Proton beam gas background

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Beam parameters and collision rate

Species Energy (GeV)	Proton 275	Proton 100	Proton 41
RMS Emittance h/v (nm)	18/1.6	20/2.7	44/10
β* h/v (cm)	80/7.1	63/5.7	90/7.1
RMS Δθ h/v (μrad)	150/150	220/220	220/380
RMS Bunch length (cm)	6	7	7.5
RMS Δ/p (10^{-4})	6.8	9.7	10.3

PM = dRT;
R =0.0821 atm/mol;
P = 2.560254e-09 mbar = 2.560254e-09*0.000986923atm = 2.5267736e-12atm
T = 293k;
M = 1.00794g/mol (molar mass)
Density = 1.0587422e-13g/L = 6.326e7 molecules/cm3

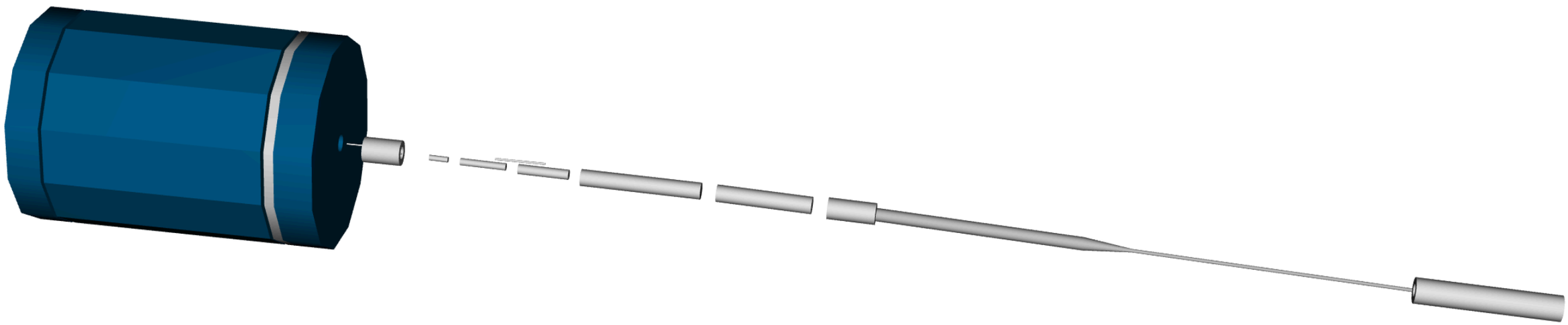
Background collision rate = $L_{bg}*\sigma_{pH}^2$;
Luminosity of background = (beam current) * (average gas density) * (length);
Current = (1.0C/s)*(protons/1.6e-19C) = 6.3e18 protons/s;
Length = 10m;
$\boldsymbol{\sigma_{pH2}}$ = 39.27mb *2 (Pythia8);

Background collision rate =
6.33e18(s-1)*6.326e7(cm-3)*1000(cm)*39.27*(1.0e-27cm2) *2 = **<u>31.45kHz</u>**; //275GeV
30.74kHz; // 100GeV
30.96kHz; // 41GeV

