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# Background from C37 collimator for E160

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**Abstract**

A summary of the schematics of the C37 collimator is presented along with it's purpose in E160. The question has arisen as to how the background radiation depends on the accuracy of the alignment of C37. Data on the photon background and the effect of C37 on the beam is presented and analyzed. Conclusions are drawn as to optimal positioning of C37.

## 1 Introduction

C37 will be used to collimate the gamma beam 53 meters down beam from the 1mm diamond. Due to the high energy and momenta distributions of the incident photons, background showers will be created by C37. A sweeping magnet located after C37 can remove the charged particles. This report examines the photons that travel through the collimator undisturbed and the relevant photon background that is created by those gammas that strike the collimator. The point of analysis is at the beginning of the DC2 collimator, 42 meters down beam of C37.

## 2 Physical Layout

C37 consists of four sets of 10.5 cm x 20.3 cm x 49.5 cm blocks. The blocks are organized into two jaws which open along the y-axis and the x-axis. The separation between the blocks in each jaw is set to 4 mm for this simulation. The two jaws are separated by 3 mm in the z direction. The net effect of this is to create a 4 mm x 4 mm square hole for the beam to traverse. Each block consists of mostly copper and tungsten. The body of each block is water cooled and thus contains some piping. The tungsten section is located in the last 13.7 cm of each block.

# 3 Simulation

The simulation of the beam at C37 is carried out by a GEANT3 program in jaskey/geant/E160/C37.f. The data is analyzed by several .kumacs in PAW also located in jaskey/geant/E160. The shell-script file 'runC37' in jaskey/geant/E160/ will run and compile an entire data set. jaskey/geant/E160/readme.txt gives directions for running the simulation. This report is located in jaskey/geant/E160/C37report.tex. This simulation represents the error in positioning C37 by angles off perfect alignment. Zero degrees in the zx-plane and zero degrees in the zy plane is considered 'perfect' parallel alignment to the beam line. The beam line is considered to run straight along the z-axis. Two separate simulations were run to obtain the data in this report. In the first, the collimator is rotated from 0.00 degrees to 0.06 degrees along an axis parallel to the y-axis located at the front end of the collimator (where the beam initially enters). This is referred to as the zx offset. Data is taken at one-hundredth degree intervals. Each interval consists of a run of the GEANT simulation with identical input for photon trajectories. The data file for photon trajectories is jaskey/geant/E160/photon.dat and the statistics for it are given in Figures 1 and 2. The photons are typical photons for an E160 beam, produced by the 1 mm diamond, with an endpoint of 48 GeV. The second run is the same as the first with the exception that C37 is now rotated around an axis parallel to the x-axis (zy offset) located at the front of the collimator.

# 4 Results

The results from the simulation show correlations between the angle of the collimator, the number of particles transmitted through the collimator with no interaction, and the number of particles in the background shower. As the tilt is increased, the number of initial photons successfully traversing the collimator decreases (Figures 3, 4). This decrease is related to the geometry of the hole, and how it's area decreases with increasing tilt. The number of background particles also increases with increasing tilt; the sharpest increase is seen after 0.05 degrees (Figures 5, 6). The mean energy of the background photons is low, between 0 and 1.3 GeV. This distribution is flat with the largest ranges of energy occurring after 0.04 degrees(Figures 15, 16). In Figures 7 thru 12, the distributions are extremely flat, evidencing no dependence of mean radius, for background or transmitted photons, on the offset angle.

# 5 Conclusion

The positioning of C37 effects both the power of the beam and the background radiation at DC2. At increasing angles of tilt, the background counts increase and the number of useful photons decreases. This is seen most dramatically after 0.05 degrees. After tilt is increased beyond 0.04 degrees the energy range of the background tends to increase. It is recommended that the collimator be aligned with an error of less than 0.04 degrees.

