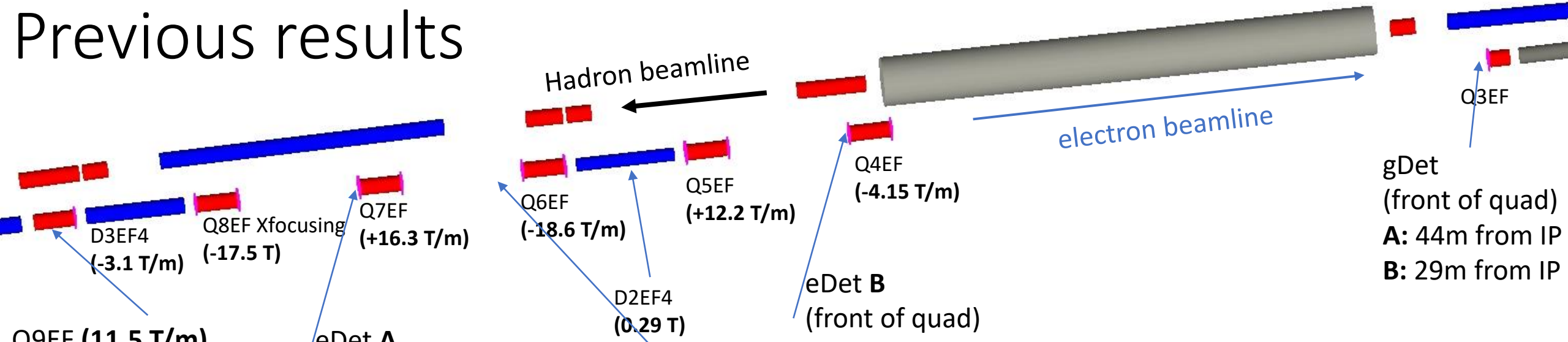
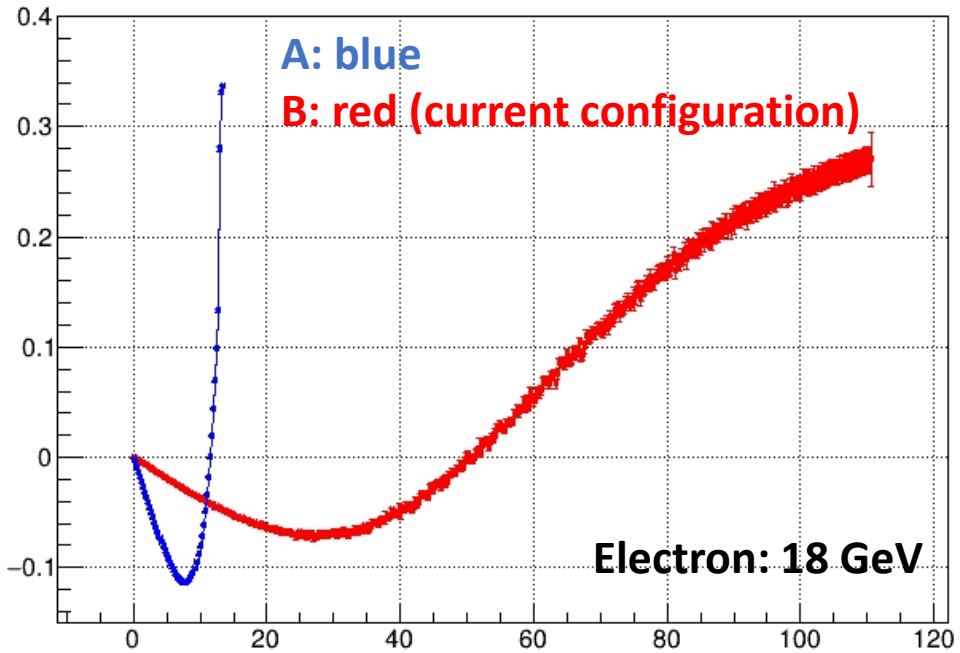
Compton polarimetry at IP6

