

Beam Simulations on CLAS12 using eAST physics list

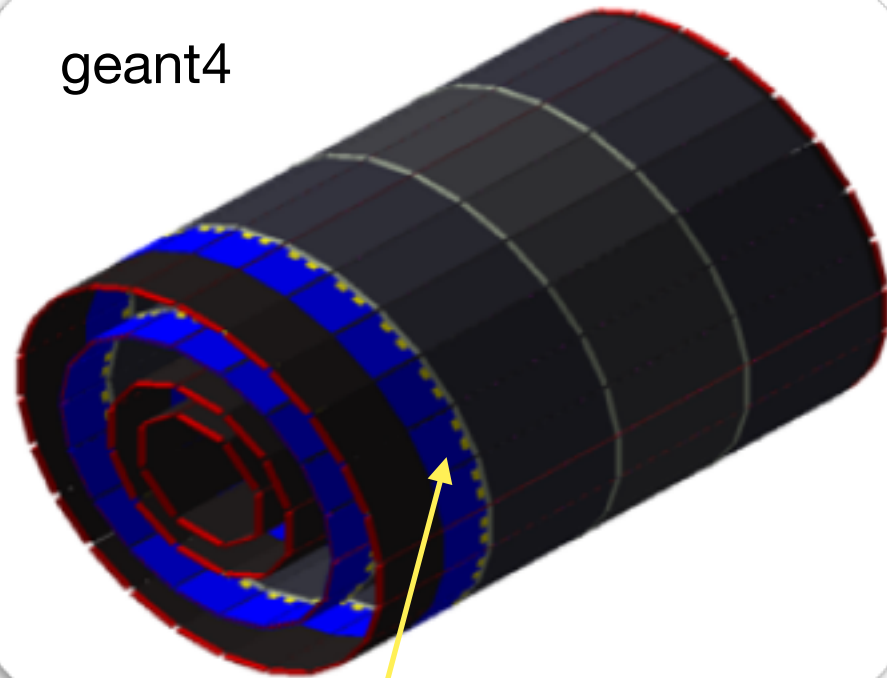
- ➡ installed geant4 10.7.p02
- ➡ eAST installation:
- ➡ complete eAST installation
- ➡ install eAST physics list in GEMC
- ➡ run gemc BEAM on CLAS12: BST (central detector) rates, compare with nominal

