Hit and channel rates in MPGD detectors with backgrounds

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MPGD rates

- Sept 15: Elke's email reminded that there were new updates on the background estimates.
- Sept 11: Shujie and Barak presented some work on tracking with 2µs background added to signal events.

This study:

- Use the same simulation file produced by Shujie to check the rates on MPGDs
- Compare with no-backgorund simulation

What is simulated:

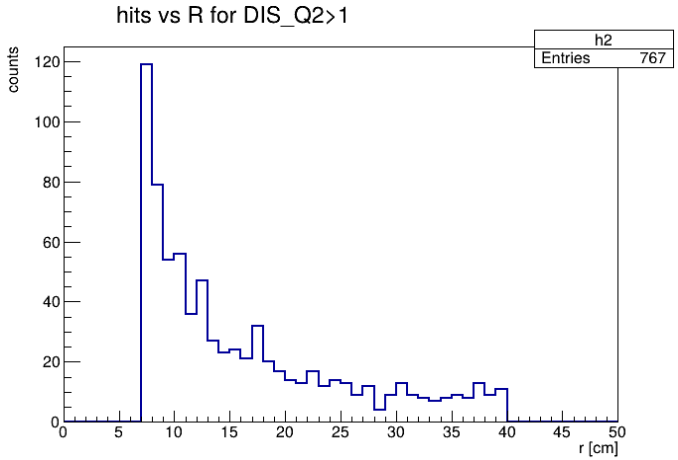
- One DIS event $Q^2>1GeV^2$ per event in the 18x275 beam configuration
- 2µs equivalent of background hits merged to every DIS event
- For the no-background, use one of the 18x275 $Q^2>1GeV^2$ assuming 500kHz collision rate

Remarks:

- Why 2µs ? Because this is the expected time-frame window in the streaming r/o DAQ
- Which background sources? AFAIK, all are included: e and p beam gas, synchrotron radiation, …
- The physics event chosen ($Q^2>1GeV^2$) is only a fraction of the total cross section, but IMHO sufficiently representative in term of hit distribution
- **No cluster size considered** all channel rates must be multiplied by a factor 2 or 3

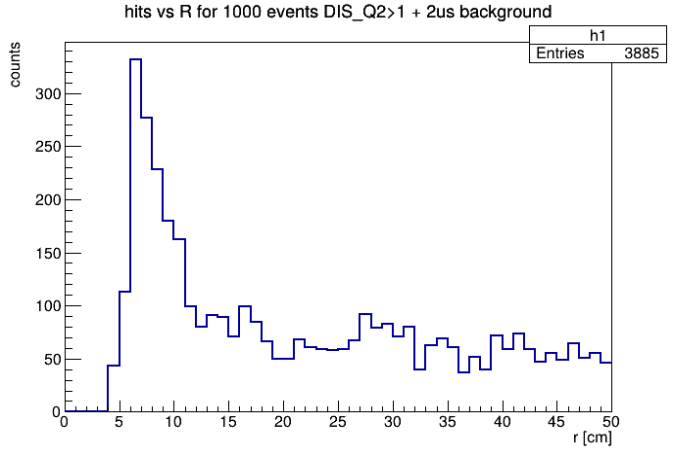
Backward ECT

DIS events, No bkg



Disk at z~-111cm
Max hit rate: ~1.8kHz/cm2
Max channel rate: ~4.5kHz
Disk at z~-121cm
Max hit rate: ~2.5kHz/cm2
Max channel rate: ~6.2kHz

DIS events, 2μs bkg



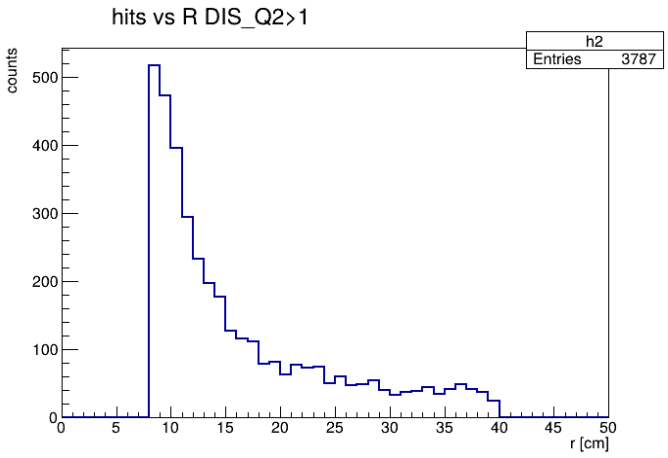
Disk at z~-111cm
Max hit rate: ~3.5kHz/cm2
Max channel rate: ~8.7kHz
Disk at z~-121cm
Max hit rate: ~2.8kHz/cm2
Max channel rate: ~6.9kHz

