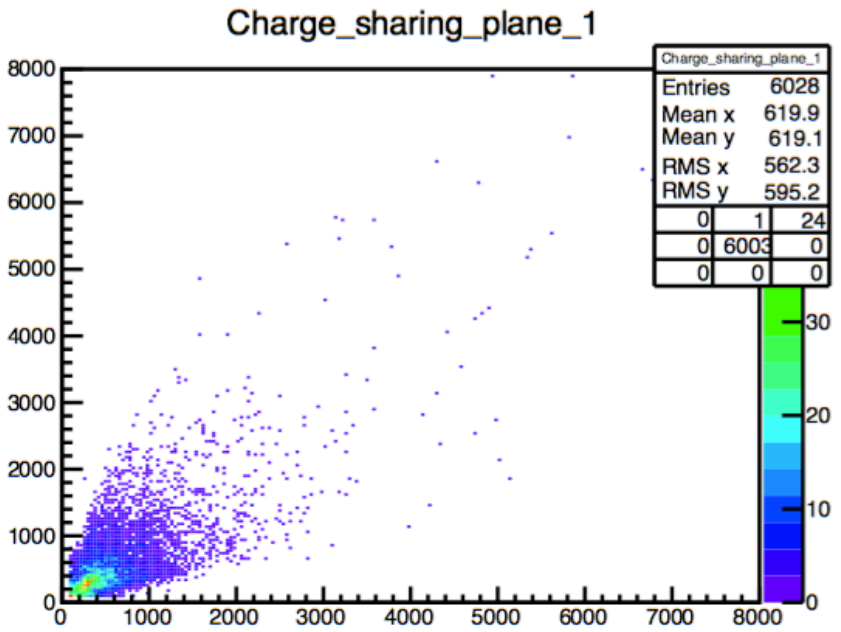
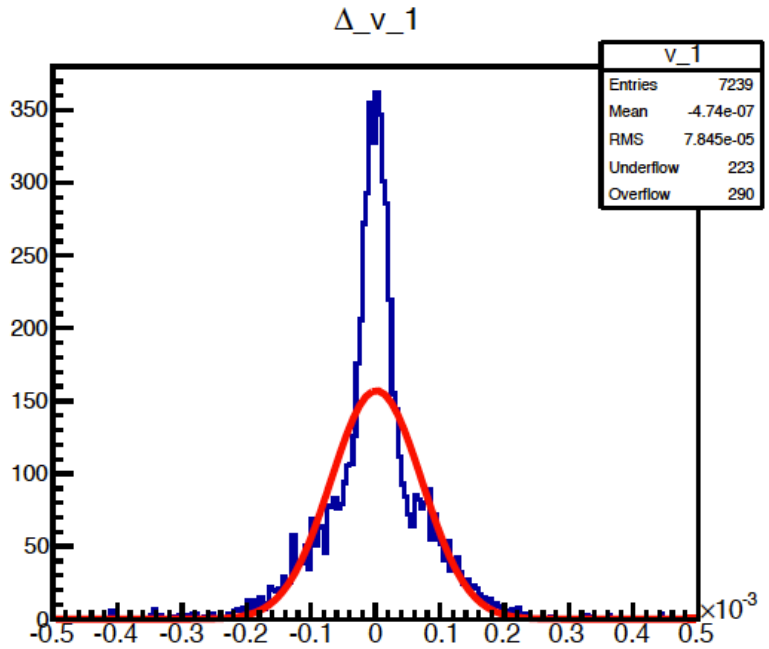
Charge Correlation and GEM Position Resolution

