

The $\beta^* \frac{dL}{dz}$ Simulation Project

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■ Introduction

- Introduction
- Parameter Generation

- Introduction
- Parameter Generation
- Implementation

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- Implementation
- Validation

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- Implementation
- Validation
- Summary

Introduction

- The longitudinal luminosity distribution ($\frac{dL}{dz}$) can be approximated as

$$\frac{dL}{dz} \propto \frac{e^{\frac{-(z-z_0)^2}{2\sigma_z^2}}}{1 + \frac{(z-z_{min})^2}{\beta^*{}^2}}$$

- Currently, this distribution is approximated further as a Gaussian.
- However, a Gaussian does not represent the data well in the peak or the tails.
- This talk presents an implementation of this $\beta^* \frac{dL}{dz}$ function in the CDF simulation framework.

Run Dependent $\beta^* \frac{dL}{dz}$ Parameter Estimation

- The beam line DB only holds Gaussian parameters for $\frac{dL}{dz}$, so a run dependent parameterization must be determined via fits to the data.
- The following recipe was used to estimate the four parameters which determine the function's shape:
 - ◆ Good run list generated from the DQM v7.0 list (all runs up to Aug. '04, offline lumi = 100 nb^{-1} , no requirements on electrons, muons, or Si).
 - ◆ The *FitBeamModule-Willis/cotz* histograms for each run were summed in blocks of 25 (minbias data) in order to accumulate sufficient statistics.
 - ◆ The summed z vtx histos (representing 25 runs each) were fit to the $\beta^* \frac{dL}{dz}$ function, and their parameters recorded.
 - ◆ The resulting 32 parameter sets are used in the simulation implementation.

Implementation

- Selects the $\beta^* \frac{dL}{dz}$ parameter set for the current run number.
- For each event, one z coord is thrown per primary vertex according to the current parameter set using the von Neumann MC method.
- Initialization problems \Rightarrow Gaussian distribution
- TCL user interface:

```
talk GenPrimVert  
NonGaussZVertex set true
```

