

PVDIS FOM and GEM size with longer endcap

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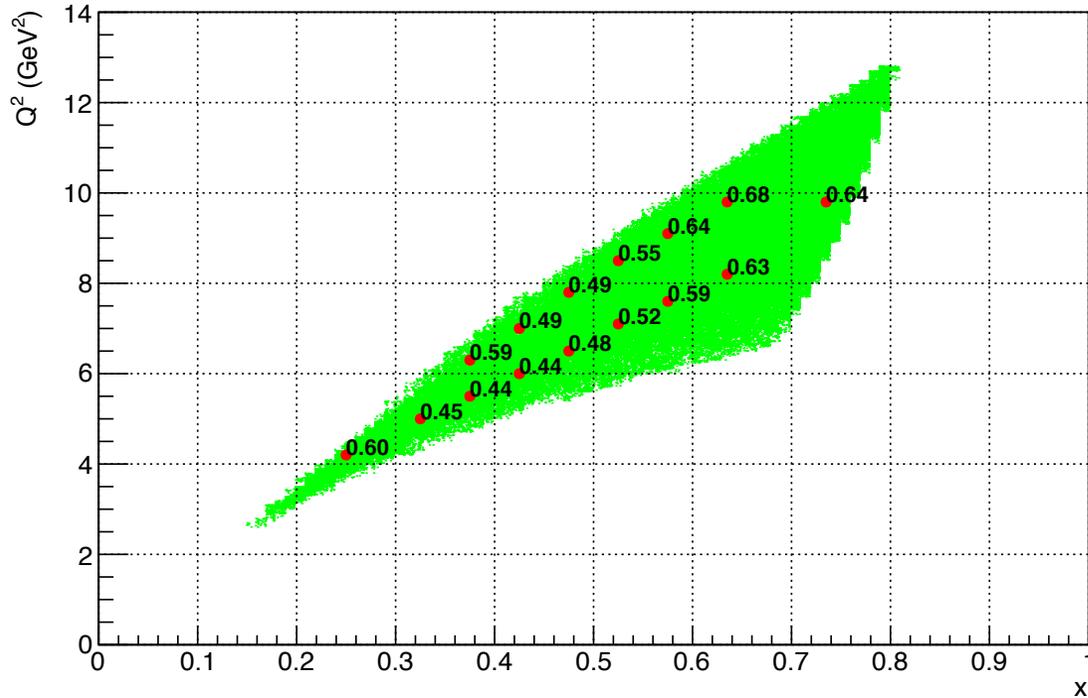
08/04/2020

Syracuse University

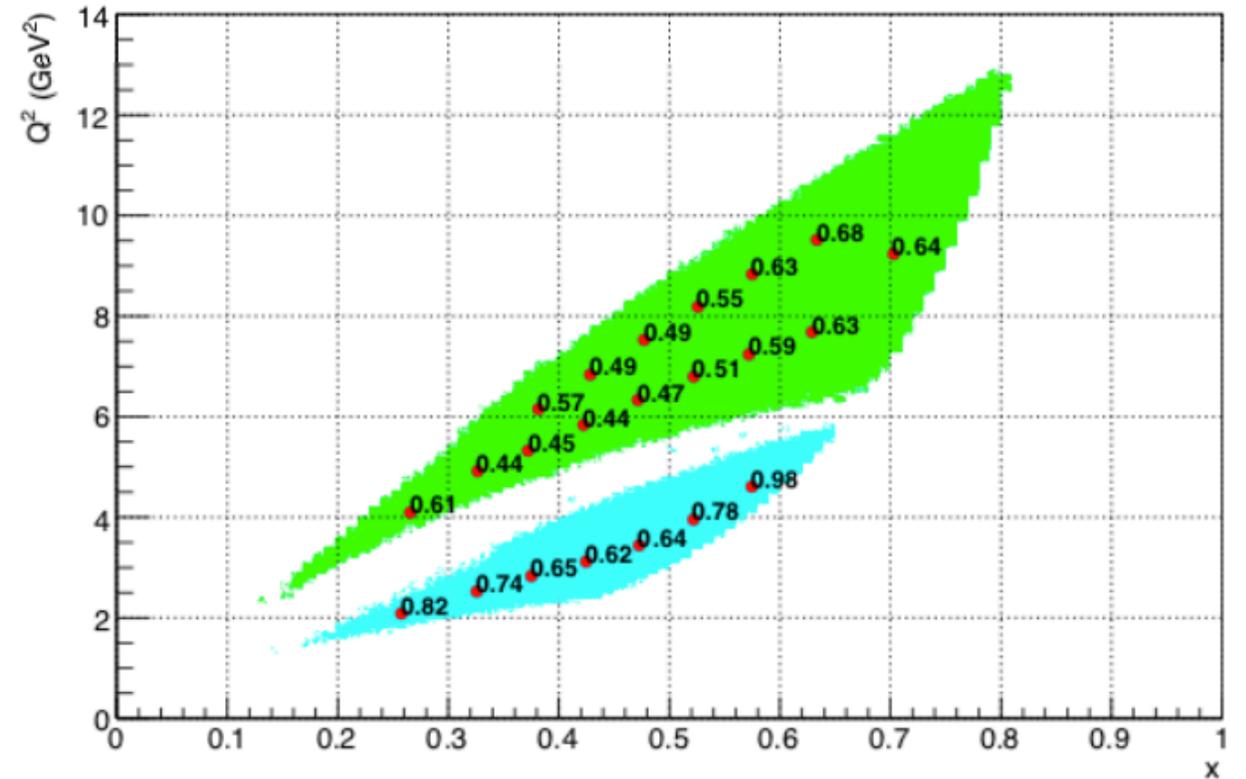
PVDIS FOM comparison

- Requiring $W > 2$ GeV and exist a hit on ec with tid = 1 and $110 \text{ cm} < r < 270 \text{ cm}$, and the latest ec trigger curve
- Reproduce the FOM in pCDR within 0.02% difference
- No cut on GEM: for example requiring the track must hit the active area of all GEMs

Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target



PVDIS Asymmetry Uncertainty (%)



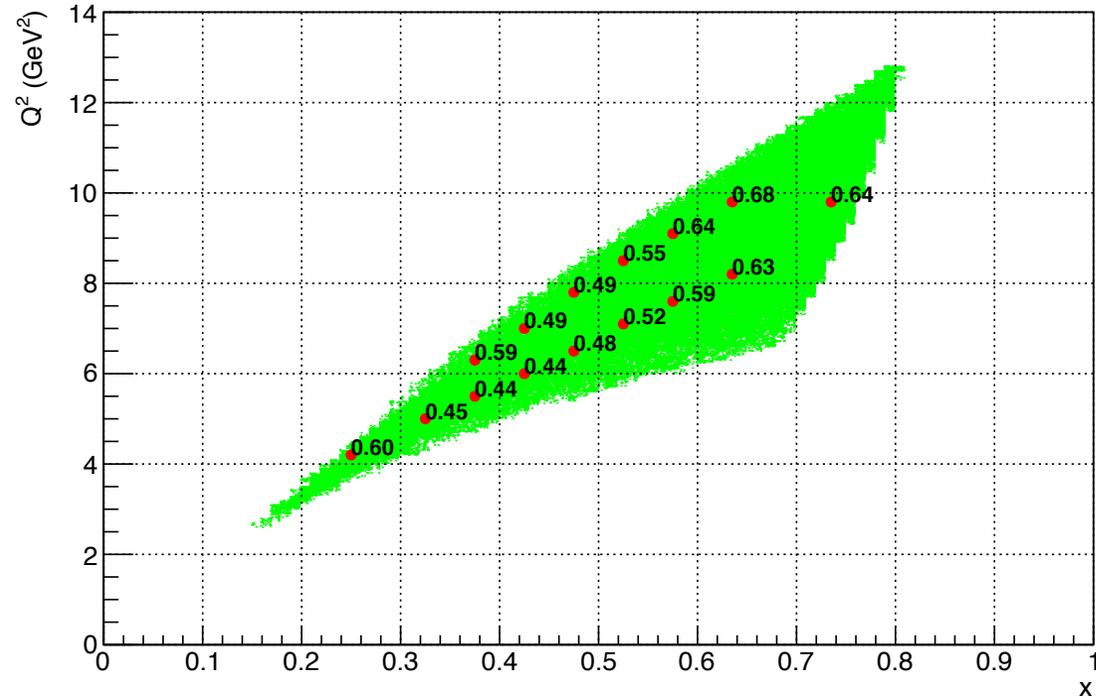
PVDIS FOM comparison

Layer	Z (cm)	R_{min}^{needed} (cm)	R_{max}^{needed} (cm)	R_{min}^{actual} (cm)	R_{max}^{actual} (cm)	pitch (mm)	# of channels
1	157.5	51	118	50	118	0.4	55.8 k
2	185.5	62	136	61	140	0.6	29.5 k
3	190	65	140	61	140	0.6	29.5 k
4	306	111	221	110	228	0.8	36.0 k
5	315	115	228	110	228	0.8	36.0 k
Total							≈ 187 k