next steps

- ➡ run gemc BEAM on CLAS12: DC occupancies, compare with nominal

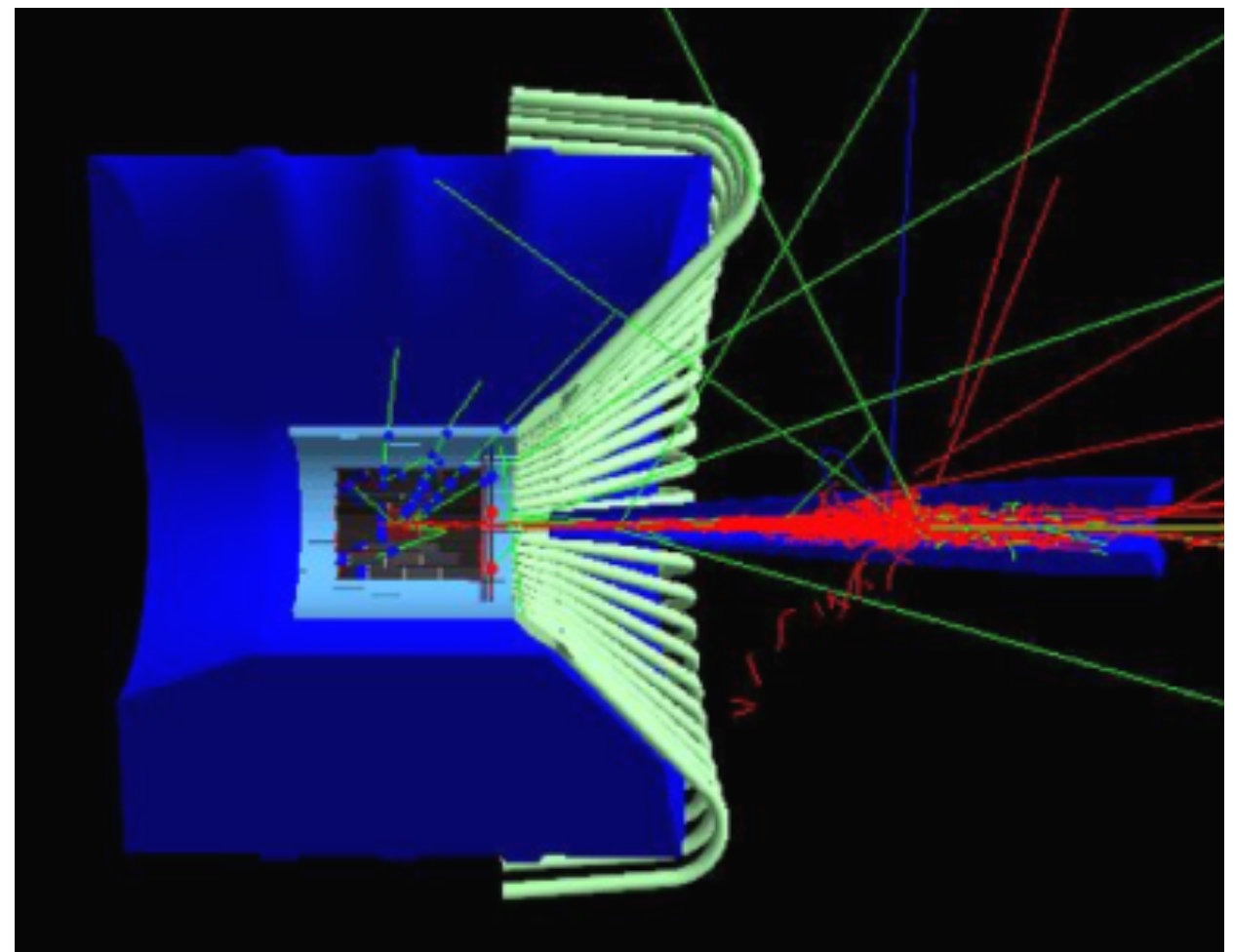
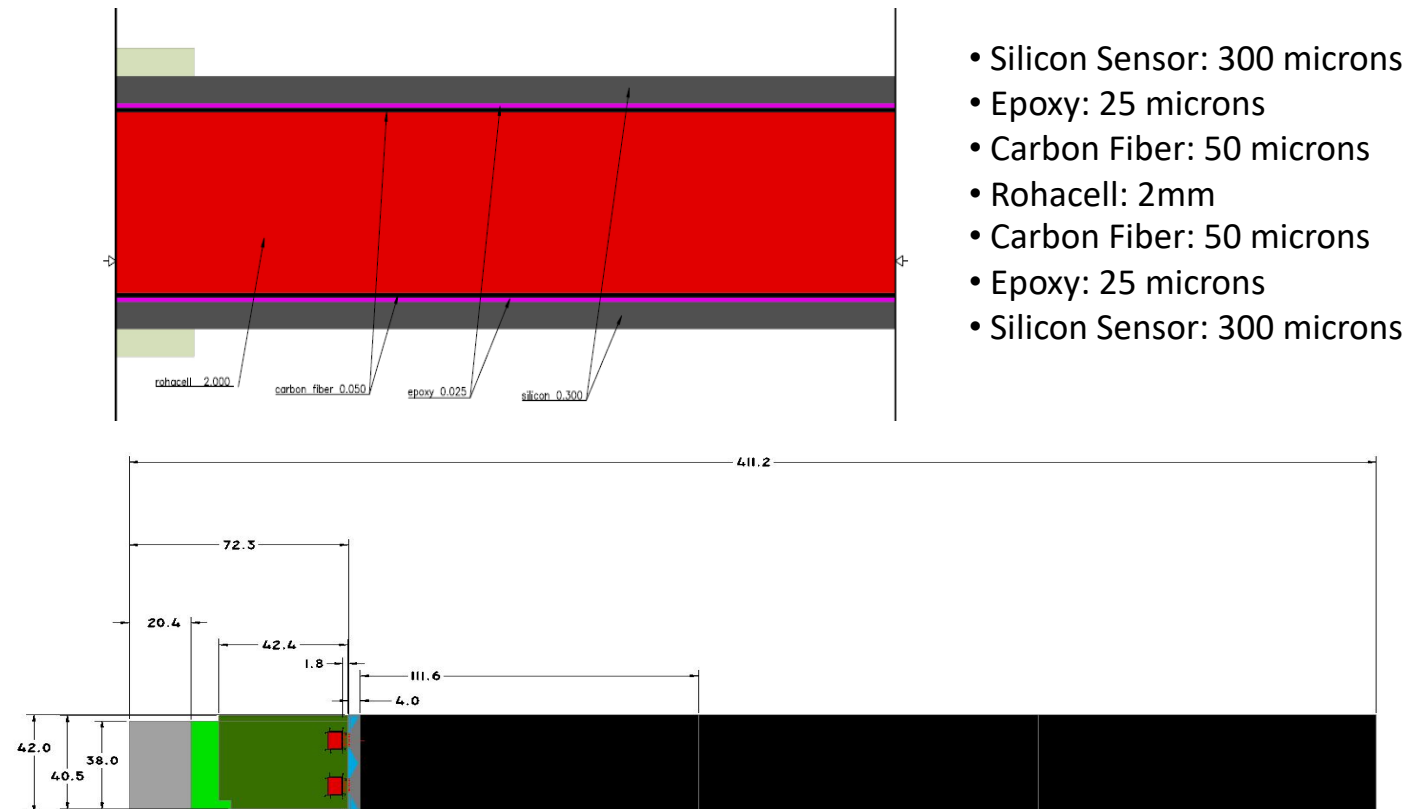
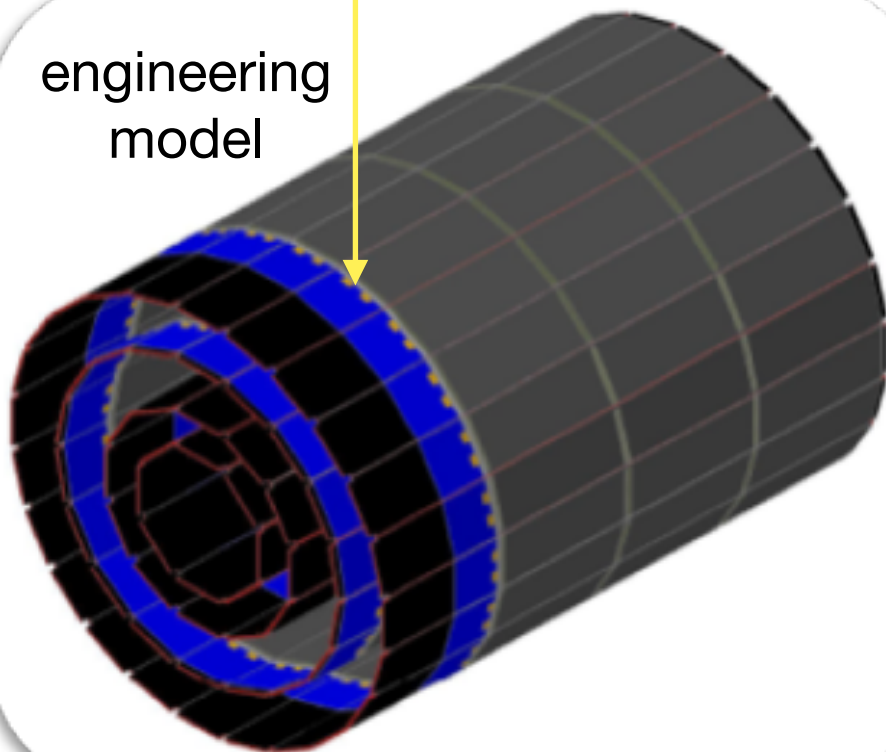
BST Simulation: Geometry implementation