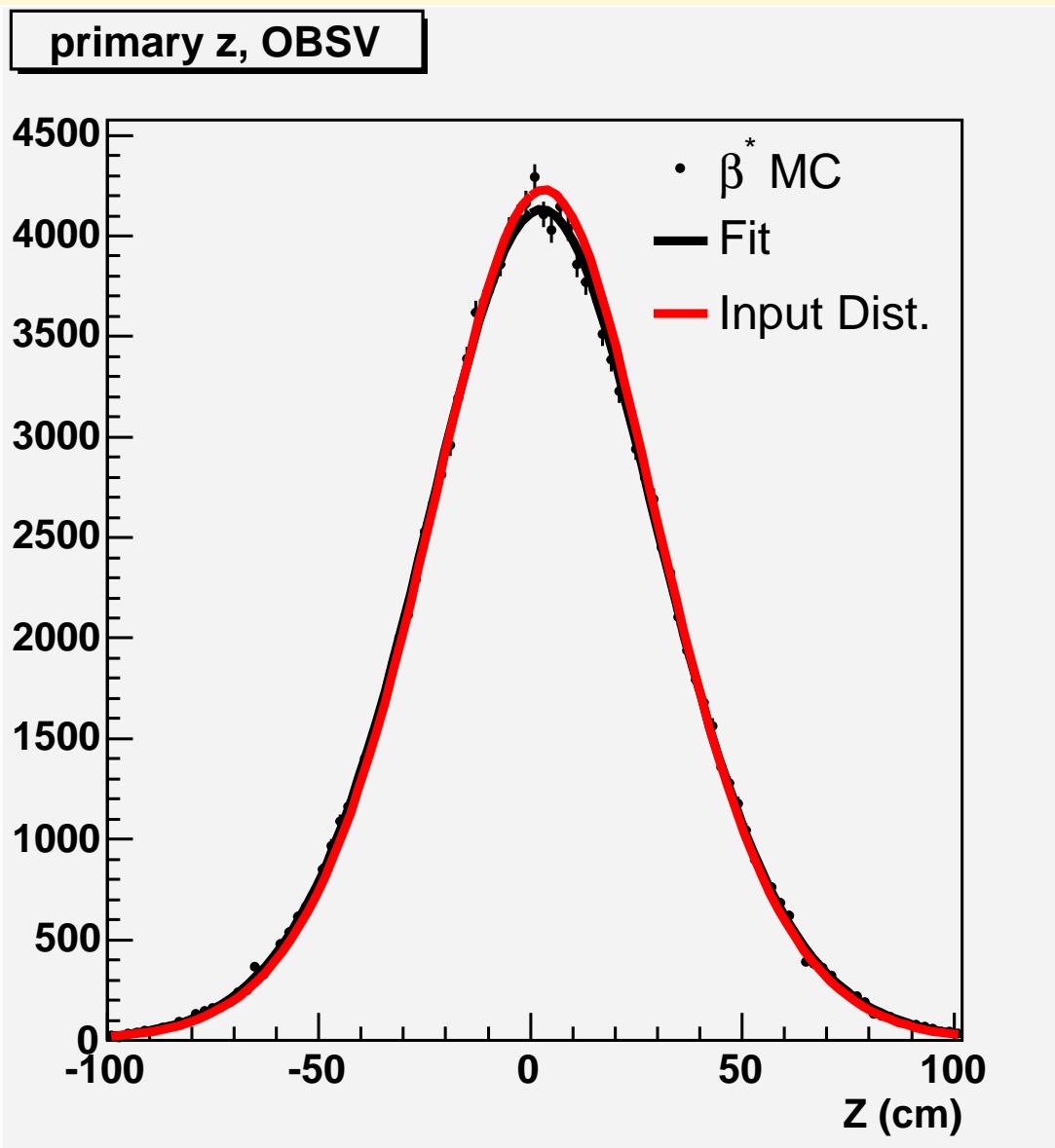
Validation - Strategy

- The QCD group has minbias data as well as Pythia dijet ($p_T > 0$)MC samples in Stntuple format ==> Stntuple analysis.
- 16 Run numbers chosen at random from mcProduction runlist.
- mcProduction used to generate 1M Pythia dijet ($p_T > 0$) events, using 16 runs and the same TCL files used to generate the QCD group sample (pydj000).
- Stntuples created using dev_242.
- $\frac{dL}{dz}$ histo's created from OBSV and ZVertexColl (greatest $\sum p_T$ vertex, only one per event).

MC Validation Run List

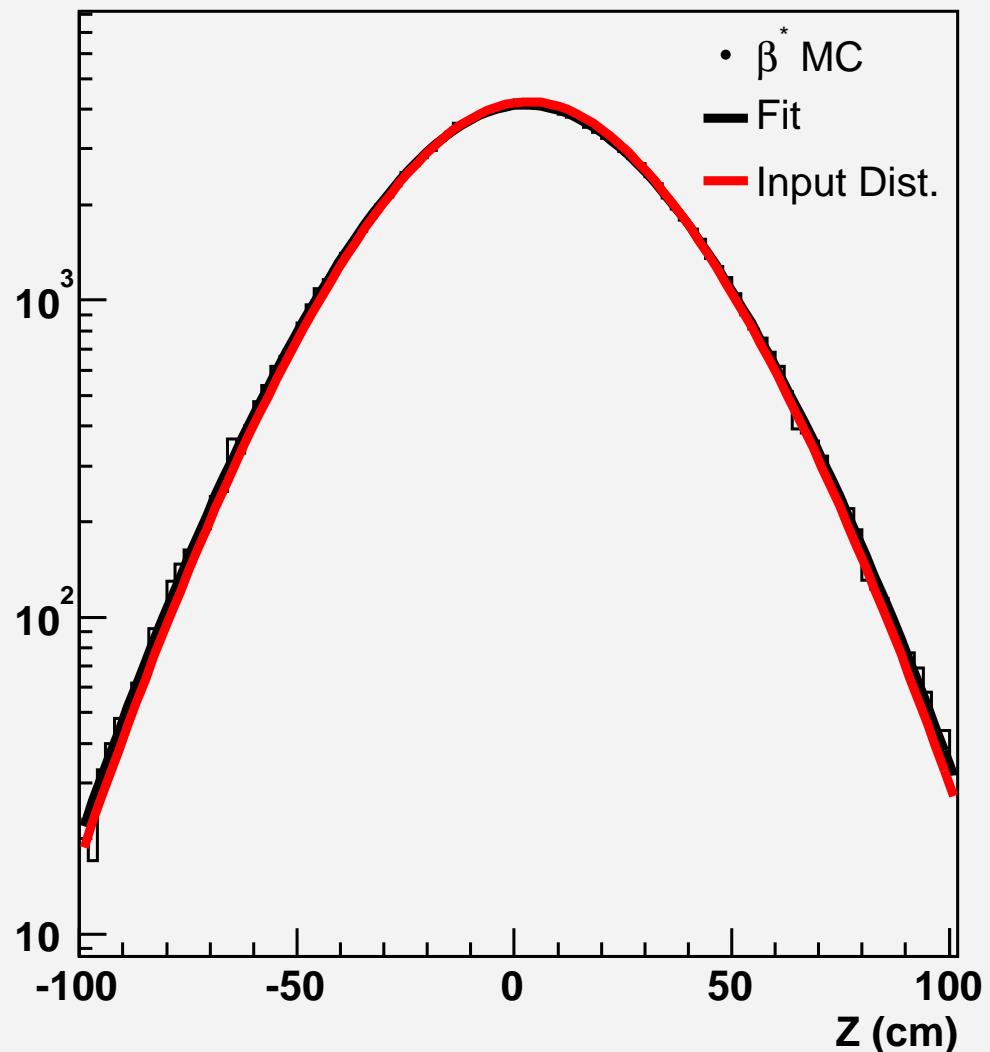
Run	$\int L$	Run	$\int L$
149387	567.57	177214	588.38
149682	125.05	178030	324.43
150803	354.01		
155996	349.72		
162396	386.97		
162631	1354.37		
162663	351.23		
163012	848.36		
165435	321.66		
166529	1020.94		
166614	926.81		
167023	952.88		
167186	1069.39		
167997	344.16		