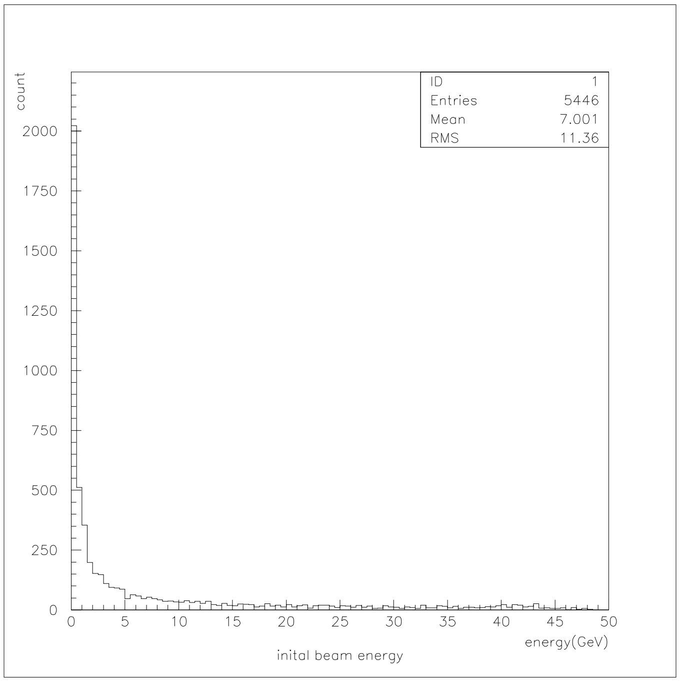


Figure 1: Energy distribution of initial beam

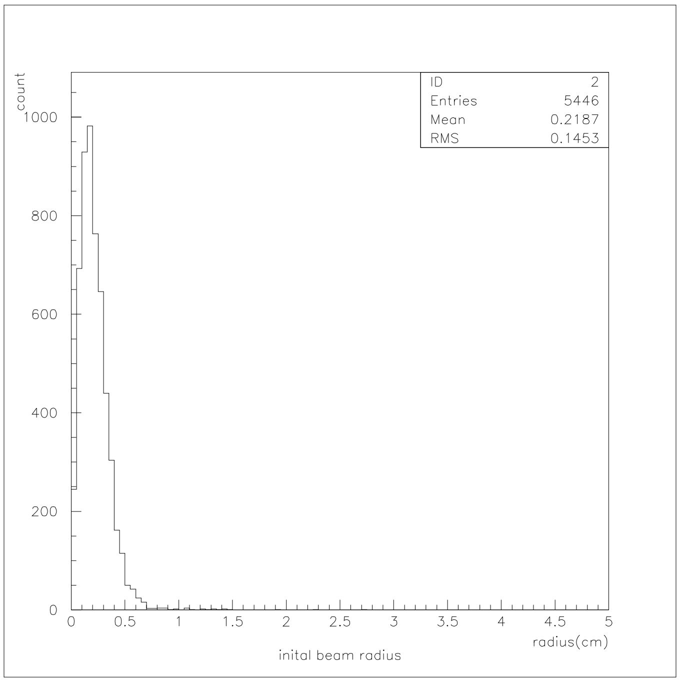


Figure 2: Radial distribution of initial beam

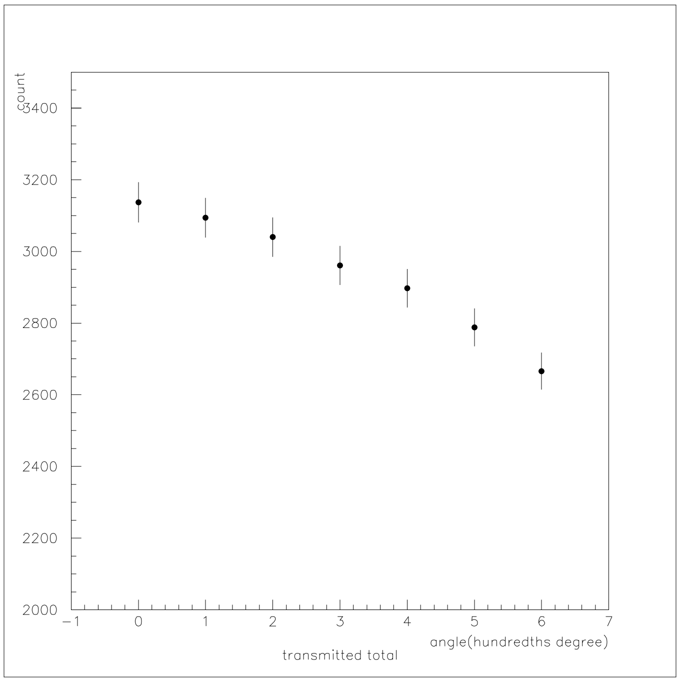


Figure 3: zx offset: The number of photons that transmit through C37 without interacting decrease as the collimator is tilted as a steeper angle.