geant4

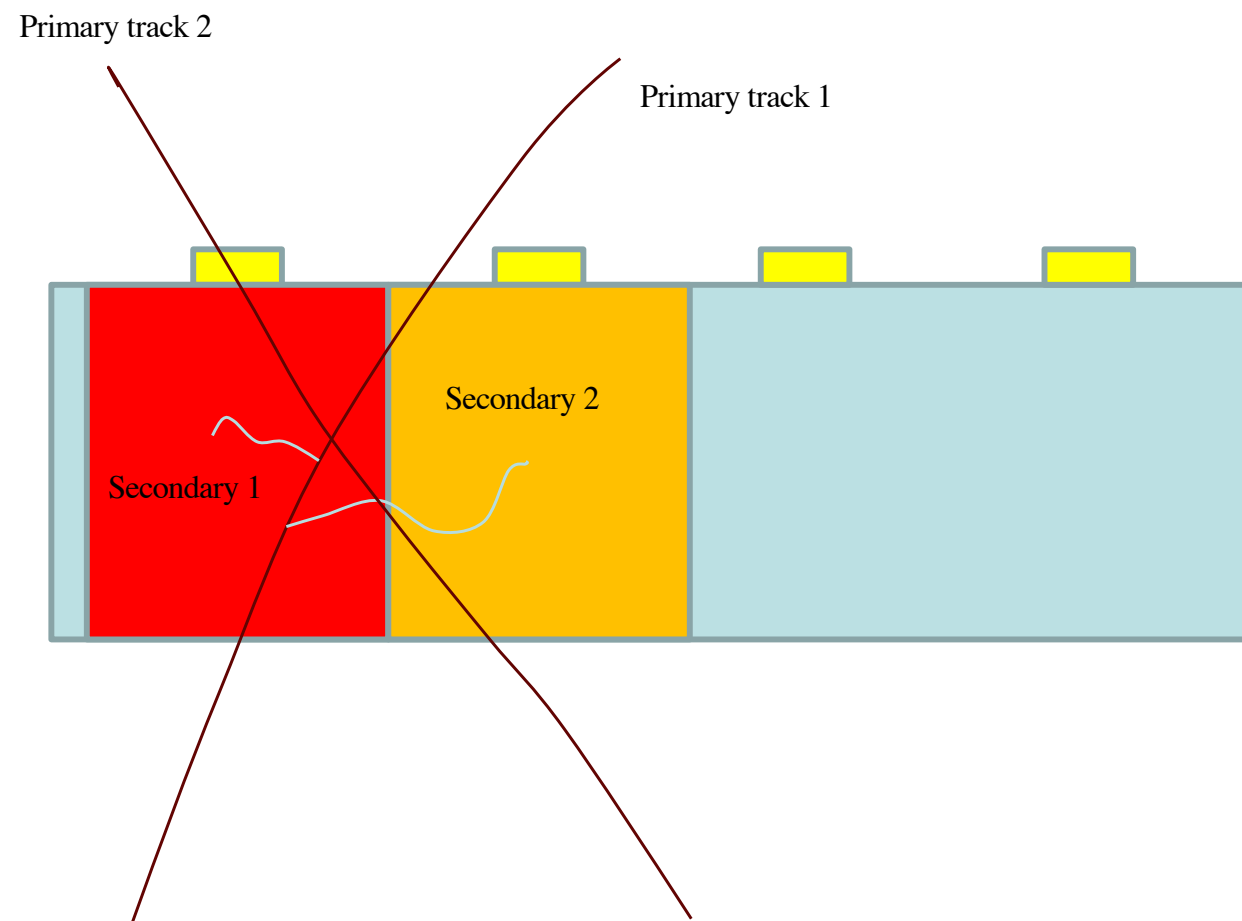


FSSR2

engineering
model

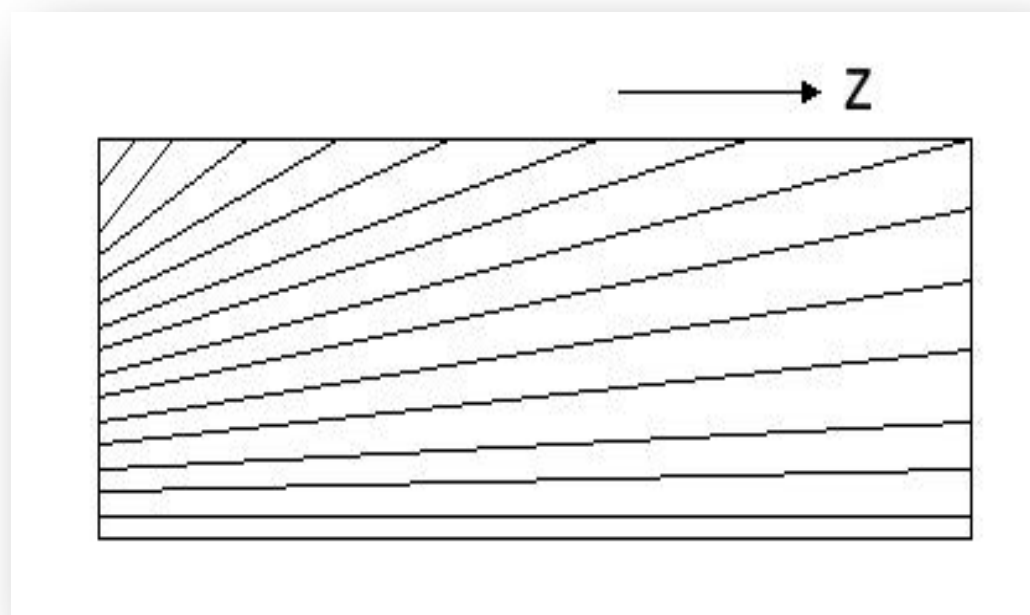


BST Simulation: Hit Definition, Energy Sharing

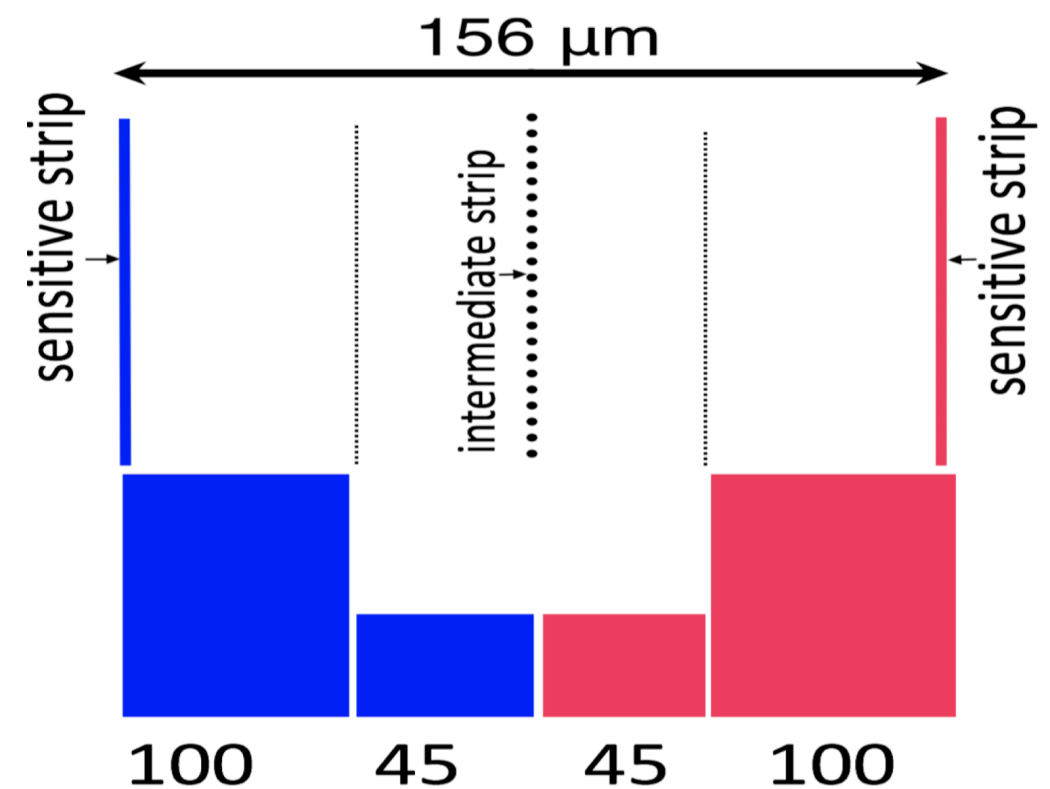


Time Window: 132 ns

