Bertini Cascade Problems and Fixes

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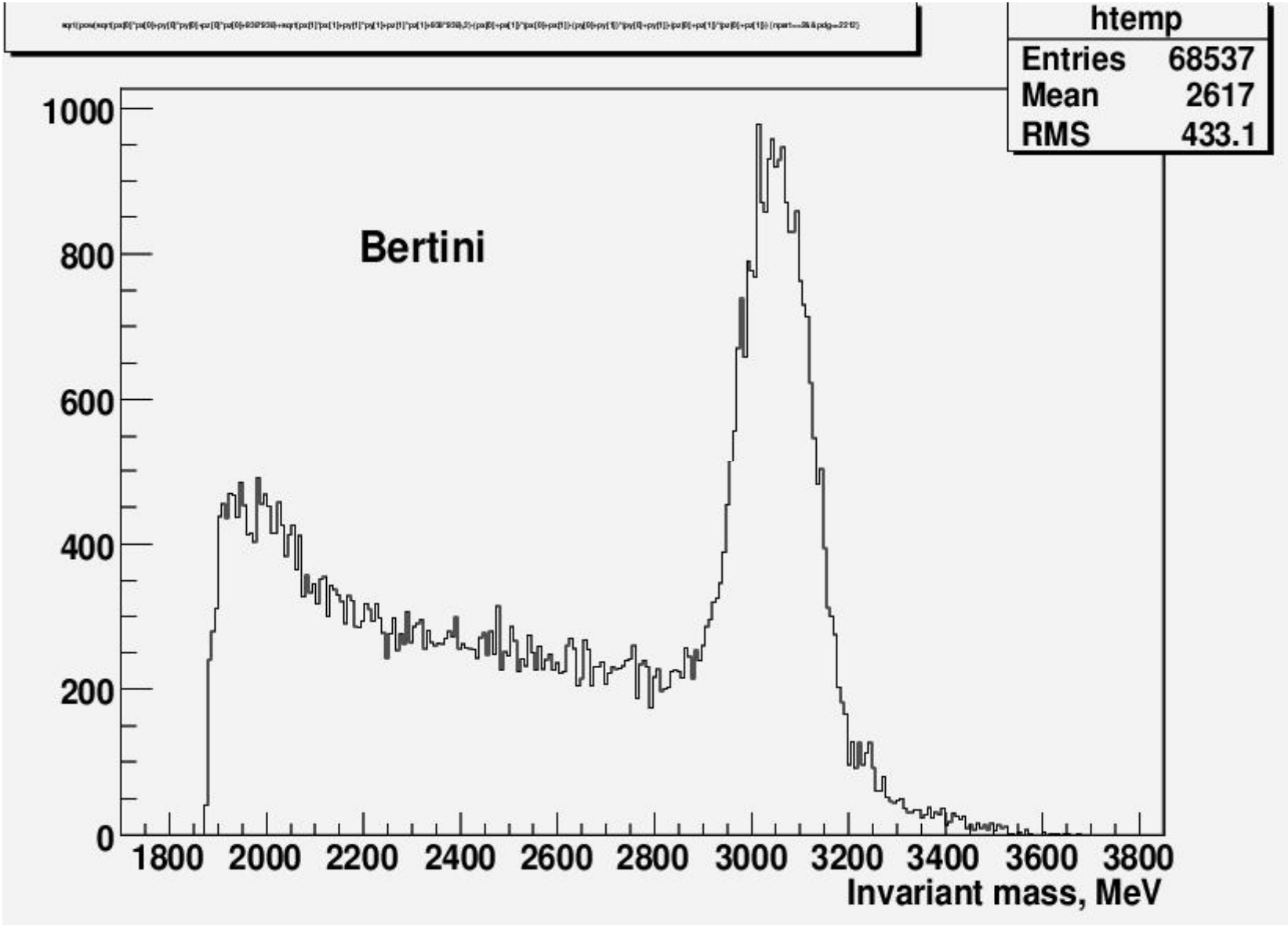
Outline

- Problem Report #896
- 4 GeV/c and 10 GeV/c proton scattering validations
- Angular distribution questions

