IFR Background Report

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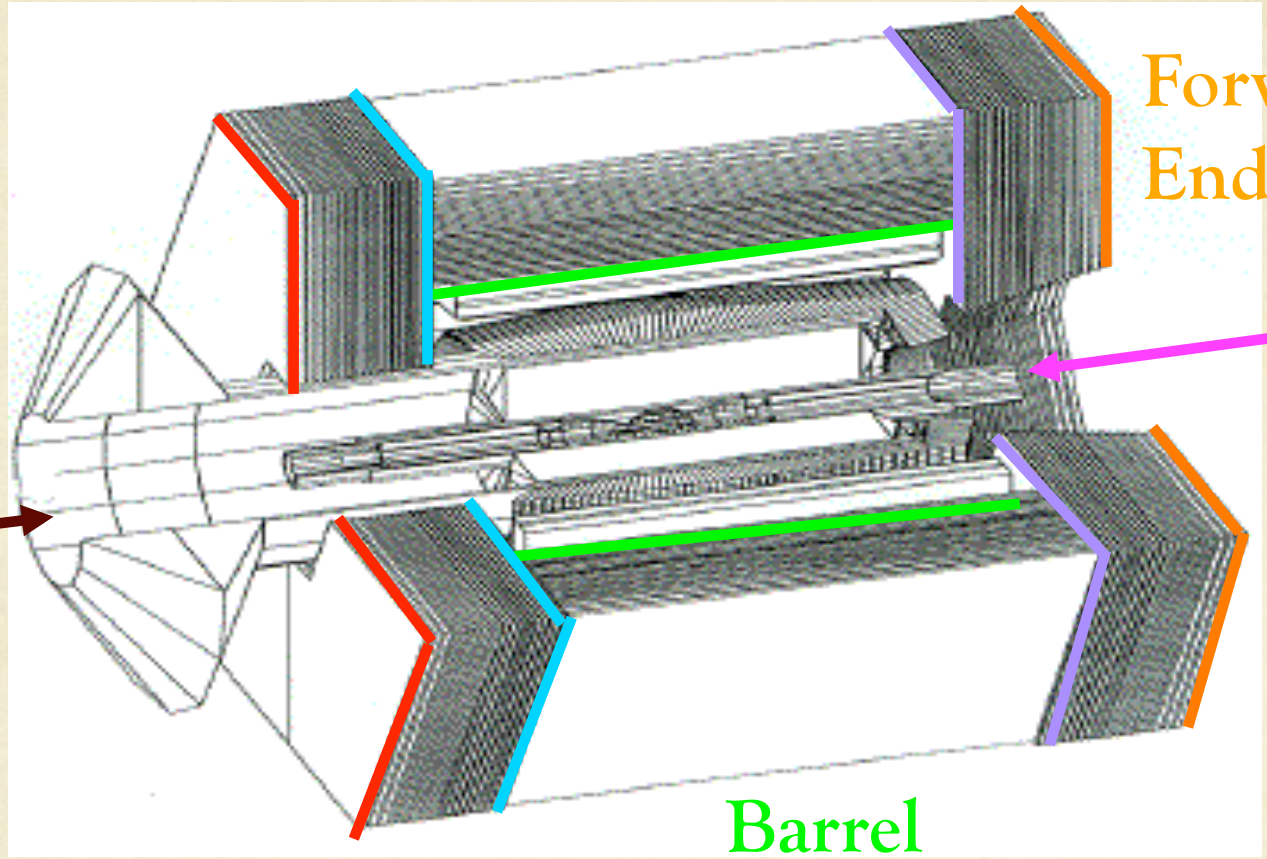
Hot regions



Barrel: innermost layers, mostly neutrons

FWD encaps (hottest region) : inner layer and outer layers (BEAM halo), neutrons, electron and photons

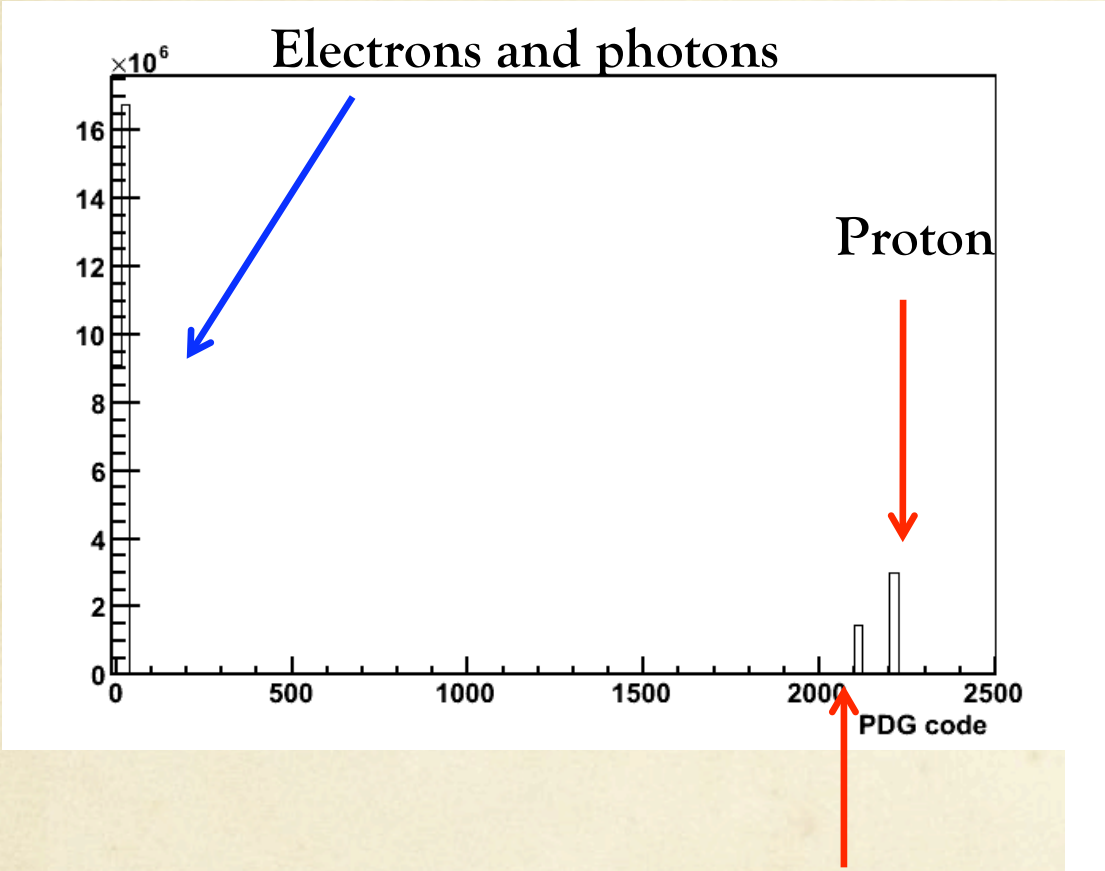
BWD encaps: inner layer and small radii

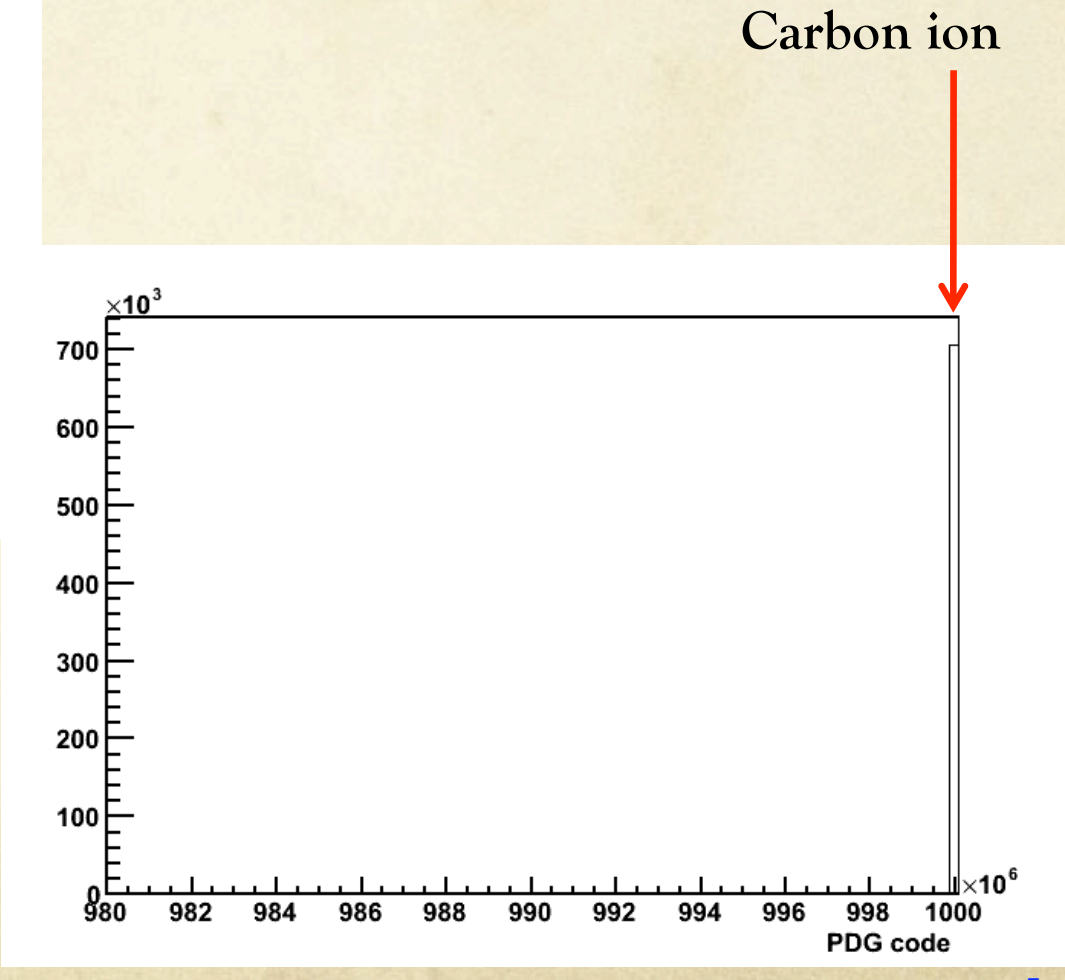
Outline

- ✓ Radiative BhaBha Background Studies (neutrons, photons and electron)
- ✓ Touschek background (neutrons, photons and electron)
- ✓ Pair background (neutrons, photons and electron)
- ✓ Background Studies on our FEEs

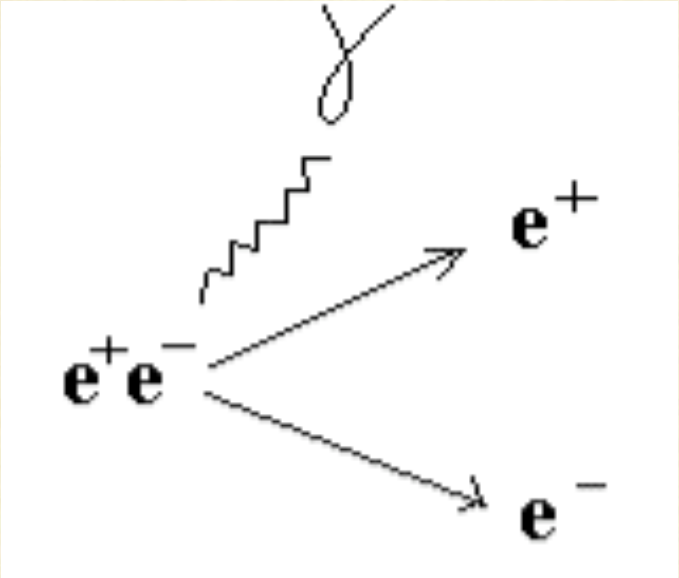
Beam Composition

- For BhaBha, Touschek and Pair events the particle crossing the IFR are photons, electron, protons, neutrons and heavy nuclei