All energies deposited within
the Time Window are summed
in the same strip



exaggerated strips layout



BST Simulation: CLAS12 Background Studies

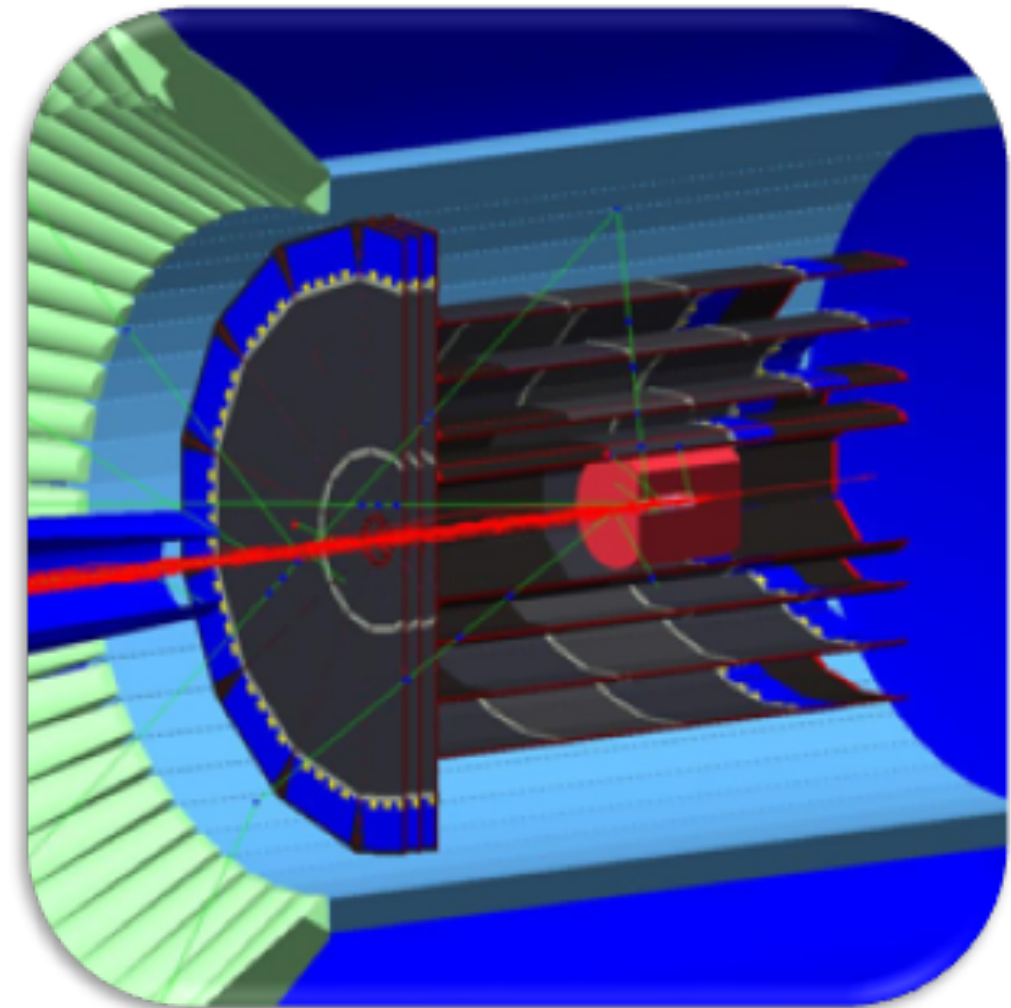
CLAS12 Nominal Luminosity: $L=10^{35} \text{ cm}^{-2}\text{s}^{-1}$

