

# Tagger microscope/quadrupole commissioning study

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GlueX collaboration meeting, May 9-11, 2016

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# Purpose of study

- Electron collimation - proof of principle

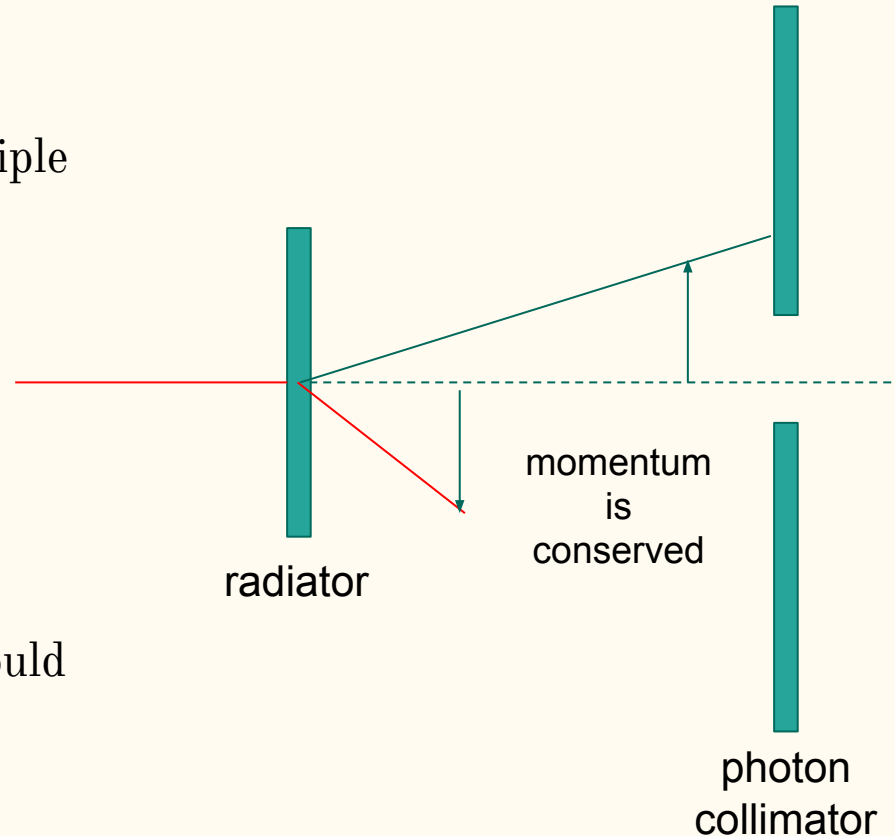
distance radiator-collimator: 76m

distance radiator-microscope: 7.5m

magnification at TAGM: 0.3

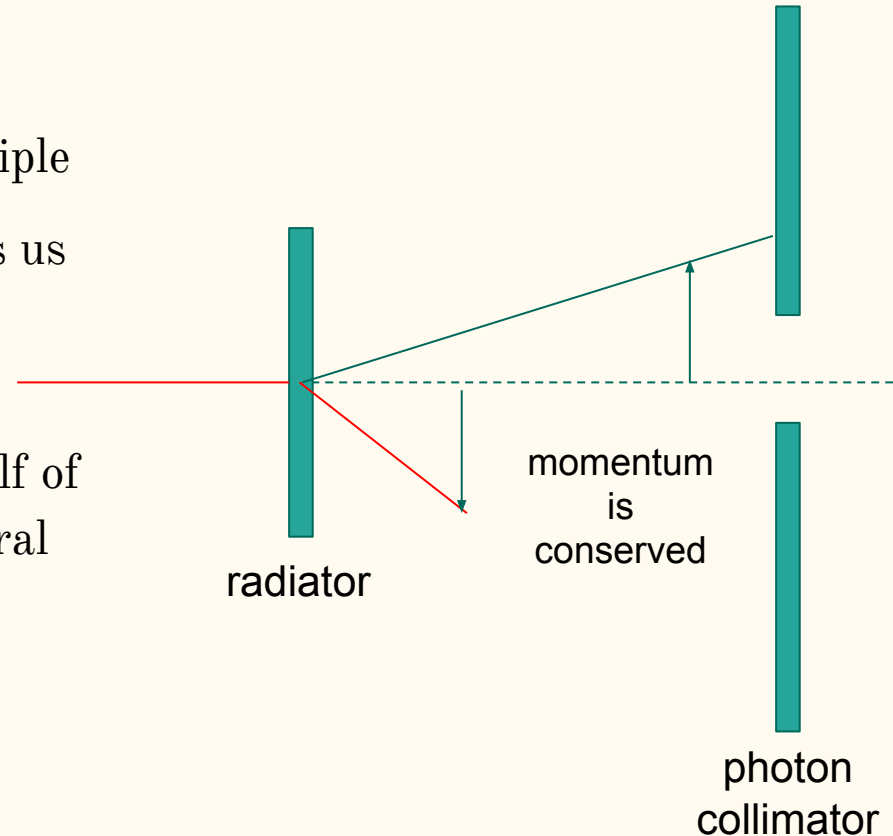
3.4mm  $\rightarrow$  1.1mm at TAGM

- Essentially all of the useful tags should fall inside just one 2mm row of the TAGM



# Purpose of study

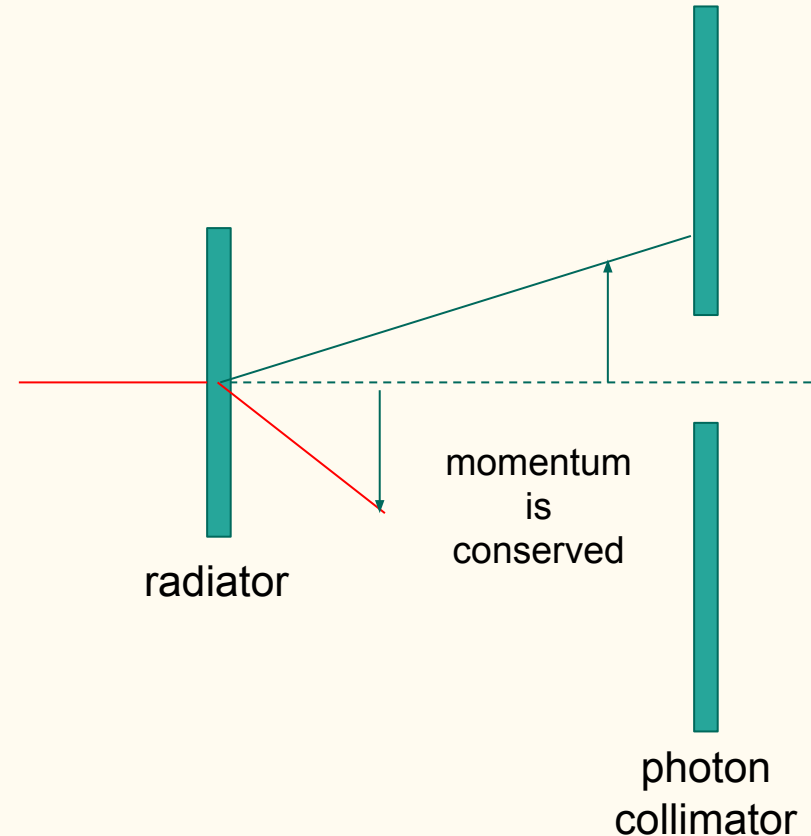
- Electron collimation - proof of principle
- ORing all 5 rows in a column makes us less sensitive to beam motion at the radiator, but...
- It hurts our performance: almost half of the TAGM hits fall outside the central row, and generate accidentals.



# Purpose of study

Questions to be answered in study:

1. How is this 1.2mm collimated stripe affected by the spot size of the electron beam (**where the quadrupole comes in**)
2. Does multiple scattering (radiator, tagger exit window) substantially widen the stripe?
3. Is the stripe stable enough to turn off the other TAGM rows and run?



