IP6 Compton simulation update

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Simulation setup

https://arxiv.org/pdf/hep-ph/9711447.pdf

- Using our default Compton generator
  - https://gitlab.com/eic/mceg/comptonRad
- The generator gives out the 4-momentum for both the photon and electron together with 4 weight factors: unpolarized and polarized tree level cross sections (eq 26,27 of paper) and the order alpha corrections (not used for the following analysis)
- To obtain the average analyzing power for a particular configuration (or average over any number of bins) we need to weight by cross section
- An average FOM can also be calculated weighting by sqrt(N)

$$W_1 = \frac{1}{2\rho^{(n)}(x)}\left[\frac{d^n\sigma^{(0)}}{dx^n}(s,-) + \frac{d^n\sigma^{(0)}}{dx^n}(s,+)\right]$$ **unpolarized xsection** (26)

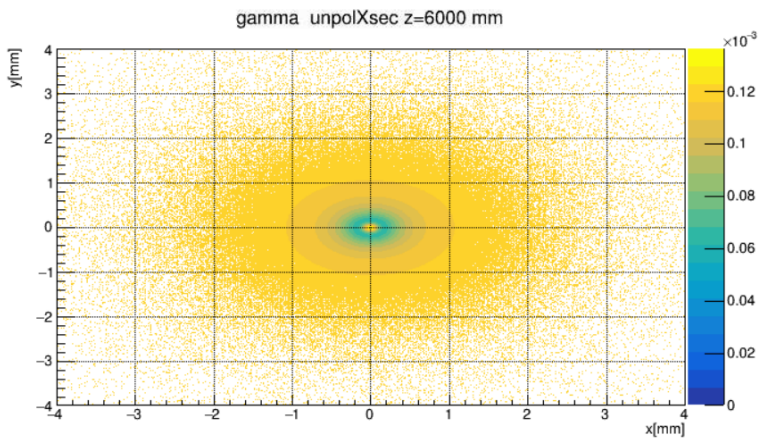
$$W_2 = \frac{1}{2\rho^{(n)}(x)}\left[\frac{d^n\sigma^{(0)}}{dx^n}(s,-) - \frac{d^n\sigma^{(0)}}{dx^n}(s,+)\right]$$ **polarized xsection** (27)

$$A_N = \frac{\sigma^- - \sigma^+}{\sigma^- + \sigma^+} = \frac{\sigma^p}{\sigma^u} \equiv \frac{W_1}{W_2}$$

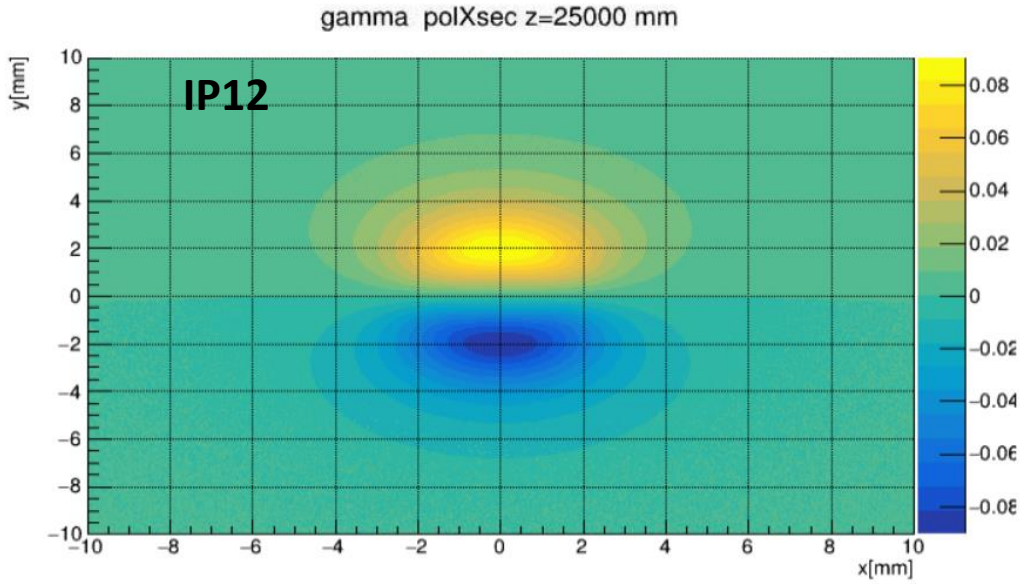
$$\langle A_N \rangle = \frac{\sum_i A_{N,i} \cdot \sigma_i^u}{\sum_i \sigma_i^u} = \frac{\sum_i \sigma_i^p}{\sum_i \sigma_i^u}$$

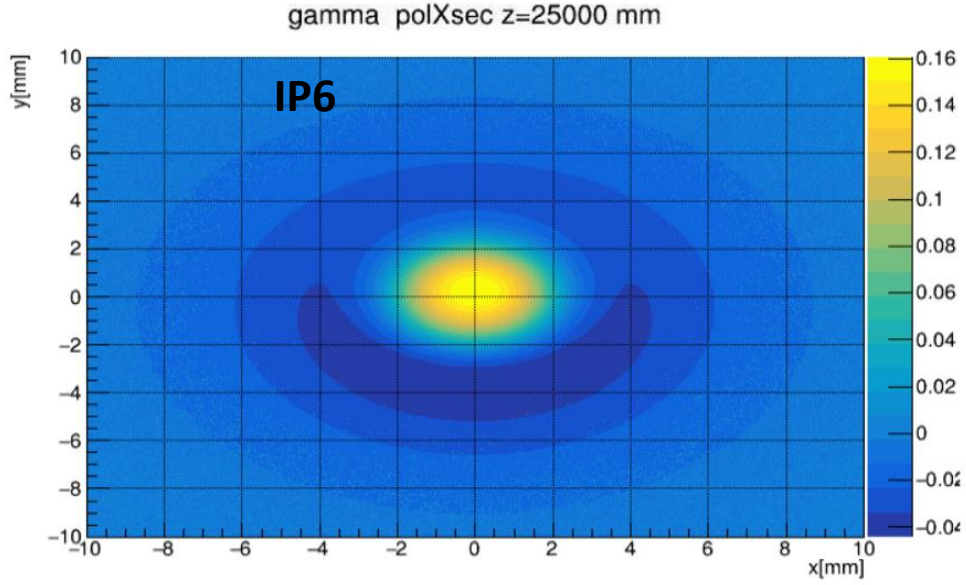
$$\langle FOM \rangle = \frac{\sum_i A_{N,i} \cdot \sqrt{\sigma_i^u} \cdot \sigma_i^u}{\sum_i \sigma_i^u} = \frac{\sum_i \sigma_i^p \cdot \sqrt{\sigma_i^u}}{\sum_i \sigma_i^u}$$

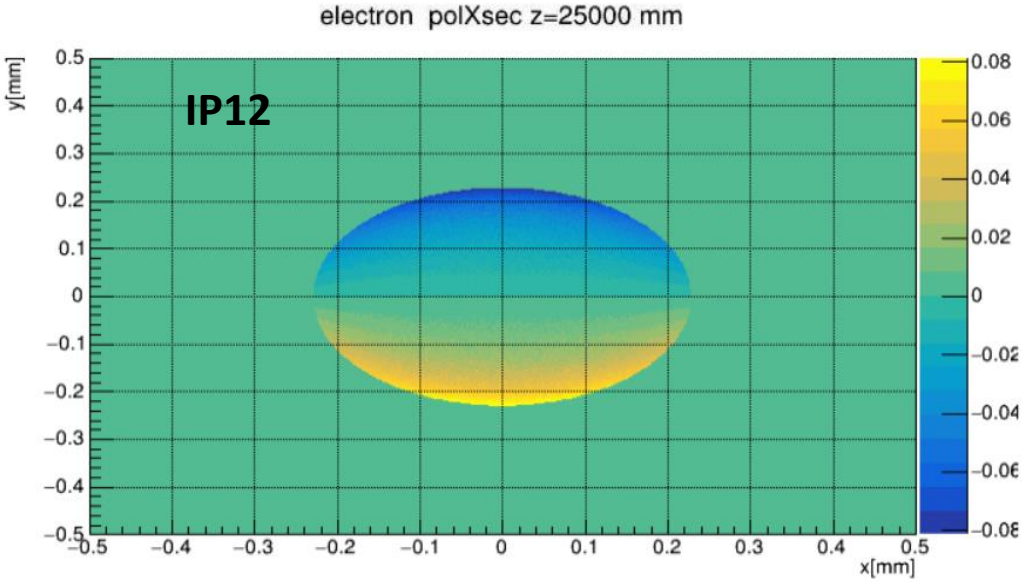
$$\langle E \cdot A_N \rangle = \frac{\sum_i E_i \cdot \sigma_i^p}{\sum_i E_i \cdot \sigma_i^u}$$