Input vs Output - Run 162631

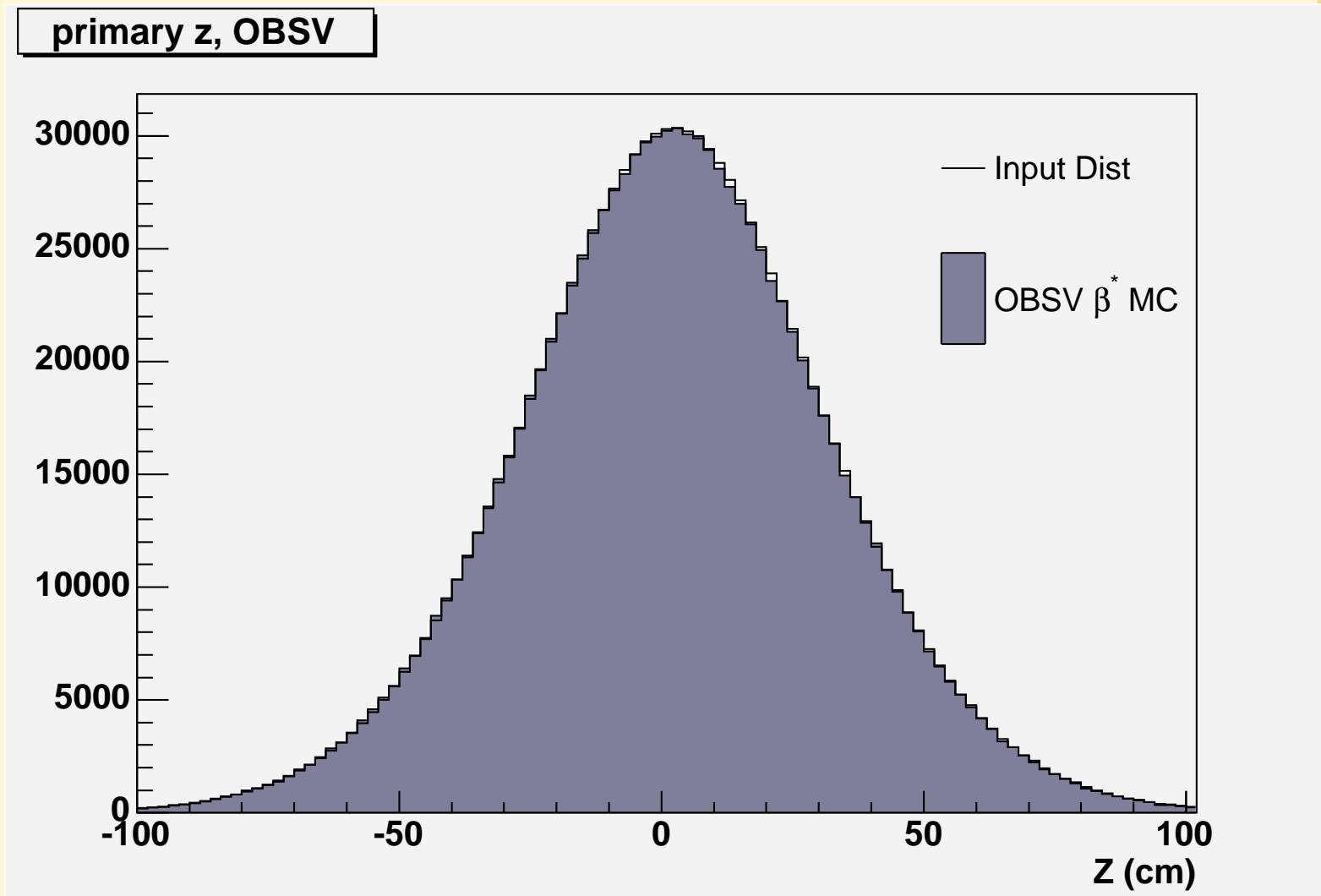


Input vs Output - Run 162631

primary z, OBSV

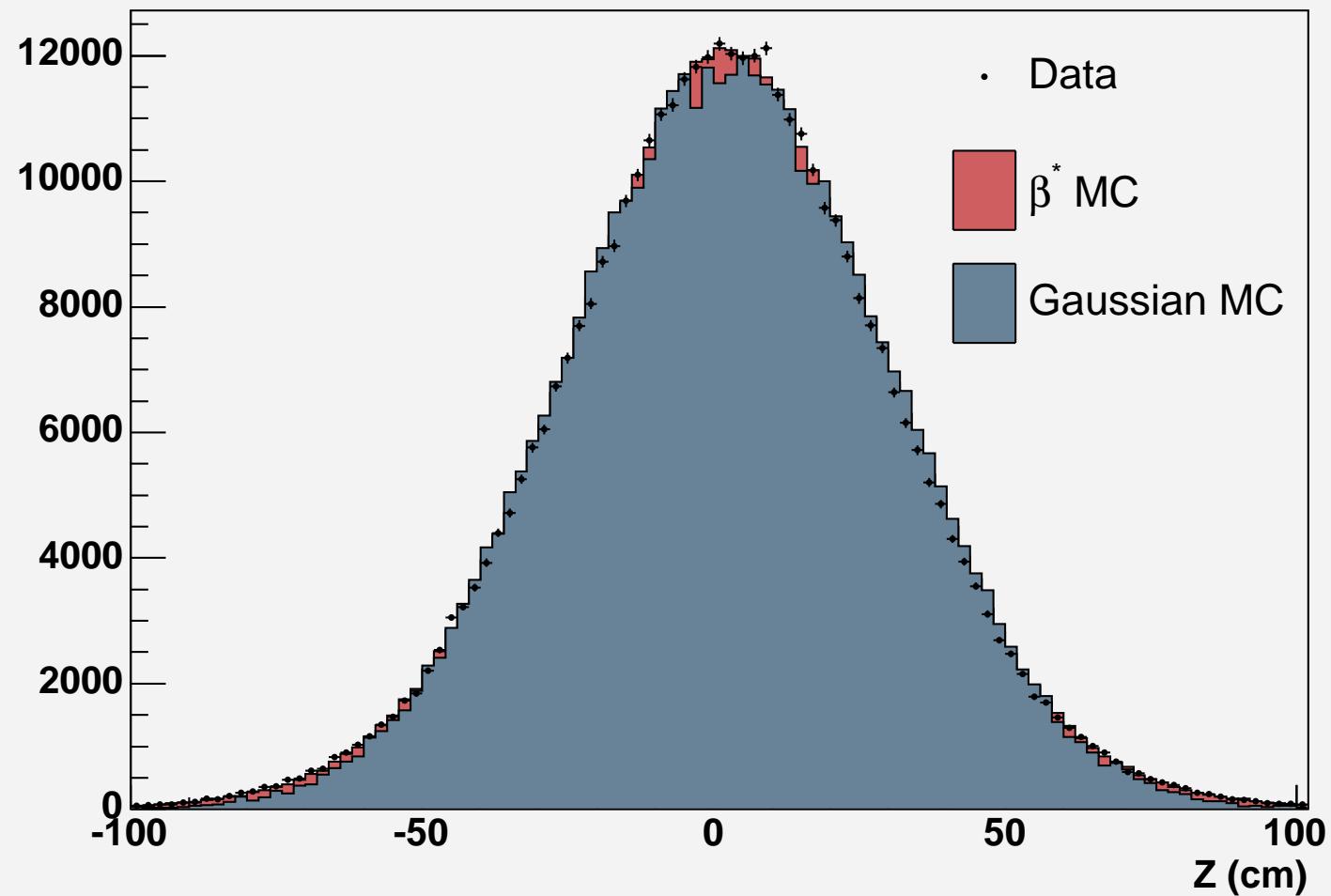


Input vs Output - 16 Runs

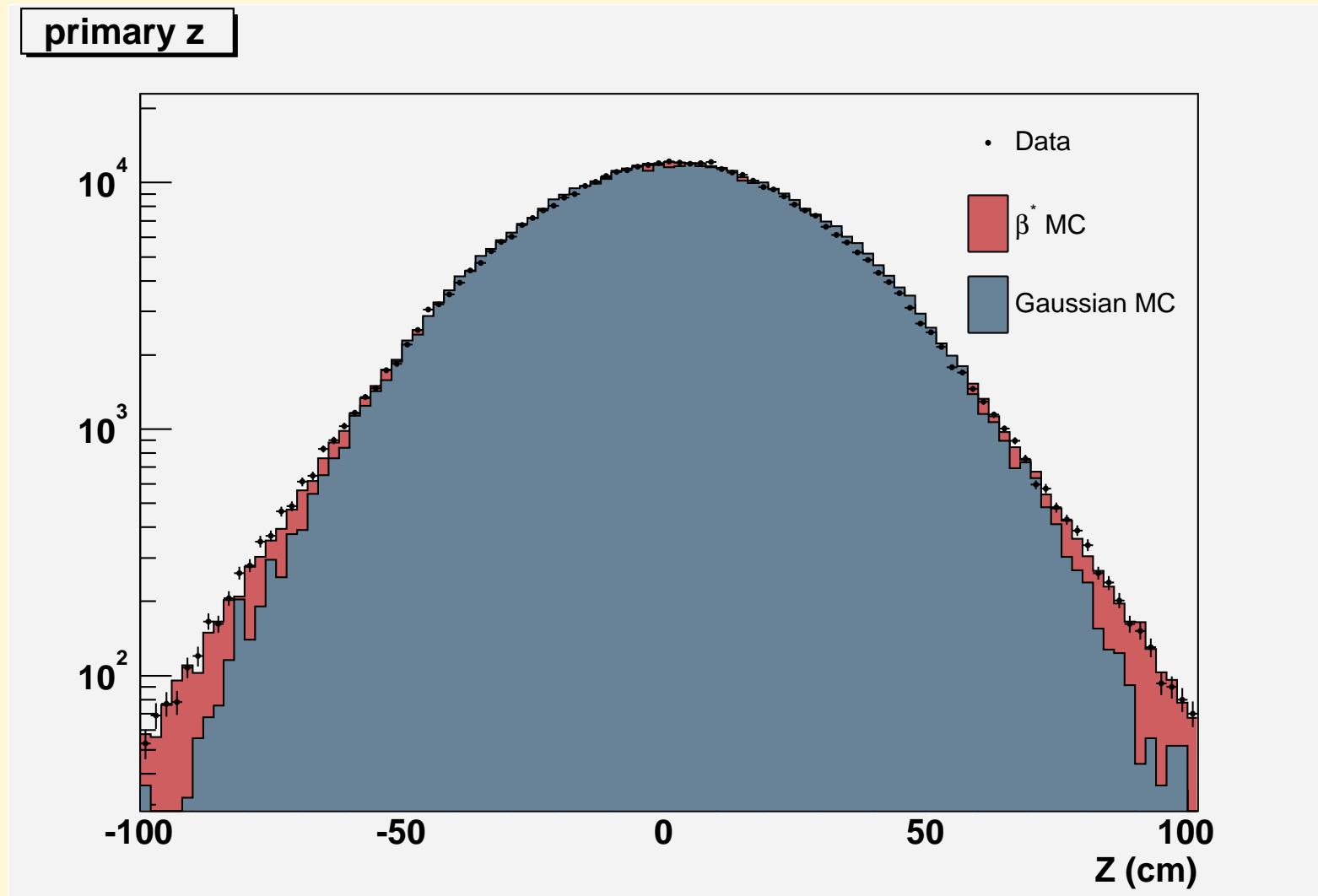