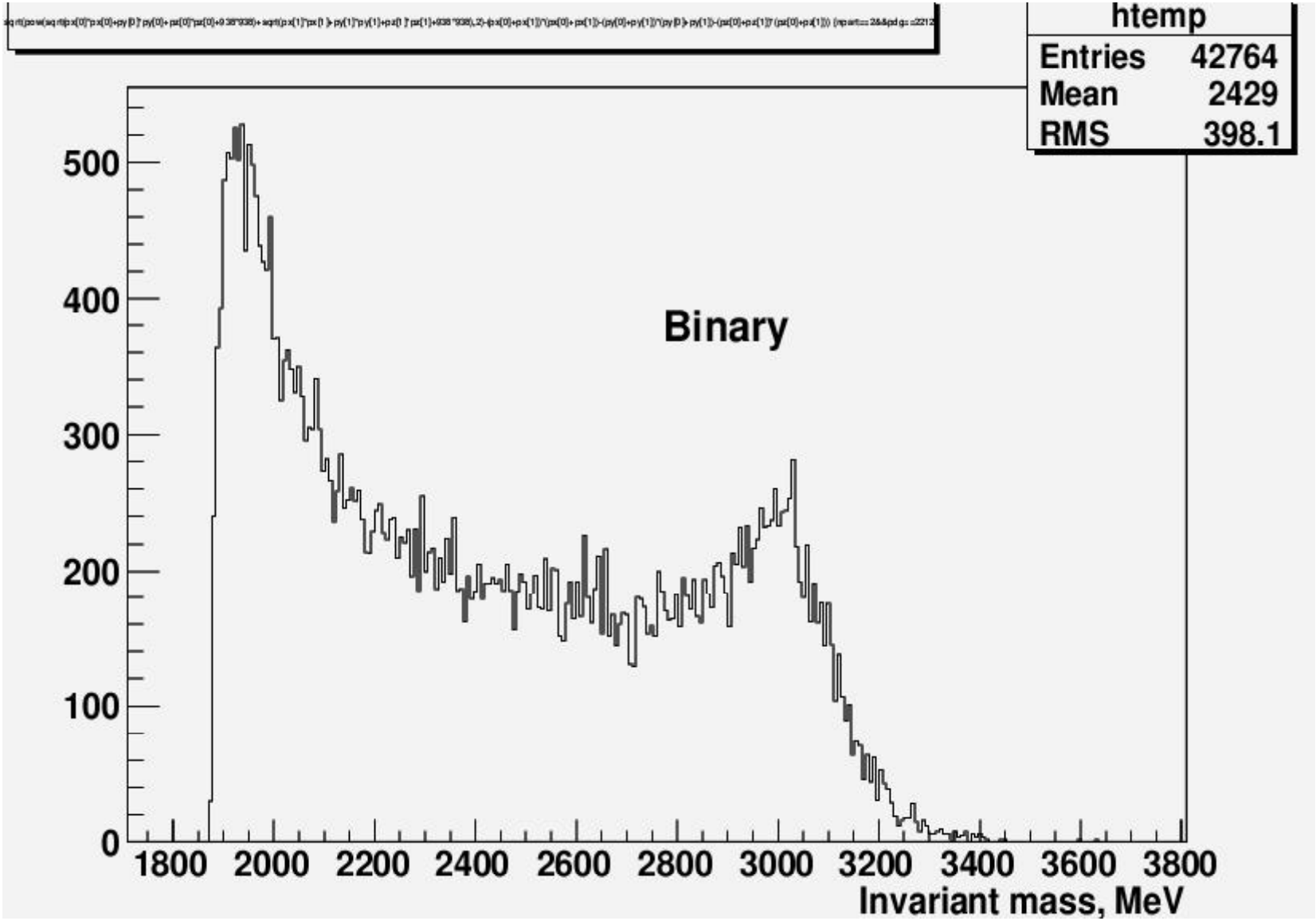
Problem Report # 896

- 4 GeV/c protons on Be
  - two proton invariant mass shows a large peak at ~3.1 GeV
  - corresponds to p-p elastic scattering in CM
  - same thing not seen in Binary cascade