Radiative BhaBha background crossing the IFR detector



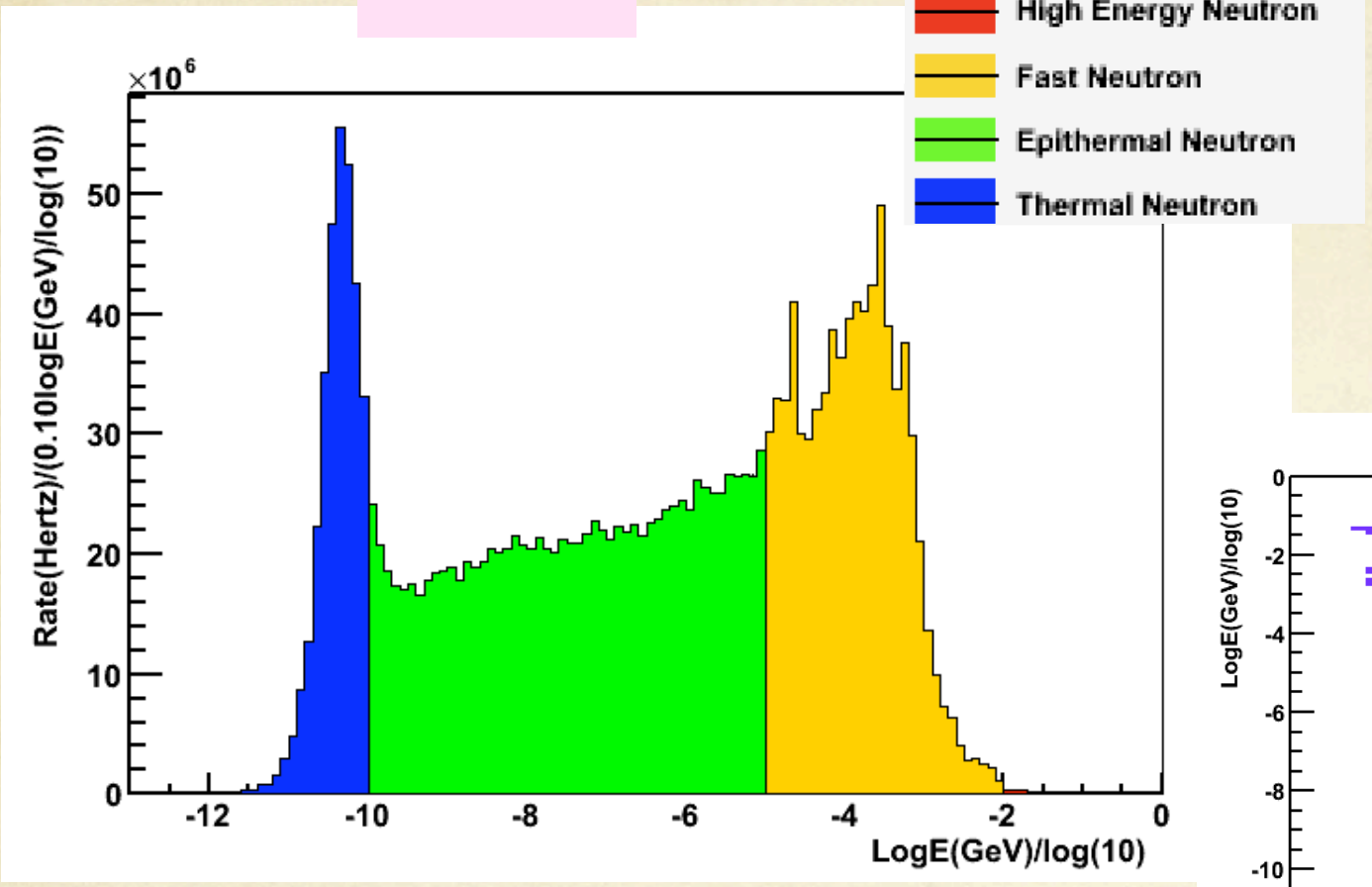
Neutrons

Why do we have to worry about neutrons

- Neutrons damage silicon devices →Neutrons damage SiPM
- The silicon damage function has a strong dependance on the energy spectrum therefore we scaled all the doses in this presentation to 1MeV equivalent accordingly to ASTM E 722 - 93.

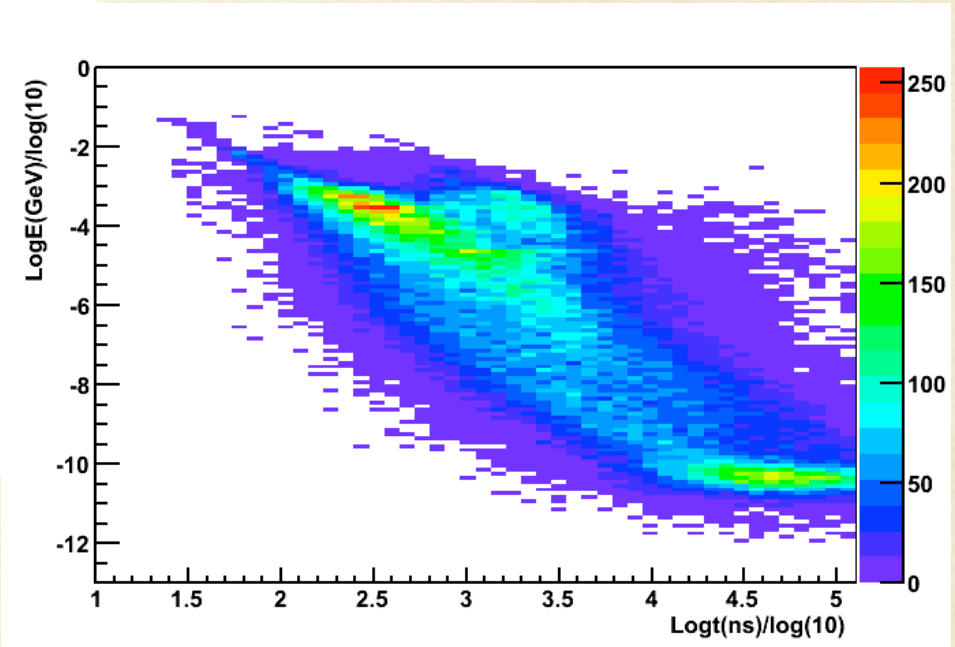
Neutron Energy Distributions for Radiativa BhaBha events

Barrel



Barrel

Energy vs time distributions



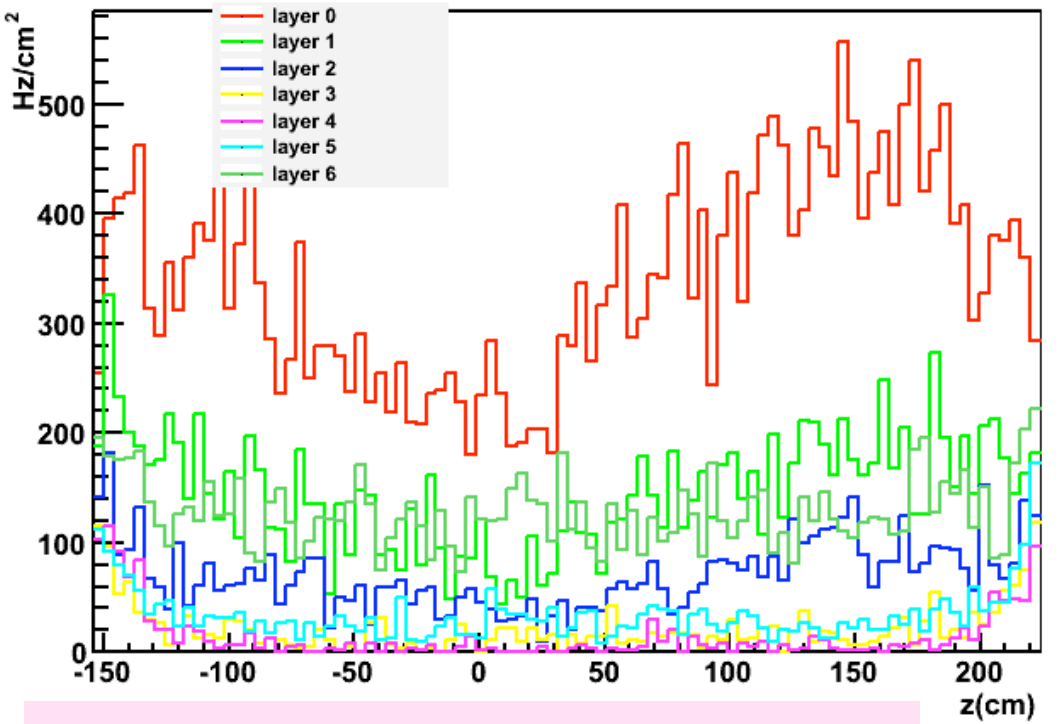
The Energy distribution for FWD and BWD Endcap are similar

Neutron Rates

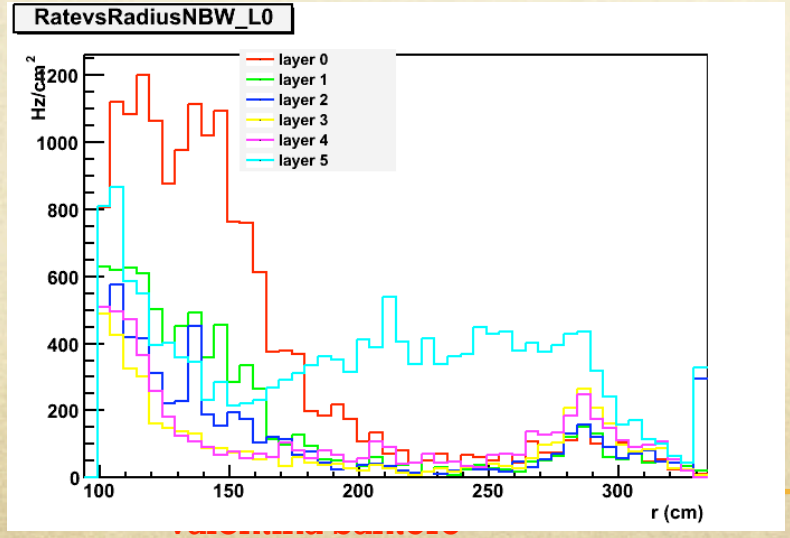
Rate vs Z-coordinate for Barrel

Rate of 450Hz/cm^2 -> about 3x10^9 neutrons/cm^2 for a year

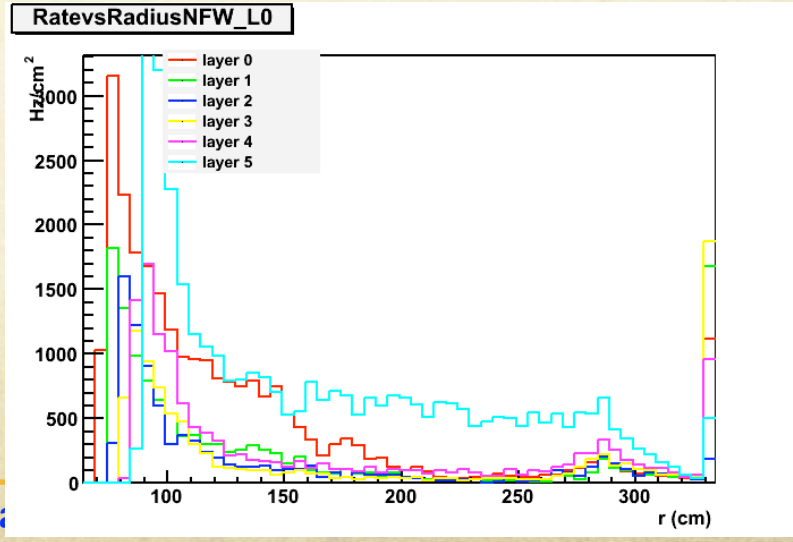
All the rate are normalized to 1MeV energy



