PXD Background Studies

13th Intl. DEPFET Workshop
Ringberg 2013

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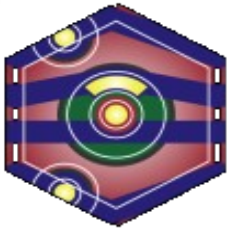
Two largest backgrounds considered:



Two photon QED (luminosity)
Touscheck (machine)

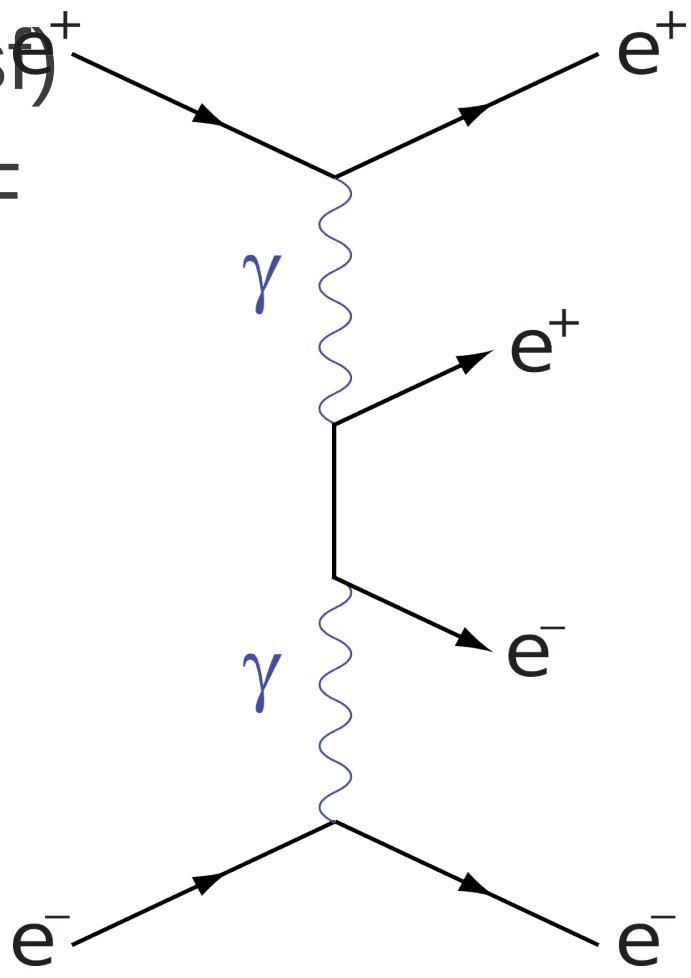
→ Occupancy of the sensors
Impact on DAQ, tracking, data reduction etc.

Two Photon Background

- Generated with BDK (basf)
- Expected events per ROF

(no detector acceptance cut)