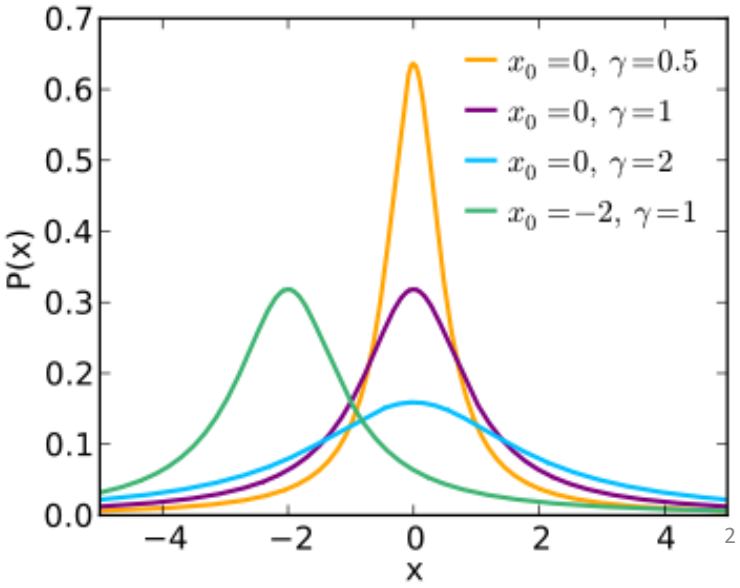
- Two main problems I mentioned in the collaboration meeting:
  - Charge correlation too bad with Lorentzian model
  - Distribution for the GEM position resolution looks strange



