Last week summary

- Comparing different productions:
1. Physics lists: BERT vs BERT_HP
differences of the number of neutrons below 10% except for the barrel region a factor 1.7 more is present with HP list. Need to look at the energy distribution of the neutron in the barrel.

2. Delta E cut: 0.002 vs 0.05 vs 0.5
Differences below 10% between the different production. Number of neutrons exiting the final focus increases with the decreasing of the cut but this does not reflect on the IFR.

3. Shielded vs Unshielded
The shield works well as photon and electron shielding but as well as neutron generator: rates increases from a factor 1.8 in the barrel up to a factor ~6 in the forward endcap

- Measuring the neutron rates
The rates are more or less what we can expect extrapolating the BaBar ones to the SuperB luminosity, maybe a little less. They come mainly from the:
1. final focus (found 2 hot spots)
2. shielding when present
3. flanges, supports of the SVT/DCH
4. inactive volumes (info not saved in the rootfiles)

- Complications
1. Using the boundaries is somehow difficult or at least tricky because it happens quite frequently that a neutron passes the same surface more than once.
2. The Final Focus is simulated only up to +-300cm i.d. right below the endcaps, therefore all the rates are underestimated, in addition “we may be still missing some major neutron source, located say 5-6 meters away from IP” (quoting Jerry Va’vra).
3. Missing some MC truth information in the rootfiles

- What’s next
1. We can deal with complication number 1
2. We need a better description of the final focus (complication #2)
3. We need to save on the rootfiles (even a smaller production 50k events) the MC truth information for the generation of all the neutron (complication #3).

- Questions
1. is it worth to spend much time on this production (missing part of the final focus, the part that’s in also need to be upgraded, missing some MC info)?
2. Which is the best configuration for studying neutrons with FullSim? Need more thinking but probably BERT_HP and DeltaE=0.05.

Goal for this production:

understand differences between different physics lists, cuts and configurations.

look for problems, missing stuff and improvements.

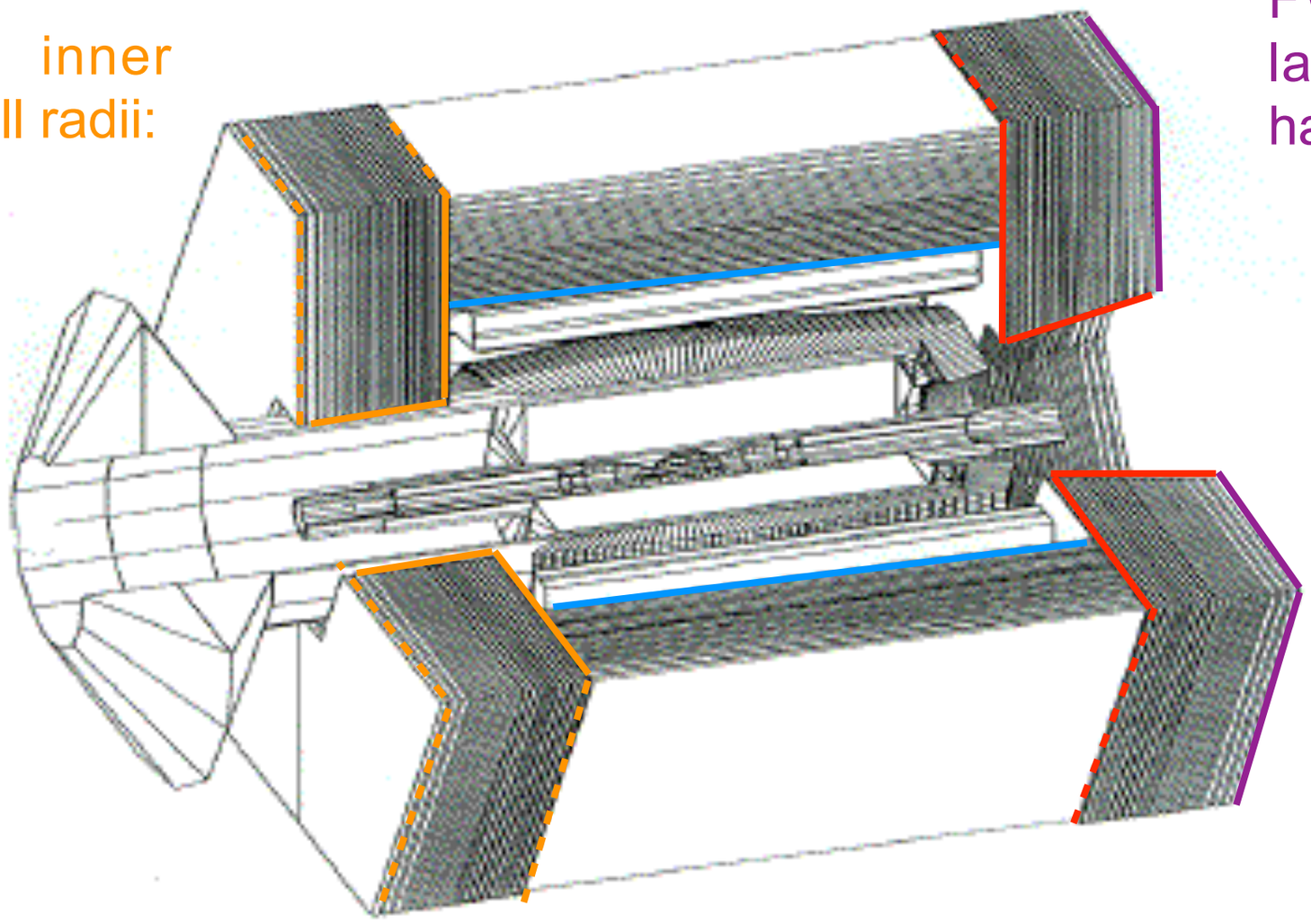
tune the machinery and tools for background analysis.

