SoLID Baffle and Background Update

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UVa

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PVDIS challenge

- High luminosity ($1.27e^{39}$/cm2/s for 50uA on 40cm LD2 target) causes high rate and high energy dose on detectors
- Baffle shields low energy EM photons directly from target while low energy electrons are bent away by field
- Most interesting physics at high Q2 and high x needs DIS electrons with highest energy which bend least and fly like photons, so comprise is needed
- Positive pions contribute in background at trigger level and are better to be suppressed

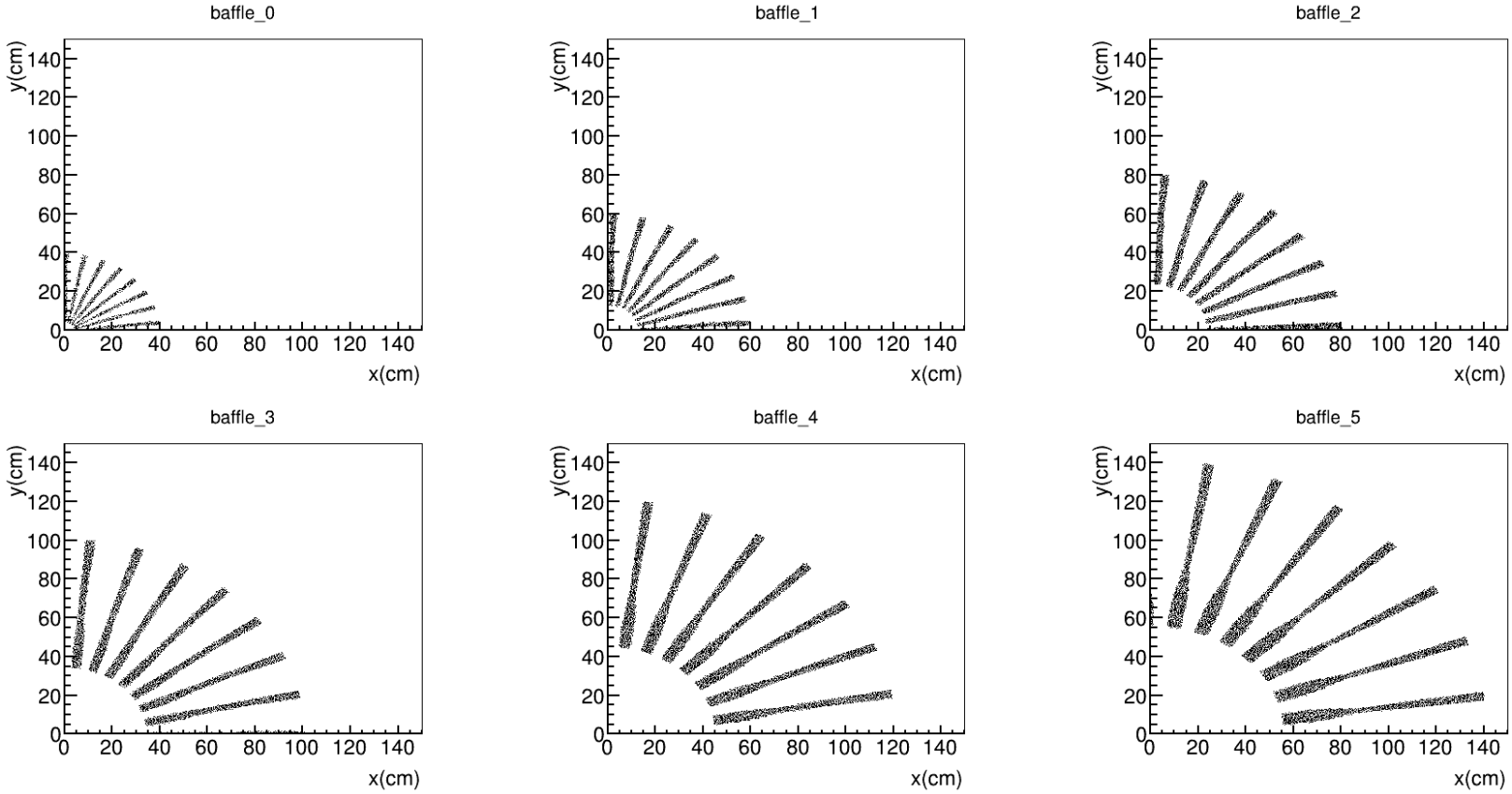
Design Condition

- SoLID latest CLEOv8 field map
- 30 sectors with each sector covering 12 deg
- each plate is 9cm thick lead
- Z (40, 68, 96, 124, 152, 180) cm
  - no overlap with current setup
- Rin (4.00, 12.86, 23.61, 34.36, 45.10, 55.85)cm
- Rout (39.60, 59.94, 80.28, 100.63, 120.97, 141.31)cm
  - Optimized for polar angle 21-36 deg acceptance of full 40cm long target with center at 10cm, except the first baffle inner radius needs to be at 4cm instead of 2cm to avoid more EM background

Current Baffle

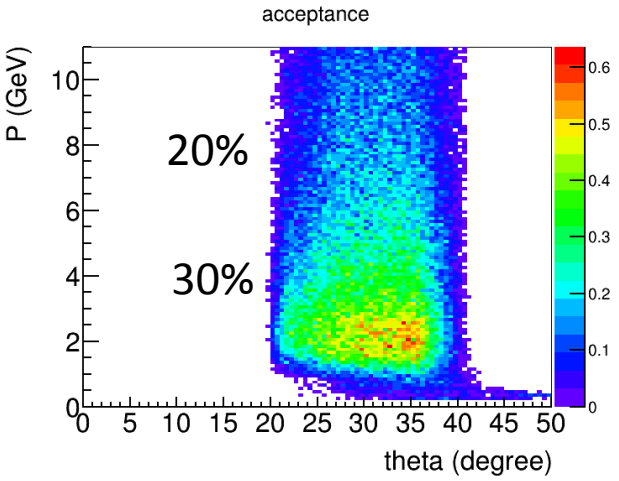
(Smaller Z baffle cut inner)

