Comparing SIMC and MCEEP for use in Hall A

SIMC

- **Sim**ulation for Hall **C**
- Quasielastic, elastic, hypernuclear and pion production reactions
- Events generated by uniform sampling of spectrometer phase space
- A(e,e'π) events generated from predetermined weighting function
- Modular code; straightforward to include new physics subroutines
- Two input files to control simulations; can set various “flags”

MCEEP

- **M**onte **C**arlo for (**e**,**e'p**)
- Originally created for semi-inclusive scattering experiments
- Applicable to any single hadron emission reaction
- Uniform random sampling method to populate experimental acceptance
- Code is modular; relatively simple to add specialised subroutines
- Single input file to control **everything**

Some Similarities and Differences

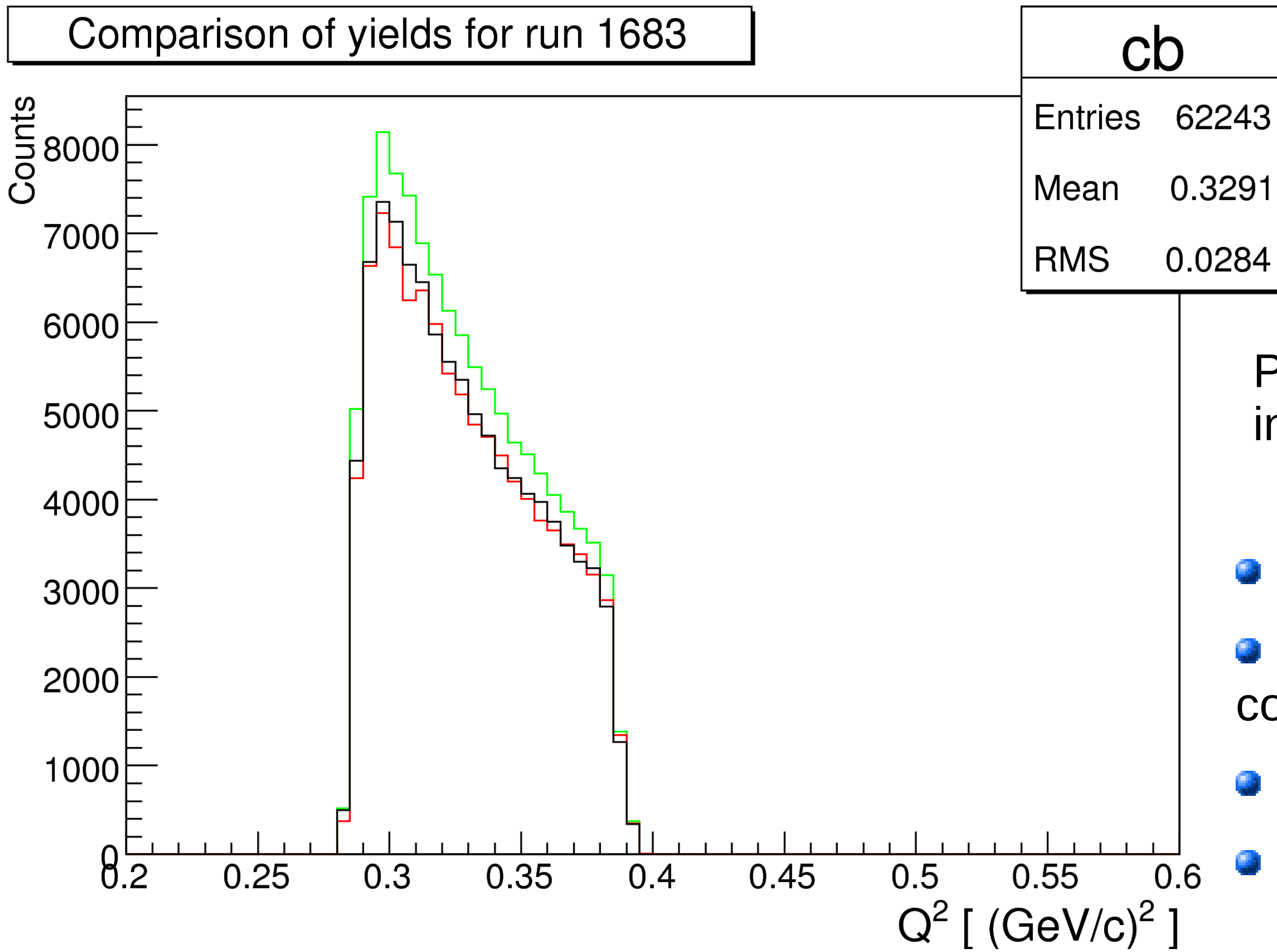
Both simulation codes include,

- Events generation – uniform sampling method
- Spectrometer models including appropriate optics models
- Aperture checks for rays traced through spectrometer
- Radiative effects, multiple scattering, energy loss
- Various theoretical models built in