not really extract reliable rate numbers but look at the order of magnitudes.

look for any additional information that can be useful to understand/ remediate backgrounds.

IFR regions where the background can be an issue

BWD endcap inner layers and small radii:



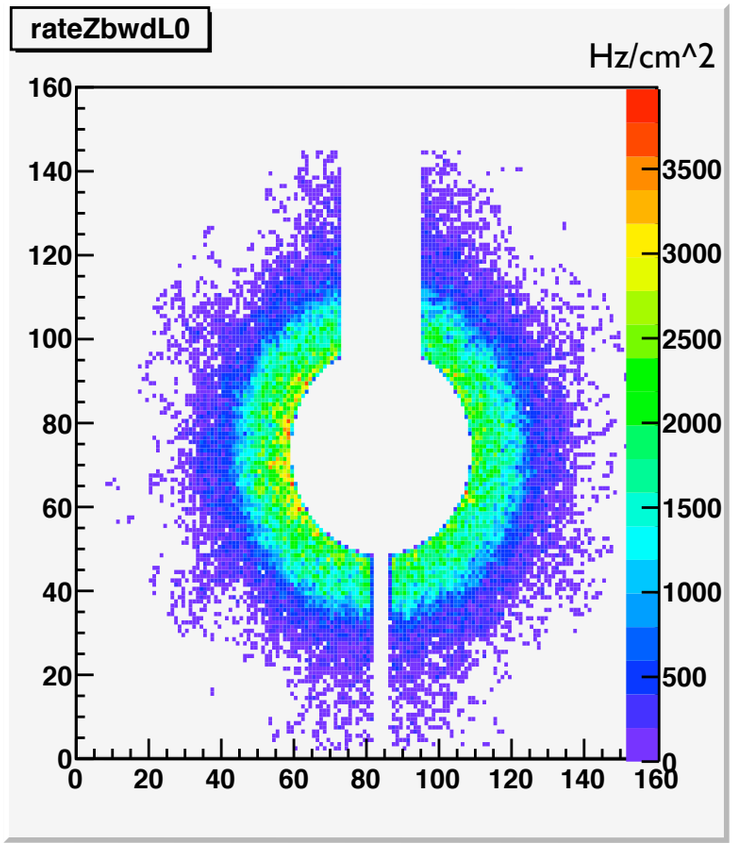
FWD endcap outer layer for the beam halo.

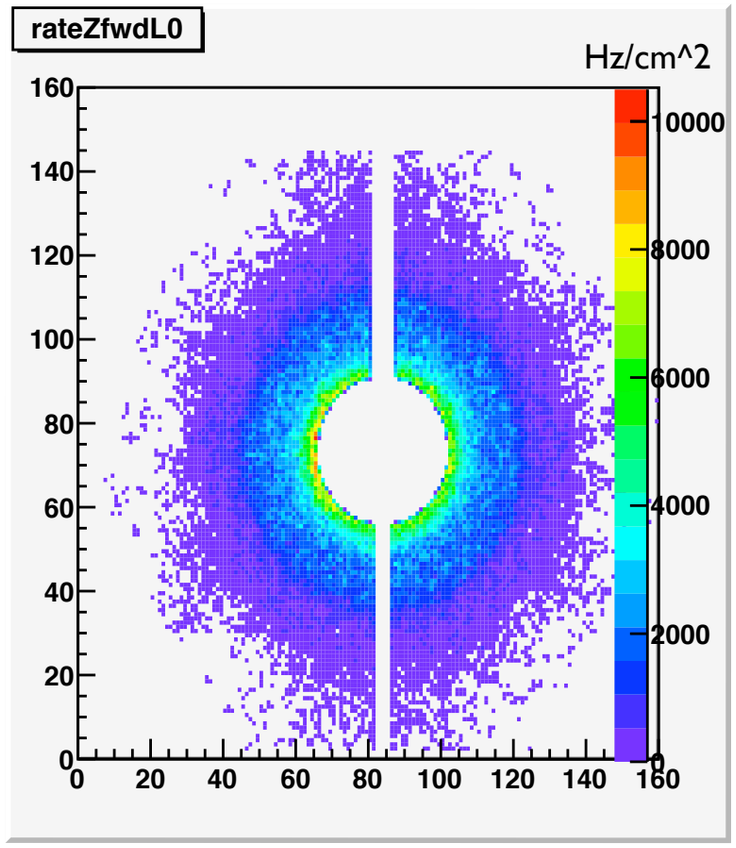
FWD endcap inner layers and small radii (it's the hottest region): neutrons, photons, electrons