$$\text{Target: LH2} \quad \left\{ \begin{array}{l} l_T = 5\text{cm} \\ \rho = 0.0708\text{g} / \text{cm}^3 \end{array} \right.$$

$$L = R \cdot \frac{\rho N_A l_T}{A} \Rightarrow R_{\text{LH2}} = 4.739 \cdot 10^{11} \text{ beam electrons} / \text{s}$$

- BST Electronics Time Window: 132 ns
- Simulation Time Window: 250 ns:

132,000 electrons / event

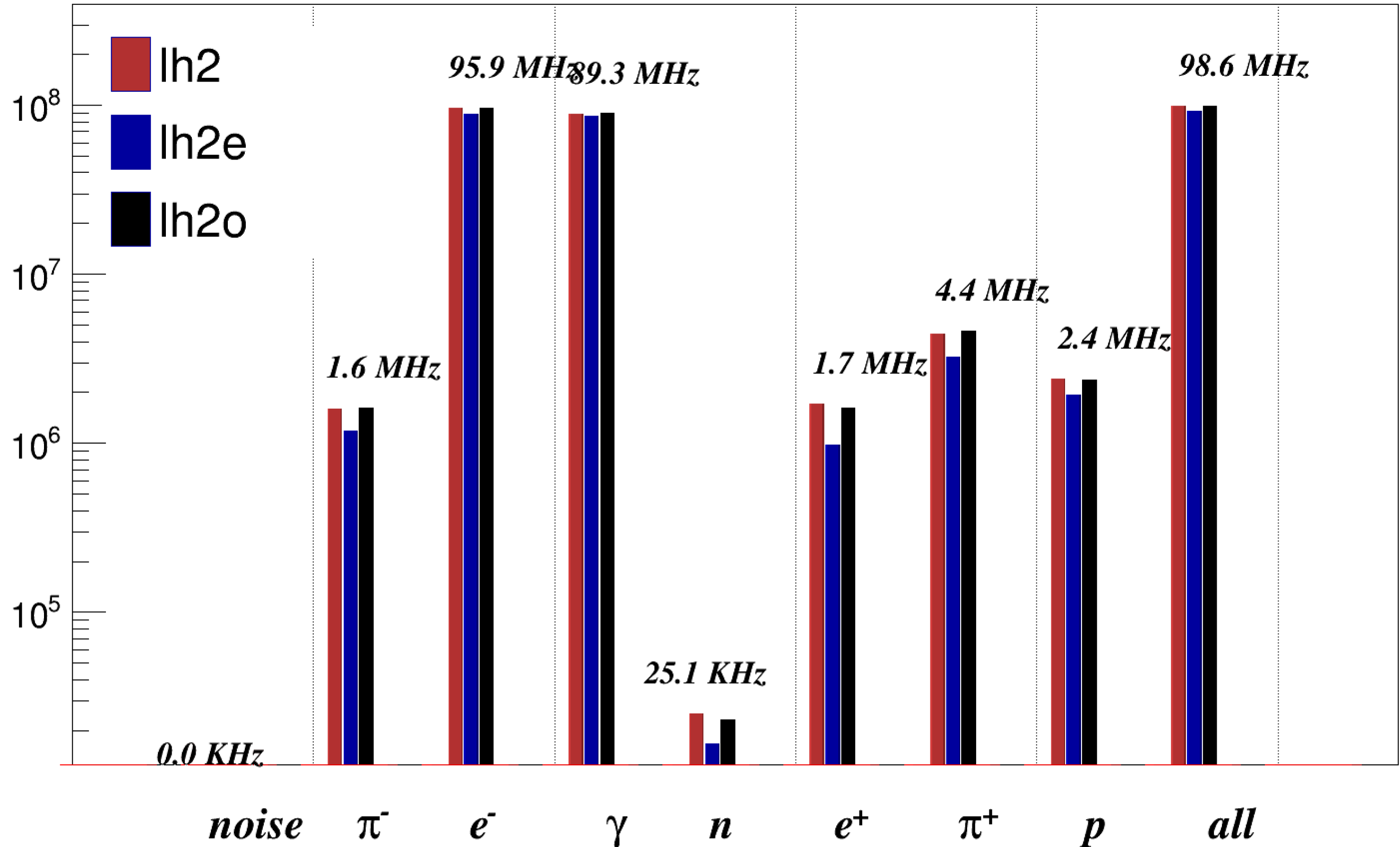


1/60 of full luminosity
(2000 beam electrons)