- Continue with Seamus's approach, but take all design conditions into account
  - refer to
    - https://hallaweb.jlab.org/wiki/index.php/Baffle_Design
    - https://hallaweb.jlab.org/wiki/index.php/Solid_design_FOM

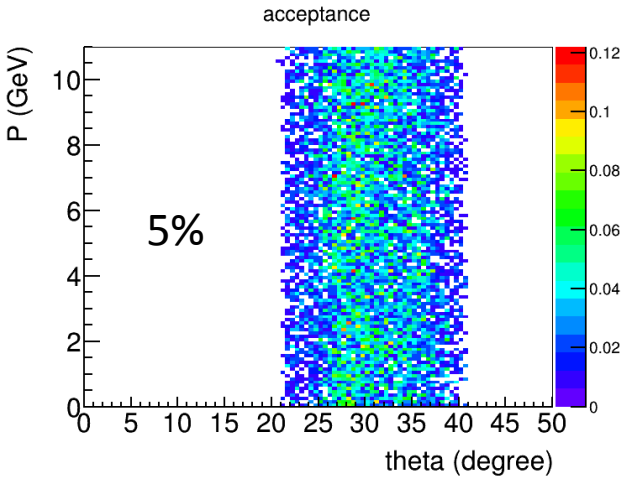


General acceptance

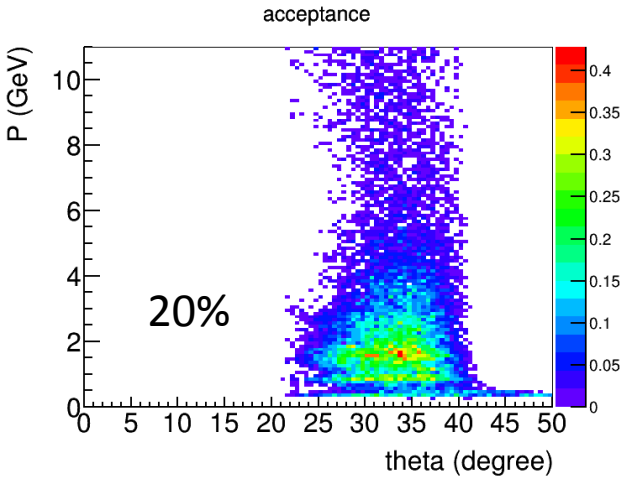
negative



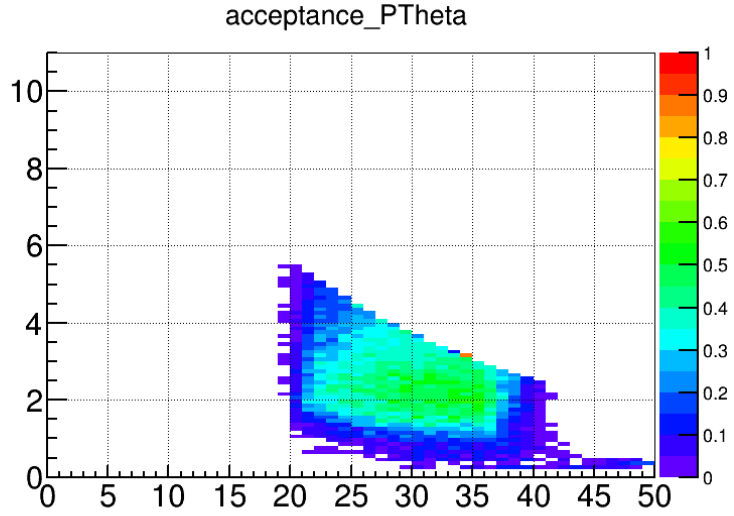
neutral

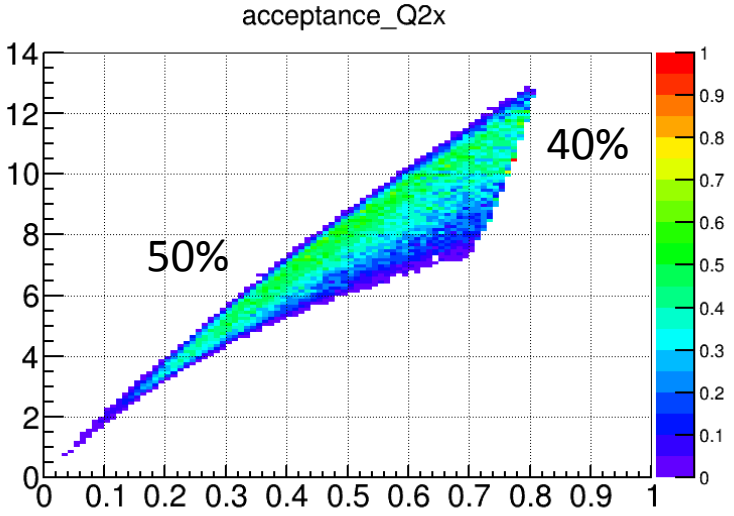


positive



eDIS acceptance





Apv Error

- 50uA 85% polarized 11GeV beam on 40cm LD2 for 120 days
- Trigger at 2GeV

BaBar field and baffle, from proposal

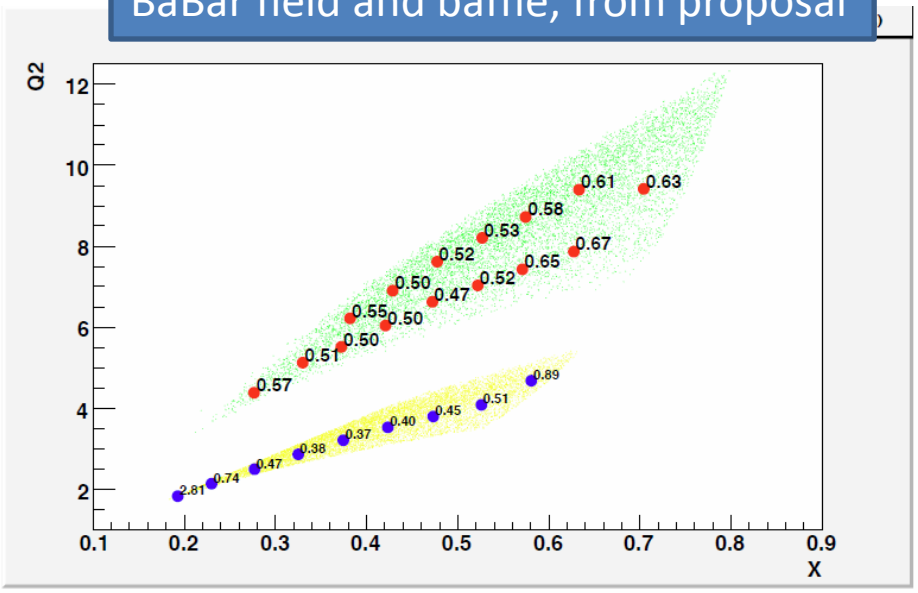
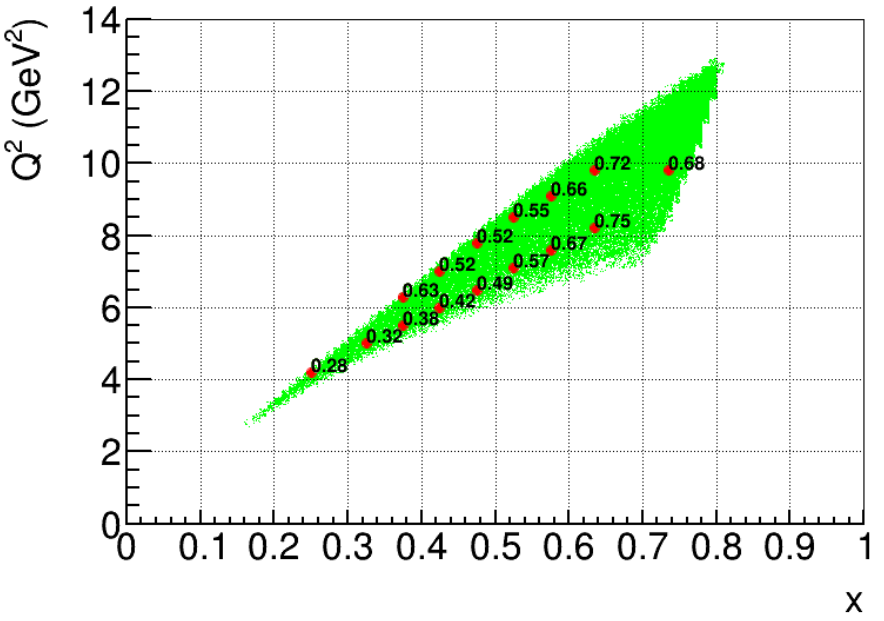