N = L*t*Xs = 116800



with

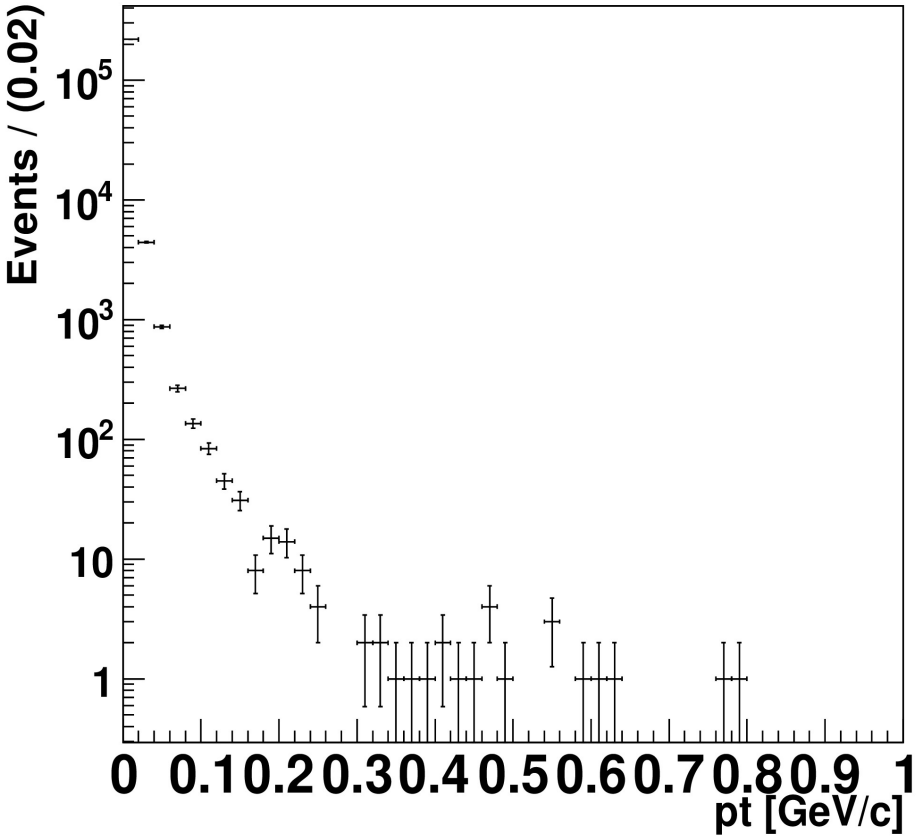
luminosity: L = 0.8/pbs,

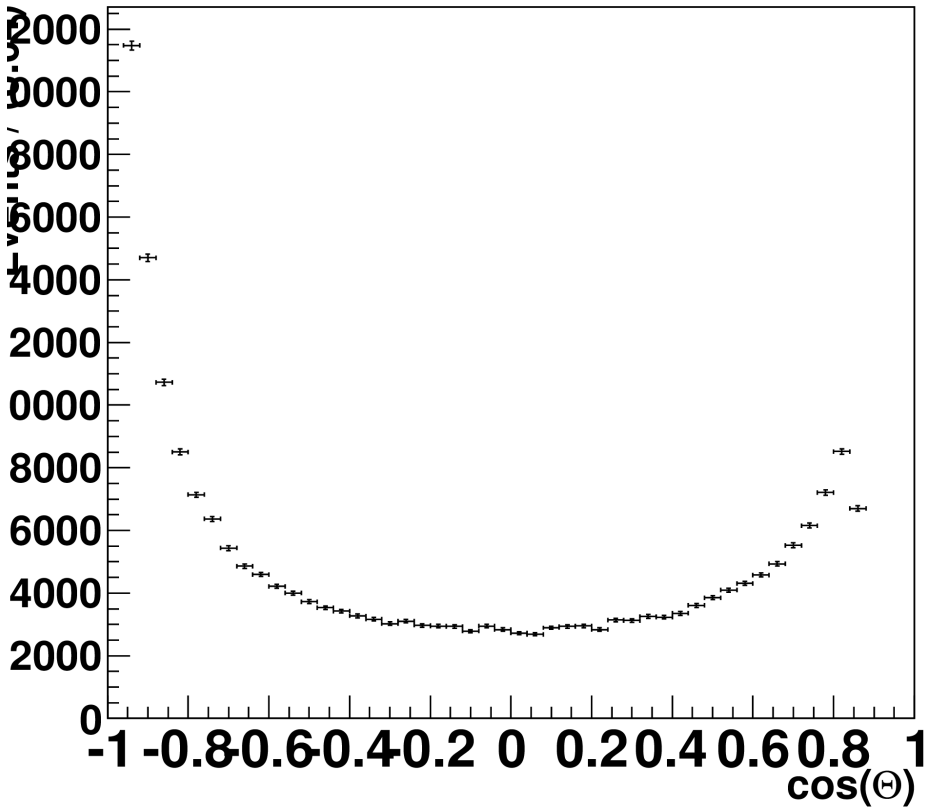
readout time: t = 20us,

crosssection: Xs = 7.3 x 10^9 pb

BDK (Generator Level)

CMS, cuts: p_t >3 MeV & -0.96 < cos(Θ) < 0.87





~0.5 % within detector acceptance

BDK - Towards ROF Files

- Generate Events with BDK → HepEvt files
- Full simulation → root files

```
paramloader = register_module('Gearbox')
geobuilder = register_module('Geometry')
g4sim = register_module('FullSim')
```

- ROF files building → ROF root files

```
rofbuilder  = register_module('ROFBuilder')

rofbuilder.param('Subdetector', 1)
rofbuilder.param('ComponentName', "TwoPhotonQED")
rofbuilder.param('GeneratorName', "BDK")
rofbuilder.param('MCParticleWriteMode', 2)
rofbuilder.param('EventsPerReadoutFrame', 116800)
rofbuilder.param('SimHitCollectionName',"PXDSimHits")
rofbuilder.param('SimHitMCPartRelationName',
"MCParticlesToPXDSimHits")
```

Occupancy Study

Occupancy = N(PXDDigihits)/N(PixelPXD)

per layer and event

Npixel = 250 * 768 * 2 * N(ladders, 8 or 12)

= **3072000** (layer 1) and **4608000** (layer 2)

To make 'mixBKG' run I had to perform another full simulation while adding and analyzing the BKG.

```
main.add_module(evtmetagen)
main.add_module(gearbox)
main.add_module(geometry)
main.add_module(simulation) ?
main.add_module(bgmixer)
main.add_module(pxddigi)
main.add_module(pxdclust)
main.add_module(bkgs)
main.add_module(progress)
```

