Status & results of PFA studies at U. Iowa

Mat Charles
Usha Mallik

Event Type

$$e^+e^- \to Z_1 Z_2$$

CM energy: 500 GeV

$Z_2 \to \nu\underline{\nu}$ (light jets)

$Z_1 \to q\underline{q}$ (light jets)

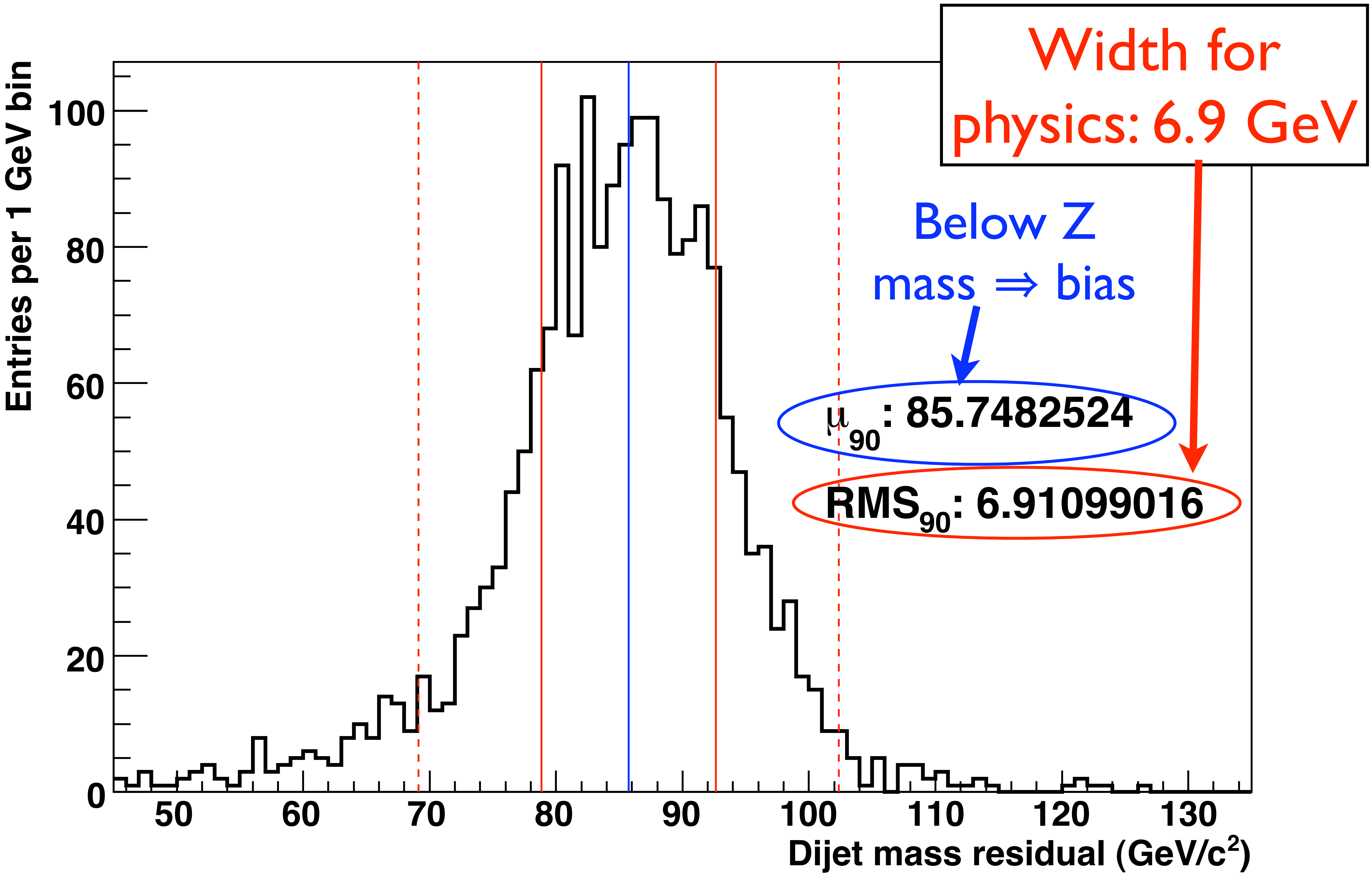
- This produces jets that have realistic energies, but without excessive overlap.
- No confusion from jet-finding when calculating dijet mass.

Barrel angle cuts

- For $e^+e^- \to ZZ, Z \to$ light jets, jets tend to be produced at small angles.
- In most events, a lot of energy goes down the beampipe and resolution is lousy even with perfect pattern recognition.
- So we will look only at barrel events, defined by one of:
  - Thrust of reconstructed jet has $|\cos\vartheta| < 0.8$
  - Generated quark has $|\cos\vartheta| < 0.8$ in truth info
- Turns out not to make a big difference which we use.

