# Proton beam gas background update with new threshold and time resolution

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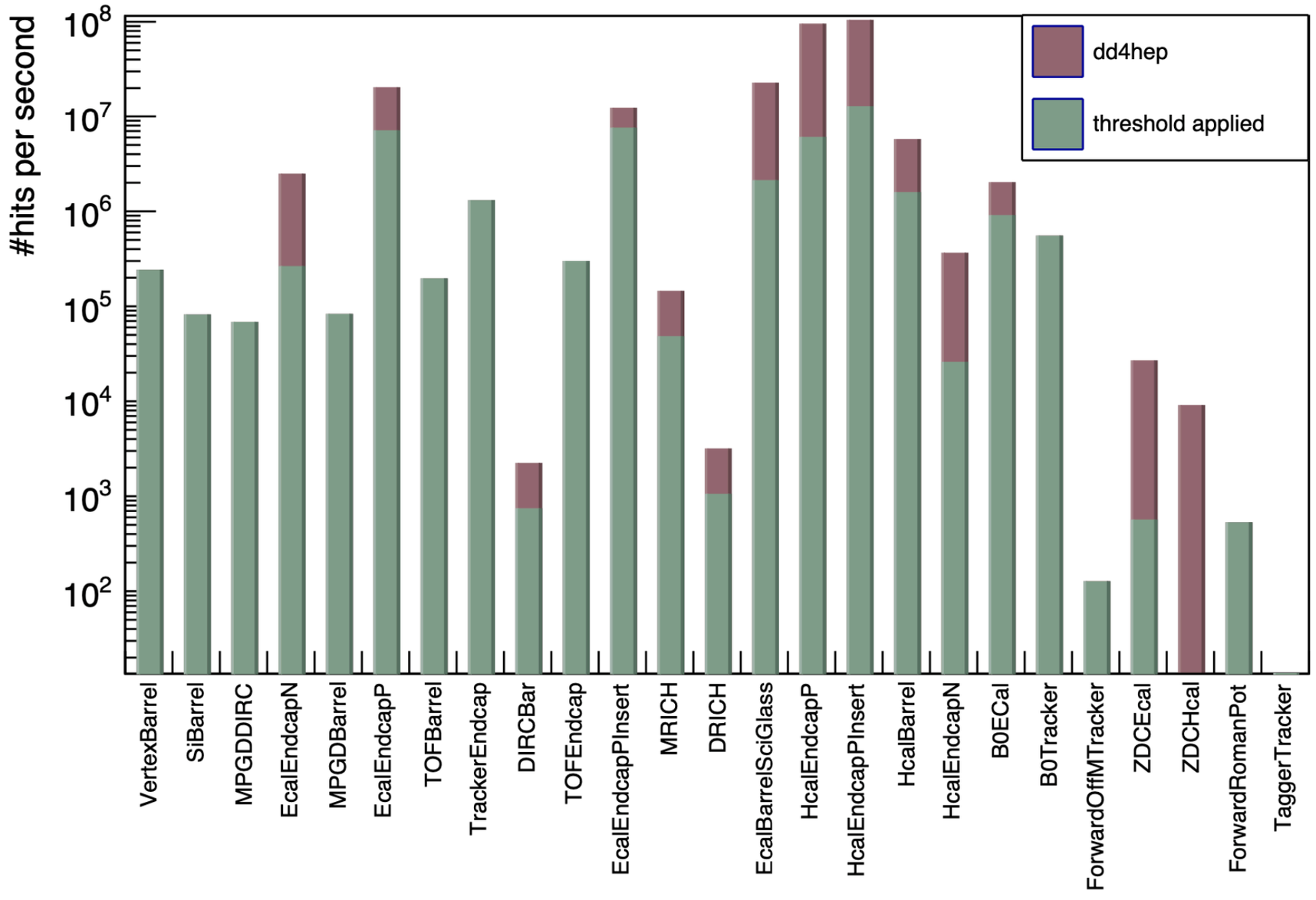
2023.04.11

# Threshold and timing

| Sub-detector | threshold | time resolution |
|---|---|---|
| VertexBarrel | 0.65keV | 2μs |
| SiBarrel | 0.65keV | 2μs |
| MPGDDIRC | 0.25keV | 20ns |
| EcalEndcapN | 5.0MeV | 5ns |
| MPGDBarrel | 0.25keV | 20ns |
| EcalEndcapP | 3.0MeV | 5ns |
| TOFBarrel | 0.5keV | 50ps |
| TrackerEndcap | 0.65keV | 50ps |
| DIRCBar | 0.2p.e. | 50ps |
| TOFEndcap | 0.5keV | 50ps |
| EcalEndcapPInsert | 3.0MeV | 5ns |
| MRICH | 0.5p.e. | 50ps |
| DRICH | 0.5p.e. | 50ps |
| EcalBarrelSciGlass | 2.5MeV | 5ns |
| HcalEndcapP | 500keV | 25ns |
| HcalEndcapPInsert | 500keV | 25ns |
| HcalBarrel | 75keV | 25ns |
| HcalEndcapN | 170keV | 25ns |
| B0ECal | 1MeV | 5ns |
| B0Tracker | 1.0keV | 40ps |
| ForwardOffMTracker | 1.0keV | 40ps |
| ZDCEcal | 1MeV | 5ns |
| ZDCHcal | 100MeV | 25ns |
| ForwardRomanPot | 1.0keV | 40ps |
| TaggerTracker | 1.0keV | 5ns |

