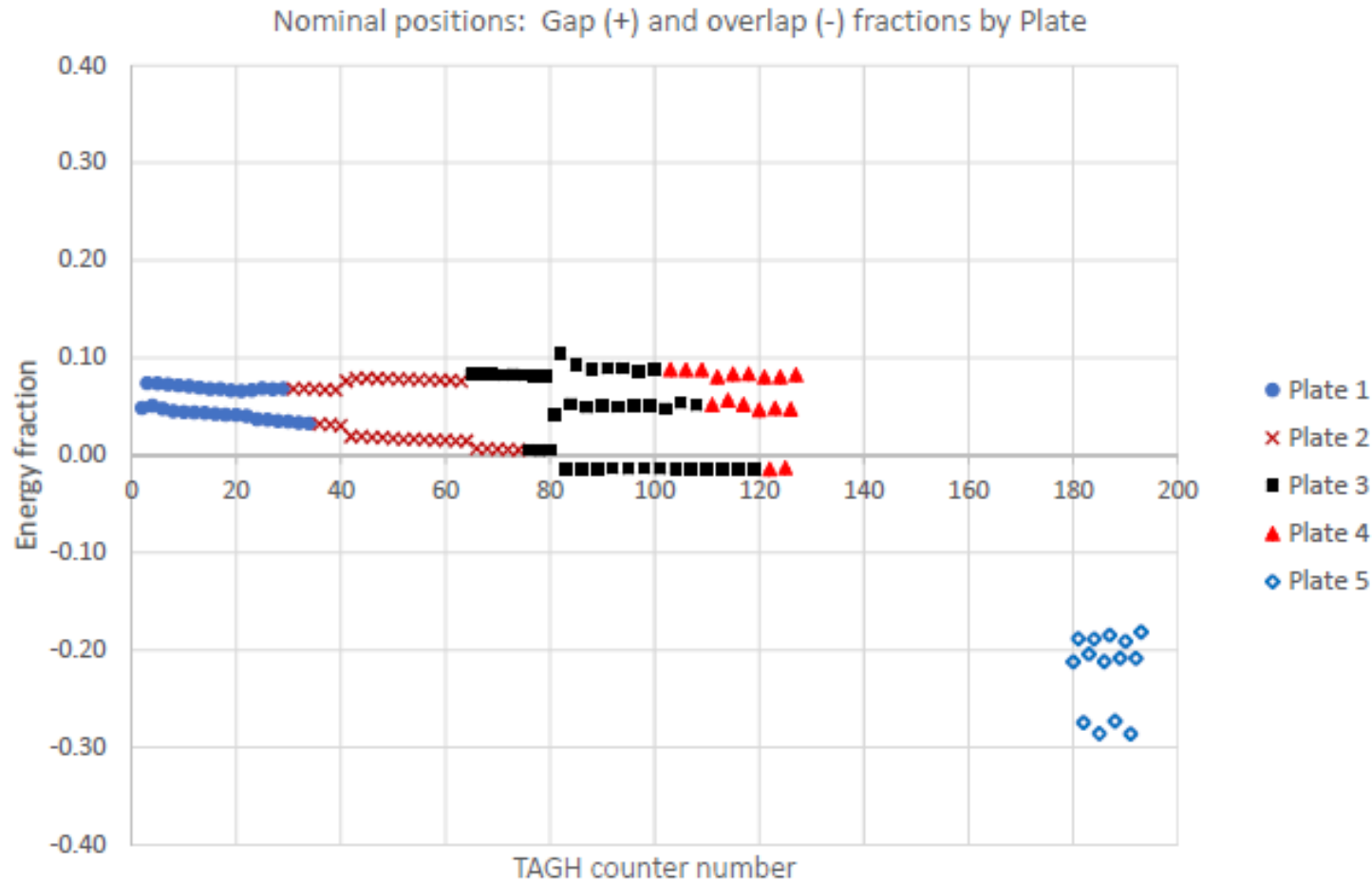
CUA

8 May 2017

In the April 24 beamline meeting, we discussed the “untagged” spectrum calculated from the PS data, and it occurred to me that the nominal TAGH energy channel widths may not have taken into account the fact that some of the channels have an energy overlap, even for on-axis electrons. When I reported on the new TAGH plate survey data in the January beamline meeting, I did not discuss the effect on energy overlaps.