Differences between the codes include,

- Spectrometer transport models: COSY vs SNAKE (MCEEP also includes a COSY transport subroutine)
- Simulation control through the input file, e.g. collimators
- Variable labels/names, units required, plotting observables

Hydrogen Elastics Yield Comparison

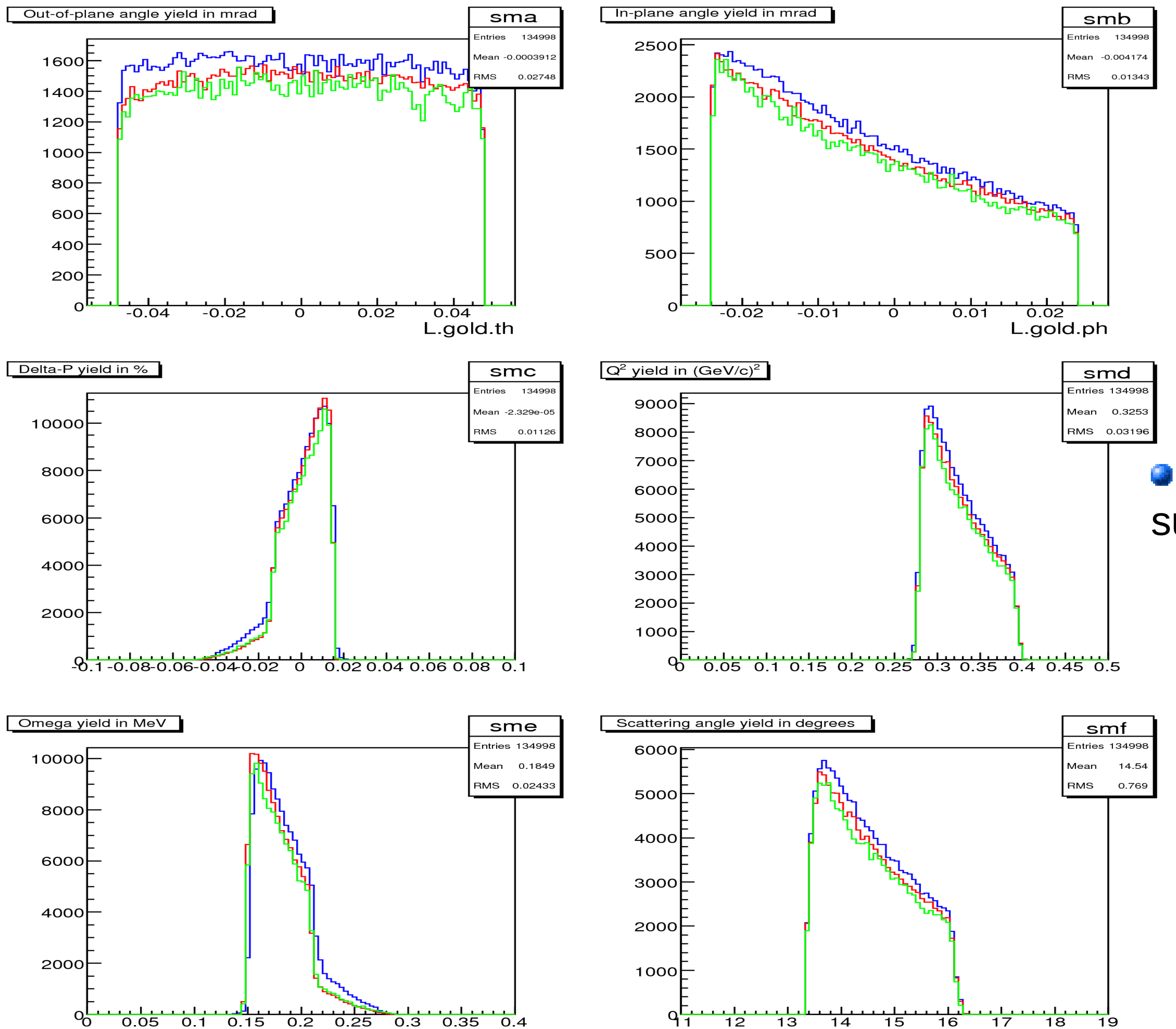


Problem: **20**% discrepancy in the elastic cross-section

- E01020 had similar issue
- Check codes and run consistent simulations
- SIMC/Data < 1.0%
- MCEEP/Data < 4.5%

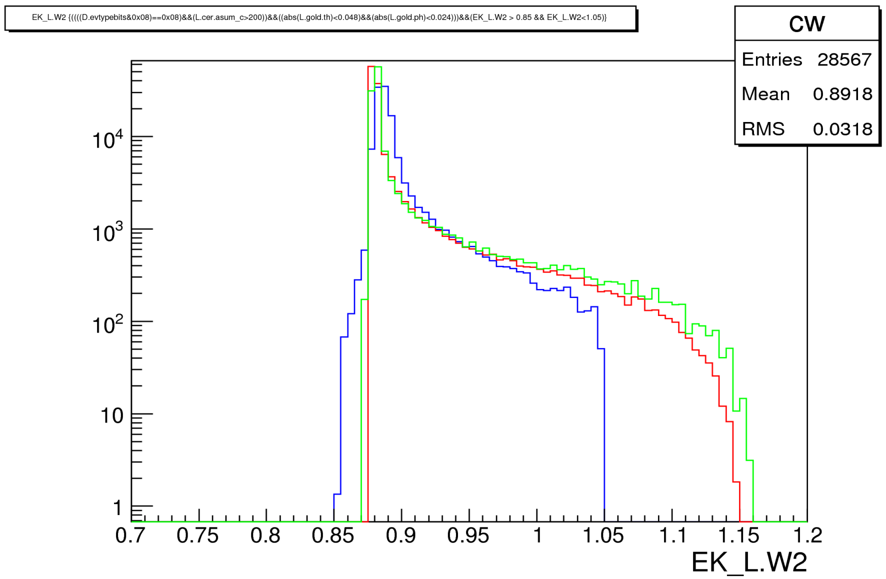
  (integrated yields)

