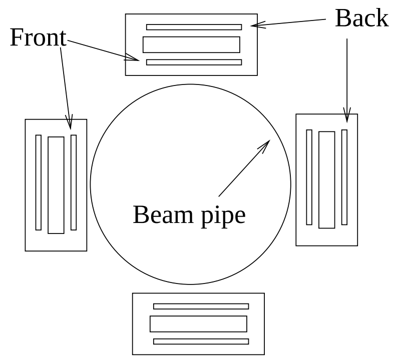
# Explaining the Beast Diode Data.

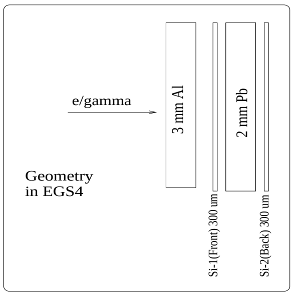
*Saroj Sahu, 6th Jan 1999*

The Front/Back convention of the silicon PIN diodes in the Beast is given in the Figure below. Essentially, the *Front* diode faces the beampipe. The two diodes in each box are separated by a 2 mm layer of lead, which makes the diode sandwich effectively a rudimentary calorimeter. The idea is that if the background is coming from soft photons/charged particles, then they will be primarily stopped before the Front-layer, and therefore the Front/Back ratio will be $> 1$. However, if the background is dominated by high energy particles, then the Pb layer will become a shower amplifier, and the Back layer will see more energy than the front, thereby pulling the Front/Back ratio $< 1$.

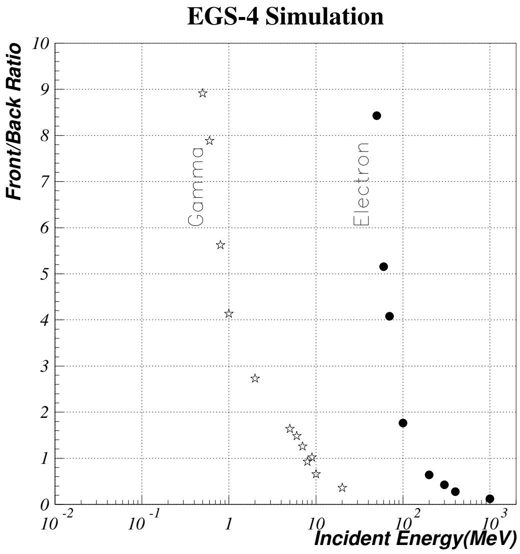



Front/Back Convention in Data

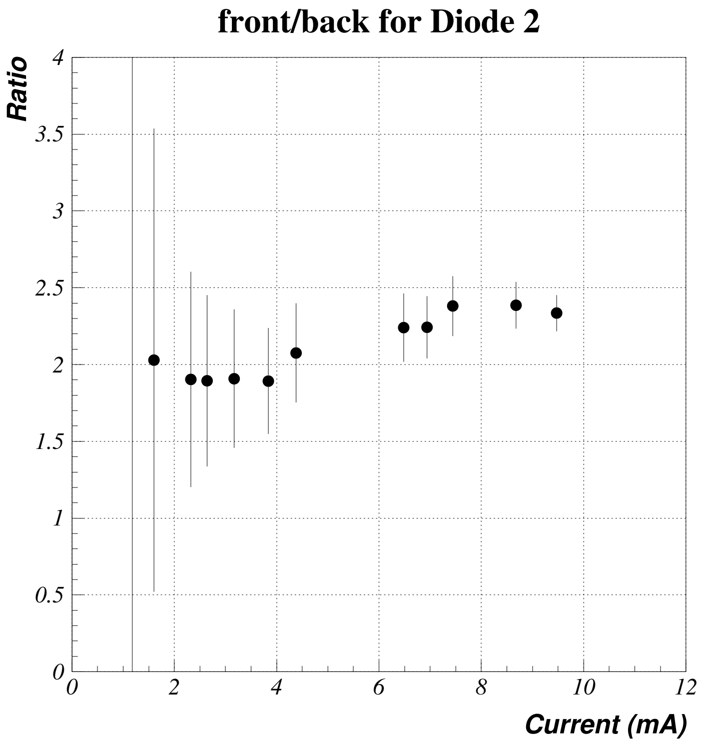
I did an EGS-4 simulation with the configuration shown in the following picture. The cut-off applied was 100 eV, the minimum available in EGS.(Compare this with the minimum cut-off of 100 keV in Geant). The 3 mm Al simulates the equivalent material due to beampipe and skin of the diode box. The Front/Back ratio is plotted with as a function of incident