Settings

- PXDDigitization:

```
pxddigi = register_module('PXDDigitizer')

pxddigi.param('ElectronicEffects', False)
pxddigi.param('SimpleDriftModel', False)
```

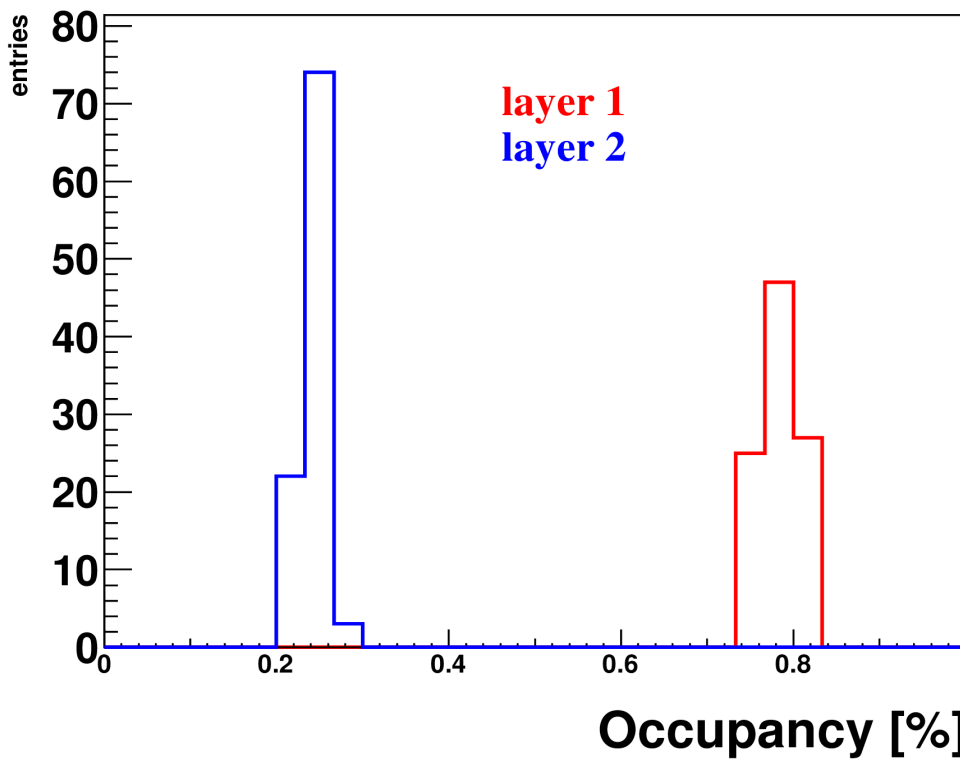
- PXDClusterization:

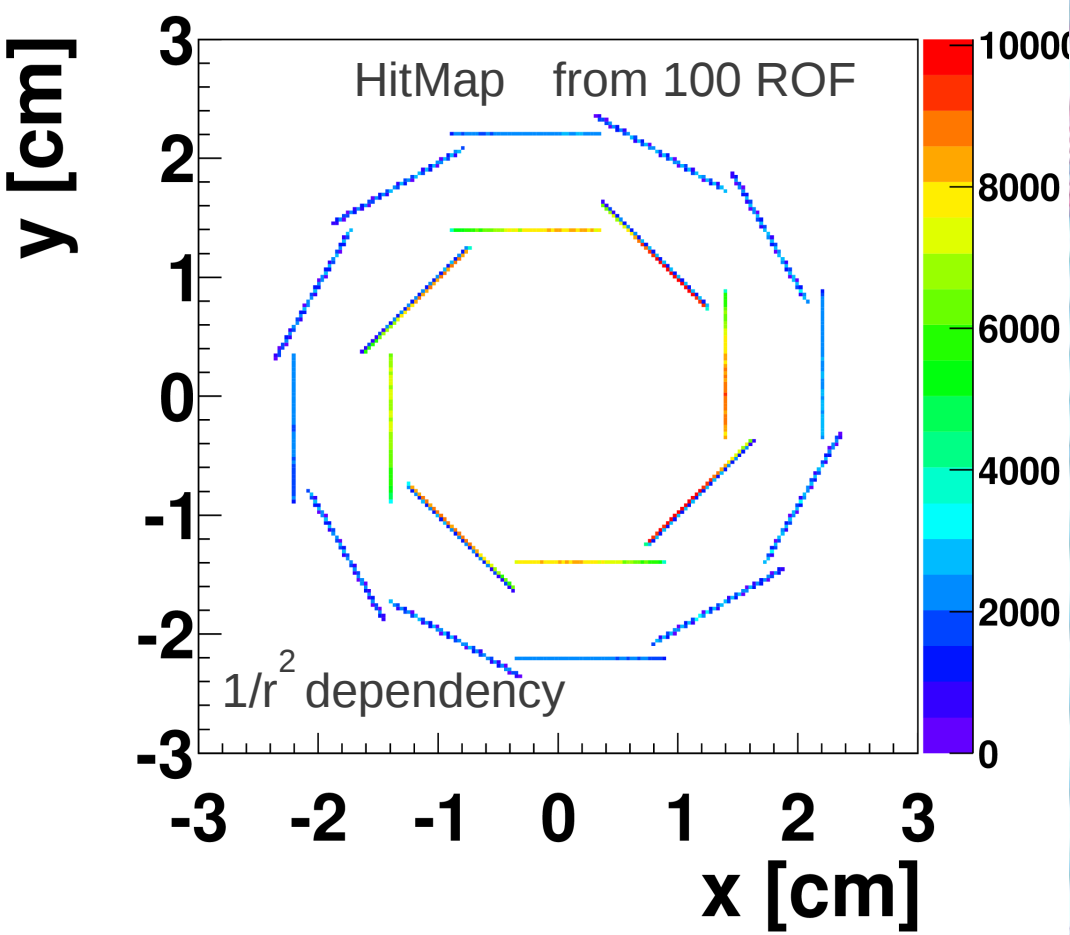
```
pxdclust = register_module('PXDClusterizer')

pxdclust.param('NoiseSN', 3.0)
pxdclust.param('SeedSN', 3.0)
pxdclust.param('ClusterSN', 3.0)
```