First look at this effect for on-axis electrons (no beam spread, no bremsstrahlung angle):

Using the nominal counter positions (before the 2016 survey), these effects were very small, except for counters 179-193.

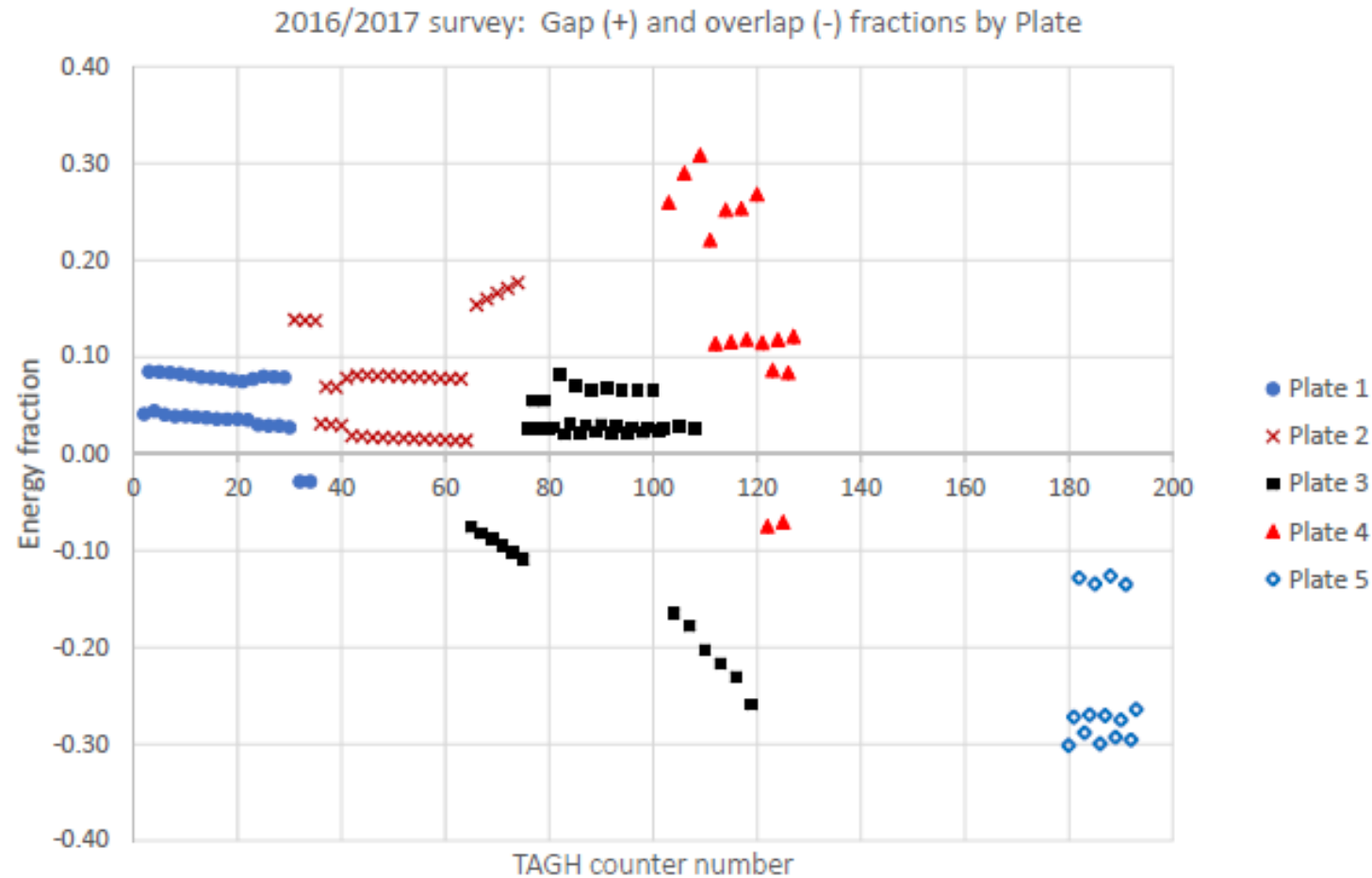


On-axis electrons

Colors indicate mounting plate.