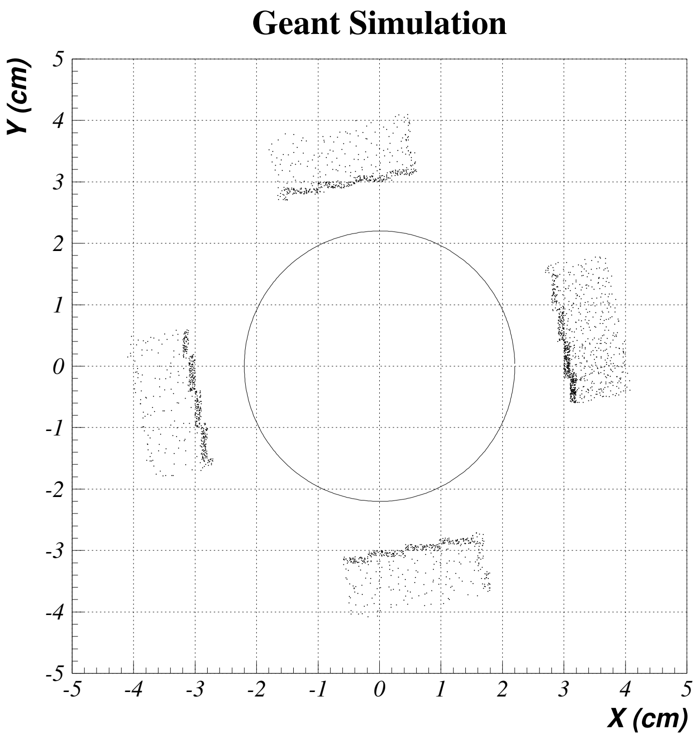

energy of photon and electron. A behaviour similar to what described before is observed. Note that $E_\gamma < 0.5 MeV$ and $E_e < 0.1 MeV$ don't make it to diodes at all.



From the Real Data Run 451, the Ratio of Front/Back is shown below. The ratio is around 2. It means the spectrum of particles reaching the diode-box could be either few MeV $\gamma$ or hundreds of MeV $e^{\pm}$, as suggested by the EGS simulation.



How do we know that ? Well - take a look at the Geant Simulation of Beast (Hey Jorge - it works - thanks !!). It is a simulation of spent electrons - mind you the cut-off used was 1 MeV. The following picture tells us where the particles (both photons and charged particles) mostly enter the diode box. The strong shade on the side closer to the beam-pipe tells us that most particles enter from the bottom, *i.e.,* the assumption in the EGS simulation is valid. The smeared part is due to some particles entering from the sides.



Yes.. yes.. I know you are asking what kind of energy spectra these particles entering the diode box have. In the following picture, I show the distribution of particles "entering" the diode box. Note that relative number of $e^{\pm}$ is much less than that of $\gamma$s. Note the X-axis - it is the $log_{10}$ of the energy. The *mean* appearing on the statistics box can be translated (roughly) to the geometric mean of the energy distribution, which is pretty close to the arithmetic mean for this kind of distribution. Translation is : Geometric Mean = $10^{\mu}$. So, $< E_\gamma >= 10^{-2.25} GeV = 6 MeV$. $< E_{e^\pm} >= 10^{-1.7} GeV = 20 MeV$. If you look at the EGS plot for 6 MeV $\gamma$ you see the F/B ratio to be about 2, and that's what you see in the Real Data !!

**Summary : The Front/Back ratio of Diodes from real data can be explained by the Simulation.**