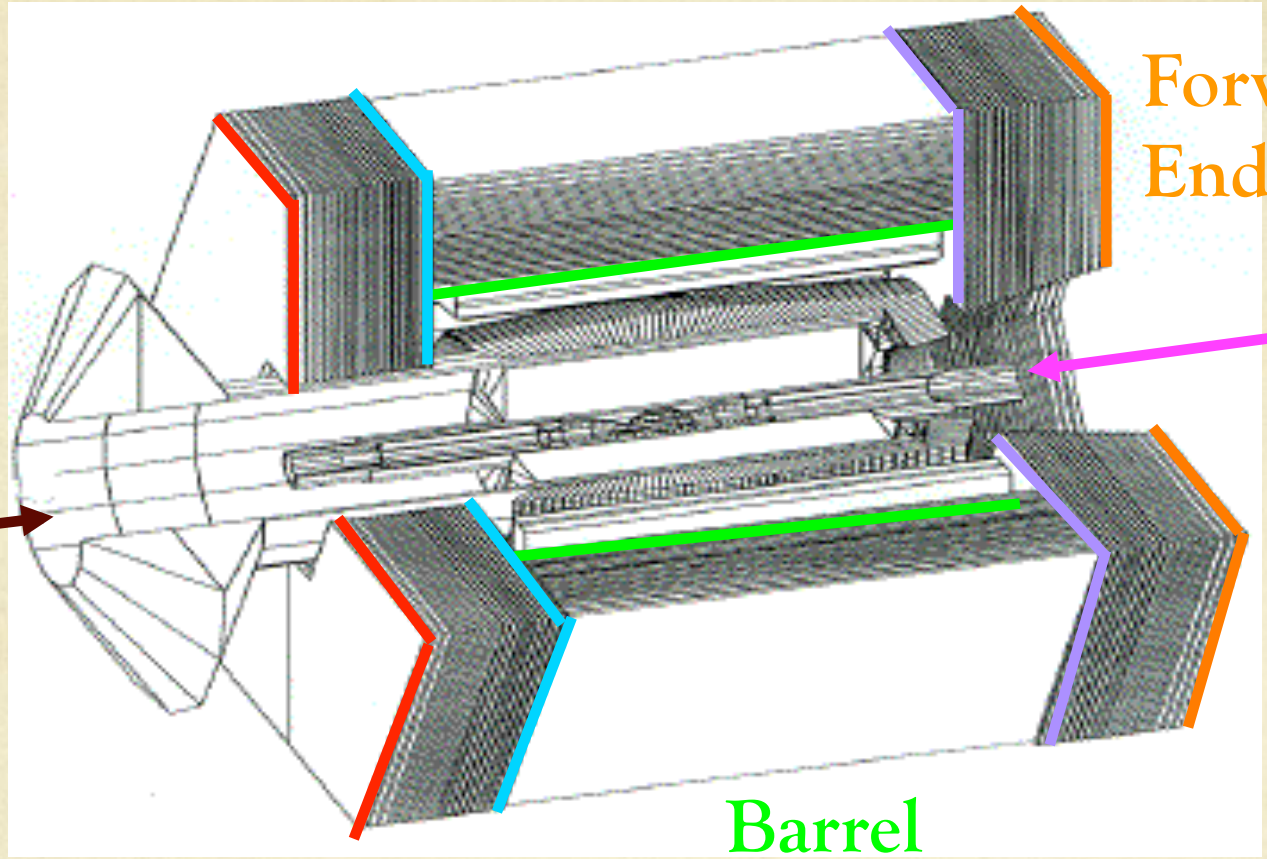
IFR Background

Valentina Santoro
INFN Ferrara

Hot regions



Barrel: innermost layers, mostly neutrons

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

BWD encaps: inner layers and small radii

Summer 2012 Production

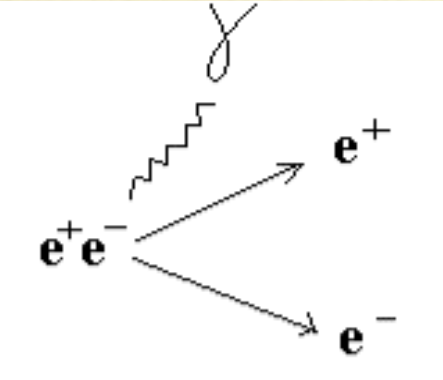
- ✓ New IFR Shielding System
- ✓ Radiative BhaBha events usually the rad-bhabha events are simulated using the cut k= DeltaE/E > 30%, where this parameter is the fraction of of energy in the CM radiated by the photon. This cut ensures that we include 99.999999% of the rad-bhabha losses around ± 10 meters from the IP. Events with low kappa will be simulated separatelly.
- ✓ Radiative BhaBha events: Low kappa 0.5 < kappa < 30% The sample is expected to give a significant contribution to the neutron cloud, mainly from neutrons produced from high energy electrons/positrons hitting on the 1st and 2nd downstream dipoles.

FIRST TIME SIMULATED

- ✓ Pairs events
- ✓ Touschek events (HER and LER)
- ✓ Beam-gas (HER and LER)
- ✓ Synchrotron radiation from (SR) LER and HER

FIRST TIME SIMULATED
NO ENTRIES IN THE IFR

Effect of the Shielding on Radiative BhaBha Background



Some ``Shielding Physics"

We added a **Polyethylene** $(C_2H_4)_nH_2$.)Boron Loaded (5%) shield for the following reasons

PE has a high hydrogen density which slows neutron particles down so they can be absorbed.

Hydrogen slow down neutron since when a fast neutron collides with a light nucleus, it loses a large fraction of its energy

The Boron we used is natural Boron that is composed about 20% ^{10}B and 80% ^{11}B. ^{10}B has a very high cross section for capture of thermal neutron