# run selection

- radiator is JD70-119 in PARA orientation
- first few runs in study are at 80nA, later runs are at 200nA
- all runs considered were collected in early AM on April 15:
  - 11333 (36M events) IQ= +4A
  - 11336 (35M events) IQ= -4A
  - 11338 (18M events) IQ= -5A
  - 11340 (34M events) IQ= +5A
  - 11365 (38M events) IQ= +6A
  - 11385 (37M events) IQ= -6A
  - 11386 (35M events) IQ= -7A
  - 11387 (35M events) IQ= +7A
  - 11359 (20M events) IQ= 0A
- aside - 80% of the effort in this study was getting these data staged from tape and transferred offsite

# hits selection and cuts

for each TAGM hit:

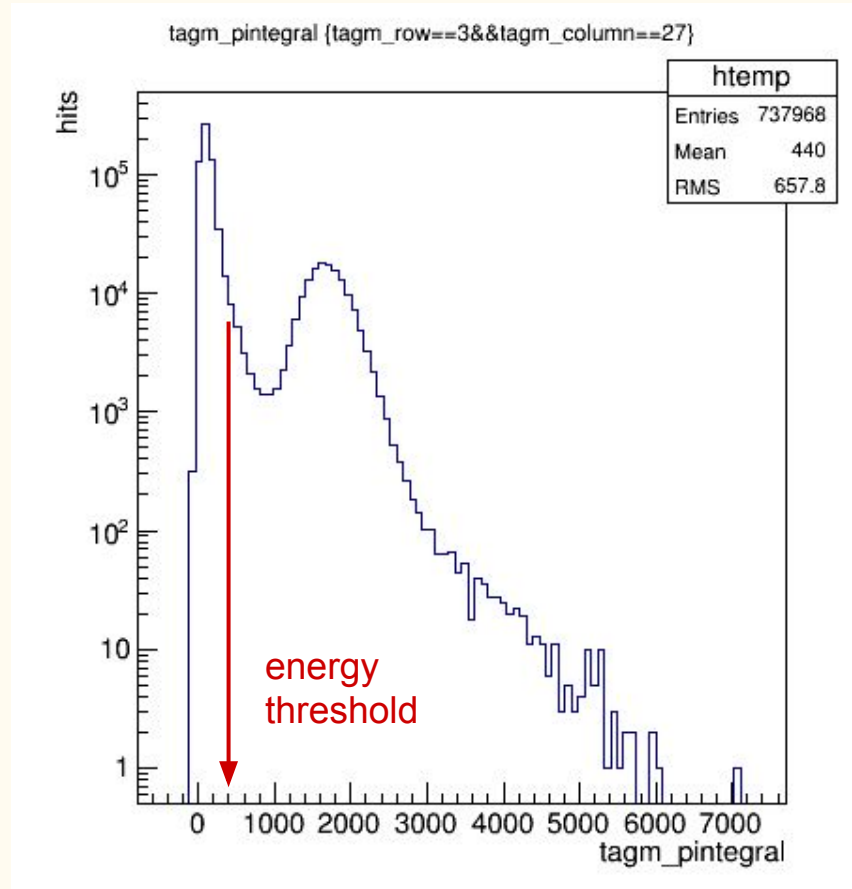
require individual-fiber channels

for each PS hit:

require 2% energy match

require minimum TAGM energy

histogram  $t(\text{TAGM}) - t(\text{PS})$



# accidentals subtraction

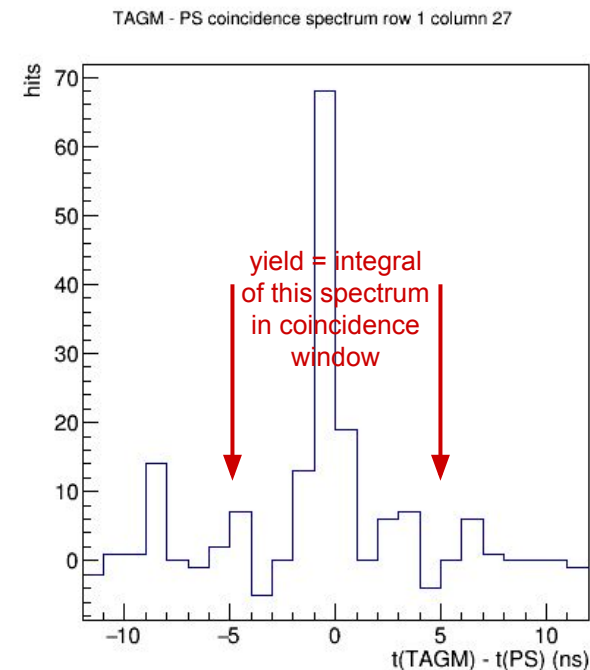
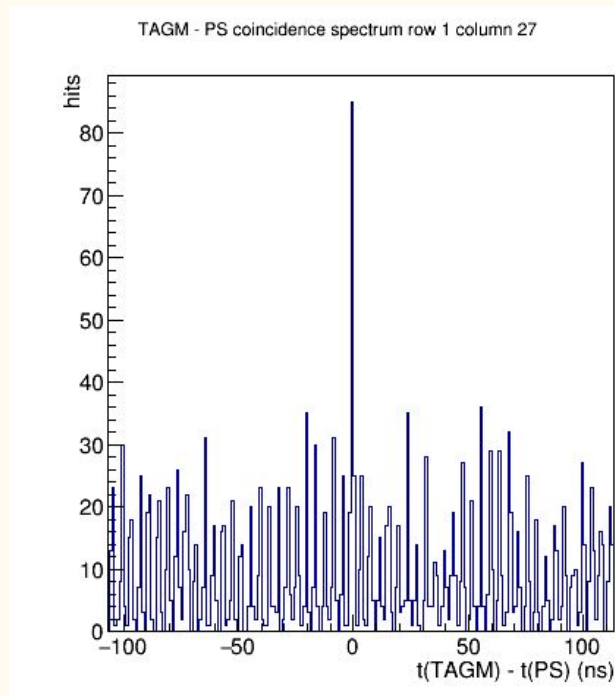
>95% of hits are tagging electrons

>95% of hits are accidentals

beam structure is clearly visible

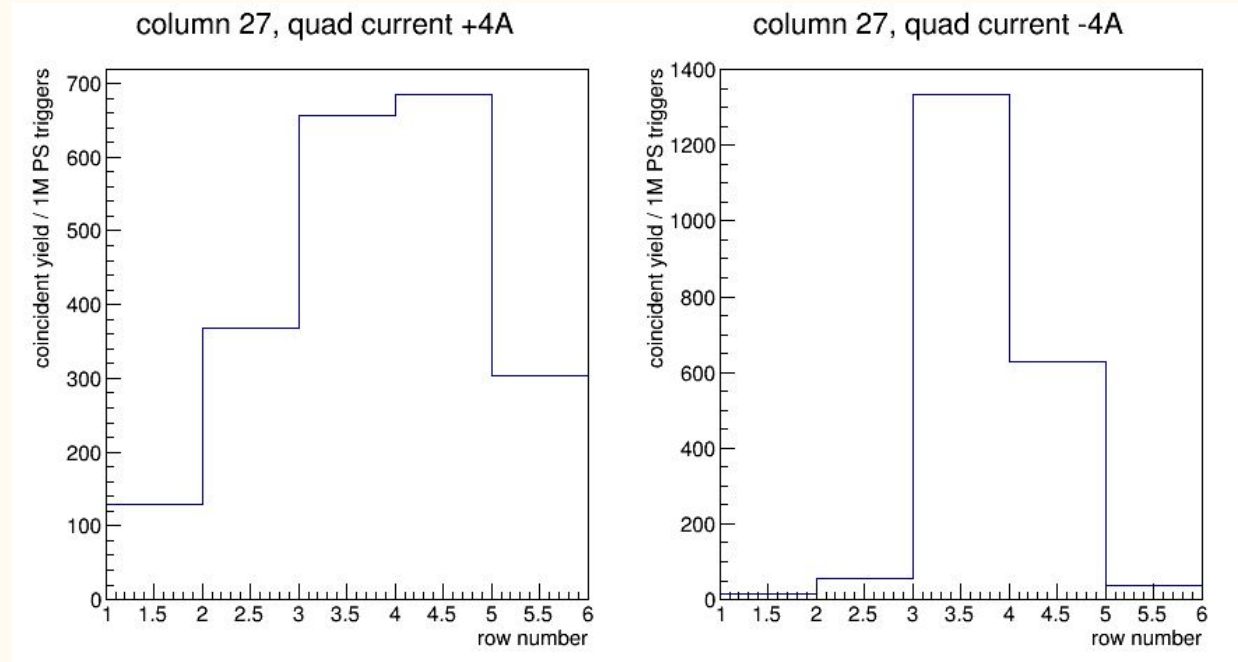
subtract accidentals using 16 intervals of 24ns width on either side of the coincidence peak ( $\Delta t=0$ )