Figure 4: Anticipated statistical precision for Solid

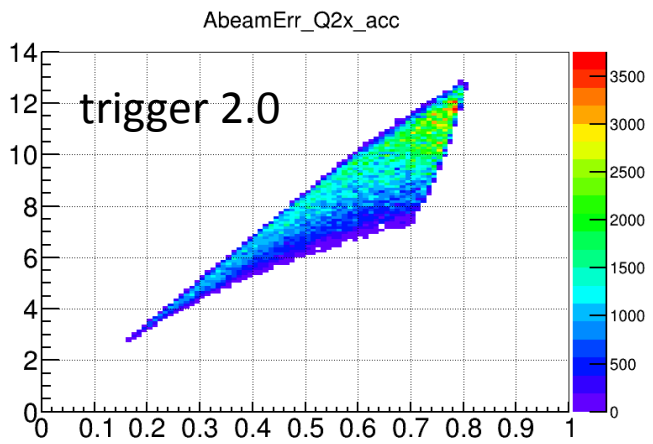
CLEO field and baffle, from proposal

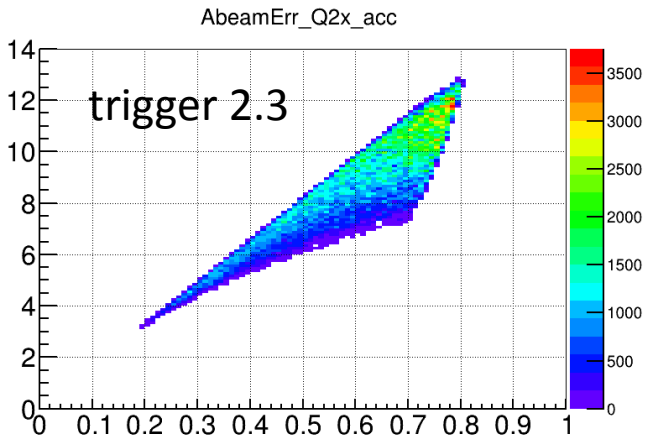


Trigger effect

ApvErr	trigger (GeV)
0.17,0.24,0.36,0.38,0.42,0.39,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67	0.0
0.20,0.26,0.36,0.40,0.42,0.40,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67	1.5
0.27,0.31,0.37,0.62,0.45,0.51,0.48,0.51,0.56,0.54,0.66,0.65,0.75,0.70,0.67	2.0
0.38,0.37,0.39,0.96,0.42,0.74,0.48,0.65,0.56,0.65,0.66,0.75,0.75,0.74,0.67	2.3
0.53,0.43,0.43,1.46,0.44,1.03,0.48,0.86,0.56,0.80,0.66,0.89,0.75,0.83,0.69	2.5
2.13,0.84,0.63,0.00,0.56,9.22,0.56,2.83,0.60,2.14,0.68,1.97,0.75,1.40,0.81	3.0