Rate vs radius for BWD Endcap



Rate vs radius for FWD Endcap



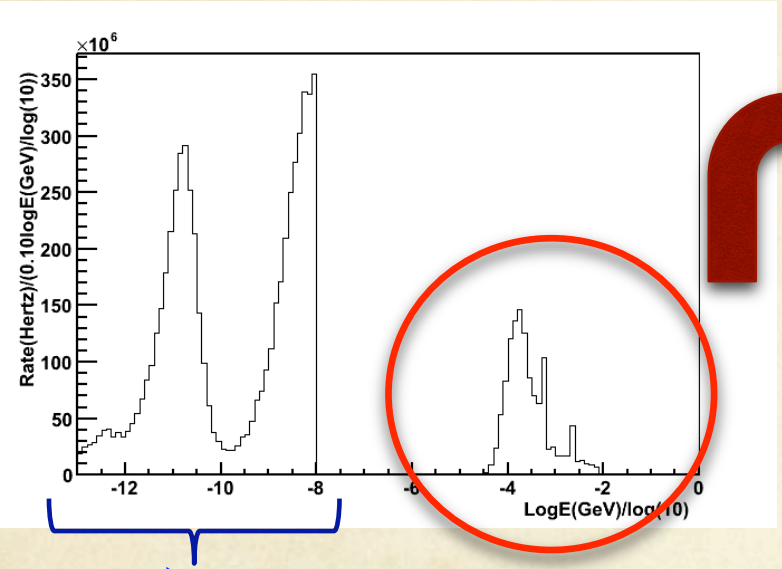
Photons

Why do we have to worry about photons

- High Energy Photons convert in e^+e^- that produce signal in the detector

Photon Energy Distributions for Radiativa BhaBha events

Barrel

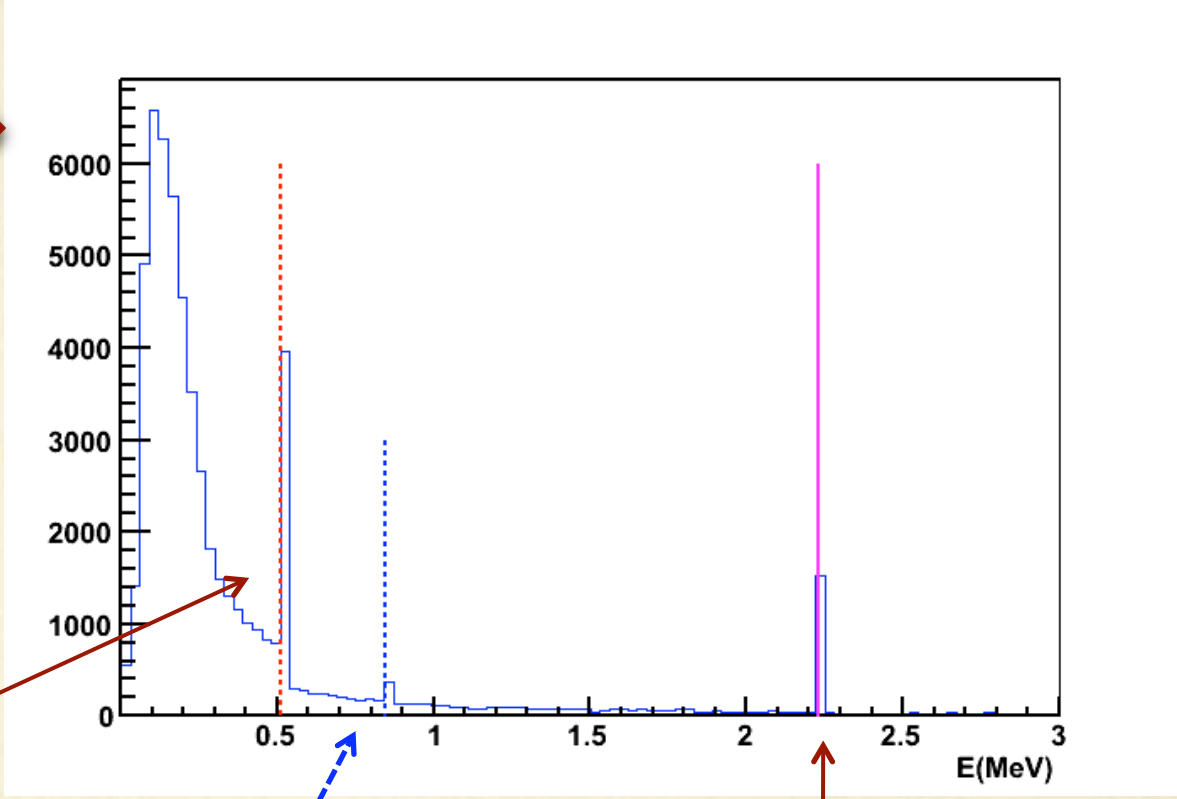


Low energy photons

Photons of energy ~0.512 MeV are from annihilation radiation

Barrel

Photon spectrum in the high energy region



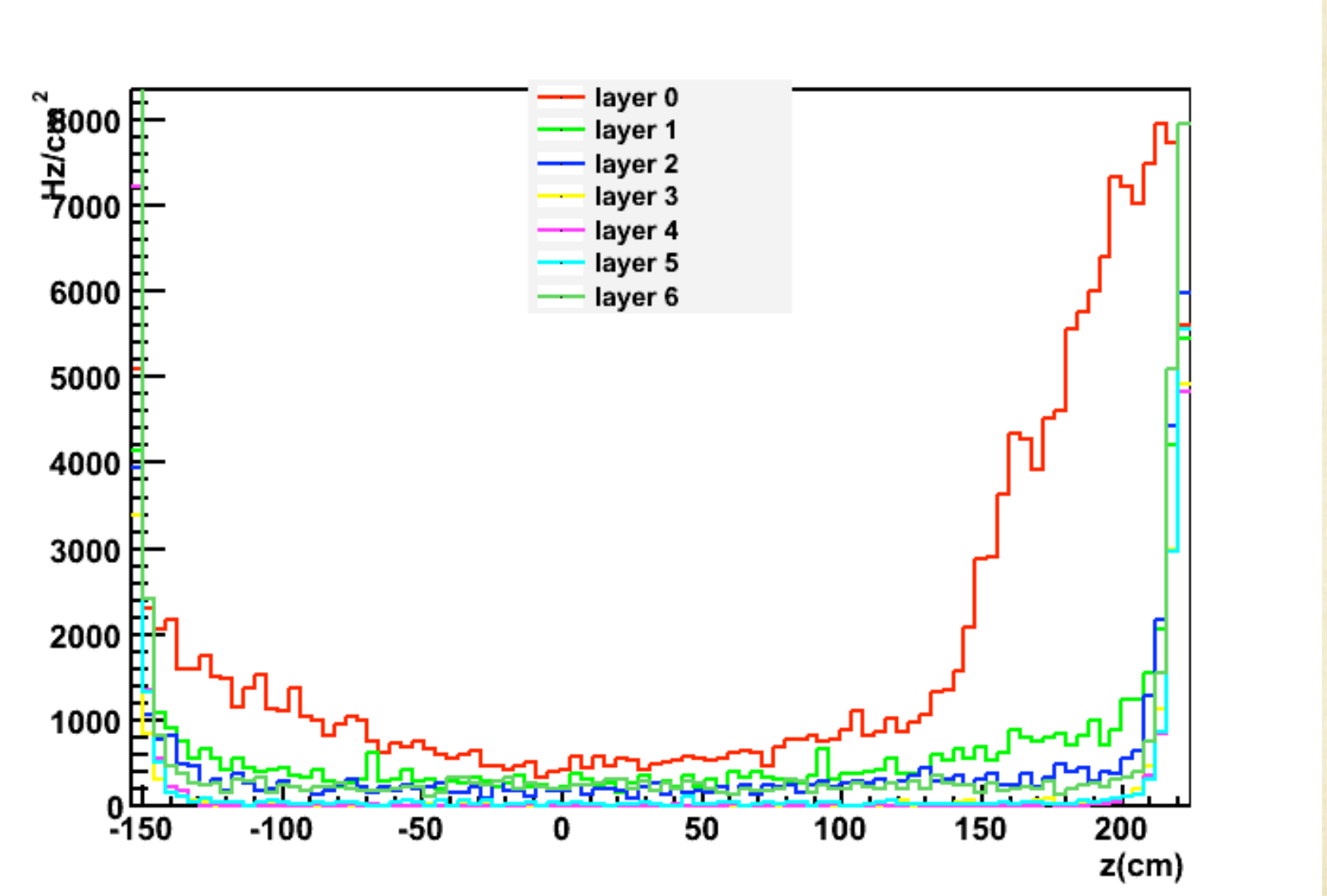
Photons of energy ~0.847 MeV are due from neutron inelastic scattering on Fe^{56}

Photons of energy ~2.223 MeV are from neutron capture on Hydrogen

The Energy distribution for FWD and BWD Endcap are similar

γ rates for Different layers

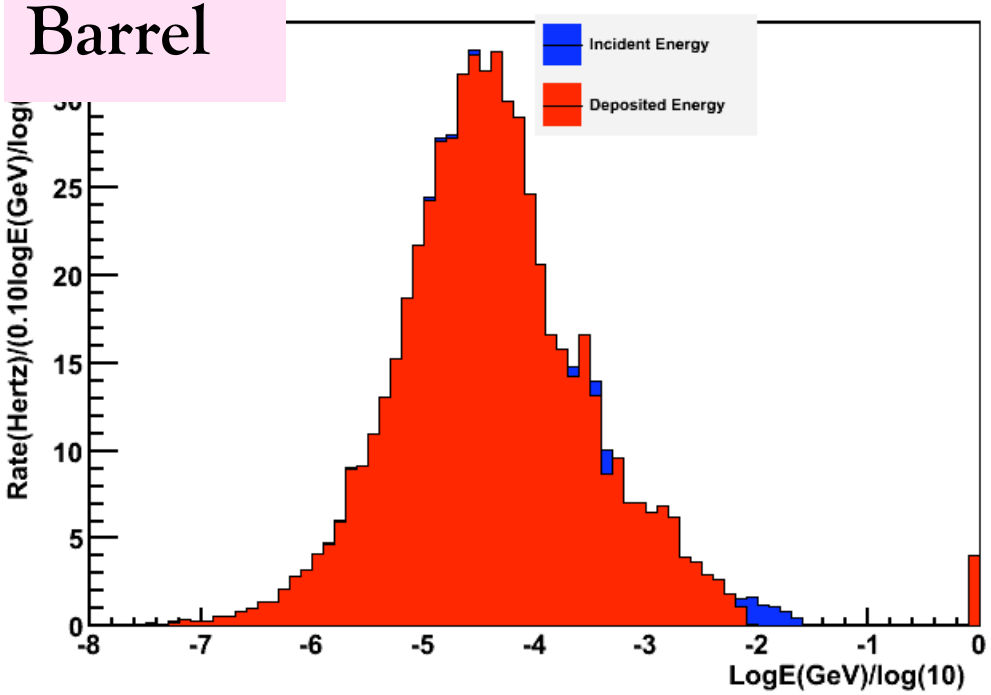
Rate vs Z-coordinate for Barrel



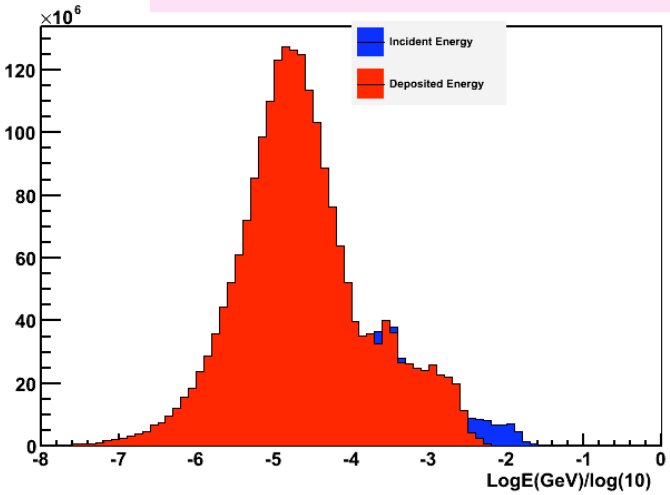
This rate is due only to photon with E >10keV