Data vs MC - 16 Runs

primary z

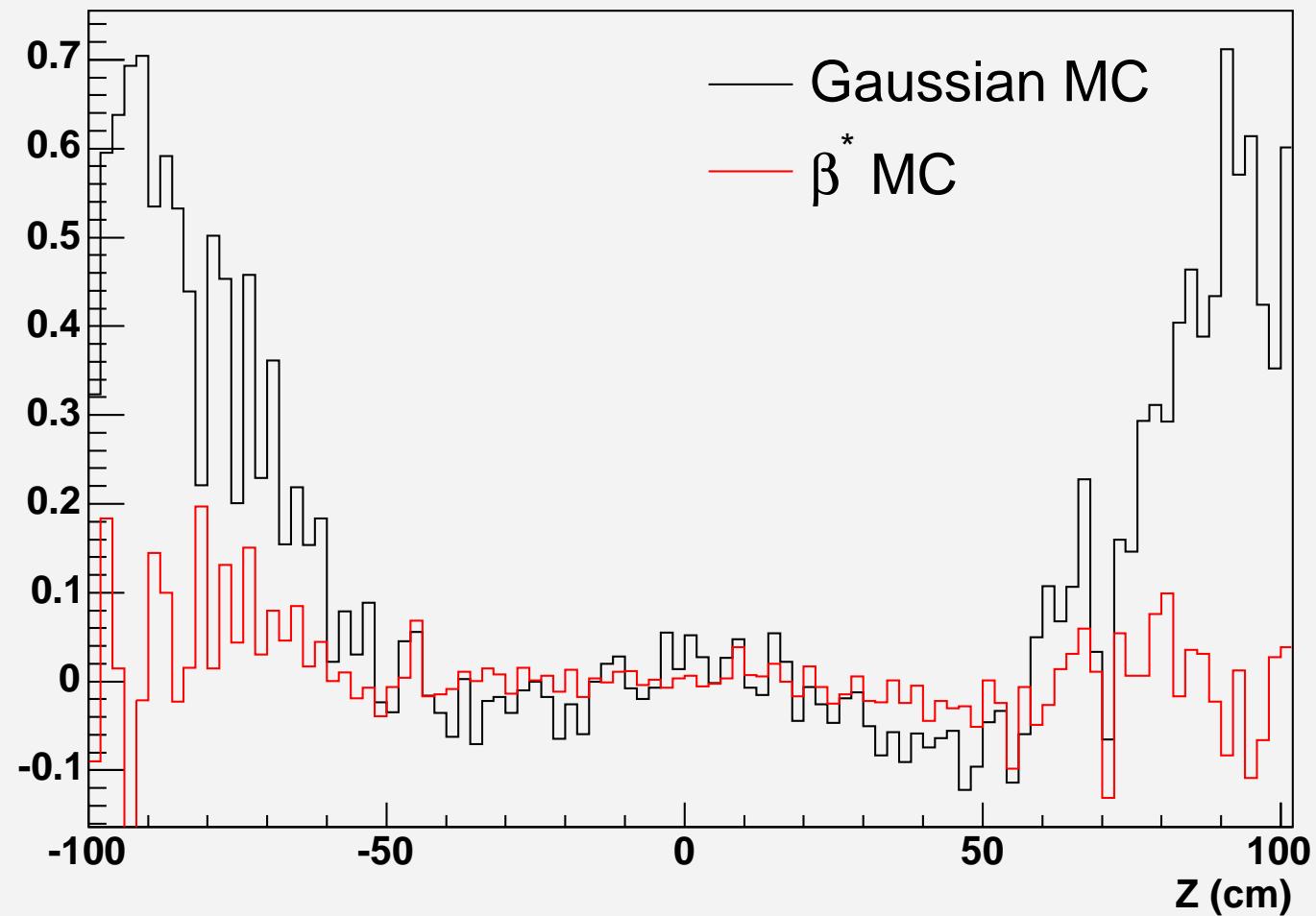


Data vs MC - 16 Runs

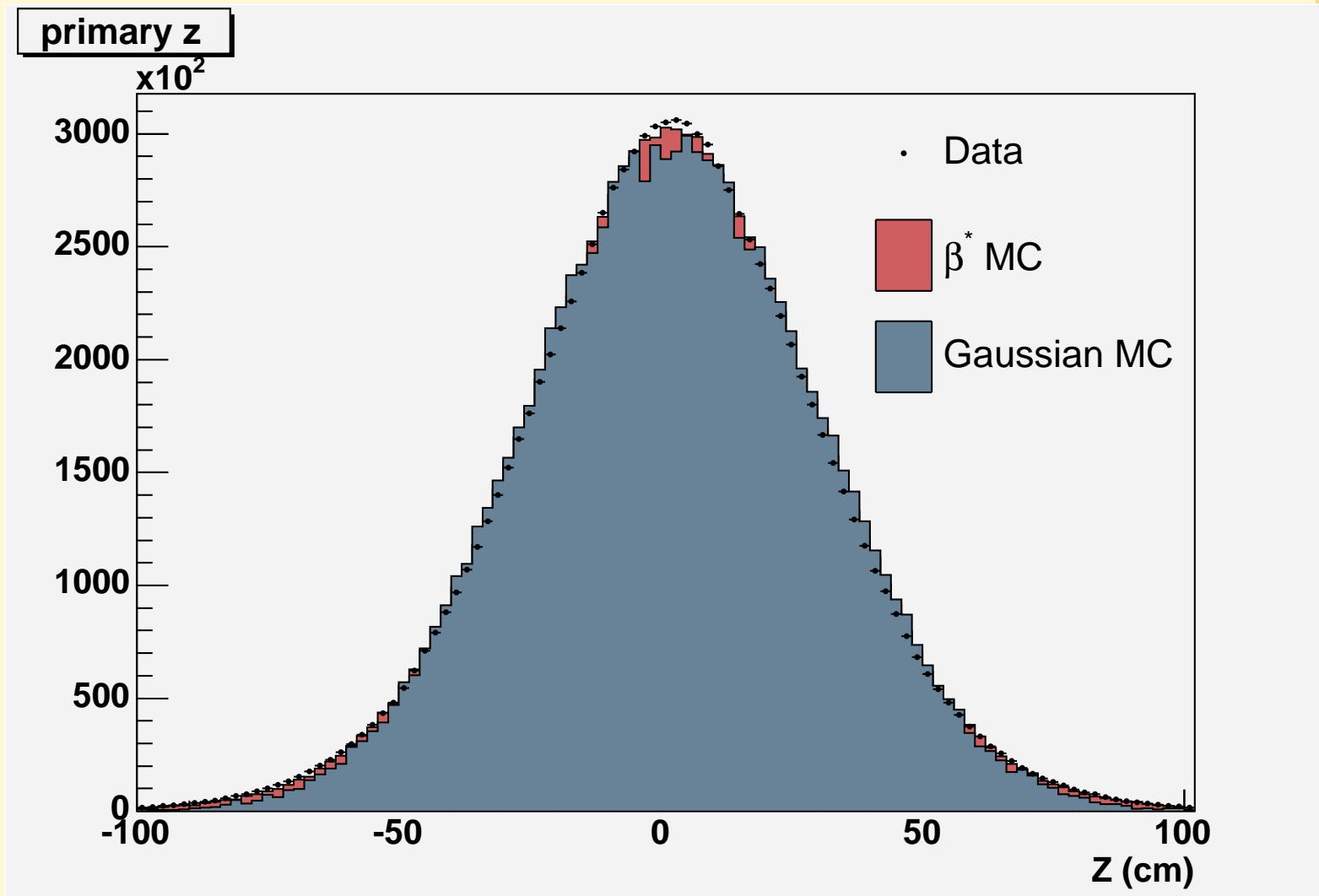


Fractional Differences - 16 Runs