Ciprian Gal

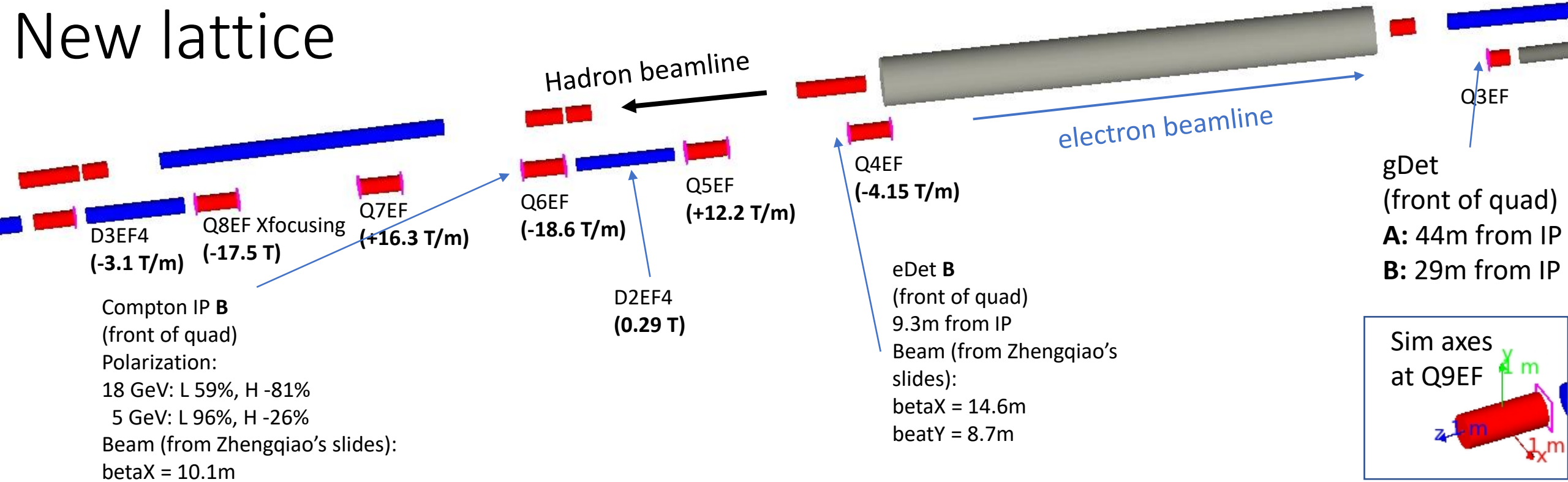
Previous results



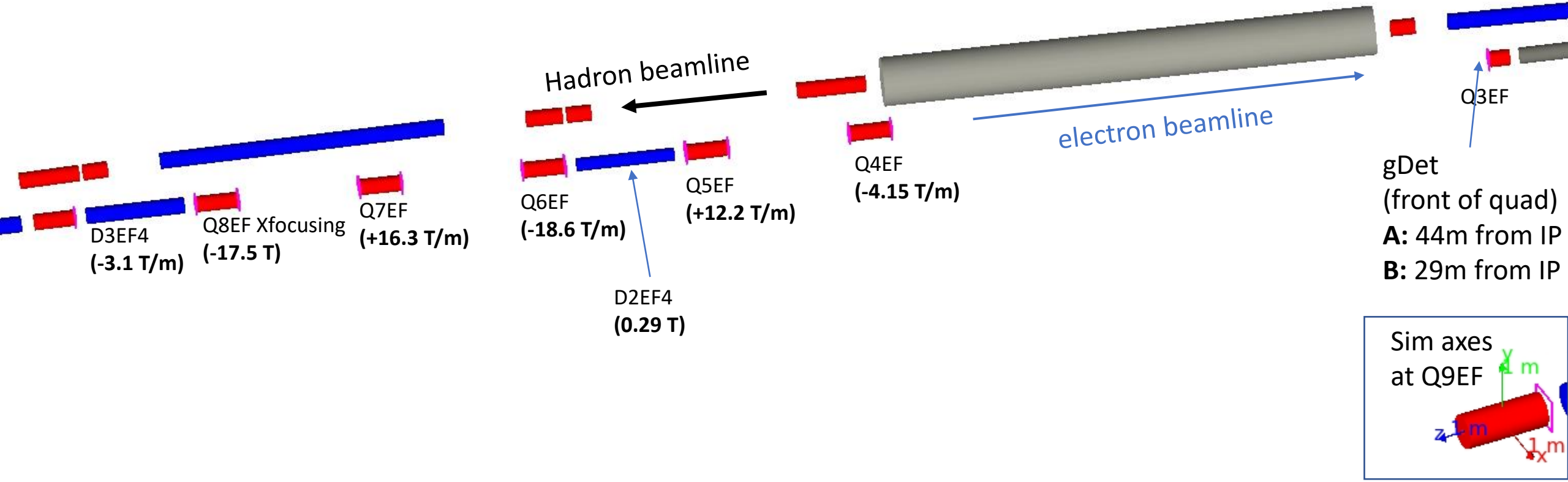
- The decision to place the IP location in front of Q6 was based on the comparison of the scattered electron signal (bottom plot on the right) where we saw that the US location produced a very distorted signal that was very close to the beam