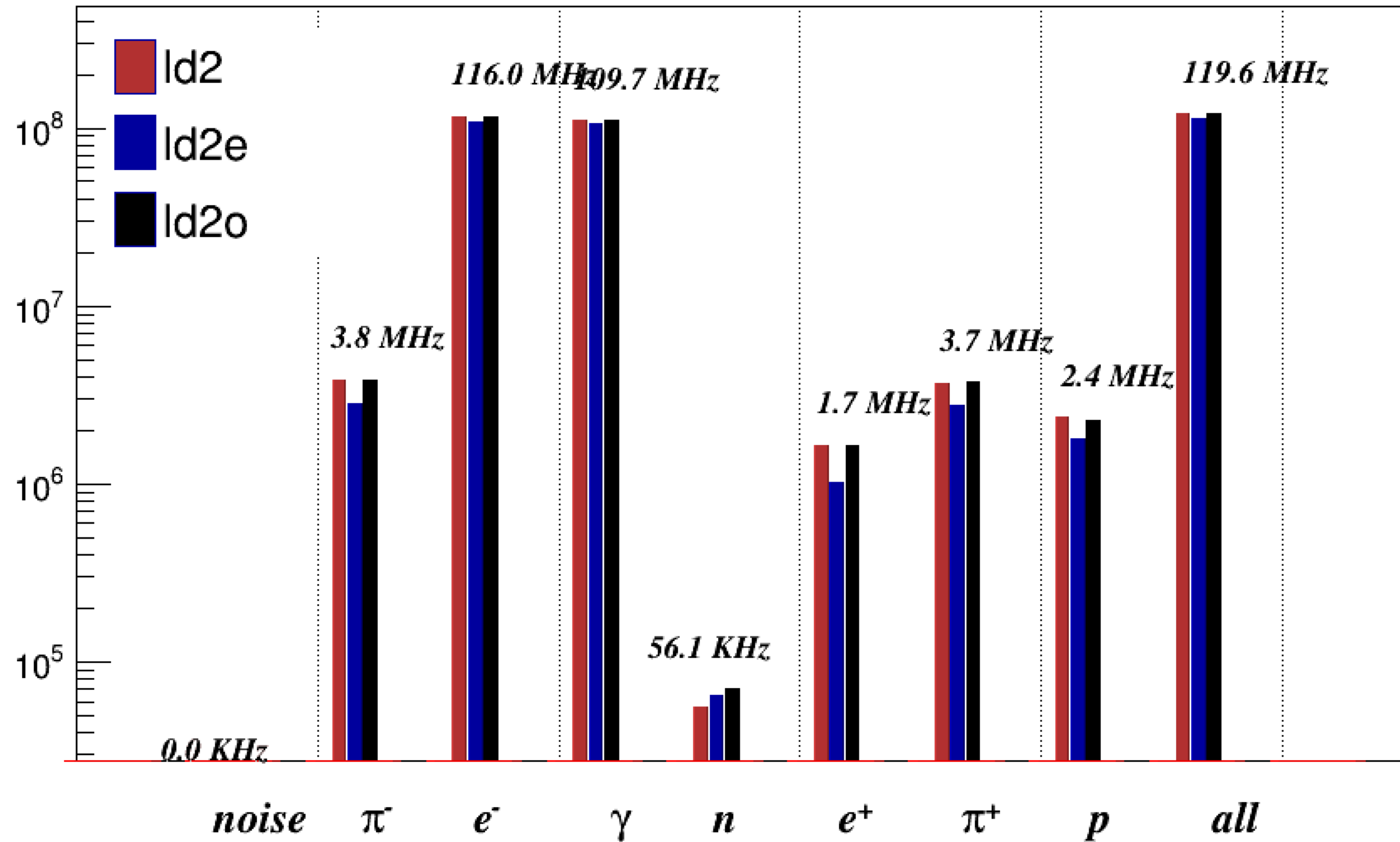
Configurations: liquid hydrogen, liquid deuterium targets. Geant4 10.6.p02 vs 10.7.p02, eAST Physics

for reference, 10K events = 1.32 Billion electrons

BST Simulation: liquid hydrogen



BST Simulation: liquid deuterium



BST Fluences: liquid hydrogen target

particles	GeV/s	mrads	rad/year
pi-	289	0.142196	4484
e-	3203	1.57494	49667
gamma	1262	0.620828	19578
n	17	0.0087096	274
e+	129	0.0635259	2003
pi+	638	0.313635	9890
p	1561	0.767527	24204
all	3673	1.80566	56943

lh2: Geant4 10.7.p02 FTFP_BERT_HP
20550 entries = 0.0050964 seconds beam time

particles	GeV/s	mrads	rad/year
pi-	263	0.129642	4088
e-	3082	1.51541	47789
gamma	1232	0.605797	19104
n	17	0.00872421	275
e+	131	0.064459	2032
pi+	629	0.309403	9757
p	1542	0.758229	23911
all	3573	1.75663	55397

lh2e: Geant4 10.7.p02 east Physics List
26010 entries = 0.00645048 seconds beam time

particles	GeV/s	mrads	rad/year
pi-	260	0.127966	4035
e-	3166	1.55648	49085
gamma	1280	0.629274	19844
n	26	0.0129104	407
e+	121	0.0595061	1876
pi+	624	0.306816	9675
p	1538	0.756304	23850
all	3618	1.77886	56098

lh2o: Geant4 10.6.p02 FTFP_BERT_HP
16470 entries = 0.00408456 seconds beam time

BST Fluences: liquid deuterium target

particles	GeV/s	mrads	rad/year
pi-	598	0.29407	9273
e-	3497	1.71927	54218
gamma	1899	0.933911	29451
n	29	0.0147316	464
e+	121	0.0598196	1886
pi+	509	0.250656	7904
p	1477	0.726185	22900
all	4342	2.13476	67321