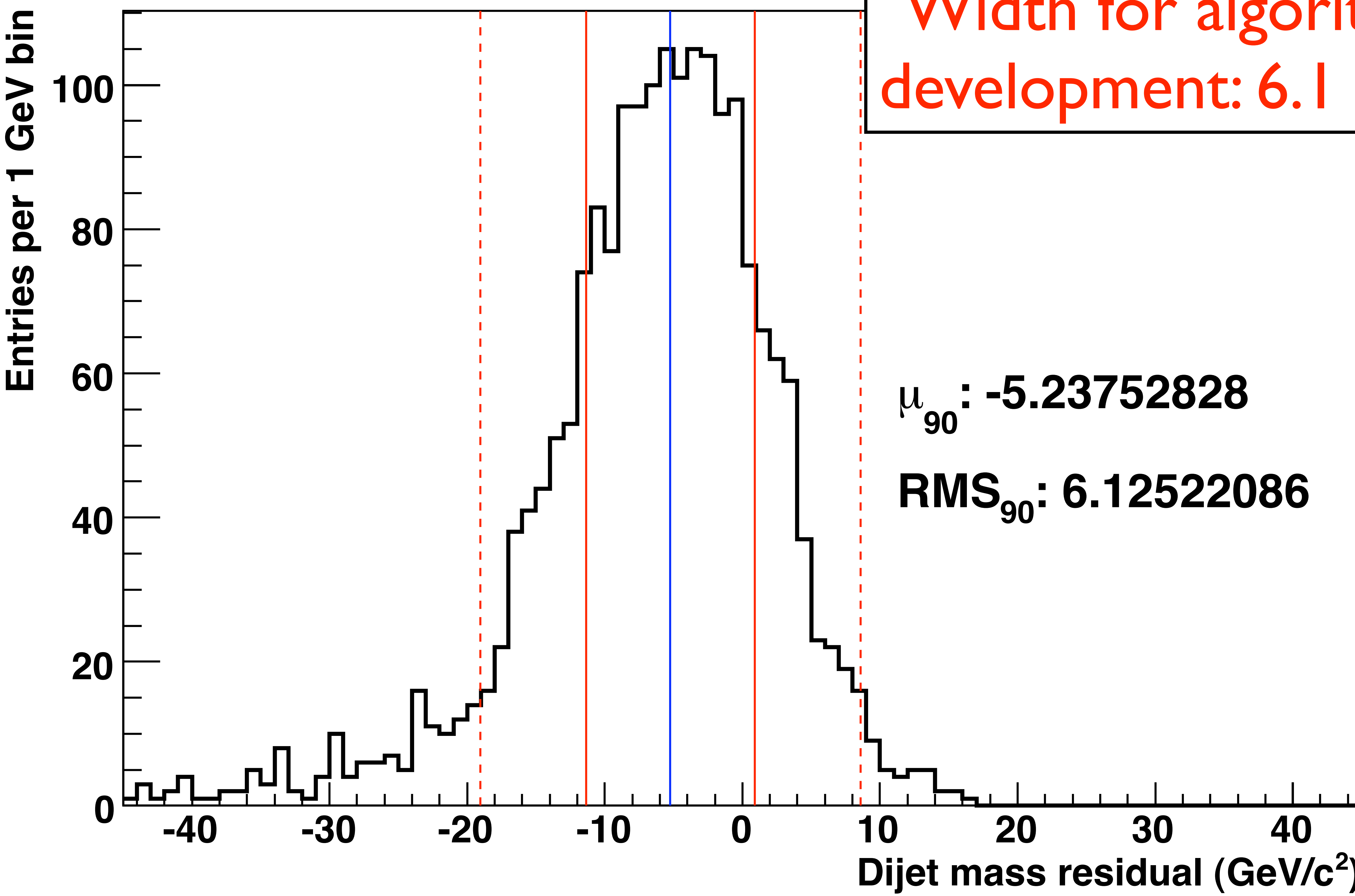
acme0605

Event mass in barrel



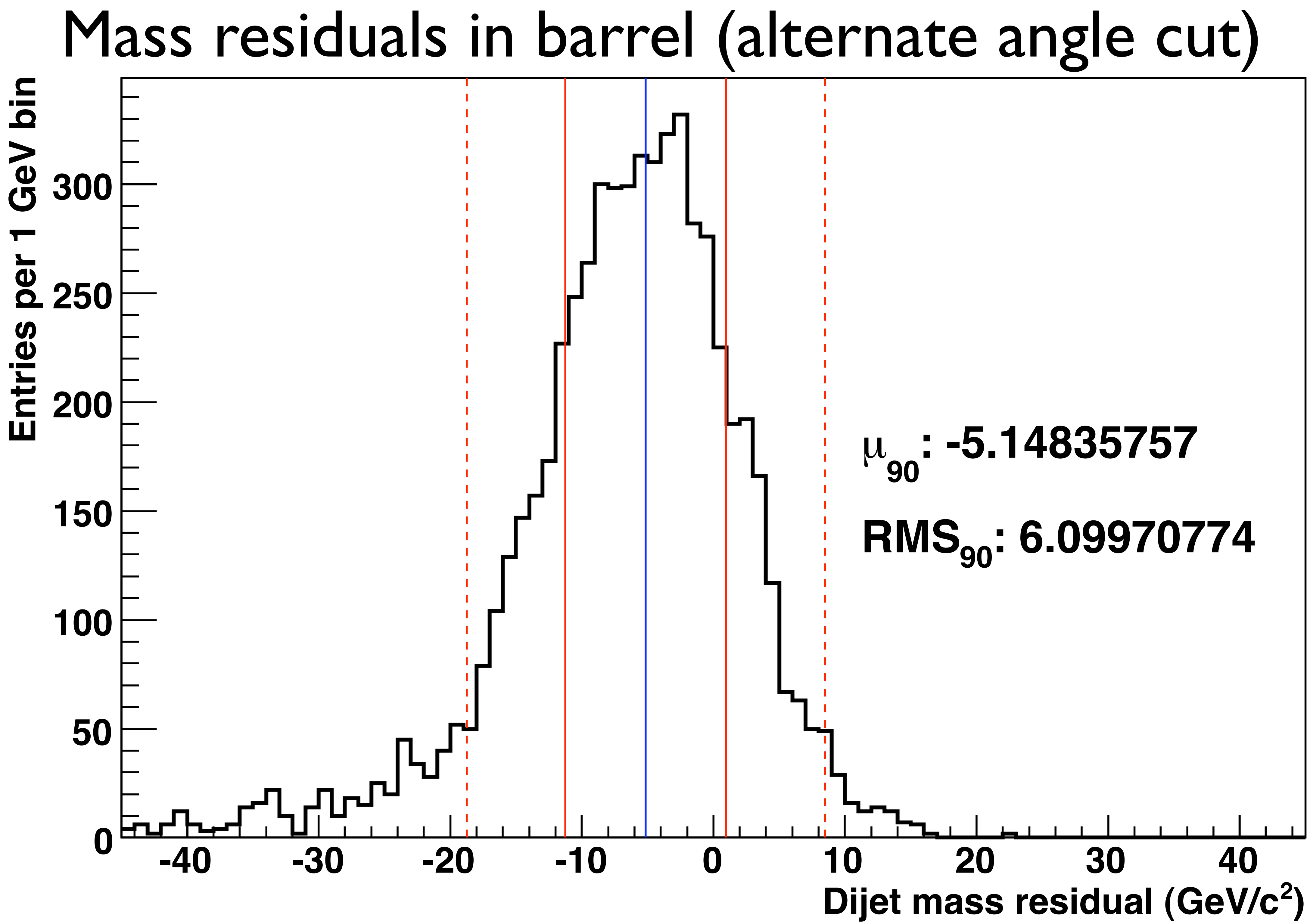
acme0605

Mass residuals in barrel



Width for algorithm development: 6.1 GeV

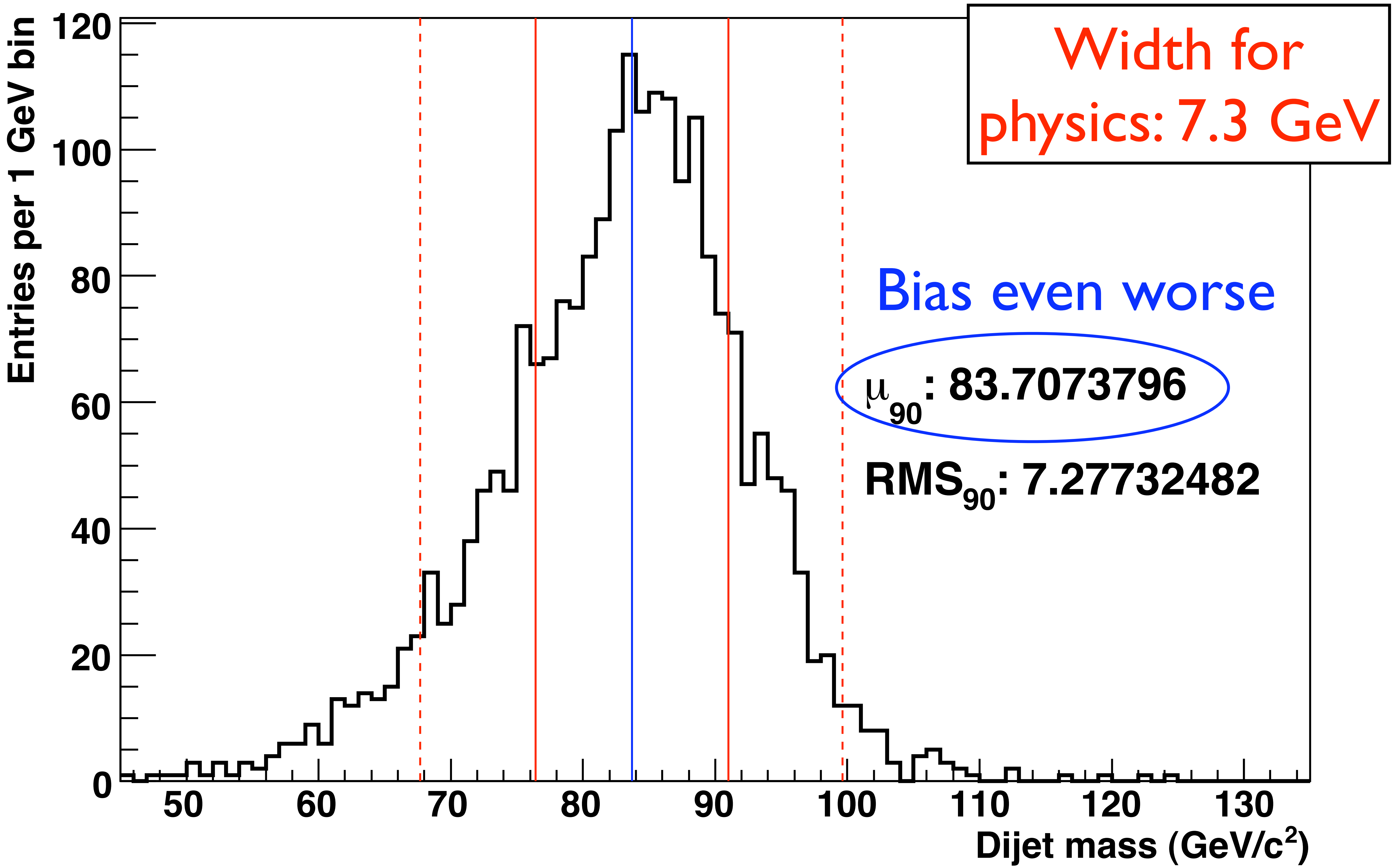
acme0605