p + Be: Two-proton Invariant Mass



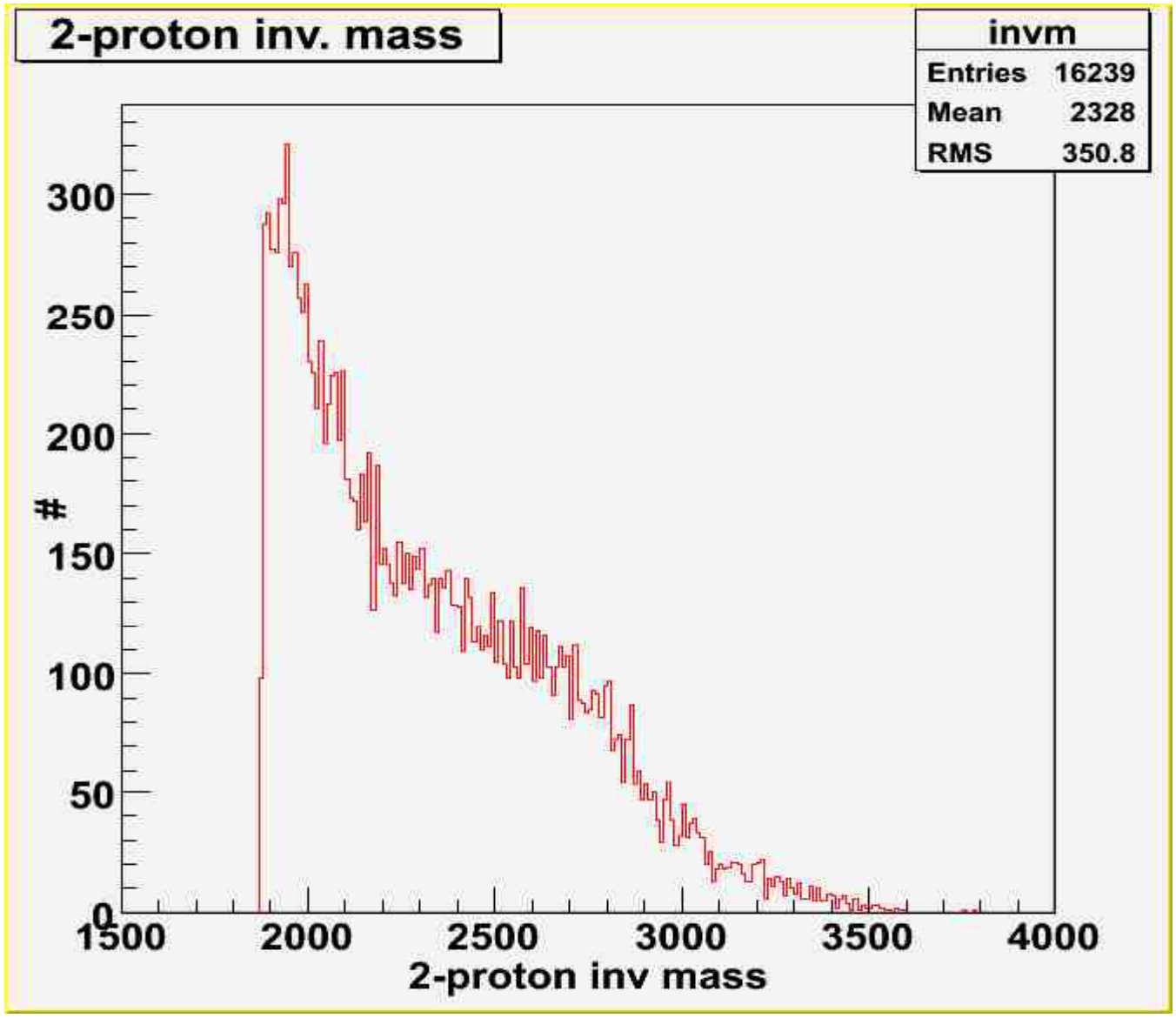
p + Be: Two-proton Invariant Mass



Fix: Remove Quasi-elastic Scattering

- Modified classes:
  - G4IntraNucleiCascader
  - G4ElementaryParticleCollider
- If there is only one projectile-nucleon reaction within nucleus, and reaction is elastic, reject event and try again