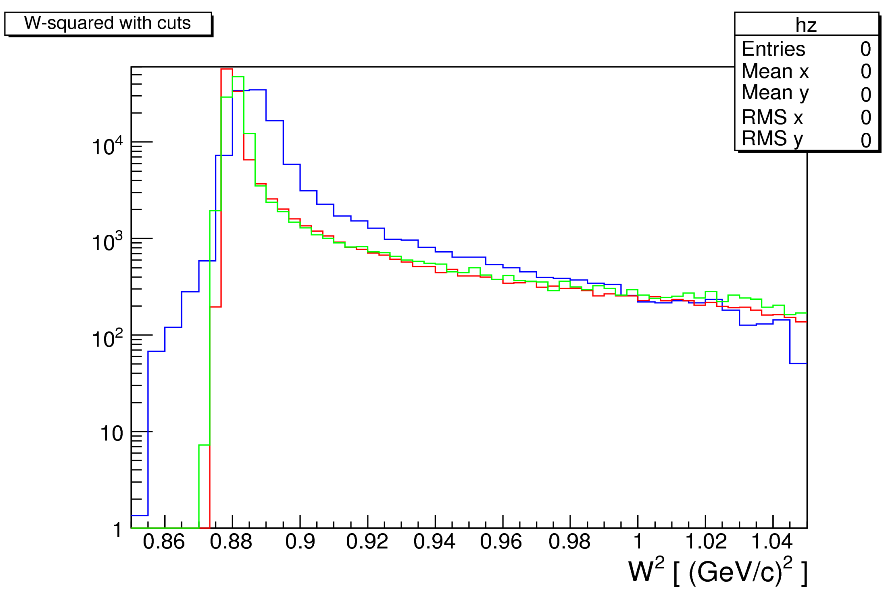
Data Variables Comparison



- Data not background subtracted

W2 Distribution Comparison

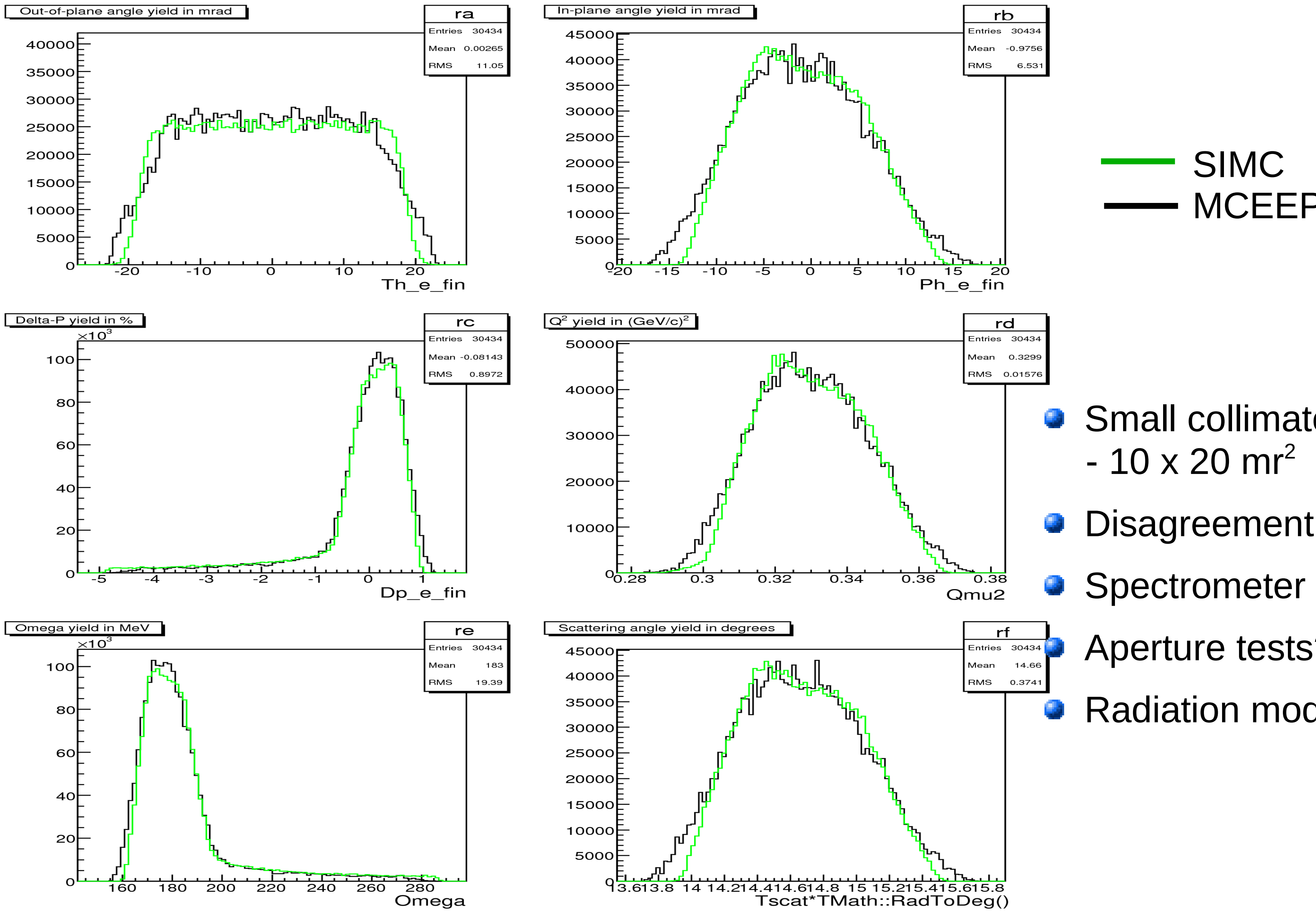




Data
SIMC
MCEEP

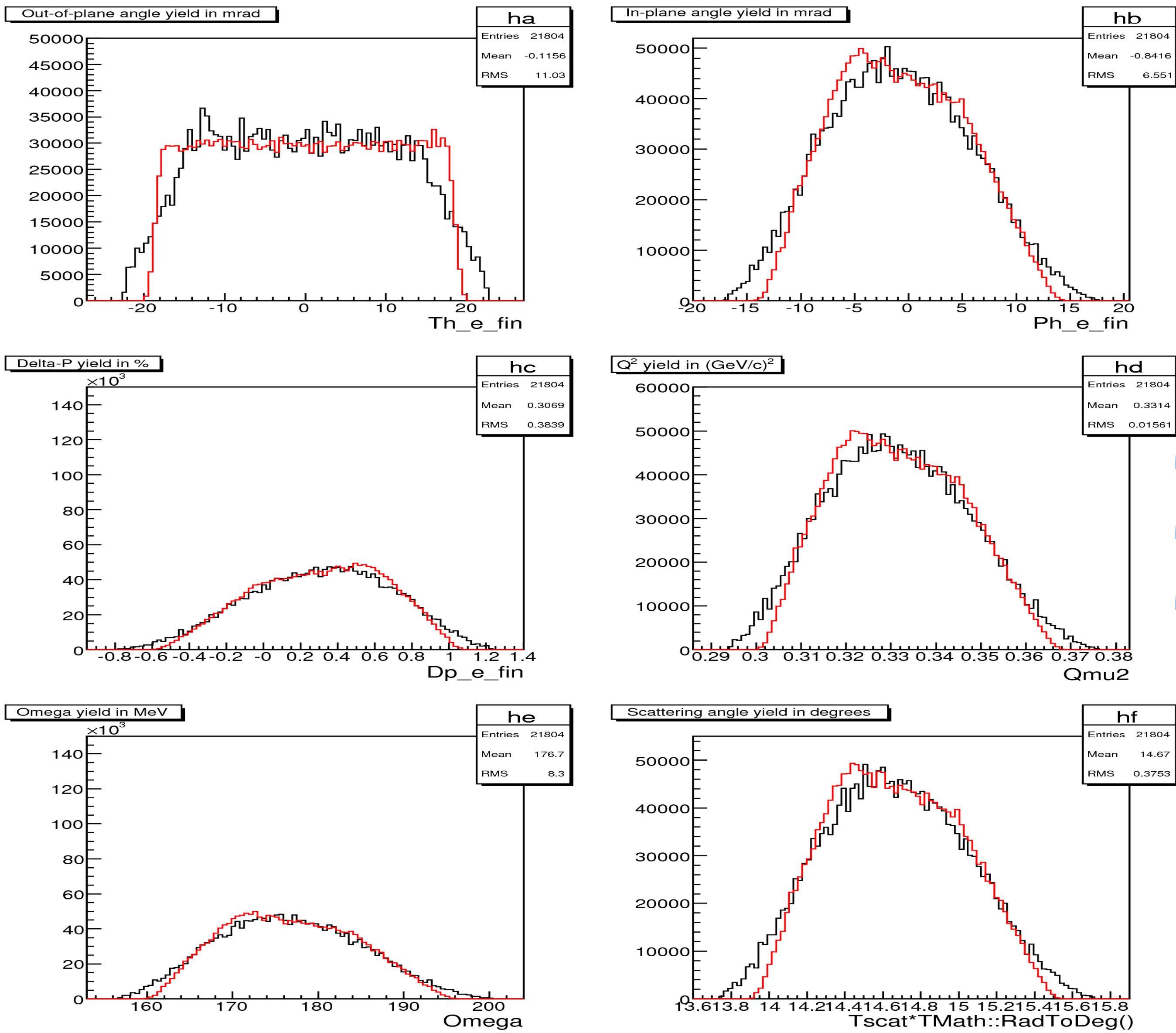
- No collimator in simulations
- Acceptance & PID cuts applied
- Simulation tails shapes agree
- Differences in the peak region
- Smearing or resolution effects?

Radiation ON



- Small collimator model - 10 x 20 mr^2
- Disagreement at edges
- Spectrometer models?
- Aperture tests?
- Radiation models?