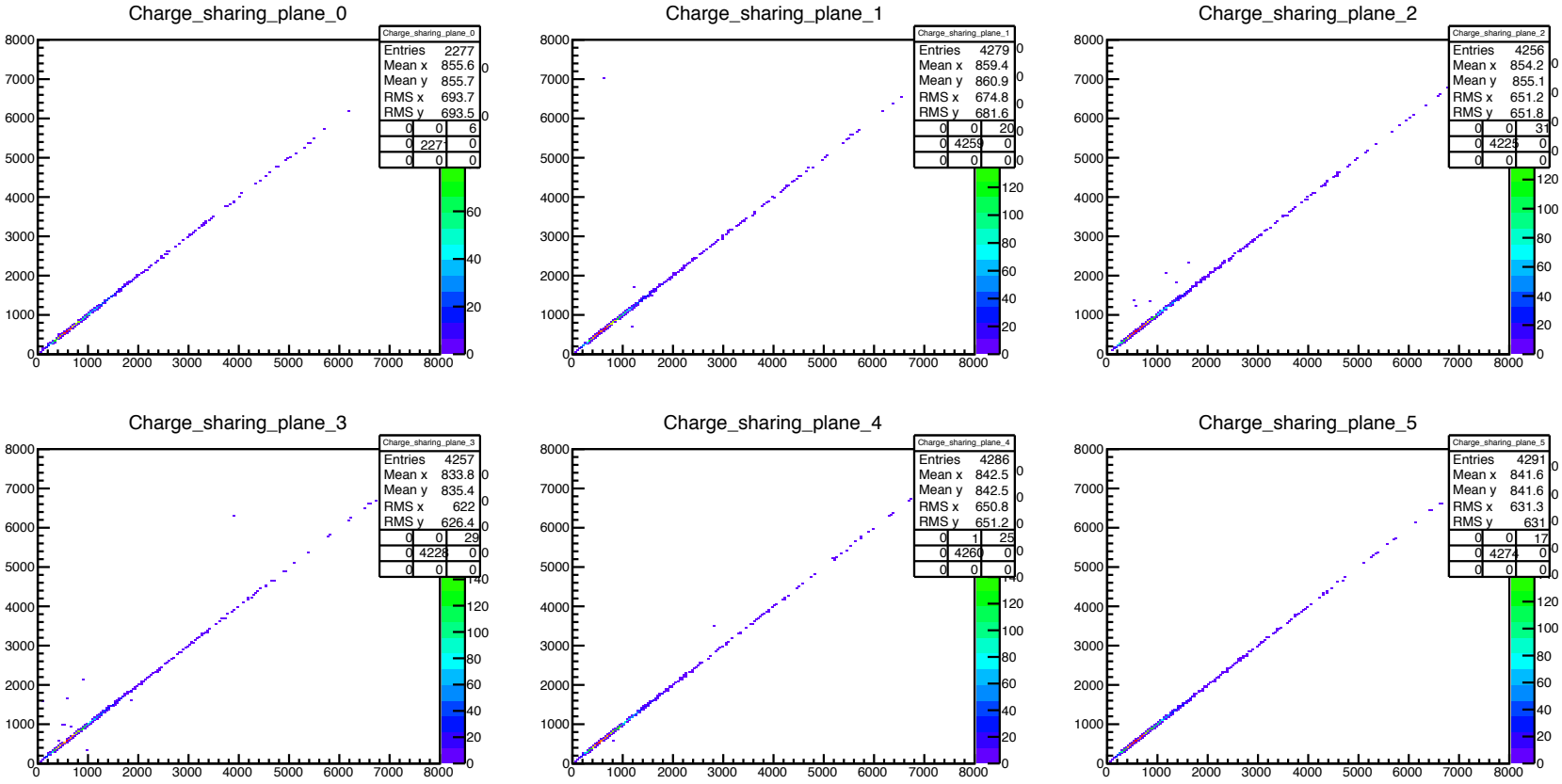


Possible Explanation

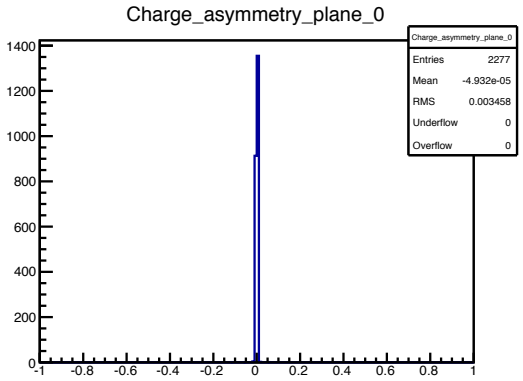
- Integration step size is too large:
  - If strips are aligned in the y direction, step size in x was the strip pitch (400 um), step size in y is 1/10 of strip pitch (40 um)
  - Full width half maximum of the Lorentzian of an ion is typically in the order to a few tens of microns
  - Now I reduce the step size to something close to the width of the Lorentzian

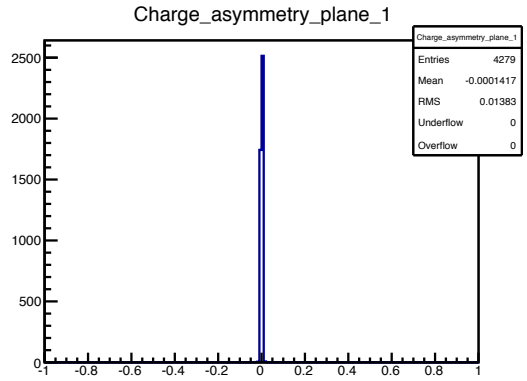


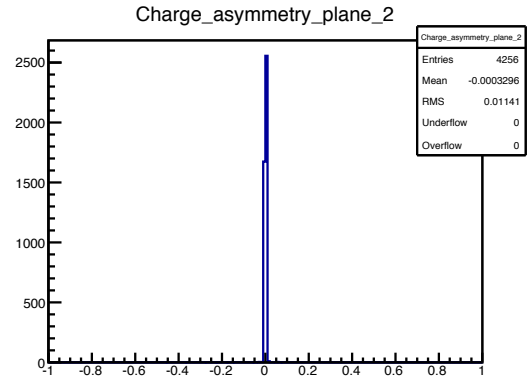
Charge Correlation No Noise No Threshold Cut

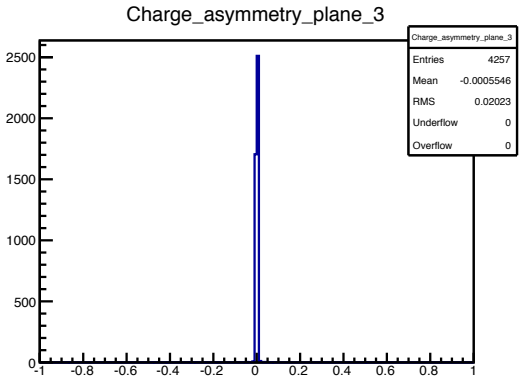


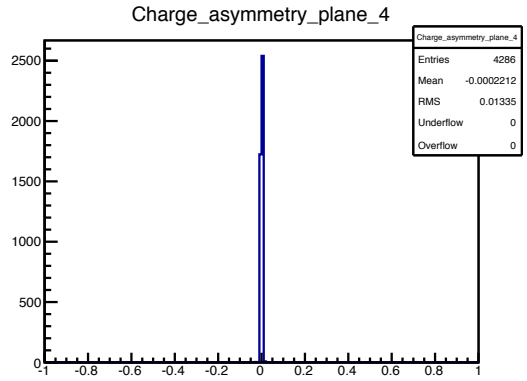
Charge Asymmetry No Noise No Threshold Cut