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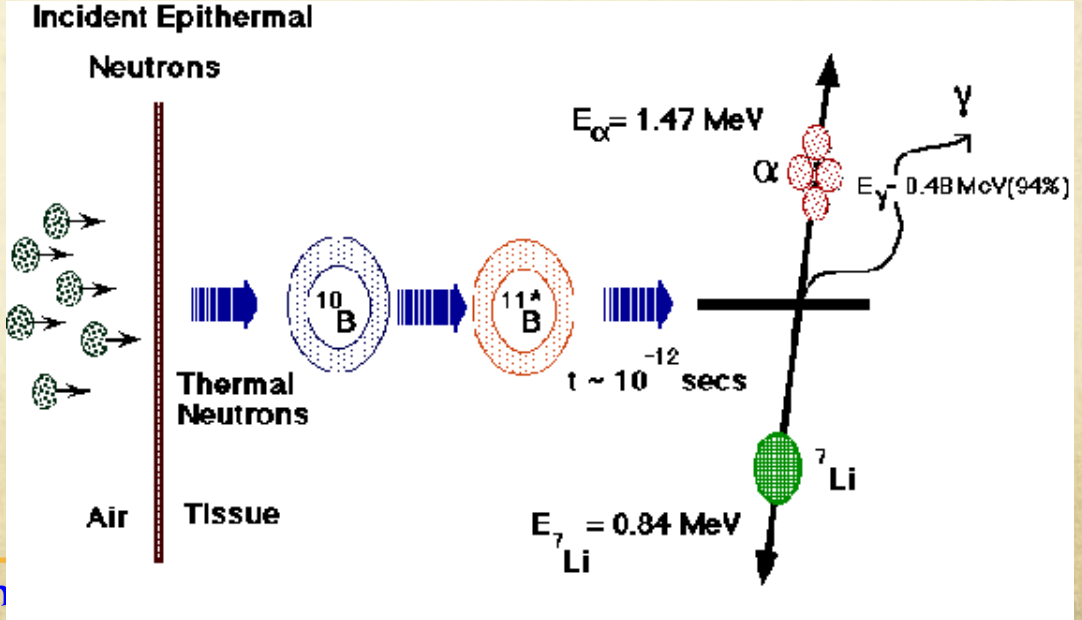
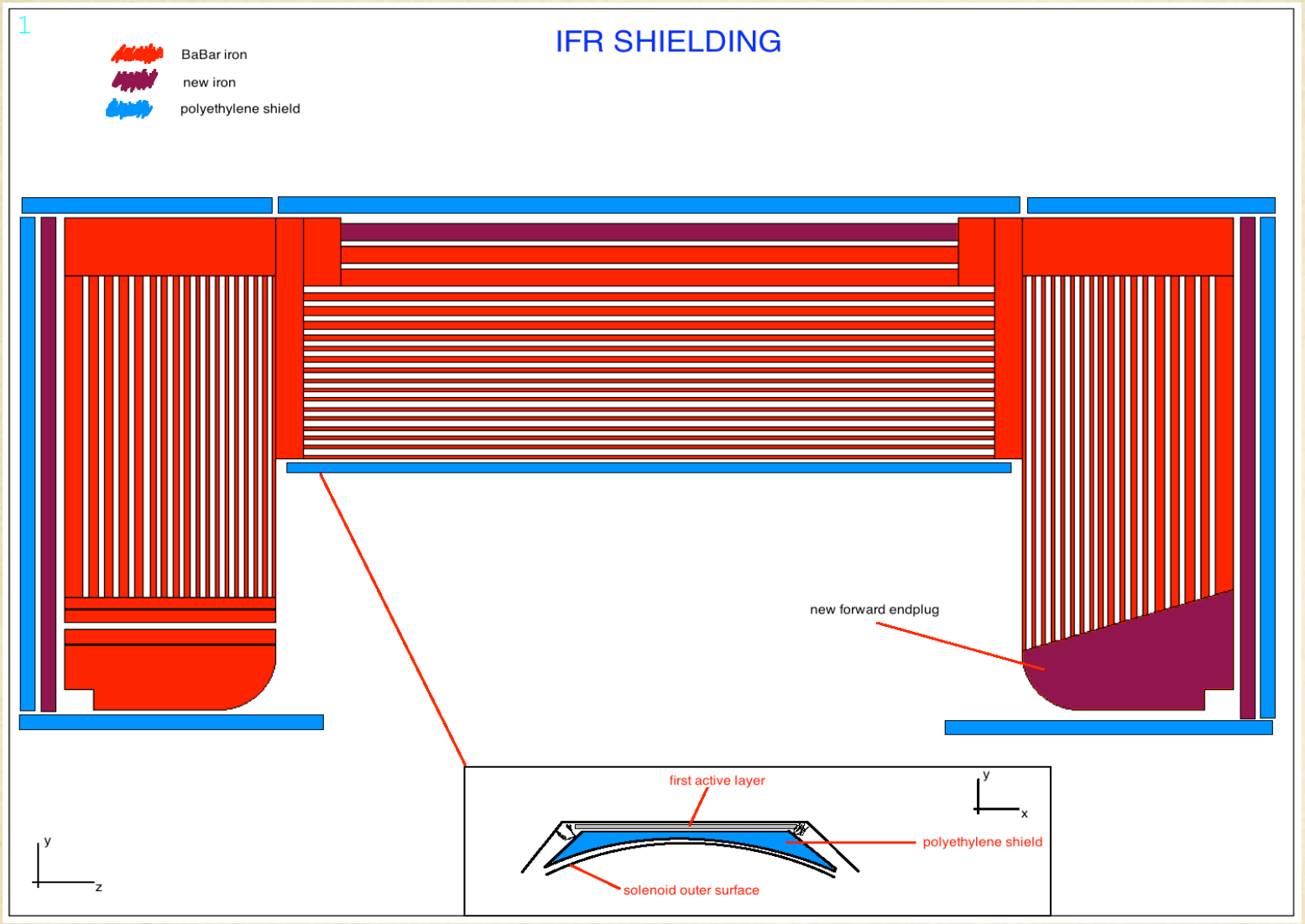


Shield configuration

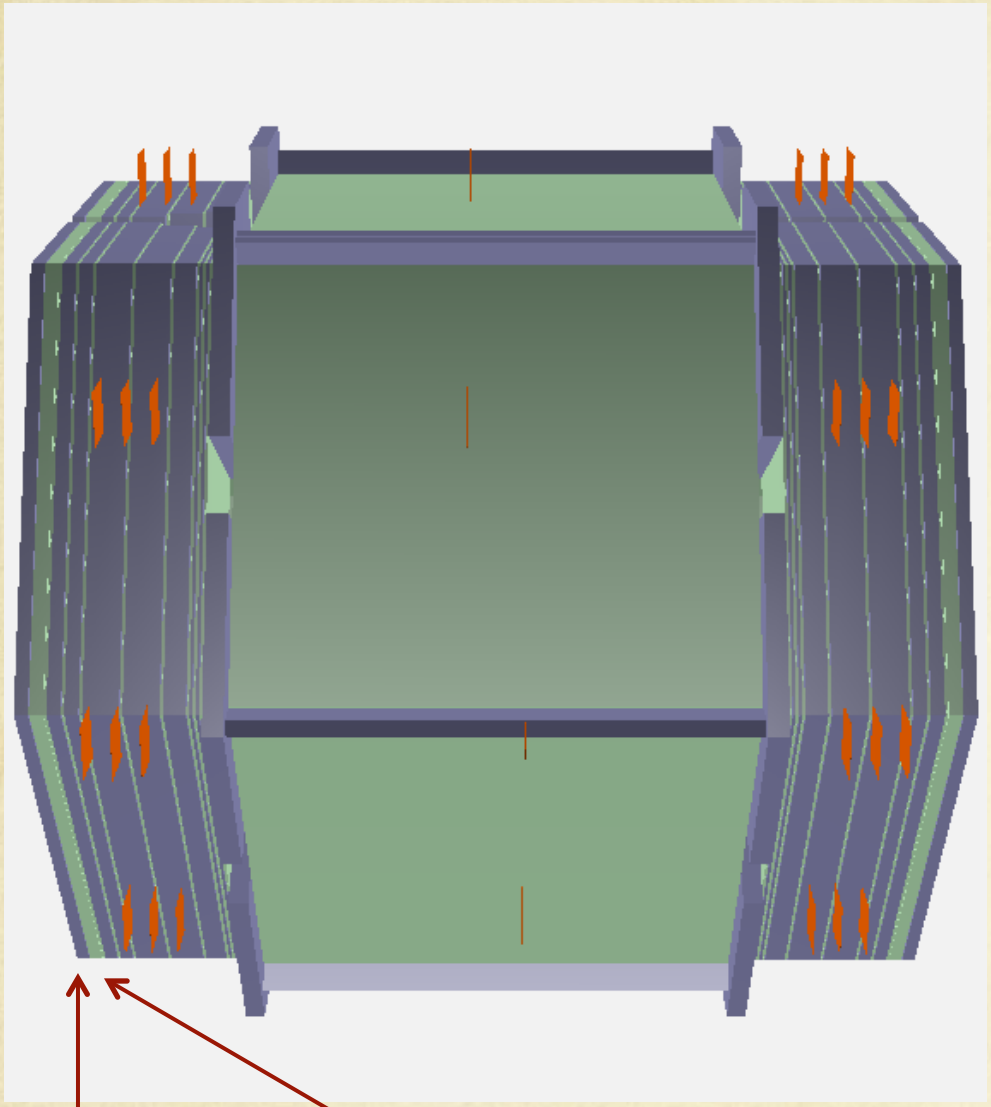


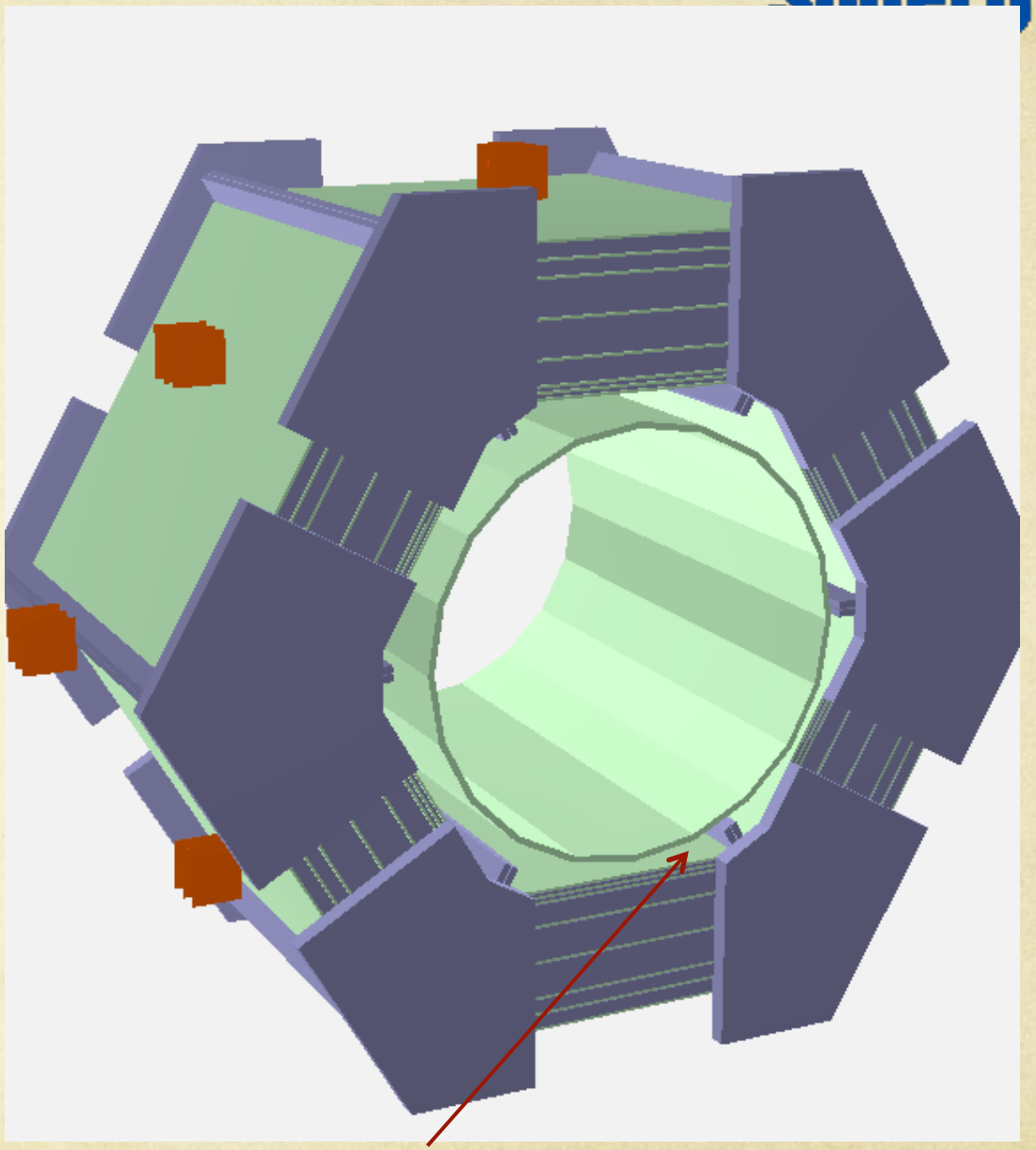
This shielding configuration is mechanically rather complicated and probably expensive.

