PVDIS Baffles response

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Director's Review Findings and Recommendations

- (Finding) Choice of material in the baffle appears not to have been optimized. A study of the effects of different material choices that incorporate physics signals, background levels and activation of the material could provide useful information.

- (Recommendation) It should be confirmed that the baffle design, including the support structure, is optimized for background rejection and signal acceptance. Furthermore the baffle design should minimize generation of secondary backgrounds.

Material Property

	Aluminum	Iron	Copper	lead	Tungsten Powder (60% density of Tungsten)	Tungsten
Radiation length (cm)	*8.897*	*1.757*	*1.436*	*0.5612*	*0.583*	*0.3504*
Nuclear interaction length (cm)	*39.70*	*16.77*	*15.32*	*17.59*	*16.58*	*9.946*
structure	*easy*	*Easy (Stainless steel)*	*Easy (Alloy)*	*Too soft, need holder*	*Easy to mold and glue*	*Hard to machine*
Cost	*Cheap*	*Cheap*	*Cheap*	*Cheap*	*Expensive?*	*expensive*
activation	*Less*	*More?*	*Less?*	*More*	*More*	*more*

- Current baffle weights 15t if made of lead and it needs precision within 0.5cm (?)
- Conductor like Copper won't affect solenoid magnetic field as far as ramping current slowly and the baffle is not made of one piece. (briefly discussed with Paul Brindza)

Result Comparison

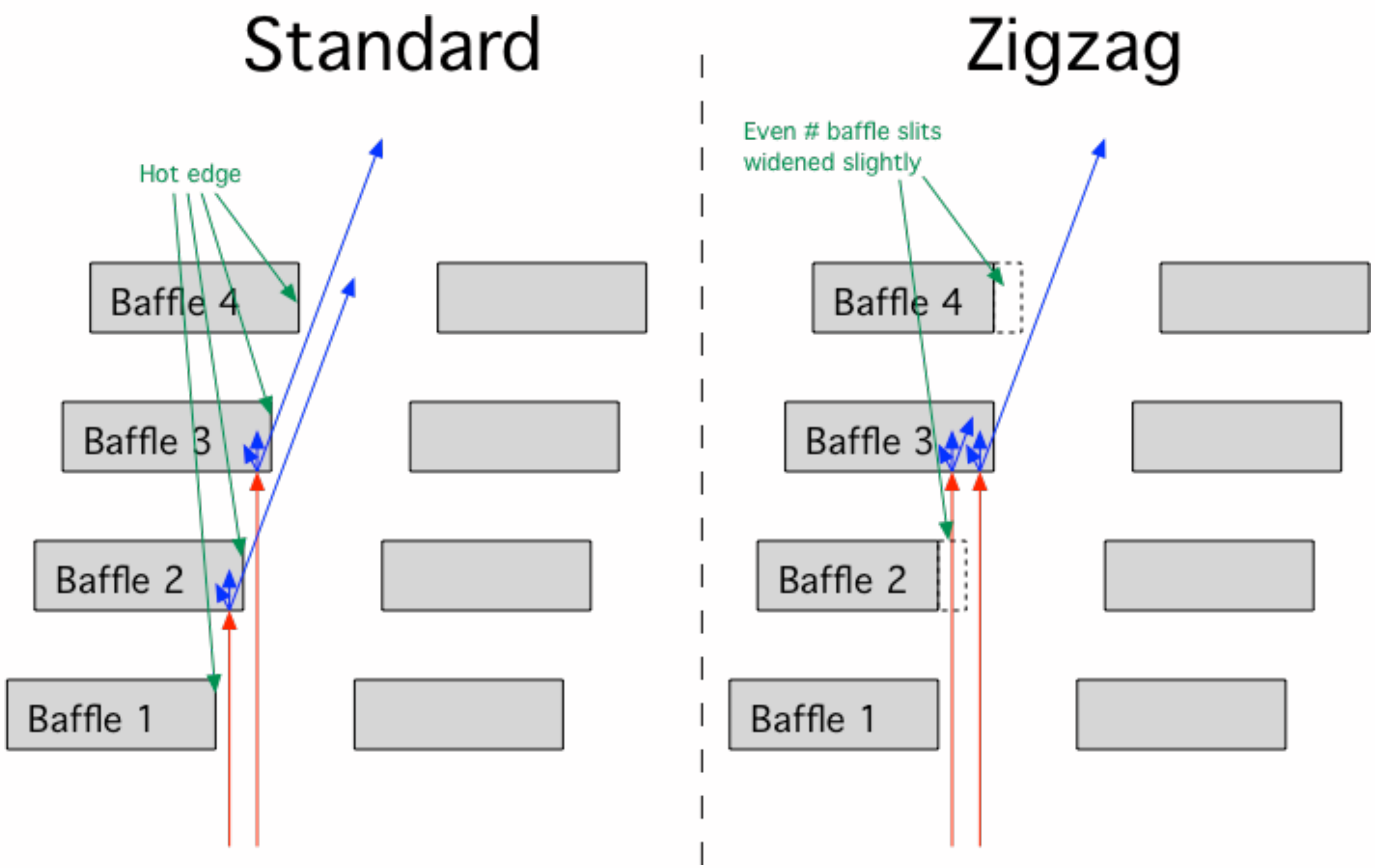
Rate (kHz)	GEMC 1.7 with geant4.9.5.p01	GEMC 2.1 with geant4.9.5.p01	GEMC 2.1 with geant4.9.6.p02							
	Lead, No shield	*Lead, No shield*	*Lead, No shield*	*Lead, shield*	*Copper, shield*	*StainlessSteel, shield*	*Tungsten Powder, shield*	*Tungsten, shield*	*Aluminum, shield*	*No baffle, No shield*
EC trigger (total)	*5.61e3*	*6.13e3*	*5.26e3*	*5.45e3*	*4.78e3*	*5.68e3*	*5.25e3*	*4.59e3*	*14.44e3*	*101.7e3*
EC trigger (pi-)	*4.83e3*	*5.03e3*	*4.37e3*	*4.37e3*	*3.57e3*	*4.47e3*	*4.21e3*	*4e3*	*7.33e3*	*2.95e4*
EC trigger (pi+)	*0.28e3*	*0.287e3*	*0.249e3*	*0.261e3*	*0.244e3*	*0.332e3*	*0.283e3*	*0.07e3*	*2.94e3*	*2.87e4*
EC neutron		*2.83e8*	*1.94e8*	*0.47e8*	*0.335e8*	*0.316e8*	*0.4e8*	*0.29e8*	*0.479e8*	*1.265e8*

