



Background rates in ePIC endcap ECals

Dmitry Kalinkin

University of Kentucky

Charge

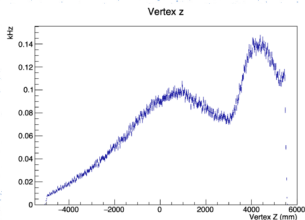
Need to evaluate impact of backgrounds on EcalEndcapN. Using a following plan:

- 1 Take Electron and Proton Beam Gas generator-level HepMC files from <https://wiki.bnl.gov/EPIC/index.php?title=Background>
- 2 Do full detector simulation (no event mixing, no reconstruction) – epic 23.08.0
- 3 Calculate hit counts at select energy deposition thresholds
- 4 Normalize the processed events to the total rate as given in the table on the wiki

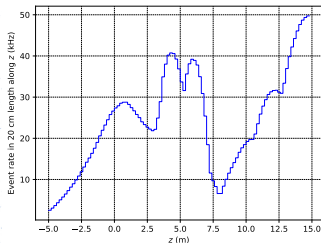
Electron Beam Gas	3.2 MHz
DIS	184 kHz ← to be updated
Proton Beam Gas	31.9 kHz

- 5 Cross check with other similar subsystems (EcalEndcapP) and with previous results from this WG

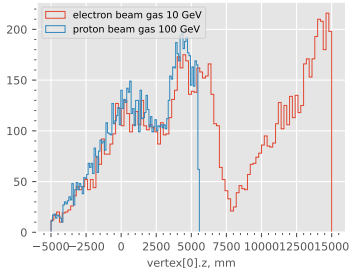
Input vertices



[Electron Beam Gas on the wiki](#)

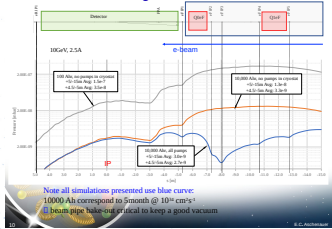


[Hadron Beam Gas on the wiki](#)



Vertices from the HepMC files – Look consistent

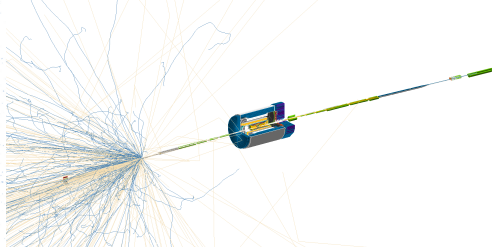
Pressure Profile along IP



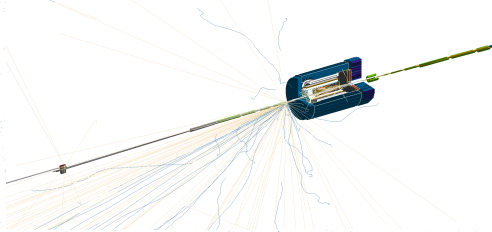
Elke's presentation at a TIC meeting

Sample event displays (hitting EcalEndcapN)

Electron Beam Gas

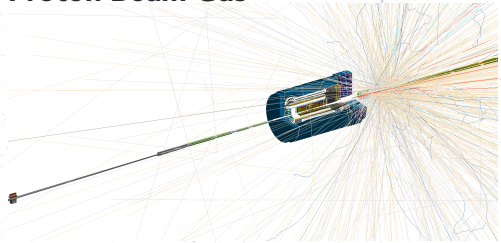


Interacted after passing the detector

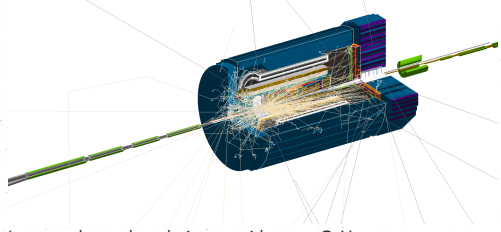


Sprayed the calorimeter from $z > 0$ with ≈ 9.3 GeV

Proton Beam Gas



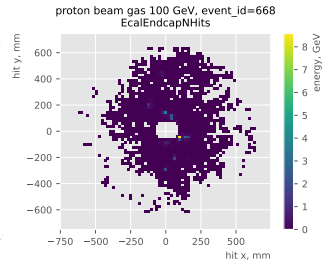
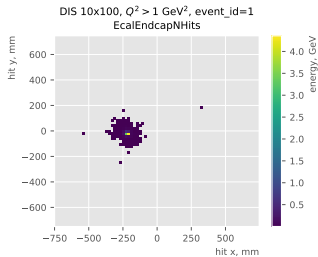
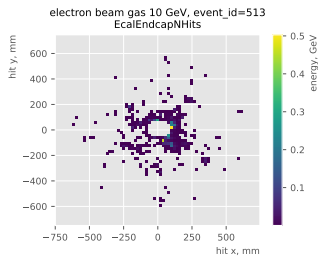
Interacted after passing the detector