But it's a working prototype we are using to study with the simulation the effect of the shielding materials on the background.

Some beampipe and tunnel shielding will be implemented once the maximum rate allowed will be established.

Our Current Shields Implementation





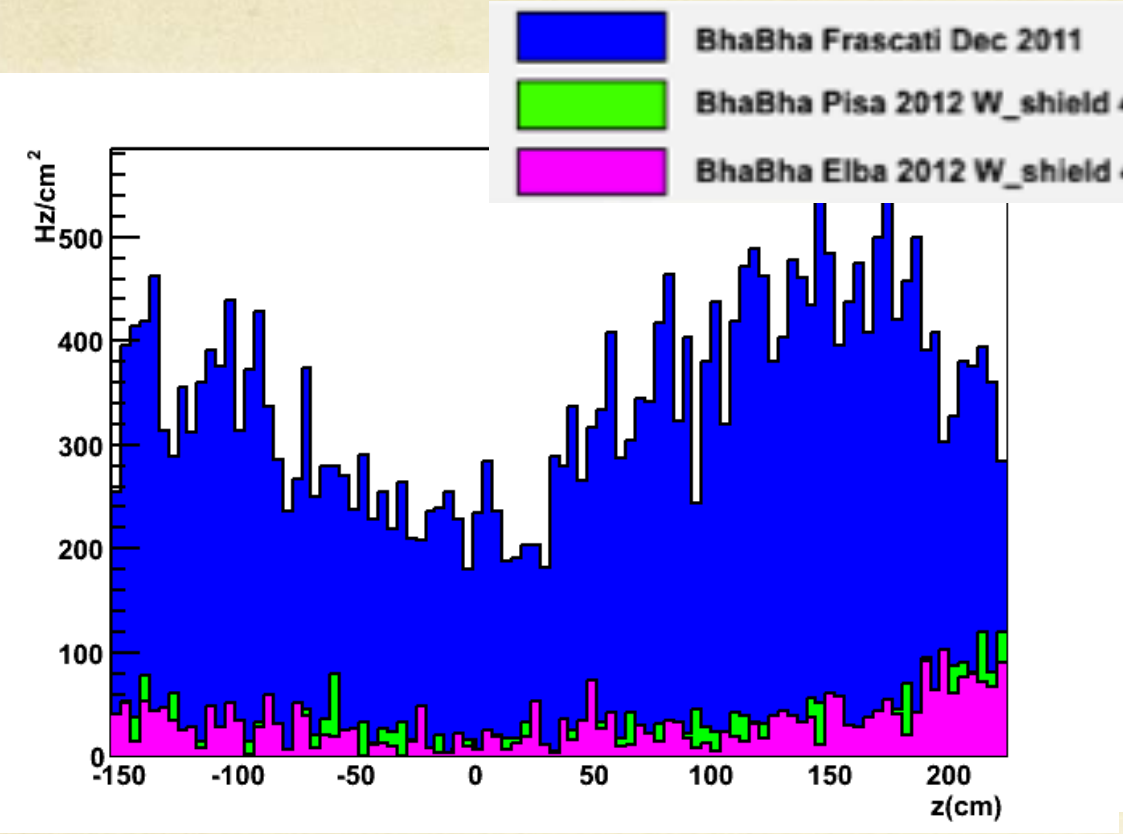
All the IFR is " wrapped" by 10 cm of PE+10 cm iron

5 cm PE

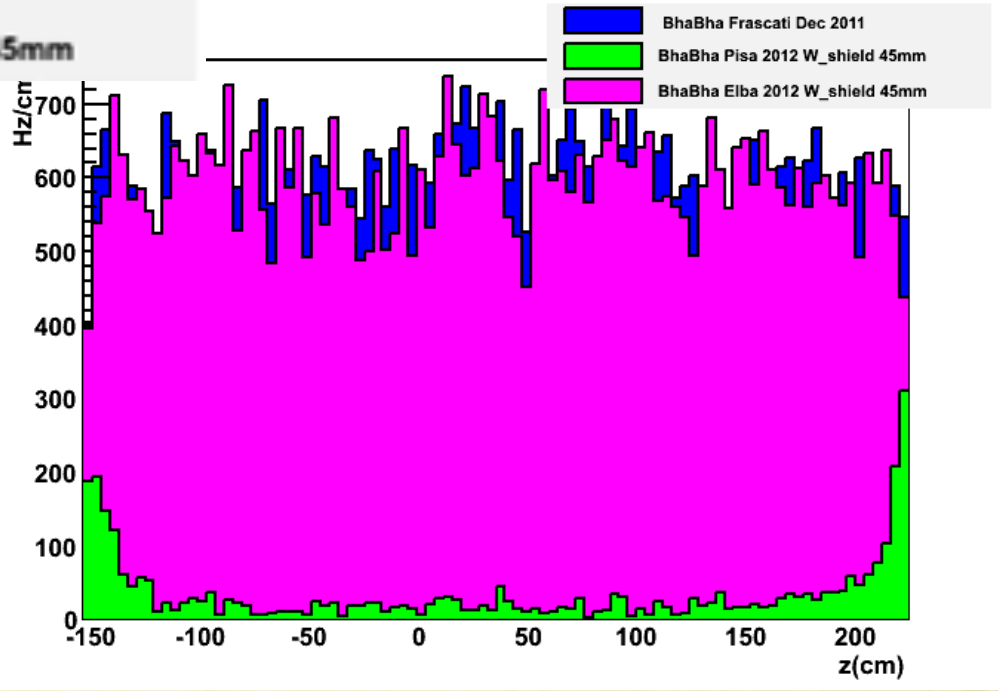
Neutron Distributions for Radiativa BhaBha events

