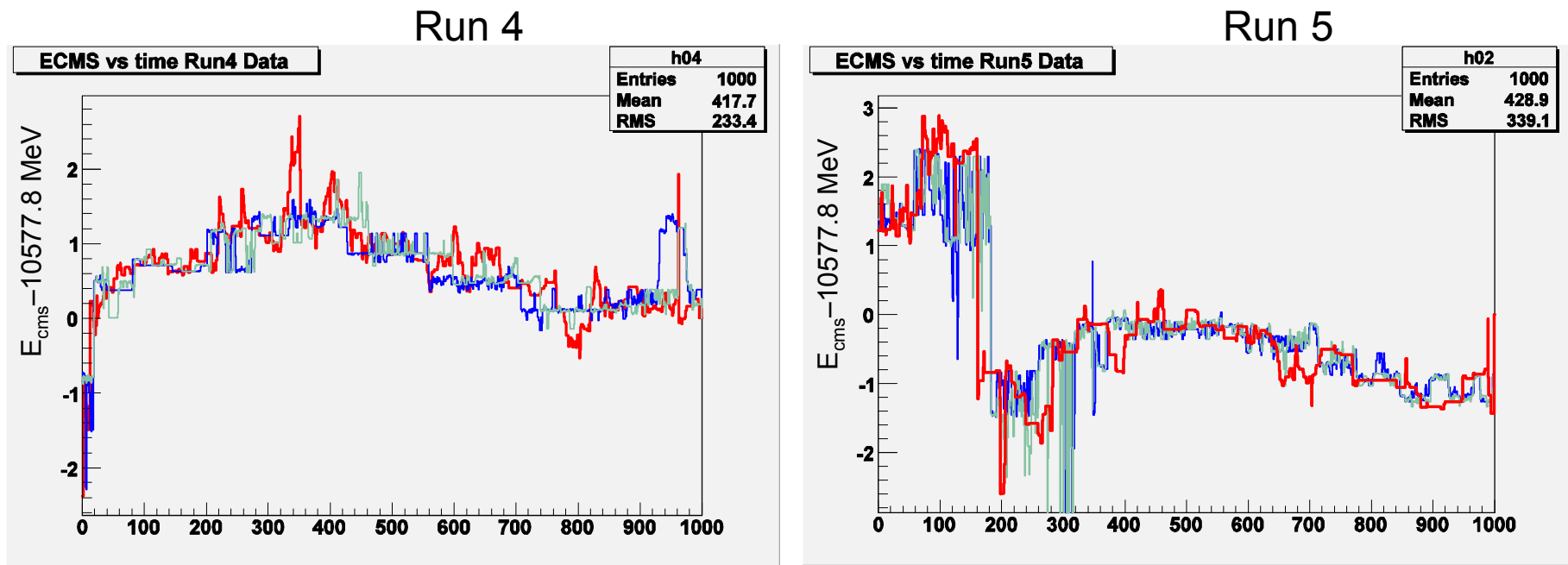# Corrections to the MC B-momentum spectra due to Data – MC cms energy differences

