Analysis of BCAL Test Run 2334

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Run Conditions and BCAL Sums

This note summarizes results of a quick analysis of BCAL test run number 2334. The data were collected in September 2006. For this particular run the photon beam was centered on the calorimeter module (horizontally and vertically) and directed at 90°. This analysis is based on 10% of the data from run 2334.

The data shown include only those events for which there is only one beam photon in the event and the TDC readout for this beam photon was required to lie in the range from 580 to 610 ns. Figure 1 shows the distribution of the sum of the 18 phototubes at the North end of the module and the corresponding sum at the South end. The distributions are very similar.

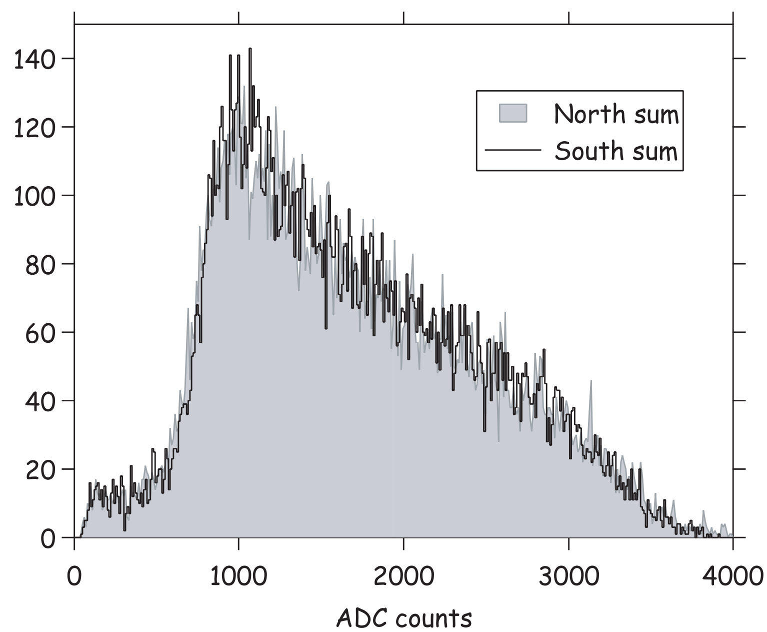

Figure 1: Distribution of the sum of the 18 phototubes at the North end of the BCAL module (filled histogram) and the corresponding sum for the South (unfilled histogram) end.

Approximate Calibration

In order to obtain an approximate energy calibration constant we first compute the geometric mean of the energy sums for the North and South ends: $E_{cal} = \sqrt{E_N \cdot E_S}$ and plot E_{beam}/E_{cal} where E_{beam} is the beam energy in MeV as determined by the beam tagger and E_{cal} is in ADC counts. The distribution in the ratio is shown in Figure 2 and is presented on a linear (filled histogram) and logarithmic (unfilled histogram) scale. A fit to a Gaussian yields a mean of 0.197. This calibration constant (from ADC counts to MeV) is independent of beam photon energy. From here on, calorimeter energy, E_{cal}, is the geometric mean of the two ends of the BCAL module expressed in MeV.

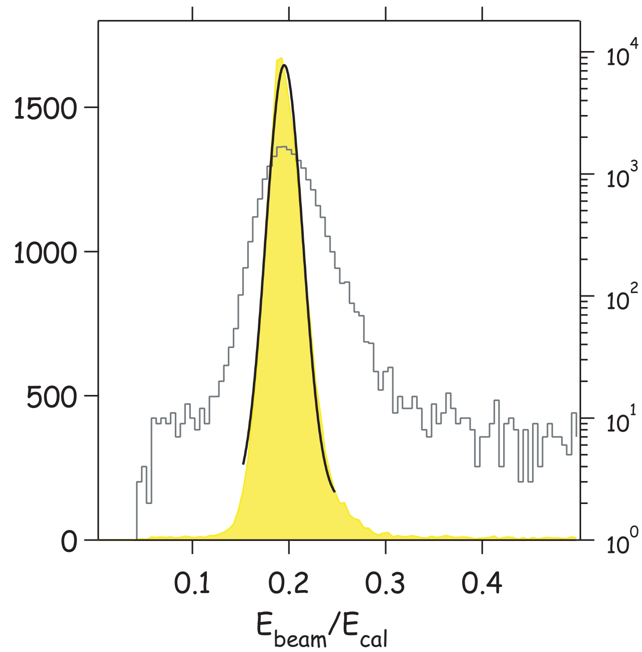

Figure 2: Distribution of E_{beam}/E_{cal} where E_{beam} is the beam energy in MeV as determined by the beam tagger and E_{cal} is the geometric mean of the North and South phototube sums in ADC counts. The distribution is presented on a linear (filled histogram) and logarithmic (unfilled histogram) scale. A fit to a Gaussian yields a mean of 0.197.