Electron Energy Distributions for Radiativa BhaBha events

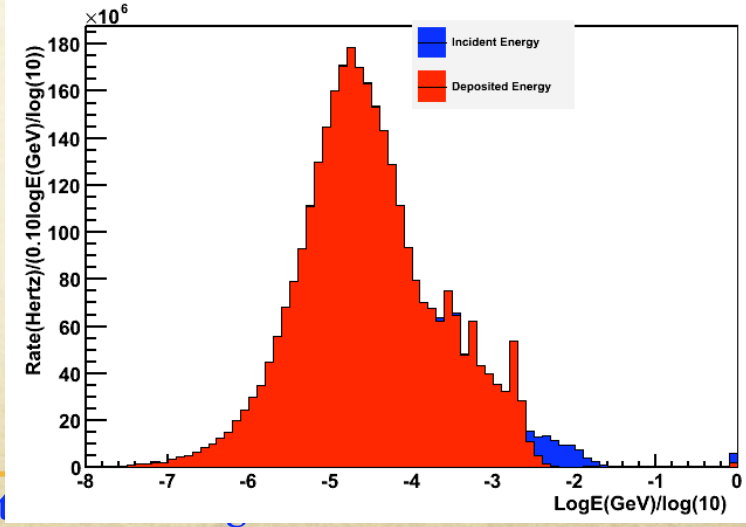
Barrel



Backward Endcap

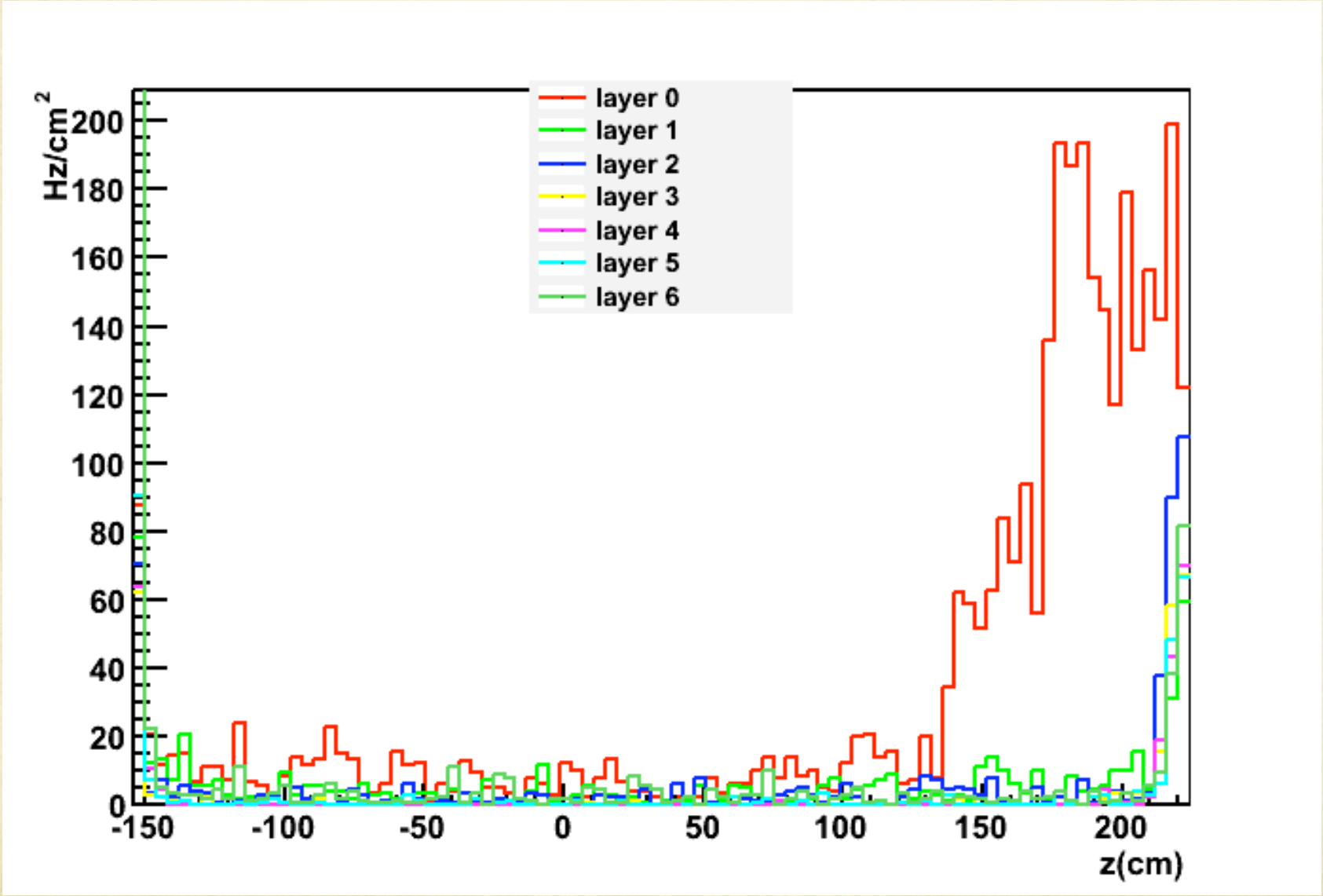


Forward Endcap



Electron rates for Different layers

Rate vs Z-coordinate for Barrel

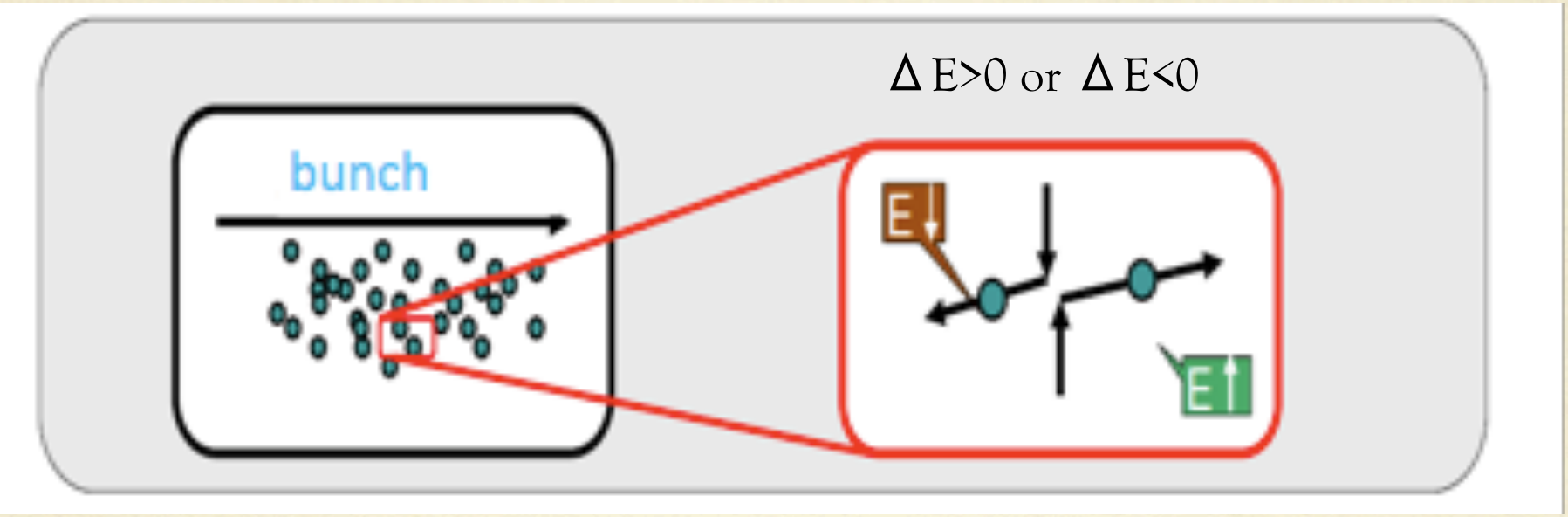


Summary on BhaBha studies

- ✓ The neutrons rates are very high and dangerous for our Sipm
- ✓ The photons and electrons rates are high but they should not be a problem

Touschek events studies

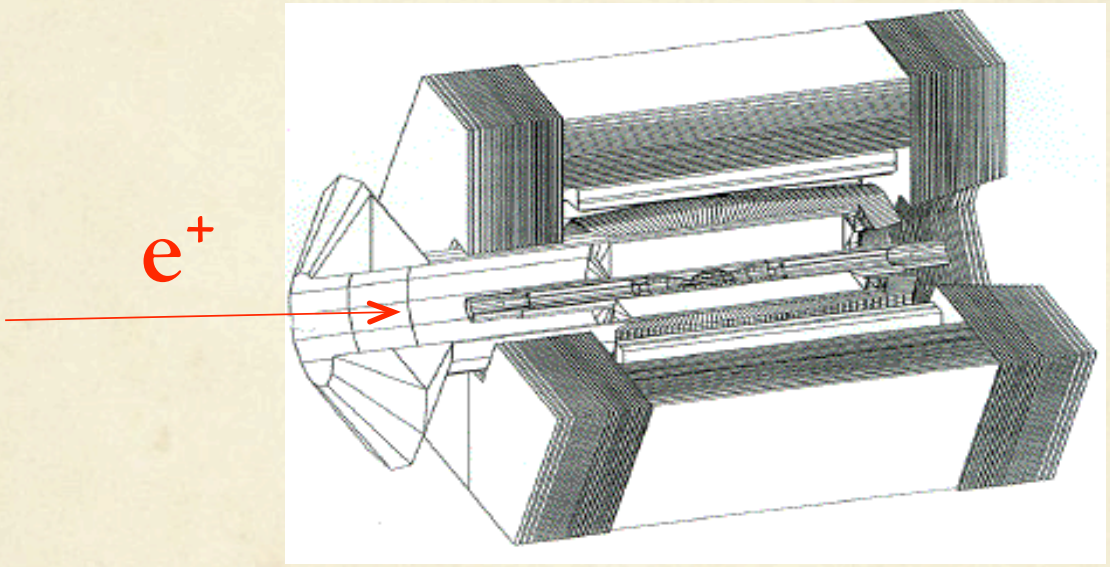
Touschek scattering results from a Coulomb collision of two relativistic electrons in a particle beam, producing an instantaneous change in particle energy



Why we don't like Touschek events:

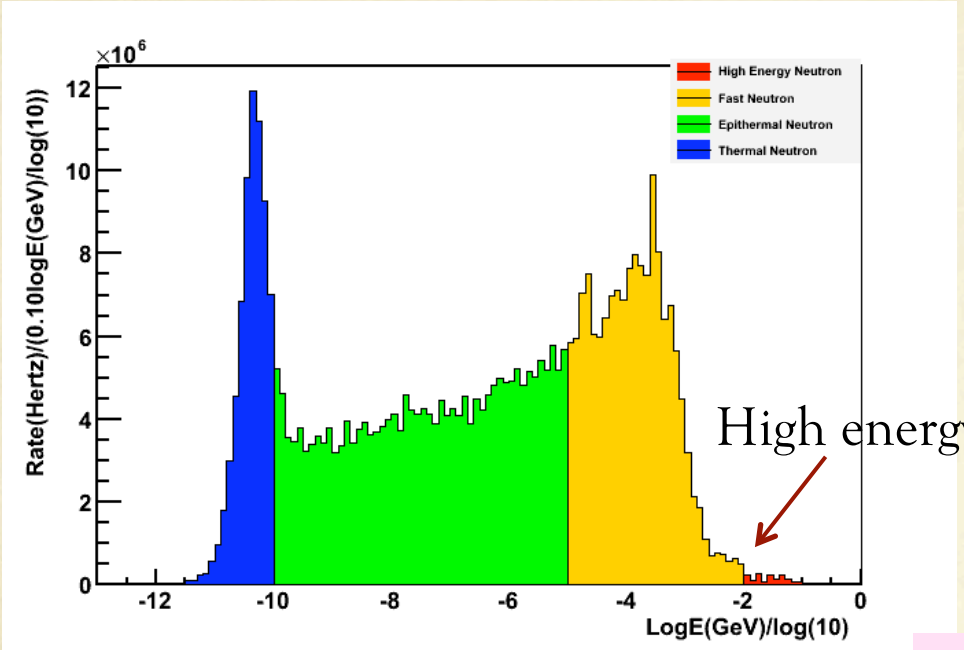
Scattered e^+/e^- goes off trajectory -> lost at beam pipe wall near IP ->creates shower ->reach detector