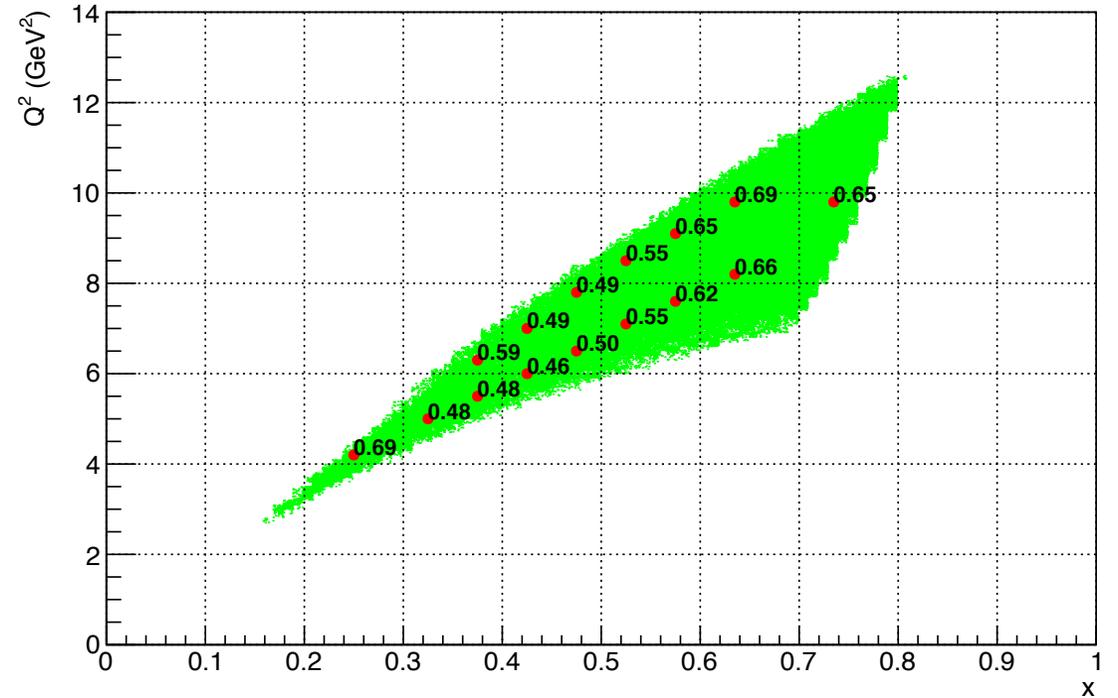
PVDIS FOM comparison

- Left: Requiring $W > 2$ GeV and exist a hit on ec with tid = 1 and $110 \text{ cm} < r < 270 \text{ cm}$, and the latest ec trigger curve
- Right: in addition, require the track hit all 5 GEMs

Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target

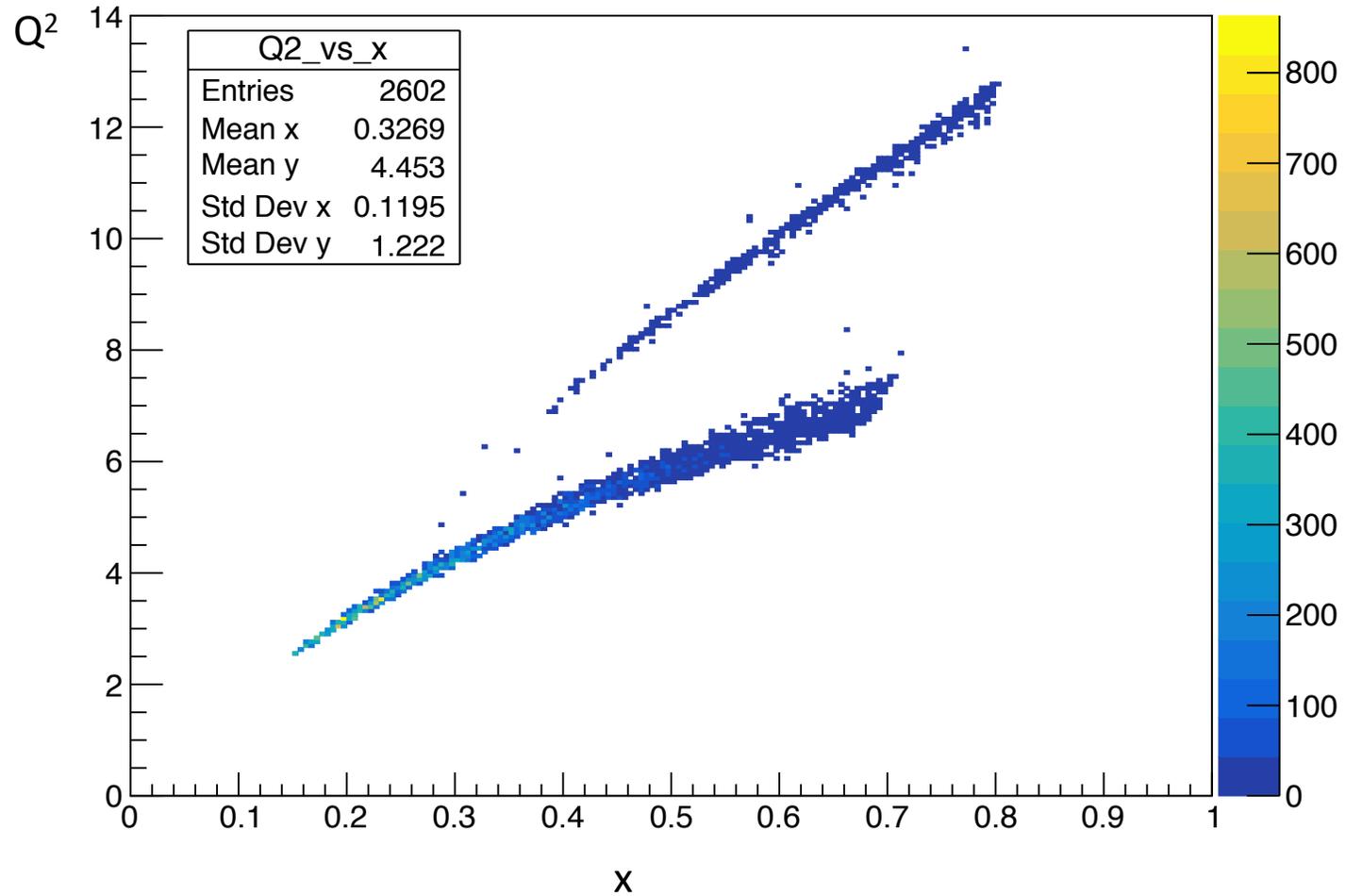


Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target



Event loss due to GEM size

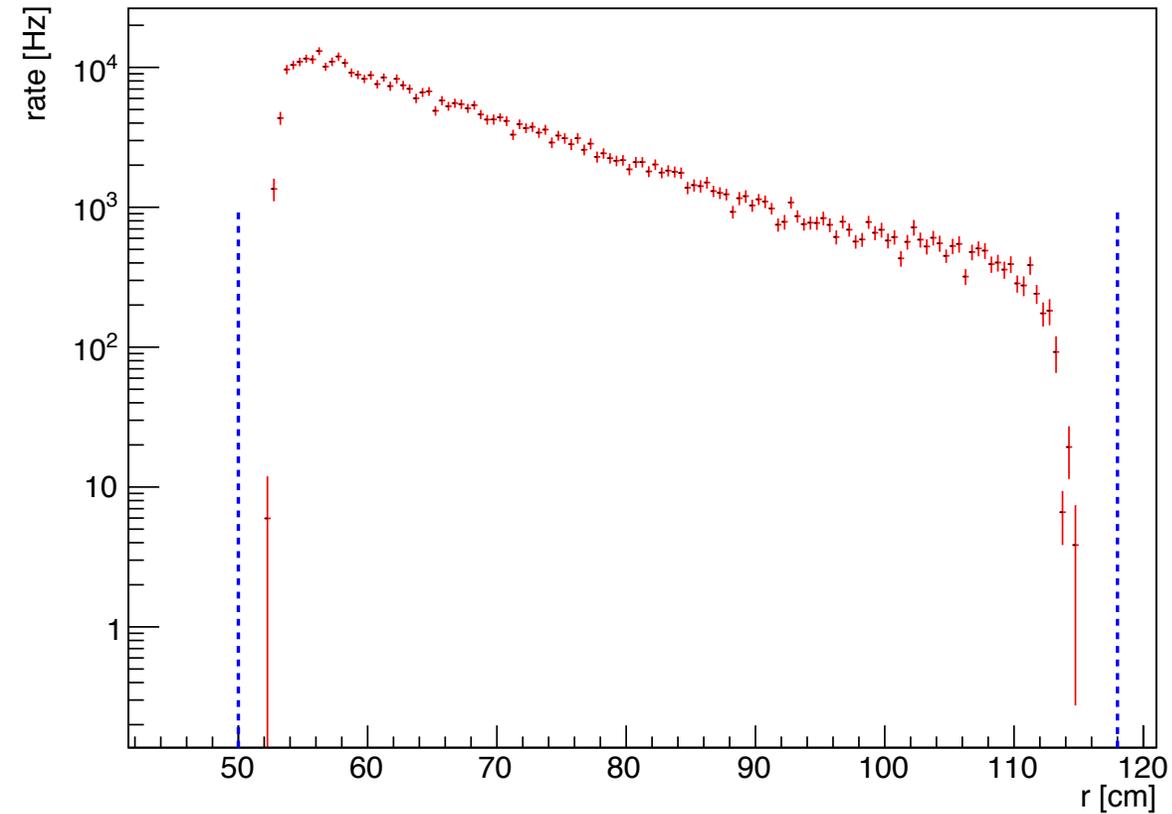
Q2_vs_x



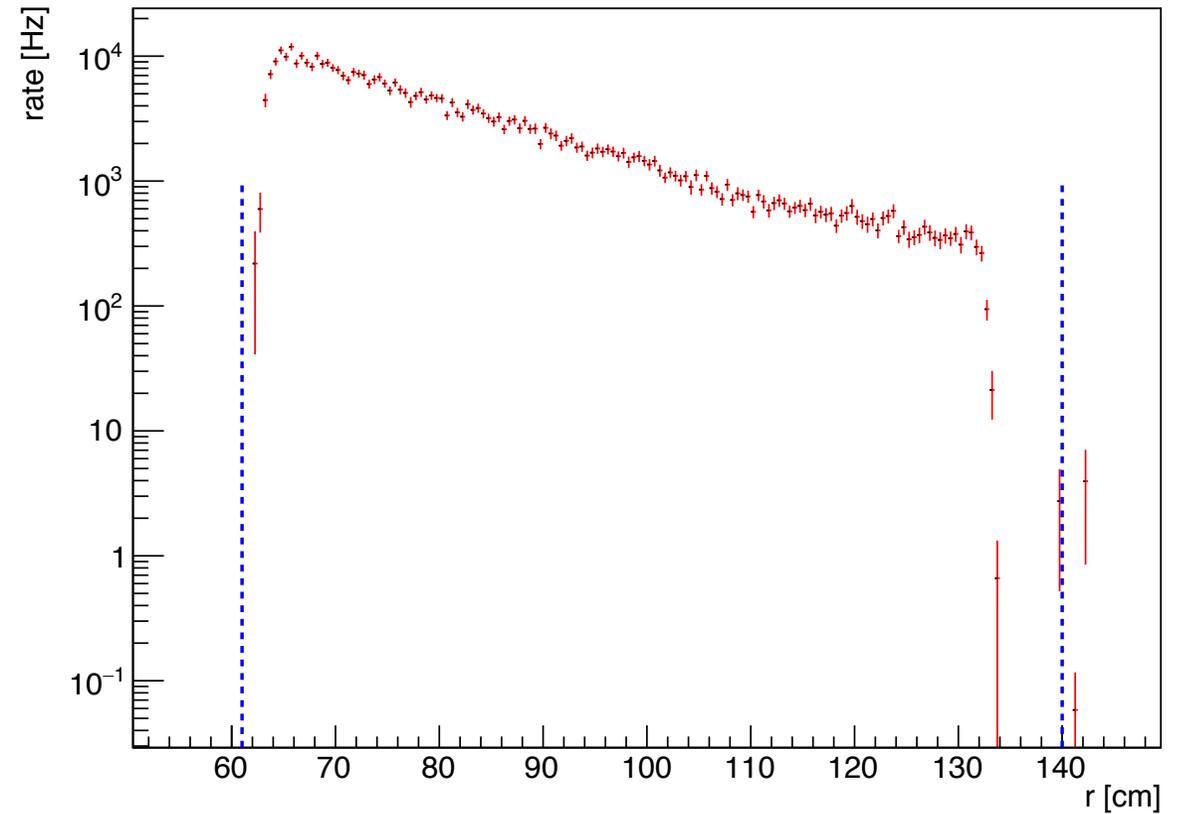
GEM size

- Red histogram: r coordinate of hit on GEM, that satisfy $W > 2$ GeV and exist a hit on ec with tid = 1 and $110 \text{ cm} < r < 270 \text{ cm}$
- Blue dash line: size of GEM according to pcdr