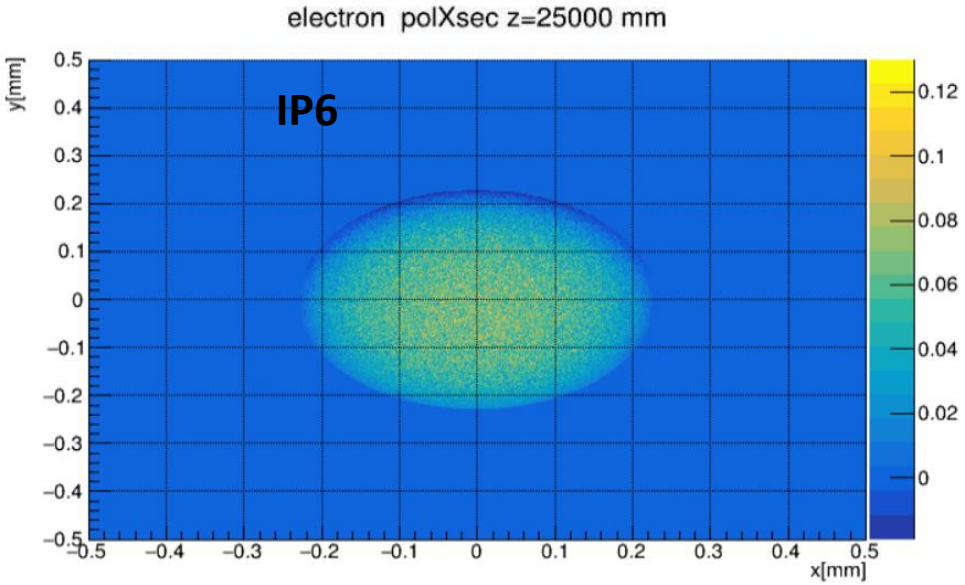


5GeV: transverse dependence

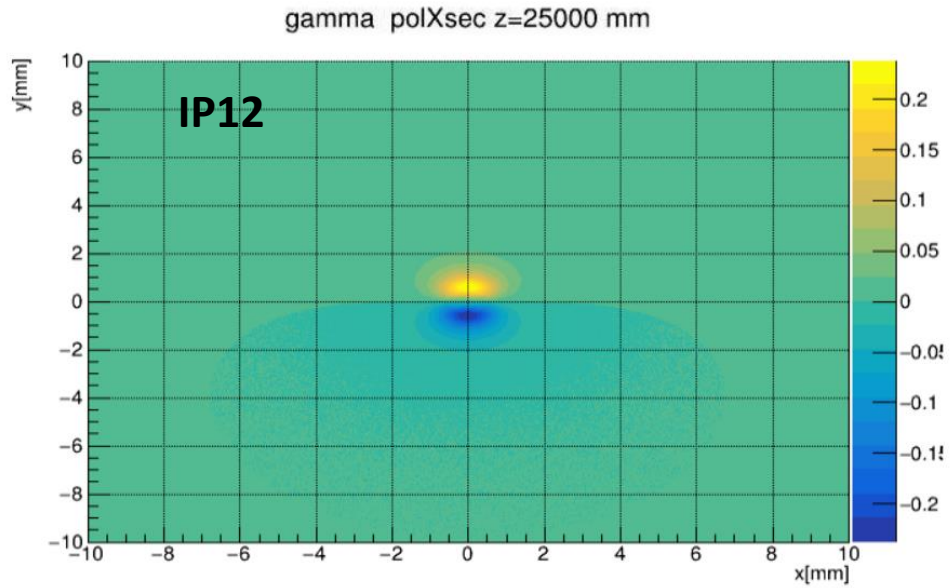


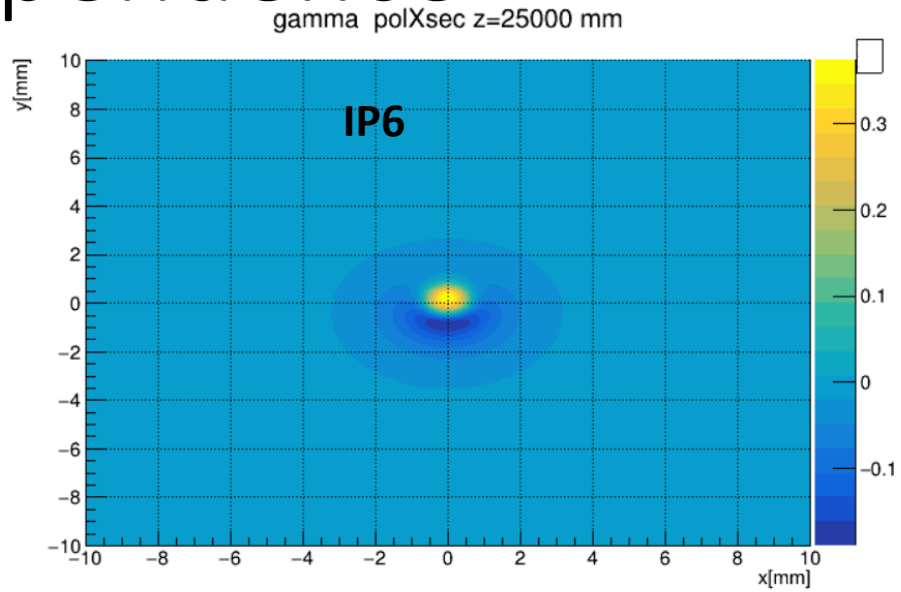


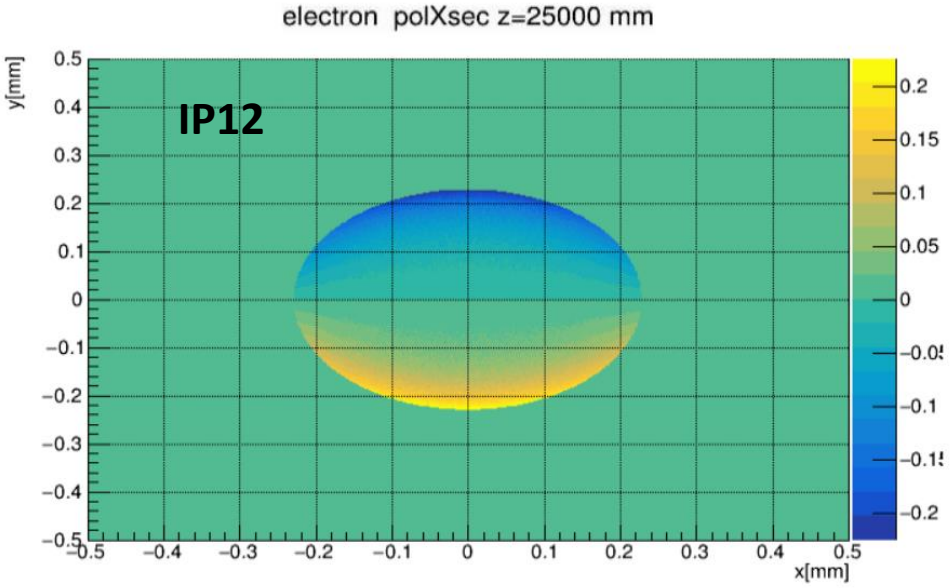


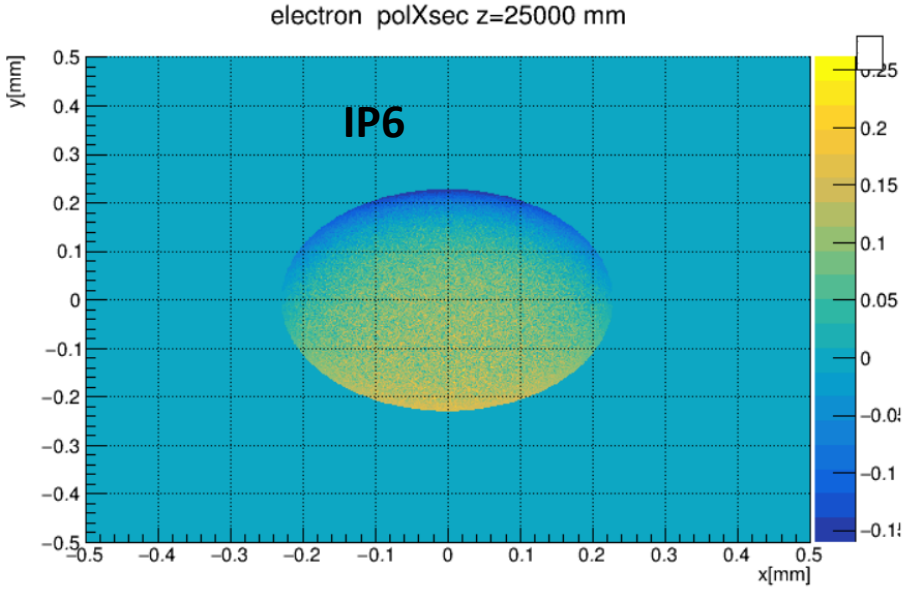


18GeV: transverse dependence





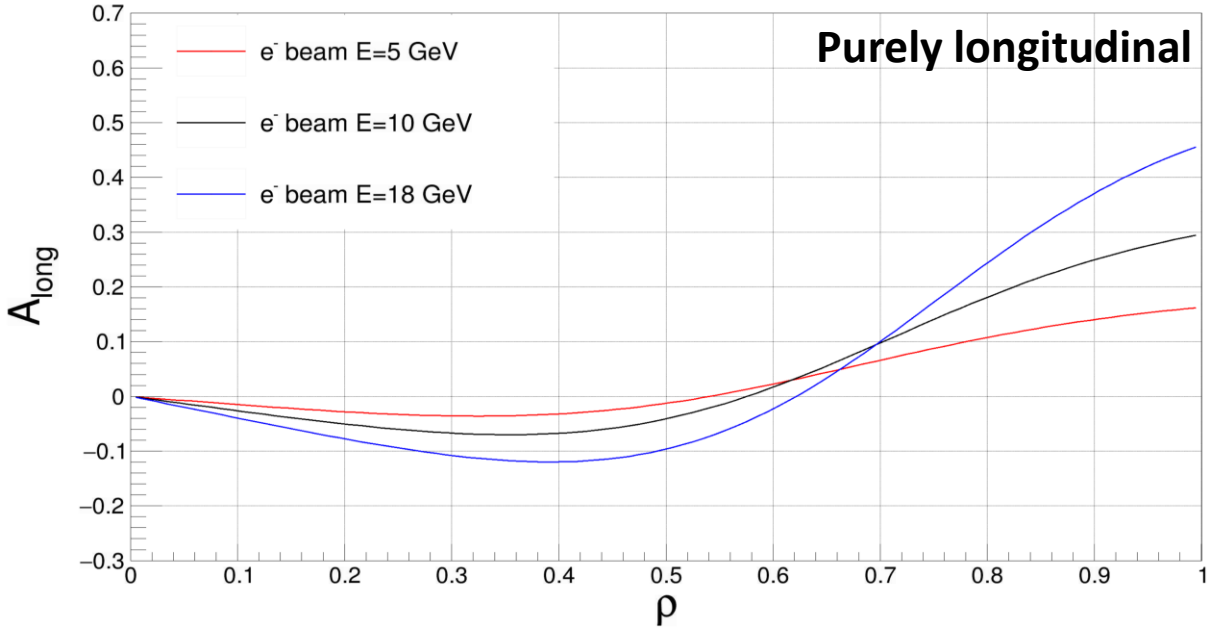


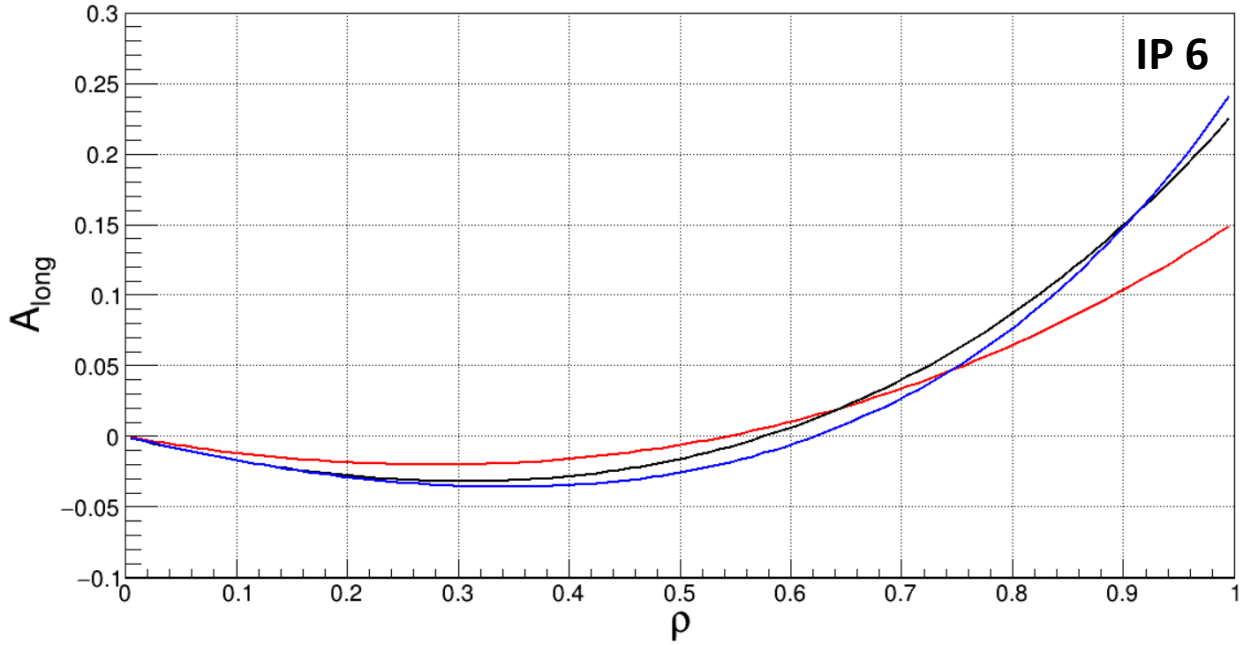


IP6 polarization is more complicated

- The different beam energies will provide different amounts of longitudinal polarizations
  - This brings the analyzing power as a function of backscattered photon energy for all three configurations in a similar range

	polarization at Compton IP	
Beam energy [GeV]	Longitudinal [%]	Vertical [%]
5	97.6	21.6
10	90.7	42.2
18	70.8	70.6