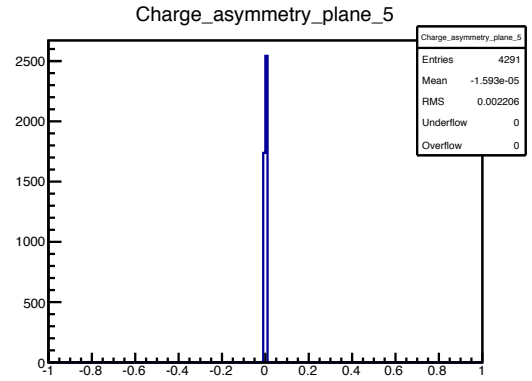




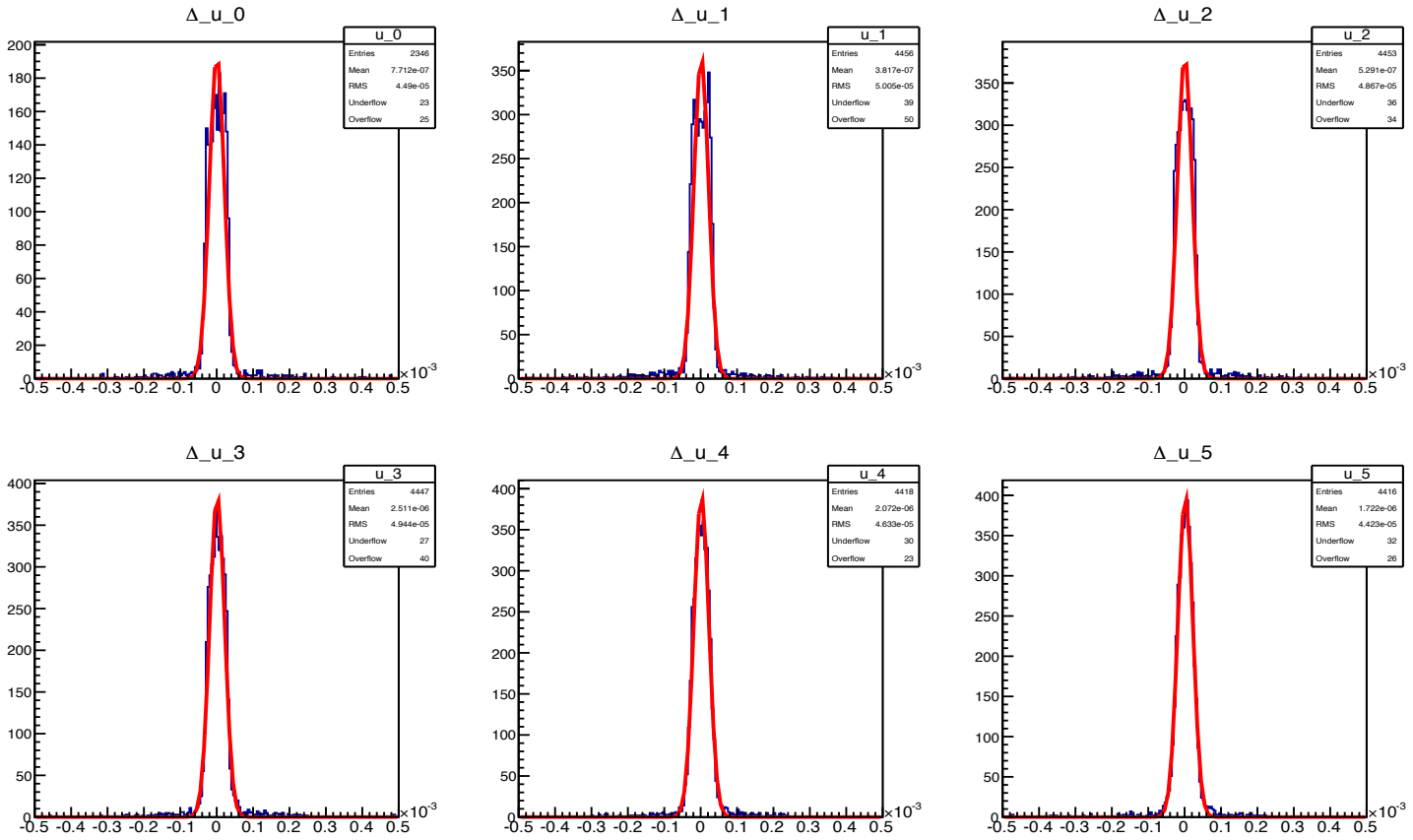