Apparently, Counter 179-193 positions were calculated assuming 3 mm widths, but 4 mm counters were installed. Further discussion later.

Using Dec. 2016/Jan. 2017 survey data:



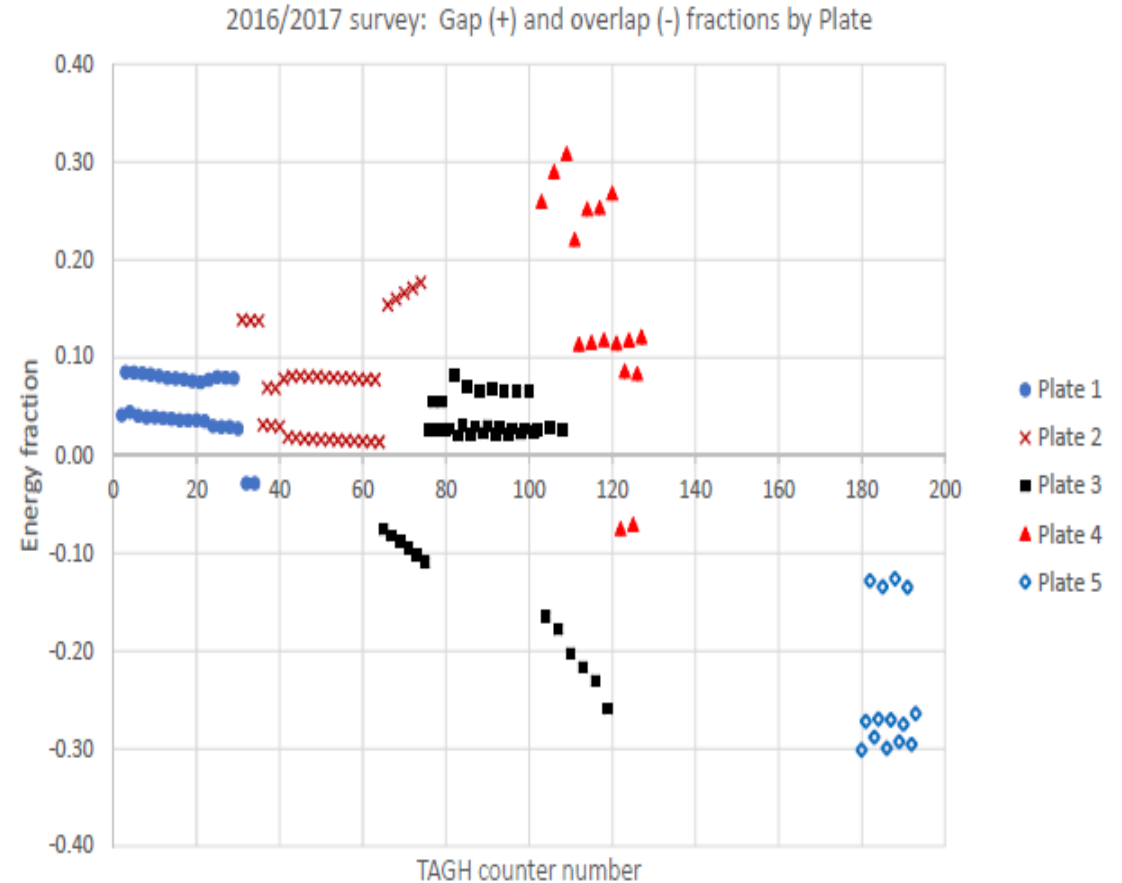
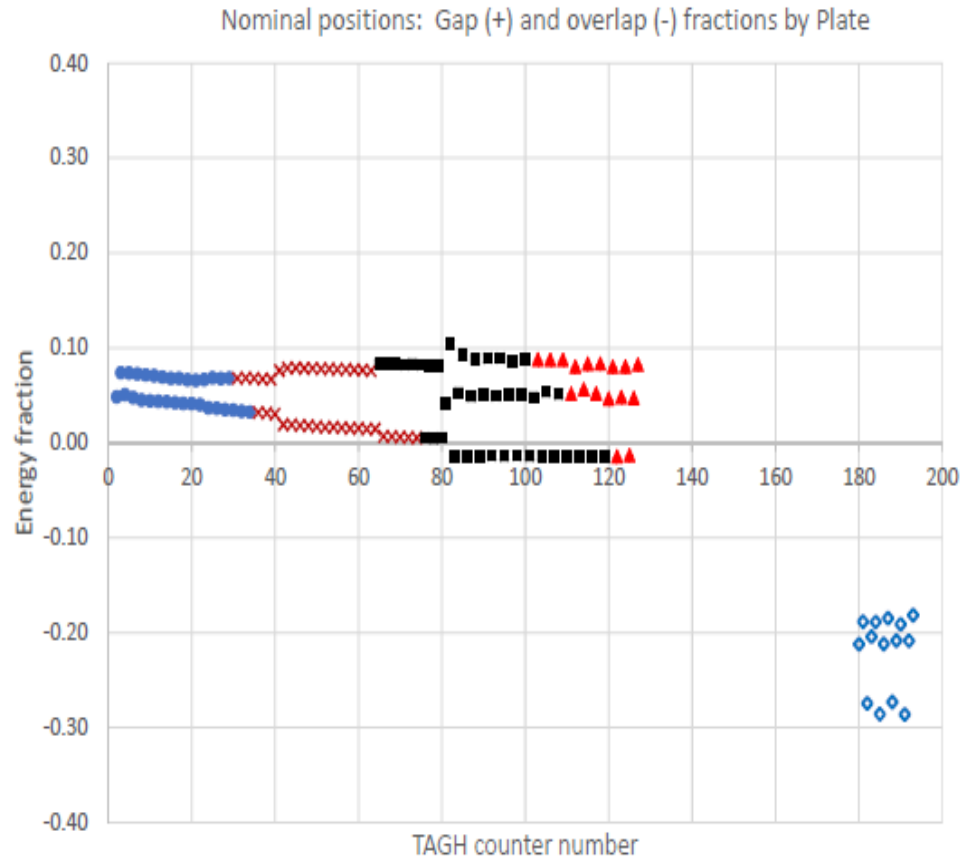
On-axis electrons