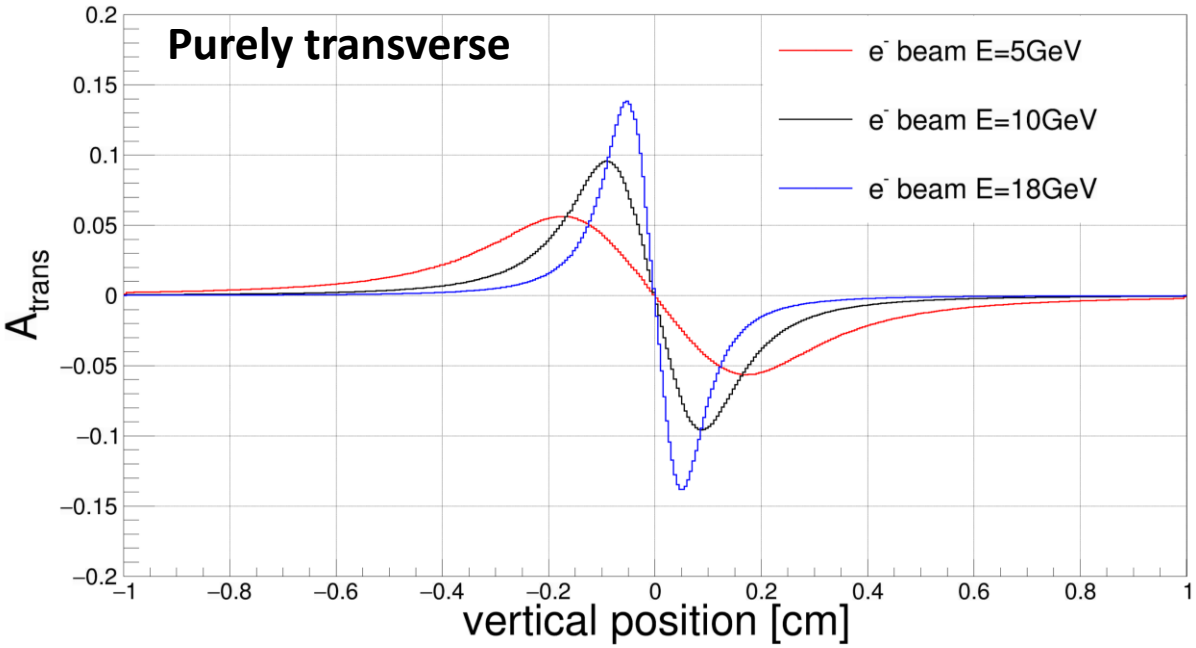


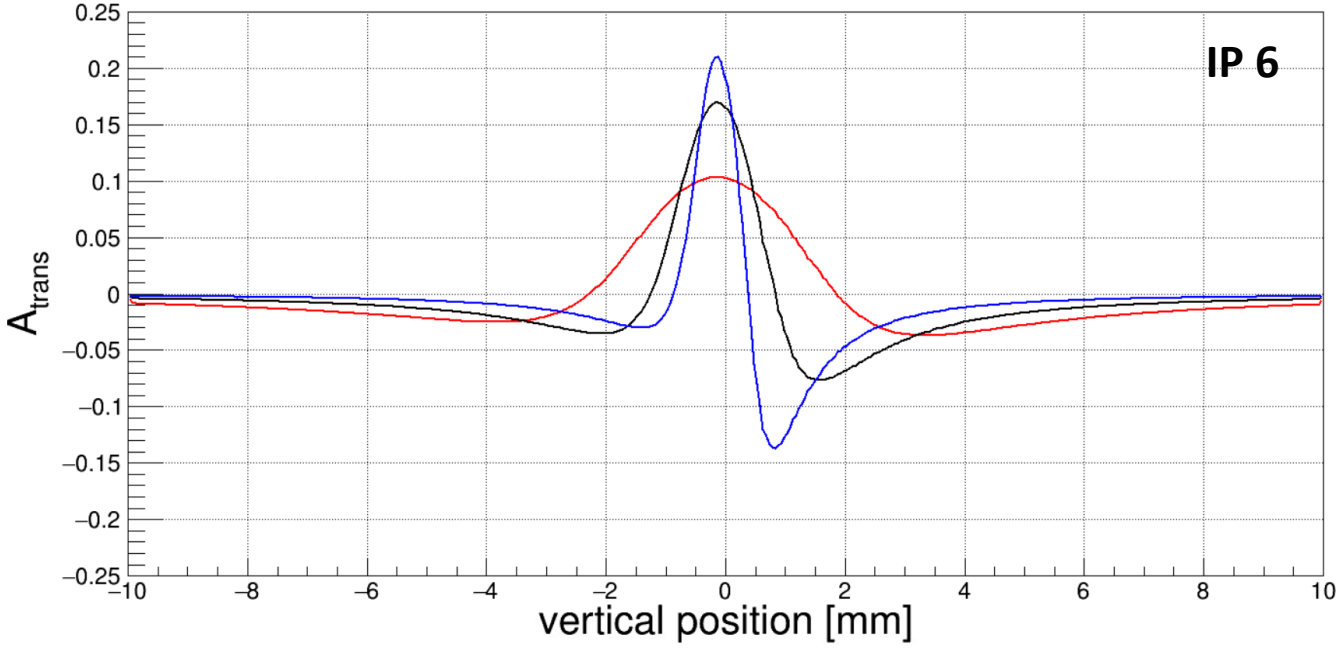


IP6 polarization is more complicated

- The up down asymmetry typically seen in transverse polarimeters is significantly more complicated for the IP6 configurations
- To determine detector requirements we'll need to do a smarter analysis than I had suggested at IP12

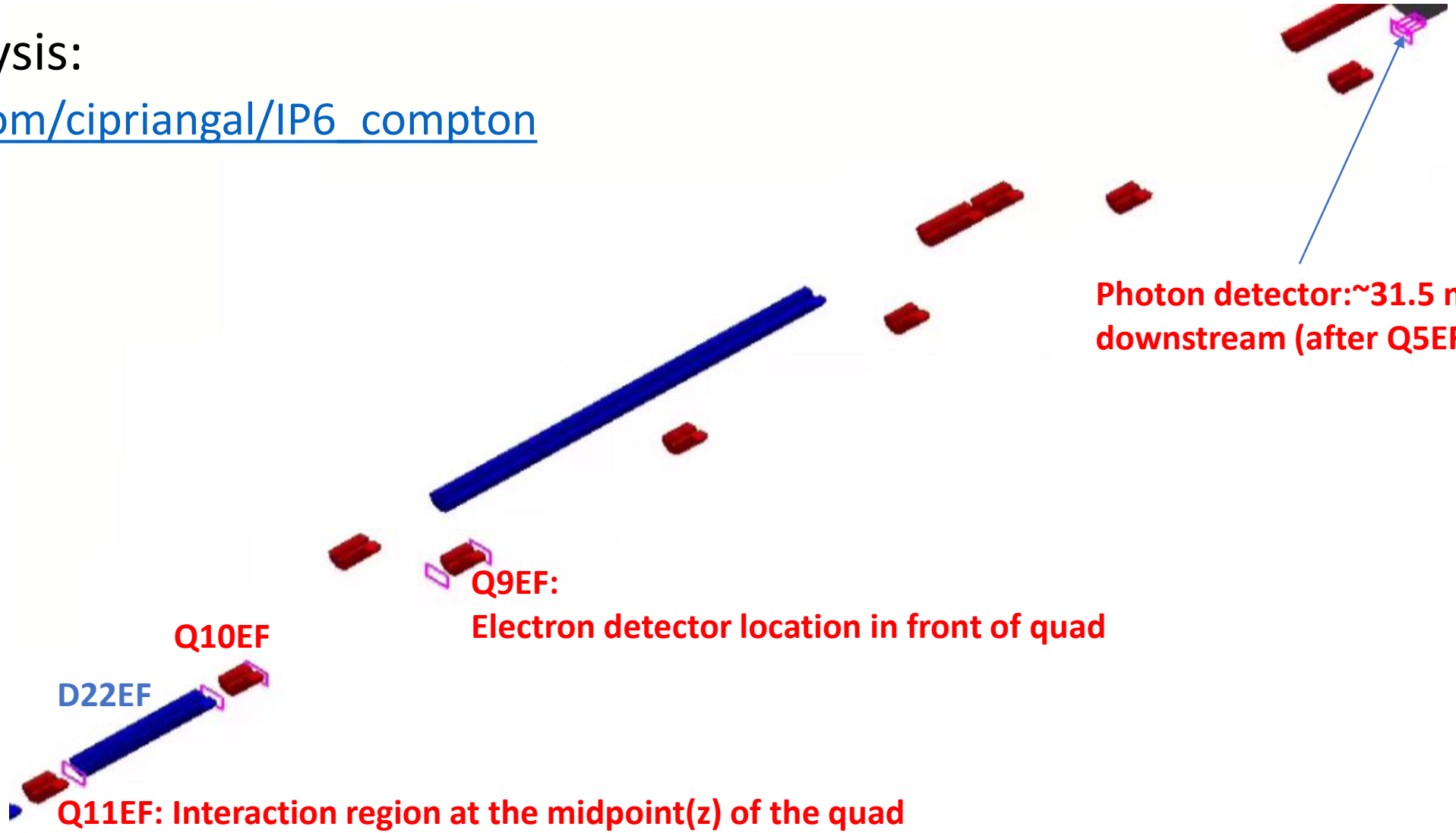
	polarization at Compton IP	
Beam energy [GeV]	Longitudinal [%]	Vertical [%]
5	97.6	21.6
10	90.7	42.2
18	70.8	70.6