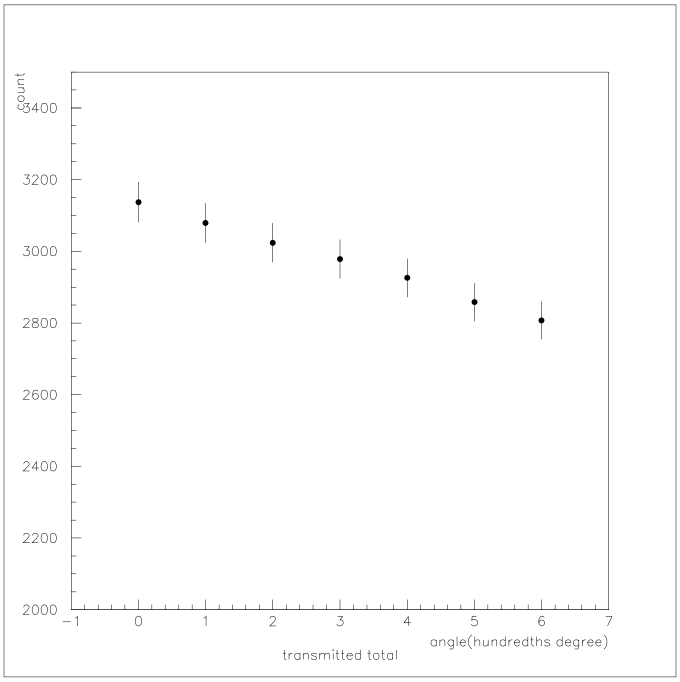


Figure 4: zy offset: The number of photons that transmit through C37 without interacting decrease as the collimator is tilted as a steeper angle.

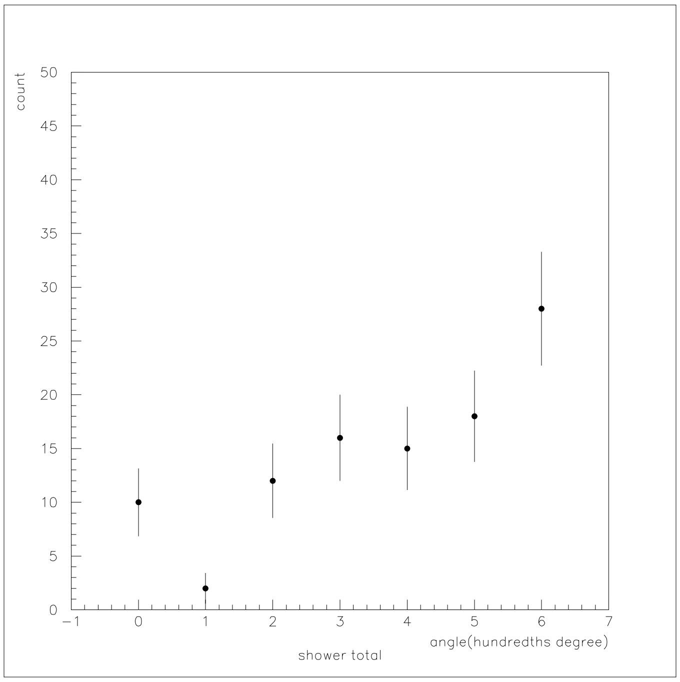


Figure 5: zx offset: The number of background photons increases as the collimator is tilted as a steeper angle.