New lattice



- Using this information (together with the emittance) we can determine the transverse beam width and position – angle correlation to fully take into account this effect on the Compton events
- One should additionally take into account the longitudinal profile (not worked out in this presentation)



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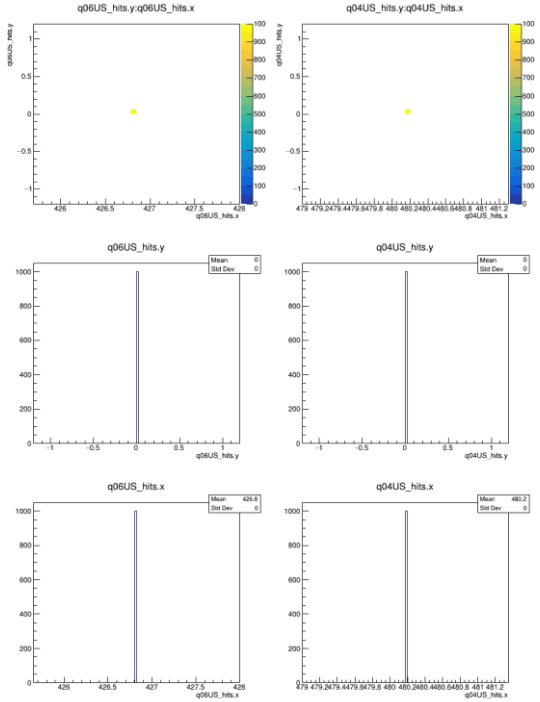
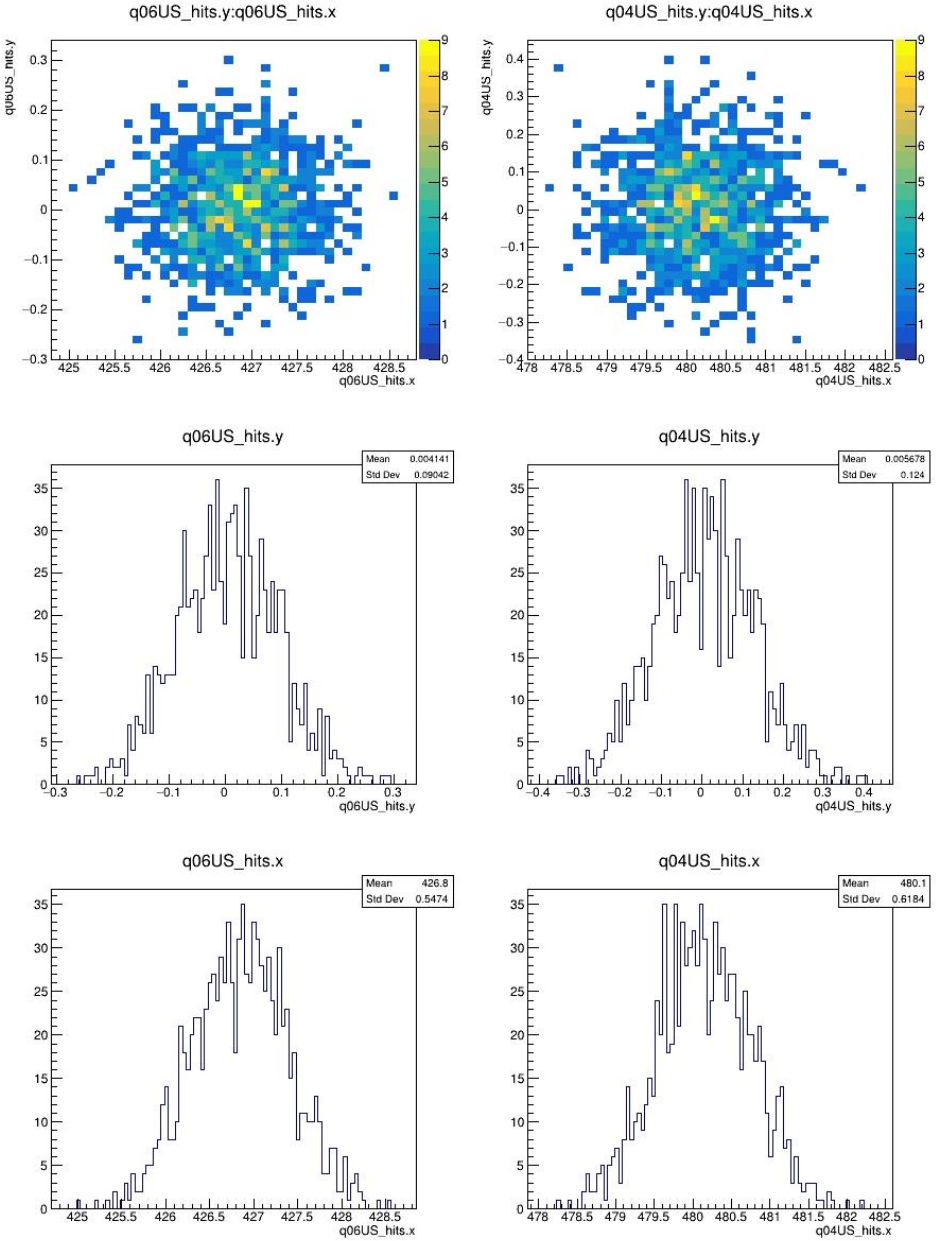
Beam x-checks