Interacted near the calorimeter with ≈ 71.7 GeV

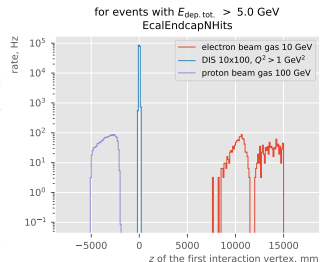
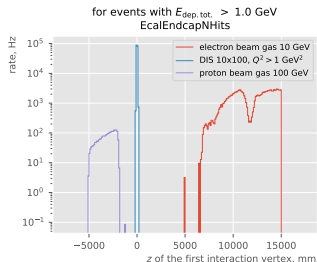
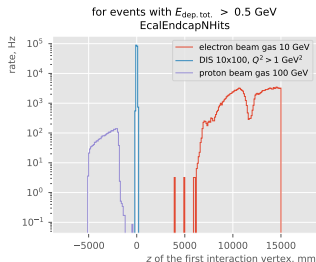
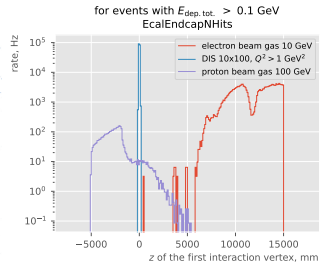
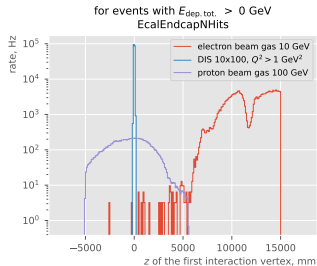
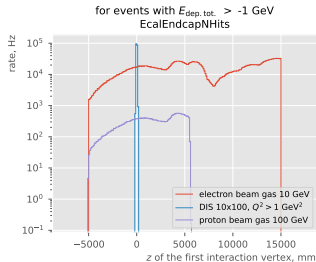
Sample event energy depositions (EcalEndcapN)

Events with highest $E_{\text{dep. tot.}}$ in the sample

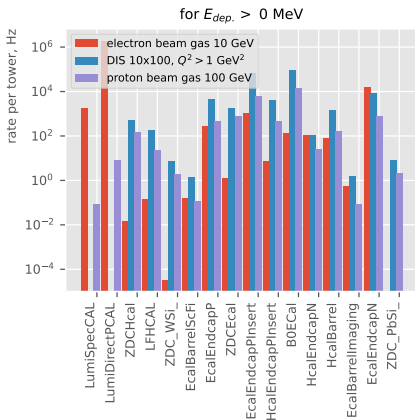


See backup for EcalEndcapP

Hit rates vs interaction vertex z (EcalEndcapN)



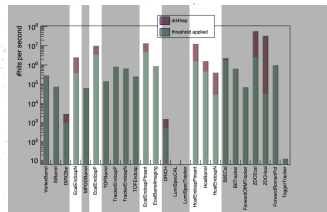
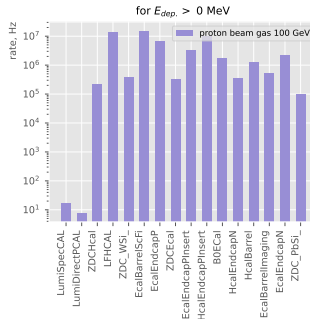
Hit rates per detector cell



```
num_towers_cache = {
    "LumiSpecCAL": 200,
    "LumiDirectPCAL": 1,
    "ZDCHcal": 1470,
    "LFHcal": 578338,
    "ZDC_WSi": 187043,
    "EcalBarrelScFi": 124205483,
    "EcalEndcapP": 15037,
    "ZDCEcal": 400,
    "EcalEndcapInsert": 536,
    "HcalEndcapInsert": 20251,
    "B0Ecal": 131,
    "HcalEndcapN": 13800,
    "HcalBarrel": 7680,
    "EcalBarrelImaging": 5765469,
    "EcalEndcapN": 2988,
    "ZDC_PbSi": 44344,
}
```