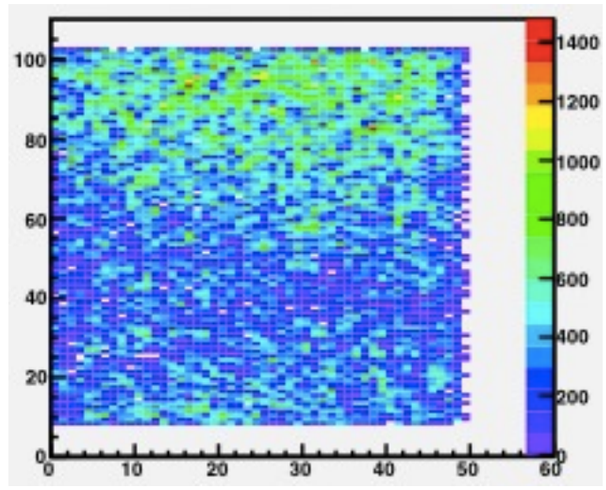
BWD endcap outer layers should be shielded by the SOB and additional iron.

Barrel innermost layers: mostly neutrons. This is a crucial region because SiPM should go there.

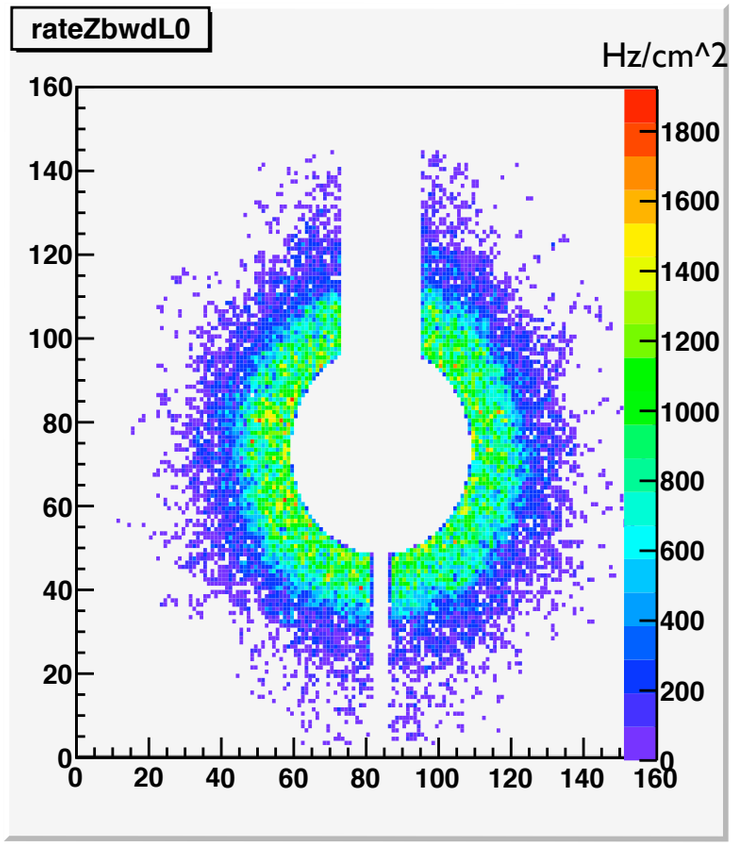
Produzione SHIELDED

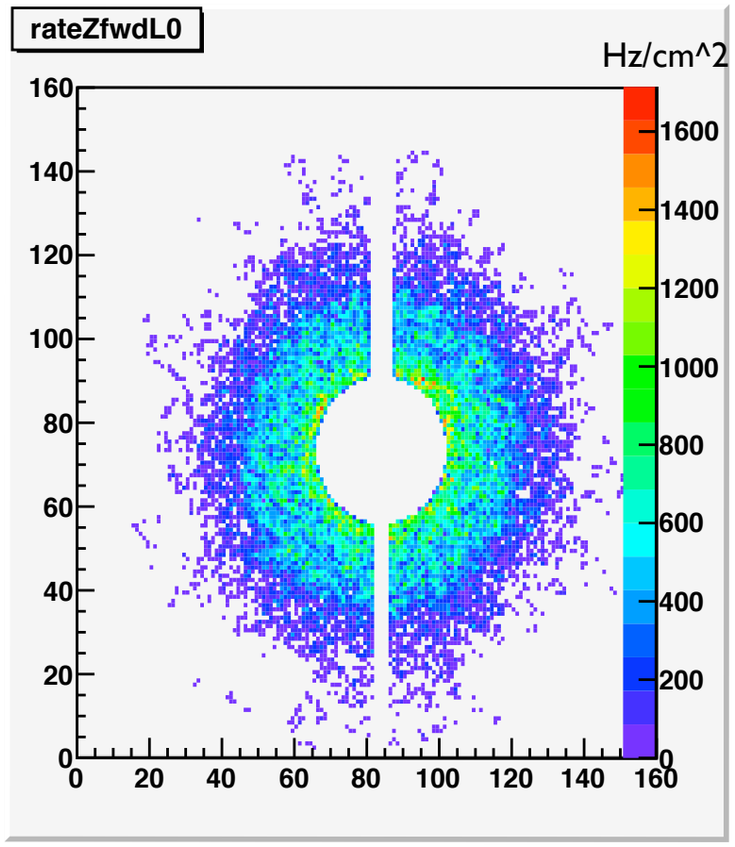