ApvErr at large Q2 and large x starts to increase if trigger > 2GeV

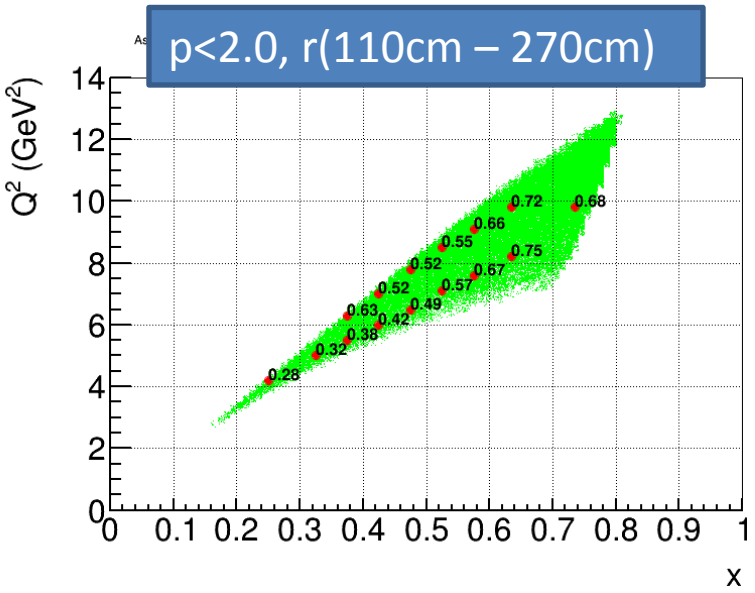


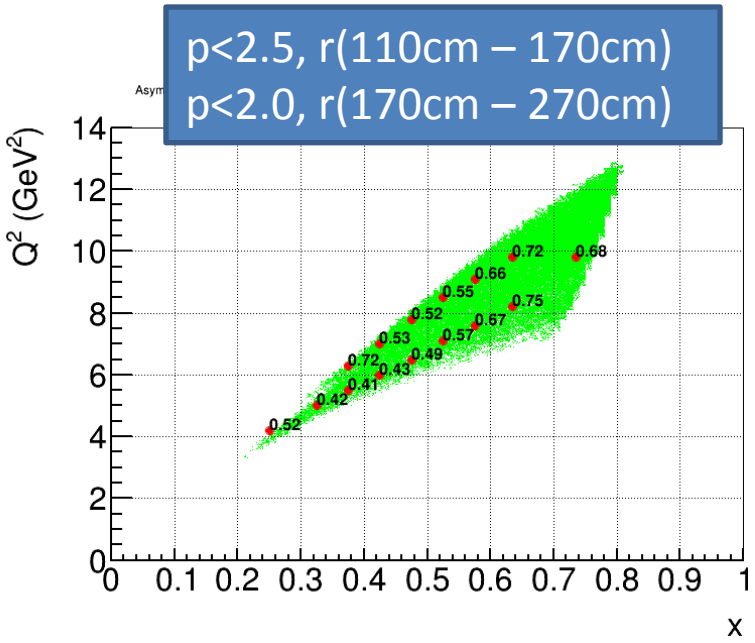


Trigger effect

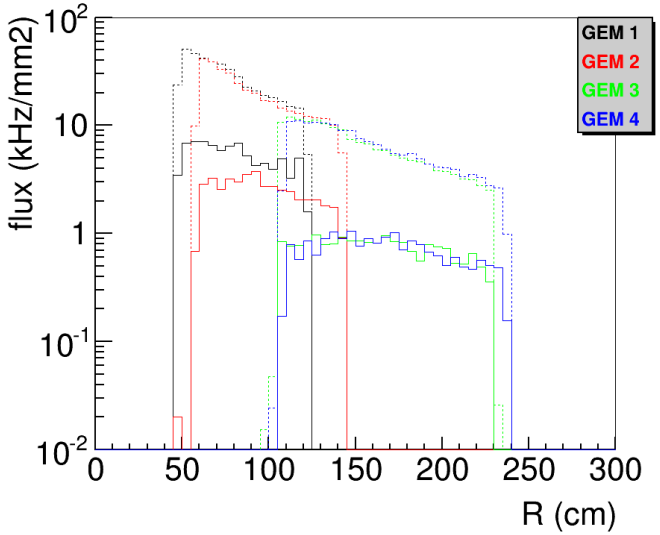
ApvErr	trigger (GeV)
0.28,0.32,0.38,0.63,0.42,0.52,0.49,0.52,0.57,0.55,0.67,0.66,0.75,0.72,0.68	p<2.0, r(110cm – 270cm)
1.90,0.58,0.44,0.72,0.43,0.53,0.49,0.52,0.57,0.55,0.67,0.66,0.75,0.72,0.68	p<3.0, r(110cm – 140cm) p<2.5 ,r(140cm – 170cm) p<2.0, r (170cm – 270cm)
0.52,0.42,0.41,0.72,0.43,0.53,0.49,0.52,0.57,0.55,0.67,0.66,0.75,0.72,0.68	p<2.5, r(110cm – 170cm) p<2.0, r(170cm – 270cm)