Numbers of cells estimated by counting unique cell IDs in the simulation outputs

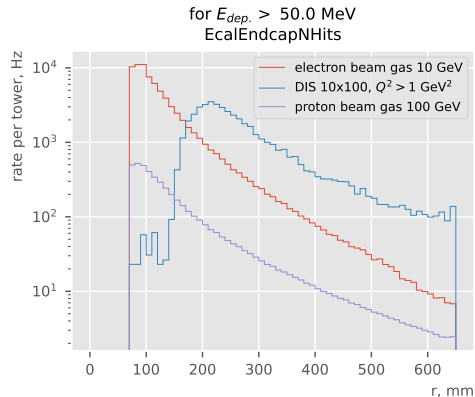
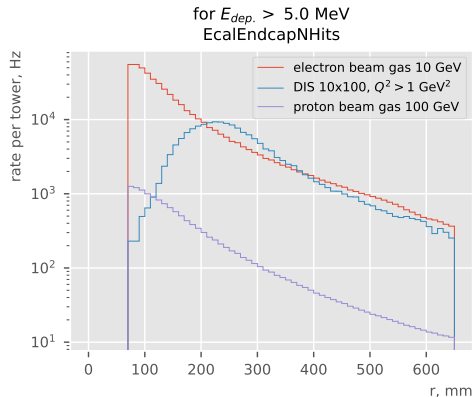
Proton Beam Gas



Hadron Beam Gas on the wiki

Hit rates per cell vs its distance to beam r (EcalEndcapN)

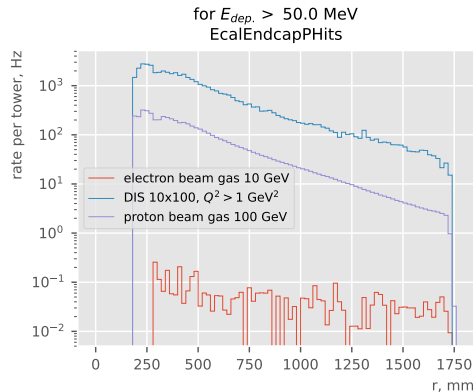
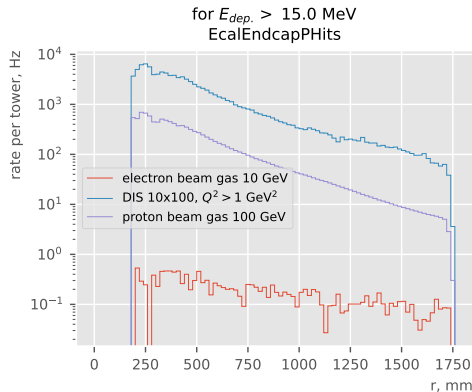
r – distance from the $x = y = 0$ to the position of a sensitive volume



The rates for towers closest to the beam are concerning

Hit rates per cell vs its distance to beam r (EcalEndcapP)

r – distance from the $x = y = 0$ to the position of a sensitive volume



The rates for towers closest to the beam are concerning

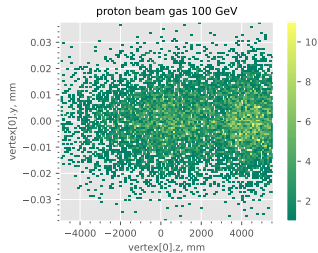
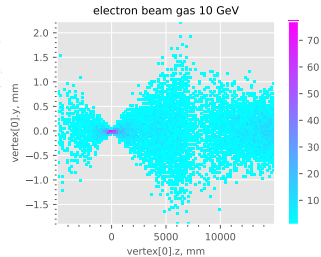
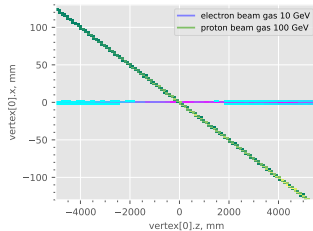
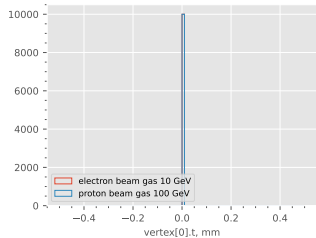
- » High Electron Beam Gas background rates seen in EcalEndcapN close to the beamline