(basf2: rev. 5530)

(tools: rev. 5536)

Occupancy from BDK

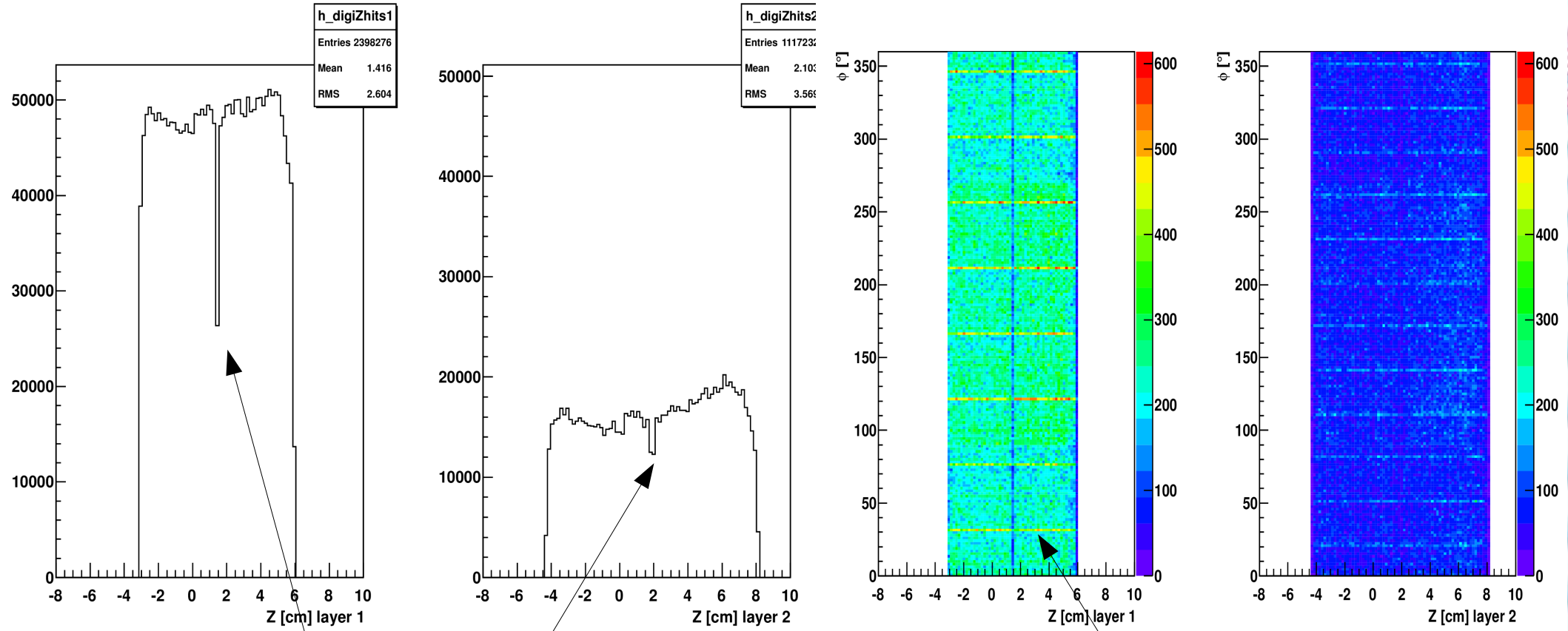




Occupancy:
~0.8 % for layer 1
~0.2 % for layer 2

Andreas' B2GM talk: 0.6-0.7 % for layer 1
KoralW, (Bad Aibling) 0.2 % for layer 2