Touschek events HER



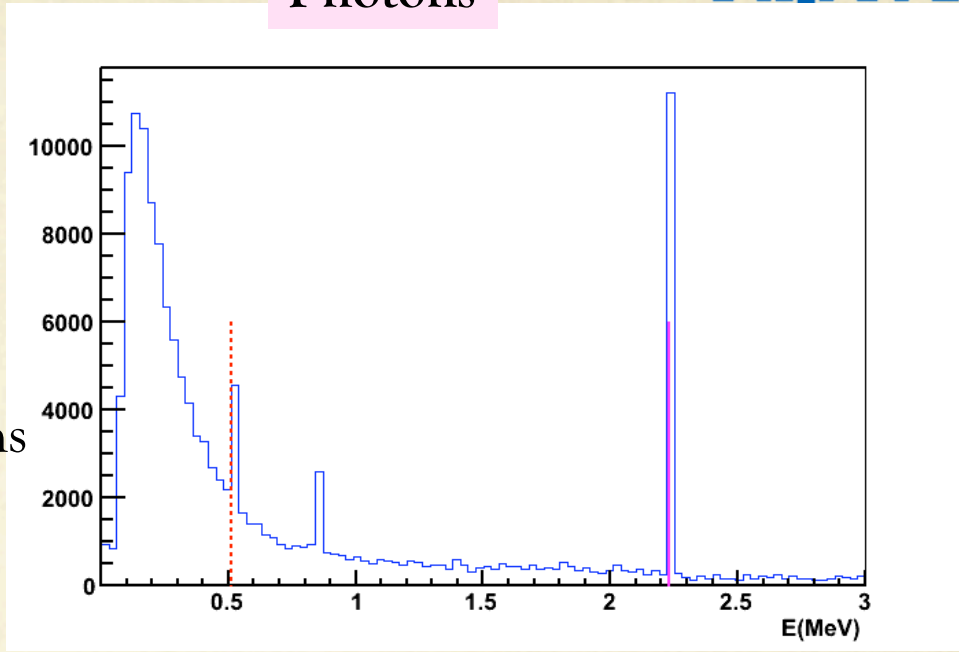
Energy distribution for Touschek events

Neutrons

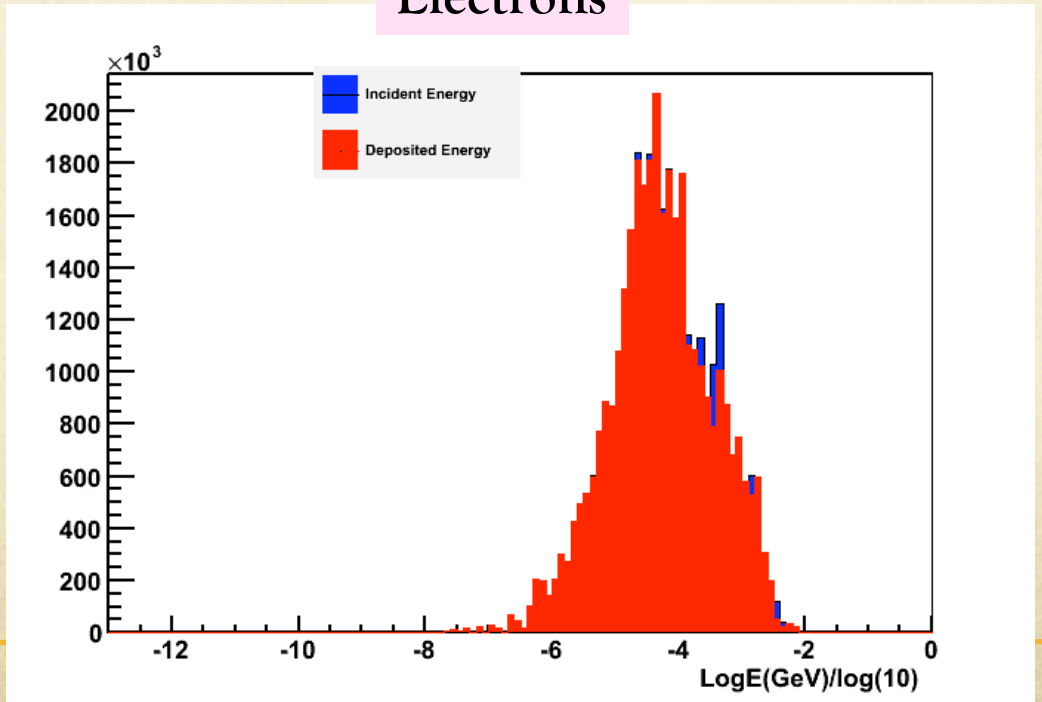


High energy neutrons

Photons



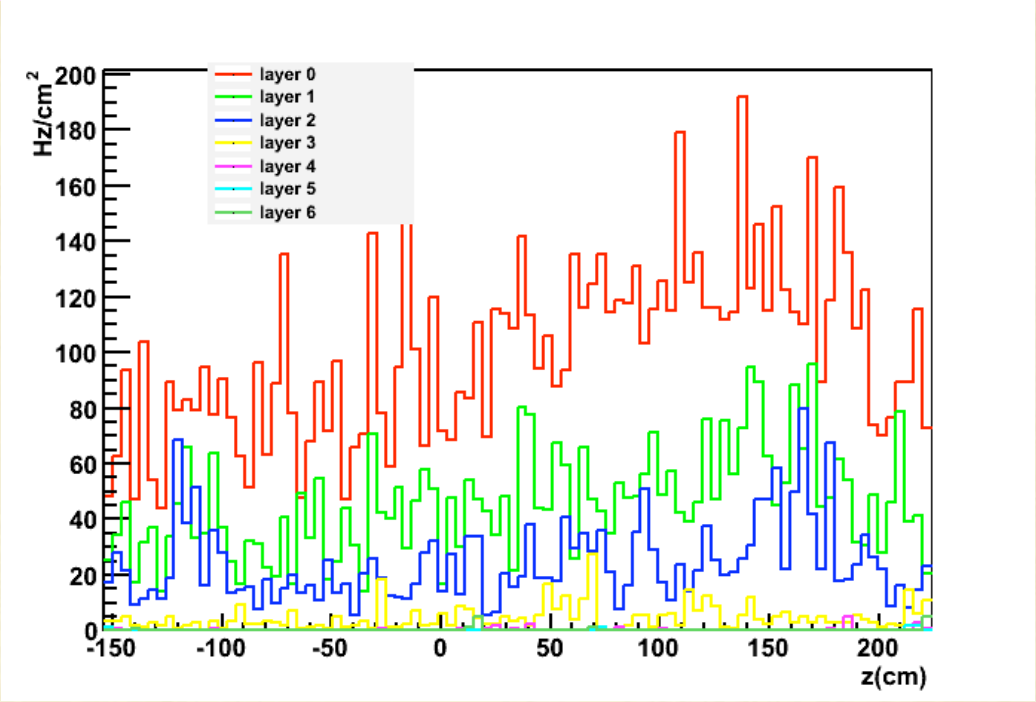
Electrons



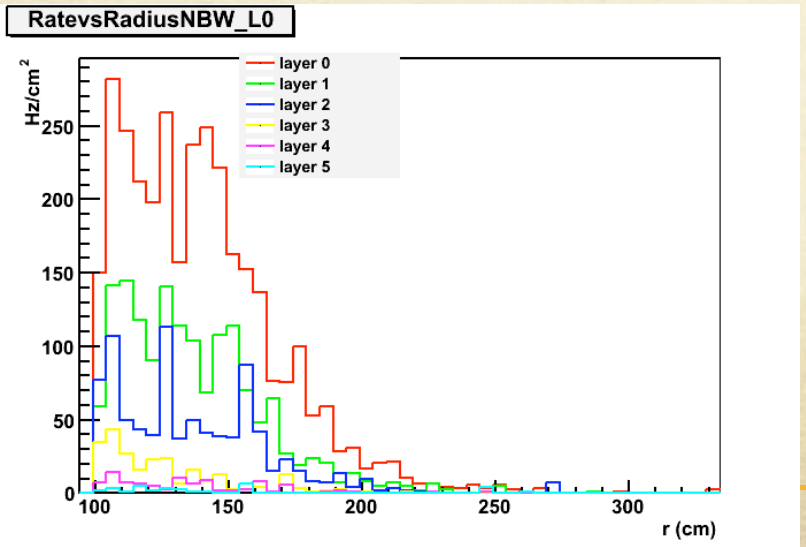
Neutron Rates for Touschek HER events

Rate vs Z-coordinate for Barrel

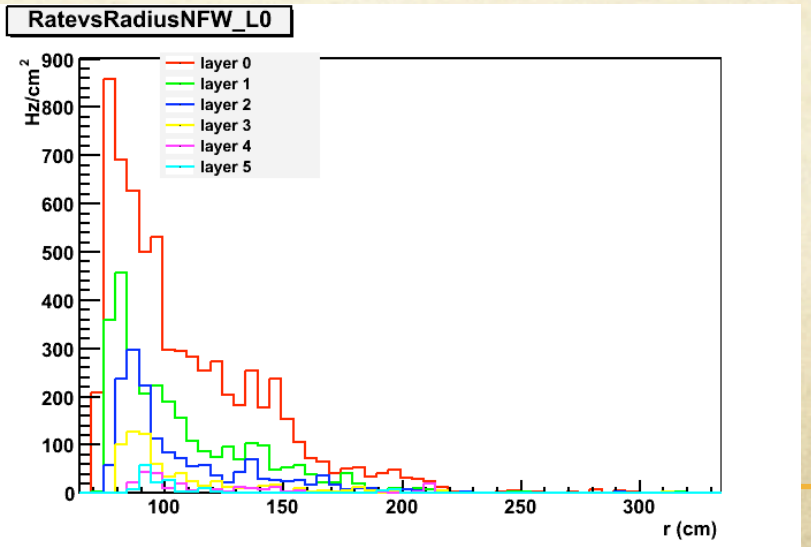
Rates are small but not negligible



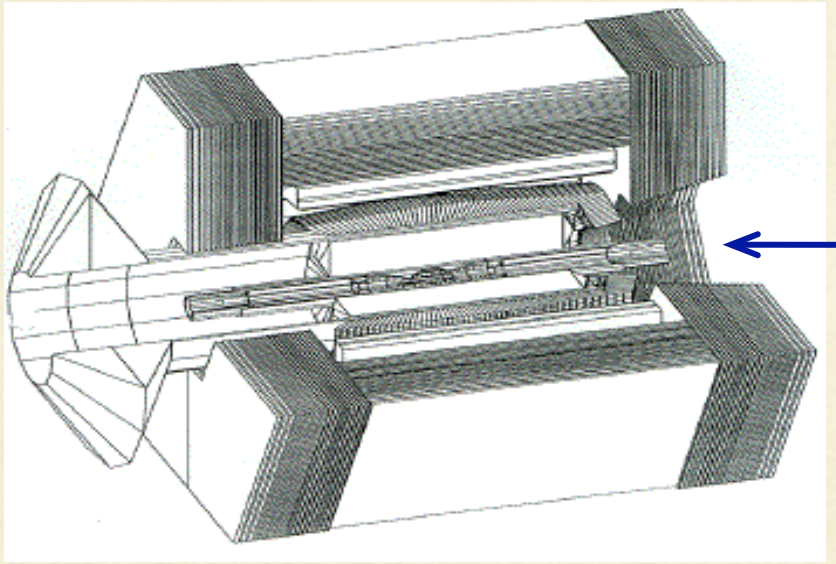
Rate vs radius for BWD Endcap



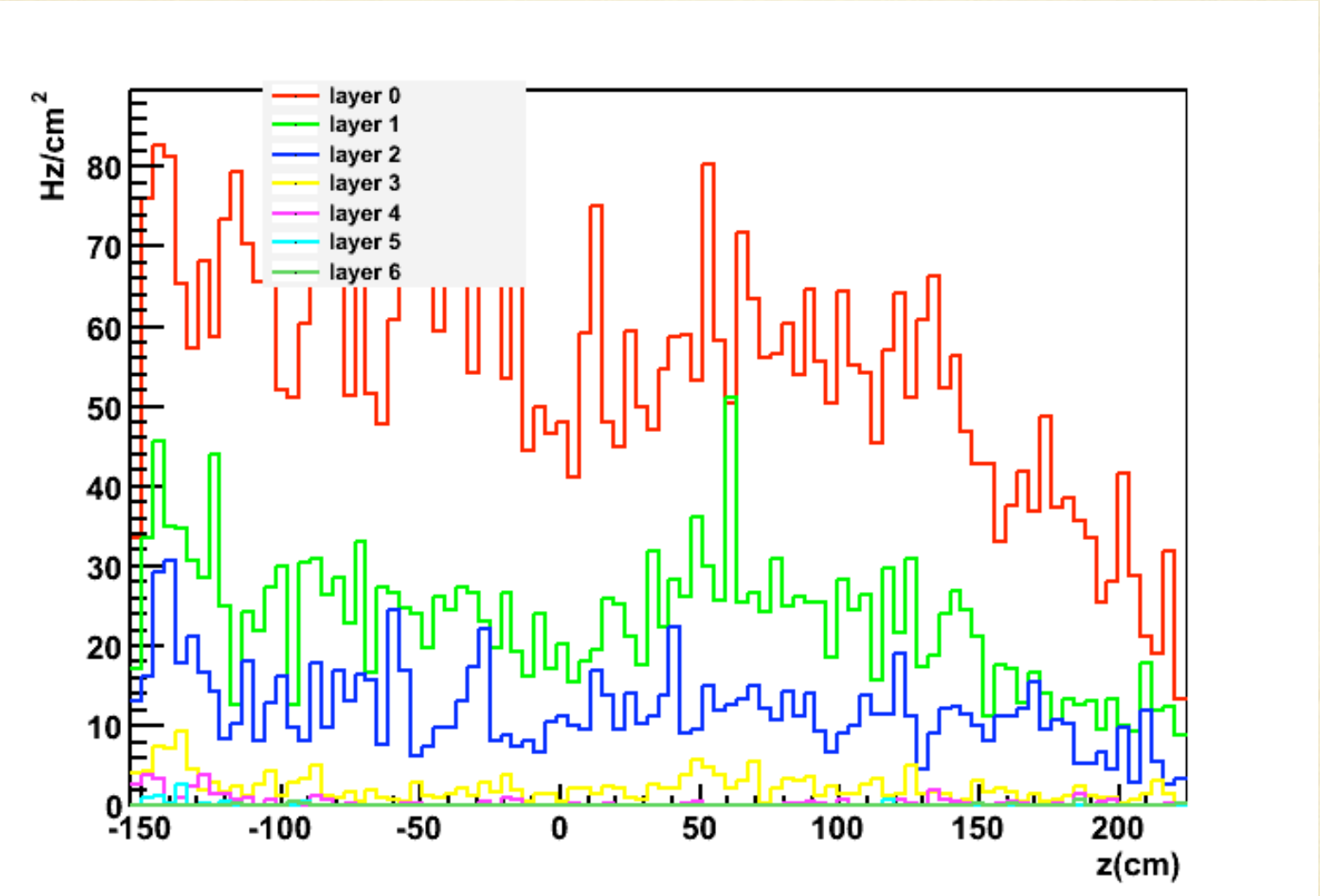
Rate vs radius for FWD Endcap



Touschek events LER



Rate vs Z-coordinate

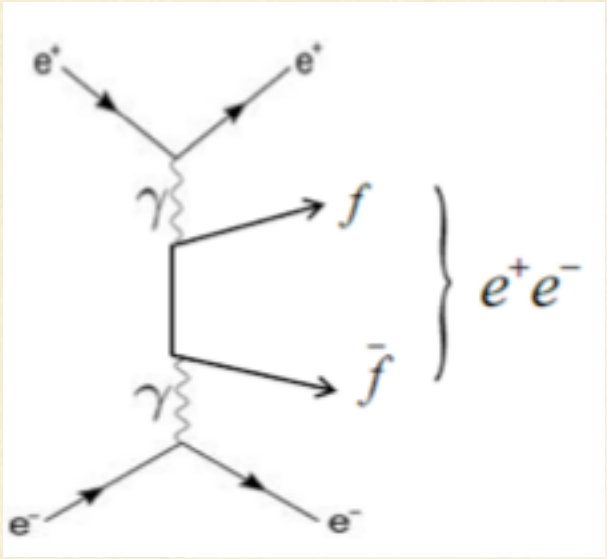


Rates for LER are smaller than for HER

Summary on Touschek studies

- ✓ Touschek background studied for the HER and LER
- ✓ Results for the HER and LER show that the rate are small compared to the BhaBha one.