Barrel

Rate L0 vs Z-coordinate for Barrel



Rate L7 vs Z-coordinate for Barrel

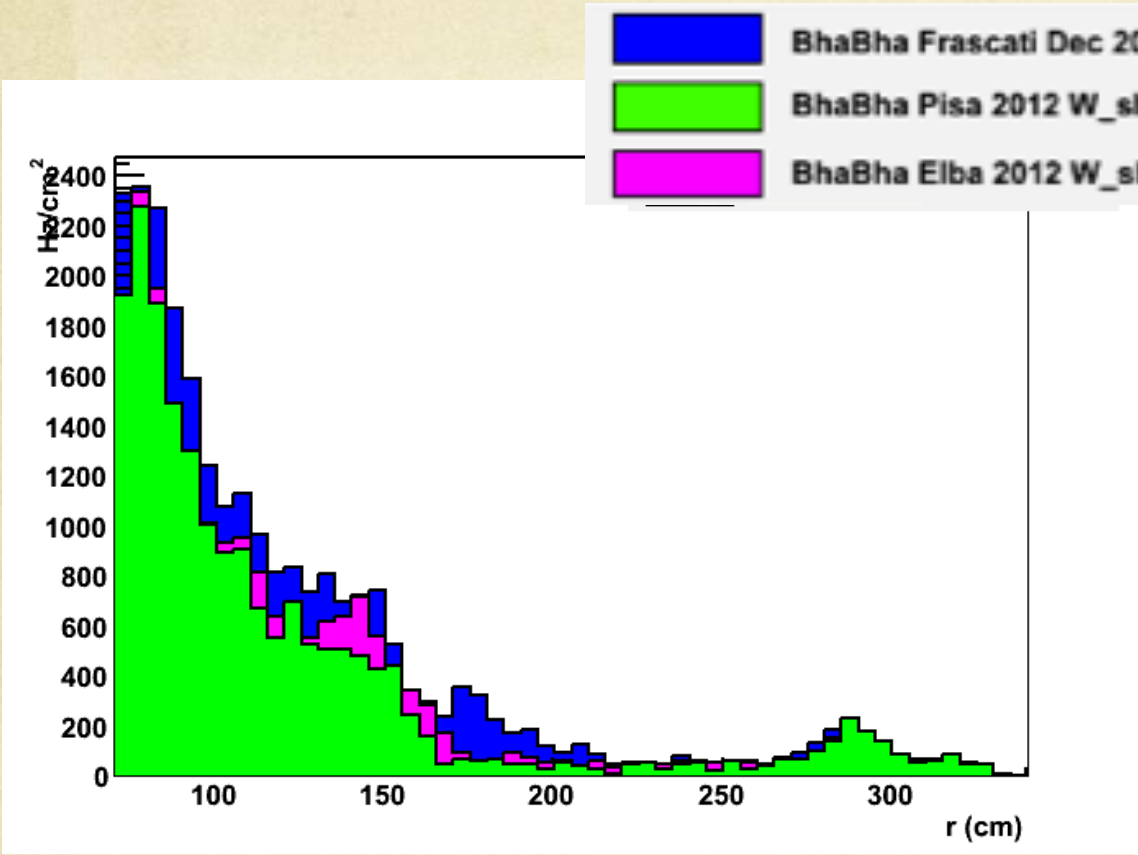


Significant reduction of the neutron rate on Barrel L0 and Barrel Layer 7 ~1 order of magnitude

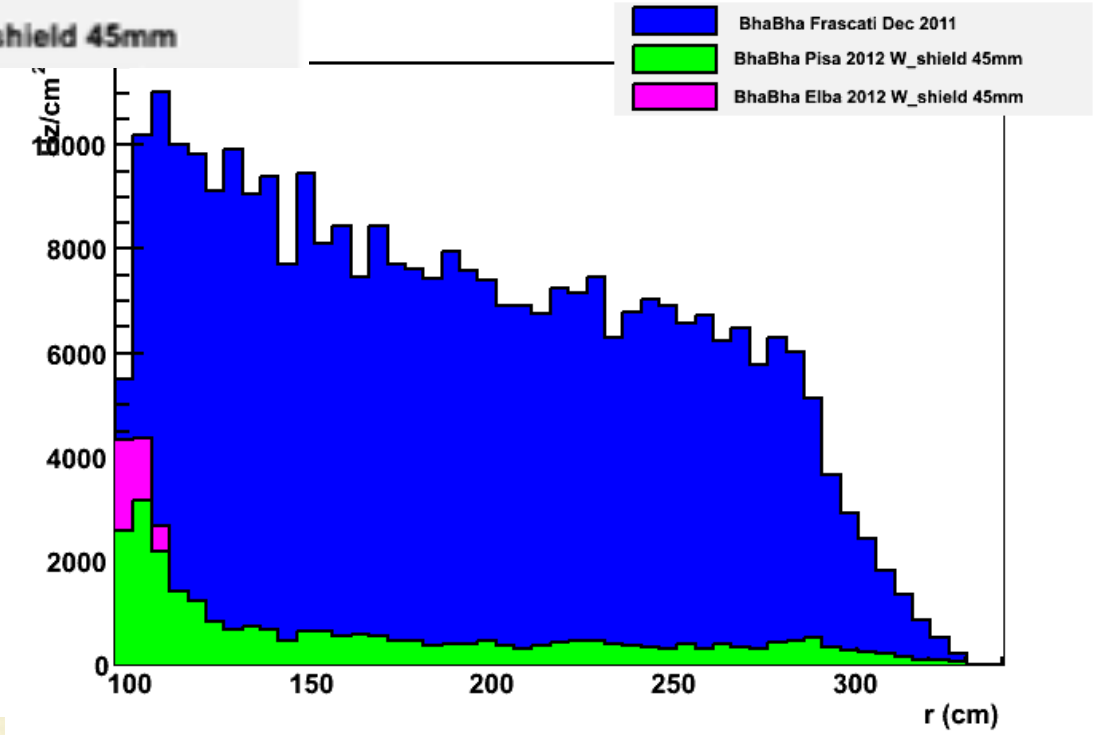
Neutron Distributions for Radiativa BhaBha events

ENDCAP

Rate L0 vs Z-coordinate for FWD

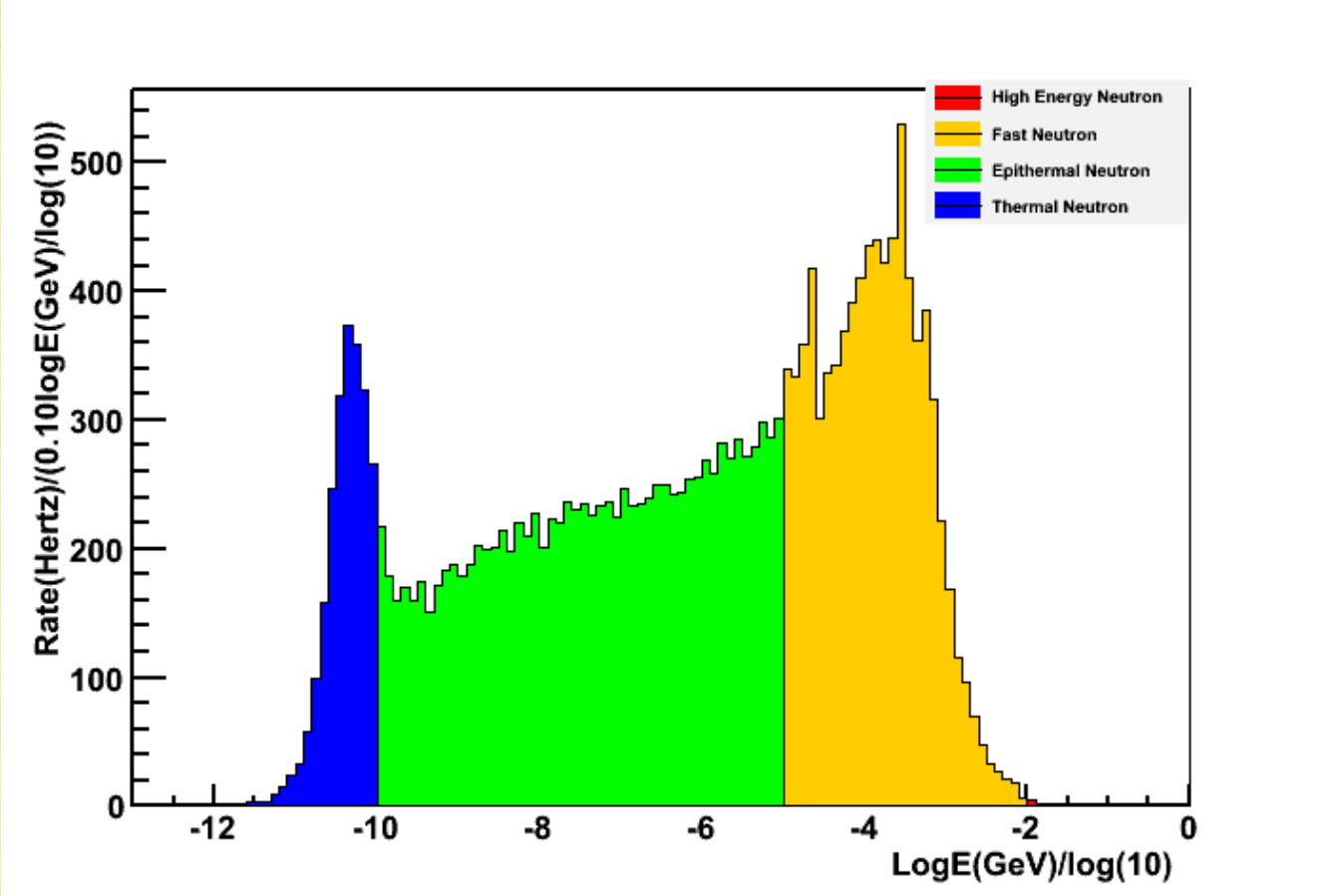


Rate L7 vs Z-coordinate for FWD



Significant reduction of the neutron rate on FWD L7 but this does not happen on L0 since the L0 is not shielded

Reminder: Who are our neutrons ?