Small displacements and rotations ($< 2 \text{ mm}$, $< 0.06^\circ$) have a large effect on overlaps.

Note: For 64-120, overlaps are largest where adjacent counters are on **different plates**. Overlaps could be reduced by realigning Plates 3 and 4.

Counter 179-193 overlaps are not much changed.

Same plots, side by side:



Large changes result from small shifts in plates 3 and 4:
 <2.2 mm, $<0.064^\circ$

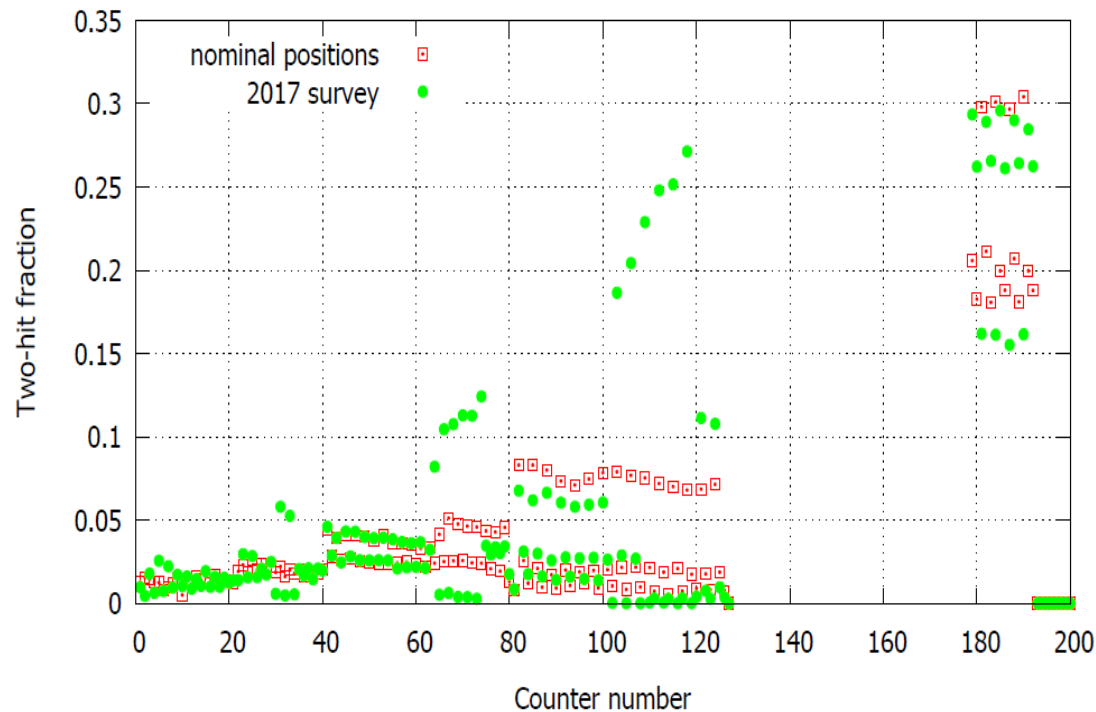
Summary of changes for each counter plate
 (from 1/30/2017 presentation)