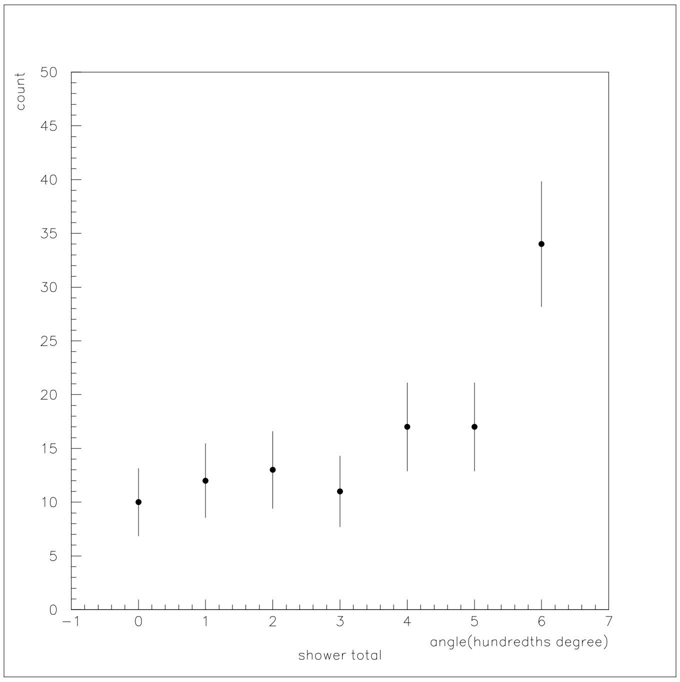


Figure 6: zy offset: The number of background photons increases as the collimator is tilted as a steeper angle.