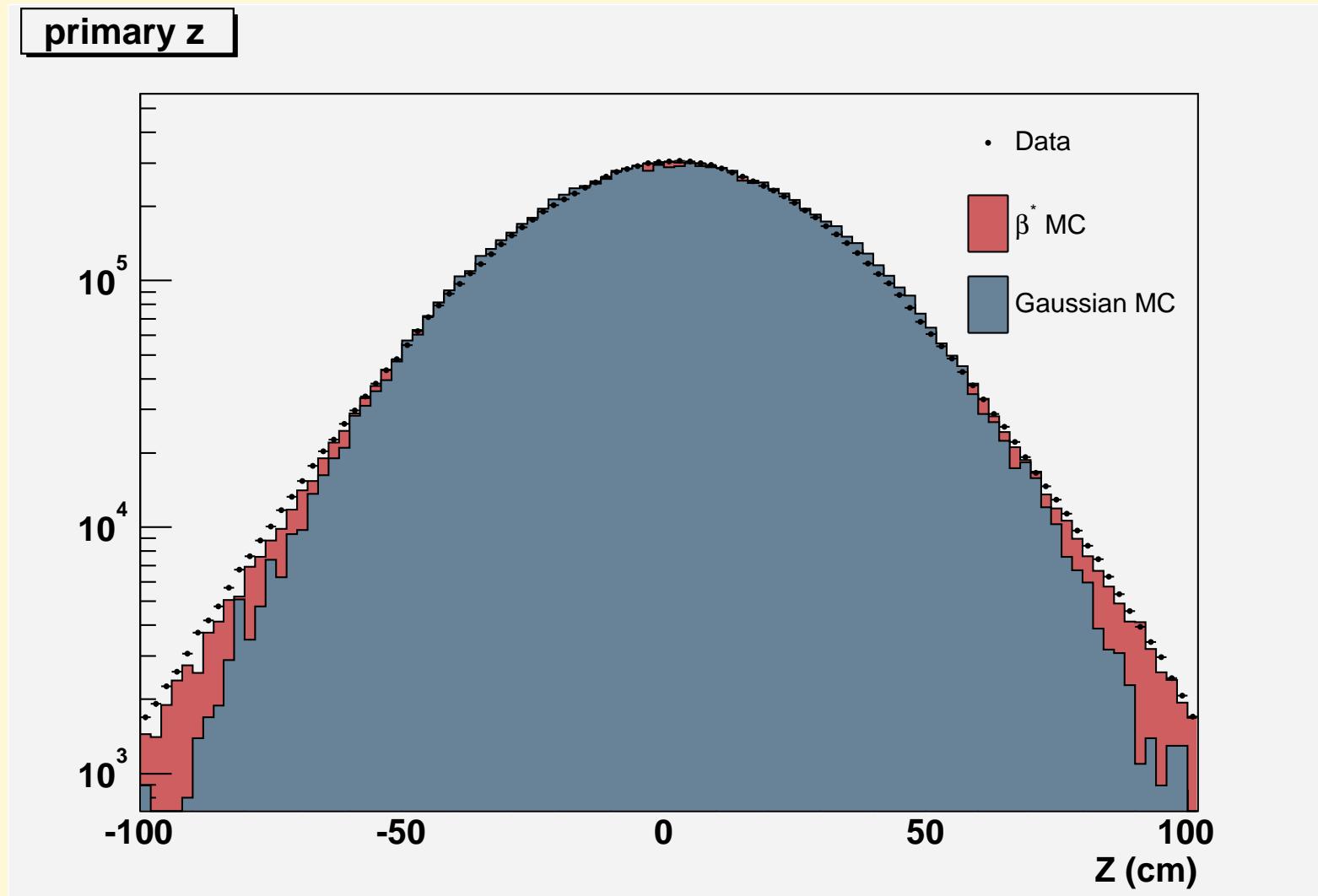
(Data - MC) / Data



Data vs MC - Runs ≤ 178030

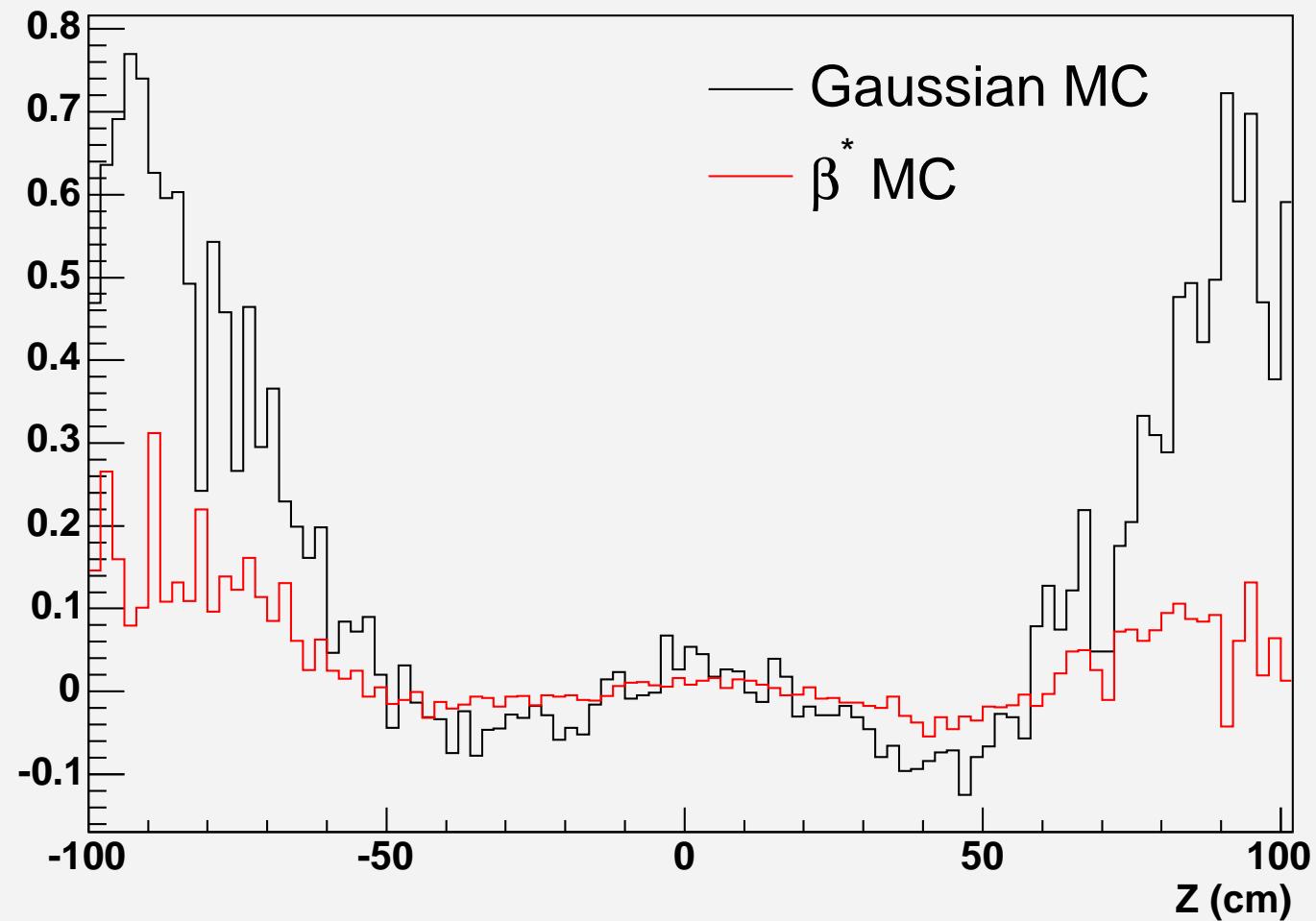


Data vs MC - Runs ≤ 178030



Fractional Differences - Runs ≤ 178030

(Data - MC) / Data



χ^2 Tests - Data (16 Runs) vs MC

Region	Gaussian χ^2/ndf	Prob	$\beta^* \chi^2/\text{ndf}$	Prob
Low Tail	532.1 / 21	0	27.78 / 21	0.147
High Tail	348.5 / 20	0	12.94 / 20	0.880
Central	339.9 / 59	0	62.55 / 59	0.351
Total	1221 / 100	0	103.3 / 100	0.391

χ^2 Tests - Data (Runs ≤ 178030) vs MC

Region	Gaussian χ^2/ndf	Prob	$\beta^* \chi^2/\text{ndf}$	Prob
Low Tail	17353 / 21	0	1452.7 / 21	0
High Tail	11060 / 20	0	391.16 / 20	0
Central	9221.5 / 59	0	1094.0 / 59	0
Total	37634 / 100	0	2937.9 / 100	0

Summary

- The new $\beta^* \frac{dL}{dz}$ simulation is ready to use.
- Data MC comparisons look good.
- Need a procedure for adding new parameter sets.