In Figure 3 we show plots of E_{cal} (unfilled histogram) and E_{beam} (filled histogram) along with a curve which falls off with beam energy ($\propto 1/E$) as expected for bremsstrahlung. The correlation of beam energy with calorimeter energy is shown in Figure 4.

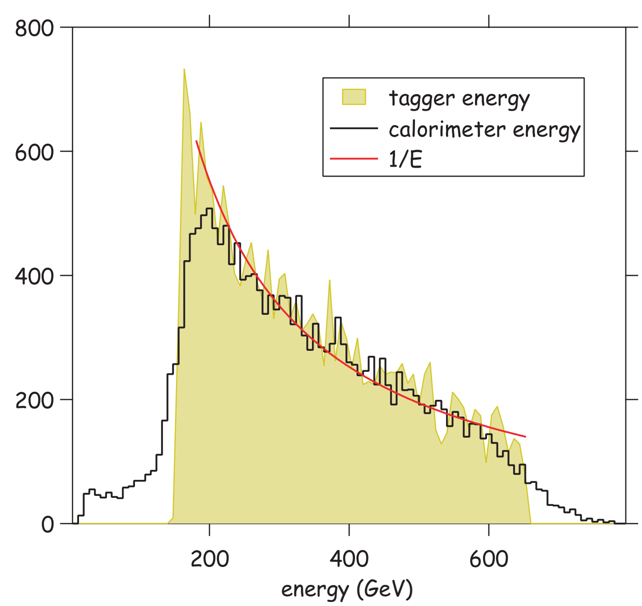

Figure 3: Plots of E_{cal} (unfilled histogram) and E_{beam} (filled histogram) along with a curve which falls off with beam energy ($\propto 1/E$) as expected for bremsstrahlung.

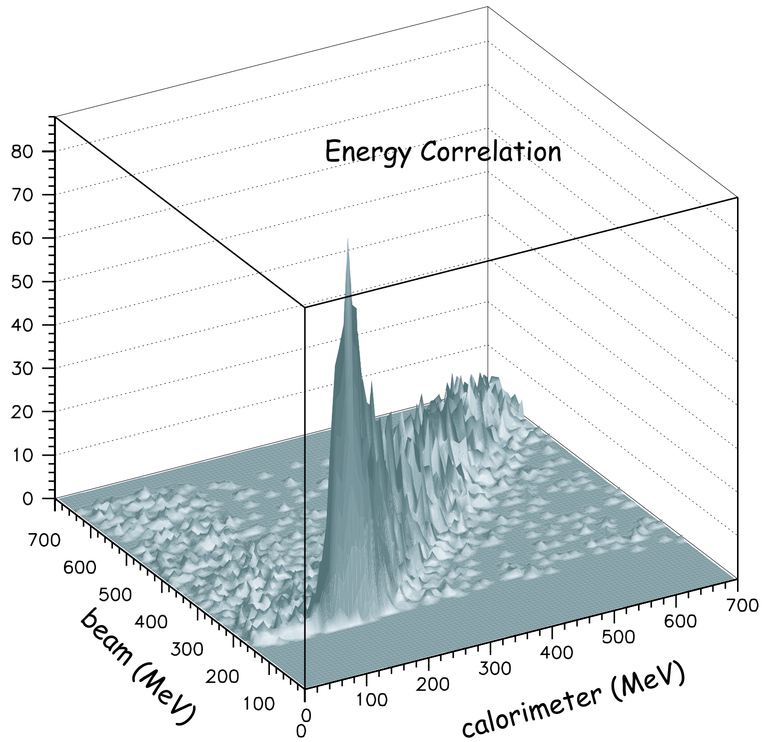

Figure 4: Correlation of beam energy with calorimeter energy.

BCAL Energy Resolution

In Figure 5 we show plots of the ratio $z = (E_{cal} - E_{beam})/E_{beam}$ for various intervals of E_{beam} along with Gaussian fits for the interval $-0.2 < z < 0.2$. In Figures 6(a) and (b) we show the means and sigmas resulting from the Gaussian fits as a function of beam energy. Note that the mean as a function of E_{beam} is independent of E_{beam}.

Also note that the *sigma* plotted in Figure 6(b) is really σ_E/E for BCAL. The curve is a result of a fit to a function of the form $a/\sqrt{E} + b$ where a and b are constants and E is measured in GeV. For these data we obtain $a = 0.050 \pm 0.005$ and $b = 0.020 \pm 0.005$. These are the statistical and floor terms respectively in the energy resolution. For the KLOE calorimeter, $a = 0.054$ and $b = 0.007$.

In this procedure we applied the same calibration constant to all the phototubes. We should properly have a separate constant for each phototube and determine those by minimizing the width of the $z = (E_{cal} - E_{beam})/E_{beam}$ distribution.