High Energy Neutrons have energy >100 MeV

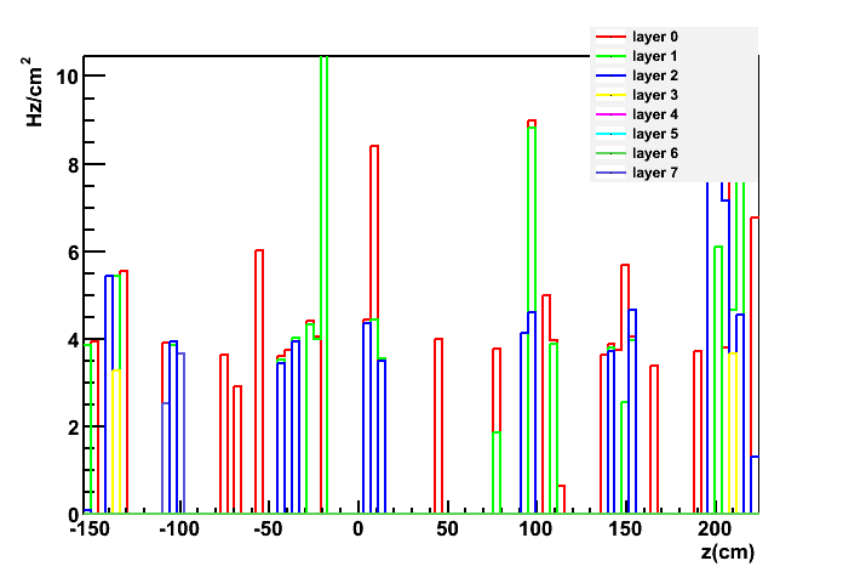
Fast Neutron have energy 10 KeV -100 MeV