Almost no change w.r.t. nominal barrel cut

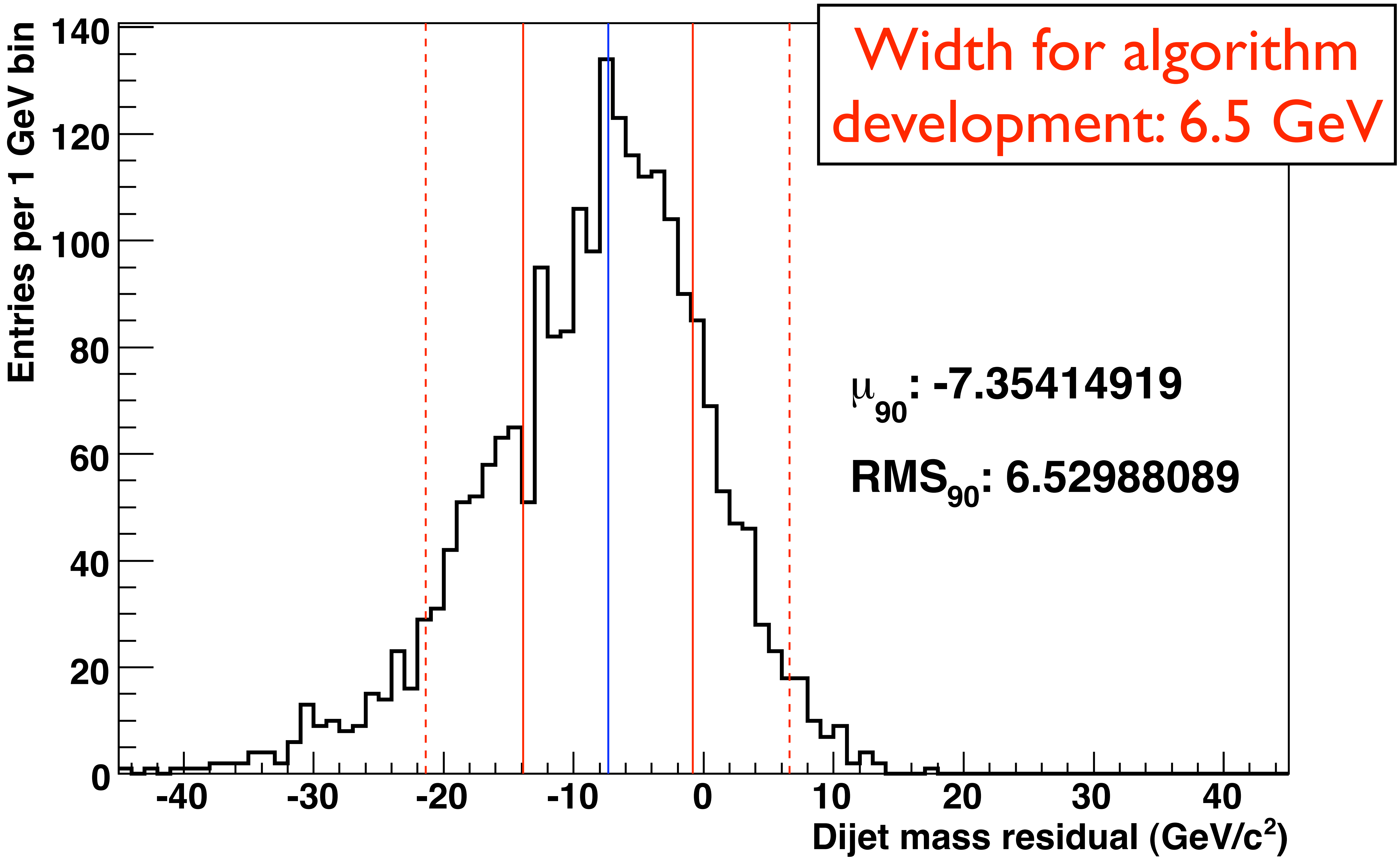
acme0605_steel_scint

Event mass in barrel



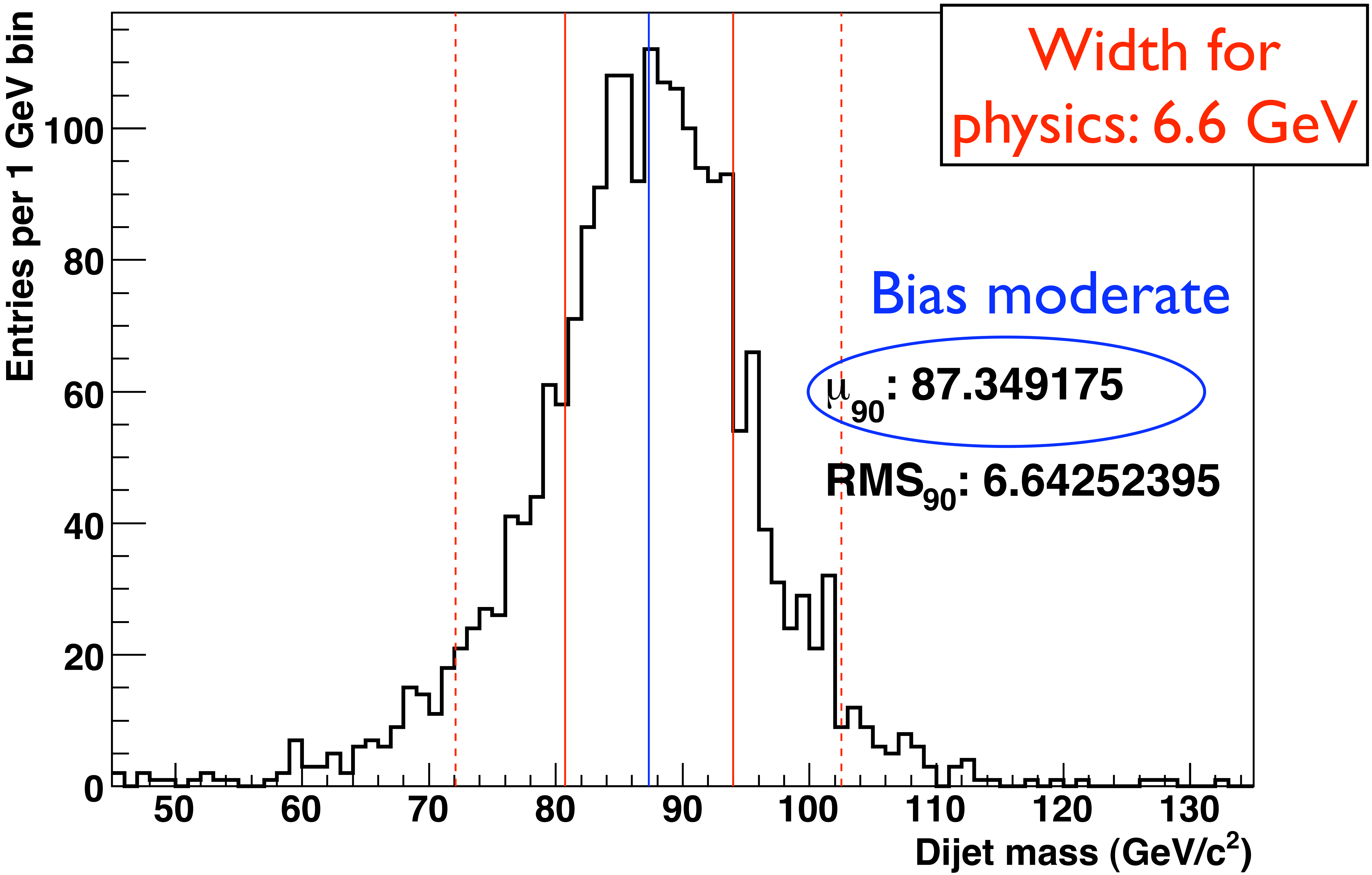
acme0605_steel_scint

Mass residuals in barrel



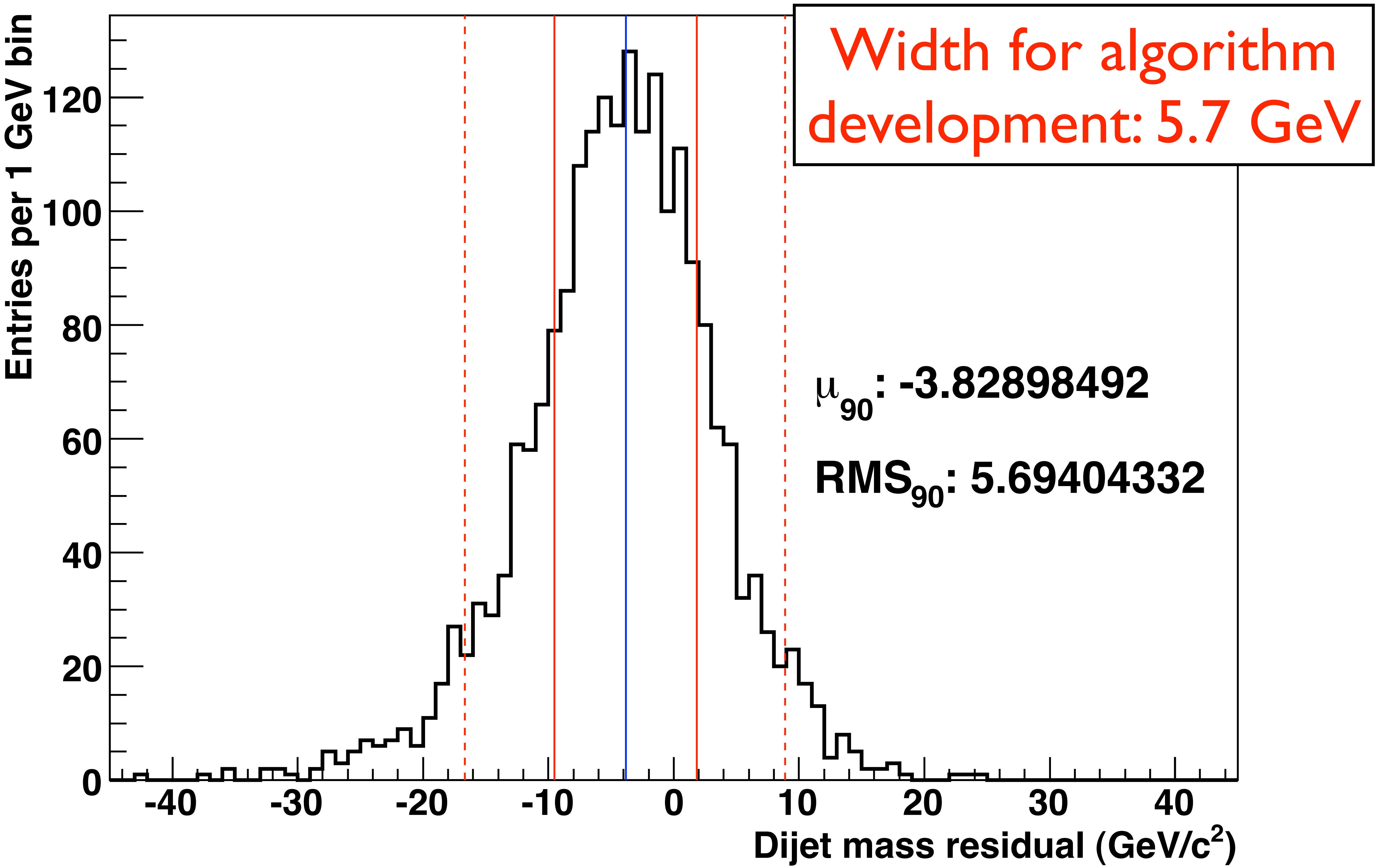