Pair Production

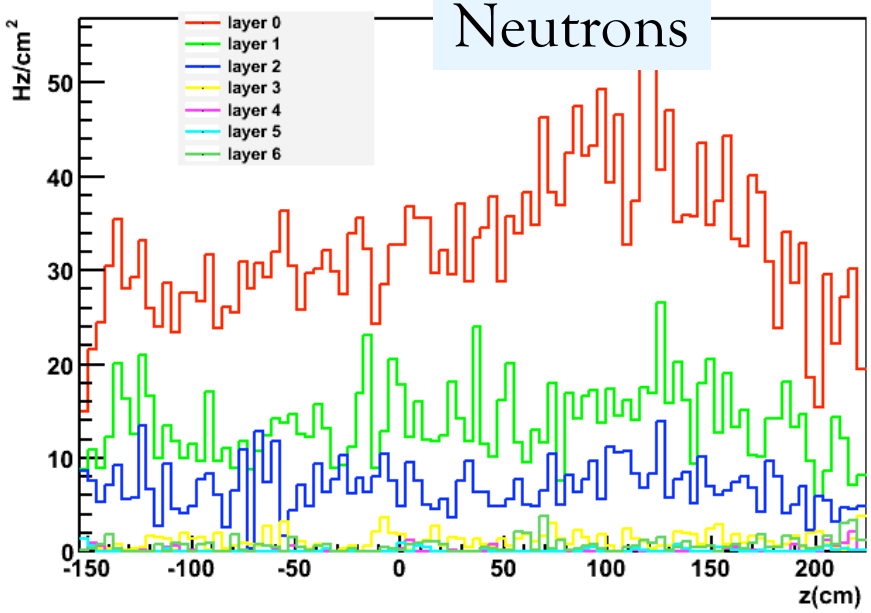


$$e^+e^- \rightarrow e^+e^-\gamma\gamma \rightarrow e^+e^-e^+e^-$$

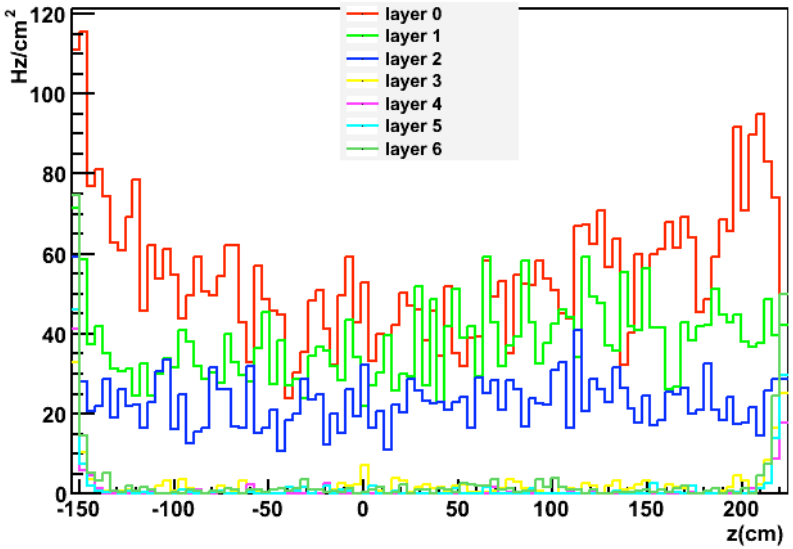
Neutron, Photon and Electrons Rates for Pair events

Rate vs Z-coordinate for Barrel

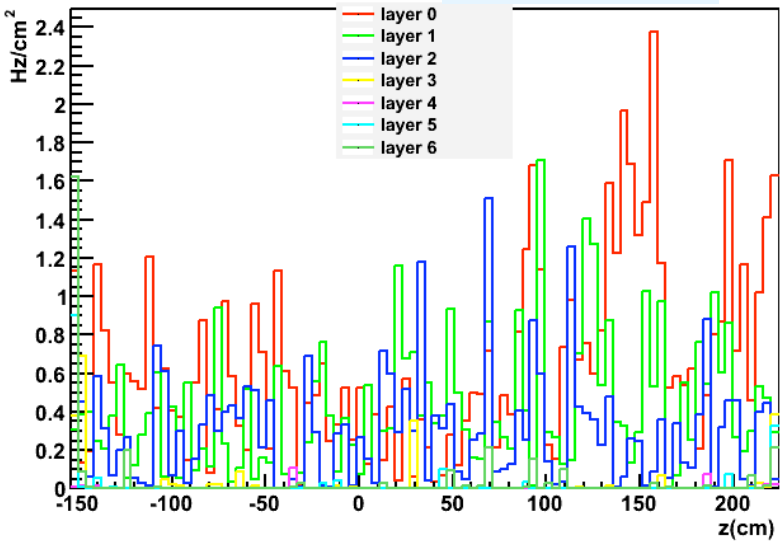
Neutrons



Photons



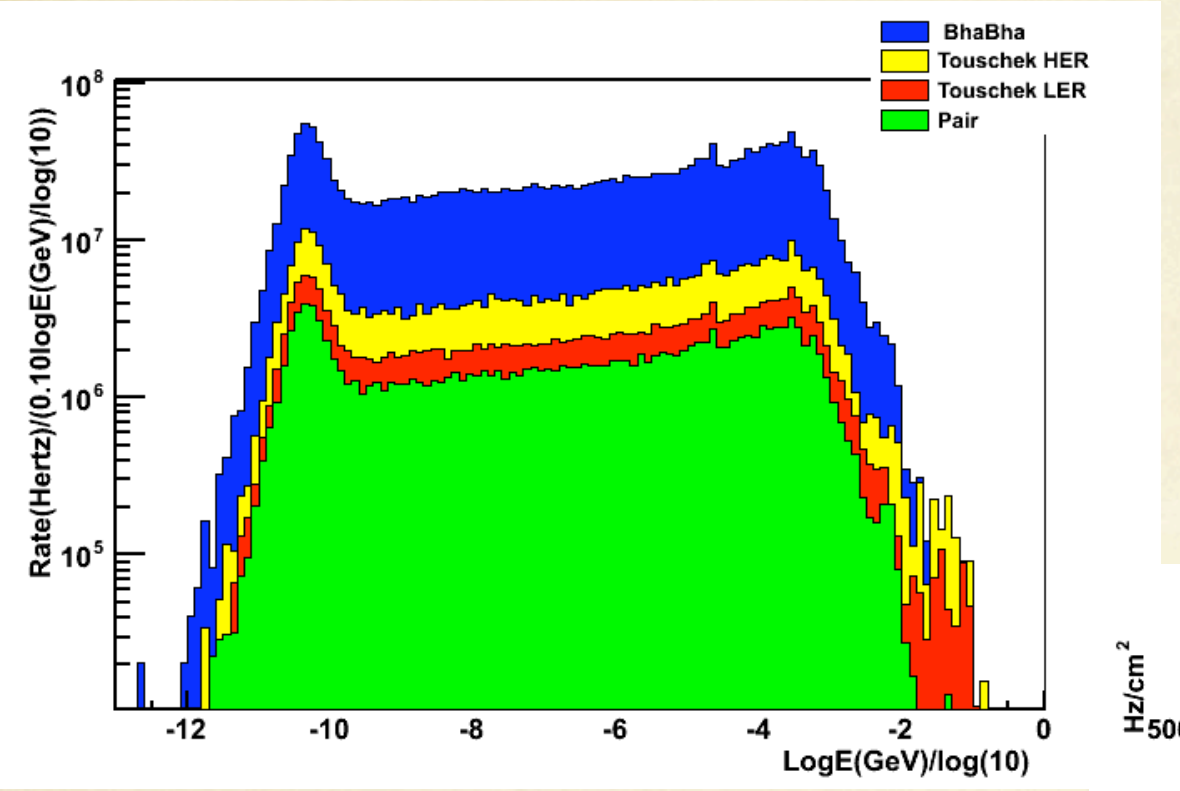
Electrons



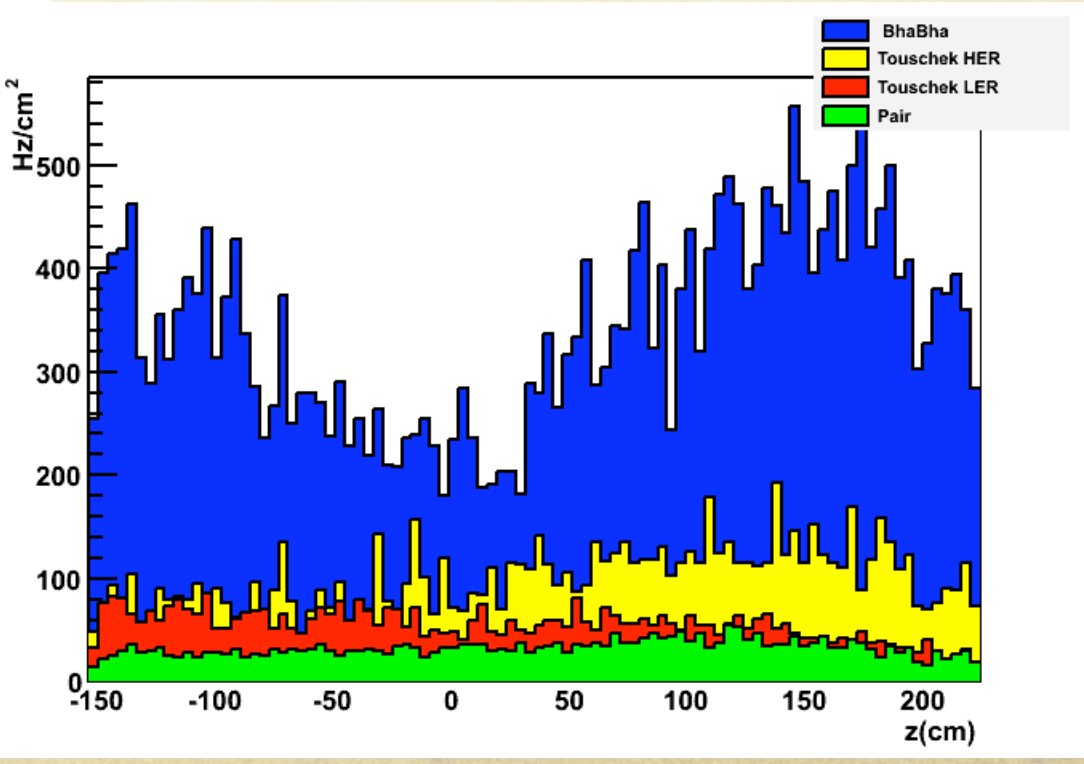
Pair background (neutrons, photons and electrons) is small compared to the BhaBha one and to the Touschek events