V.Golubev

08/31/2007

CMS energy in data and MC
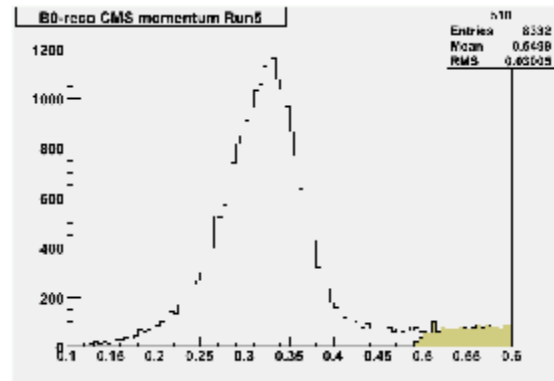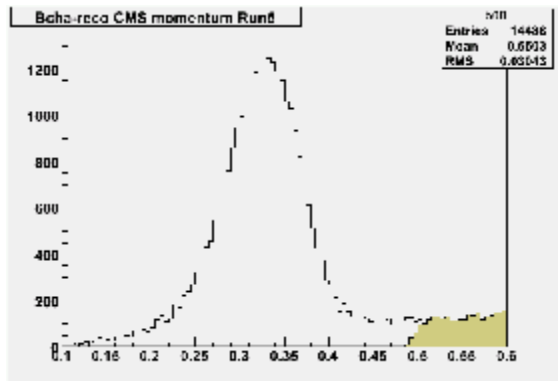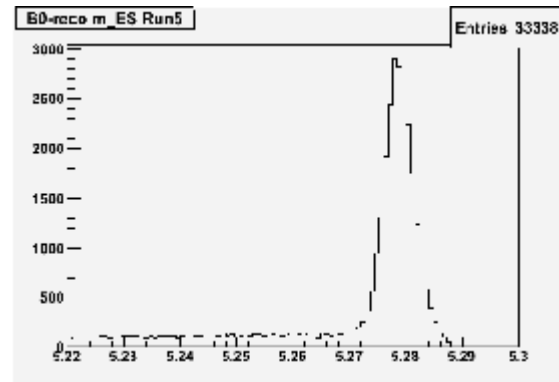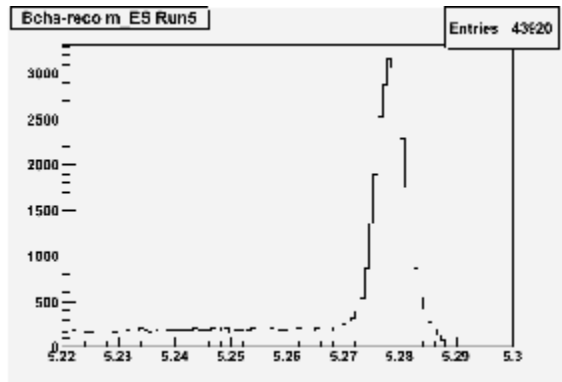
Run 4

Run 5

The "time" dependence of the assumed cms mean collision energy
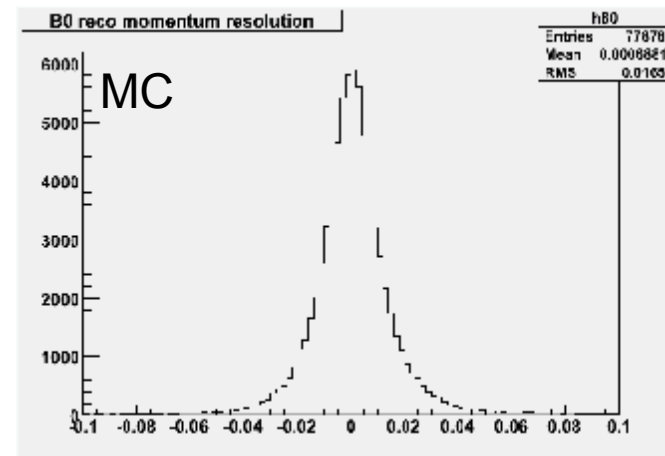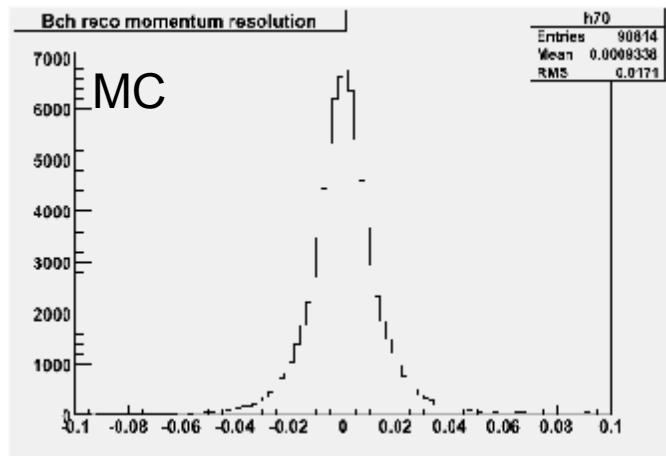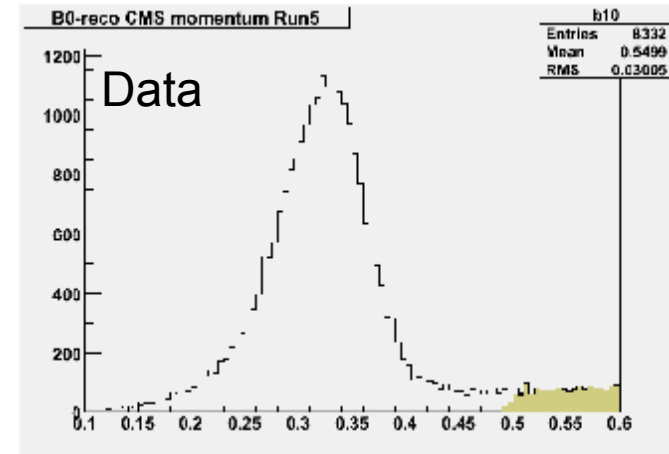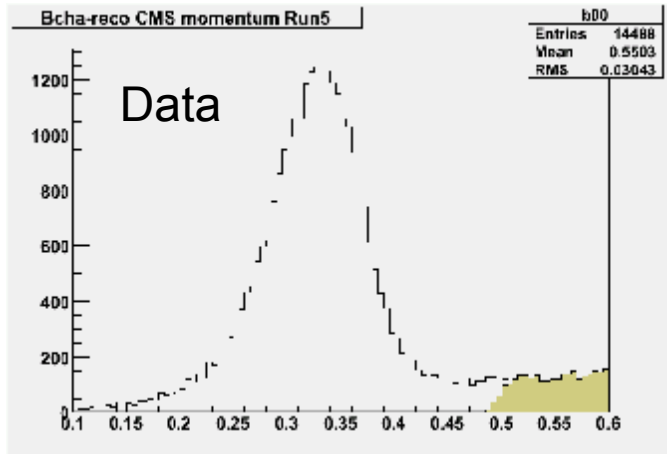
Red – data; blue – MC Bch; green – MC B^0