- I used a 2.5MeV threshold for EcalBarrelSciGlass due to lack of information on the spreadsheet.
- For MRICH, DRICH, and DIRCBar, I only apply a threshold by dividing the number of hits by three;
- I only take into account the time resolution and do not factor in the integration time (except Vertex Barrel and SiBarrel);
- I consider the time resolution to be 25ns for HCal and 5ns for ECal;

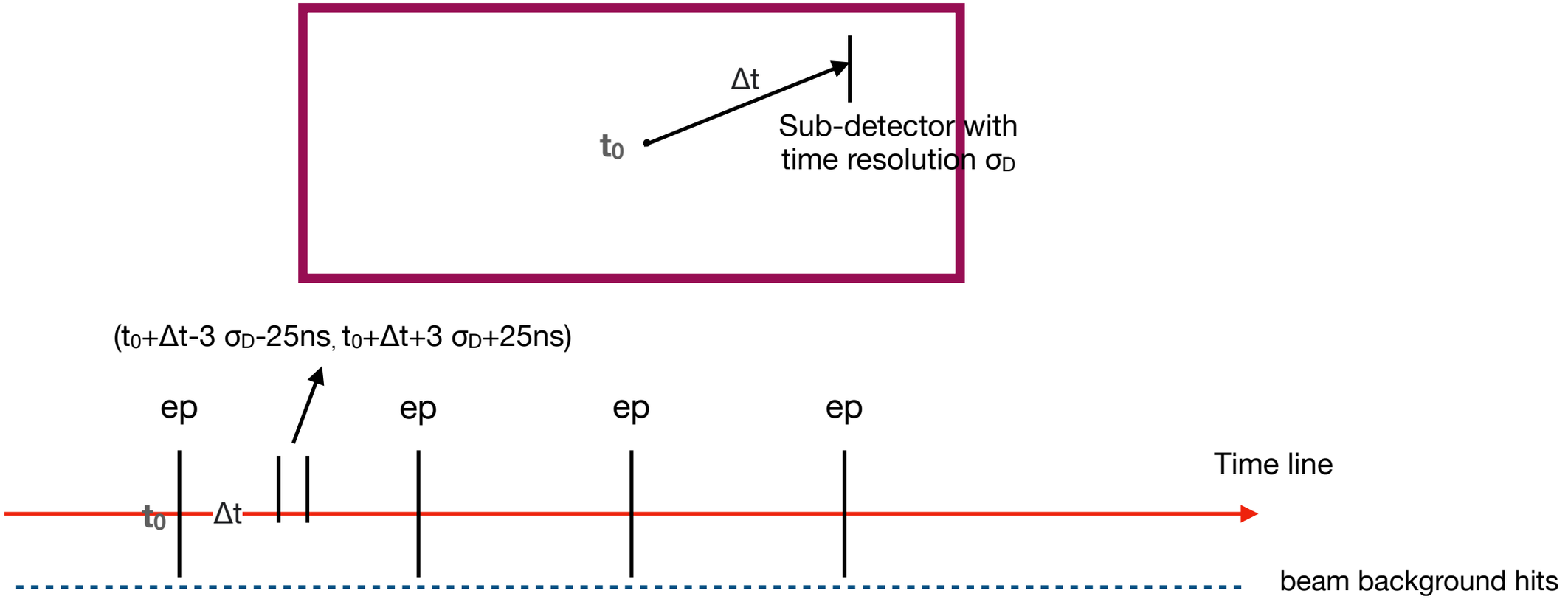
# Threshold applied




- I generated 2 million HepMC3 events for proton beam gas at 275GeV, 100GeV, and 41GeV: /gpfs/mnt/gpfs02/eic/zhangzq/pythia8/beameffect/BeamGasEvents/ProtonBeamGasEvents
- Wiki page is updated with the new threshold: https://wiki.bnl.gov/EPIC/index.php?title=Background