Neutron Rates from different background Sources

Energy distribution: Barrel

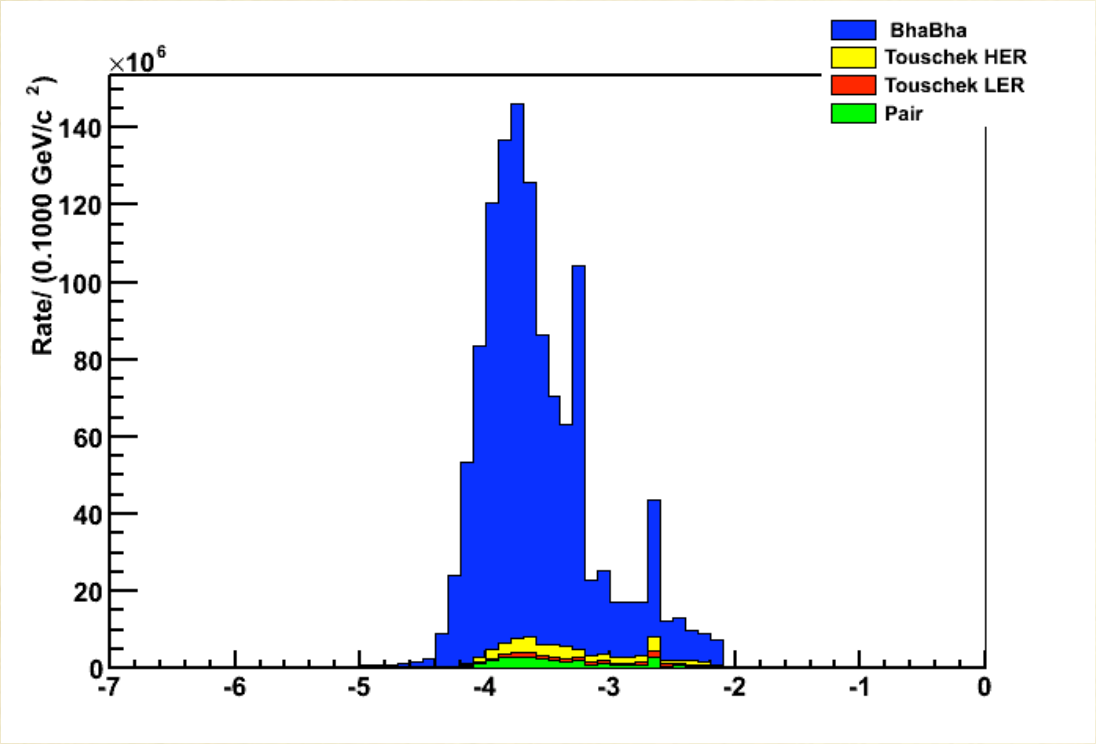


Rate for Barrel L0

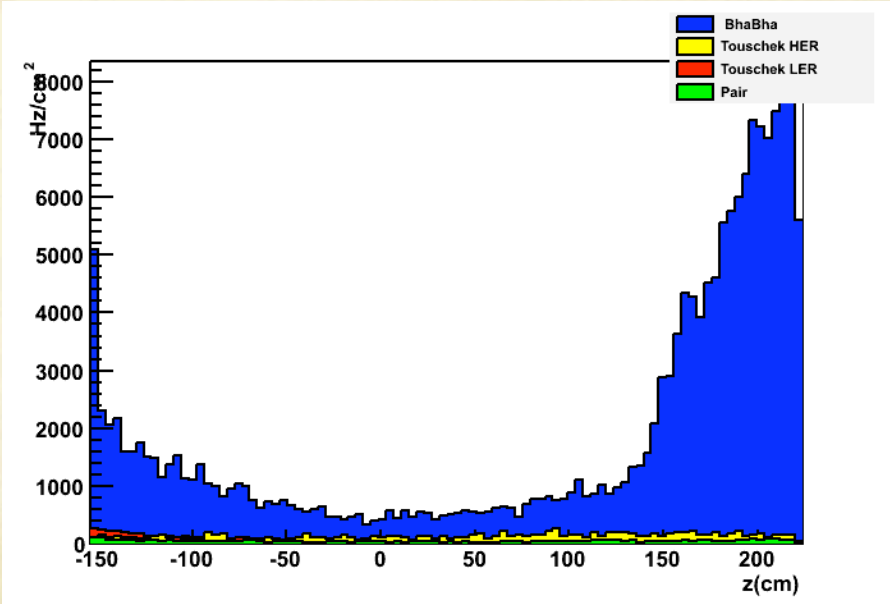


Gamma Rates from different background Sources

Energy distribution: Barrel

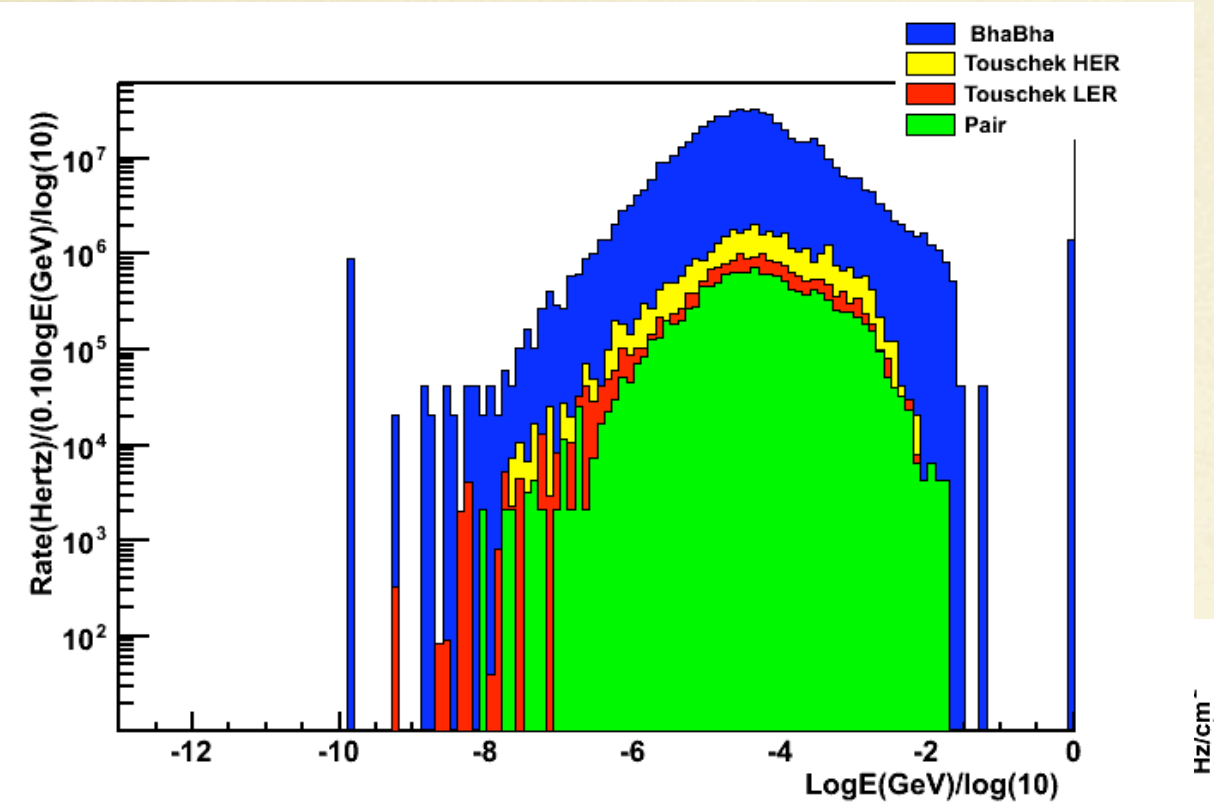


Rate for Barrel L0

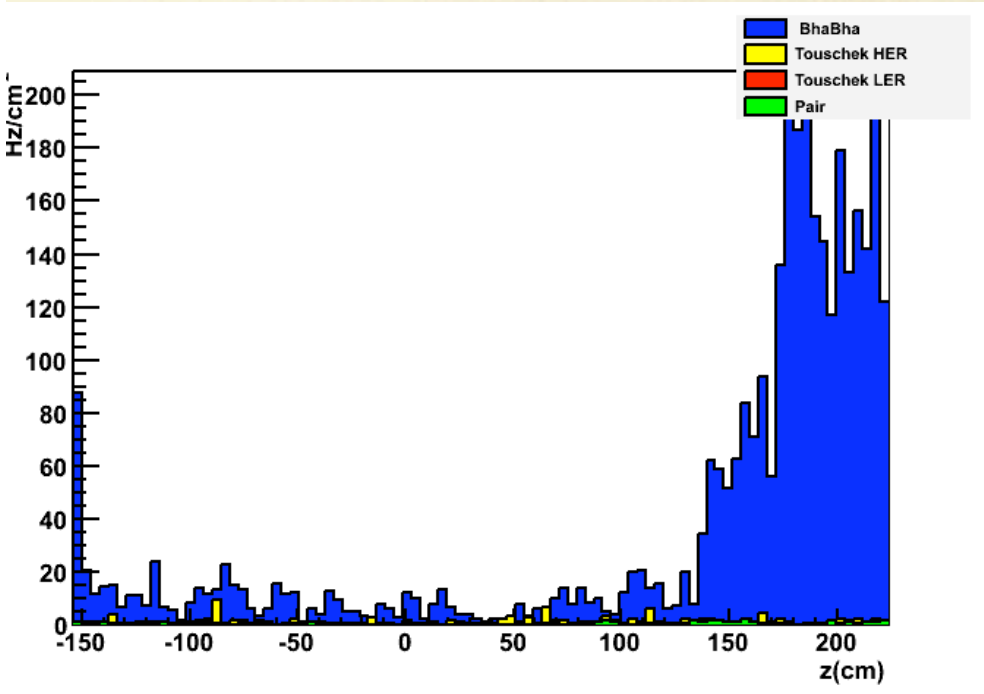


Electron Rates from different background Sources

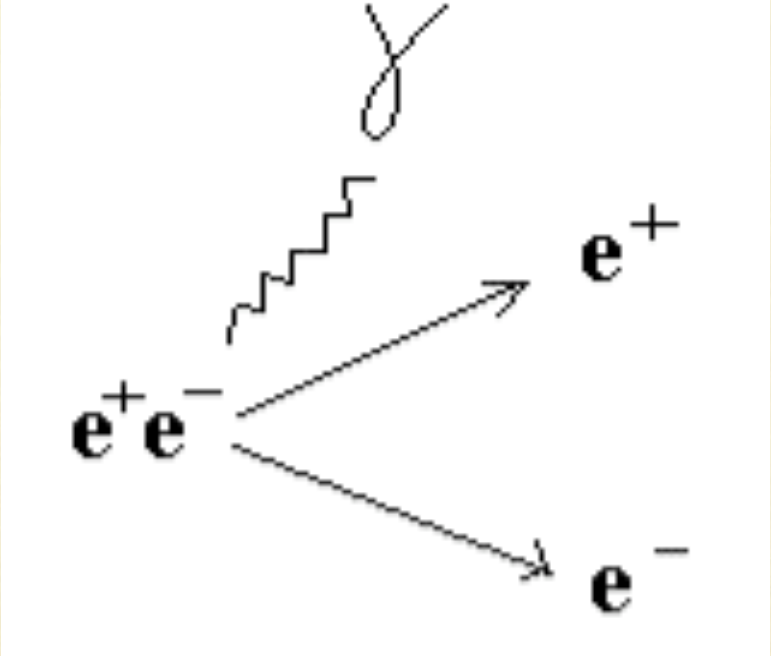
Energy distribution: Barrel



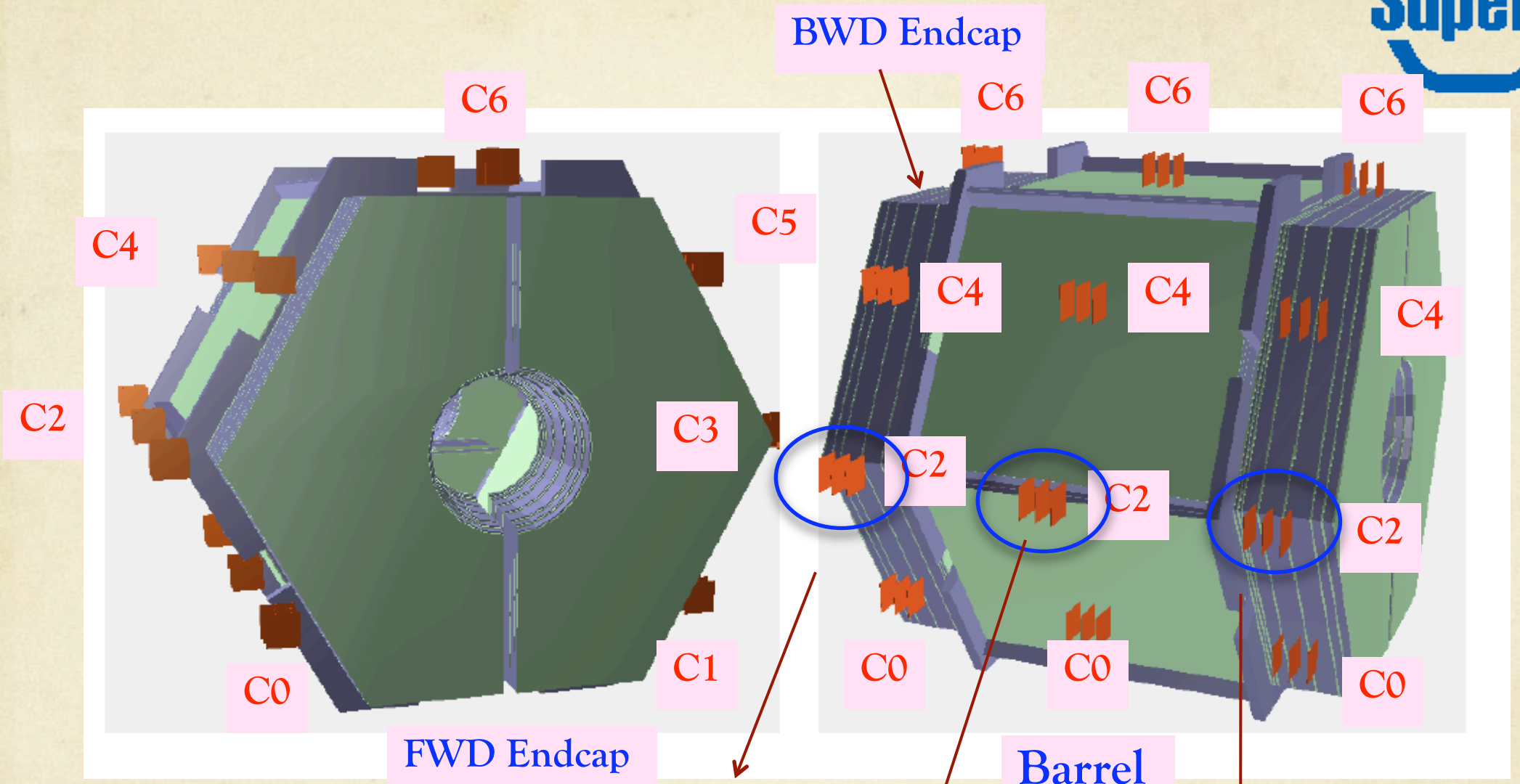
Rate for Barrel L0



Radiative BhaBha background crossing the IFR FEE boards

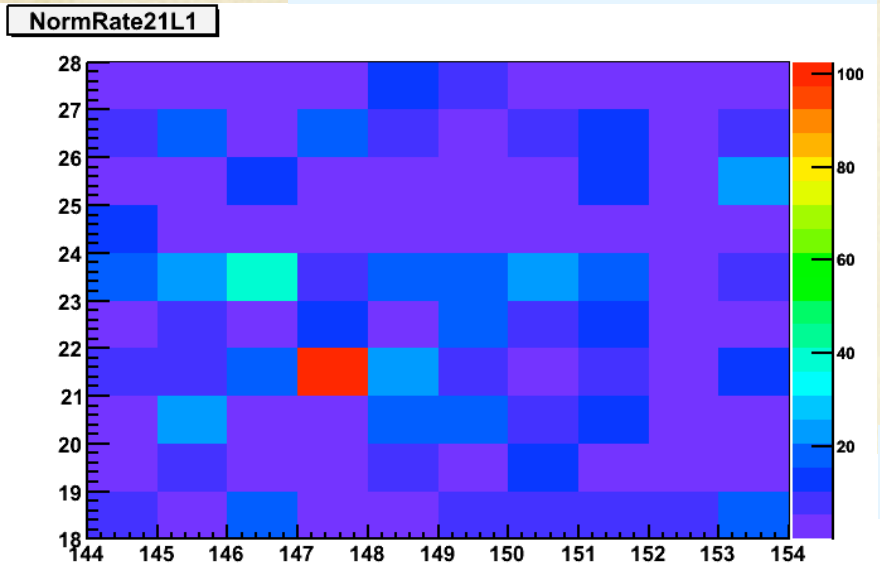


Present layout of the IFR crates



Neutron Rates for FEEs Electronics

2D view of one FEE

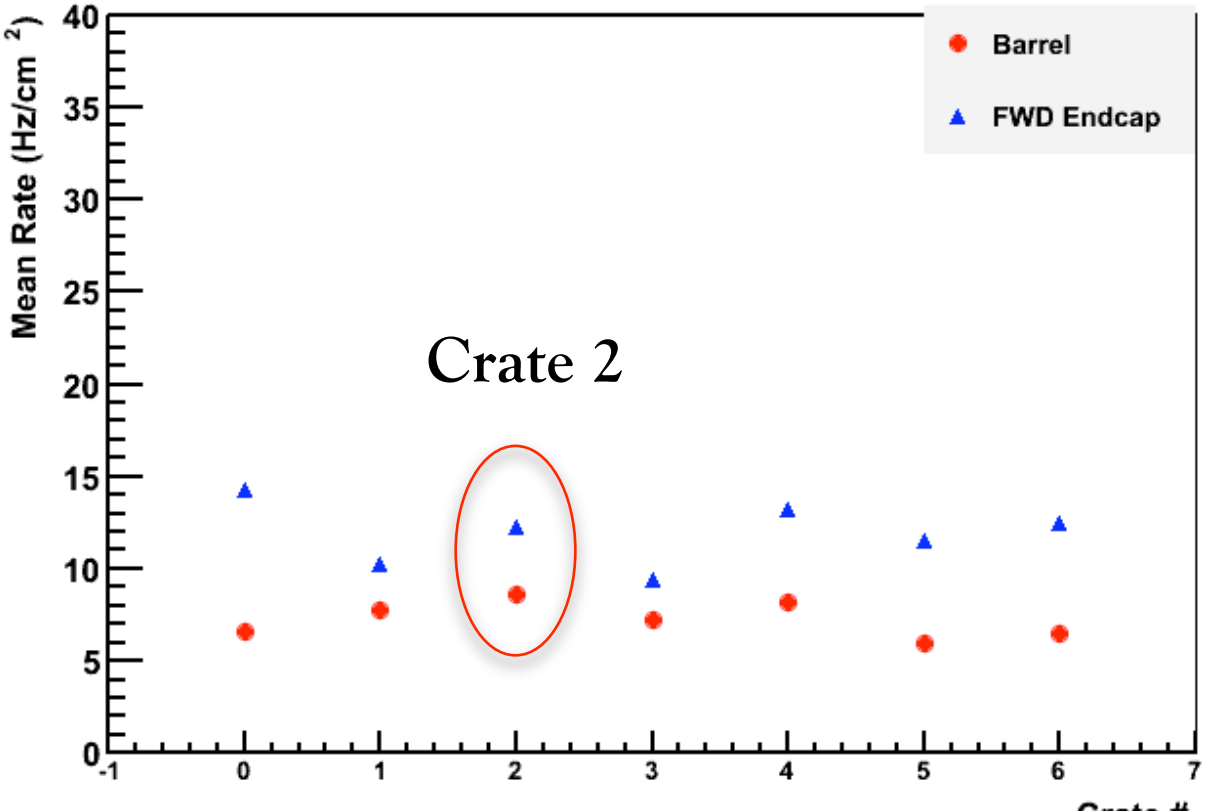


y