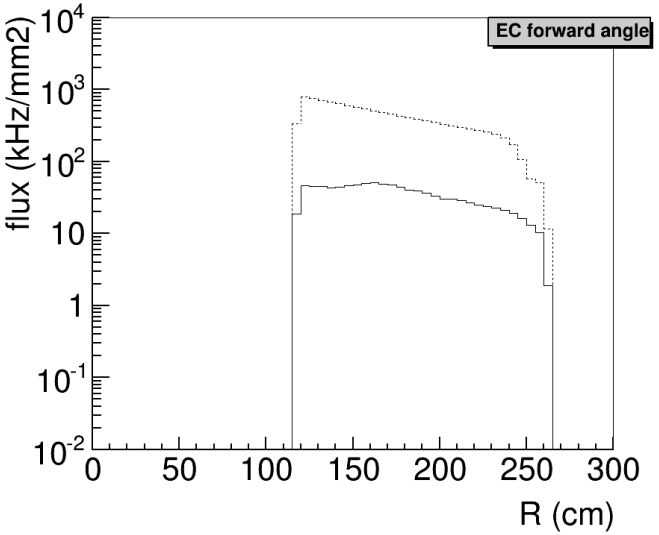
This could an option for trigger

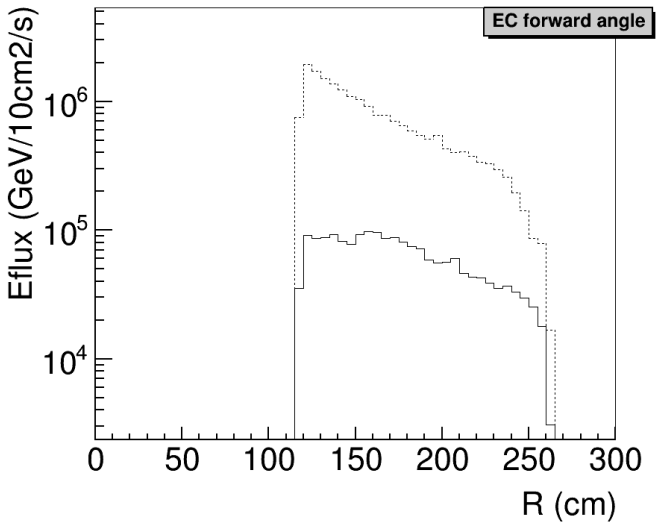




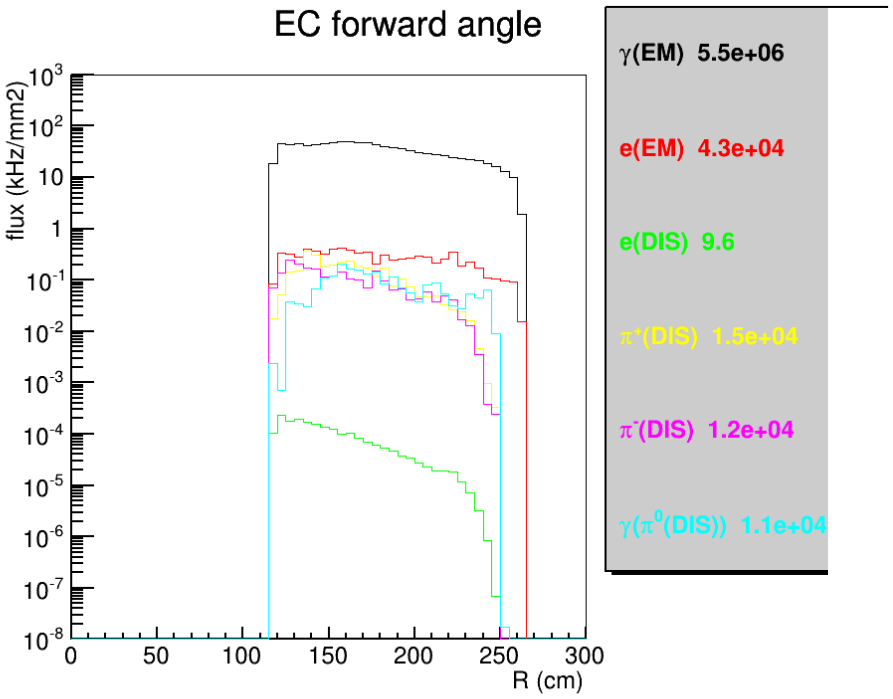
Background, baffle effect

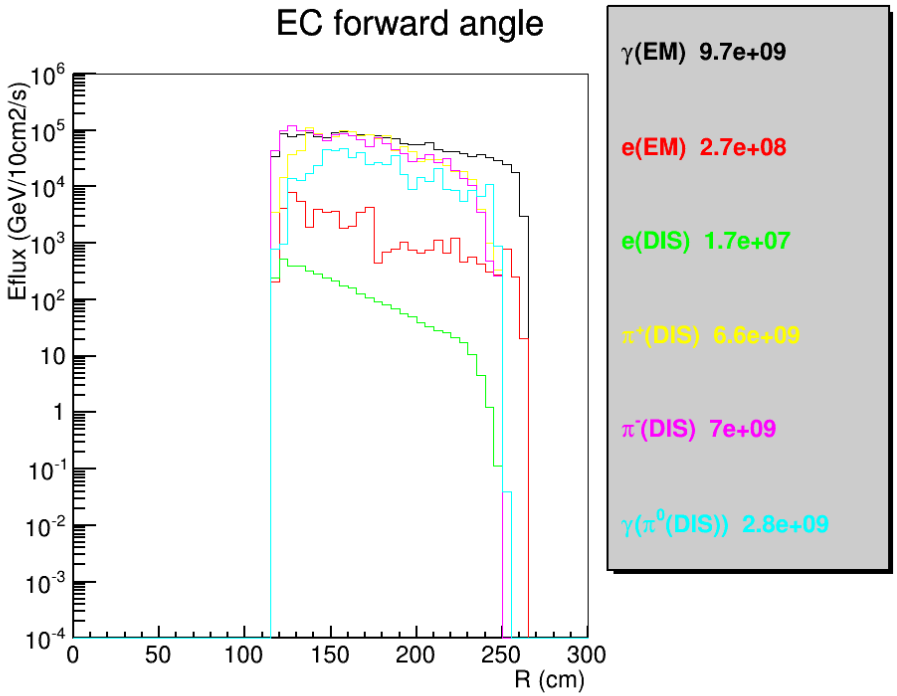




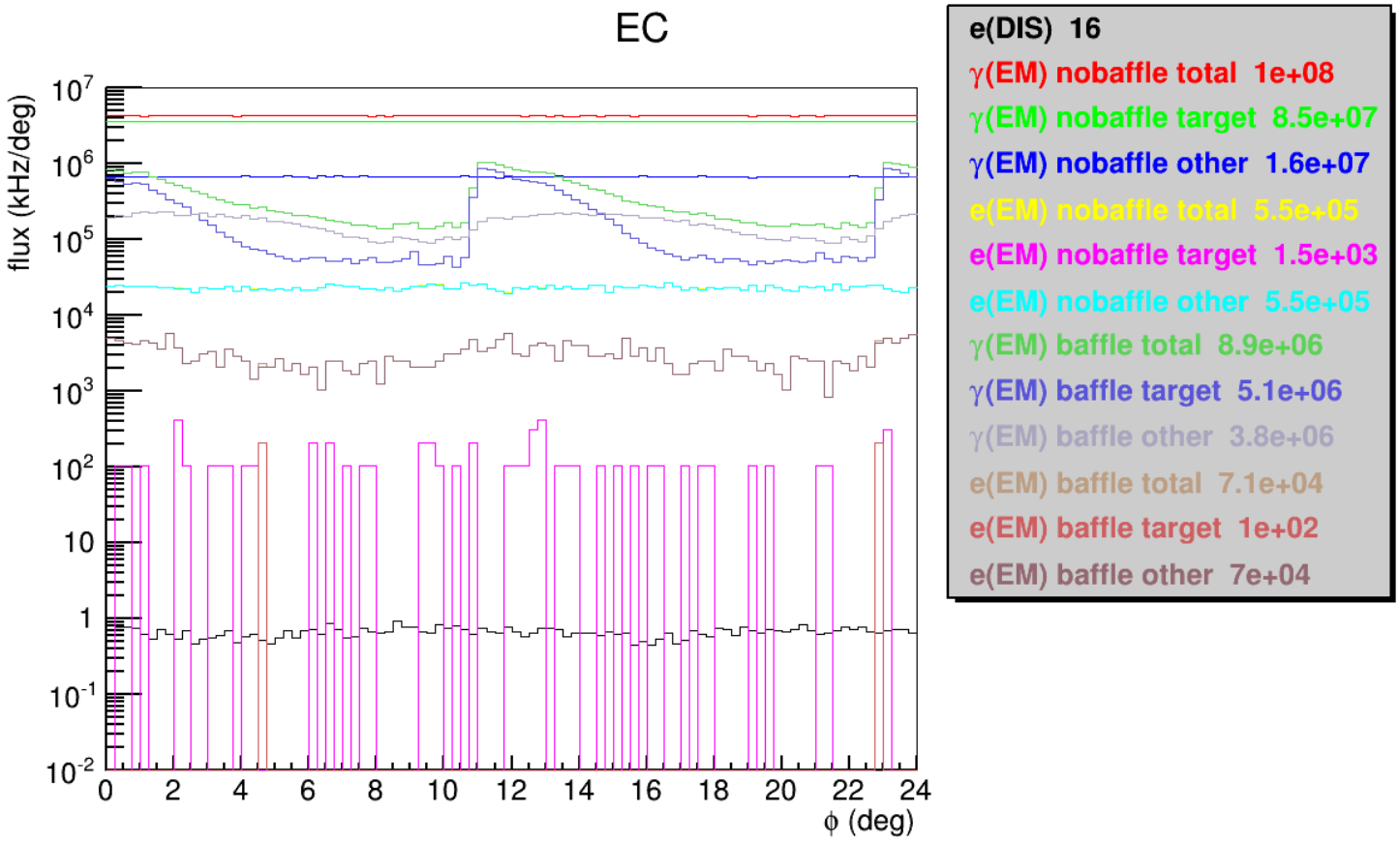


Hit on EC in R(physics+background)





Hit on EC in Phi(physics+background)



GEM geometry

PVDIS GEM

id	Z (cm)	PVDIS target center		PVDIS target full	
		R range (cm)	Area (m2)	R range (cm)	Area (m2)
1	157.5	56-107	2.6116	48-122	3.9521
2	185.5	67-128	3.7369	59-143	5.3307
3	306	113-215	10.5105	105-230	13.1554
4	315	117-222	11.1824	109-237	13.9135
total			28.0414		36.3517