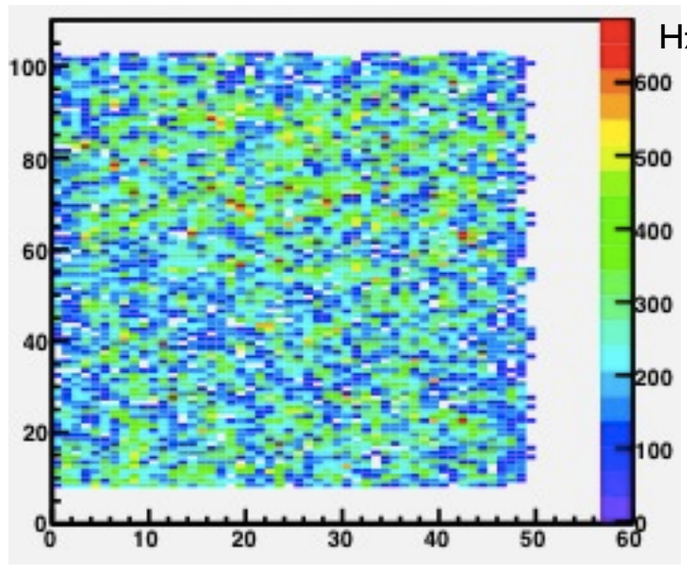




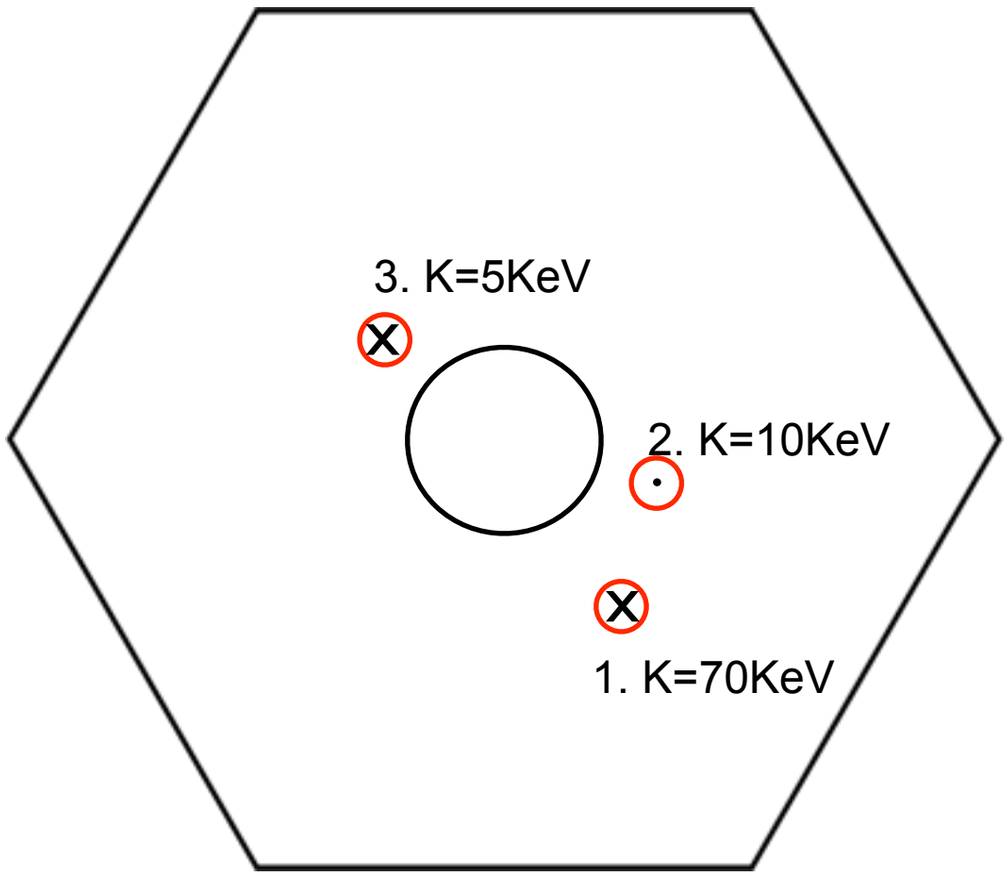
Produzione UNSHIELDED







The neutron path



A neutron is generated in the final focus with a energy around 1MeV

The neutron travels trough the inner detectors and enters the IFR FWD endcap in (1) with a kinetic energy of 70 keV.