Epithermal Neutron are Neutrons with energy 10 KeV and 0.1 ev

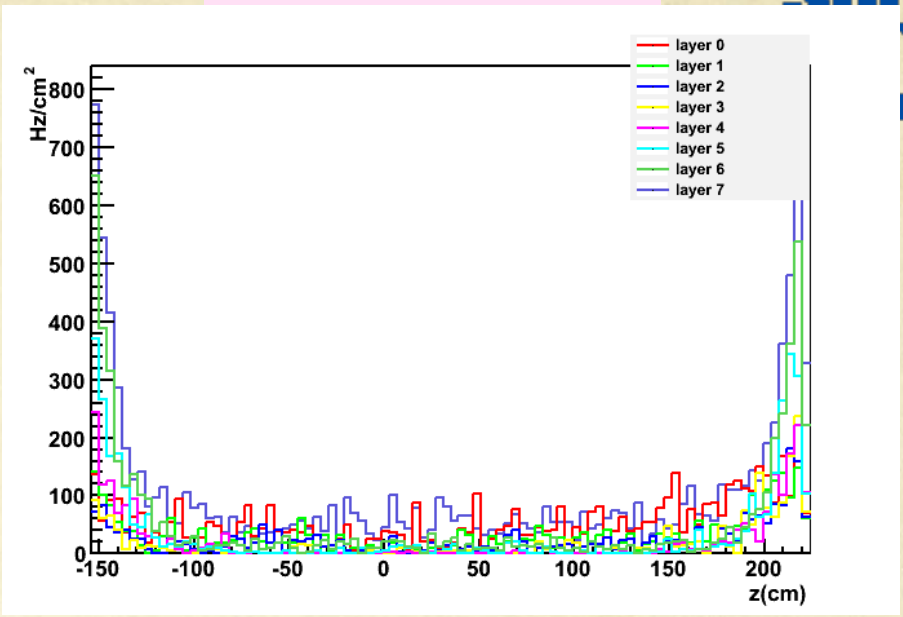
Thermal Neutron have energy <0.1 eV

Barrel Neutron Rate divided by Neutron Categories

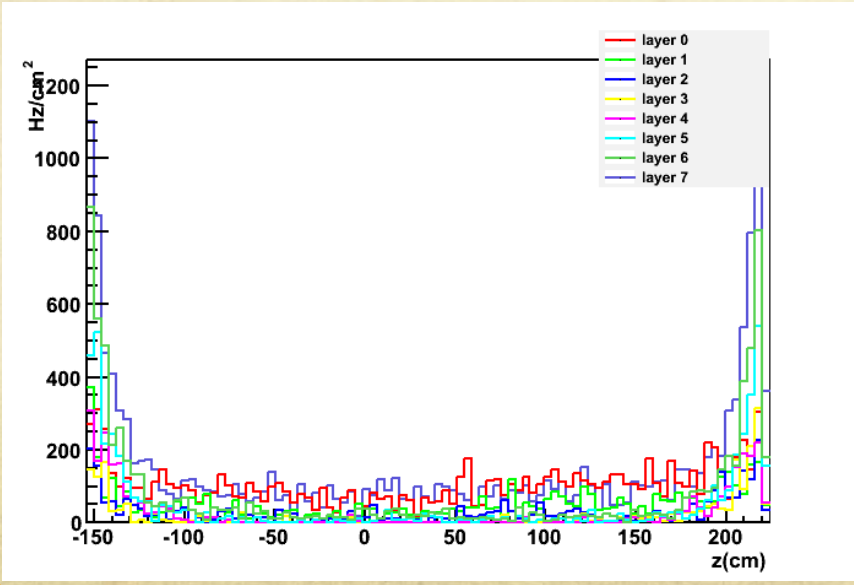
High Energy Neutrons



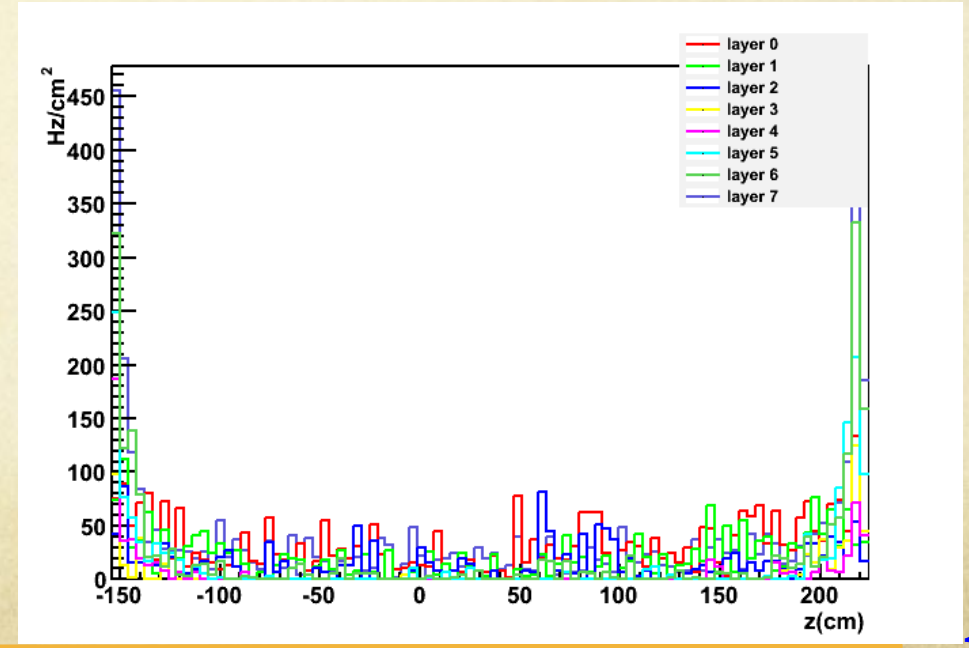
Fast Neutrons



Epithermal Neutrons

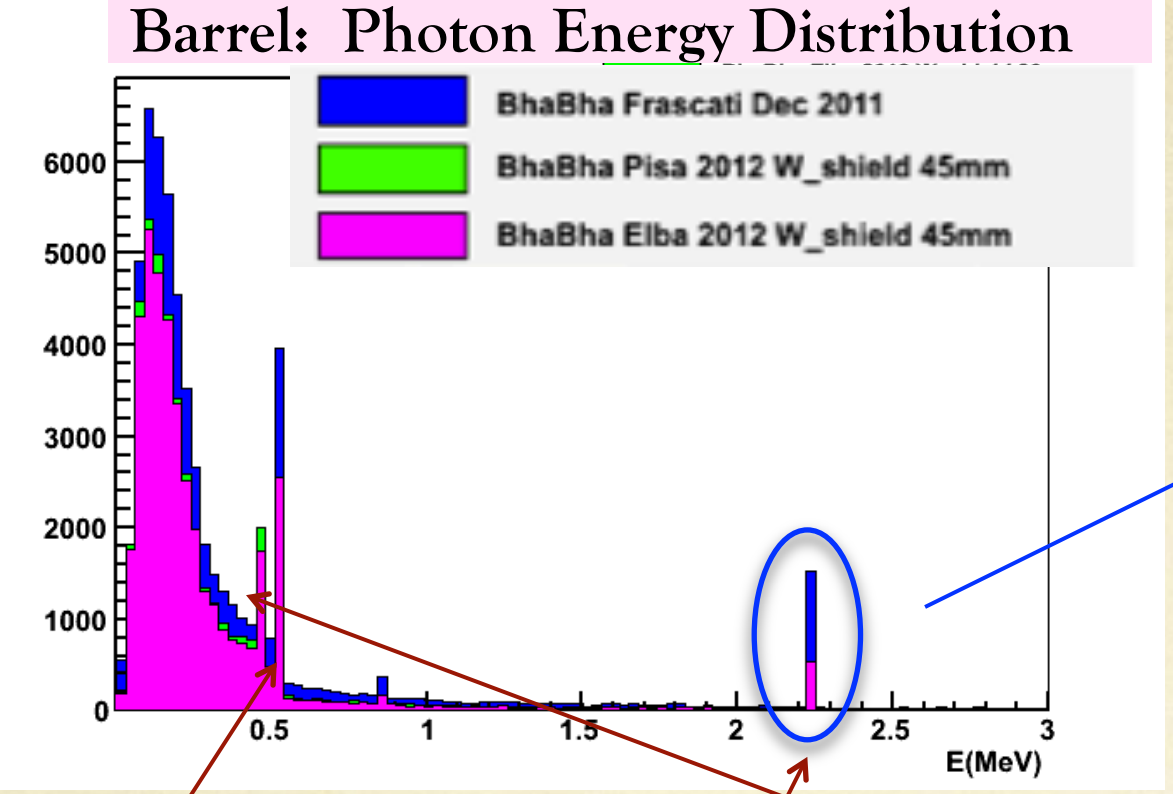


Thermal Neutrons



Photons Distributions

Barrel: Photon Energy Distribution



The number of photons due to the neutron capture on Hydrogen is significantly reduced thanks to the shield since now the thermal neutron are captured by the B^{10}

The Energy distribution for FWD and BWD Endcap are similar

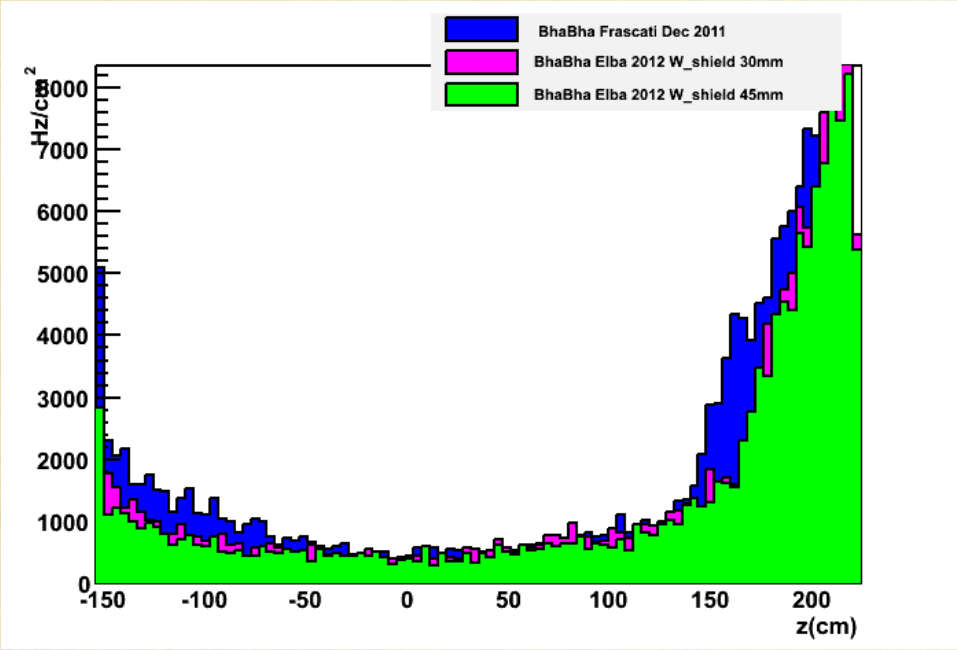
Photons of energy ~0.512 MeV are from annihilation radiation

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

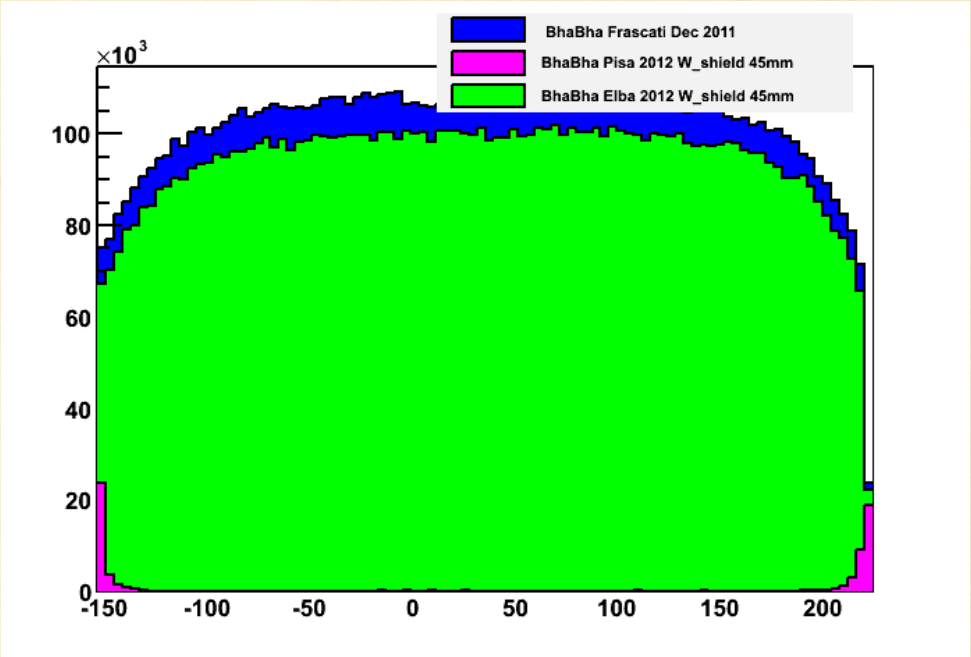
Photons of energy ~0.48 MeV are from neutron capture on B^{10}