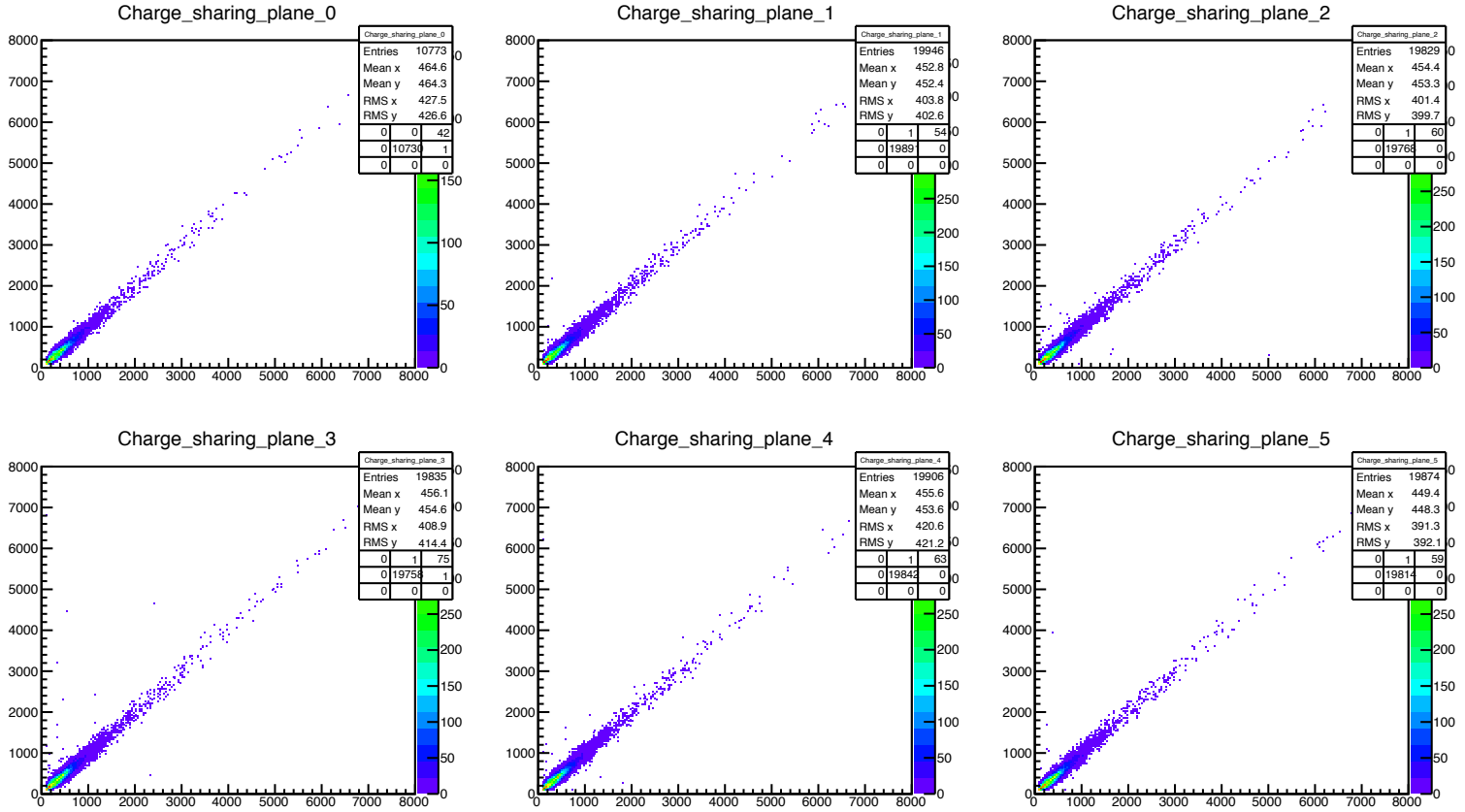


Position Resolution No Noise No Threshold Cut