Without radiation



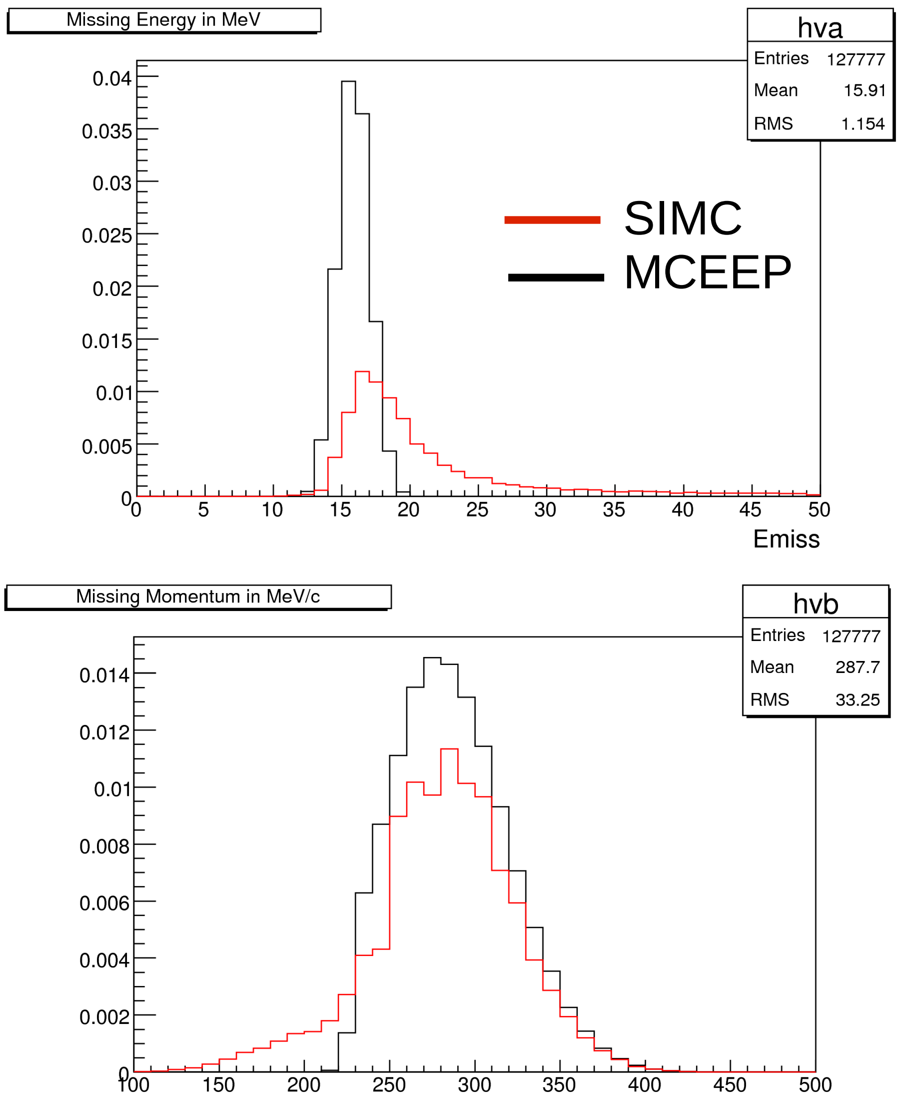
SIMC
MCEEP

- Small collimator model
- No further cuts
- Differences around the edges

Radiation Models

- Internal effects – Schwinger correction and radiative tail
- External effects – particle energy loss and particle deflection
- Radiative tail calculated using Peaking Approximation
  - assumes photon radiated along direction of either incident or scattered electrons
- External bremsstrahlung by interaction with Coulomb field of other nuclei in the medium
- Collision energy loss; energy loss straggling; multiple scattering
- SIMC includes the internal and external radiation diagrams in which all pieces can contribute radiation loss

$^{12}C(e,e'p)^{11}B$ Comparison



- Bound state scattering comparison
- Same input spectral function
- Same charge, luminosity, cuts etc.
- No tuning of smearing or resolution
- Integrated yields agree ~ 15%

Summary

- SIMC and MCEEP produce comparable results to < 5% (integrated yield)
- Question marks over differences in transport models and radiation effects
- Radiation models/effects studied more in depth for SIMC (D. Dutta article)
- MCEEP provides complete control through input file – very flexible
- SIMC requires code modification for certain parts (collimators)
- MCEEP has more extensive documentation
- SIMC actively maintained; last MCEEP release v3.9 in 2006
- SIMC is suitable for Hall A data analysis