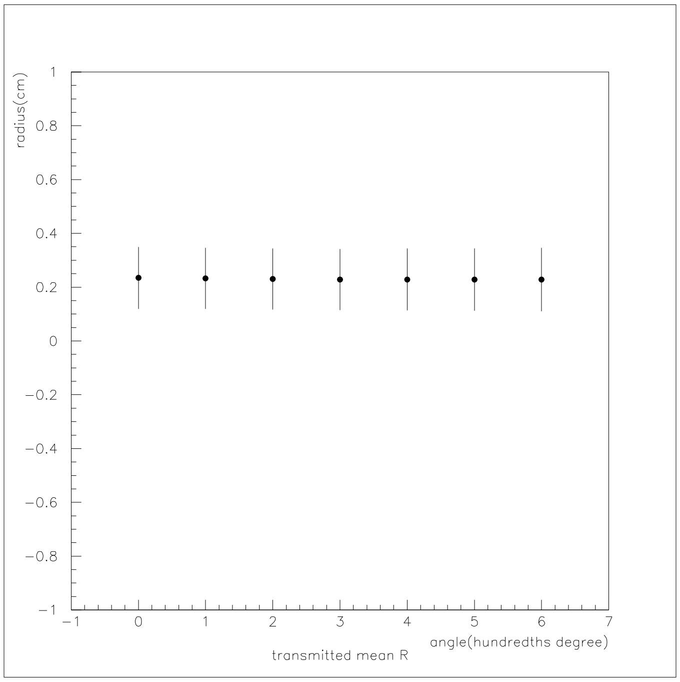


Figure 7: zx offset: The mean radius of the transmitted beam at DC2

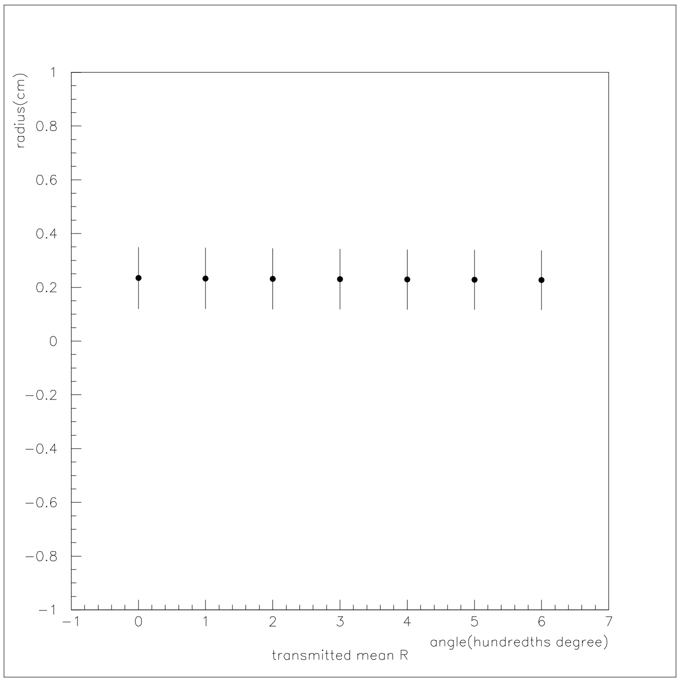


Figure 8: zy offset: The mean radius of the transmitted beam at DC2

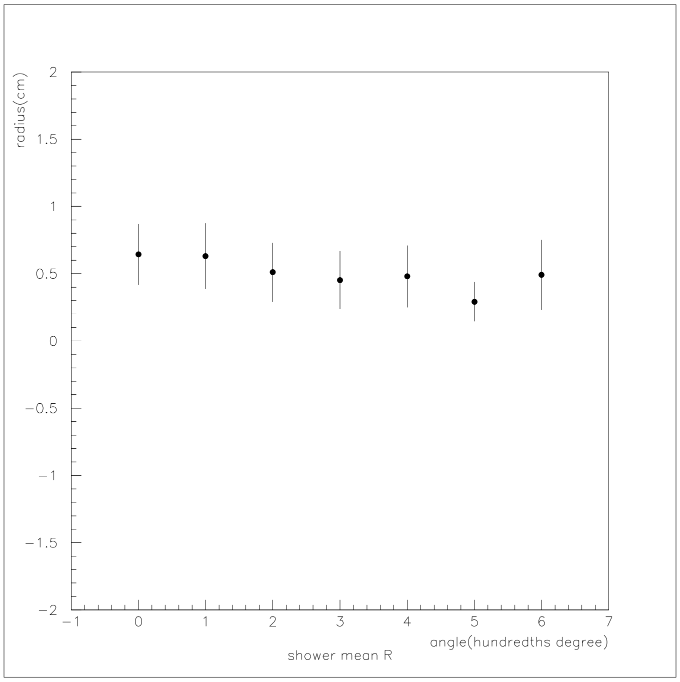


Figure 9: zx offset: The mean radius of the background photons at DC2