- CLEO coil center at 0.
- PVDIS 40cm long target with center at 10cm
- PVDIS angle 21-36 degree
- Considering the CLEO baffle, plane 1 and 2 are directly behind baffle and only need partial coverage (70-80%?), plane 3 and 4 are between Cherenkov and EC and need full coverage
- To cover full target, GEM needs to increase by 30%

SIDIS/JPsi GEM

id	Z (cm)	SIDIS target center		SIDIS target full		JPsi target center			
		R range (cm)	Area (m2)	R range (cm)	Area (m2)	R range needed (cm)	Area needed (m2)	Area addition to "SIDIS target center" (m2)	Area addition to "SIDIS target full" (m2)
1	-175	46-78	1.2466	41-87	1.8498	36-67	1.0031	0.2576	0.1210
2	-150	26-91	2.3892	23-98	2.8510	21-80	1.8720	0.0738	0.0276
3	-119	30-103	3.0502	27-112	3.7118	25-97	2.7595	0.0864	0.0327
4	-68	37-126	4.5575	34-135	5.3624	32-123	4.4312	0.1084	0.0415
5	5	46-95	2.1705	44-100	2.5334	42-90	1.9905	0.1106	0.0540
6	92	58-118	3.3175	55-123	3.8026	55-115	3.2044	0.1065	0.0000
total			16.7315		20.1110		15.2607	0.7433 (4.5%)	0.2768 (1.4%)

- CLEO coil center at 0.
- Plane (1,2,3,4) cover large angle and plane (2,3,4,5,6) cover forward angle
- SIDIS 40cm long target with center at -350cm, SIDIS angle 7.5-14.85-24 degree
- JPsi 15cm long target with center at -300cm tentatively, JPsi angle 8- 16.28-28 degree
- Jpsi coverage is only optimized by target center as it's length is smaller
- GEM size determined by "Jpsi target center" inner and "SIDIS target full" outer
- PVDIS has more than enough GEM for SIDIS/JPsi to cover full target