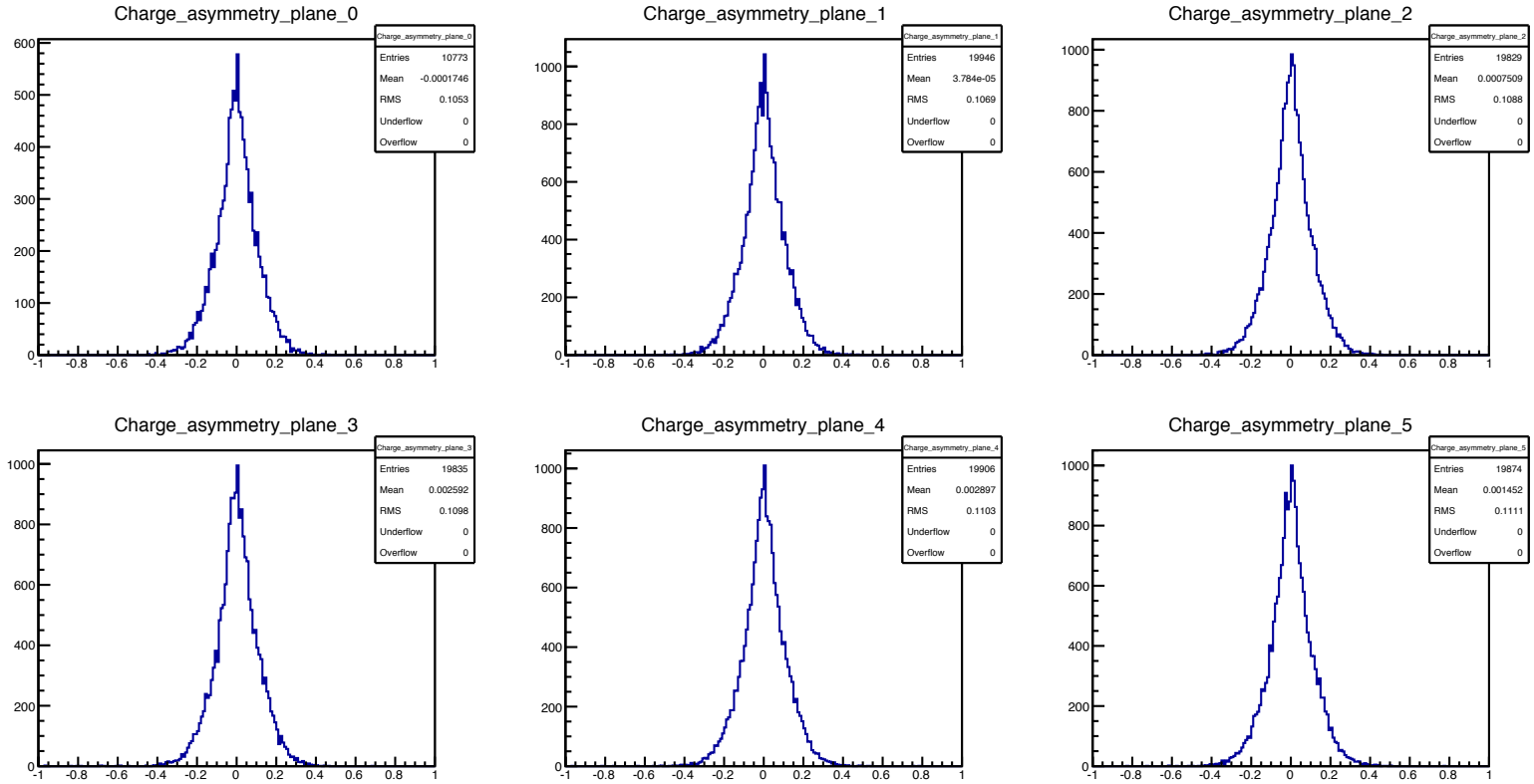


Width is about 20 um