Then it exits and re-enters the endcap surface in (2) and (3) with subsequent energy degradation.

Between (1) and (3) the elapsed time is about 6us.

The neutron generated in this event is only one, but it's counted 3 times in the boundary survey, and it also hit the first layer of the endcap 3 times with different energy.

The silicon damage function has a strong dependance on the energy spectrum therefore to obtain useful rate estimation we need to scale the doses to 1MeV equivalent accordingly to ASTM E 722 - 93.

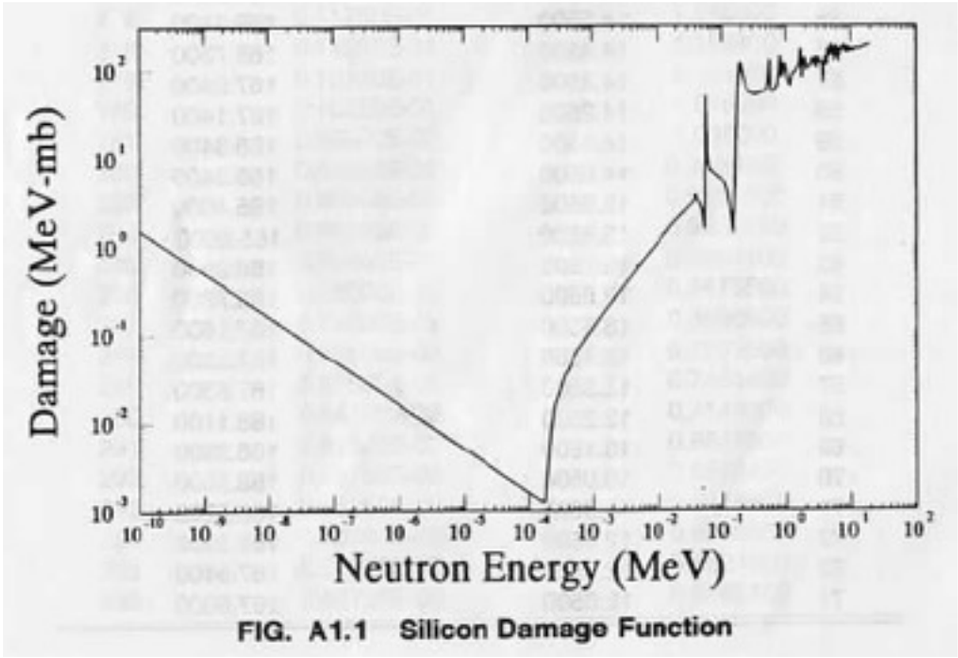
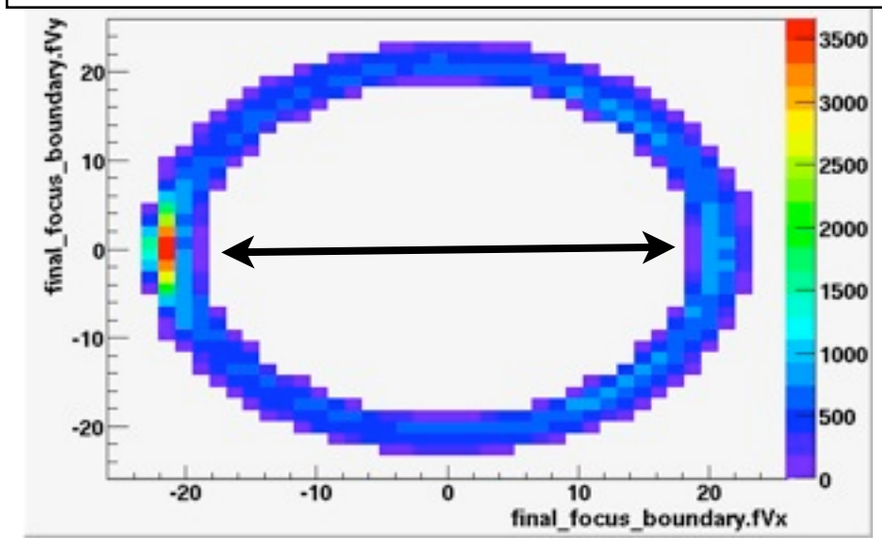
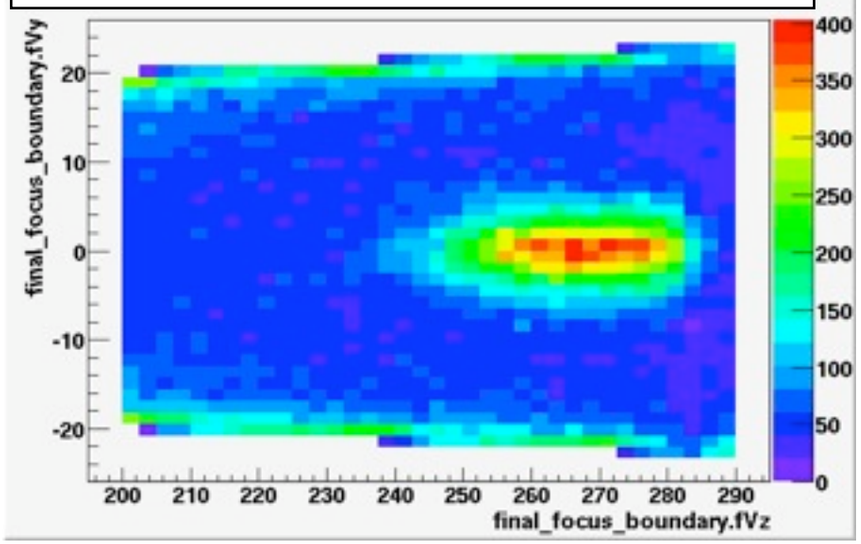