Timing cut not considered yet

- » Publish codes as an official benchmark
 - would help to make these studies collaborative
 - keep results the up to date with the simulation developments
- » Code from this study: https://github.com/eic/detector_benchmarks/pull/2

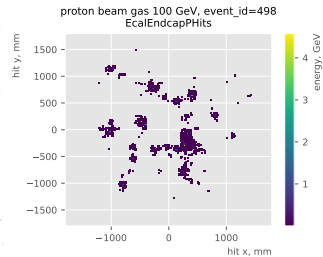
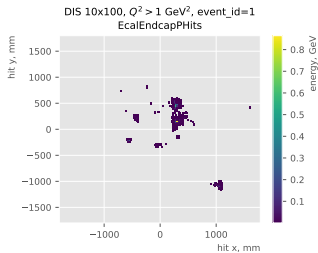
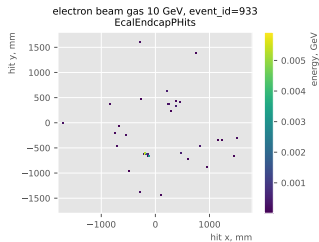
Backup

Input vertices

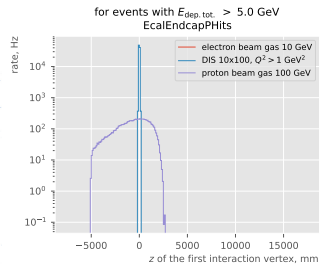
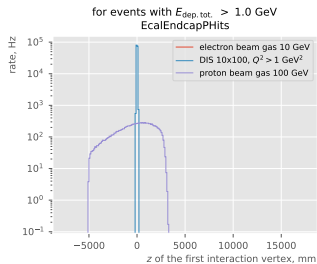
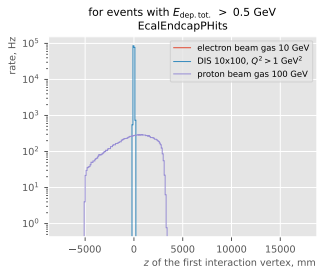
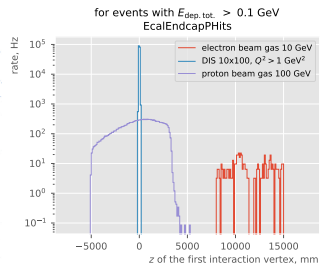
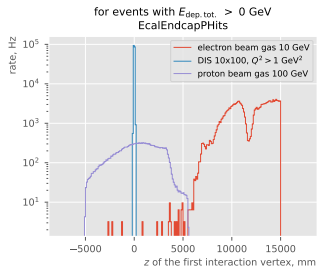
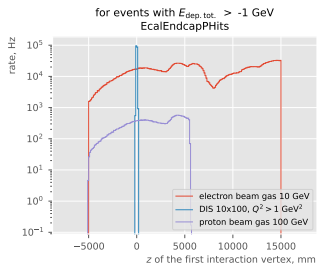


Sample event energy depositions (EcalEndcapP)

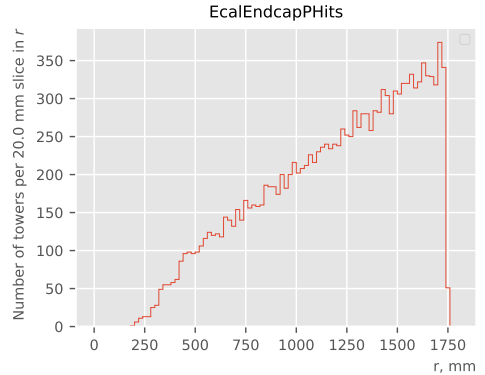
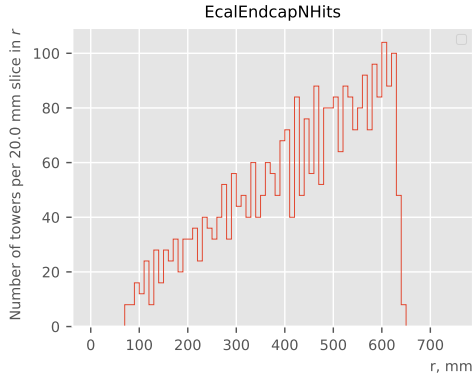
Events with highest $E_{\text{dep. tot.}}$ in the sample



Hit rates vs interaction vertex z (EcalEndcapP)



Number of cells at a given distance to the beam



$$N \sim 2\pi r$$