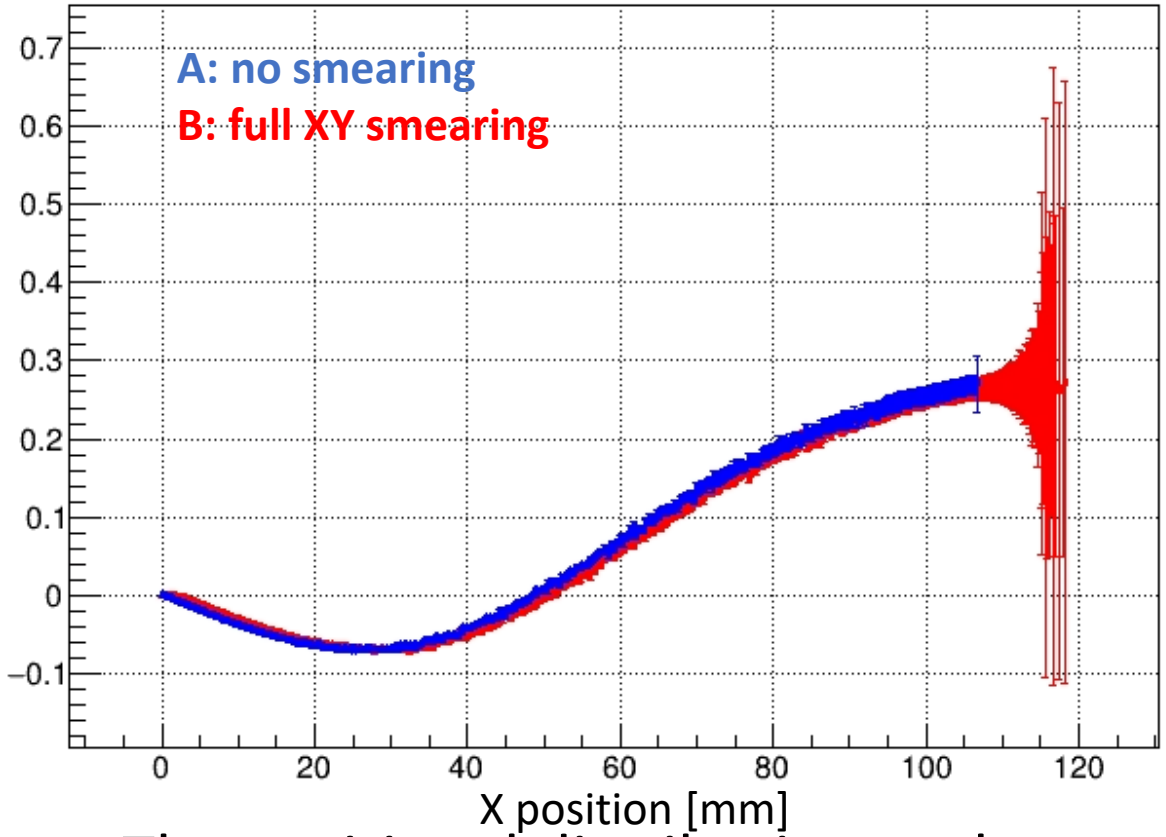
- Previous results were simulated from a point that took into account the beamline angle but didn’t take into account the transverse smearing of the beam (in either position or angle)





