TB2003 Beam Cleaning and Beam Envelope Cuts

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1 Introduction

The analysis of the 4L test beam data included beam cleaning and beam envelope cuts to remove contaminating particles in the beam. We are now running the analysis for the other four positions (4H, 1,2,3), and it appears the beam cleaning cuts work properly, but the beam envelope cut removes all of the events in every run. The beam cleaning cuts are based on the response of the upstream and downstream detectors, whereas the beam envelope cut uses the BPC track and detector position information. The results of the 4L beam cleaning and envelope cuts have been reproduced with the new version of Athena, and the new root files, so it is not a matter of code not working correctly (I think). It is possible that some aspect of the beam envelope cuts were calibrated on the 4L position, but it is unclear whether these cuts are flexible enough to take into account the motion of the various detectors as their positions were moved.

This note does a quick check to see the effect of applying the beam envelope cut. This check compares the beam cleaning and beam envelope cuts to beam cleaning alone. It is performed on a subset of runs from the 4L position, see Table 1 for the details of the runs used.

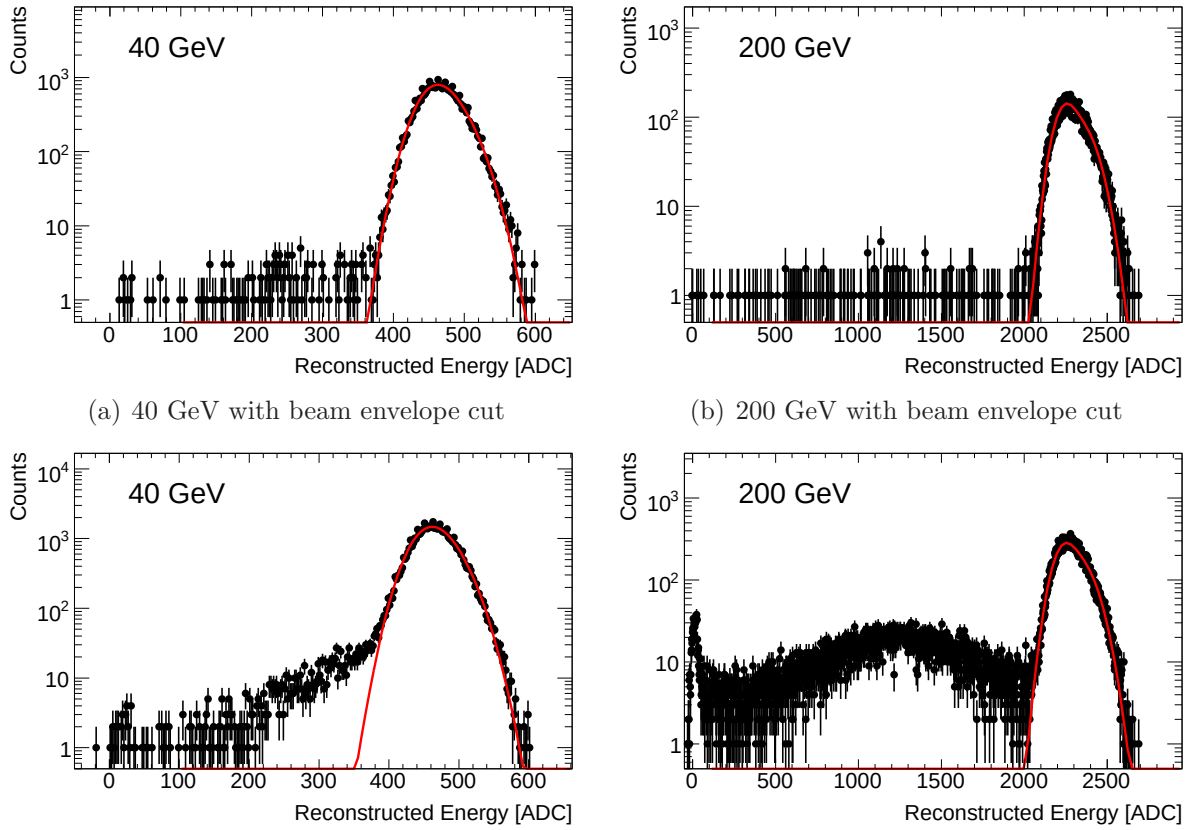
The results presented here are at the post-merger stage of the analysis, where the original CBNT root files were produced with Athena 13.0.40.

Run Range	Particle Type	Energy [GeV]
2324, 2340	el	200
3574, 3591	el	40
2315, 2323	pi	200
3870, 3880	pi	40

Table 1: Information regarding the subset of runs used in this note. All runs are from the 4L position.

2 Electrons

The electron reconstruction has been run on the subset of the 40 GeV and 200 GeV data, after the beam cleaning, but before the timing cuts. No pion modeling has been included in these results. The resulting energy distributions are shown in Figure 1. The results of the double Gaussian fit are shown in Table 2.



(a) 40 GeV with beam envelope cut

(b) 200 GeV with beam envelope cut

(c) 40 GeV with NO beam envelope cut

(d) 200 GeV with NO beam envelope cut

Figure 1: Energy distributions with (top) and without (bottom) the beam envelope cut (note the beam cleaning cuts have been applied in all cases), for 40 GeV (left) and 200 GeV (right) electrons in the 4L position.

Using these two points only, a fit was performed for the energy resolution parameters, the resulting sampling and constant terms are shown in Table 3.

Beam Energy	Fitted Energy [ADC]	Fitted RMS [ADC]	Resolution (with noise subtracted) [%]
40 GeV (with beam envelope cut)	466.9	29.2	5.6
40 GeV (no beam envelope cut)	465.2	30.0	5.8
200 GeV (with beam envelope cut)	2292.9	92.5	4.0
200 GeV (no beam envelope cut)	2288.0	93.6	4.0

Table 2: Double Gaussian fit results for the 40 GeV and 200 GeV. All runs are taken in the 4L position.