Photons Distributions

Rate L0 vs Z-coordinate for Barrel



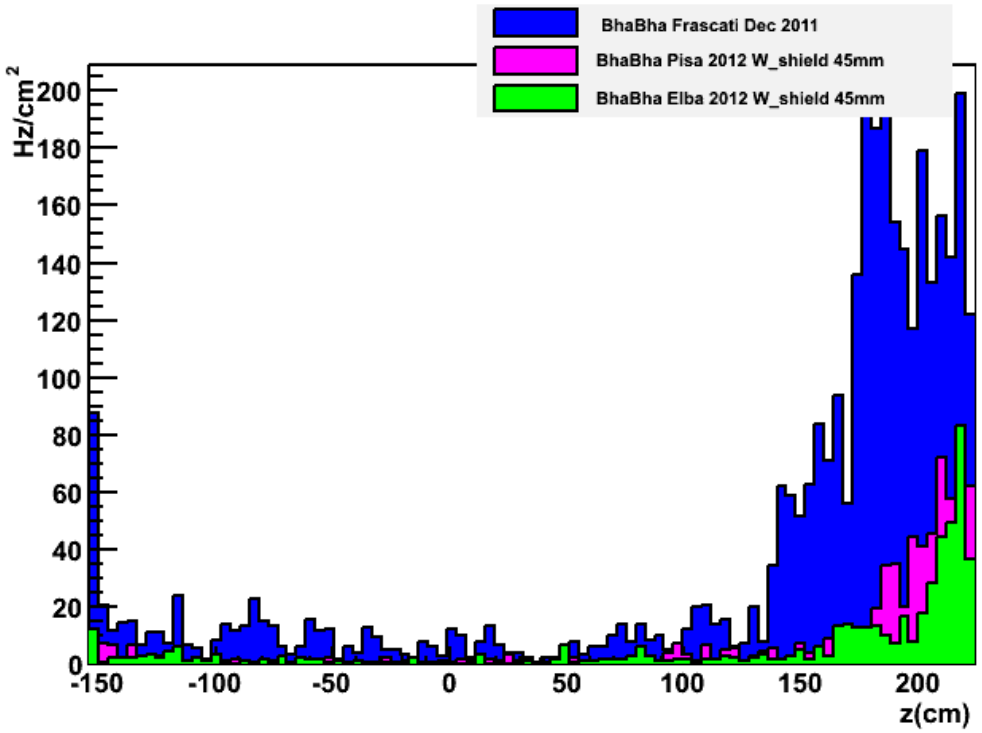
Rate L7 vs Z-coordinate for Barrel



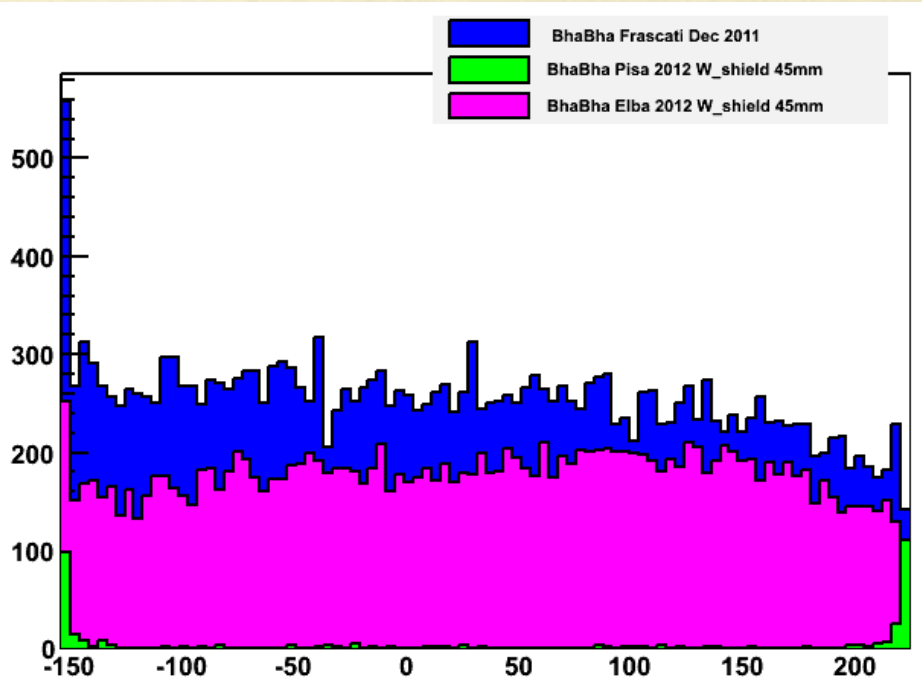
Significant reduction of the photon rate on Barrel L0 and L7

Electrons Distributions

Rate L0vs Z-coordinate for Barrel



Rate L7vs Z-coordinate for Barrel



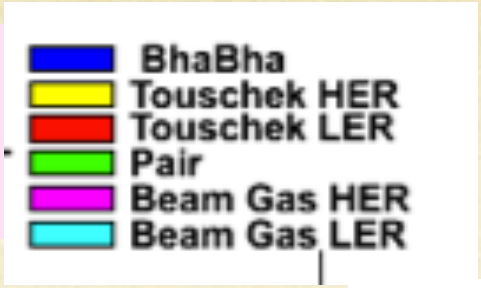
The Energy distribution for FWD and BWD Endcap are similar

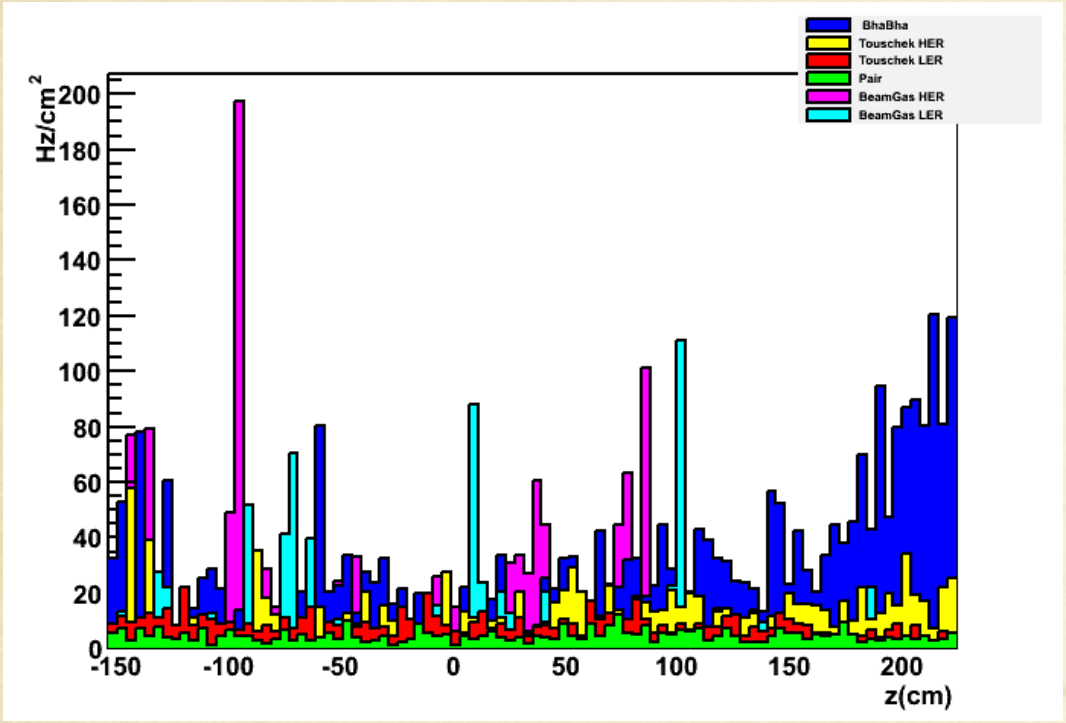
Significant reduction of the electron rate on Barrel L0 and L7

Comparison of different Background sources with the new shielding

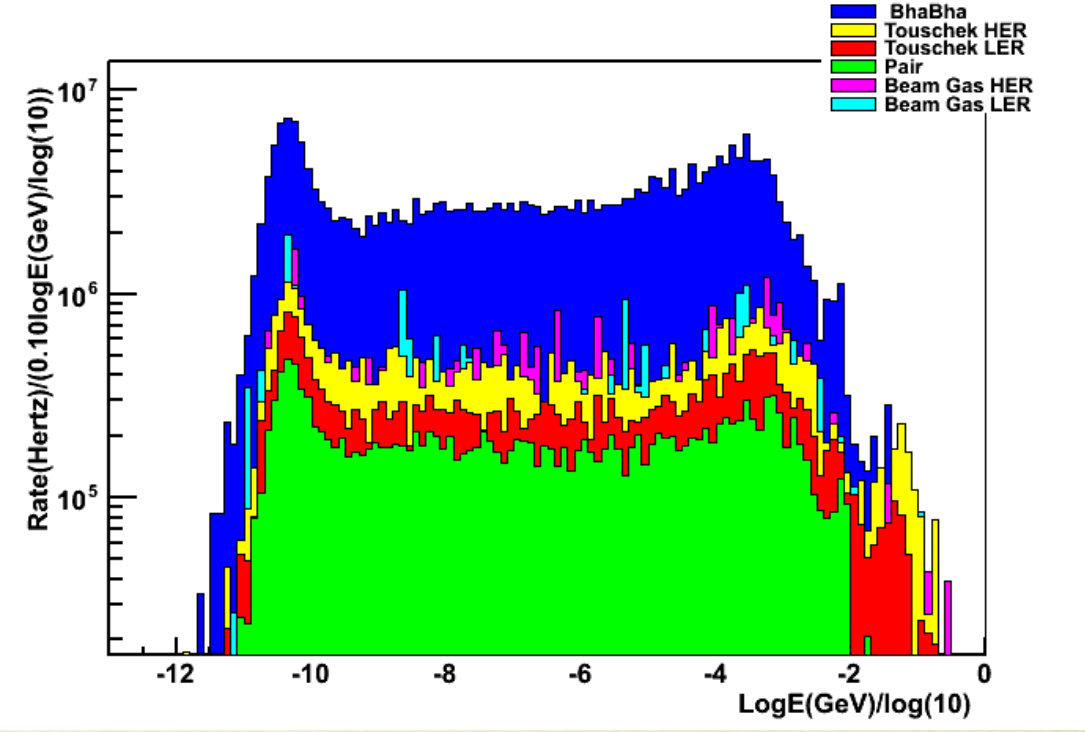
Neutrons Distributions for different Background Sources