acme0605_w_rpc

Event mass in barrel



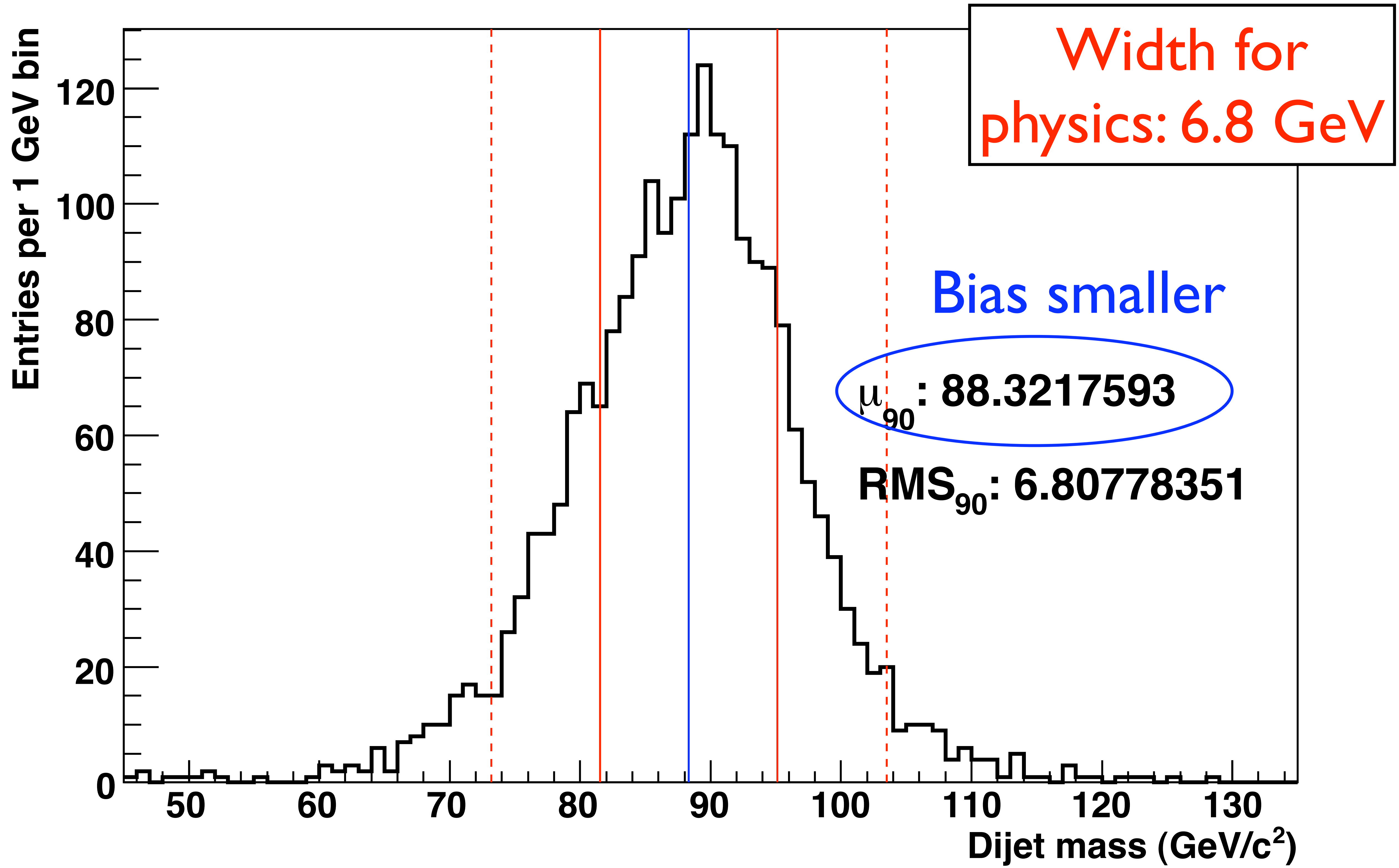
acme0605_w_rpc

Mass residuals in barrel



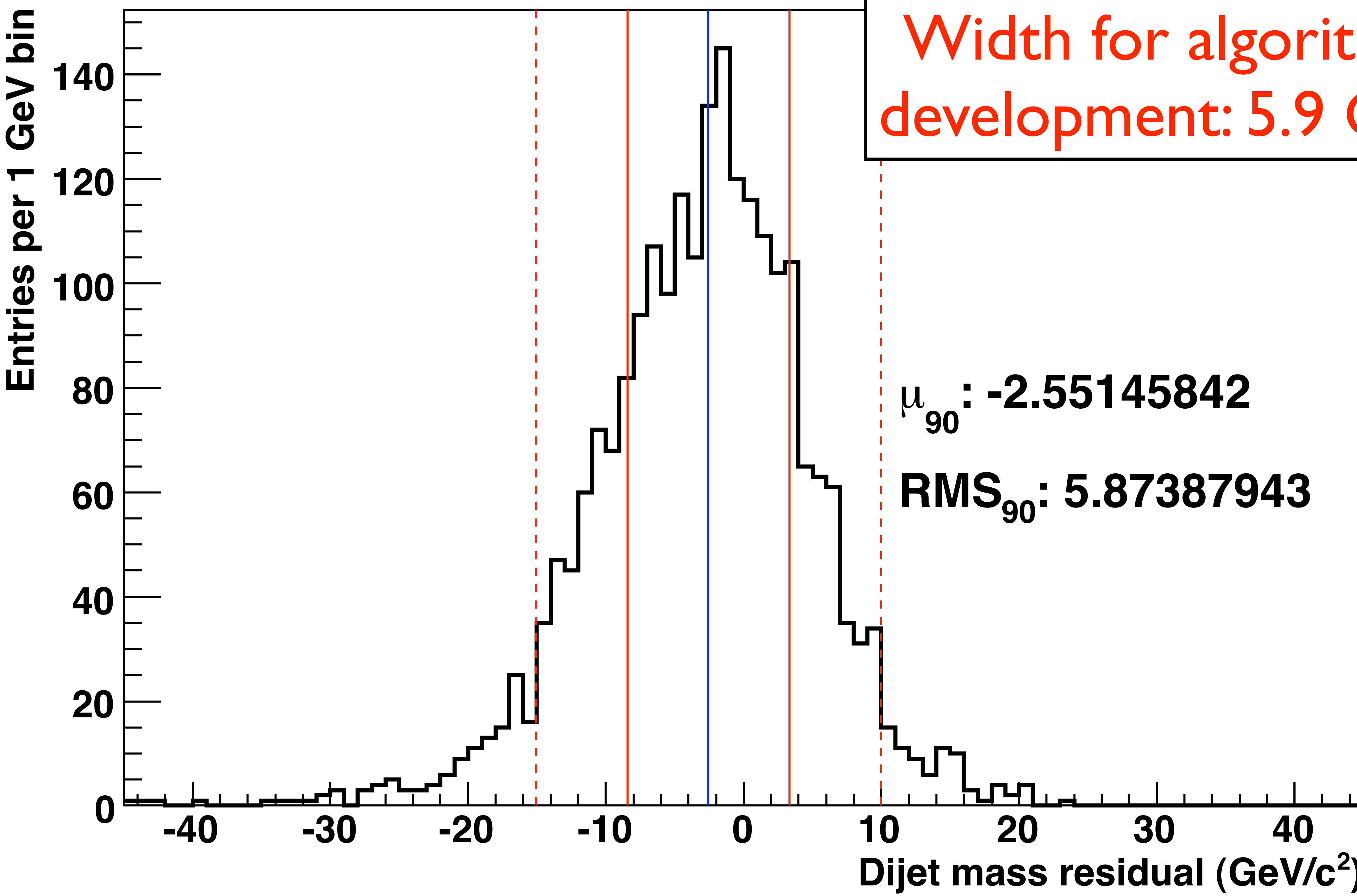
acme0605_steel_rpc

Event mass in barrel



acme0605_steel_rpc

Mass residuals in barrel



Width for algorithm development: 5.9 GeV

Summary

Design	RMS_{90} of mass (including Γ)	RMS_{90} of residuals (no Γ)	Bias
acme0605 [w/scint]	6.9 GeV	6.1 GeV	−5.2 GeV
acme0605_steel_scint	7.3 GeV	6.5 GeV	−7.4 GeV
acme0605_w_rpc	6.6 GeV	5.7 GeV	−3.8 GeV
acme0605_steel_rpc	6.8 GeV	5.9 GeV	−2.6 GeV

For this real (i.e. confused) PFA:

- RPCs give noticeably better resolution and smaller bias than scintillators
- Tungsten gives somewhat better resolution than steel

Next steps

- Code is in CVS (but considered unstable)
  - `org.lcsim.contrib.uiowa.NonTrivialPFA`
  - `org.lcsim.contrib.uiowa.NonTrivialPFAWrapper`
  - `org.lcsim.contrib.uiowa.NonTrivialPFAWrite`
- Work with Ron to feed the PFA output into his analysis tools (we are close!)
- Look again at the origin of the bias
  - For energy sums it was an excess of (neutral → charged) confusion over (charged → neutral)... is that still true for the dijet mass?
- Algorithm development, testing of new components
- Move on to next event type (4 jets)