Breco event selection

- Bch modes:11001, 11201, 14001
- B0 modes: 12001, 12101, 13001, 13101, 13201
- R2<0.3

Shaded region – M_{ES}<5.265 MeV/c^2

B-reco momentum resolution

B-reco momentum resolution is ~1/6 of the B momentum spread

B-momentum spectra approximation

For the Gaussian distribution of the electron-positron collision energy with the mean equal to E_{cms} and RMS $\sigma_{E_{cms,}}$ the *B*-momentum PDF is the following:
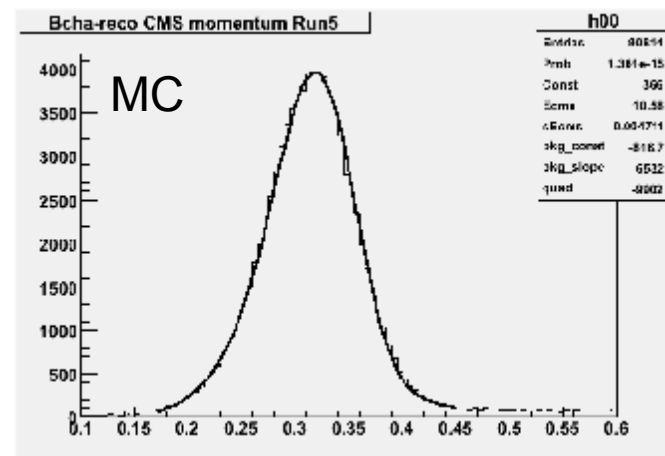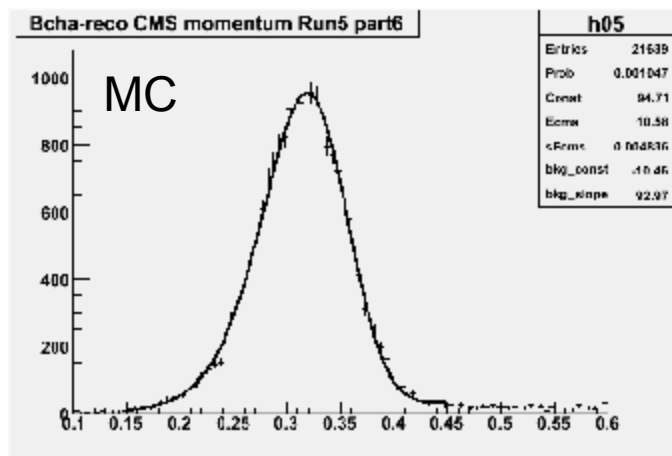
$$dW(p) = \sqrt{\frac{2}{\pi\sigma_{E_{cms}}^2}} \frac{p}{\sqrt{p^2 + m_B^2}} \exp\left(-\frac{\left(E_{cms} - 2\sqrt{p^2 + m_B^2}\right)^2}{2\sigma_{E_{cms}}^2}\right) dp$$