Occupancy from BDK

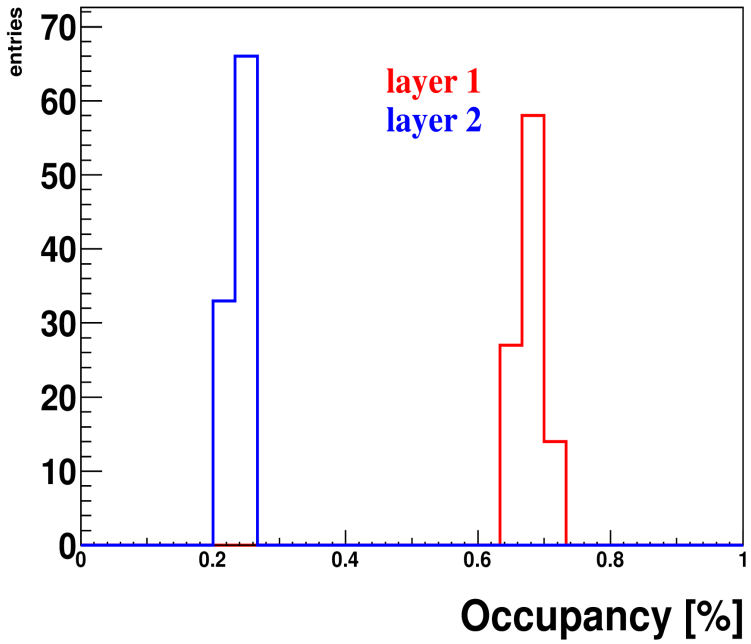


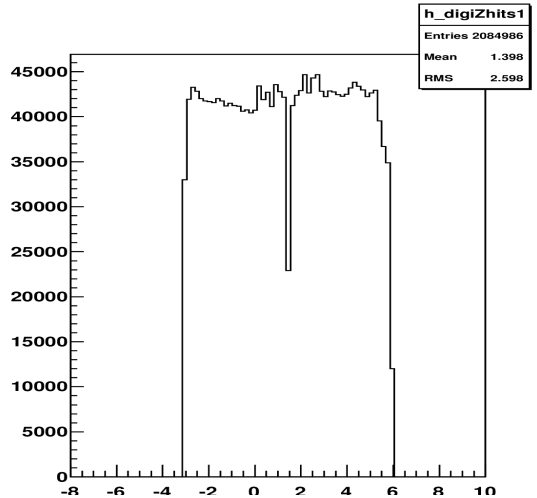
2 half ladders

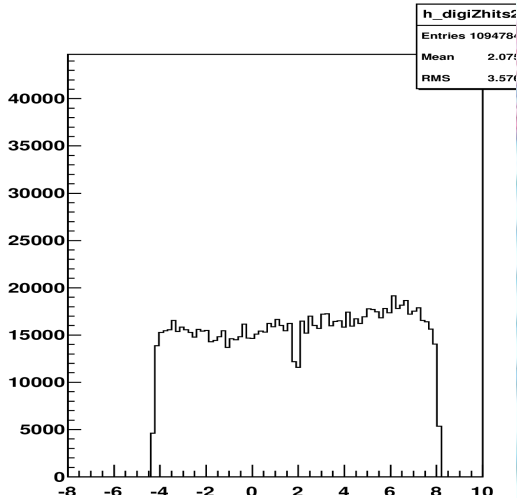
overlap

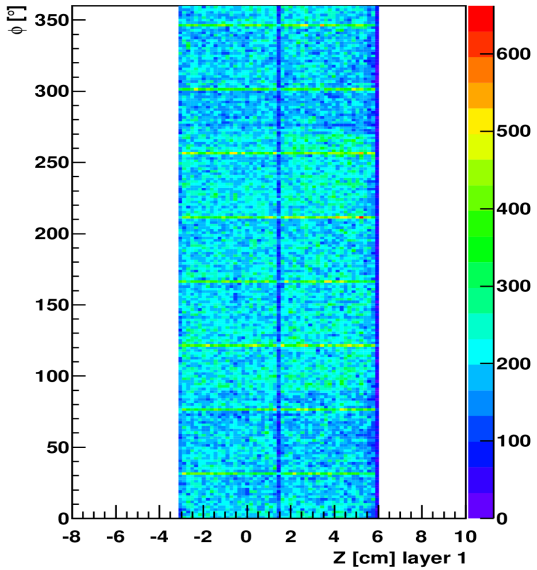
KoralW - Another Generator

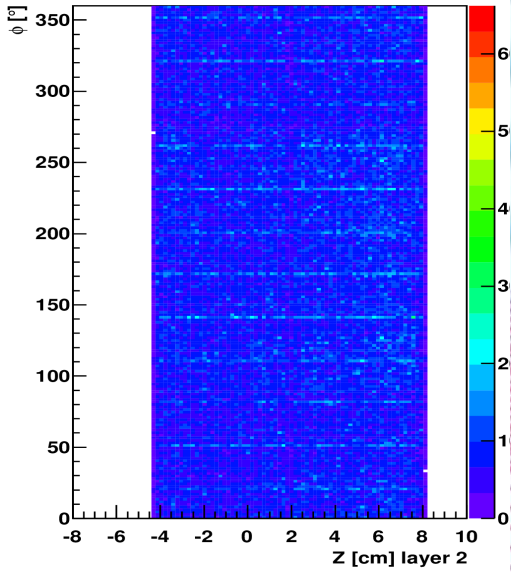
Also analyzed the file from the background page (BelleII TWiki)











Occupancy:
~0.7 % for layer 1
~0.2 % for layer 2

Touscheck

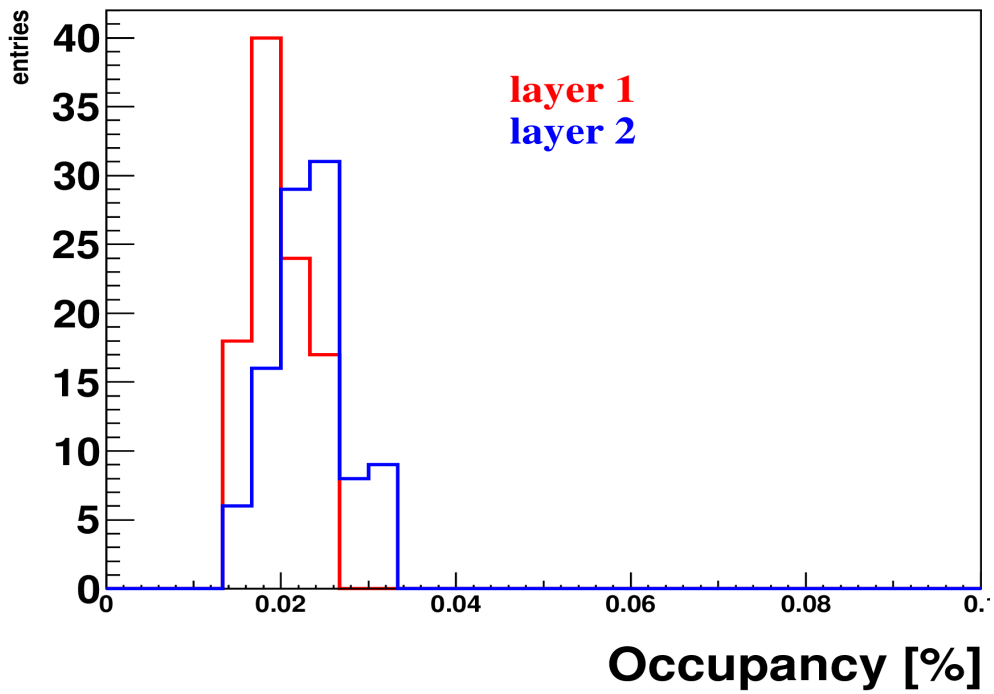
- Betatron oscillations → intrabeam scattering →

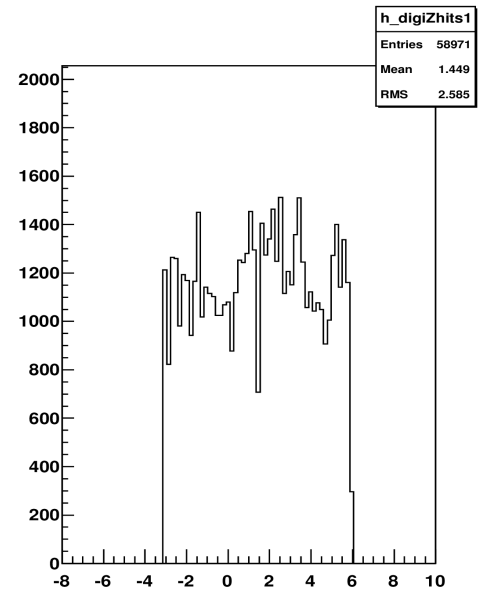
  beam looses particles that hit machine and produce showers → detector
- Coulomb scattering ~ $1/E^3$ → LER dominant
- Simulated with SAD
- Files analyzed (HER & LER together):