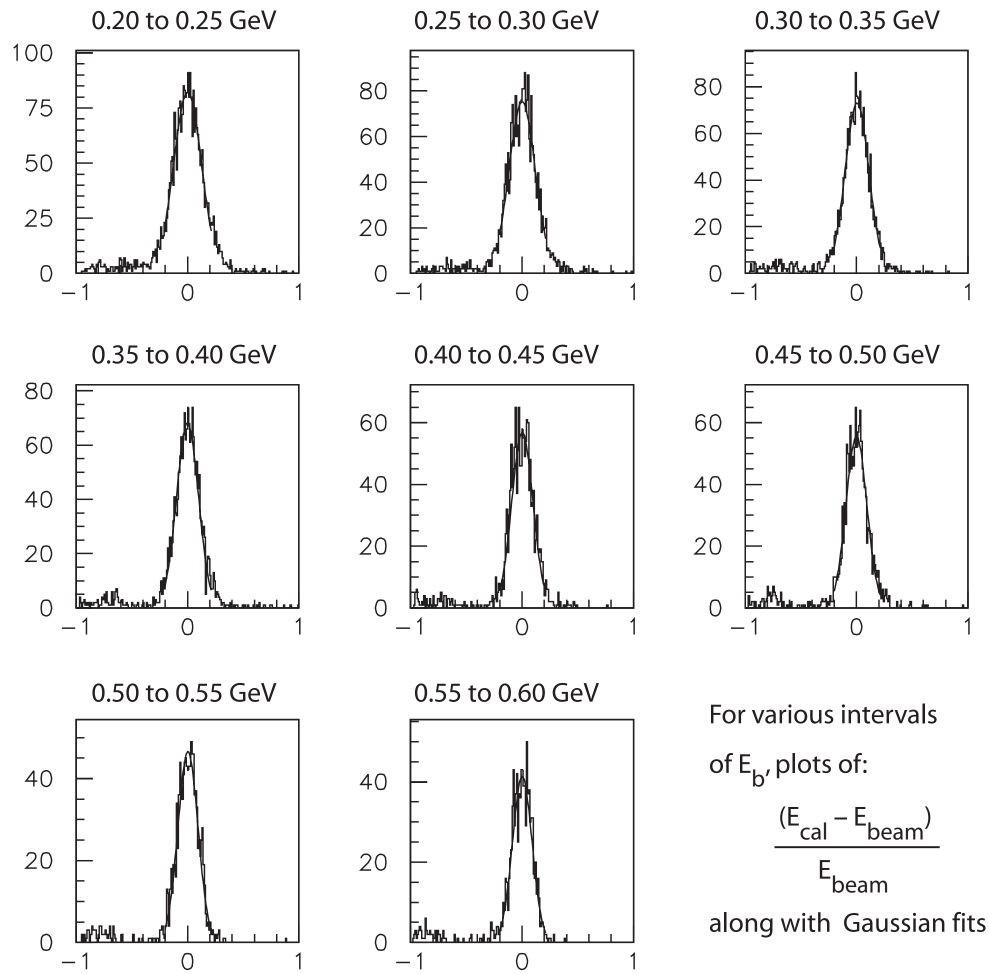

Figure 5: Plots of the ratio $z = (E_{cal} - E_{beam})/E_{beam}$ for various intervals of E_{beam} along with Gaussian fits for the interval $-0.2 < z < 0.2$.

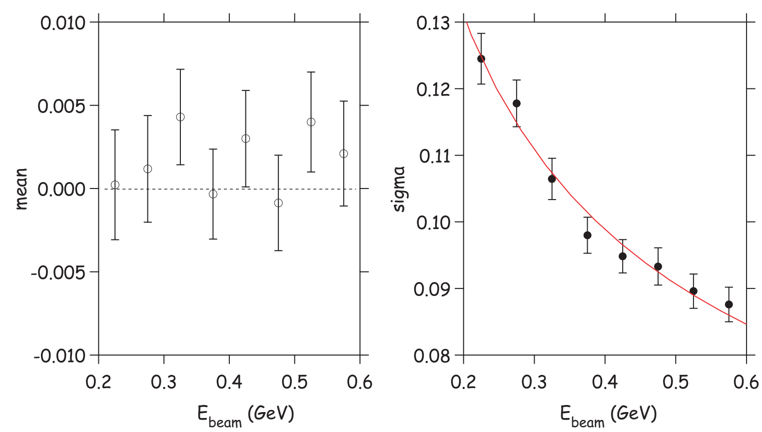

Figure 6: (a) Means and (b) Sigmas, from the Gaussian fits shown in Figure 5 as a function of E_{beam}. Note that the Sigma in (b) is really σ_E/E for the calorimeter and the curve is given by $a/\sqrt{E} + b$.