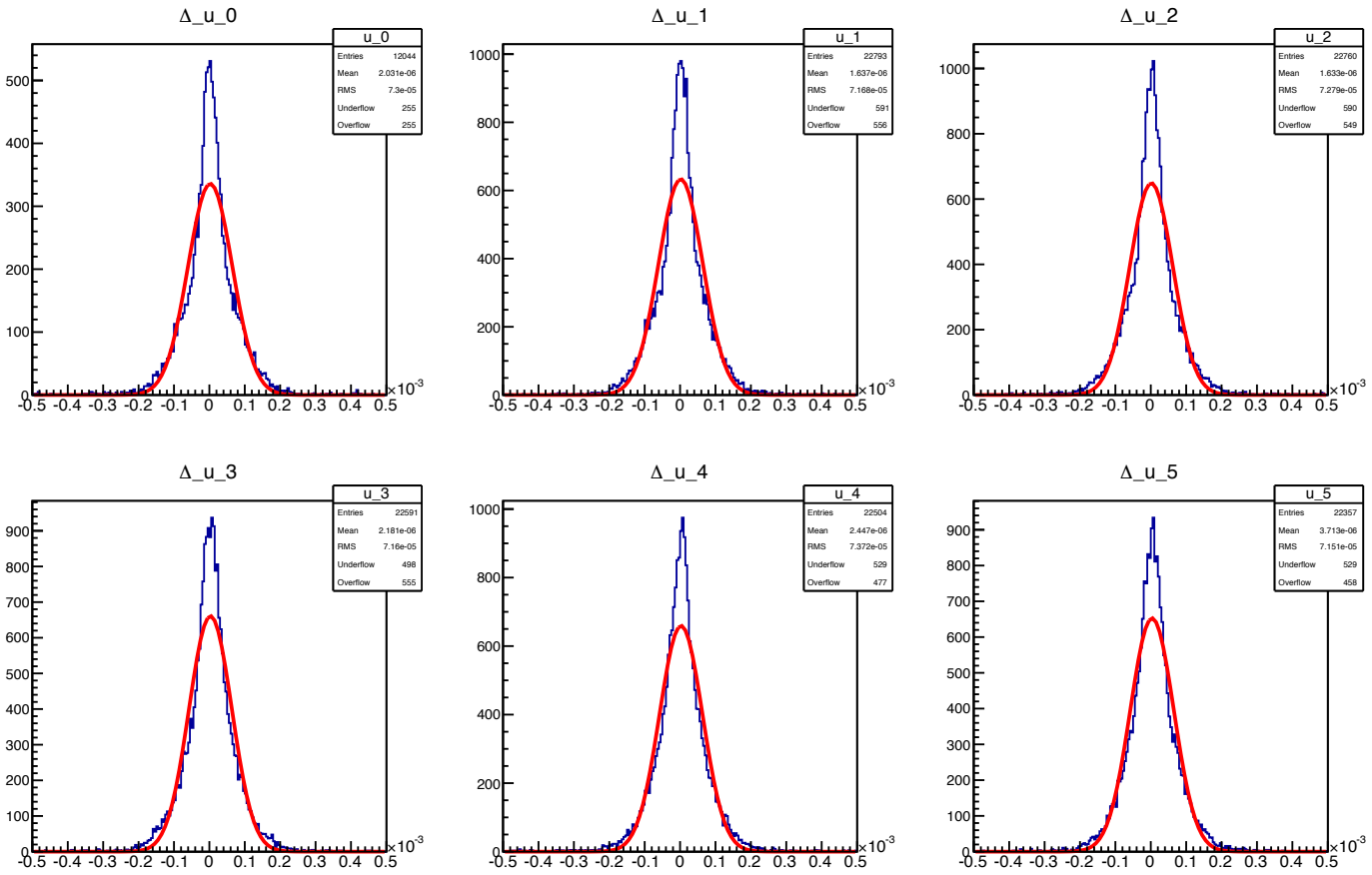
Charge Correlation Noise = 20 ADC Threshold Cut = 80 ADC