Plate	Raw shifts -no rotation		Relative to magnet - no rotation			Change in angle [deg]	Relative to magnet - with rotation			
	dx[cm]	dy[cm]	dx[cm]	dy[cm]	dx[cm]		dy[cm]			
					Min		Max	Min	Max	
1	-2.055	-0.313	-0.137	-0.085	0.0050	-0.139	-0.138	-0.085	-0.074	
2	-2.039	-0.202	-0.121	0.026	0.0000	-0.121	-0.121	0.026	0.026	
3	-2.026	-0.351	-0.108	-0.123	-0.0641	-0.103	-0.095	-0.191	-0.113	
4	-2.141	-0.341	-0.223	-0.113	0.0464	-0.267	-0.260	-0.056	0.003	
5	-2.061	-0.236	-0.143	-0.008	-0.0625	-0.136	-0.123	-0.098	0.025	
6	-1.959	-0.143	-0.041	0.085	-0.0437	-0.039	-0.032	-0.005	0.082	
7	-2.123	-0.288	-0.205	-0.060	-0.0110	-0.204	-0.202	-0.083	-0.061	
8	-2.137	0.202	-0.219	0.430	0.0064	-0.220	-0.219	0.430	0.438	

Use Monte Carlo distributions: beam ellipse, bremsstrahlung, multiple scattering – Overlap fractions don't change much (preliminary - using same Monte Carlo code as for my July 2016 presentation)