Neutrons Rate for L0 vs Z-coordinate for Barrel





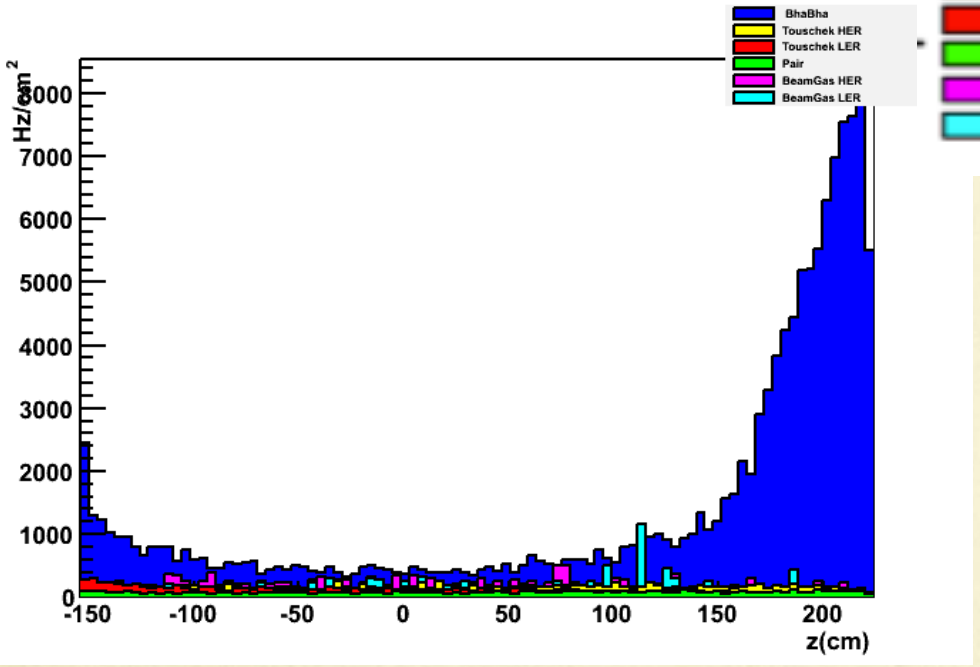
Neutrons Energy distribution for different Background Sources

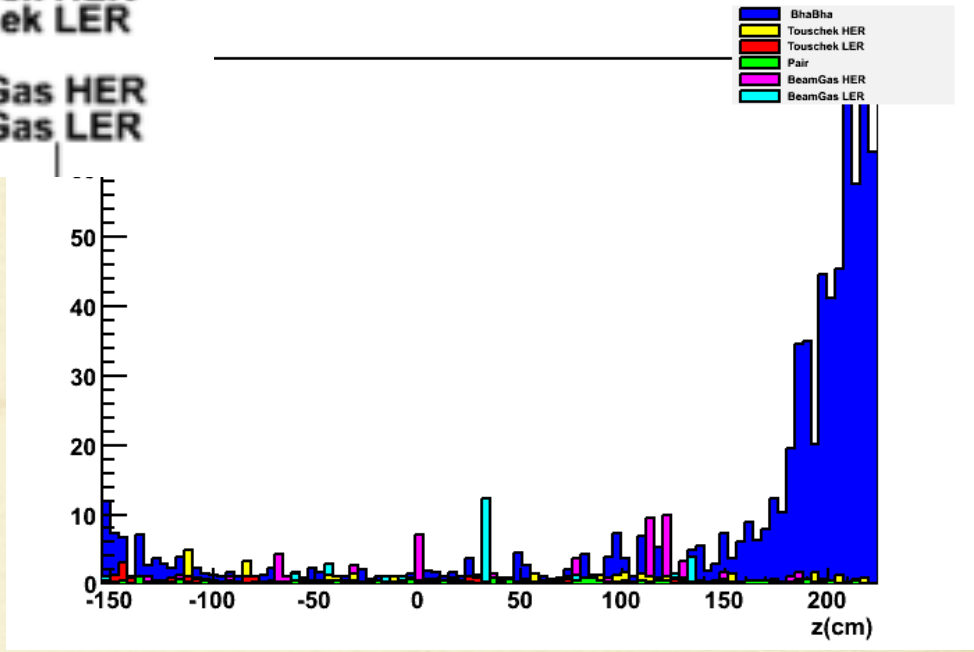


Radiative BhaBha are the main background Sources

Photons Rate for L0 vs Z-coordinate for Barrel

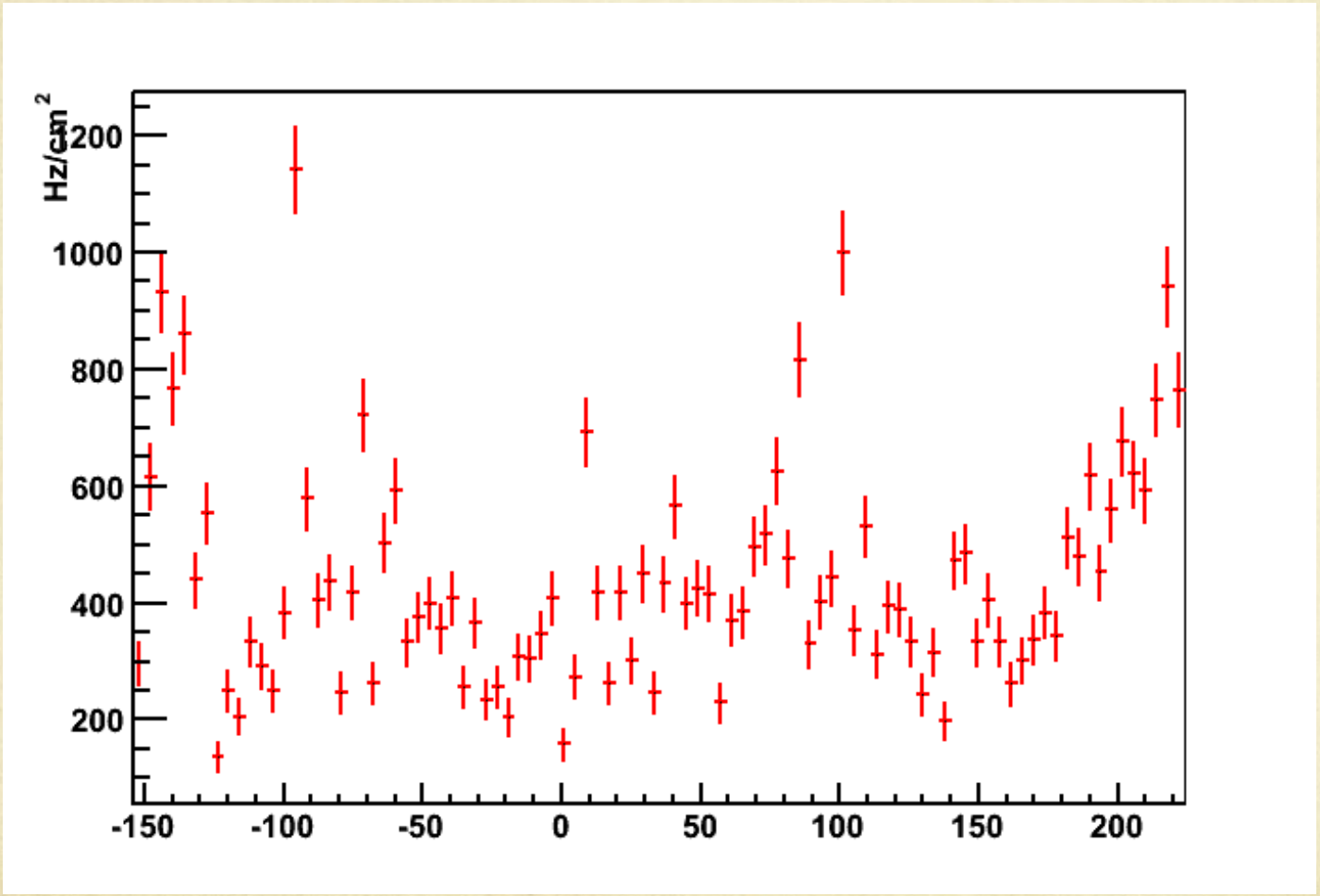
Electron Rate for L0 vs Z-coordinate for Barrel





Radiative BhaBha are the main background Sources

IFR Total Neutron Background Rate on Barrel Layer 0 including the Safety factor after the new shields: 6×10^9 neutrons/cm^2 per year



With the Shields
1 order of magnitude
Less

All the Background Sources included

Our Shielding Strategy has worked very well

As a matter of fact....

Shielding the Background from 753 B.C.

Summary and Future Plans

- ✓ All the background sources have been studied after the addition of the shielding. The results are very good (the rate went down of 1 order of magnitude).
- ✓ The shielding we studied with the simulation is not easy to be implemented in the reality
- ✓ Some additional (quick) studies will be done very soon
- ✓ IFR TDR background uploaded 10 days ago

BACK-UP SLIDES