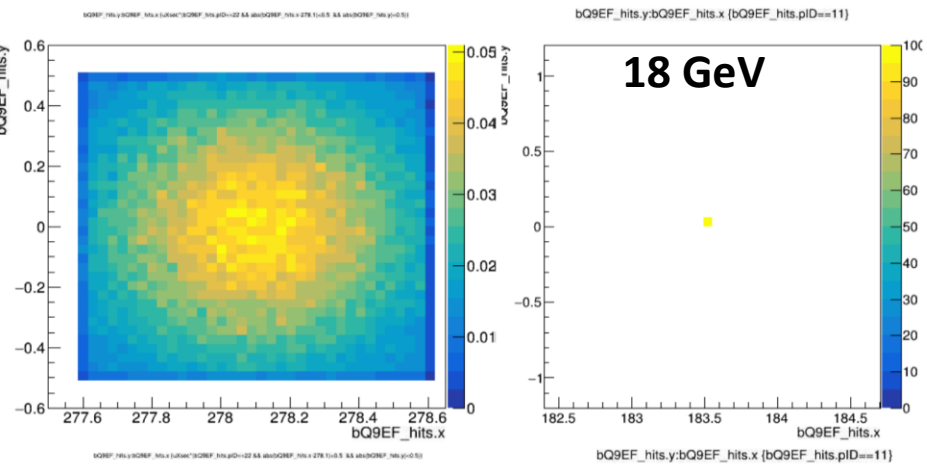


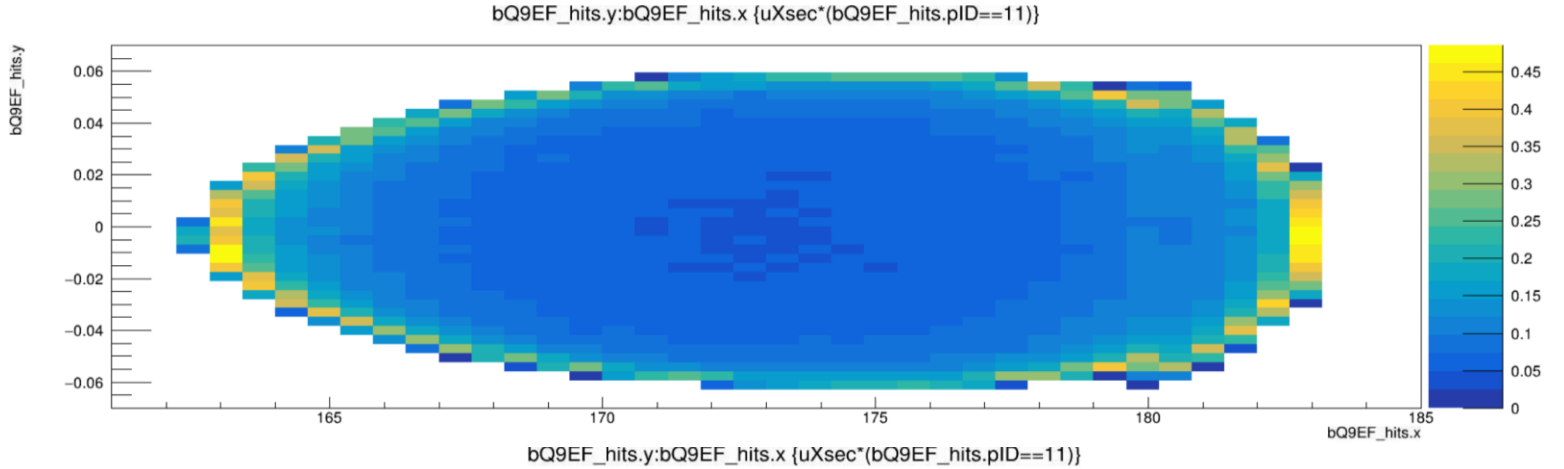
IP6 interaction region (as designed by Zhengqiao)

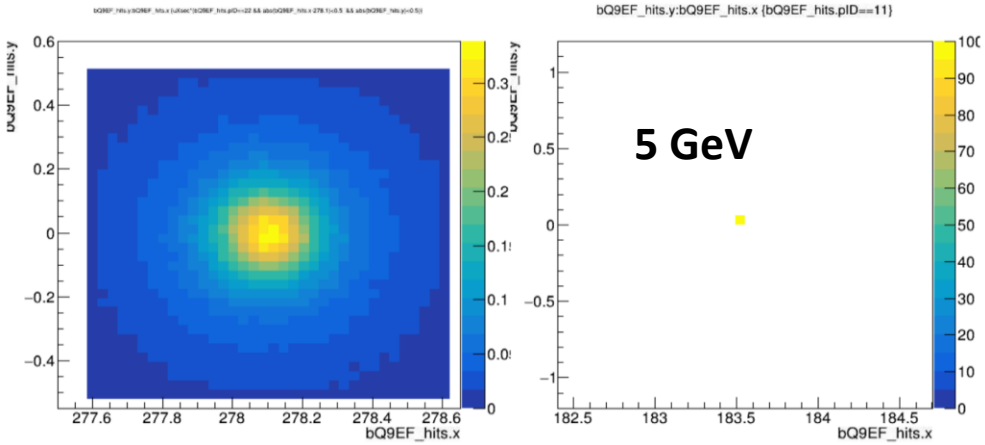
- Fork for this analysis:
  - https://github.com/cipriangal/IP6_compton