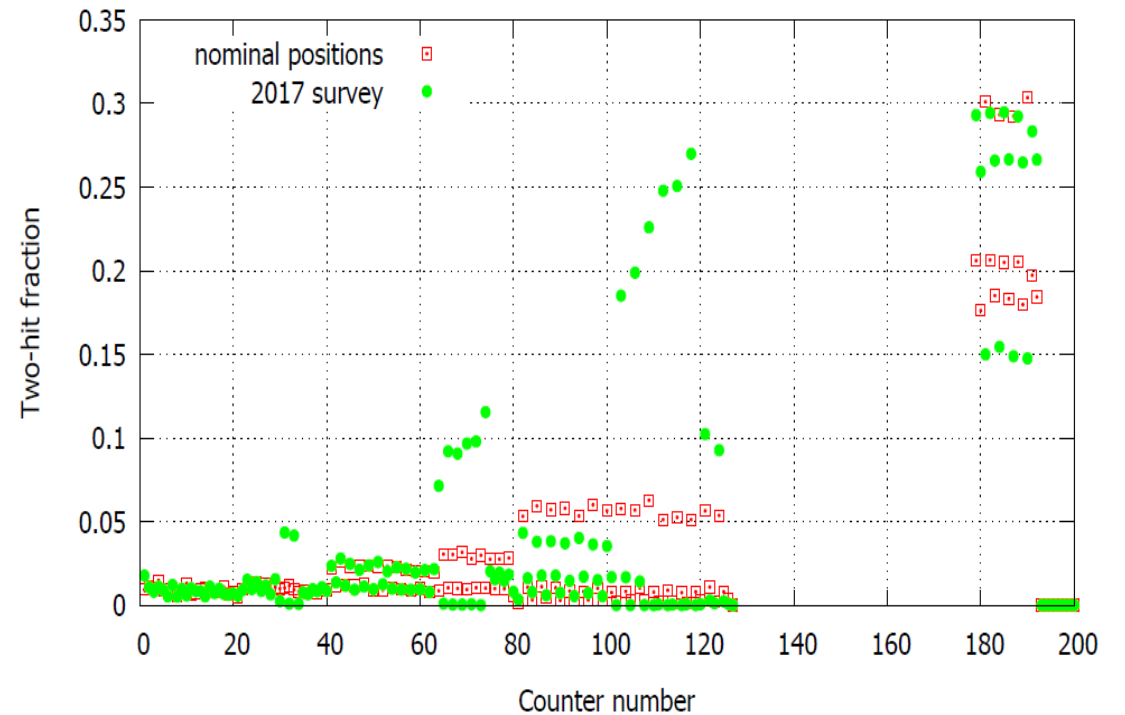
With quadrupole

Effect of new counter positions on coincidences with next counter (with quadrupole)



Without quadrupole

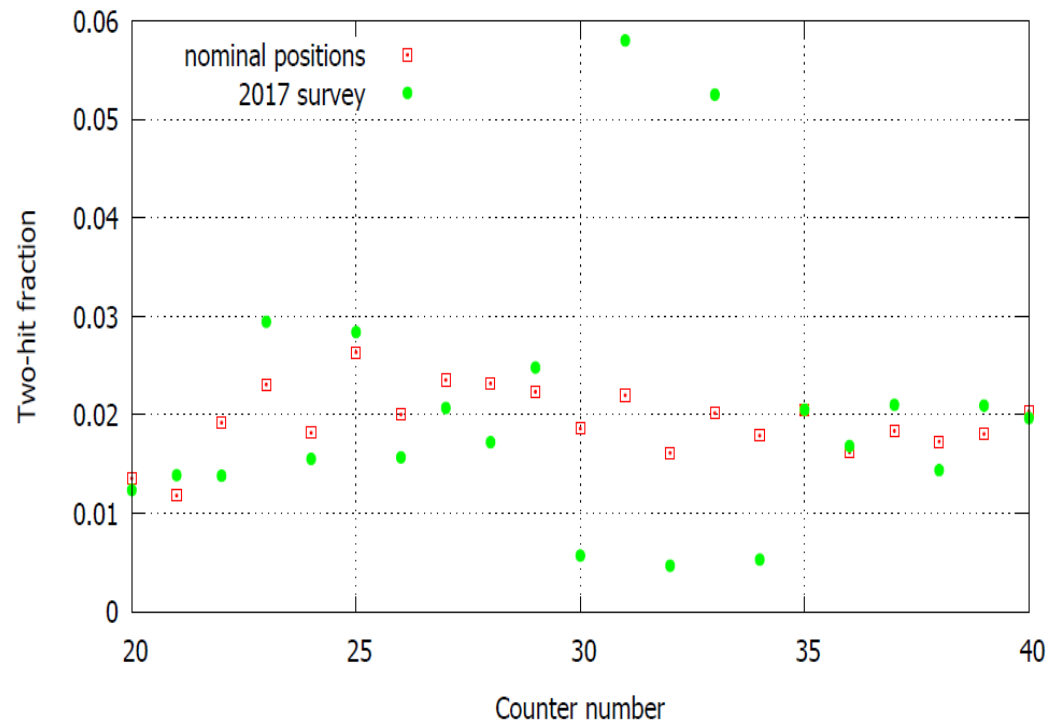
Effect of new counter positions on coincidences with next counter (no quadrupole)



Expand the horizontal scale: note alternation between large and small overlaps depending on the 2-plane or 3-plane counter arrangement