Two-proton Invariant Mass with Quasi-elastic Scattering Removed



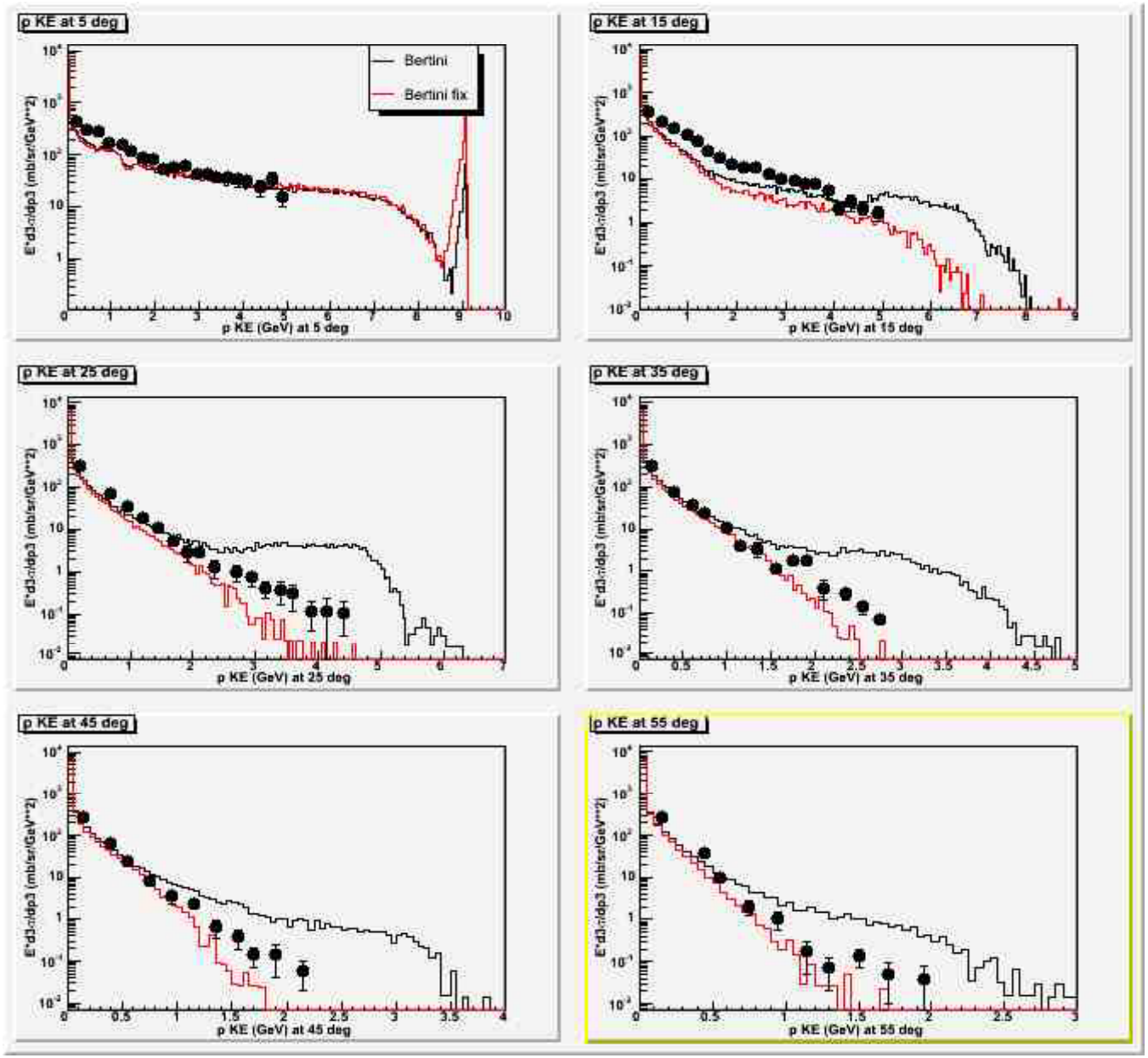
Problem

- Invariant mass spectrum still does not look like that from Binary cascade
  - is there quasi-elastic in binary cascade?
  - should some quasi-elastic remain in Bertini to make it look like binary?