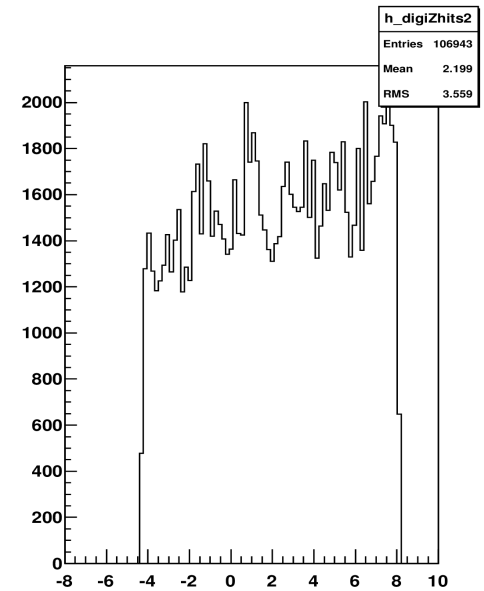
  '/gpfs/fs02/belle/users/harat/BGFile/MCprod_2013Summer/Touschek_HER/PXDROF_Touschek_HER_1ms_0x.root',

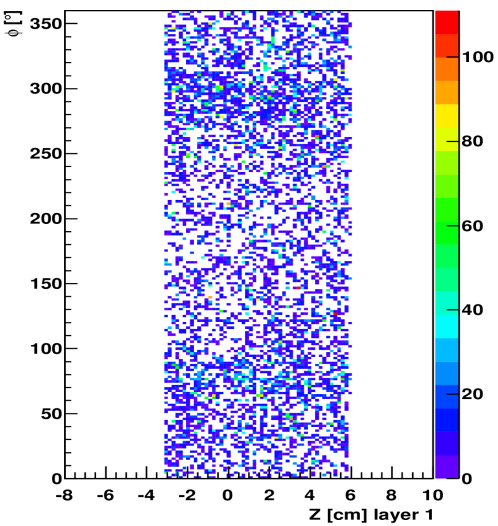
  '/gpfs/fs02/belle/users/harat/BGFile/MCprod_2013Summer/Touschek_LER/PXDROF_Touschek_LER_1ms_0x.root'