Analysis Type	Sampling [% $GeV^{1/2}$]	Constant [%]
with beam envelope cut	29.78	3.43
no beam envelope cut	28.26	3.44

Table 3: Energy resolution (noise subtracted) fit parameters using the 40 GeV and 200 GeV energy points.

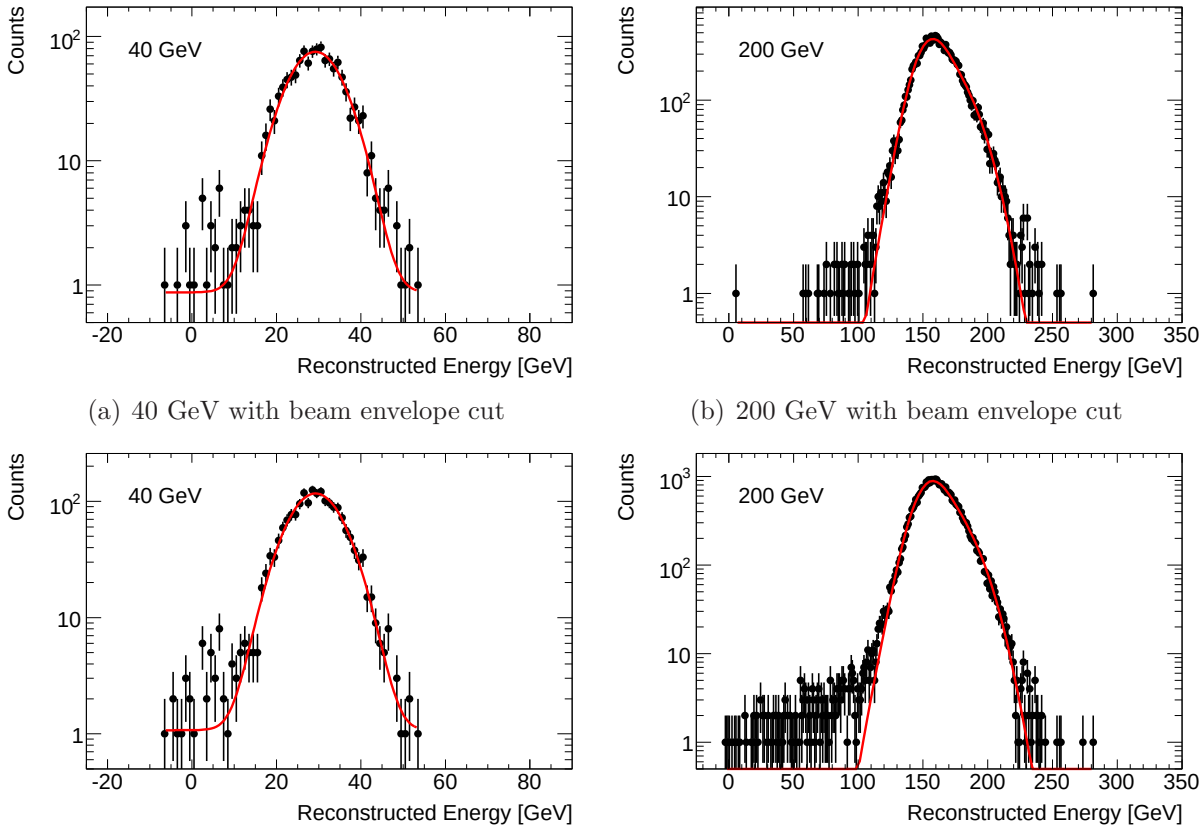
3 Pions

The pion reconstruction has been run on the subset of the 40 GeV and 200 GeV data, after the beam cleaning, but before the timing cuts. The resulting energy distributions are shown in Figure 2. The results of the double Gaussian fit are shown in Table 4. Note that all results shown are at the em scale.

Beam Energy	Fitted Energy [GeV]	Fitted RMS [GeV]	Resolution (with noise subtracted) [%]
40 GeV (with beam envelope cut)	29.0	7.1	19.8
40 GeV (no beam envelope cut)	29.1	6.9	19.3
200 GeV (with beam envelope cut)	161.9	16.2	9.7
200 GeV (no beam envelope cut)	161.7	16.5	9.9

Table 4: Double Gaussian fit results for the 40 GeV and 200 GeV. All runs are taken in the 4L position.

Using these two points only, a fit was performed for the energy resolution parameters, the resulting sampling and constant terms are shown in Table 5.



(a) 40 GeV with beam envelope cut

(b) 200 GeV with beam envelope cut

(c) 40 GeV with NO beam envelope cut

(d) 200 GeV with NO beam envelope cut

Figure 2: Energy distributions with (top) and without (bottom) the beam envelope cut (note the beam cleaning cuts have been applied in all cases), for 40 GeV (left) and 200 GeV (right) pions in the 4L position.

4 Summary

The beam envelope cut does have a small effect on the mean reconstructed energy and rms for both electrons and pions. The combination of these differences leads to different fit results for the sampling and constant terms. The beam envelope cut does a good job at further removing the low energy tail on the electrons, pions perhaps. And the beam envelope cut betters the energy resolution. Are these significant differences?

Analysis Type	Sampling [% $GeV^{1/2}$]	Constant [%]
with beam envelope cut	122.4	4.27
no beam envelope cut	117.1	5.35

Table 5: Energy resolution (noise subtracted) fit parameters using the 40 GeV and 200 GeV energy points.