Charge Asymmetry Noise = 20 ADC Threshold Cut = 80 ADC



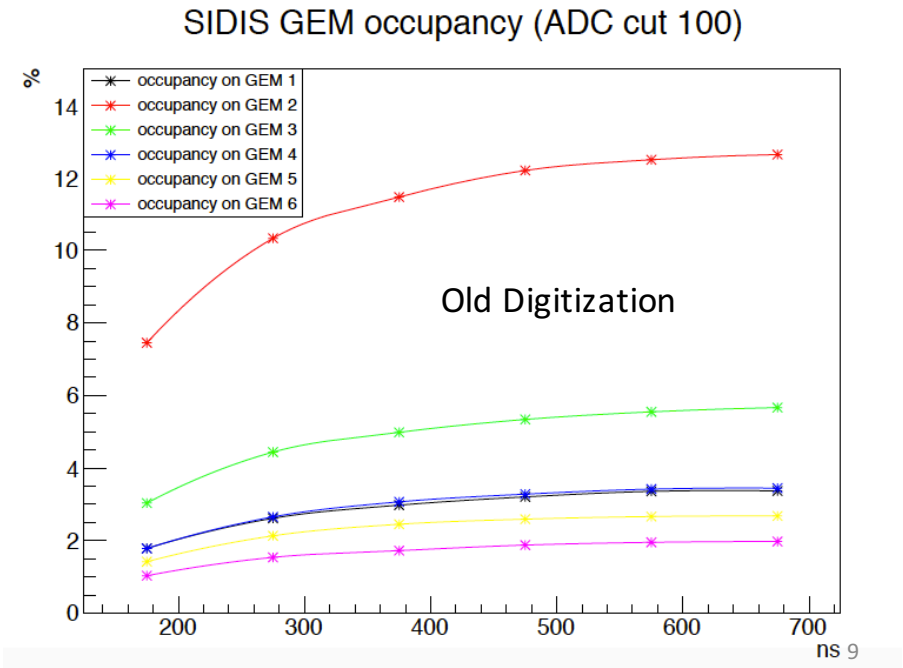
GEM Position Resolution Noise = 20 ADC Threshold Cut = 80 ADC



Width is about 60 ~ 65 um

What Is Still Needed for SIDIS 1 Time-Sample (My Opinion)

- Time window for background:
  - Right now we randomize the timing of background between 200ns before and 75ns after the trigger start time. We are taking the third time sample (t = 50ns)
  - What if some large signal last longer than 250ns?
  - It is better to randomize background event up to at least 400ns before the trigger start time
  - The impact is more obvious on trackers whose occupancy is already high



Impact of the Time Window on Occupancy

Lorentzian, time window = 275 ns, ADC cut = 80

Thres = 80	GEM 1	GEM 2	GEM 3	GEM 4	GEM 5	GEM 6
Occupancy	3.67	12.72	5.41	3.41	3.16	2.33

Lorentzian, time window = 475 ns, ADC cut = 80

Thres = 80	GEM 1	GEM 2	GEM 3	GEM 4	GEM 5	GEM 6
Occupancy	3.90	15.31	6.00	3.73	3.34	2.48

Lorentzian, time window = 475 ns, ADC cut = 100

Thres = 80	GEM 1	GEM 2	GEM 3	GEM 4	GEM 5	GEM 6
Occupancy	3.06	12.52	4.64	2.93	2.57	1.91

We don't have to use the same threshold for all trackers, we can apply a slight higher threshold on high occupancy trackers, while sacrifice a bit of efficiency

What Is Still Needed for SIDIS 1 Time-Sample (My Opinion)

- Time jitter associate with the internal clock of APV:
  - There is a time jitter of +/- 12.5 ns from APVs
  - Can all APV be synchronized among themselves? If not this can smear the charge correlation
  - For 1 sample, this time jitter could move our sampling point away from the peak
  - For 1 sample this will result in a slight loss of GEM efficiency
  - But the major impact should be on the 3-sample case, in which we are aiming for the raising edge of the signal
  - Apparently, trigger latency need very careful tuning before the experiment