The full approximation function includes linear background:

$$F(p) = A\frac{dW}{dp} + a + bp$$

Free parameters of the fit are *A*, E_{cms}, σ_{Ecms}, *a*, and *b*.

B-momentum spectra approximation
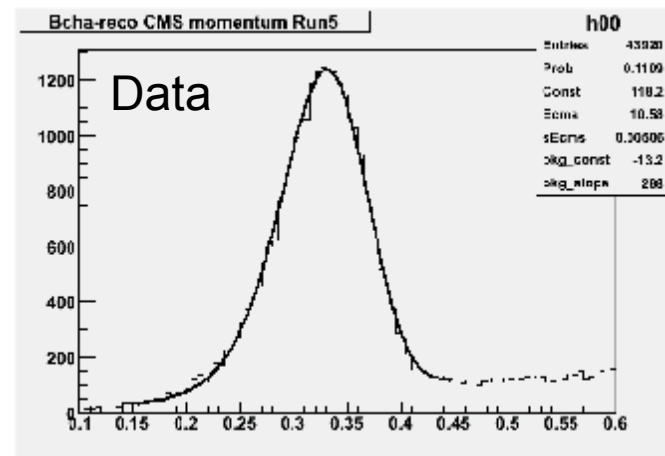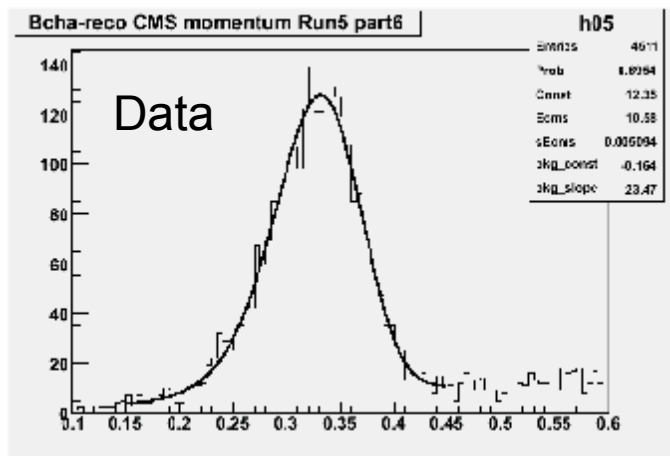
B-momentum MC spectra approximation
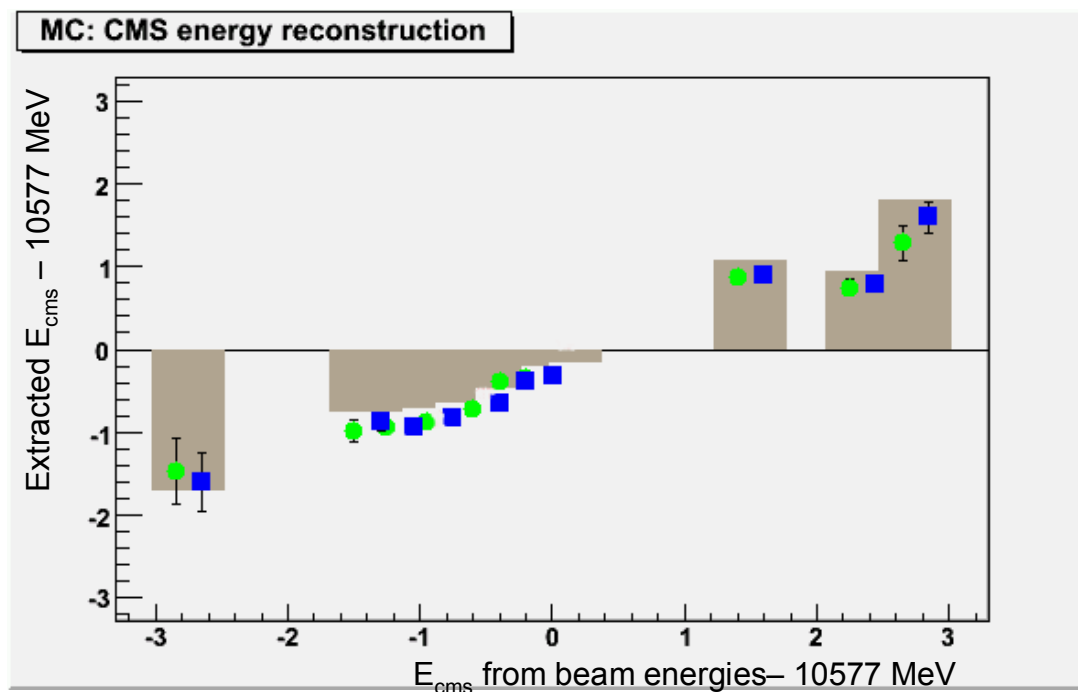
Shaded histogram – sum of the MC truth *B*-meson energies *vs E_{cms}*
from the MC beam energies
Green circles – from fits to the MC truth *B* momenta,
Blue squares – from fits to the Breco momenta