yield = integral  $[-5, 5]$ ns after accidentals subtraction



# determination of quad polarity

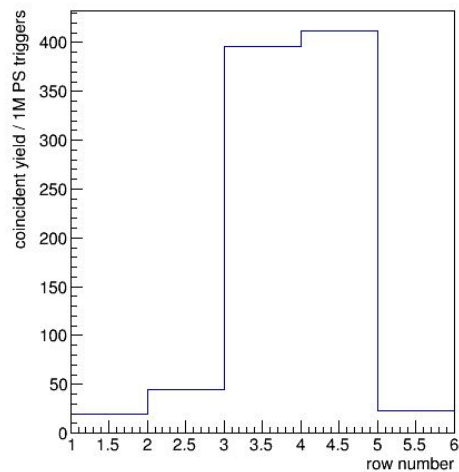
- polarity of quad windings is known by someone, but we checked it...
- each quad current was run in both senses
- result: minus sign generates vertical convergence



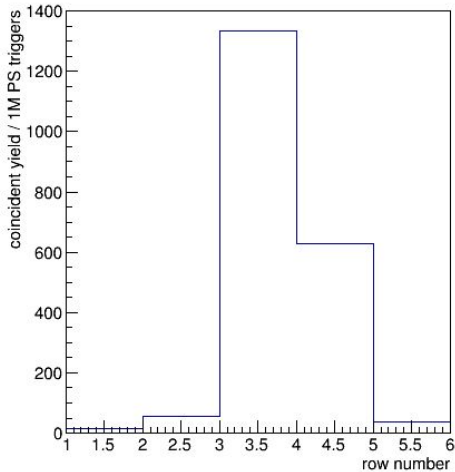


# scan over excitation current

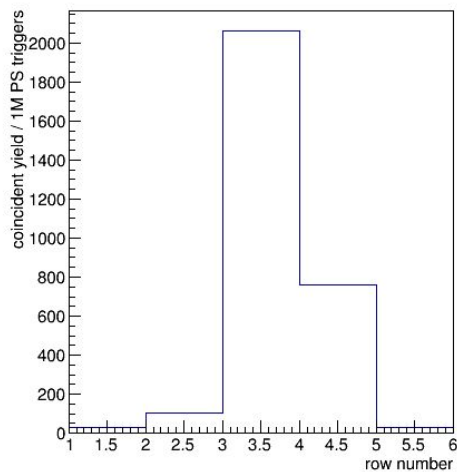
column 9, quad current -4A



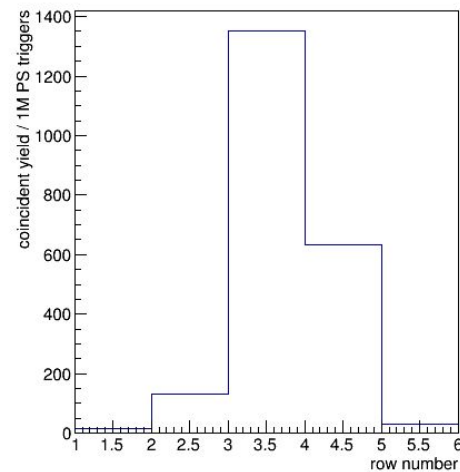
column 27, quad current -4A



column 81, quad current -4A

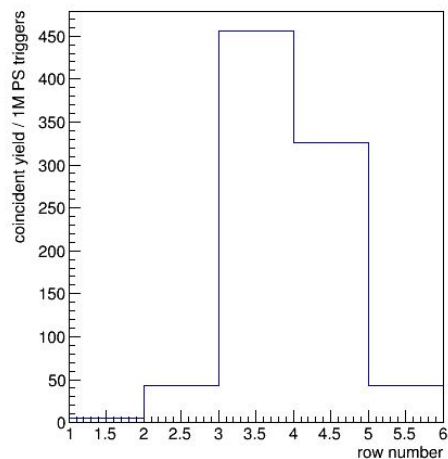


column 99, quad current -4A