FIG. A1.1 Silicon Damage Function

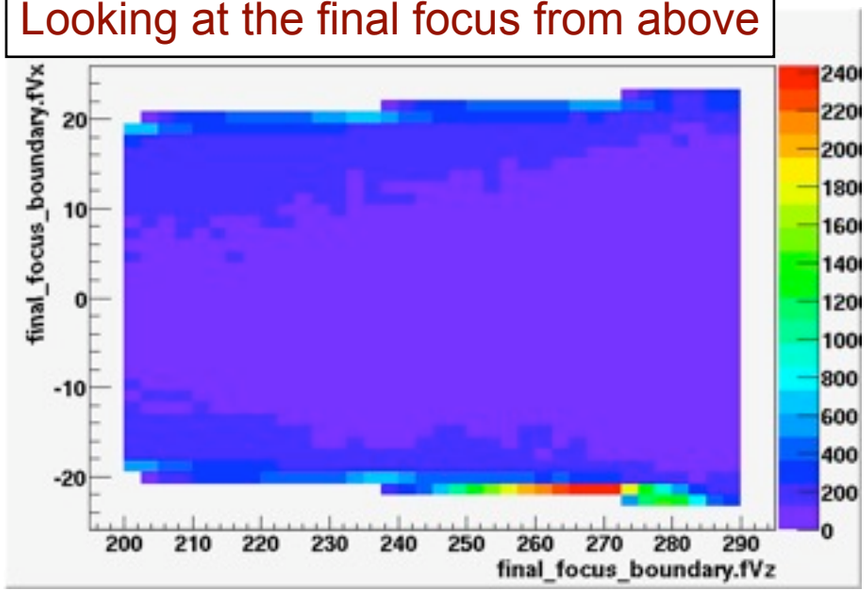
Looking at the final focus from the FWD side



Looking at the final focus from the side



Looking at the final focus from above



The hot spot is visible in all the projections of the final focus (3 left plots).

The rate of the hot spot is of the order of 100kHz/cm^2, more than six times higher than the same region on the opposite side as denoted by the black arrow on the upper-left plot.

There is a similar spot (wider along the beam pipe direction) about 1.5 m backward from the IP.

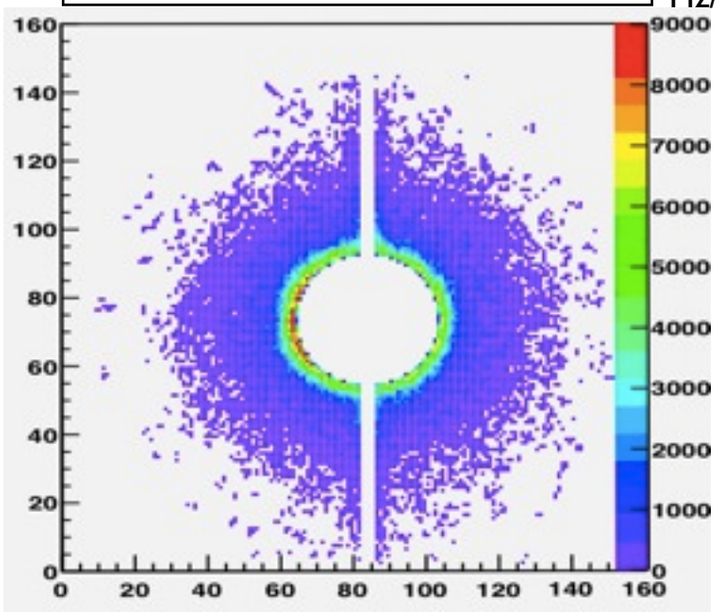
The effect of this source is visible also on the inner ring of the IFR forward endcap (bottom center plot): the left half has higher rate.