Good agreement between MC truth and reconstructed *Y*(4*S*) energies

Data *B*-momentum spectra approximation
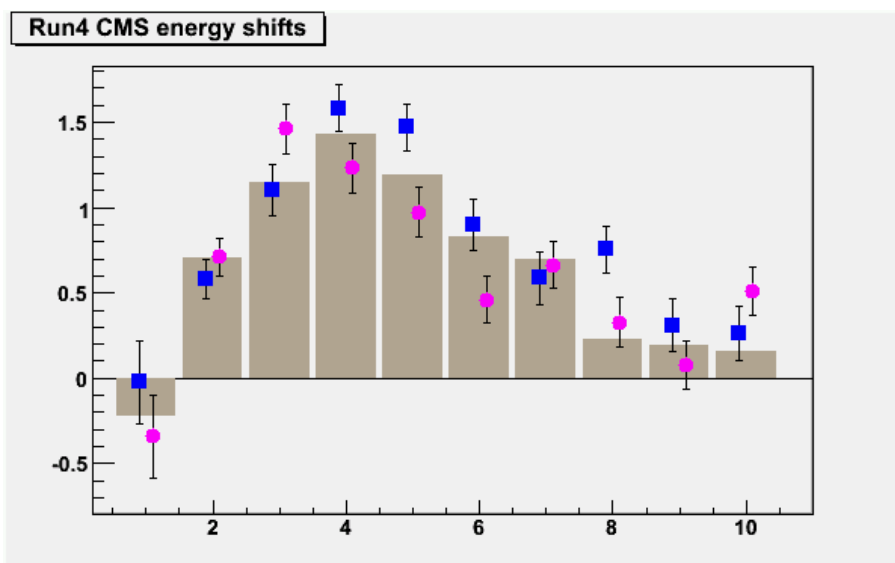
Run 4   Run 5
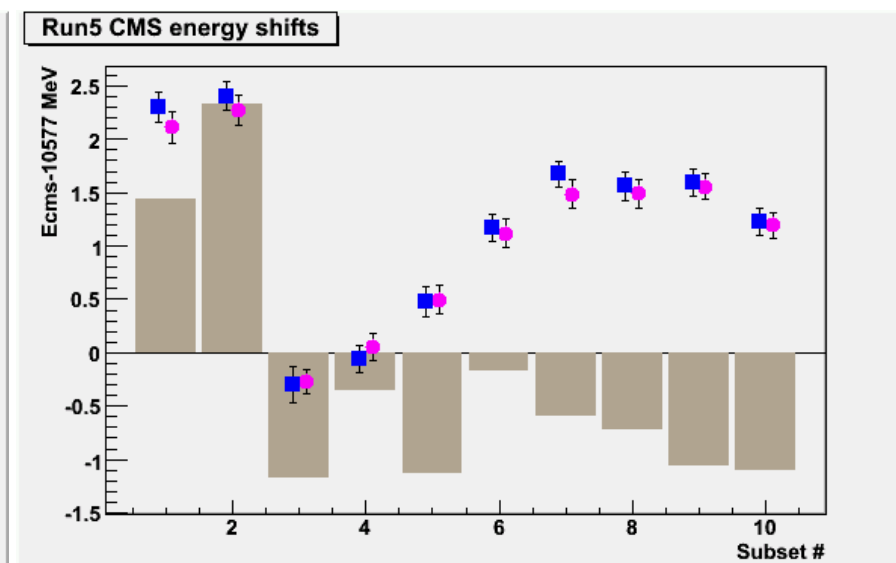
Shaded histogram – E_{cms} from beam data,
Blue circles – fit to B_{ch} reconstructed momentum spectra
Magenta – fit to B^0 reconstructed momentum spectra