hit_r_gem_ec_required_1



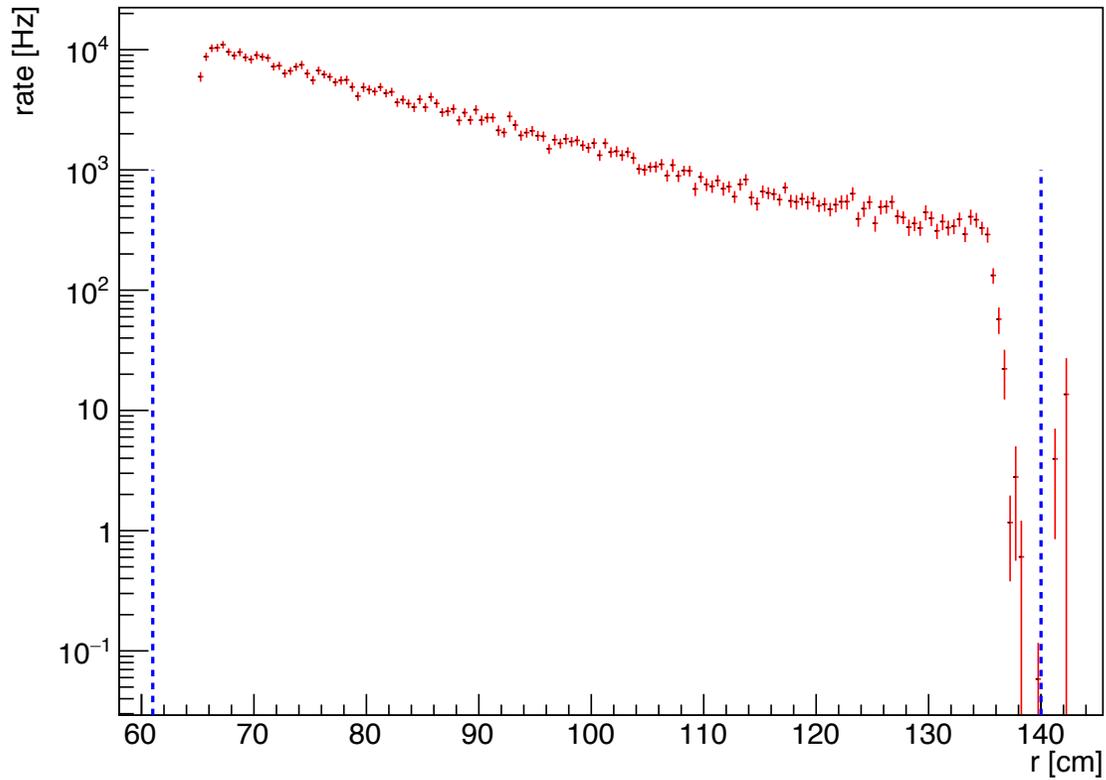
hit_r_gem_ec_required_2



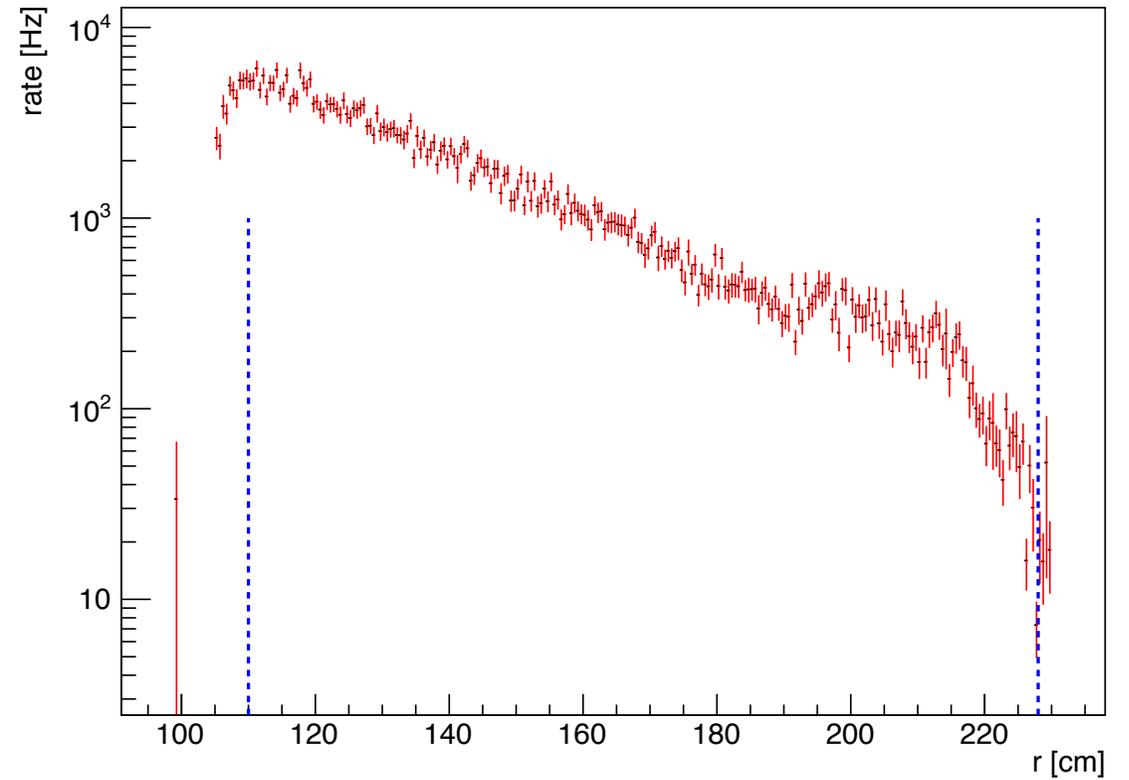
GEM size

- Red histogram: r coordinate of hit on GEM, that satisfy $W > 2$ GeV and exist a hit on ec with tid = 1 and $110 \text{ cm} < r < 270 \text{ cm}$
- Blue dash line: size of GEM according to pcdr