It seems to be an effect of the Wolf-Shield since such effect disappears in the unshielded production (bottom right).

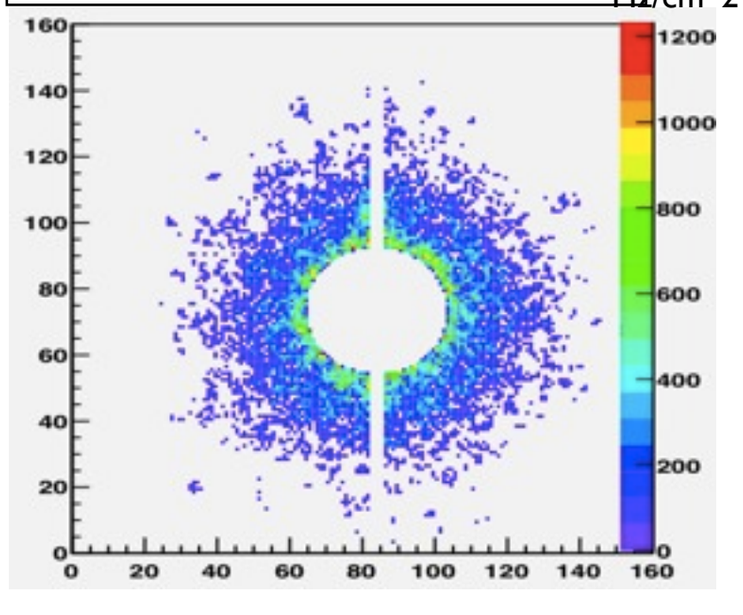
B.t.w. the maximum neutron rate on the IFR endcap inner ring with the shielding is almost one order of magnitude higher wrt the non-shielded configuration.

The plots have been done with the BERT physics list but the situation is similar using the HP list. The energy distributions are pretty much consistent to the ones produced by Eugenio.

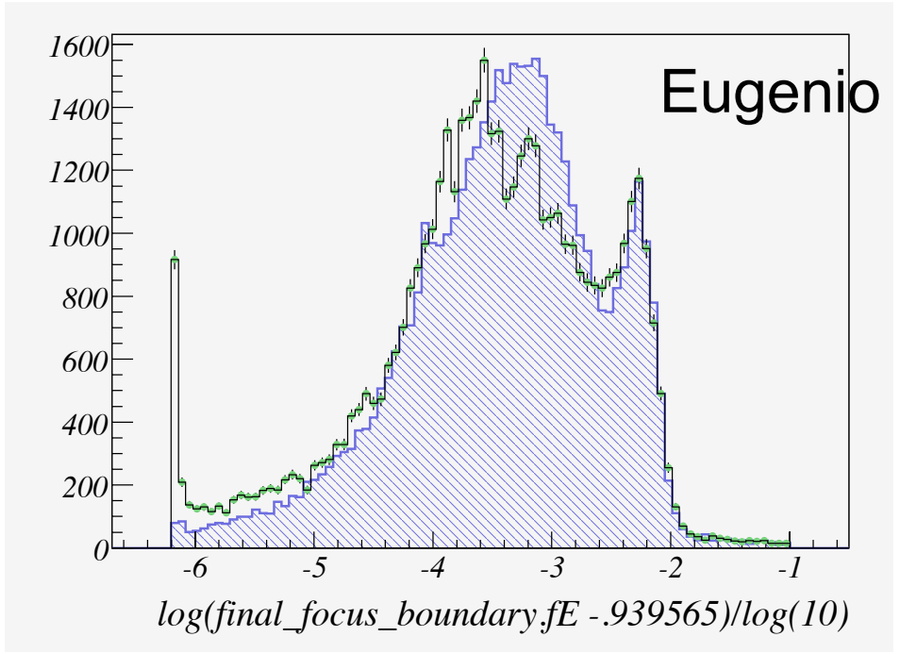
IFR FWD endcap (shielded)



IFR FWD endcap (unshielded)