# Considering timing

- Here I only provided a very rough estimation of the hit rate based on timing analysis;
- The luminosity I used is $10^{34}cm^{-2}s^{-1}$ and cross section for ep collision is $5.4*10^{-2}mb$, so the collision is $5.4*10^{5}$ Hz which means about 1852 ns per collision;
- Here I assume the uncertainty for the ep collison time is 25ns;
- The width of the time window is $2.0*(3\ \sigma_D+25ns)$ and only the beam background hits in the time window would be considered as "valid" hits;
- Take ECAL as an example, $\sigma_D = 5ns$, then the percentage of "valid" hits is $2.0*(3*5ns+25ns)/1852\ ns = 4.4\%$;



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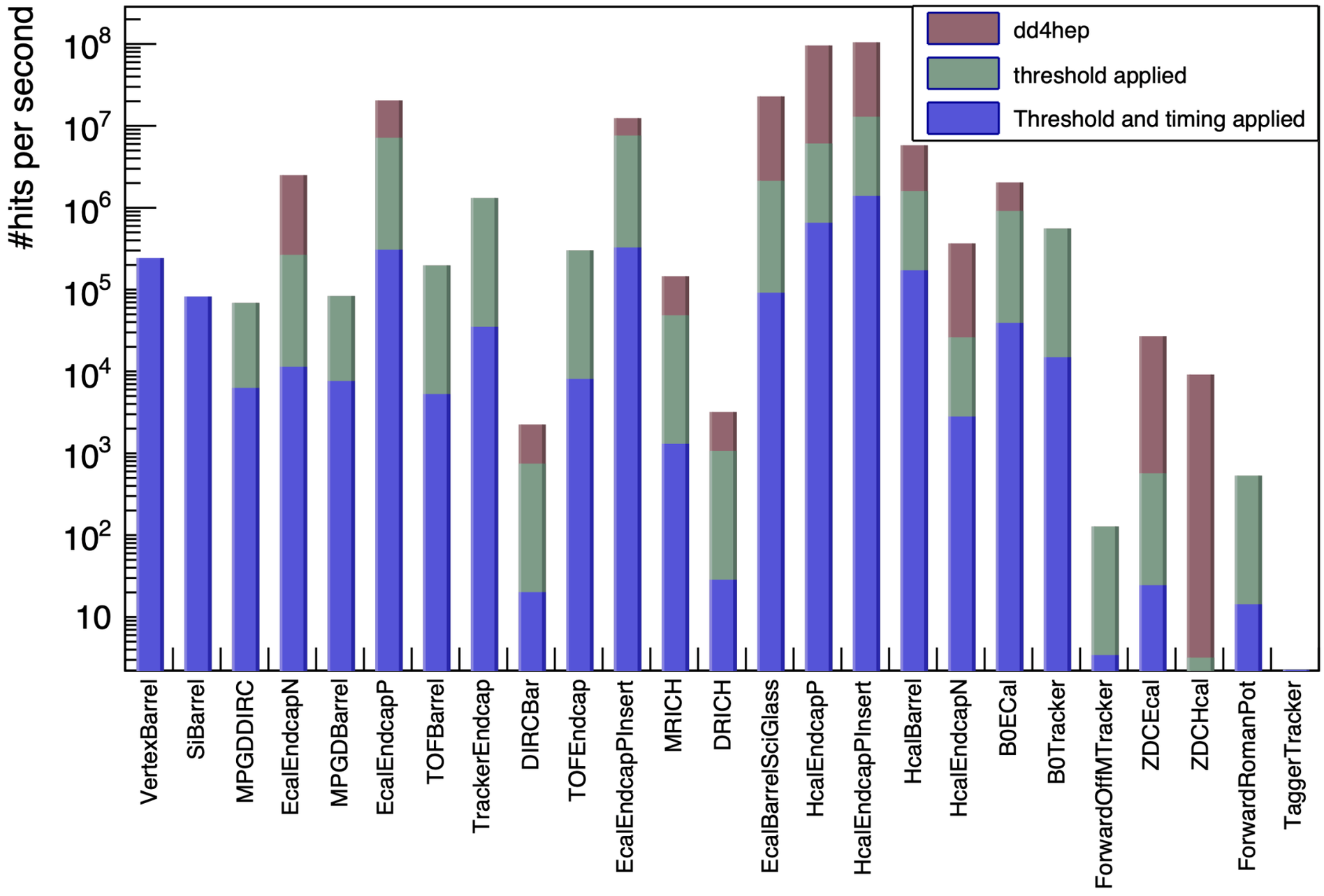

# Summary

- I generated 2 million HepMC3 events for proton beam gas at 275GeV, 100GeV, and 41GeV: /gpfs/mnt/gpfs02/eic/zhangzq/pythia8/beameffect/BeamGasEvents/ProtonBeamGasEvents
- The hit rates for sub-detectors have been updated, taking into account of new threshold and timing;
- Wiki page is updated with the new threshold: https://wiki.bnl.gov/EPIC/index.php?title=Background