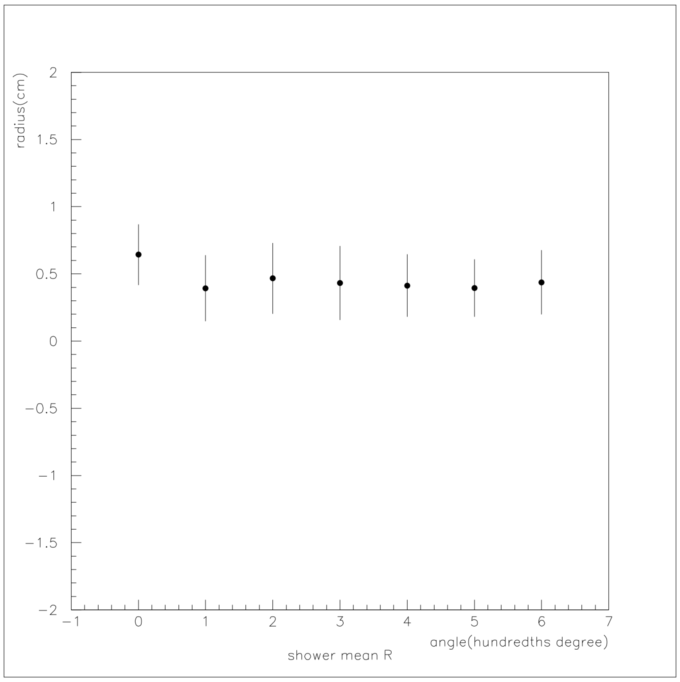


Figure 10: zy offset: The mean radius of the background photons at DC2

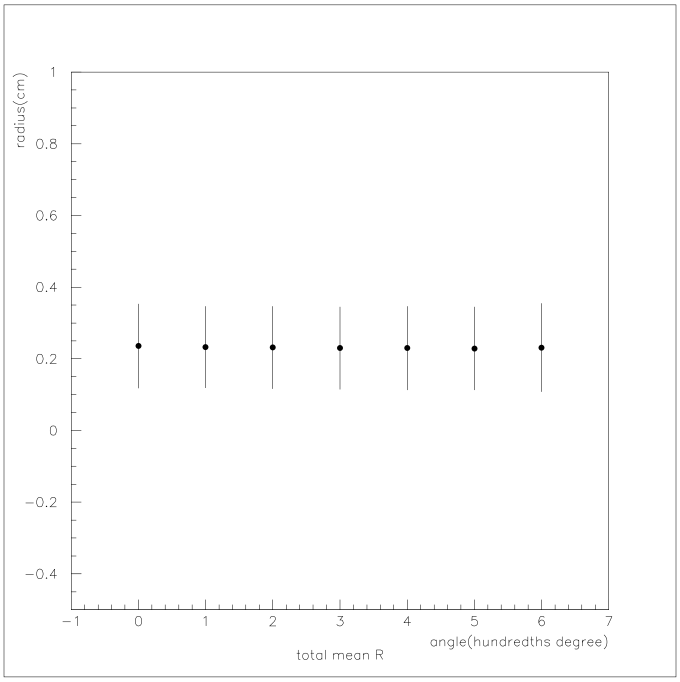


Figure 11: zx offset: The mean radius of the entire beam (background+transmitted) at DC2

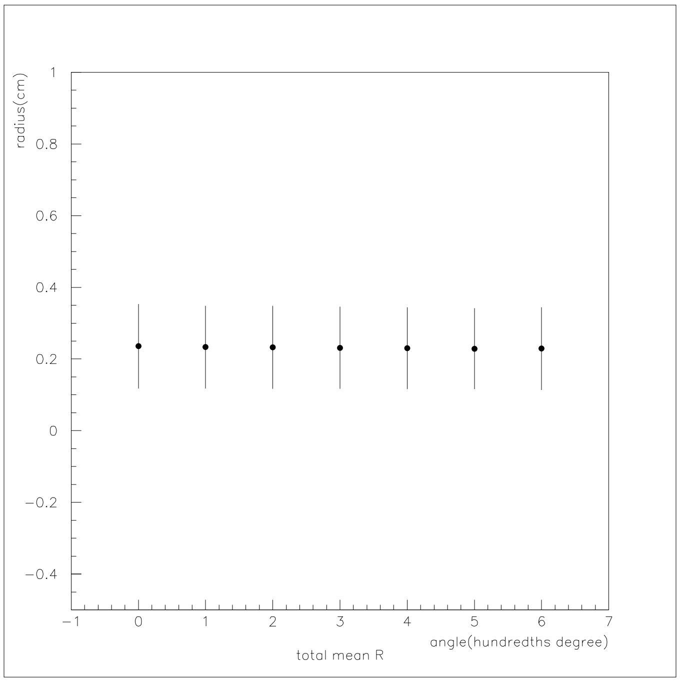


Figure 12: zy offset: The mean radius of the entire beam (background+transmitted) at DC2