Hz/cm^2

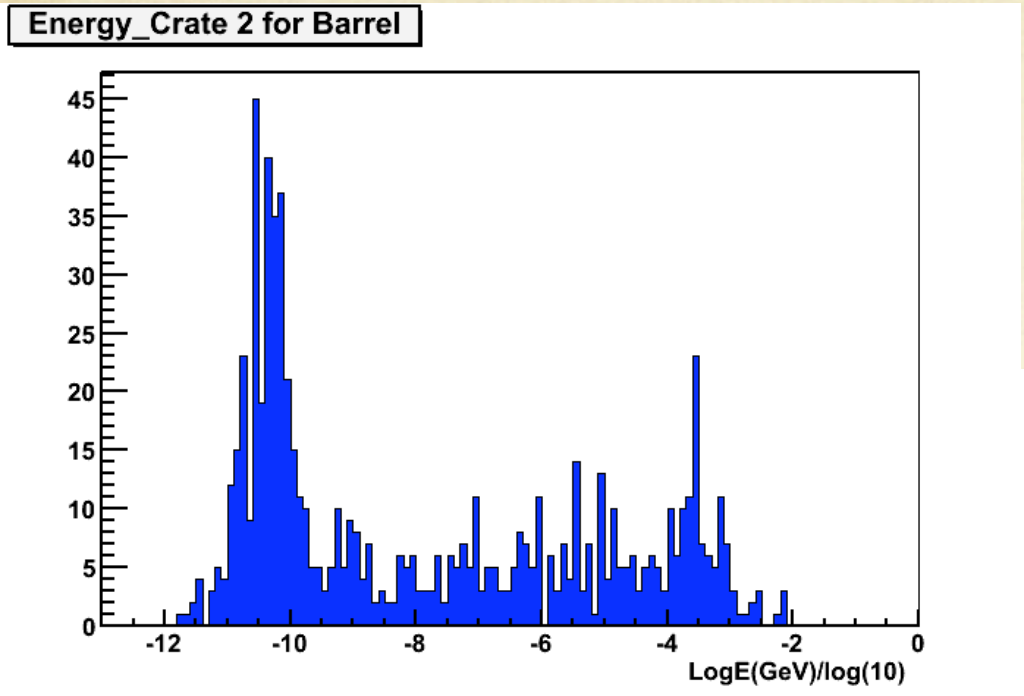
x

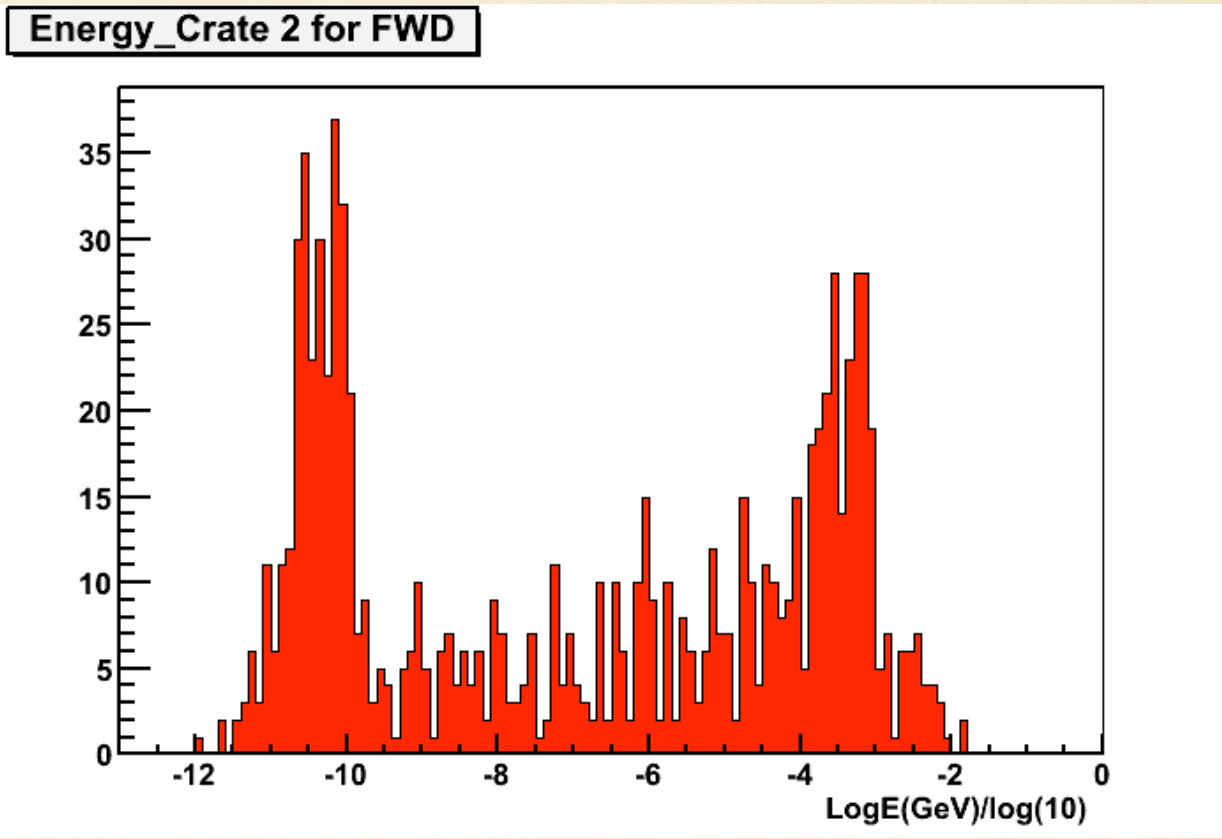
Mean Rate for each FEE in different Crates



Crates located in the FWD have systematically higher rates compared to that one in the Barrel

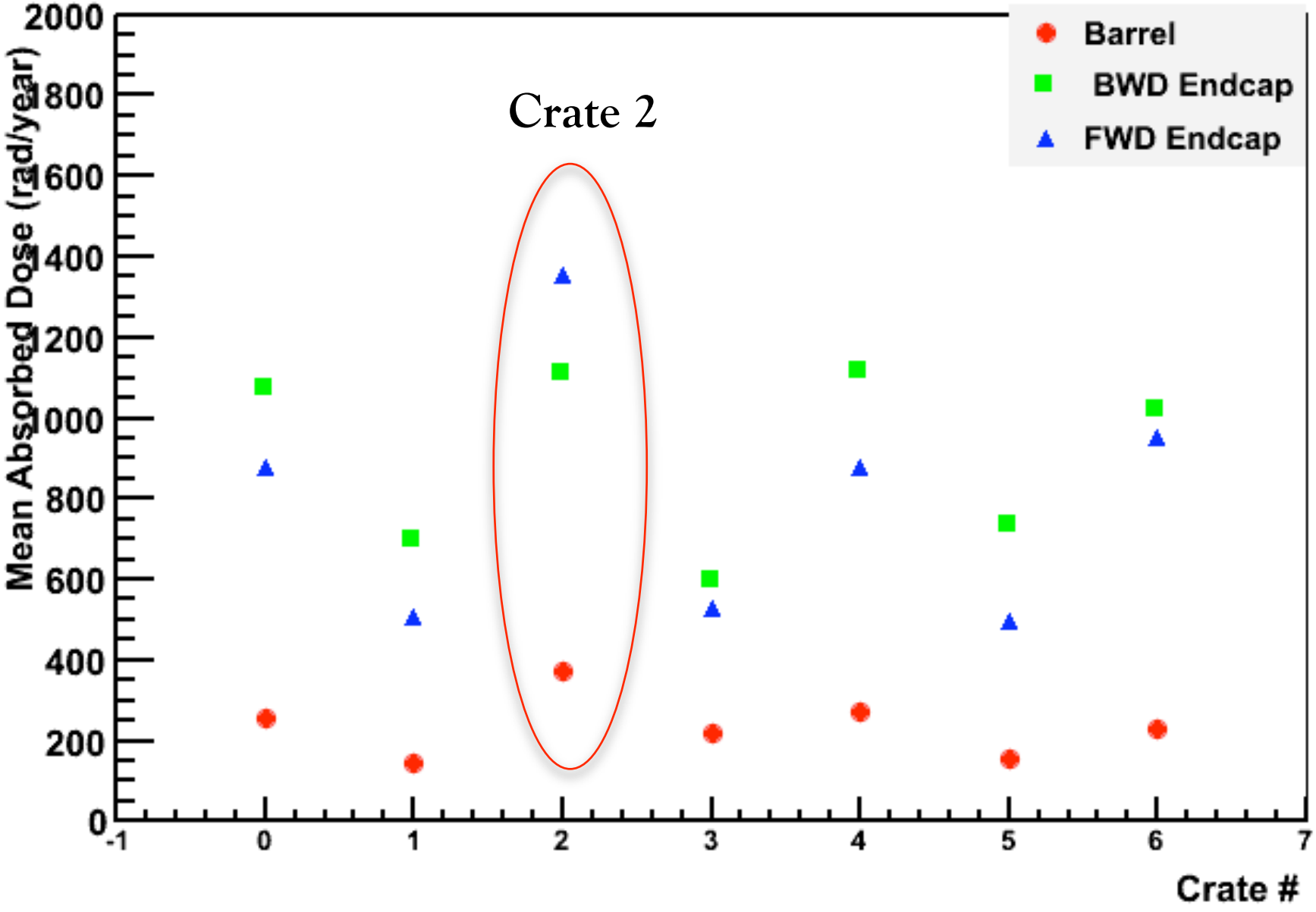
Neutron Energy Distribution for FEEs Electronics





The Energy distribution change for Electronics crate in the Barrel respect to the one in the FWD and BWD endcap

Absorbed Dose for each FEE Crates



Summary

- ✓ Radiative BhaBha, Touschek and Pair backgrounds have been studied in details.
- ✓ The effect of these backgrounds have been also studied on our FEEs
- ✓ IFR TDR background on writing

BACK-UP SLIDES

Electrons

Why do we have to worry about electrons

- Electrons are charged particle that produce signals