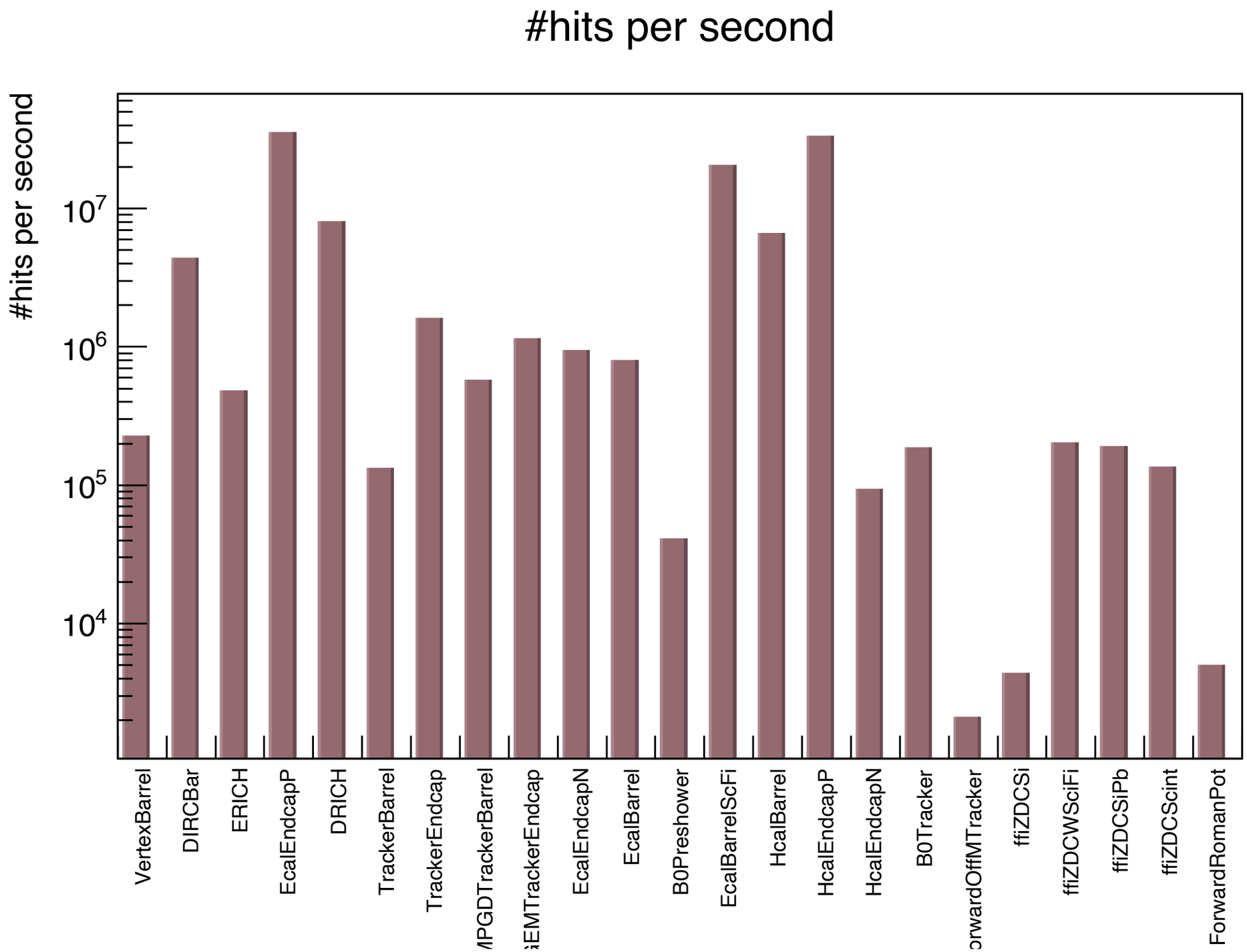
HepMc3 files

- source /opt/detector/setup.sh

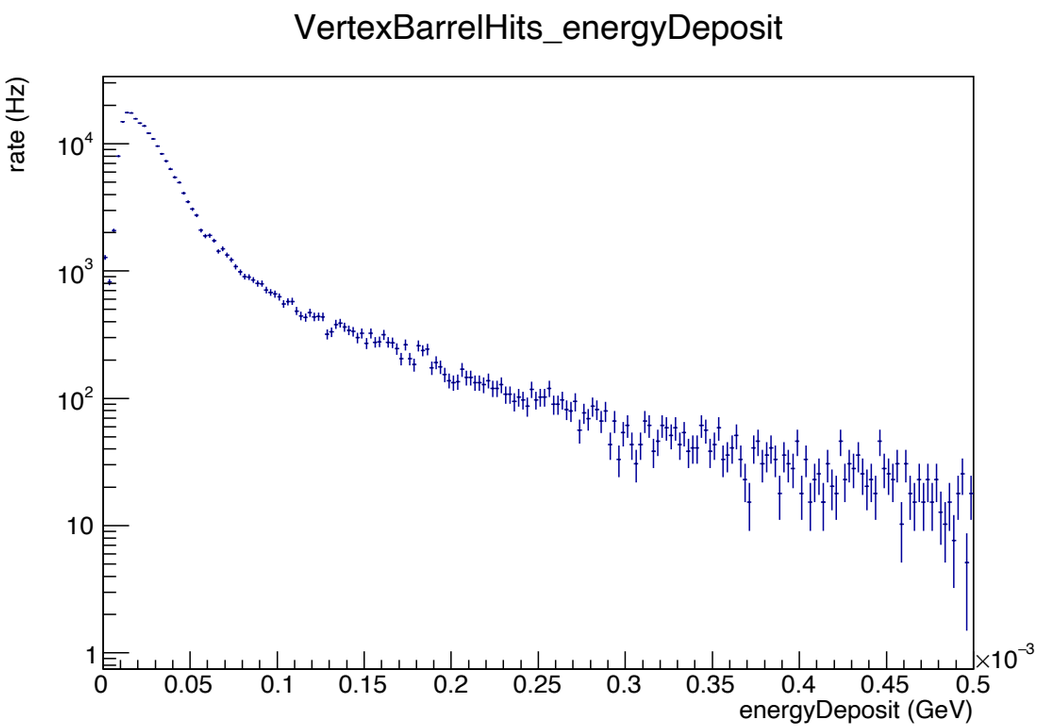
- npsim --inputFiles /gpfs/mnt/gpfs02/eic/zhangzq/pythia8/beameffect/BeamGas/test.hepmc --compactFile athena.xml --random.seed 123456 --physics.list FTFP_BERT --numberOfEvents 1000 --outputFile protonBeamGasBG.root
- We can get the hits information in all sub detectors;