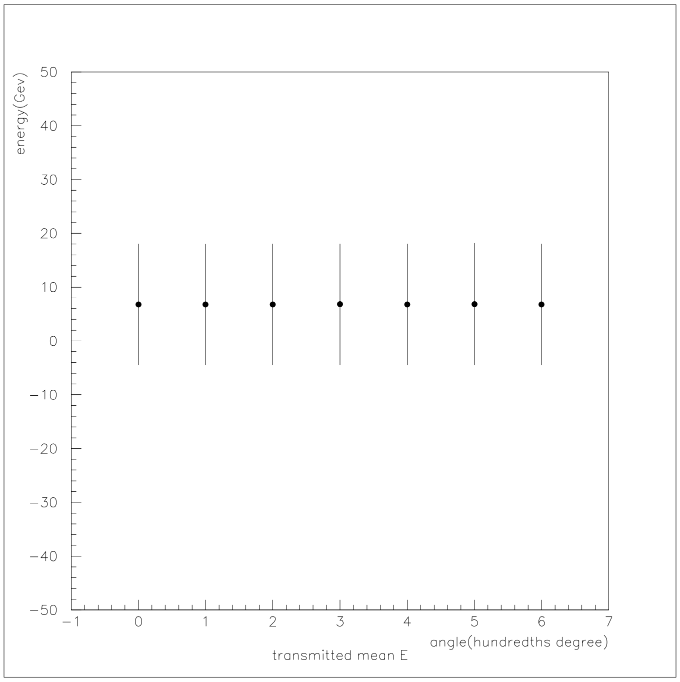


Figure 13: zx offset: The mean energy of the transmitted beam at DC2

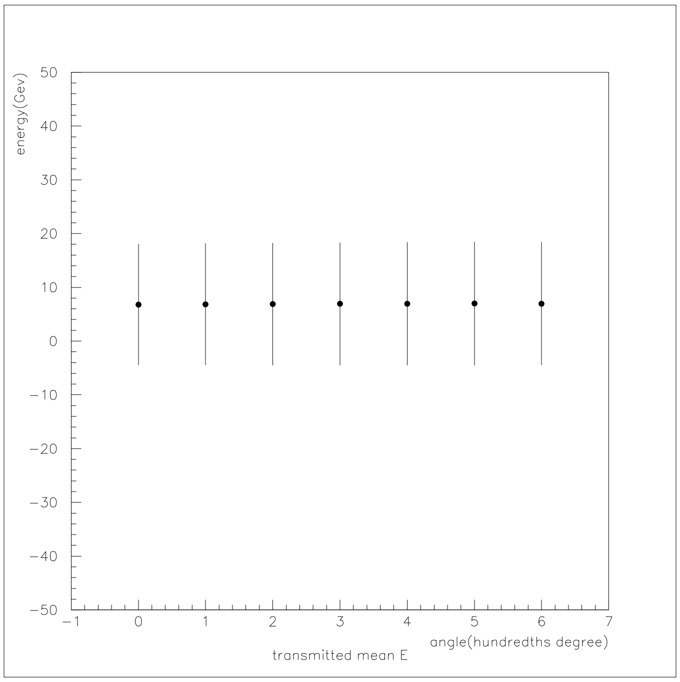


Figure 14: zy offset: The mean energy of the transmitted beam at DC2

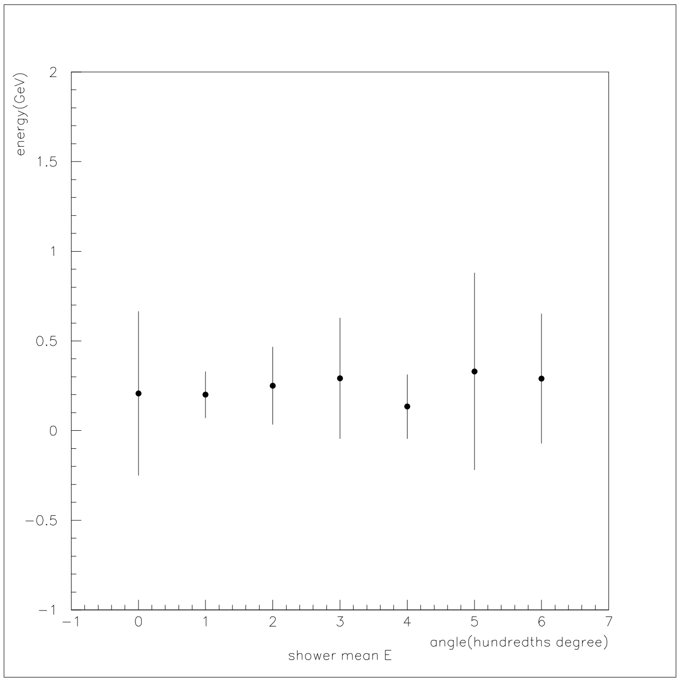


Figure 15: zx offset: The mean energy of the background at DC2