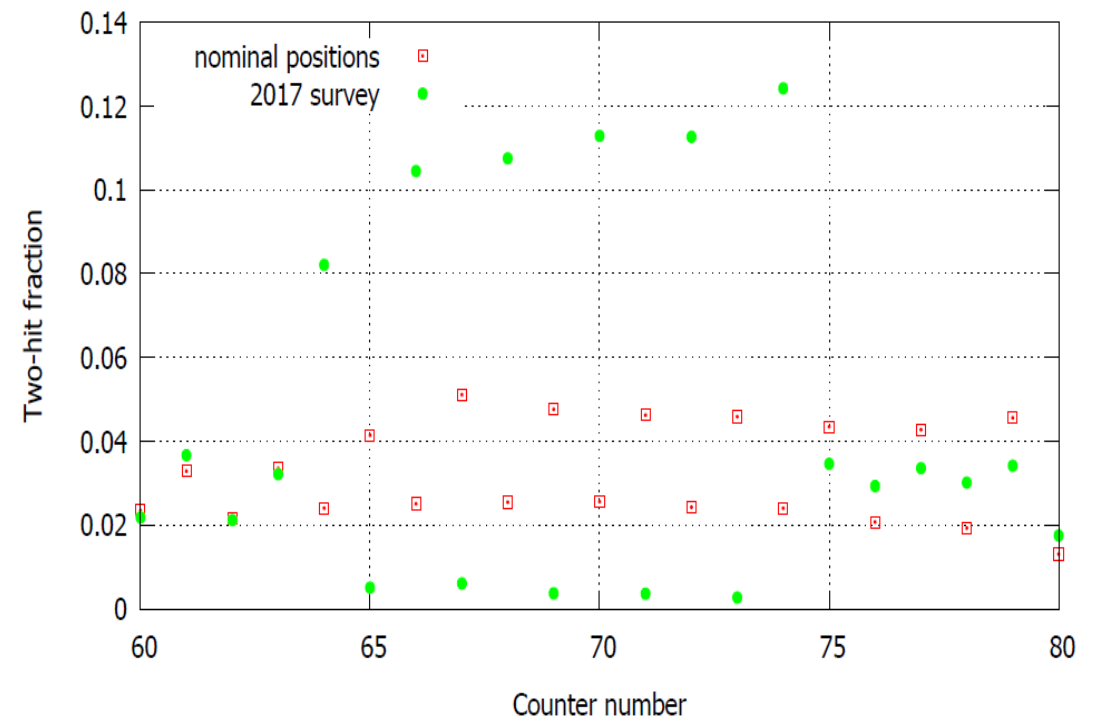
Overlaps 31-32, 33-34 large,
30-31, 32-33, 34-35 small

Effect of new counter positions on coincidences with next counter (with quadrupole)