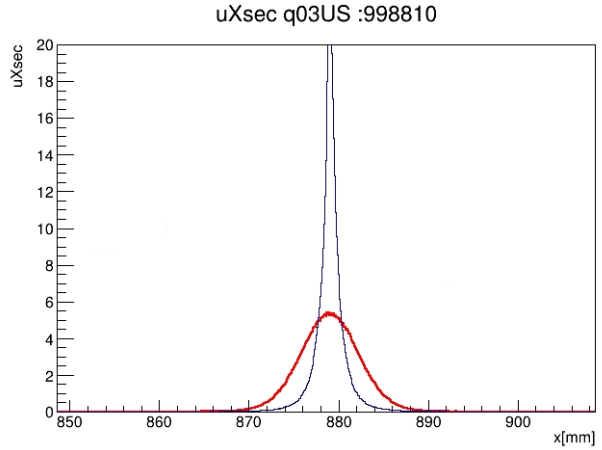
- To be able to get the correct beam width in front of Q04 I took the beam width from Zhengqiao’s slides and assumed a linear relation between distance from the beamline and beam angle (as well as a complete decorrelation between X and Y)
- The resulting parameters were at the Compton IP:
  - X: width of 0.492 mm; X’: -0.16 mrad/mm
  - Y: 0.099 mm; Y’: -0.06 mrad/mm
- Had parameters for 18 GeV alone but we should repeat the study for 5 and 10 GeV

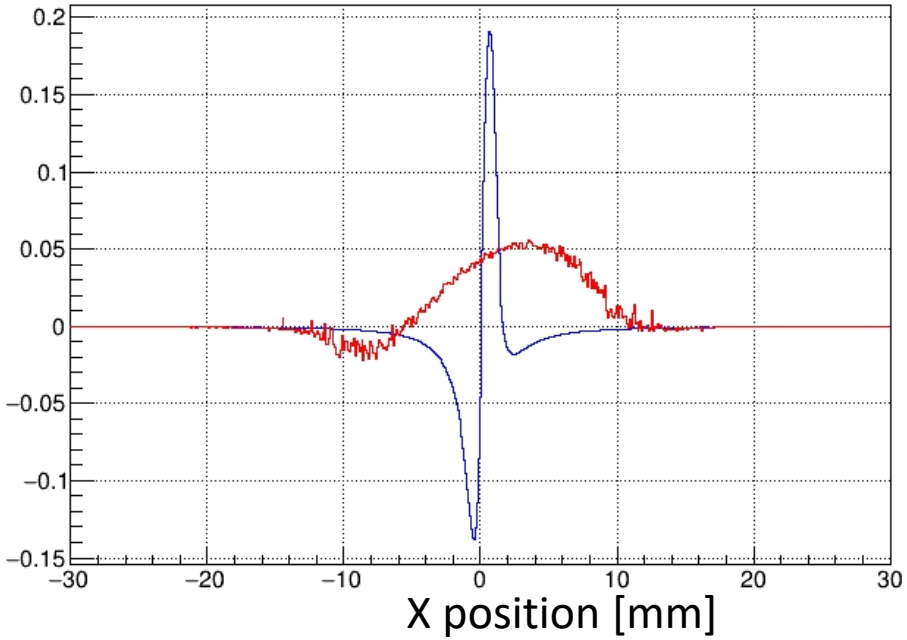
Transverse beam smearing



- The positional distribution at the electron detector and the asymmetry see a very small effect due to the smearing as expected