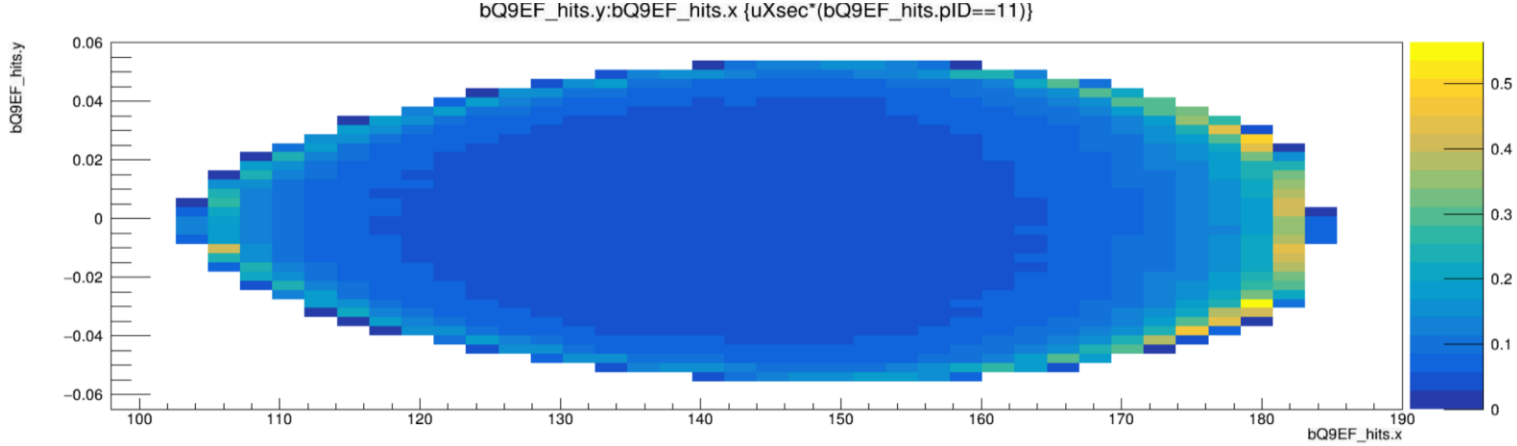


Front of Q9EF









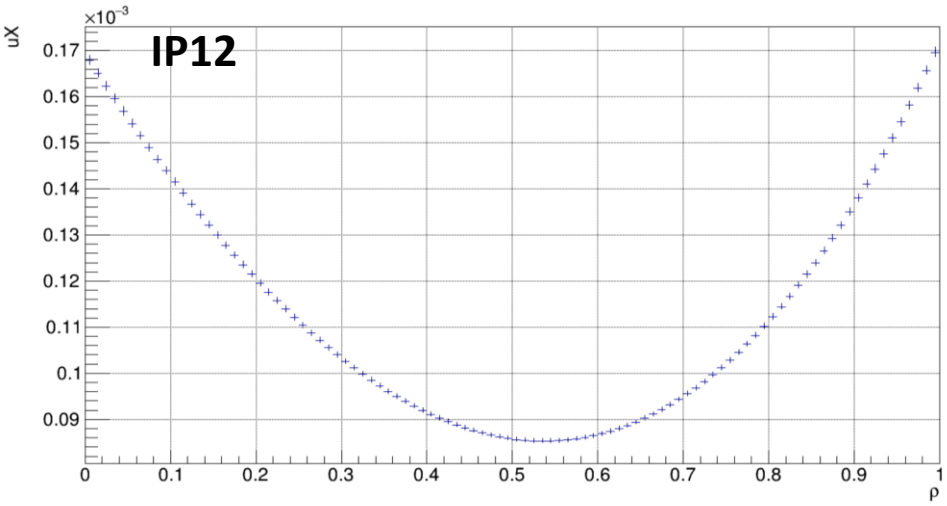
- First look at the propagation through the magnets (weighted by polarized cross section) – distributions look similar to what Zhengqiao showed previously
- Working on analysis with the polarized x-section

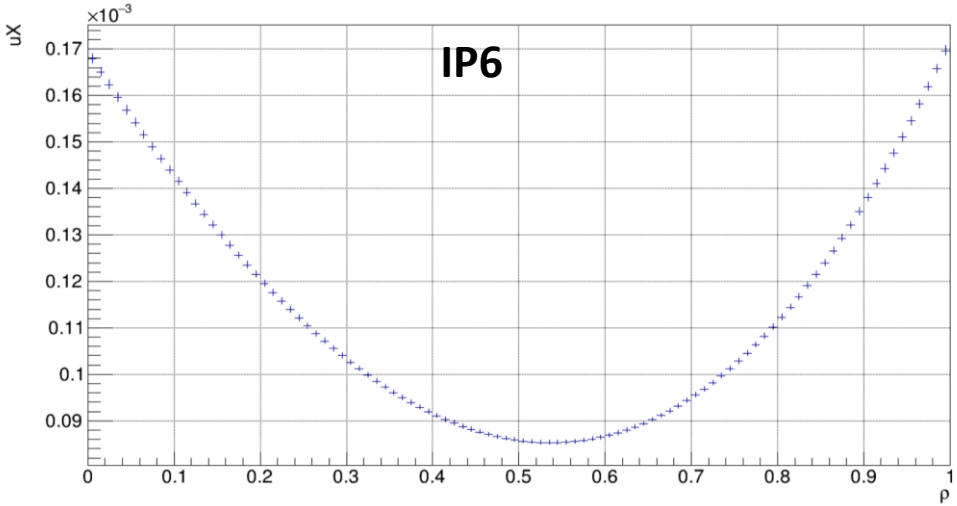
Questions

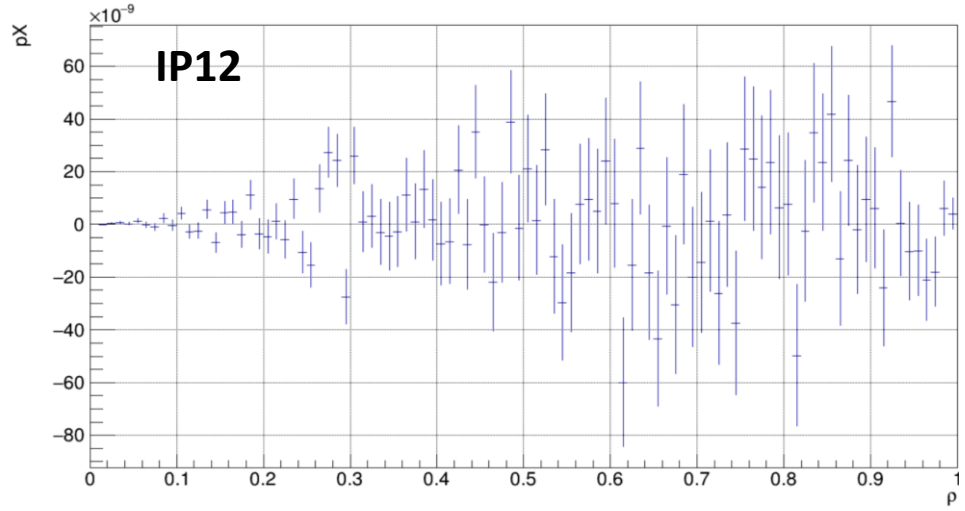
- Is a 2D fit needed in order to capture the transverse asymmetry?
  - This means that strips would be inadequate
- Should we try to develop an analysis where we correct the transverse detector response with the energy measured longitudinal measurement ?
  - How should we estimate the systematics for such a procedure?