4-th run – good agreement between Breco momentum fit and accelerator data;
Run 5 – disagreement up to 2.5 MeV.

MC cms energy correction
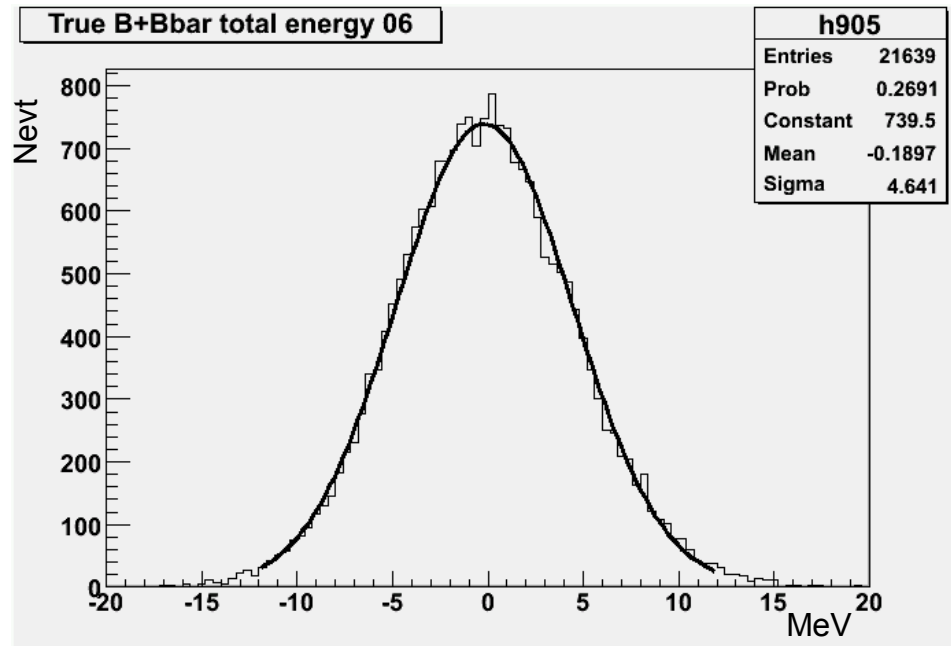
The energy spread of the produced Y(4S) is ~5 MeV, so it is possible to correct MC cms energy by reweighting events according to their MC truth Y(4S) energy. The weight function is a ratio of two Gaussians describing MC and data Y(4S) energy spectra, with the parameters obtained from the fits to Breco momentum spectra.