- Rate by simulation has stat error at least 10% level, particularly when rate is small
- Only look at result for P>1GeV, which is 2/3 total trigger rate in pCDR
- Neutron rate estimation is from beam on target and only count neutron entering EC

Photon backgrounds

5th GEM							
Generator	**Material**	**All photons > 1 MeV**		**Photons from n**		**Photons not from n**	
		rate (GHz/sector)	**% diff**	**rate (GHz/sector)**	**%diff**	**rate (GHz/sector)**	**%diff**
all pi	Pb	2.24		0.64		1.60	
beam	Pb	2.59		0.31		2.28	
all pi	Copper	2.39	7.0%	0.55	-14.5%	1.85	15.6%
beam	Copper	2.98	15.4%	0.28	-8.0%	2.70	18.5%
all pi	Pb lined Cu	2.26	1.0%	0.57	-10.4%	1.68	5.5%
beam	Pb lined Cu	2.80	8.4%	0.28	-6.8%	2.52	10.5%

Final materials choice will depend on activation, full understanding of background rates, engineering input


Standard
Zigzag
Hot edge
Even # baffle slits
widened slightly
Baffle 4
Baffle 3
Baffle 2
Baffle 1
Baffle 4
Baffle 3
Baffle 2
Baffle 1

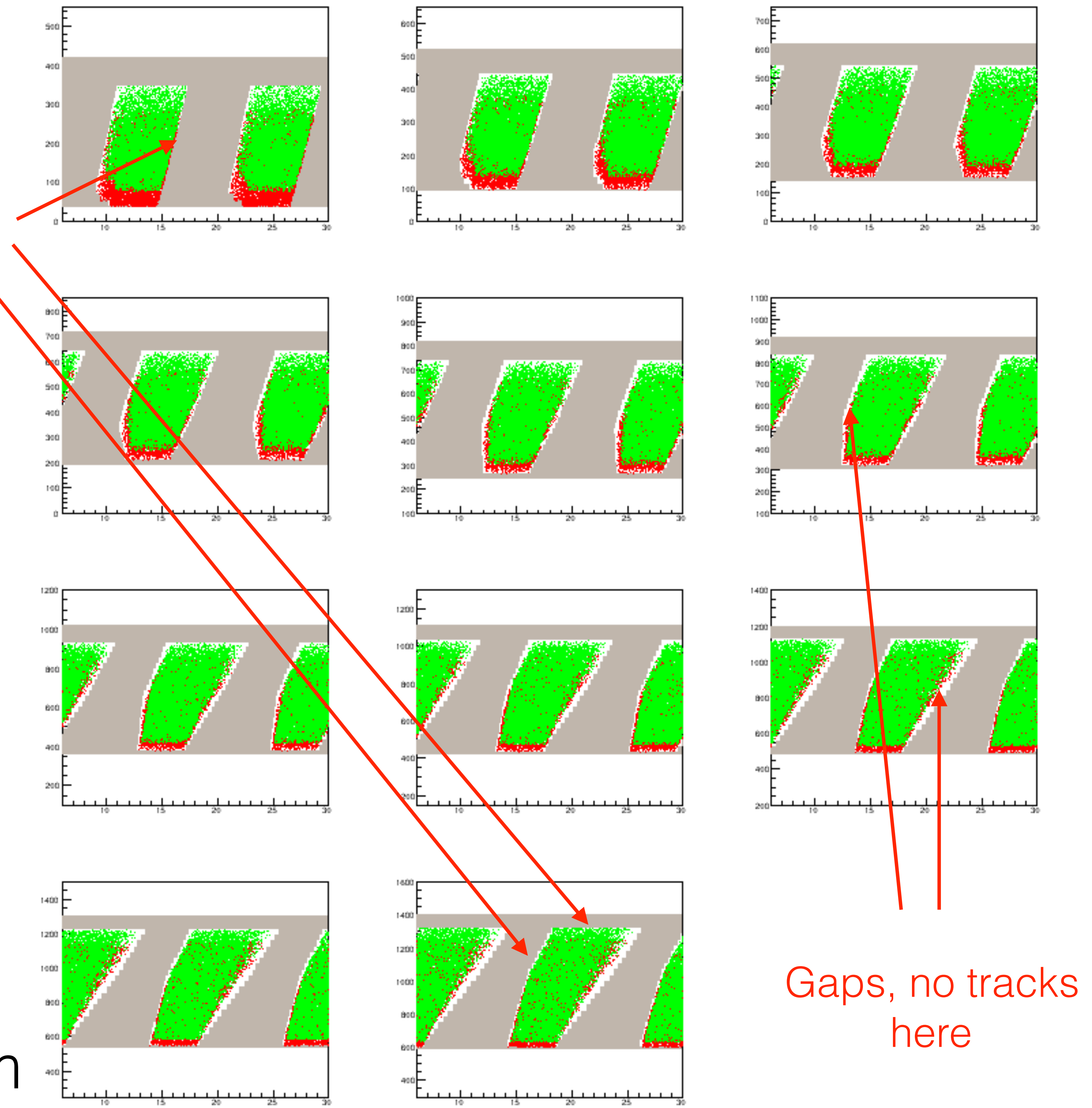
1° Zigzag, lead (π^0 generator)

Baffle	p > 1 standard	p > 1 zigzag	p > 1 % diff	p > 10 standard	p > 10 zigzag	p > 10 % diff
1	29740	32529	9.400%	5854	6200	5.900%
2	14784	5124	-65.300%	3461	865	-75.0%
3	15134	18552	22.600%	3444	4084	18.600%
4	13173	2714	-79.400%	3014	361	-88.0%
5	16037	17819	11.100%	3550	3725	4.900%
6	15021	1858	-87.600%	3281	251	-92.300%
7	18780	20968	11.700%	3752	3824	1.900%
8	18952	1464	-92.300%	3619	181	-95.0%
9	23485	29021	23.600%	4071	4337	6.500%
10	28486	2256	-92.100%	4254	215	-94.900%
11	37706	60312	60.0%	5067	6450	27.300%
Total in baffles	231298	192617	-16.700%	43367	30493	-29.700%
Total all	239019	200104	-16.300%	48649	35761	-26.500%