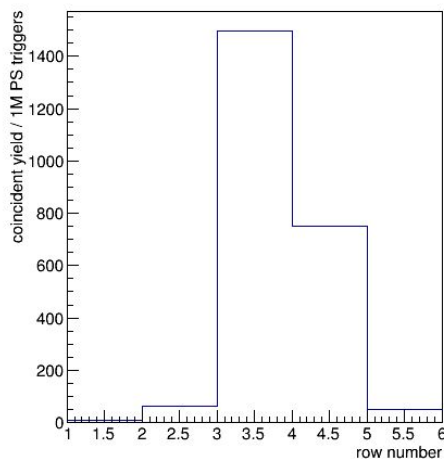


# scan over excitation current

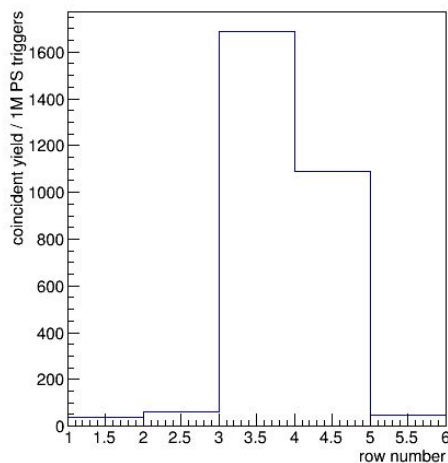
column 9, quad current -5A



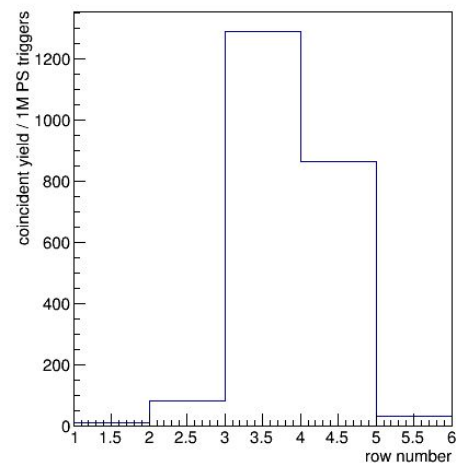
column 27, quad current -5A



column 81, quad current -5A

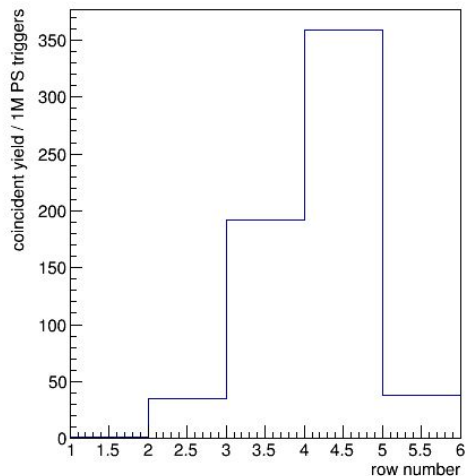


column 99, quad current -5A

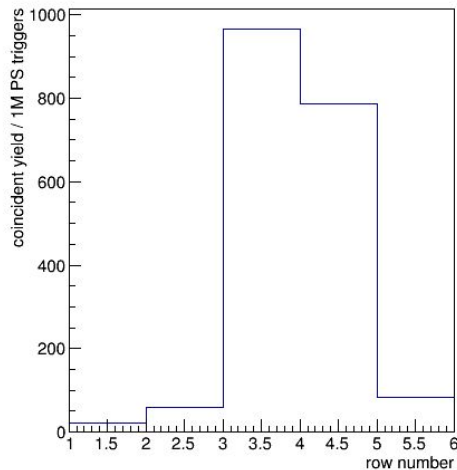


# scan over excitation current

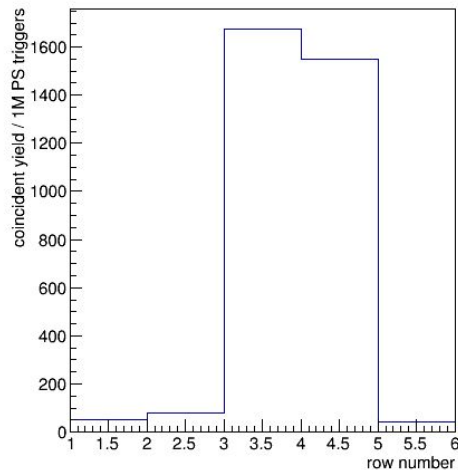
column 9, quad current -6A



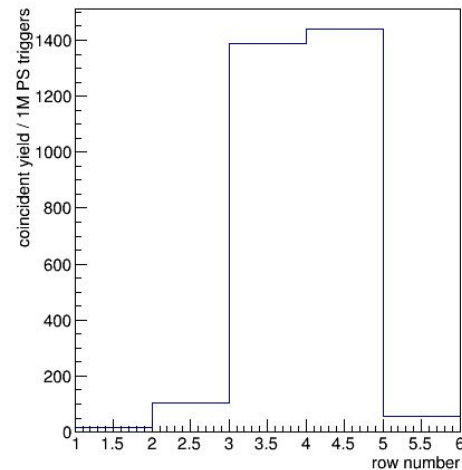
column 27, quad current -6A



column 81, quad current -6A

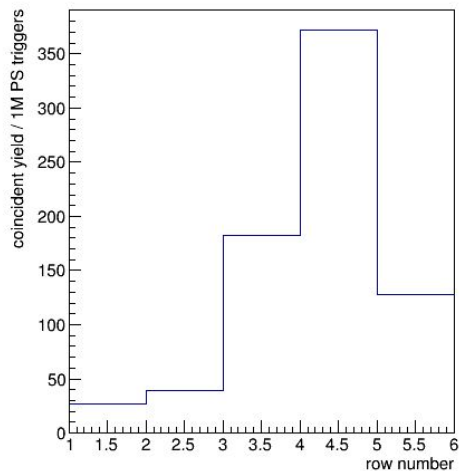


column 99, quad current -6A