MC cms energy correction

Fits to the total Breco statistics of the runs

	Edata-Emc MeV	Emc–10577 MeV
Run 1	0.42	0.20
Run 2	0.90	0.77
Run 3	0.70	0.69
Run 4	0.49	0.21
Run 5	1.43	–0.35

Weight function (assuming same σ_E in data and MC):

$$WF(E) = \xi \exp\left(-\frac{(E_{\text{data}} - E_{\text{MC}})(E_{\text{data}} - E_{\text{MC}} - 2E)}{2\sigma^2} \right)$$

$\xi \cong 1$ Is a normalization correction factor obtained from comparison of the integrals over initial and reweighted Breco momentum spectra

Weight function parameters for Runs 1 – 5

Run	E_{data}	E_{MC}	ξ^{-1}
1	10.577618	10.577202	1.0059
2	10.578668	10.577769	1.0097
3	10.578393	10.577689	1.0069
4	10.577699	10.577207	1.0052
5	10.578080	10.576655	1.0132

MC cms energy correction

Initial and corrected by event reweighting MC B-meson momentum spectra
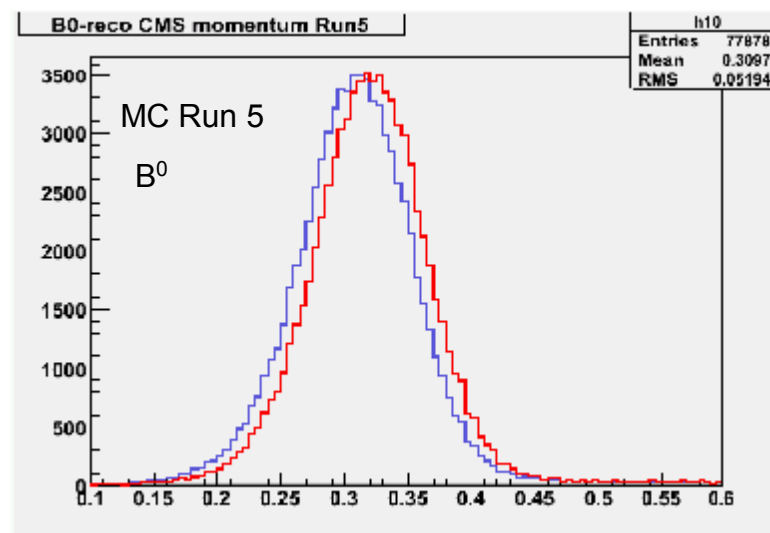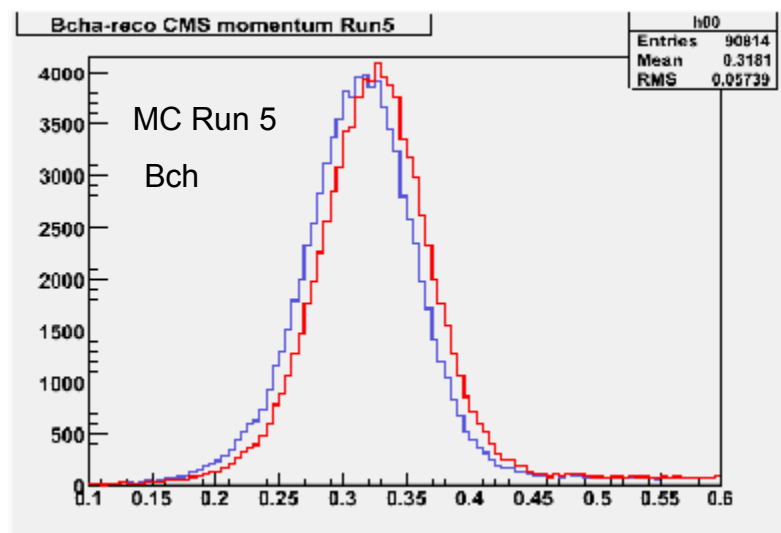
Blue – initial Breco momentum spectra, red – after reweighting.
The 1.5 MeV shift in the cms energy generates ~10 MeV/c (3%)
shift in the B momentum

Run5: Breco CosTheta distributions