hit_r_gem_ec_required_3



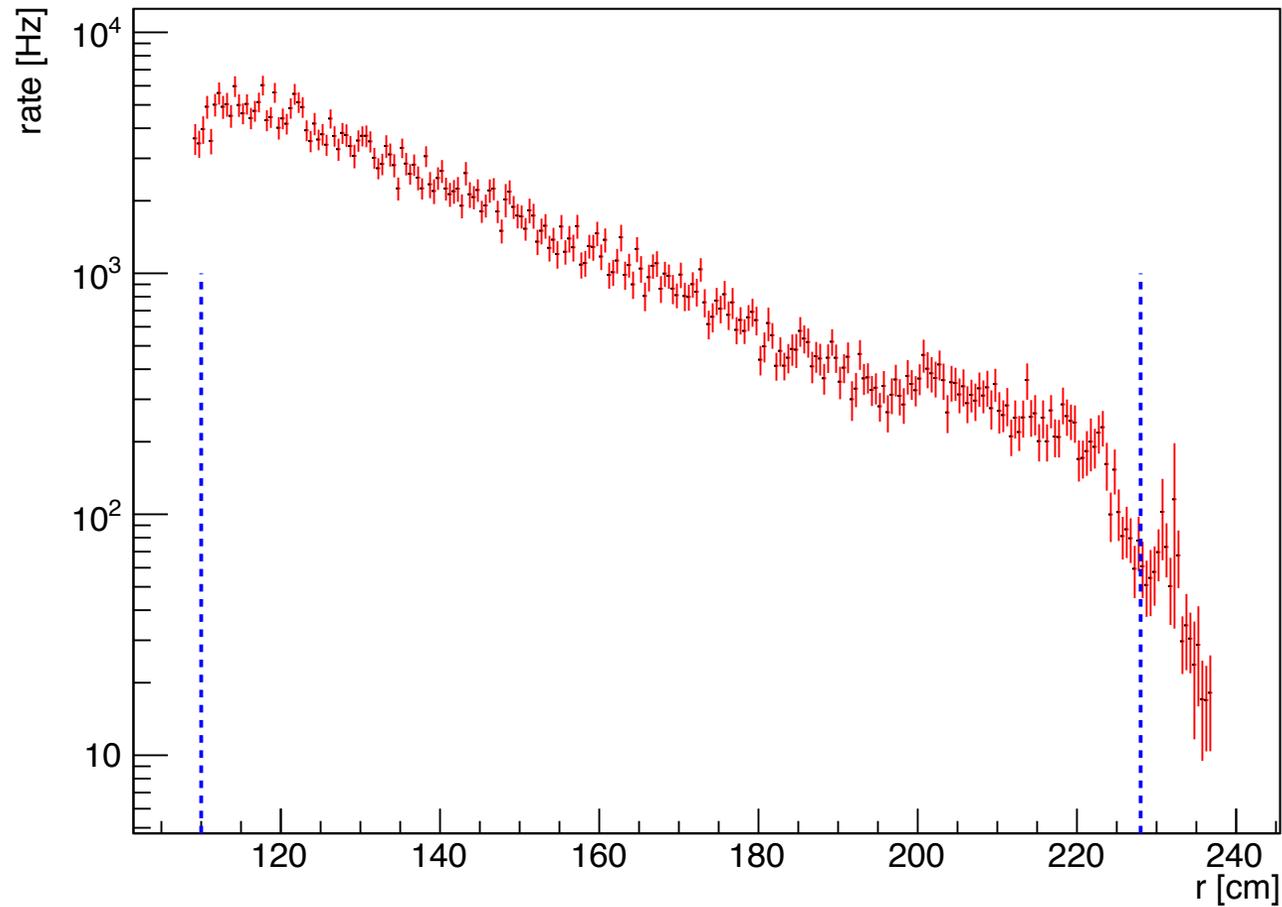
hit_r_gem_ec_required_4



GEM size

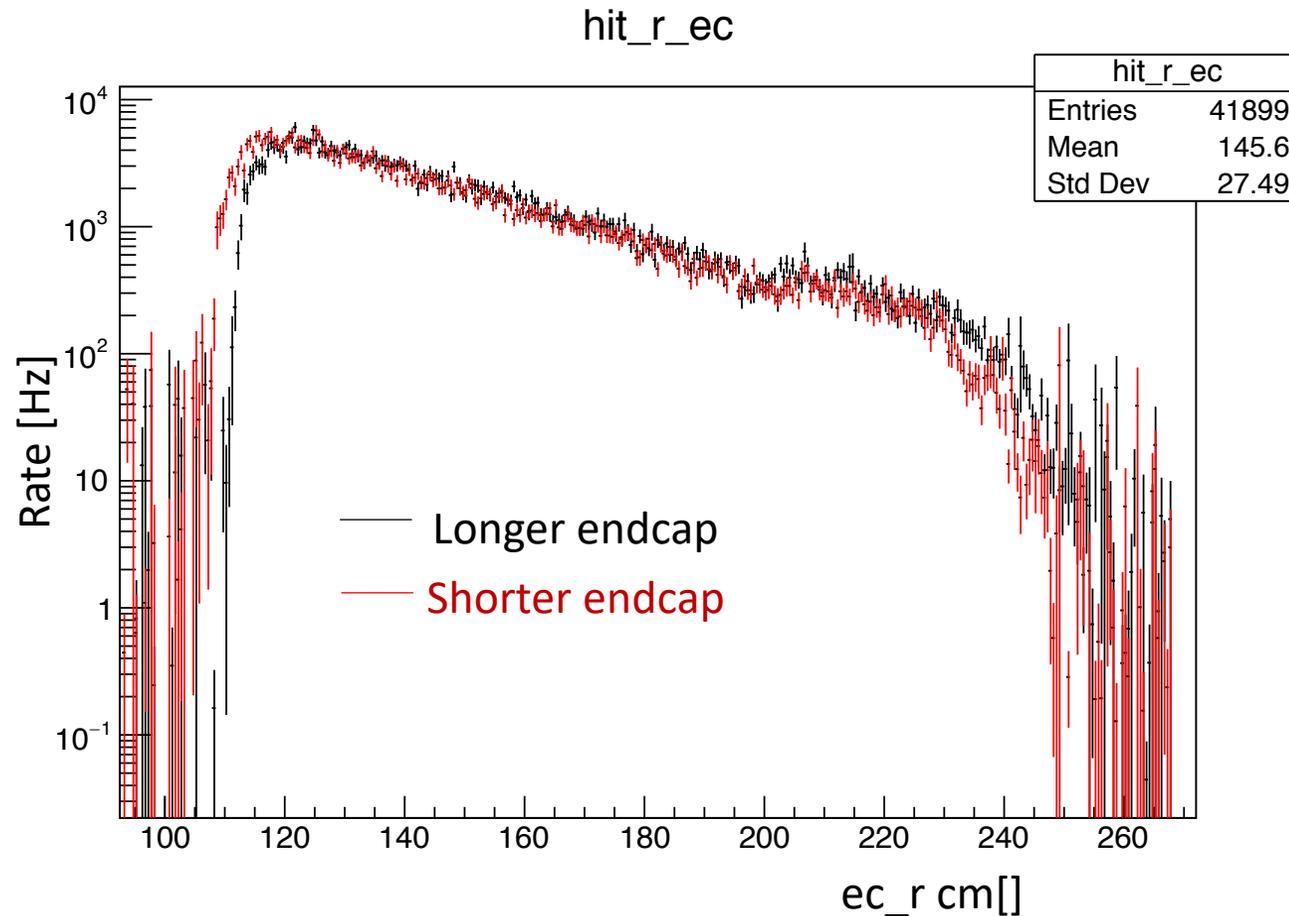
- Red histogram: r coordinate of hit on GEM, that satisfy $W > 2$ GeV and exist a hit on ec with tid = 1 and $110 \text{ cm} < r < 270 \text{ cm}$
- Blue dash line: size of GEM according to pcdr

hit_r_gem_ec_required_5



PVDIS setup with longer endcap

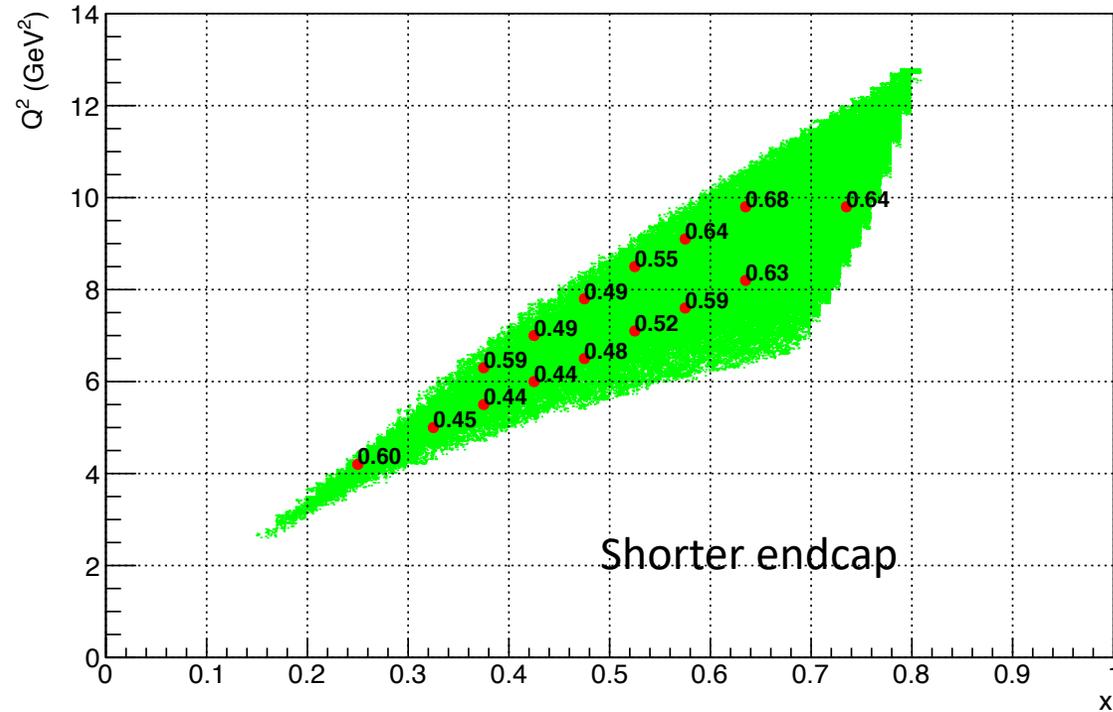
- Upstream GEMs remain at the same location
- Downstream GEMs and EC shifted downstream



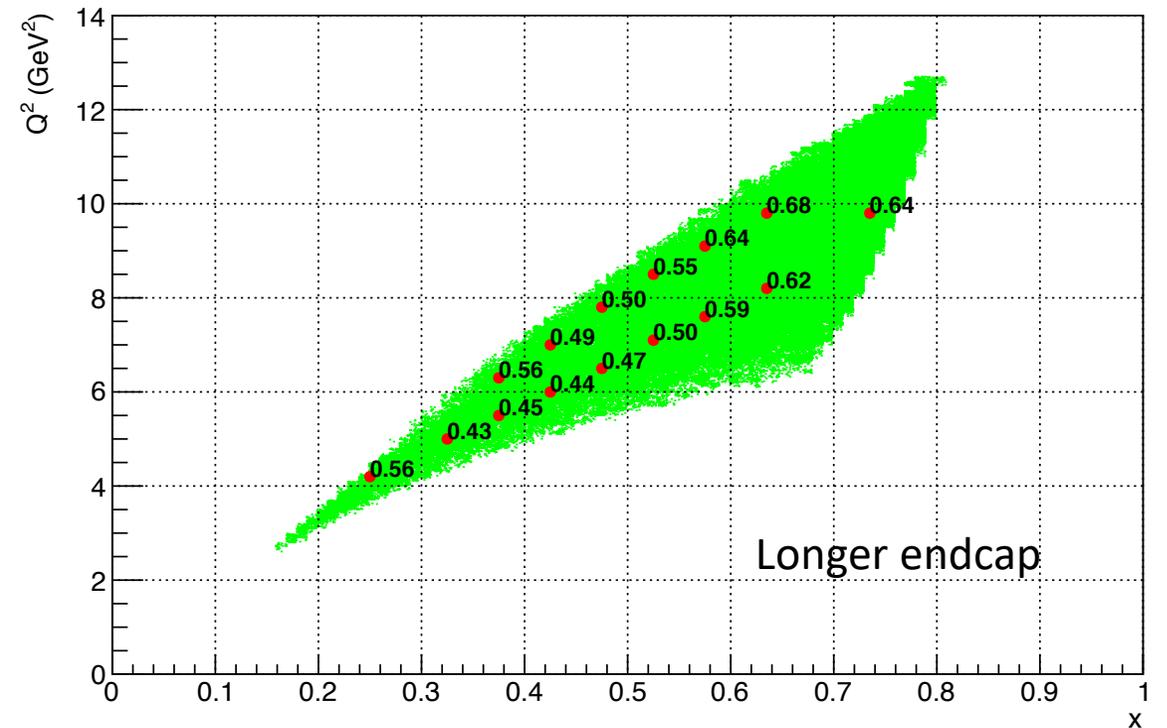
PVDIS FOM comparison for longer endcap

- Requiring $W > 2$ GeV and exist a hit on ec with $\text{tid} = 1$ and $110 \text{ cm} < r < 270 \text{ cm}$, and the latest ec trigger curve (from the shorter endcap version)
- No GEM size requirement

Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target



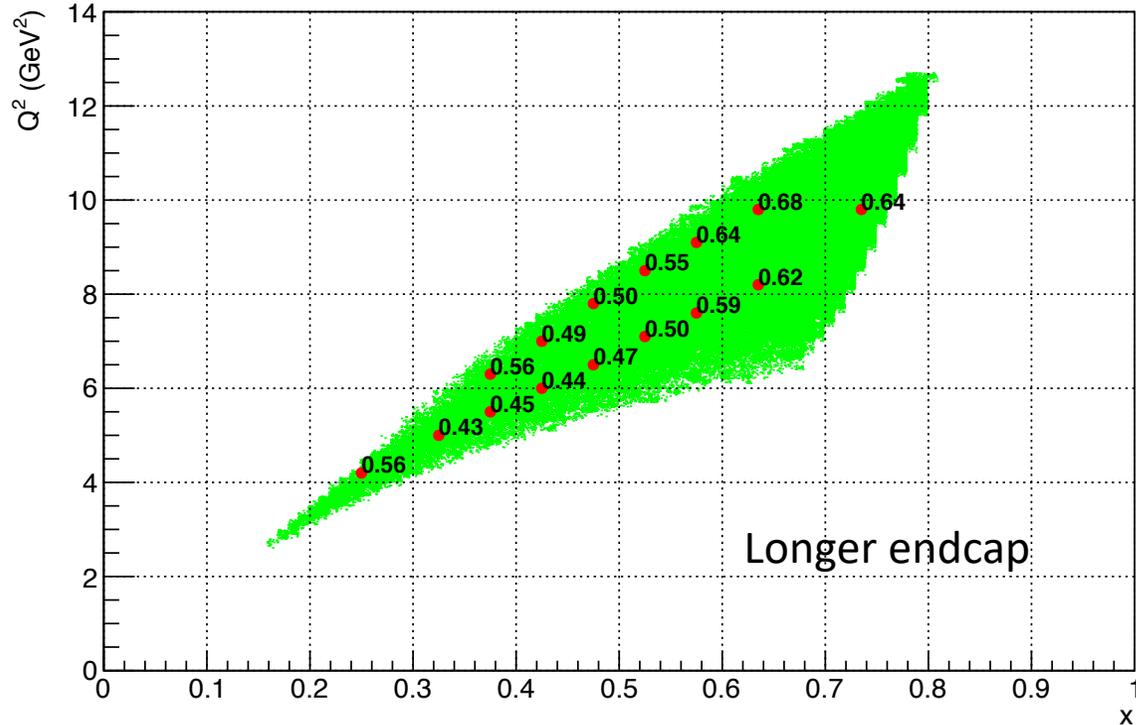
Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target



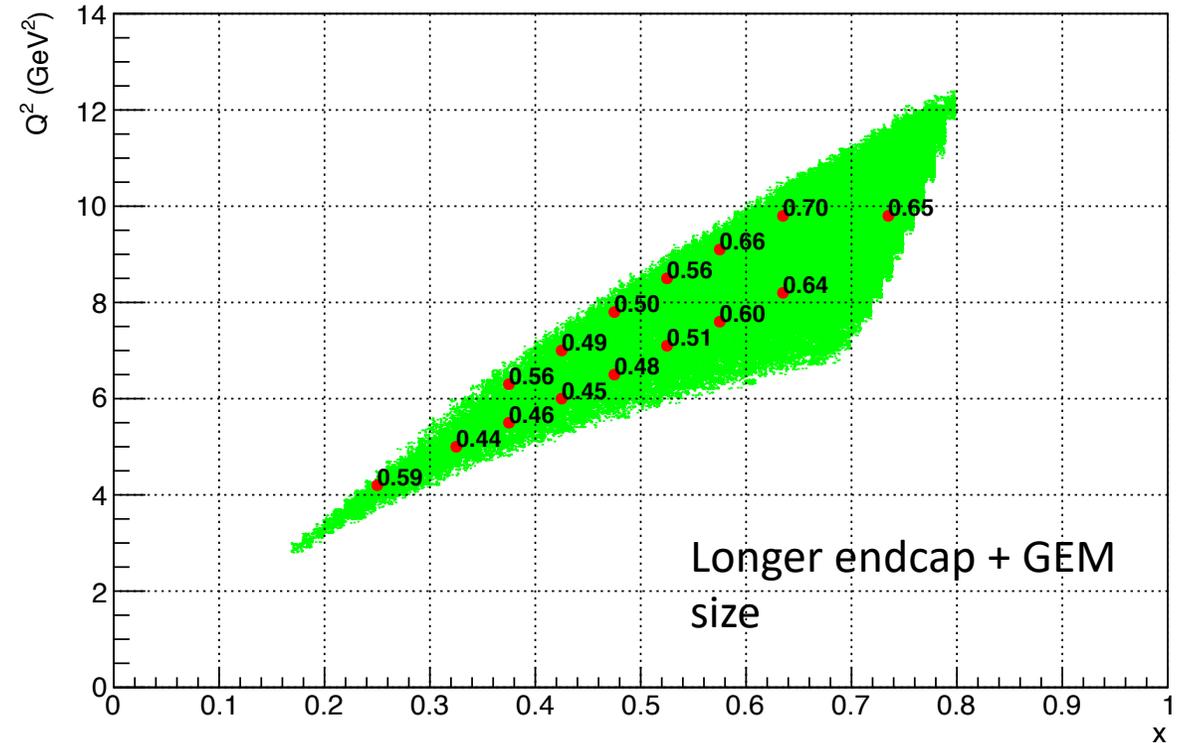
PVDIS FOM comparison for longer endcap

- Left: Requiring $W > 2$ GeV and exist a hit on ec with $\text{tid} = 1$ and $110 \text{ cm} < r < 270 \text{ cm}$, and the latest ec trigger curve (from the shorter endcap version)
- Right: in addition, require the track hit all 5 GEMs

Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target

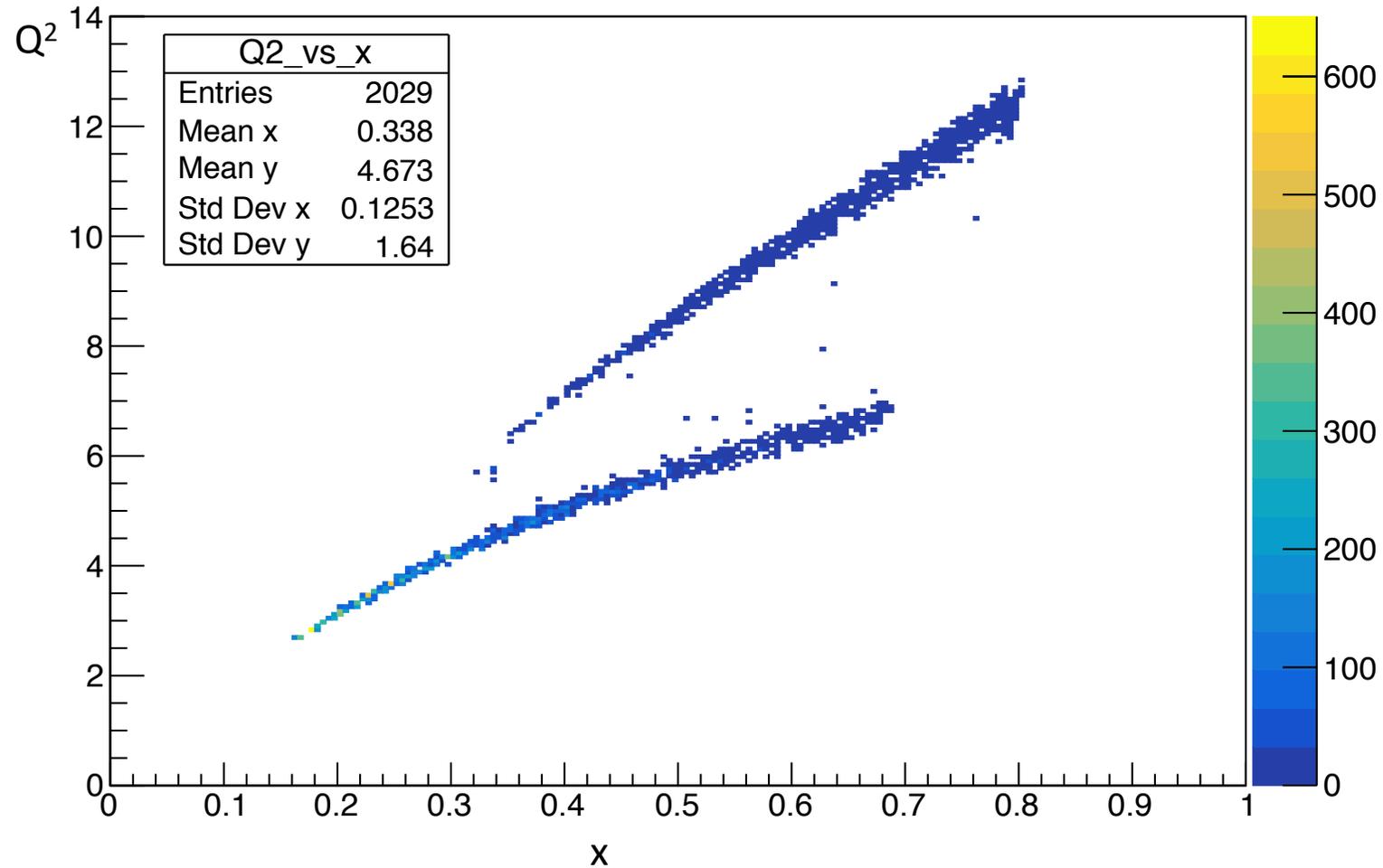


Asymmetry Uncertainty (%) with 120 days of 85% polarized 50uA electron beam on 40cm LD2 target