1d2: Geant4 10.7.p02 FTFP_BERT_HP
15030 entries = 0.00372744 seconds beam time

particles	GeV/s	mrads	rad/year
pi-	578	0.284447	8970
e-	3367	1.65518	52197
gamma	1877	0.922898	29104
n	35	0.0174742	551
e+	137	0.0677303	2135
pi+	551	0.271151	8551
p	1422	0.699185	22049
all	4286	2.10716	66451

1d2e: Geant4 10.7.p02 east Physics List
25920 entries = 0.00642816 seconds beam time

particles	GeV/s	mrads	rad/year
pi-	581	0.285652	9008
e-	3404	1.67349	52775
gamma	1969	0.968289	30535
n	38	0.0189434	597
e+	121	0.0594886	1876
pi+	507	0.249597	7871
p	1439	0.707465	22310
all	4299	2.11367	66656

1d2o: Geant4 10.6.p02 FTFP_BERT_HP
16770 entries = 0.00415896 seconds beam time

BST Damage Rates: liquid hydrogen target

particle	rate (MHz)	1 MeV Neutron Damage Rate (MHz)	
e-	94.4834	0.493892	1h2: Geant4 10.7.p02 FTFP_BERT_HP 20550 entries = 0.0050964 seconds beam time
pions	1.46966	0.950761	
neutrons	0.0357115	0.026842	
protons	2.39914	16.1369	
Total:	98.3879	17.6084	

particle	rate (MHz)	1 MeV Neutron Damage Rate (MHz)	
e-	88.1925	0.404551	1h2e: Geant4 10.7.p02 east Physics List 26010 entries = 0.00645048 seconds beam time
pions	1.12178	0.724431	
neutrons	0.0131773	0.017162	
protons	1.91242	12.6332	
Total:	91.2399	13.7794	

particle	rate (MHz)	1 MeV Neutron Damage Rate (MHz)	
e-	94.6557	0.500212	1h2o: Geant4 10.6.p02 FTFP_BERT_HP 16470 entries = 0.00408456 seconds beam time
pions	1.47262	0.952404	
neutrons	0.0242376	0.0239669	
protons	2.35986	16.0155	
Total:	98.5124	17.492	

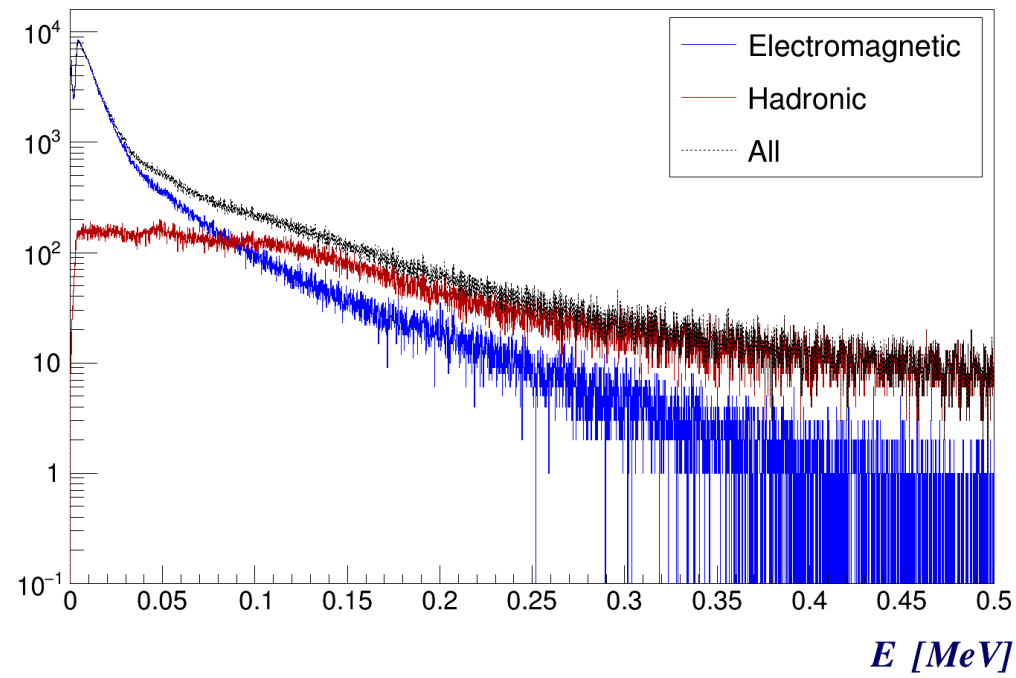
BST Damage Rates: liquid deuterium target

particle	rate (MHz)	1 MeV Neutron Damage Rate (MHz)	
e-	114.968	0.593992	1d2: Geant4 10.7.p02 FTFP_BERT_HP 15030 entries = 0.00372744 seconds beam time
pions	3.60489	2.36998	
neutrons	0.0708261	0.0422392	
protons	2.30748	13.4001	
Total:	120.952	16.4064	