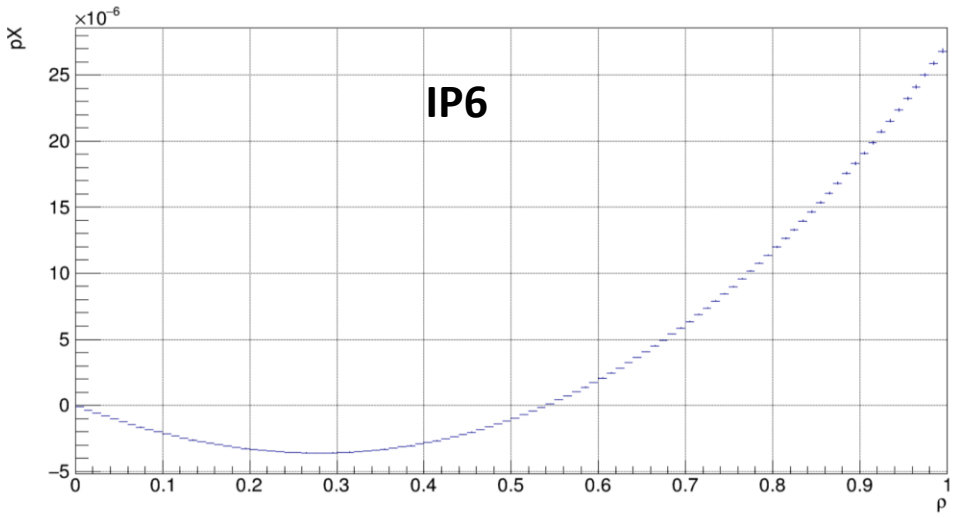
Backup

5GeV: cross-sections and energy dependence

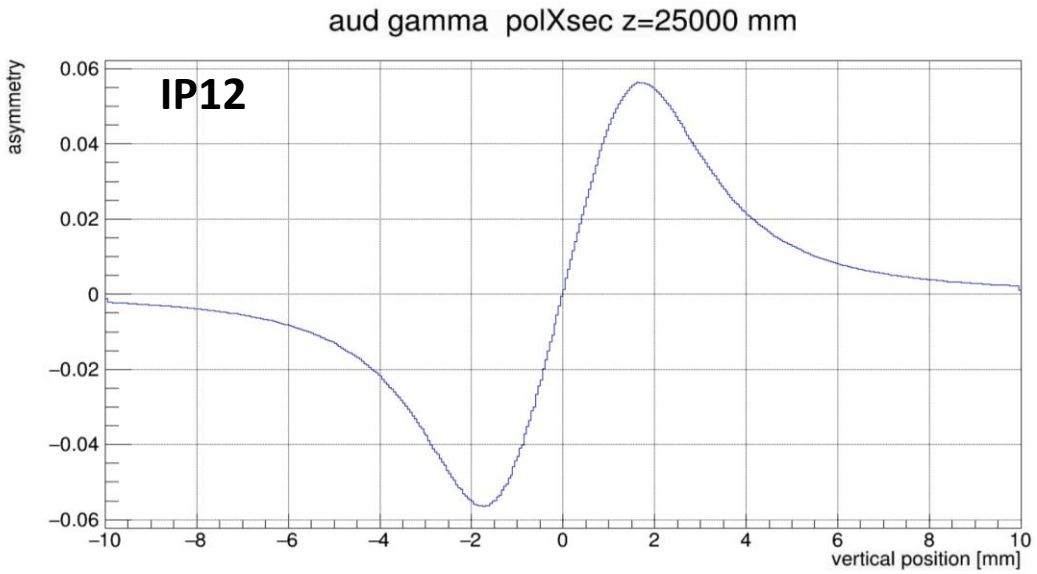


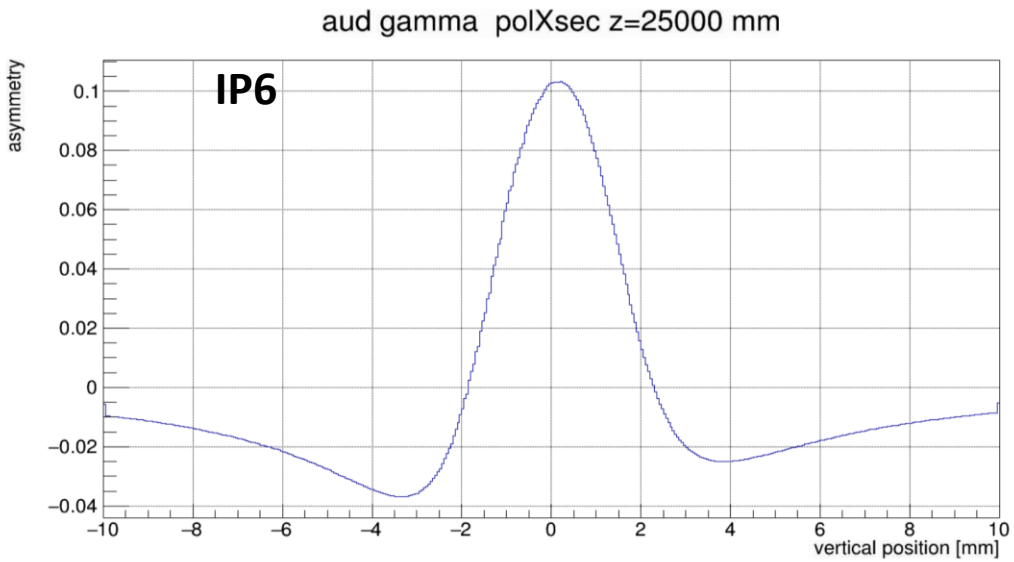


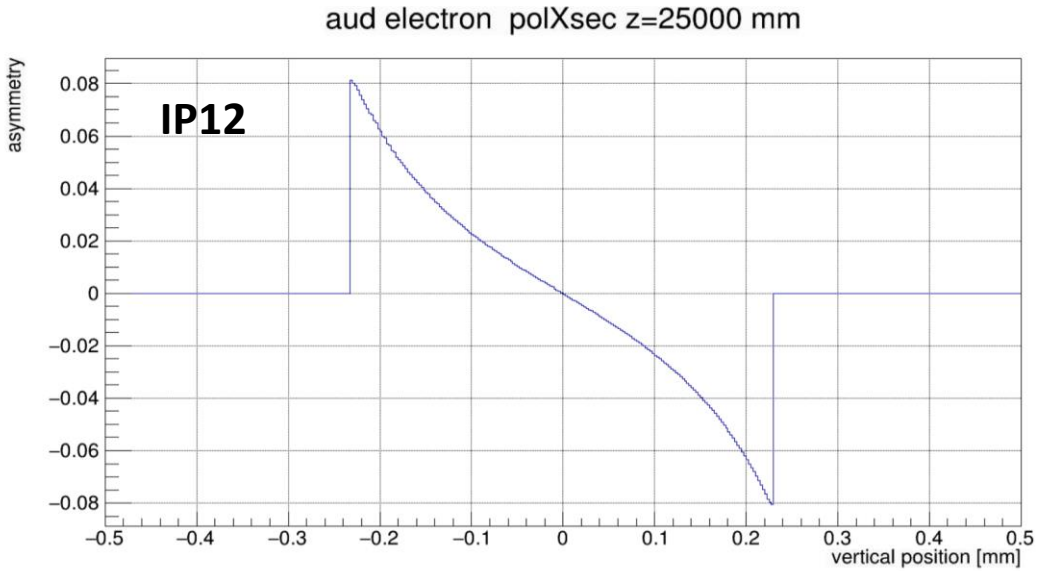


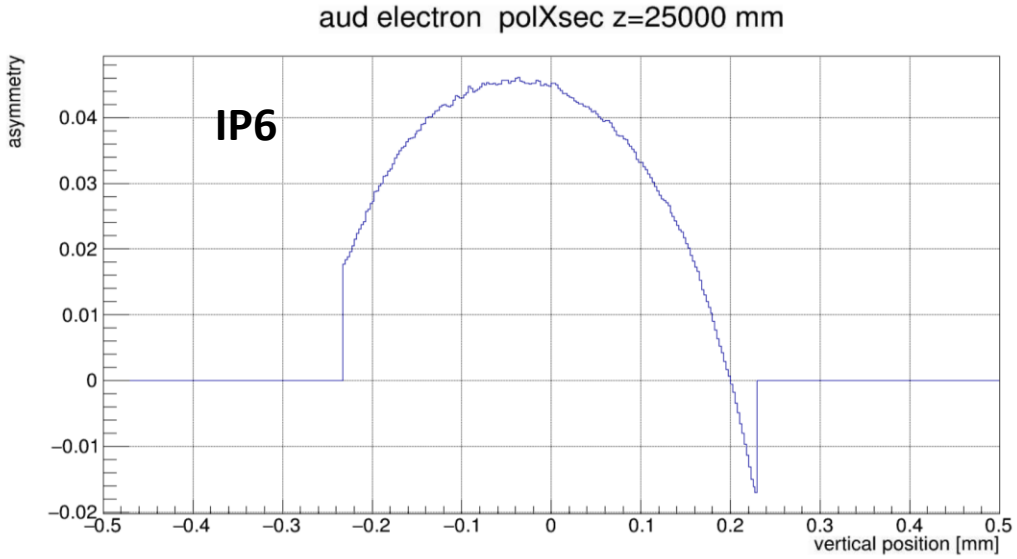