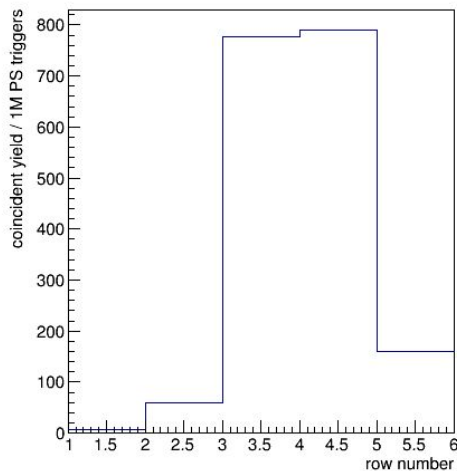


# scan over excitation current

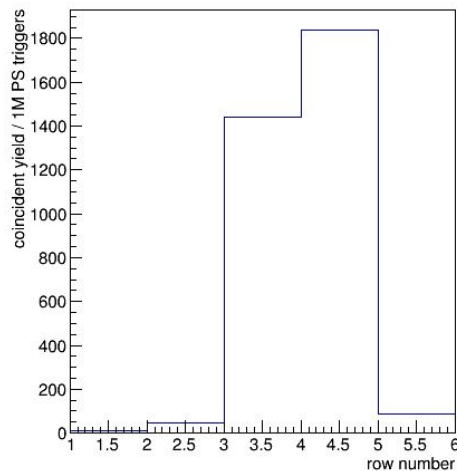
column 9, quad current -7A



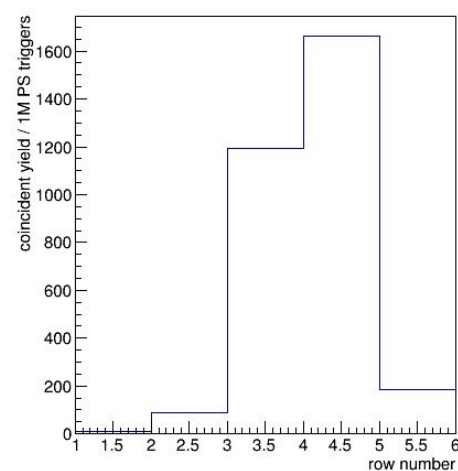
column 27, quad current -7A



column 81, quad current -7A



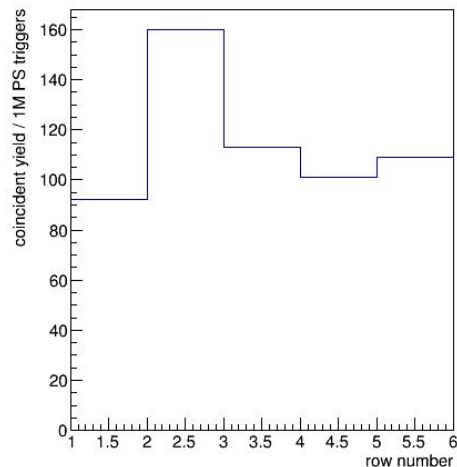
column 99, quad current -7A



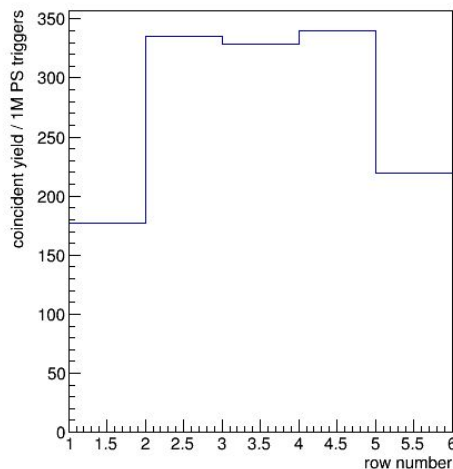
# back to zero quad field

Run 11359 taken during run between  $I_Q=+6A$  and  $I_Q=-6A$ , same conditions according to rcdB...

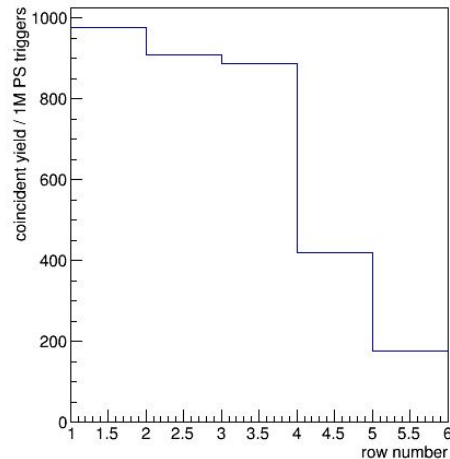
column 9, quad current 0A



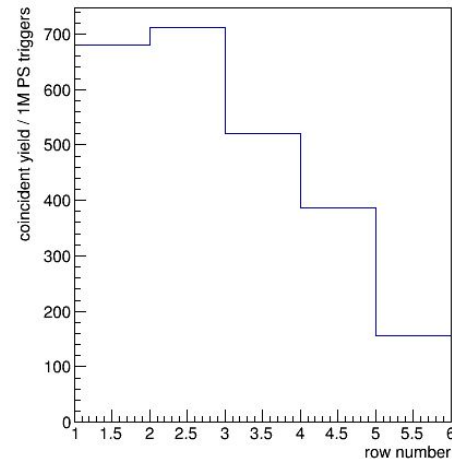
column 27, quad current 0A



column 81, quad current 0A



column 99, quad current 0A



*... not sure what happened here, bad beam tune??*

Maybe these plots should be among the “online 40” to be watched in real time.

# Conclusions

- not sure what was going on in run 11359, but
- the procedure of using just the 4 individual columns rather than doing an individual-run scan worked very well!
- behavior of vertical profile vs quadrupole current is consistent with Dan Sober's calculations.
- optimum field is in the range [-7, -6] A
- with the quadrupole on (and good alignment) only lighting two rows in the microscope keeps >95% of the tags that pass the collimator.