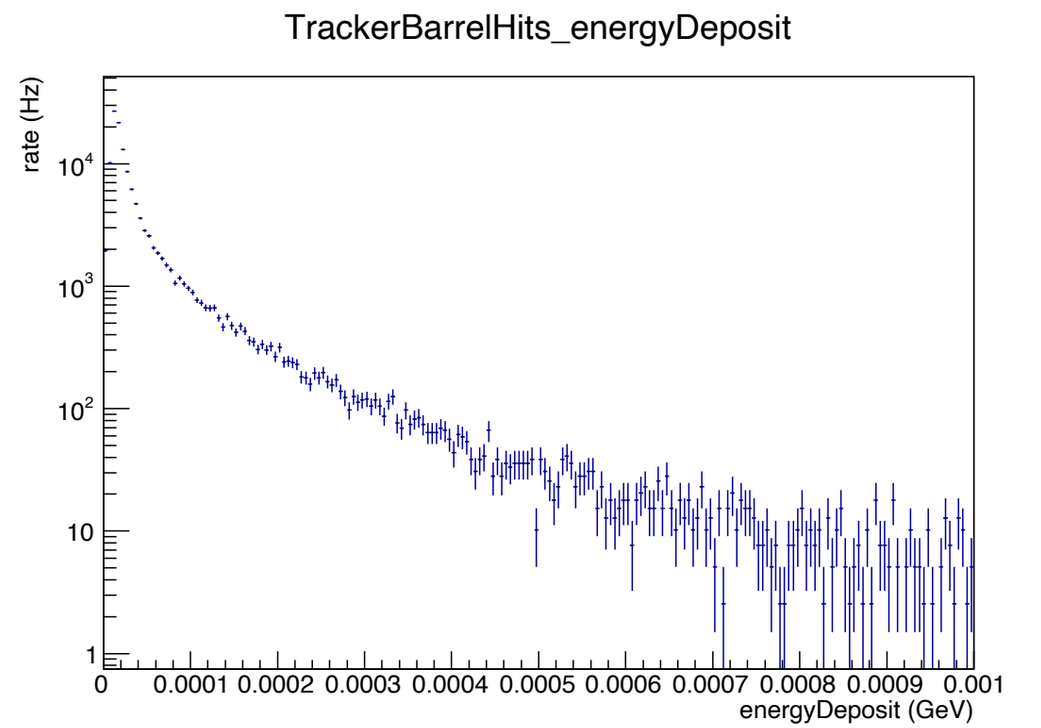


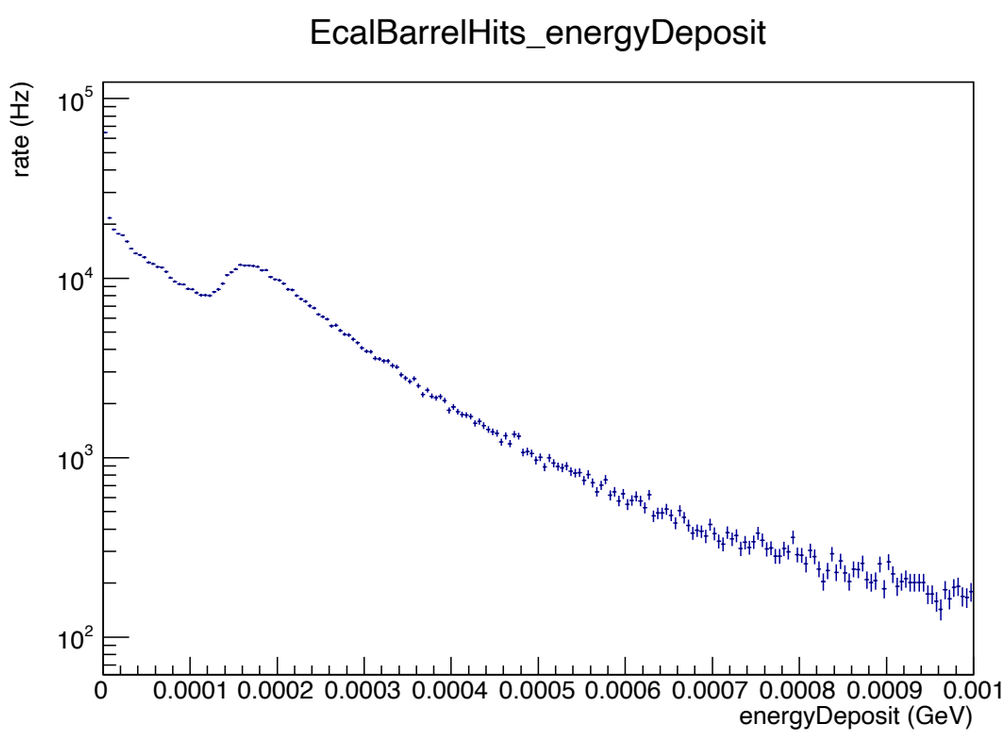