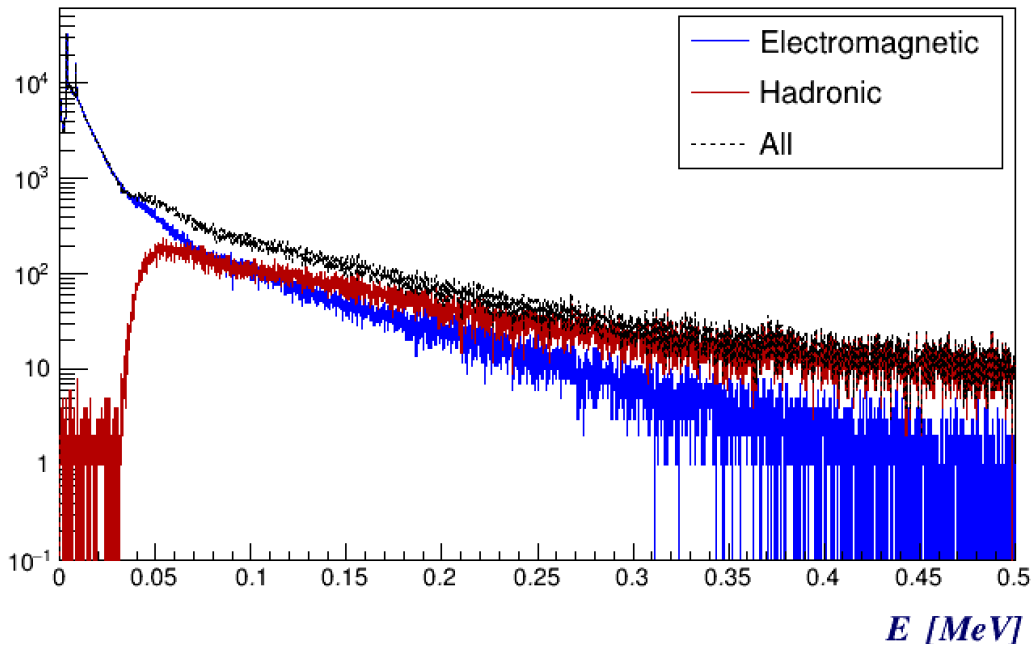
particle	rate (MHz)	1 MeV Neutron Damage Rate (MHz)	
e-	107.719	0.489047	1d2e: Geant4 10.7.p02 east Physics List 25920 entries = 0.00642816 seconds beam time
pions	2.70046	1.78683	
neutrons	0.0799607	0.0422292	
protons	1.76816	9.99107	
Total:	112.267	12.3092	

particle	rate (MHz)	1 MeV Neutron Damage Rate (MHz)	
e-	114.793	0.583306	1d2o: Geant4 10.6.p02 FTFP_BERT_HP 16770 entries = 0.00415896 seconds beam time
pions	3.54656	2.33569	
neutrons	0.0952161	0.0487435	
protons	2.18636	12.6883	
Total:	120.621	15.656	

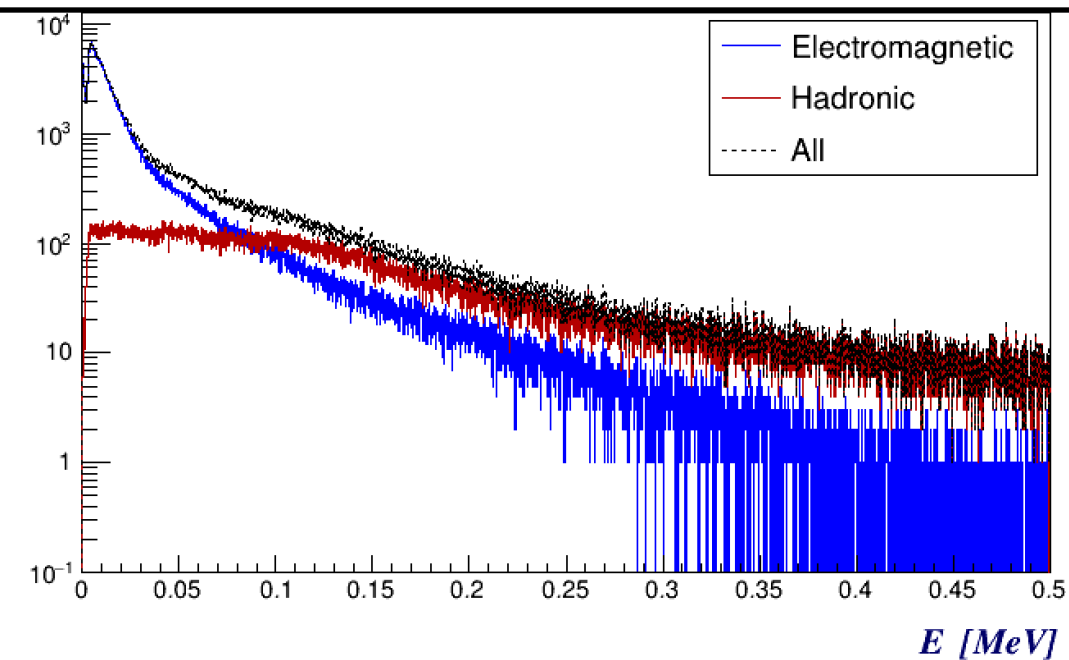
BST Simulation



1h2: Geant4 10.7.p02 FTFP_BERT_HP
20550 entries = 0.0050964 seconds beam time



1h2e: Geant4 10.7.p02 east Physics List
26010 entries = 0.00645048 seconds beam time



1h2o: Geant4 10.6.p02 FTFP_BERT_HP
16470 entries = 0.00408456 seconds beam time

BST Simulation fluences summary

liquid hydrogen fluences

target	GeV/s	GeV/(s cm2)	mrads	mrads/cm2	rad/year	rad/(year cm2)	
lh2	3673	7.83521	1.80566	0.00385167	56943	121	
lh2e	3573	7.62247	1.75663	0.00374709	55397	118	
lh2o	3618	7.7189	1.77886	0.00379449	56098	119	

liquid deuterium fluences

target	GeV/s	GeV/(s cm2)	mrads	mrads/cm2	rad/year	rad/(year cm2)	
ld2	4342	9.26324	2.13476	0.00455366	67321	143	
ld2e	4286	9.1435	2.10716	0.0044948	66451	141	
ld2o	4299	9.17173	2.11367	0.00450867	66656	142	

Summary

1. No significant differences between:

- geant4 10.7.p02 eAST physics list,
- geant4 10.7.p02 FTFP_BERT_HP
- geant4 10.6.p02 FTFP_BERT_HP

2. eAST give slightly lower particle rates in the BST region (35 to 120 theta angles), but better neutron ration for lh2/lid2

3. eAST has a hadronic cut at ~25 KeV for hadronic processes