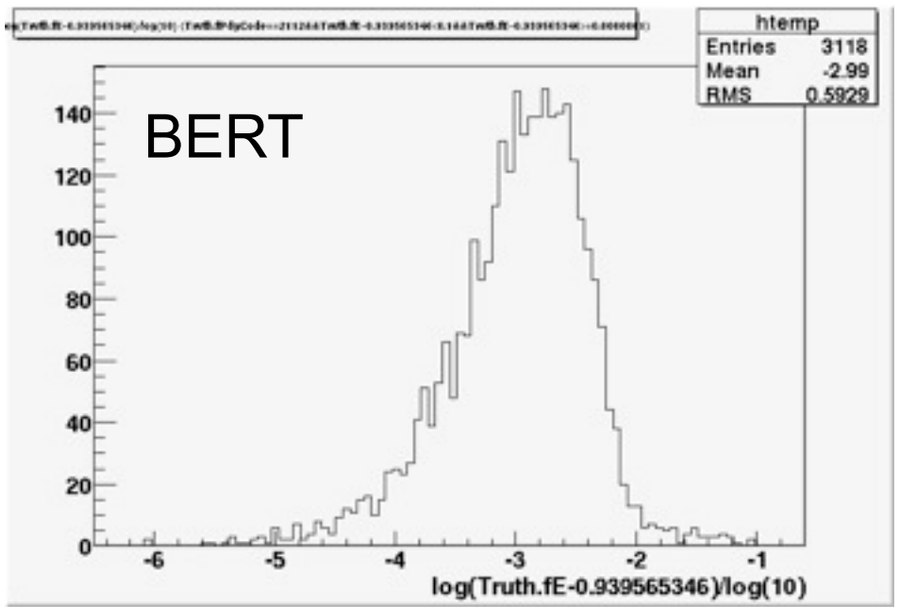


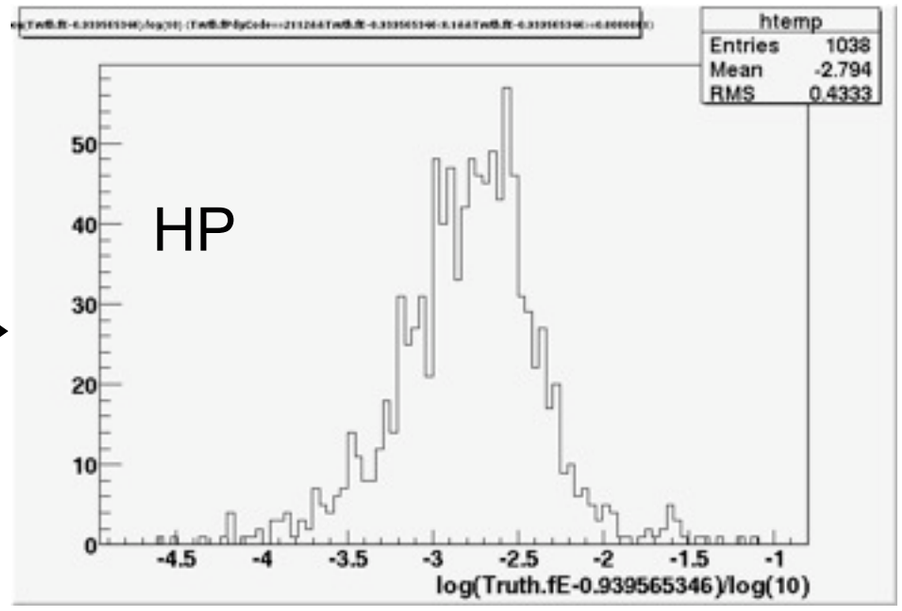
Understanding Neutron Energy distributions

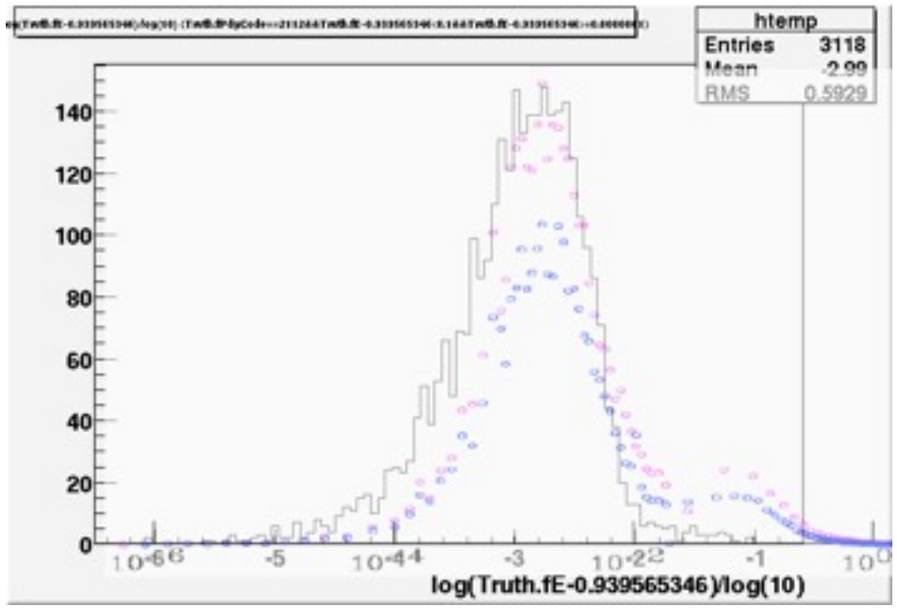


Eugenio spotted some differences between productions with 2 different physics lists: BERT vs HP.

Some discrepancy is present also for generation energy of the few neutrons which have MC truth information in the rootuples.







Good agreement between Super B simulation (MC truth generated energy) and Fluka simulation.

For a better understanding of the neutron background

- neutron MC truth

- extend the final focus up to 10 meters from the IP

are desirable.