Event loss due to GEM size

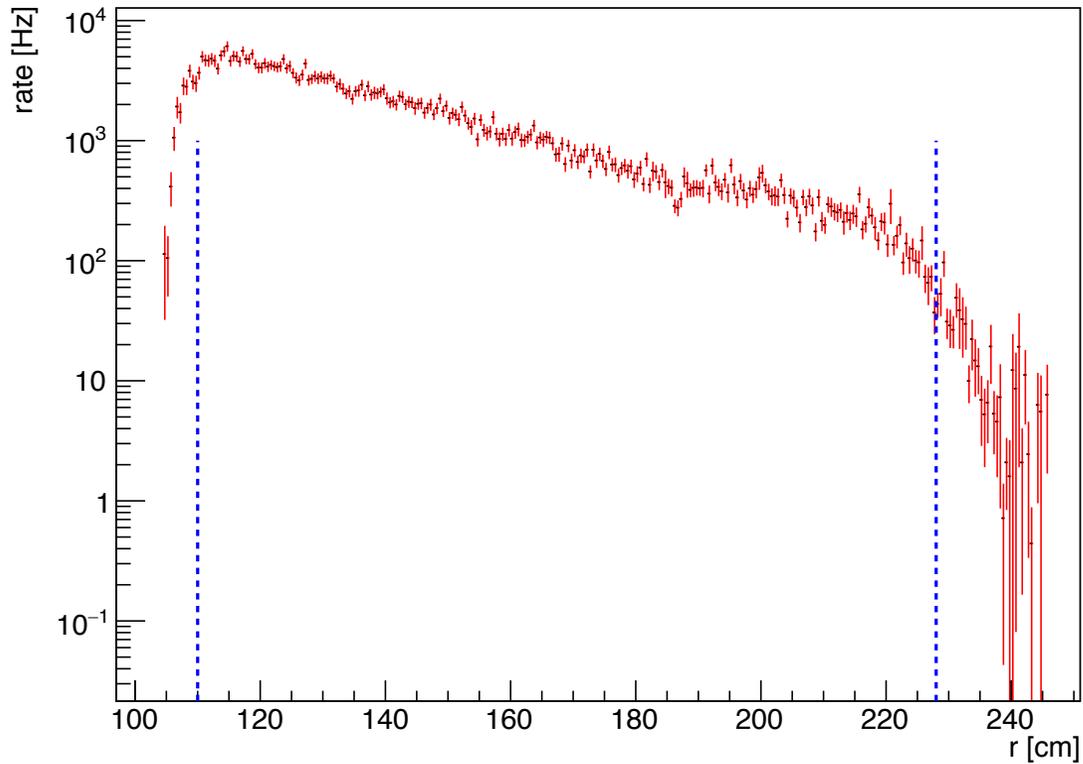
Q2_vs_x



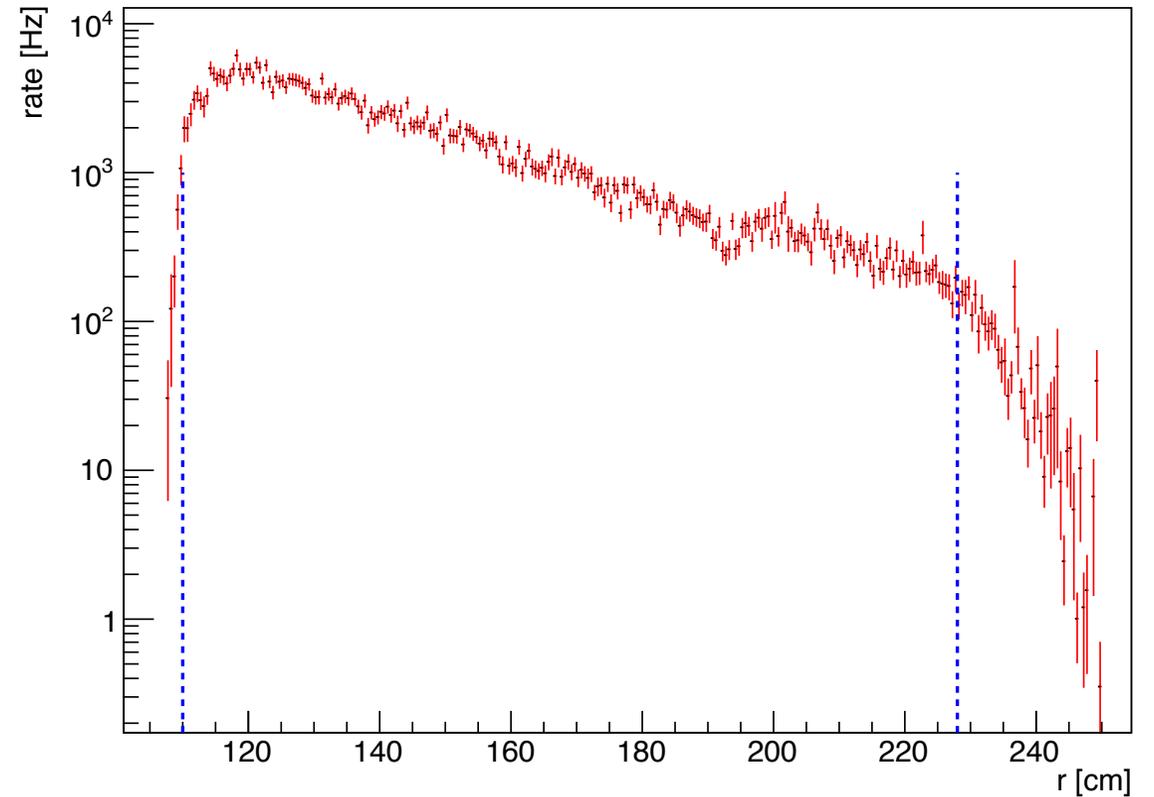
GEM size

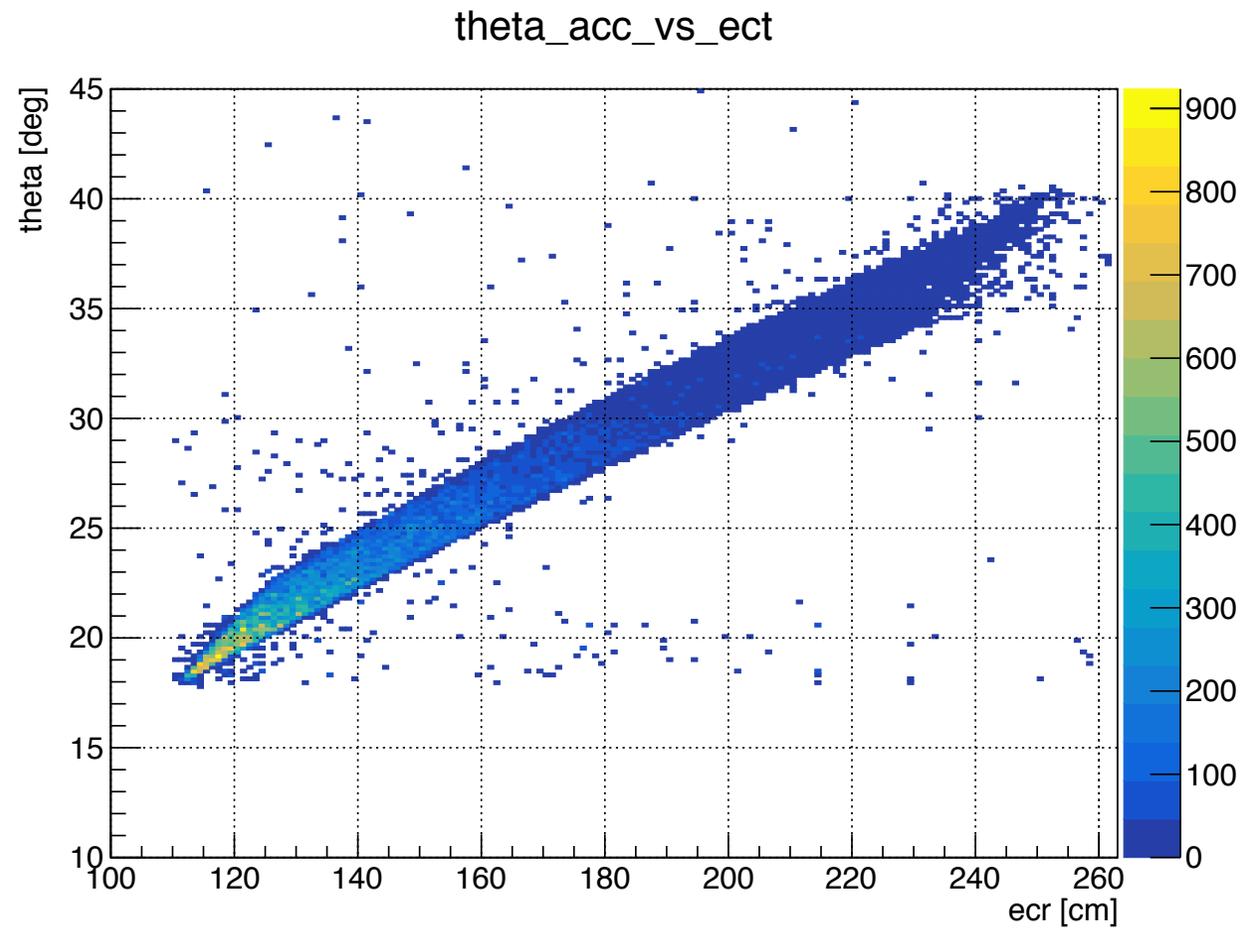
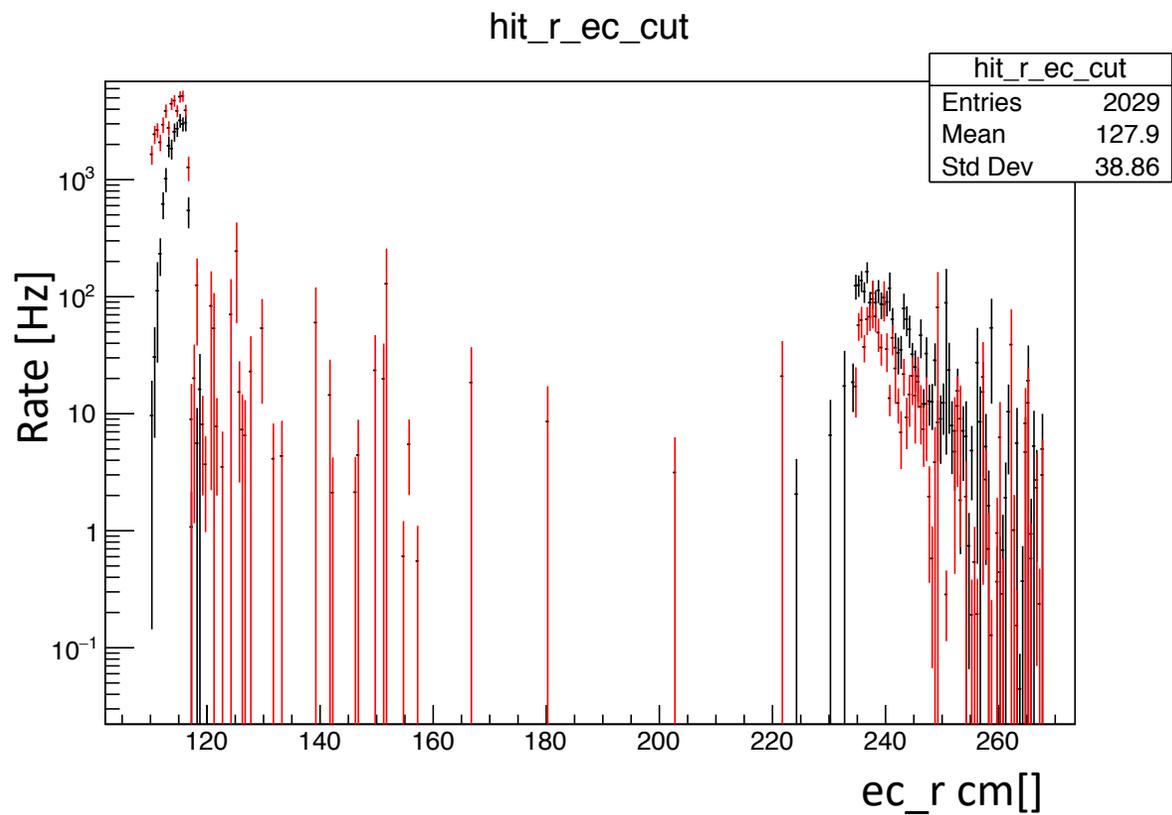
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- Blue dash line: size of GEM according to pcdr

hit_r_gem_ec_required_4



hit_r_gem_ec_required_5





Recommended GEM size

- Assuming EC works up to $r = 250$ cm, beyond that point, events are mostly due to multiple scattering
- Its better not to decrease the minimum radius significantly, unless we can turn off the HV of those areas. Otherwise they are only catching background
- R maximum will depend on the performance of EC

	R MIN [cm]	R MAX [cm]
GEM 1	51	115
GEM 2	61	135
GEM 3	63	138
GEM 4	104	237
GEM 5	107	244

Conclusion

- Seems like the down stream GEMs are a bit smaller than needed, do we want to increase their size? Are the events other side of GEM have physics interests? Do we have enough trigger efficiency on EC in those region?
- Change the large radius of a chamber will increase the channel number, change the small radius will not (just change strip length)
- If the small radius is too much smaller than needed, it will just collect more background