5GeV: transverse AN

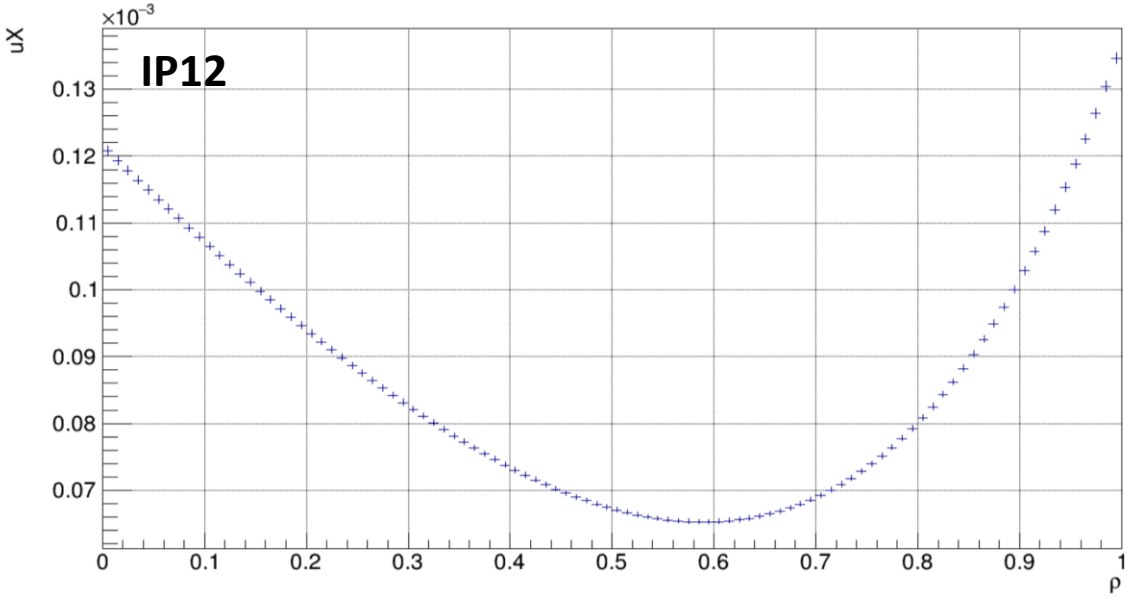


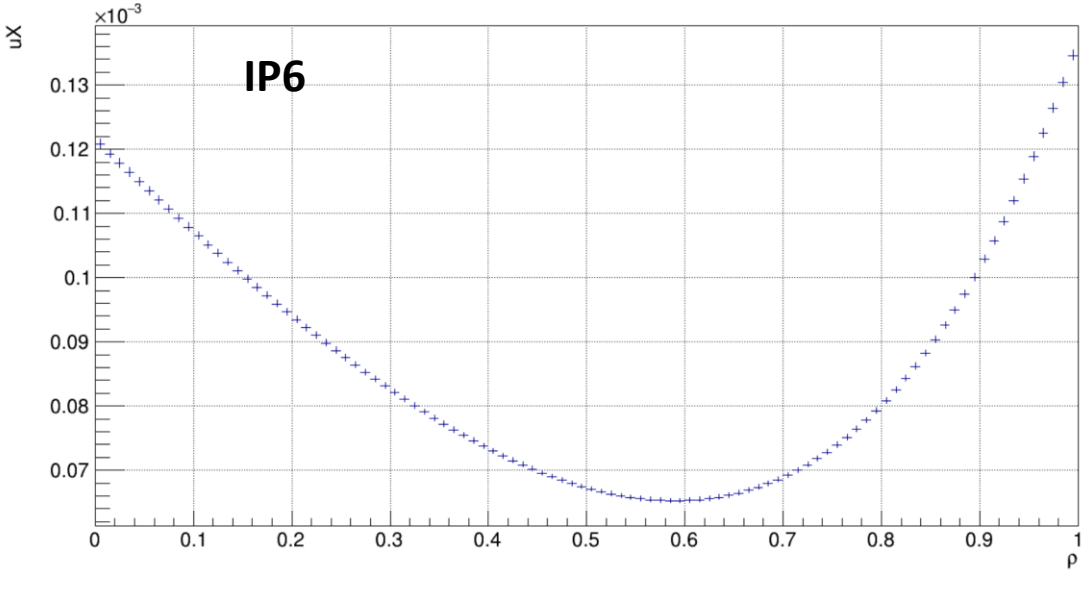


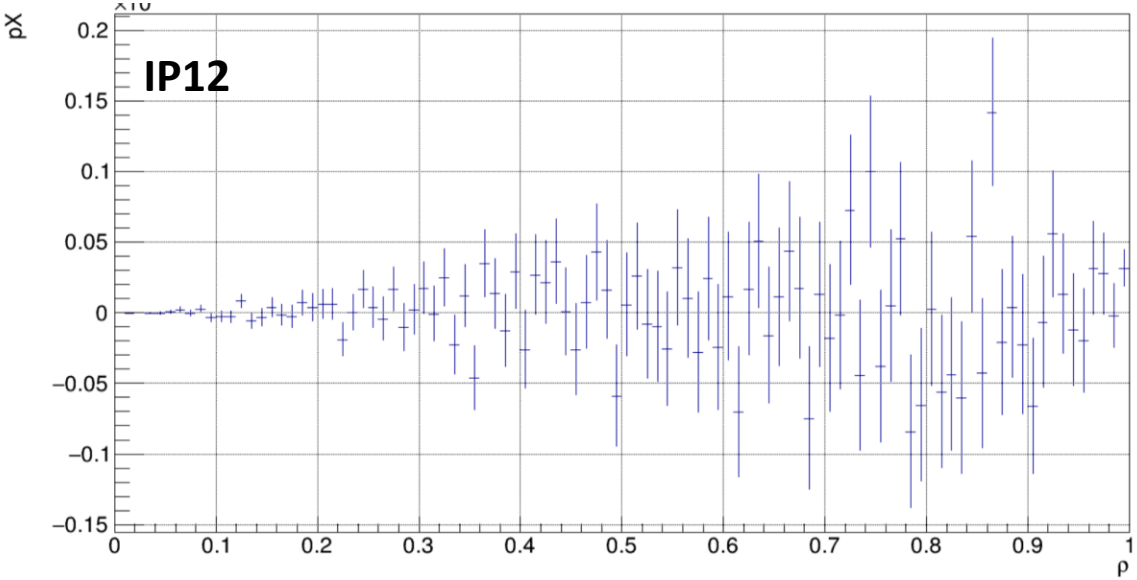


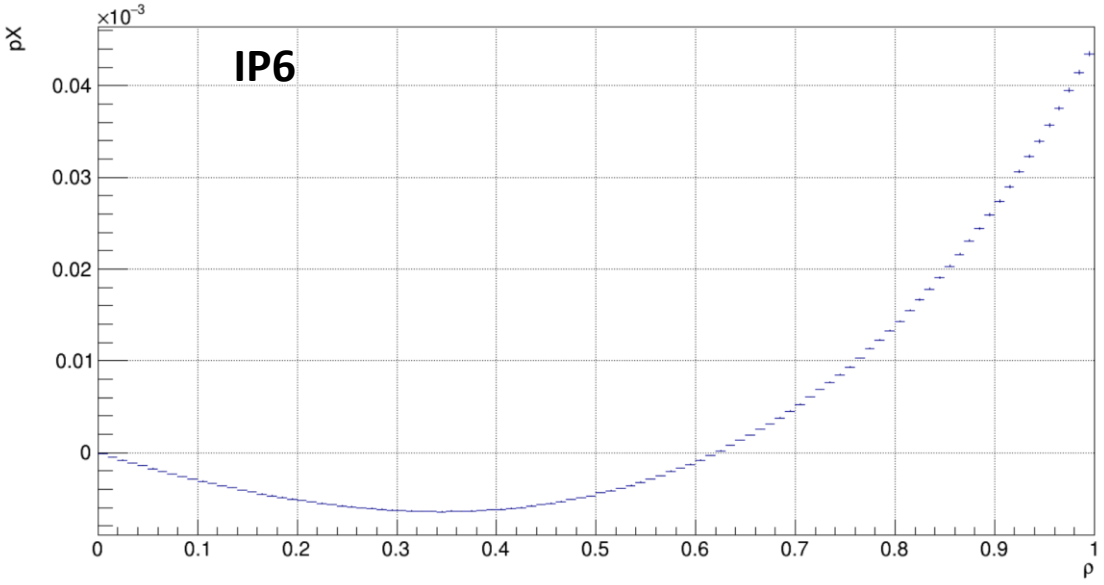


18GeV: cross-sections and energy dependence









18GeV: transverse AN