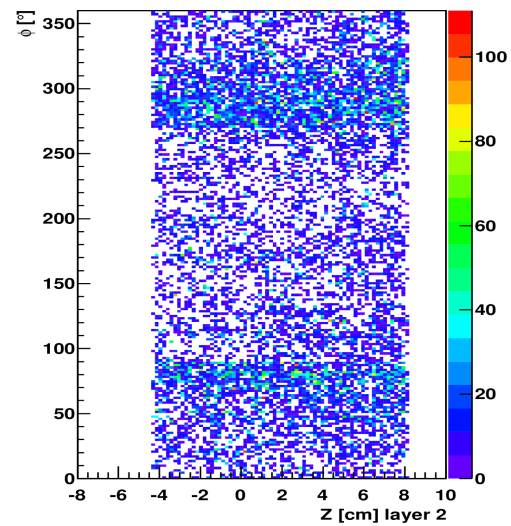
Occupancy from Touscheck











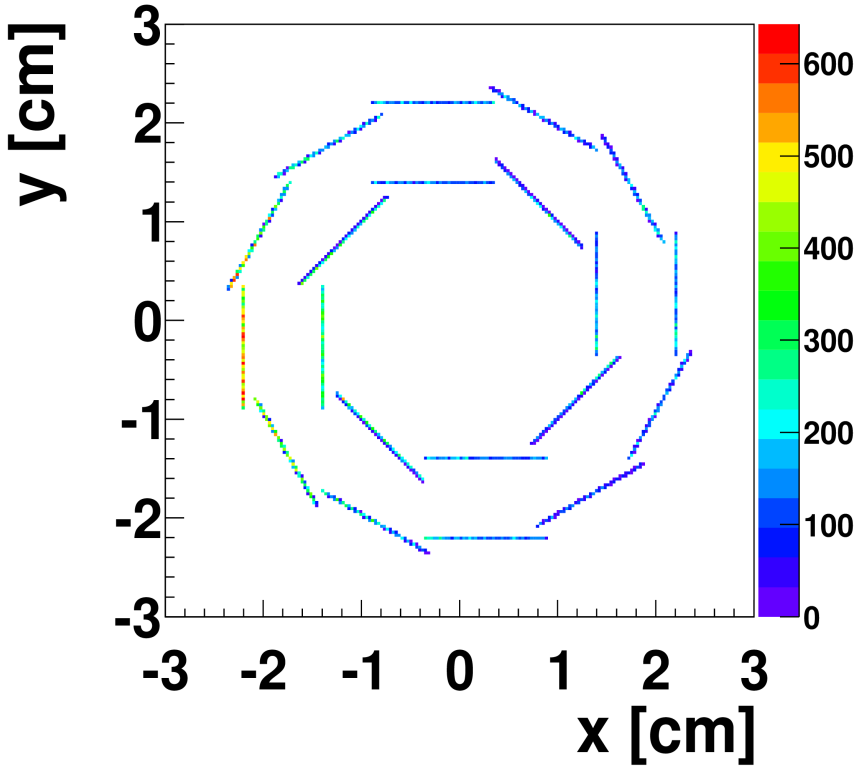
Occupancy < 0.1 %

Shielding?

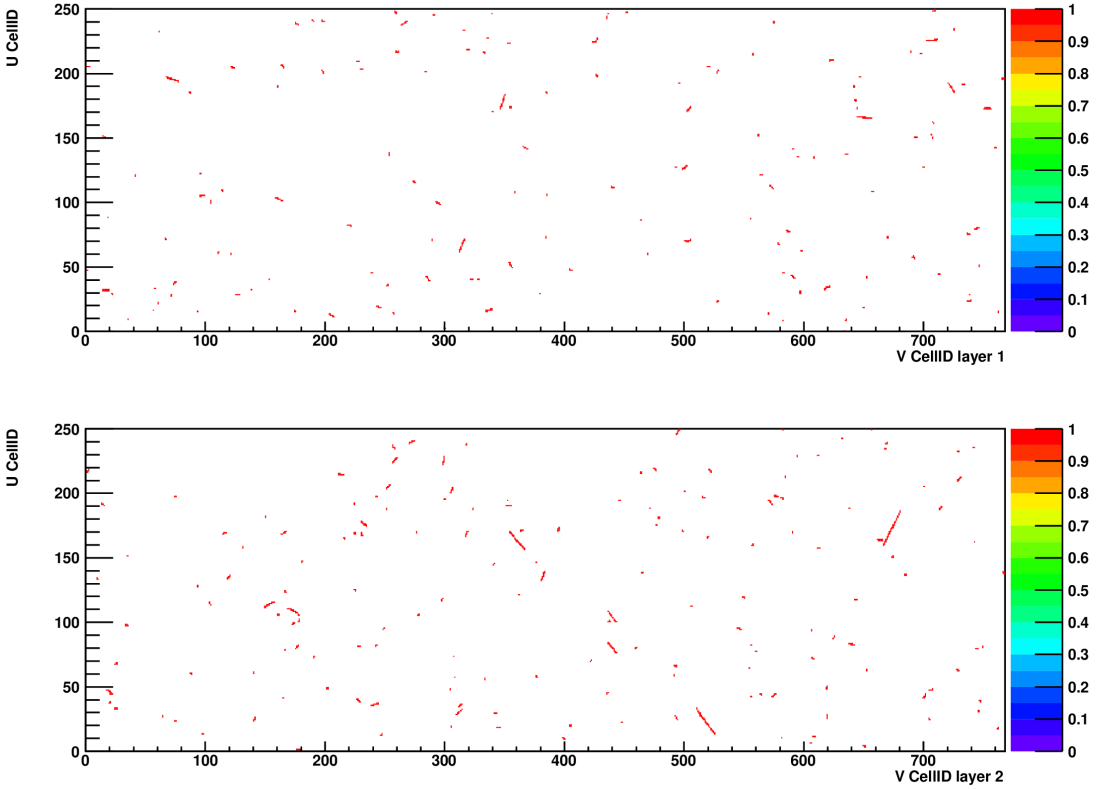
Andreas Bad Aibling talk:
Occupancy ~ 0.1 %

Occupancy from Touscheck

100 ROFs



1 ROF, all sensors



Summary

- PXD: total occupancy < 2 % needed
- two dominant (for PXD) backgrounds studied
  (others [beam-gas, RBB] are comparable small)
- Two Photon QED occupancy < 1%
- Toucheck occupancy < 0.1%

  => occupancy not critical for PXD performance
- Good agreement with previous studies (Andreas Moll, e.g. B2GM Bad Aibling)