- The distribution at the photon detector sees some significant broadening

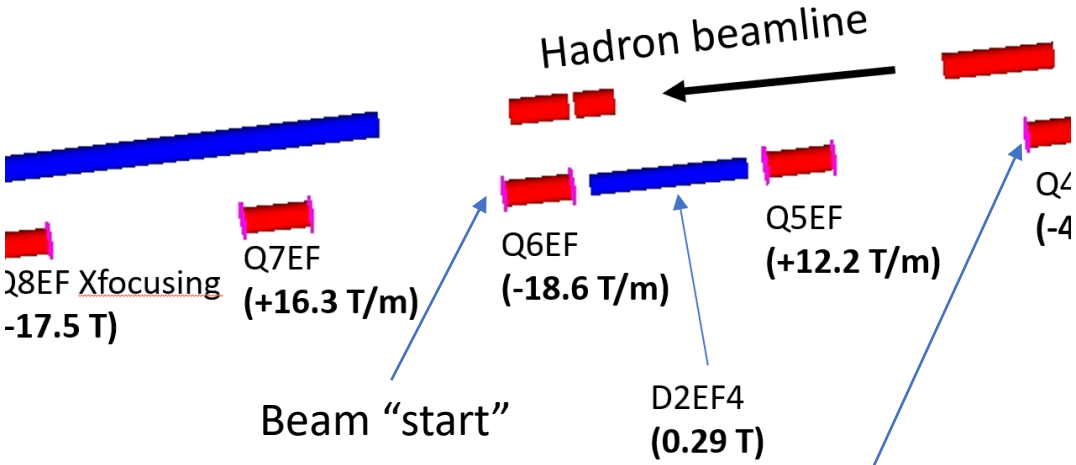


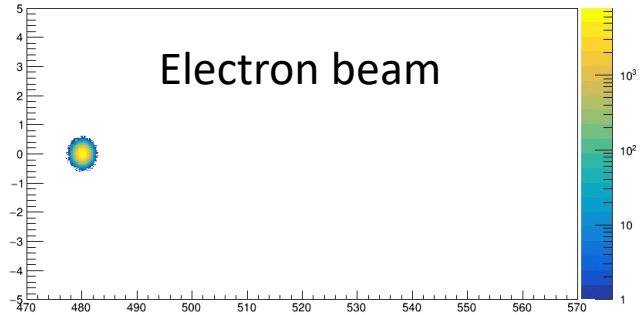


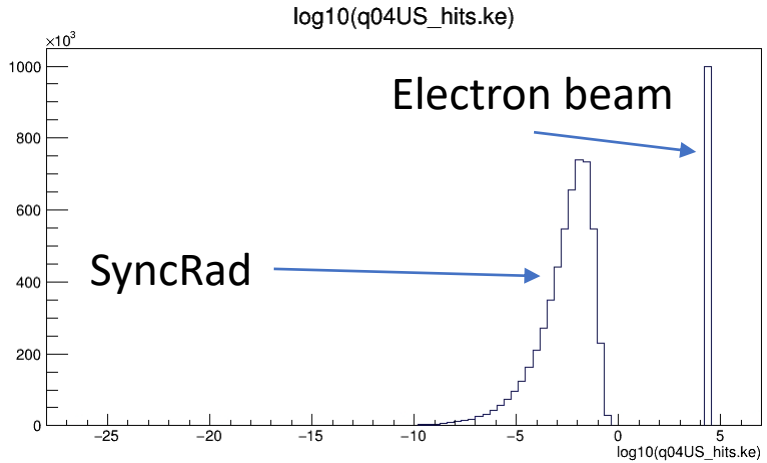
- The transverse asymmetry sees a suppression by a factor of 4 making the measurement more challenging that it already was