Hits rate in each detector

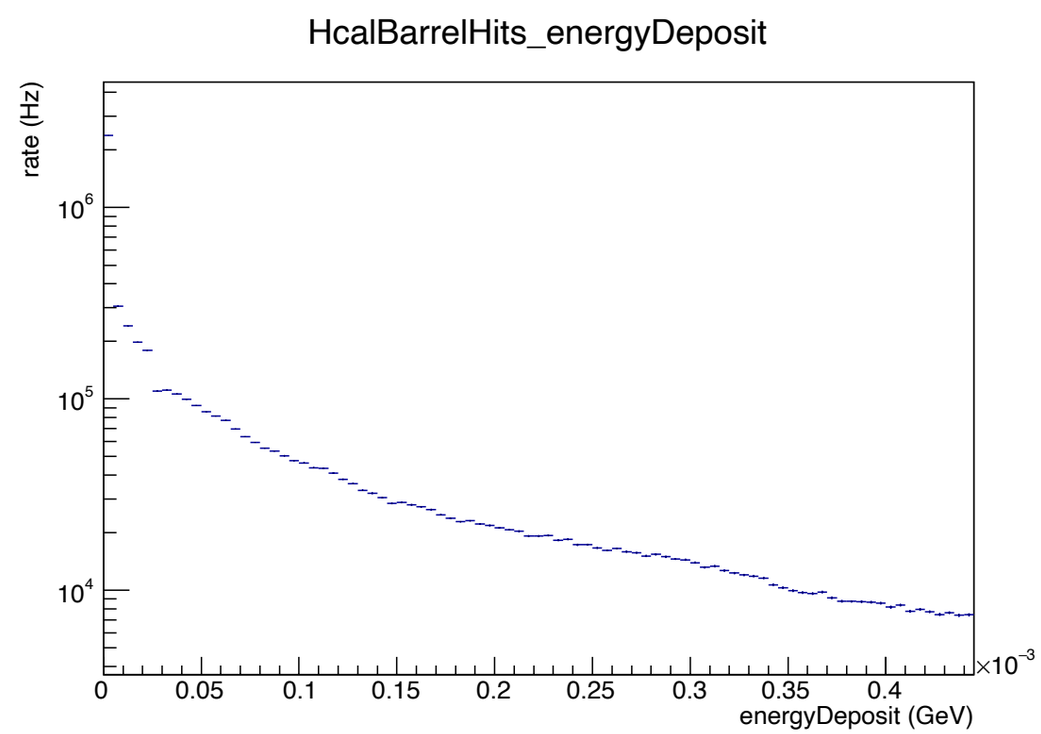


Energy deposit









Thanks!