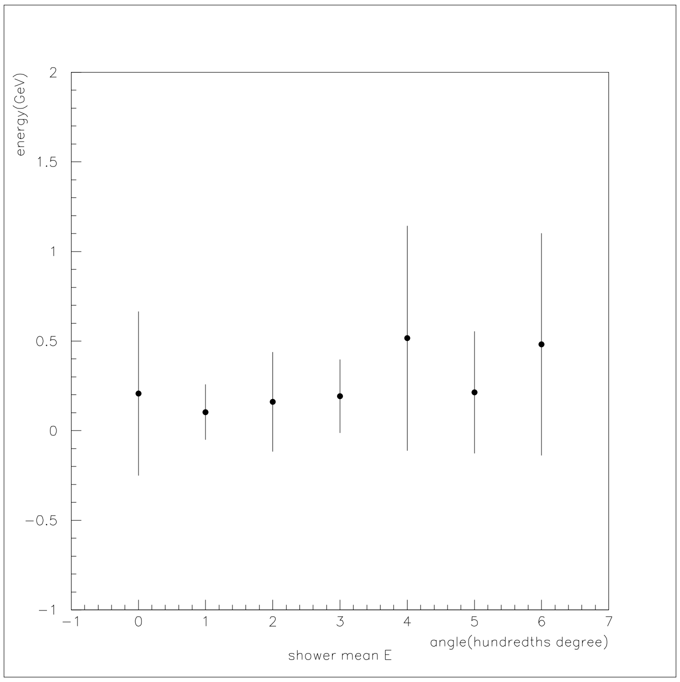


Figure 16: zy offset: The mean energy of the background at DC2

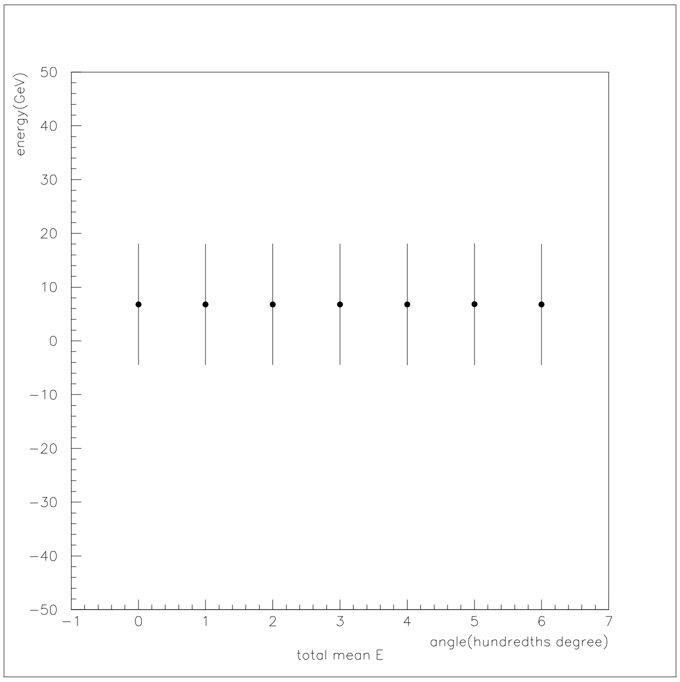


Figure 17: zx offset: The mean energy of the entire beam (background+transmitted) at DC2

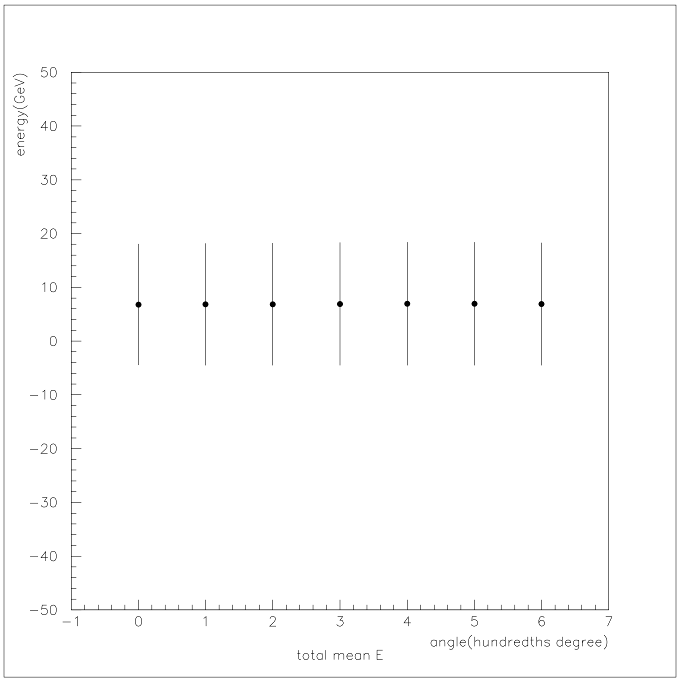


Figure 18: zy offset: The mean energy of the entire beam (background+transmitted) at DC2