Overlaps 64-65, 66-67, ..., 74-75 large,
63-64, 65-66, ..., 76-77 small

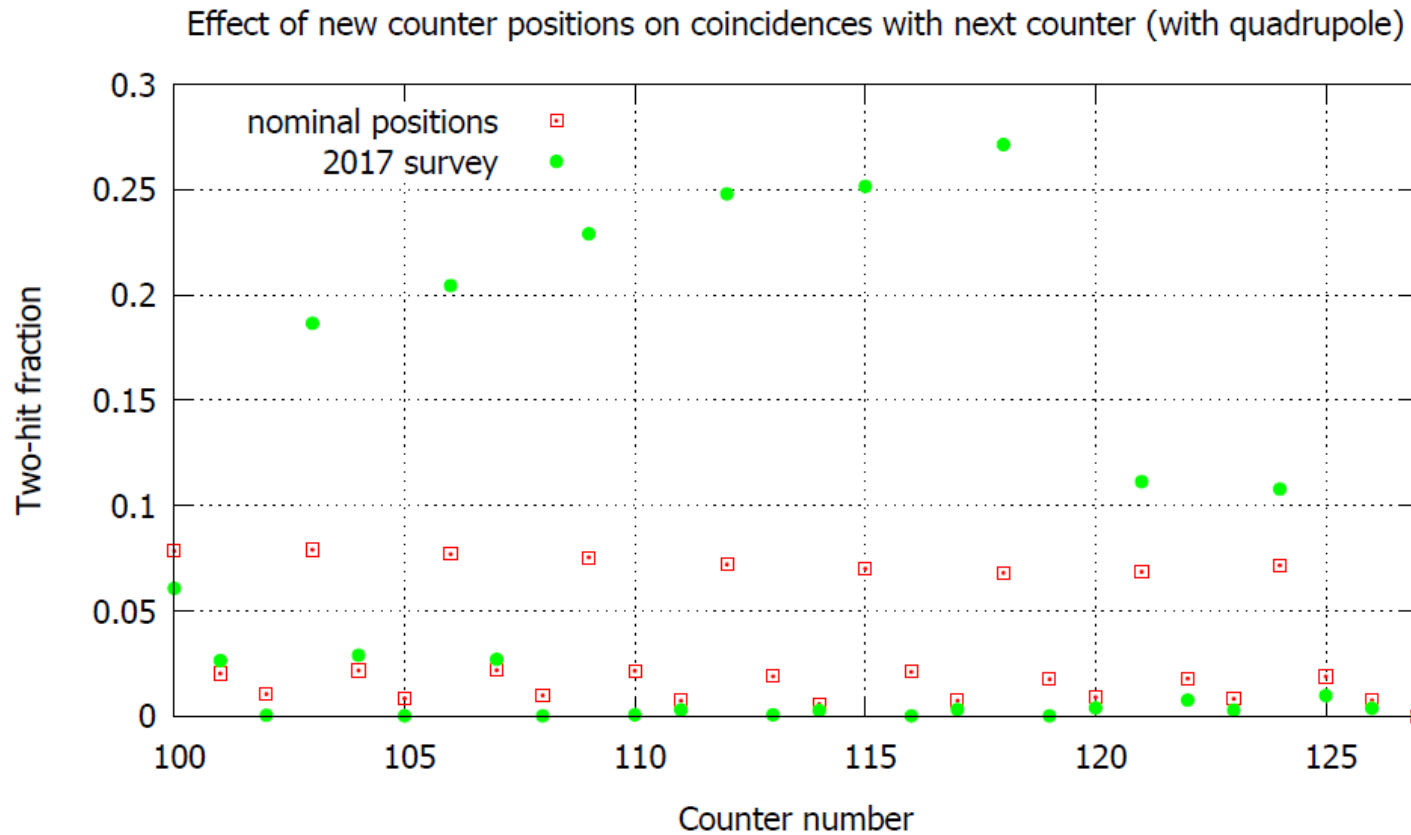
Effect of new counter positions on coincidences with next counter (with quadrupole)



3-plane region

Every **third** counter has large overlap with next counter:

Large overlaps between 103-104, 106-107, 109-110, ..., 118-119



Conclusions

There appear to be substantial overlaps in TAGH counters 64-127 due to plate small alignment errors. We should look for whether this is confirmed in detail by the data. If so, we could reduce the effect by realigning plates 3 and 4.

Overlap in counters 179-193 is largely due to use of 4 mm counters in positions originally intended for 3 mm – see next slide.

To reduce overlaps in counters 179-193, could exchange for some 3 mm counters from sampling region:

TAGH Counters Installed

Counters	Energy range [GeV]	Design width [mm]	Installed width [mm]	
1 - 22	11.78 - 11.43	21	21	Full coverage
23 - 40	11.43 - 11.00	16	16	
41 - 64	11.00 - 10.46	10	10	
65 - 81	10.46 - 10.05	8	8	
82 - 127	10.05 - 9.18	5	5	
<i>128 - 139</i>	<i>9.18 - 8.91</i>	<i>5</i>	–	<i>Not installed (Microscope region)</i>
<i>140 - 175</i>	<i>8.91 - 8.15</i>	<i>4</i>	–	
<i>176 - 178</i>	<i>8.15 - 8.13</i>	<i>3</i>	–	
179 - 193	8.13 - 7.88	3	4	Full coverage
194 - 217	7.86 - 6.45	3	4, 5	Sampling region
218 - 274	6.42 - 3.04	3	3	

Some references to topics discussed here:

Explanation of TAGH energy gaps and overlaps in terms of counter placement

BLTWG Meeting 2/1/16

https://userweb.jlab.org/~sober/HallD/Tagger_ratios_and_gaps.pdf

My TAGH Monte Carlo

BLTWG Meeting 7/18/16

https://userweb.jlab.org/~sober/HallD/First_tagger_Monte_Carlo_results.pdf

New TAGH survey and its effect on counter energies

BLTWG Meeting 1/30/17

https://userweb.jlab.org/~sober/HallD/TAGH_new_survey.pdf