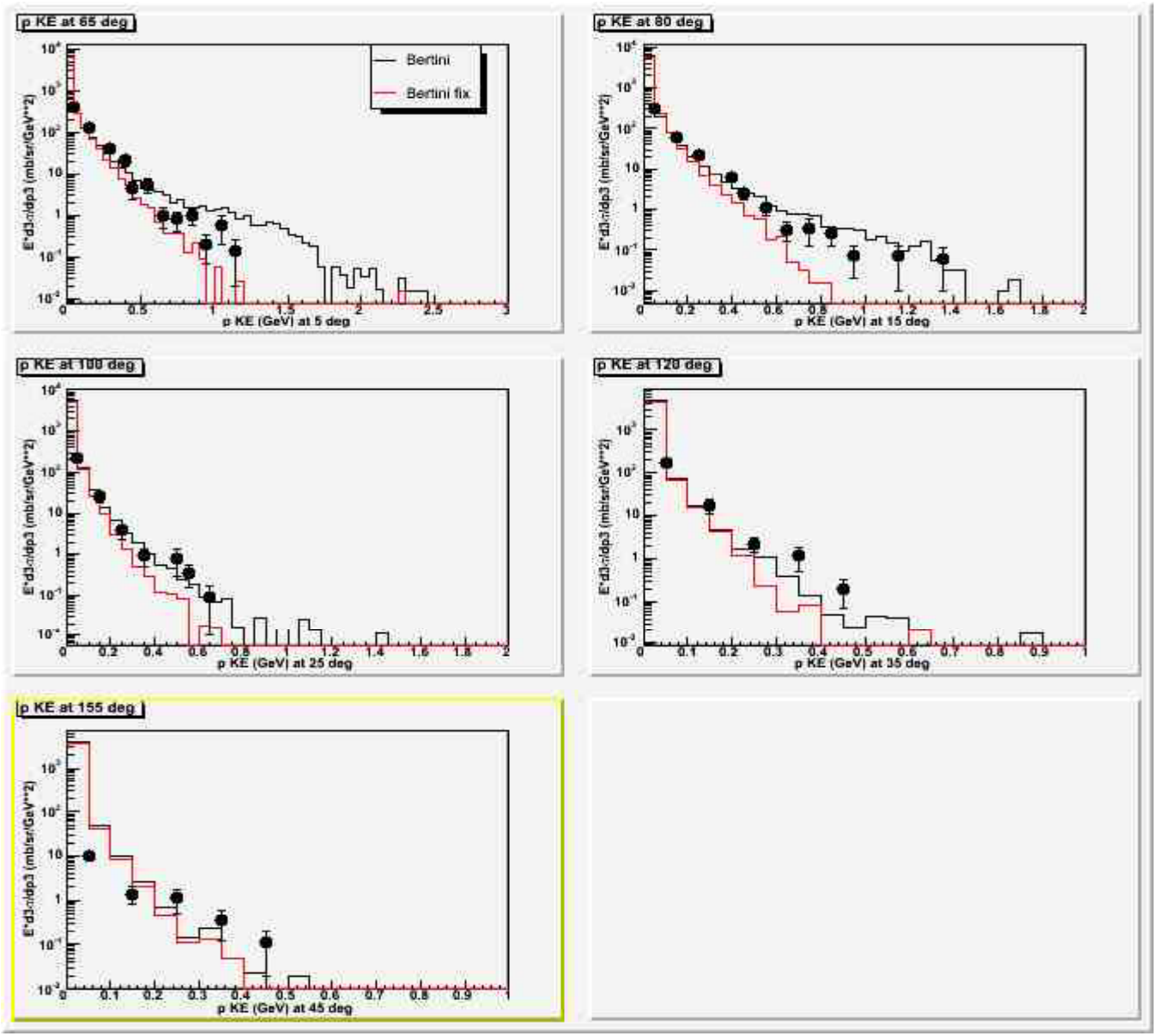
High Energy “Bump” in Proton Inealstic Scattering from Nuclei

- Validations at 4, 10 GeV/c show large discrepancy with data for several nuclei
  - effect is largest at most forward angles
  - cause at first thought to be quasi-elastic scattering
  - now know to be a parameterization problem