(Charged pions up by <10%)

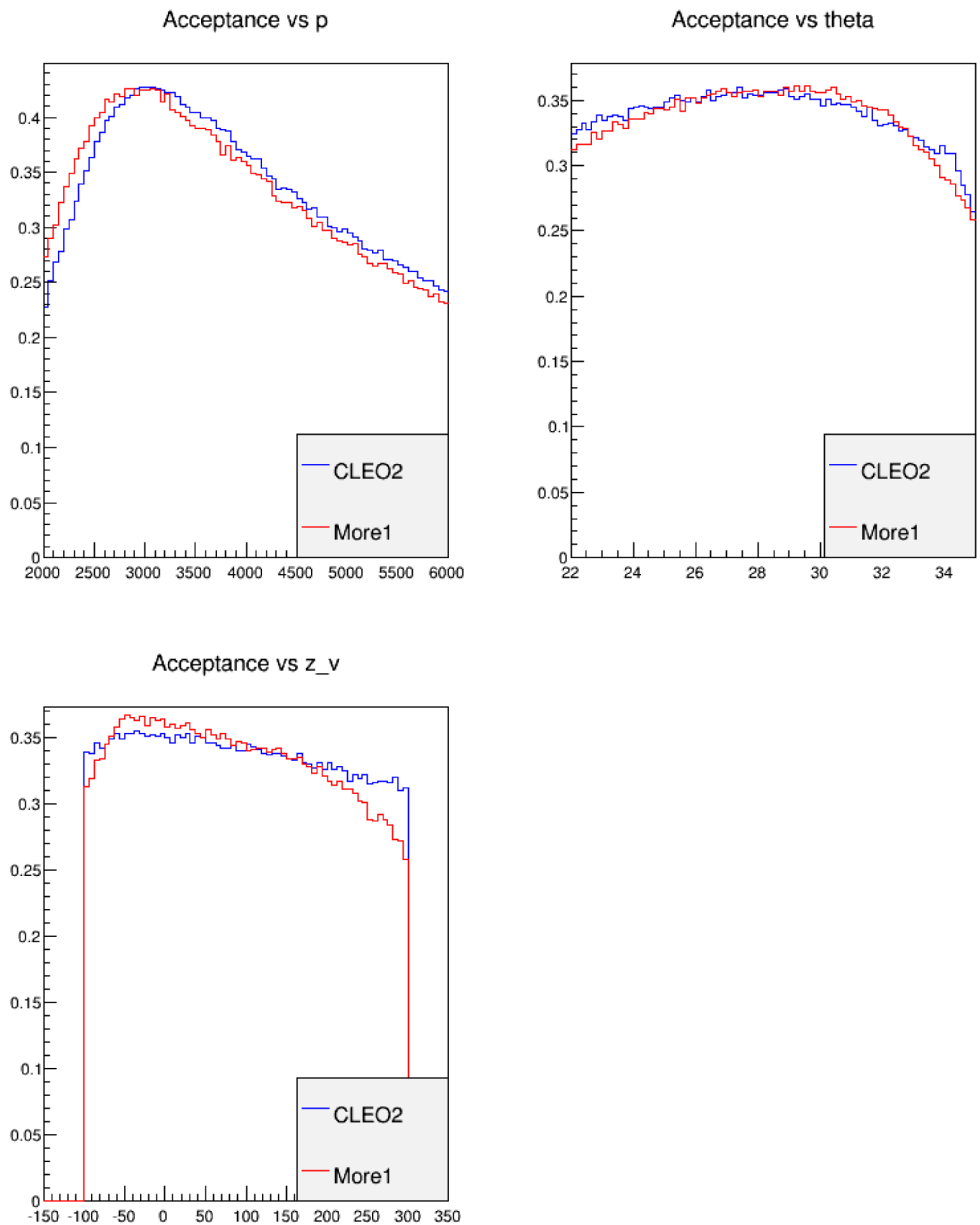
More1 with inner rings

Slit optimization

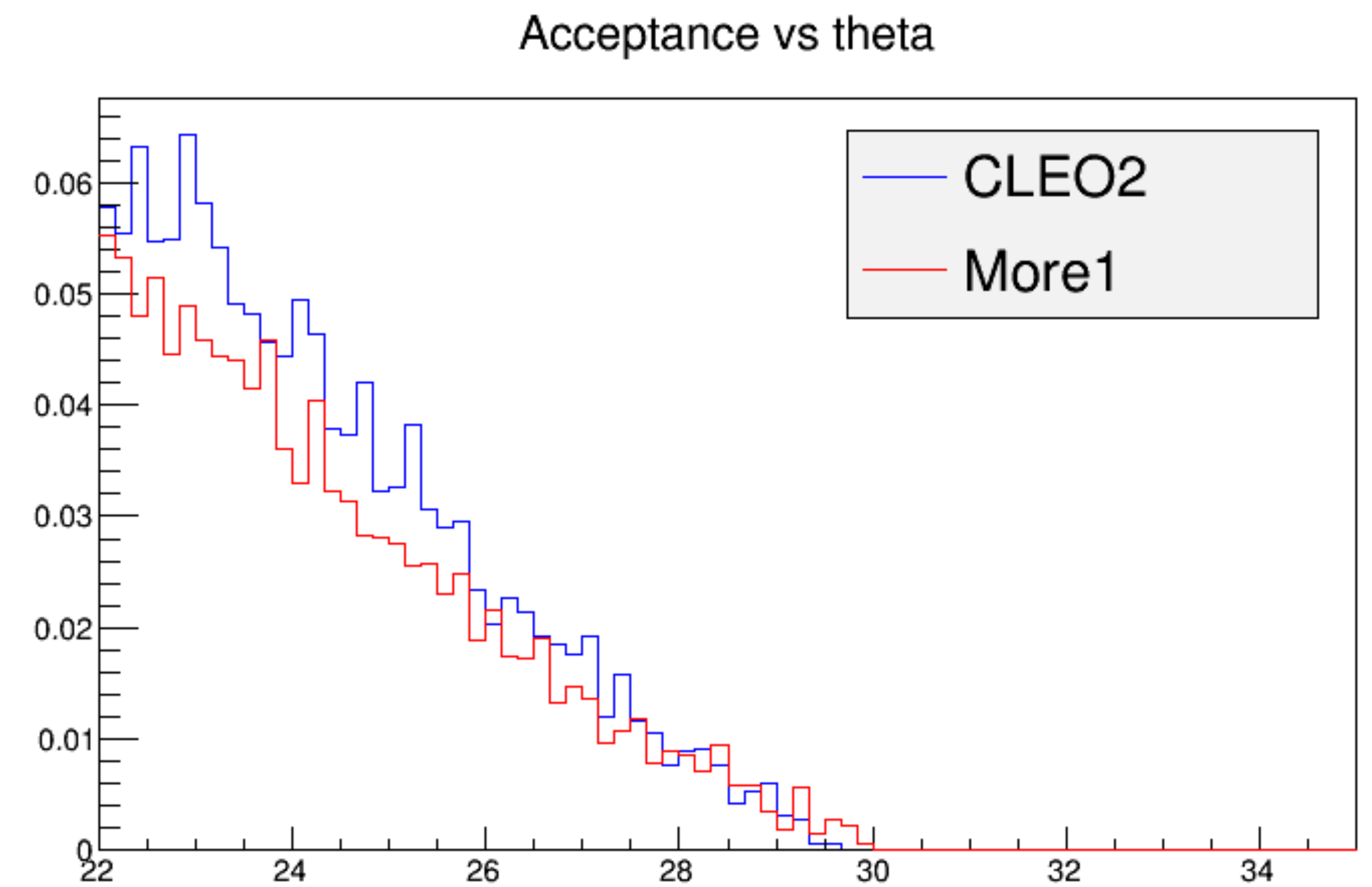


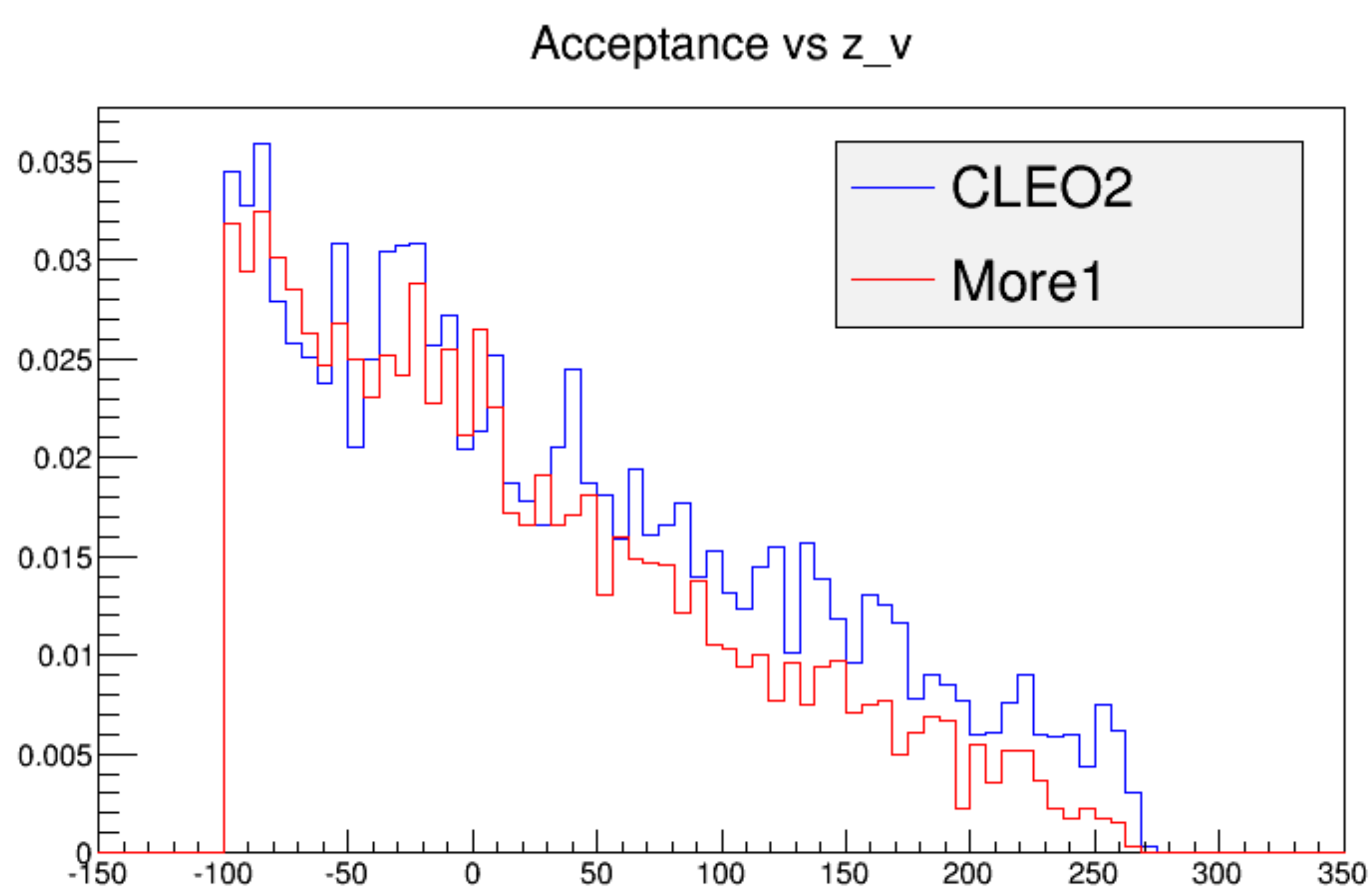
- Keep limiting edges (~) fixed
- Adjust other edges to pass track with good kinematics
- Increase outer radii of upstream plates
- Remove inner rings and small radius constrictions upstream

- After optimization, geometric acceptance for DIS e^- is generally not much different
- Vertex z dependence is reduced



- Geometric acceptance for neutrals is very similar





- We have tools for addressing questions of materials, secondary background suppression, and acceptance optimization
- Design decisions will be driven by understanding of backgrounds