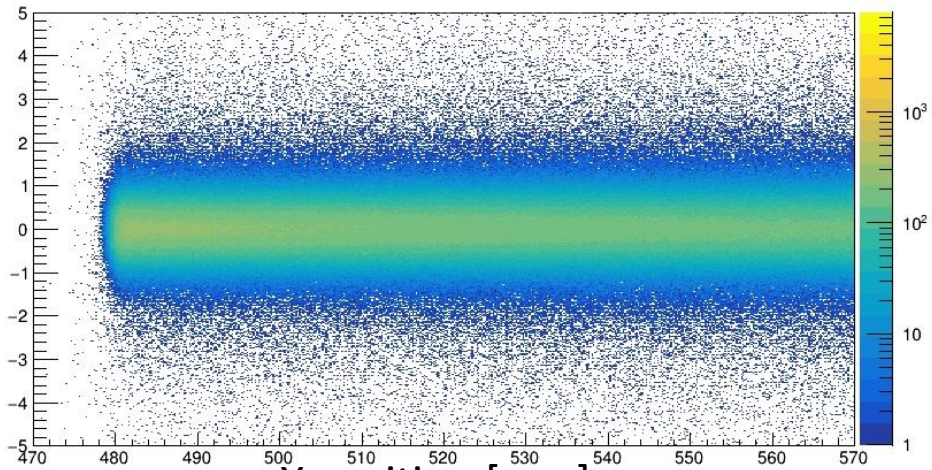
Synchrotron Radiation

- I implemented the SyncRad in the current simulation (https://github.com/cipriangal/comptonEic/) using the G4 testEM16 example
- There are two sources of SR that we need to consider:
  - the scattered Compton electron
  - the beam electrons (the overwhelming majority)
- We can see that the SR from the last dipole is on the opposite side as the scattered Compton electron