Strip area: 40cm x 615μm

Background impacts mostly the disk closer to the IP

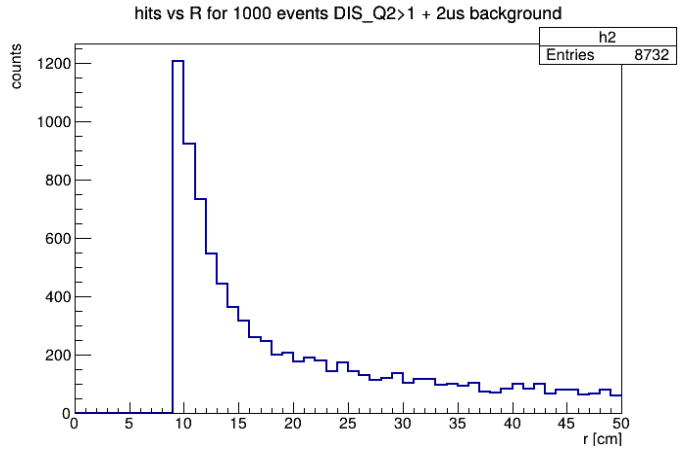
Forward ECT

DIS events, No bkg



Disk at z~ 150cm
Max hit rate: ~9 kHz/cm2
Max channel rate: ~22 kHz
Disk at z~ 163cm
Max hit rate: ~9.9 kHz/cm2
Max channel rate: ~24 kHz

DIS events, 2μs bkg



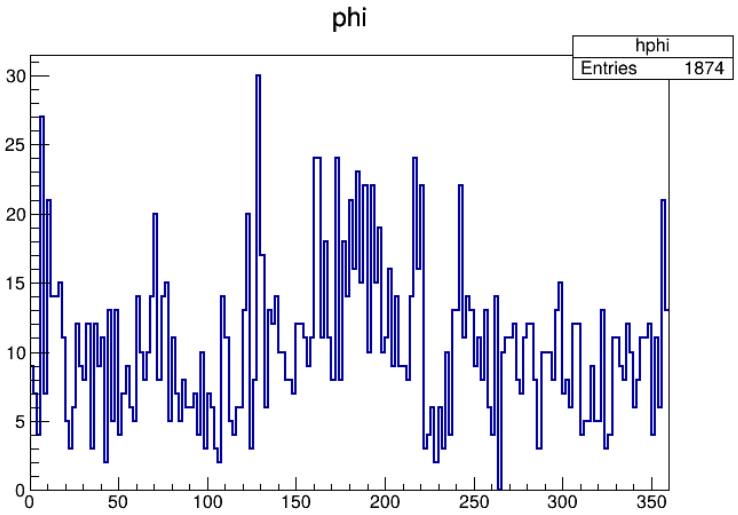
Disk at z~ 148cm
Max hit rate: ~7.7 kHz/cm2
Max channel rate: ~19 kHz
Disk at z~ 161cm
Max hit rate: ~9.1 kHz/cm2
Max channel rate: ~22 kHz

Strip area: 40cm x 615μm

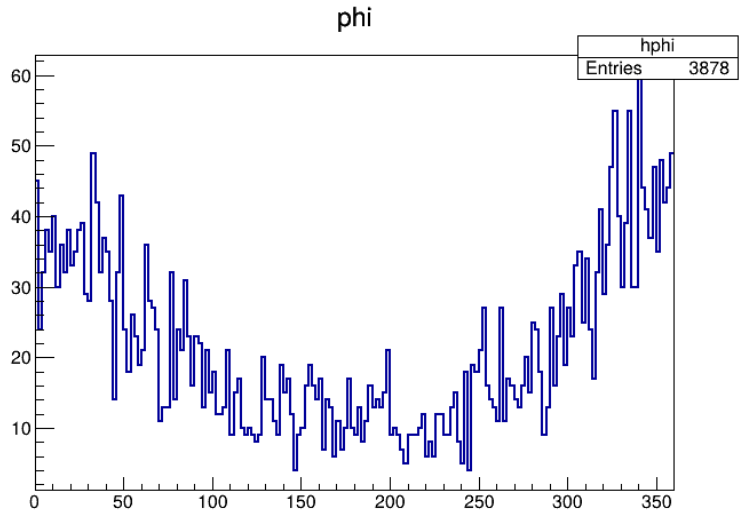
- Hit rates in the forward direction dominated by physics
- Small difference w/o and w/ bkg probably due to the non-exact identical implementations of ECT

ECT phi distributions

Backward



Forward

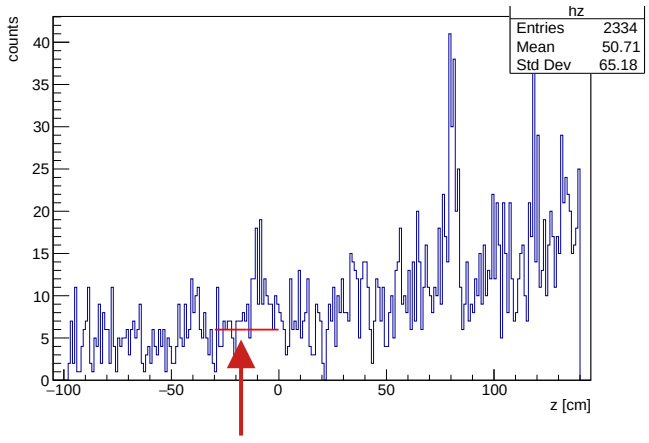


Hit distribution in phi associated to the maximum rate:

- Backward: uniform distribution
- Forward: visible effect of the crossing angle

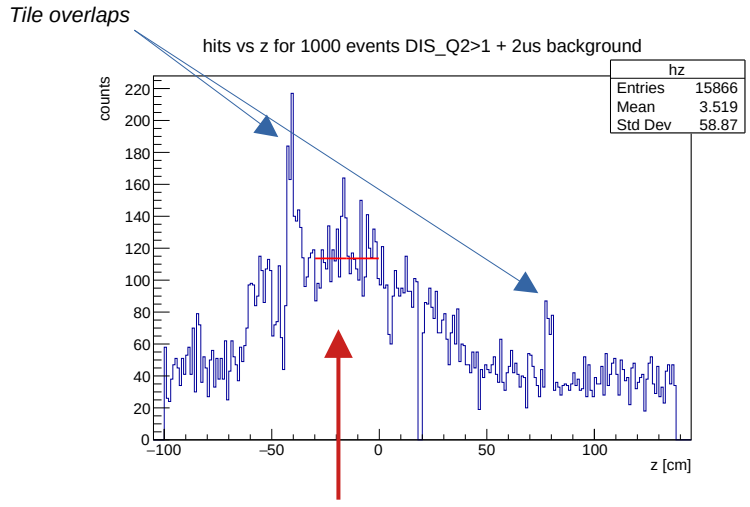
CyMBaL rates

DIS events, No bkg



Max rate ~ 20 Hits/cm2
Max channel rate : ~0.12 kHz

DIS events, 2µs bkg



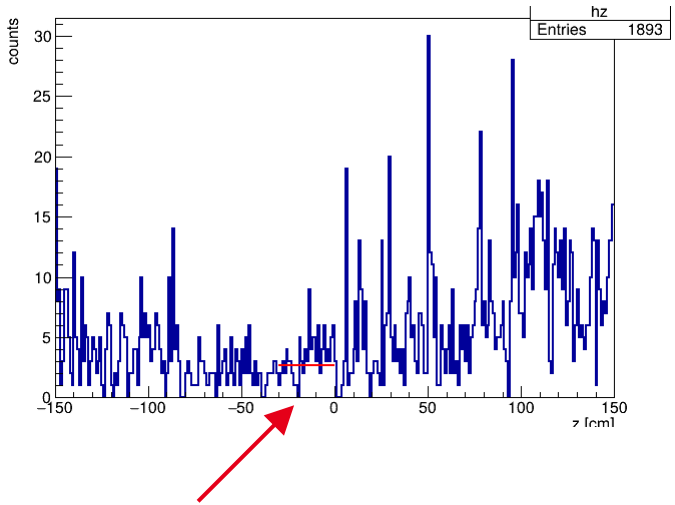
Max rate ~ 165 Hits/cm2
Max channel rate : ~1 kHz

Strip area: 58cm x 1mm

- Hit rates dominated by background hits, that have a significantly different longitudinal distributions

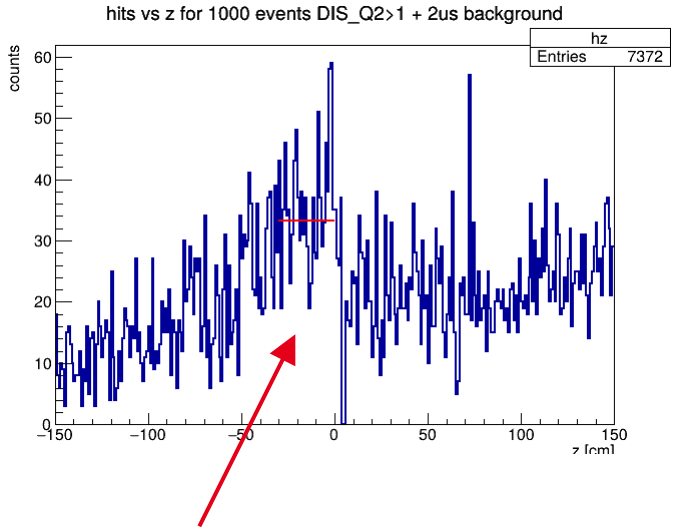
BOT rates

DIS events, No bkg



Rate ~ 6 Hits/cm2
Channel rate : ~25 Hz

DIS events, 2µs bkg



Rate ~ 36 Hits/cm2
Channel rate : ~140 Hz

Strip area: 33cm x 1.13mm

Summary

- Simulations with embedded 2μs background really useful to estimate the MPGD rates
- **Even with backgrounds, hit rates are within standard MPGD capabilities.**
- The maximum rates are expected in the forward region, mostly due to DIS interactions
- CAVEAT. The values for channel rates reported here do not include estimates for cluster size. Therefore a factor 2-3 should be considered.