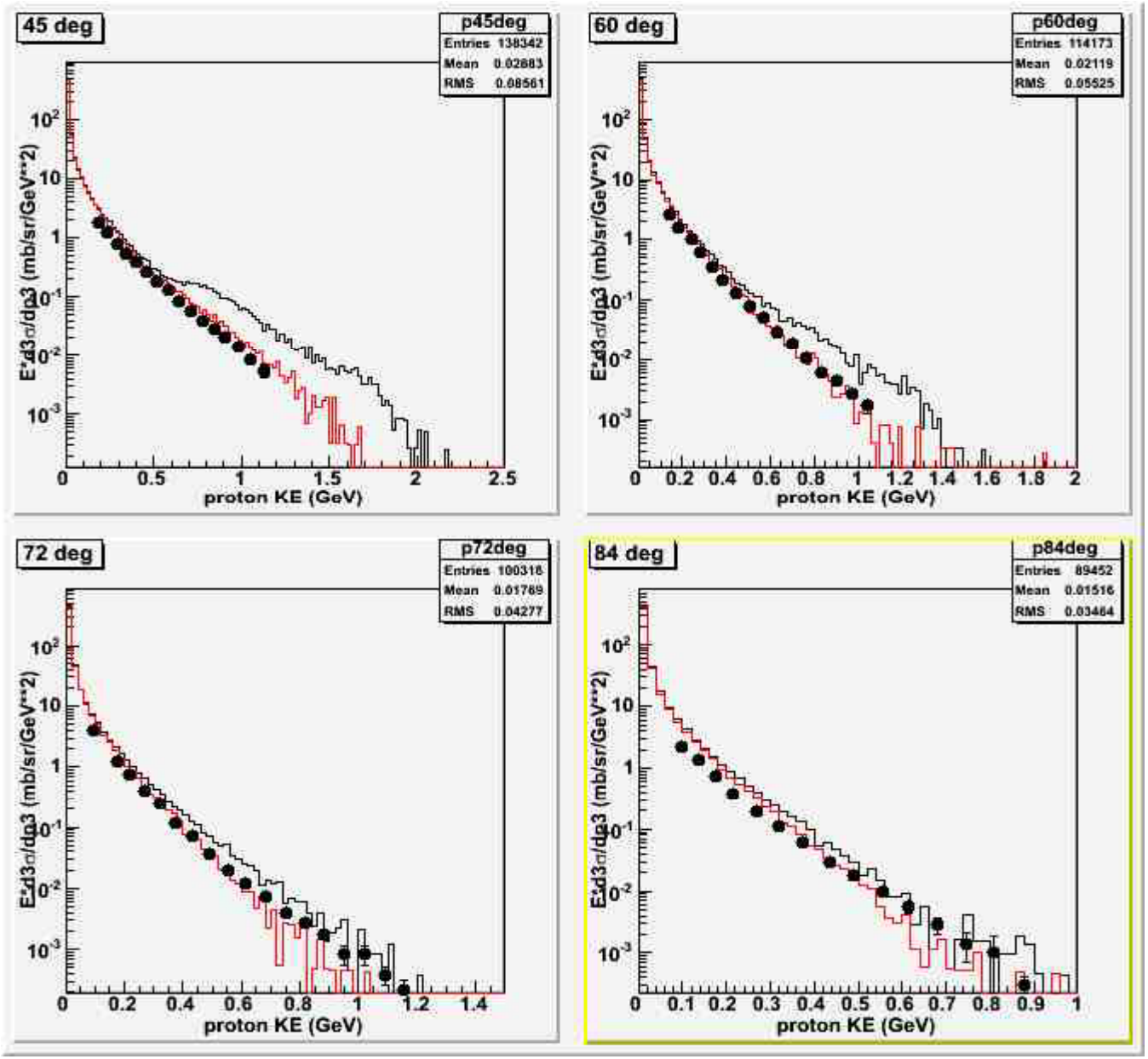
10 GeV/c ITEP Data: p + C, 0 – 60 deg
Black: original Bertini, Red: fix



10 GeV/c ITEP Data: p + C, 60 –180 deg
Black: original Bertini, Red: fix



4 GeV/c KEK Data: p + Pb, 45 – 90 deg
Black: original Bertini, Red: fix



Fix ?

- Change nucleon-nucleon angular distribution
  - new angular distribution: exp(-t) for KE > 2.4 GeV
  - original angular distribution: much less forward-peaked up to 10 GeV
- Change works well for 0 – 60 deg at 4 and 10 GeV/c
- For 60 – 180, original may be better
- Conclusion:
  - tune existing angular parameters
  - change parameterization only for 0 – 60 degrees

More Angular Distribution Problems?

- Final state angular distributions do not look correct
  - discontinuities vs energy
  - un-naturally cut-off spectra
  - strange distribution shapes

Bertini Angular Distributions at Various Collision Energies