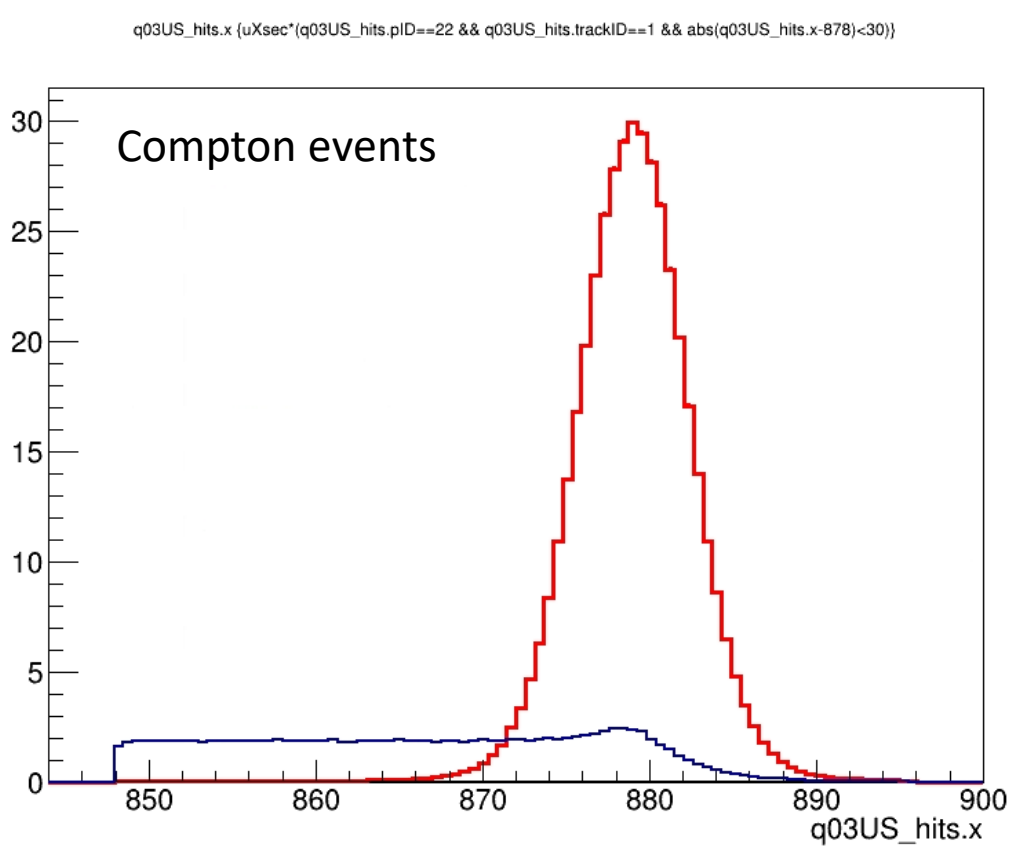


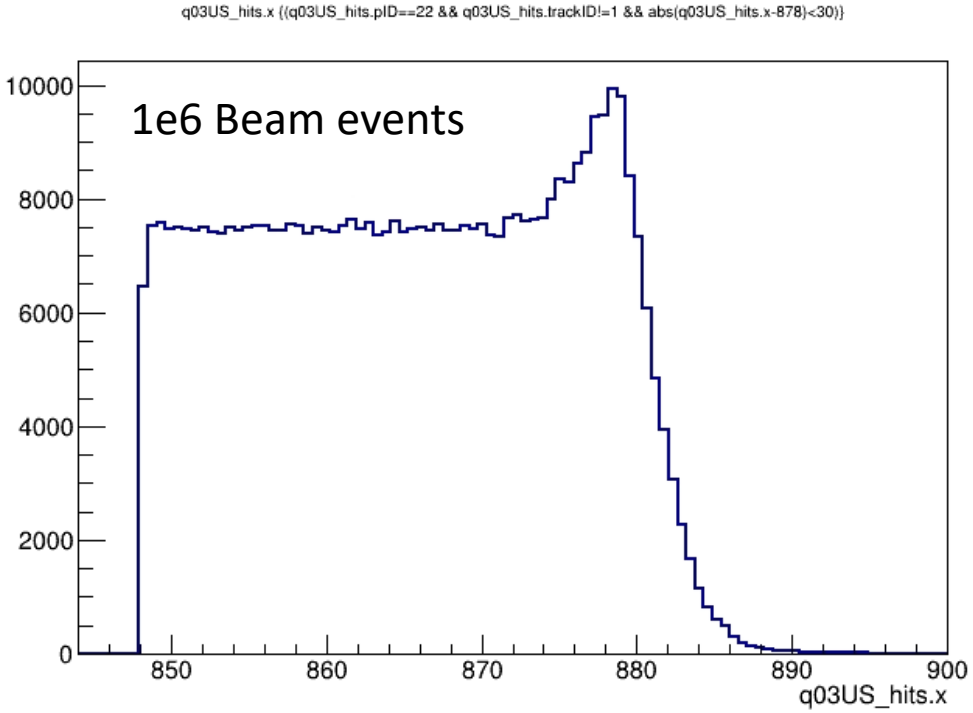


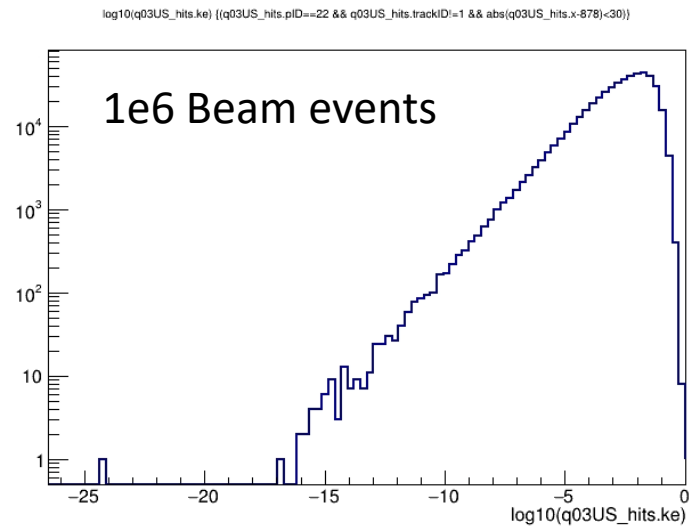




Synchrotron Radiation: photon detector







- We can see the SR from the Compton electrons is a small fraction of the photons reaching the photon detector plane
  - The also have quite a long tail

Conclusions

- The transvers beam smearing seems to have a significant effect on our ability to extract the transverse component of the polarization
  - The longitudinal smearing could potentially further add to this effect
- The beam SR should be evaluated starting further US to check whether the e-det will be affected
  - The photon detector should be able to suppress most of the SR using a pre-radiator, however the power deposition should be calculated once we know the detector geometry
- Study should be repeated for 5 and 12 GeV

Beam parameters

	275_18GeV	275_10GeV	100_10GeV	100_05GeV	42_05GeV
β_x [m]	39.211923	34.234562	26.4642	44.0955	30.6136
β_y [m]	15.523734	14.9955	19.5174	6.4097	32.1978
High divergence emittance X [nm]	24	20	20	20	20
High divergence emittance Y[nm]	2.0	1.2	1.3	2.0	3.5
High acceptance emittance X [nm]	24	20	20	20	20
High acceptance emittance Y [nm]	1.2	1.1	1.4	2.0	3.5
High divergence RMS beam size X [μm]	970.09595	827.46072	727.51907	939.10063	782.47811
High divergence RMS beam size Y [μm]	176.20292	134.14395	159.28785	113.22279	335.69674
High acceptance RMS beam size X [μm]	970.09595	827.46072	727.51907	939.10063	782.47811
High acceptance RMS beam size Y [μm]	136.48619	128.43306	165.30082	113.22279	335.69674

Table 1: The beam parameters at the position of the electron detector.

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