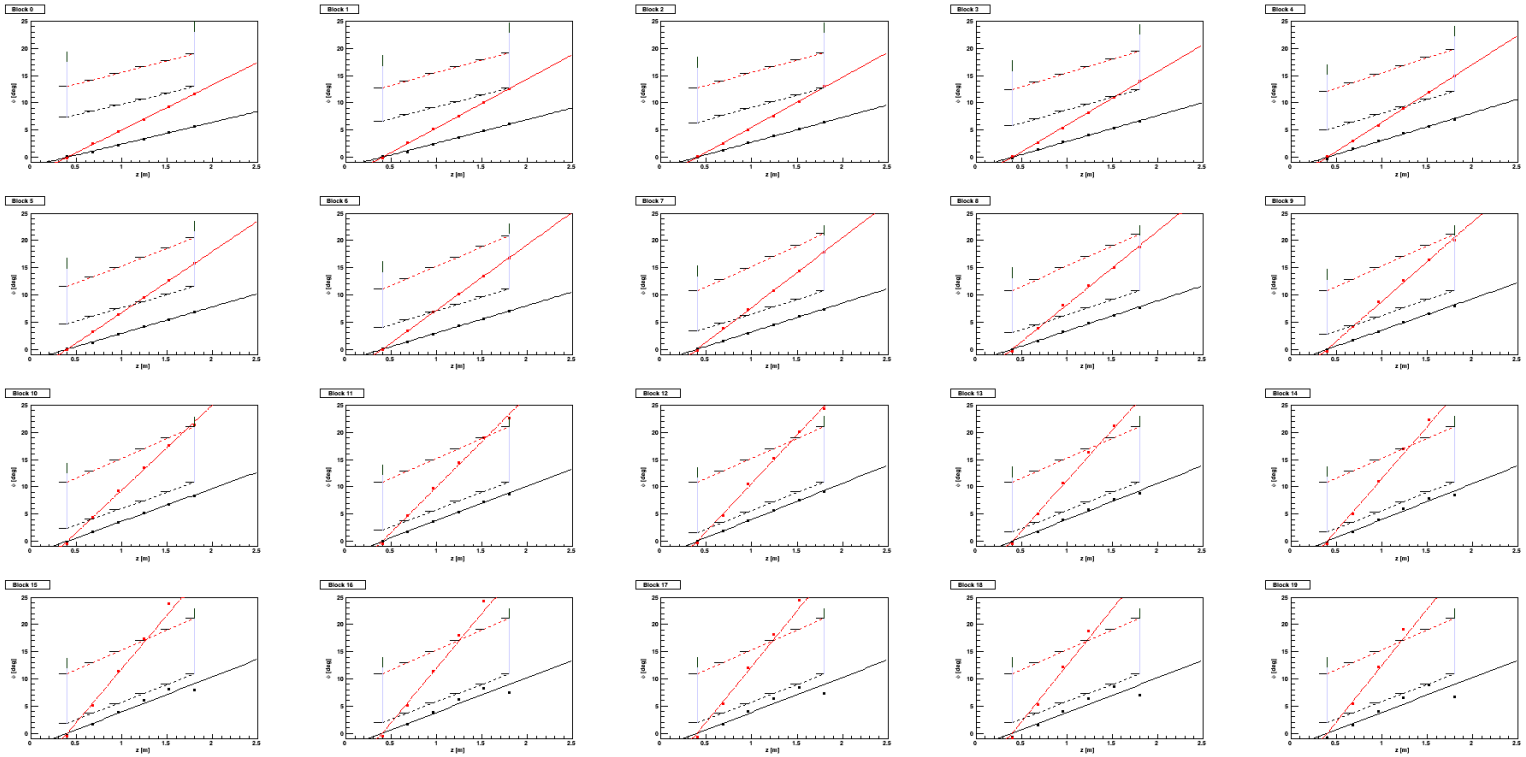
backup

Design Detail

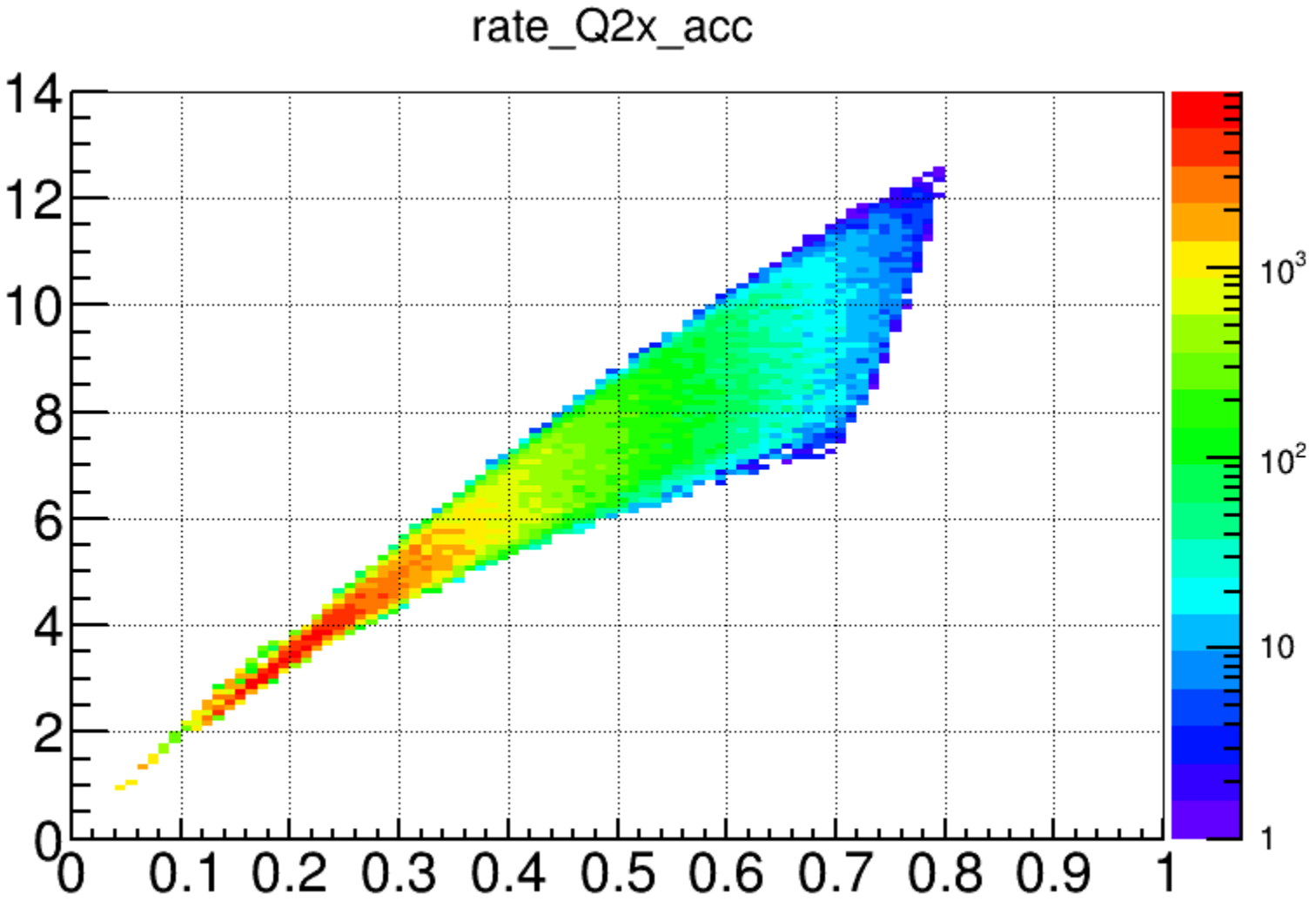
- Common
  - use SoLID CLEOv8 field map
  - 30 sectors with each sector covering 12 deg
  - Still each plate is 9cm thick of lead
  - SCALE MIN=1.4, MAX=1.4, LASTBAF=0. in makebaf5.C
- Larger Z baffle only
  - Z (40, 70, 100, 130, 160, 190) cm
    - overlap with Cherenkov and leaves no room for GEM
  - Rin (3.90, 15.30, 26.60, 37.90, 49.20, 61.01)cm
  - Rout (41.31, 62.32, 83.32, 104.33, 125.34, 142.00)cm
    - Not optimized for polar angle 21-36 deg acceptance of full 40cm long target with center at 10cm
- Smaller Z baffle only
  - Z (40, 68, 96, 124, 152, 180) cm
    - no overlap with current setup
  - Rin (2.11, 12.86, 23.61, 34.36, 45.10, 55.85)cm
  - Rout (39.60, 59.94, 80.28, 100.63, 120.97, 141.31)cm
    - Optimized for polar angle 21-36 deg acceptance of full 40cm long target with center at 10cm

Design approach
from larger Z baffle to smaller Z baffle

- Continue with Seamus's approach
  - In simulation, throw negative particles from target position with field, record tracks at different position
  - Then do linear fitting to figure out what kind of blocking should be at the assumed baffle plates position.
  - Output the opening (not block)
  - refer to
    - https://hallaweb.jlab.org/wiki/index.php/Baffle_Design
    - https://hallaweb.jlab.org/wiki/index.php/Solid_design_FOM
- Fix a bug of detector plane position in the input file
- Change Z, Rin, Rout to the desired values



eDIS rate


rate_Q2x_acc
14
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
10^3
10^2
10
1