Resolutions from CLAS12: gemc vs data

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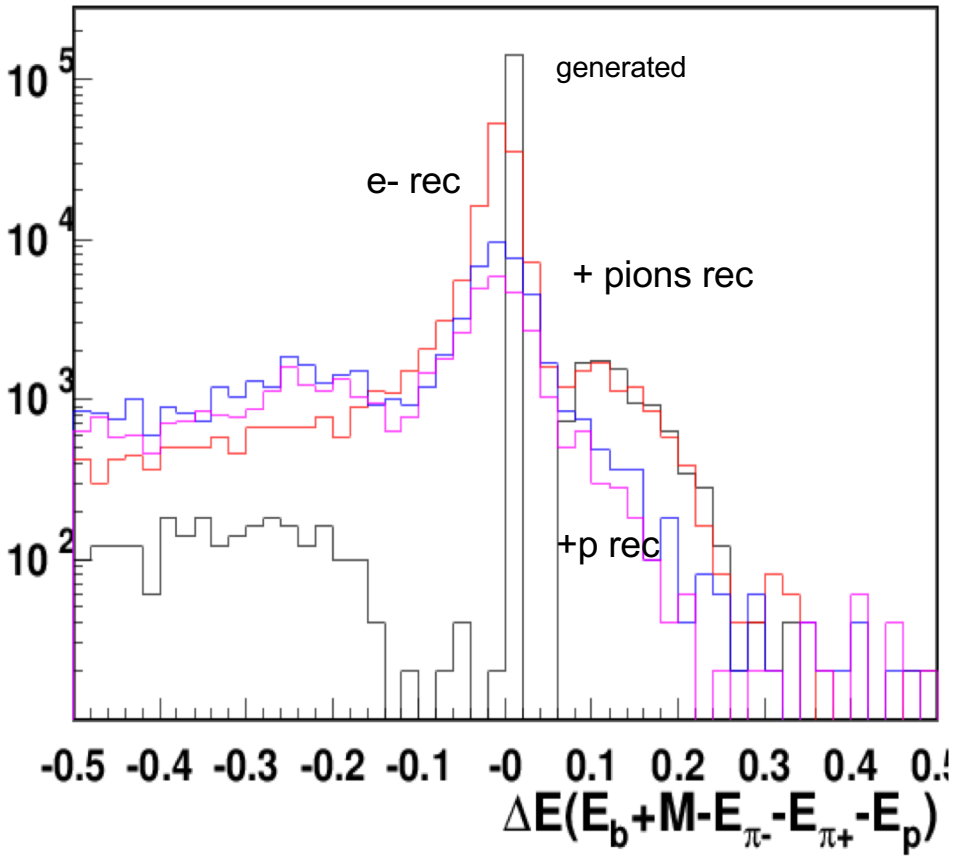
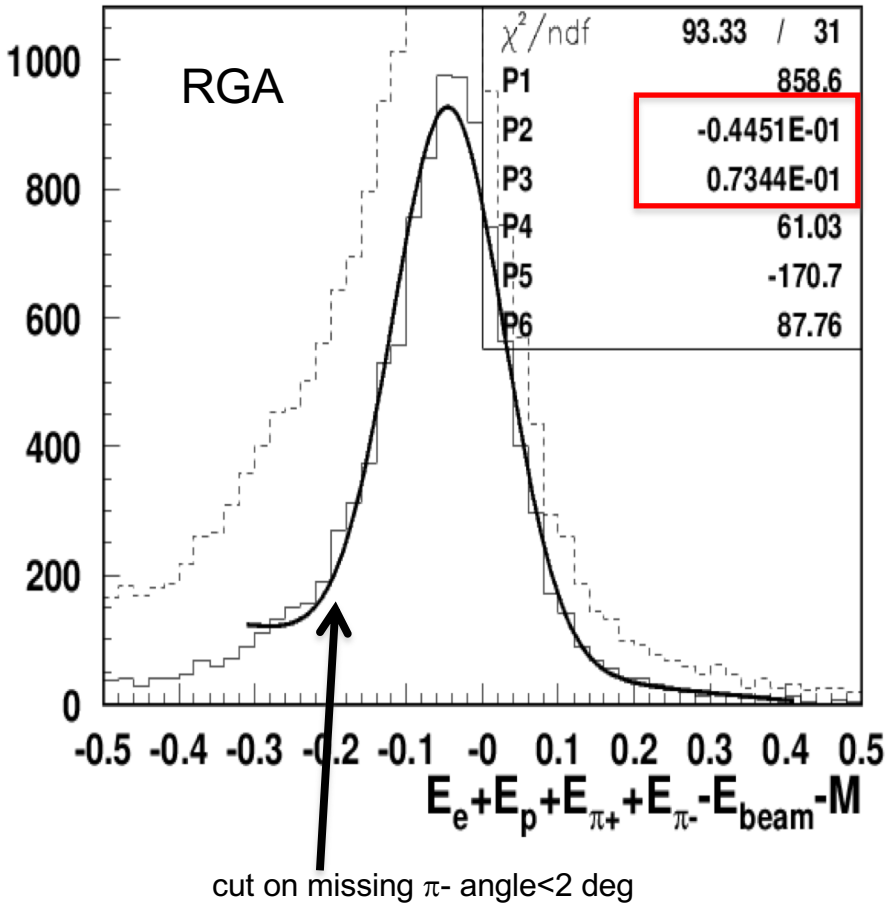
CLAS Collaboration Meeting Nov 14, 2019

- Studies of resolutions and energy loss using gemc
- Comparing resolutions in gemc and RGA
- Parameterizing resolutions
- Input for FASTMC
- Conclusions

Energy balance from gemc and RGA

Look at ep→e'π+π−pX

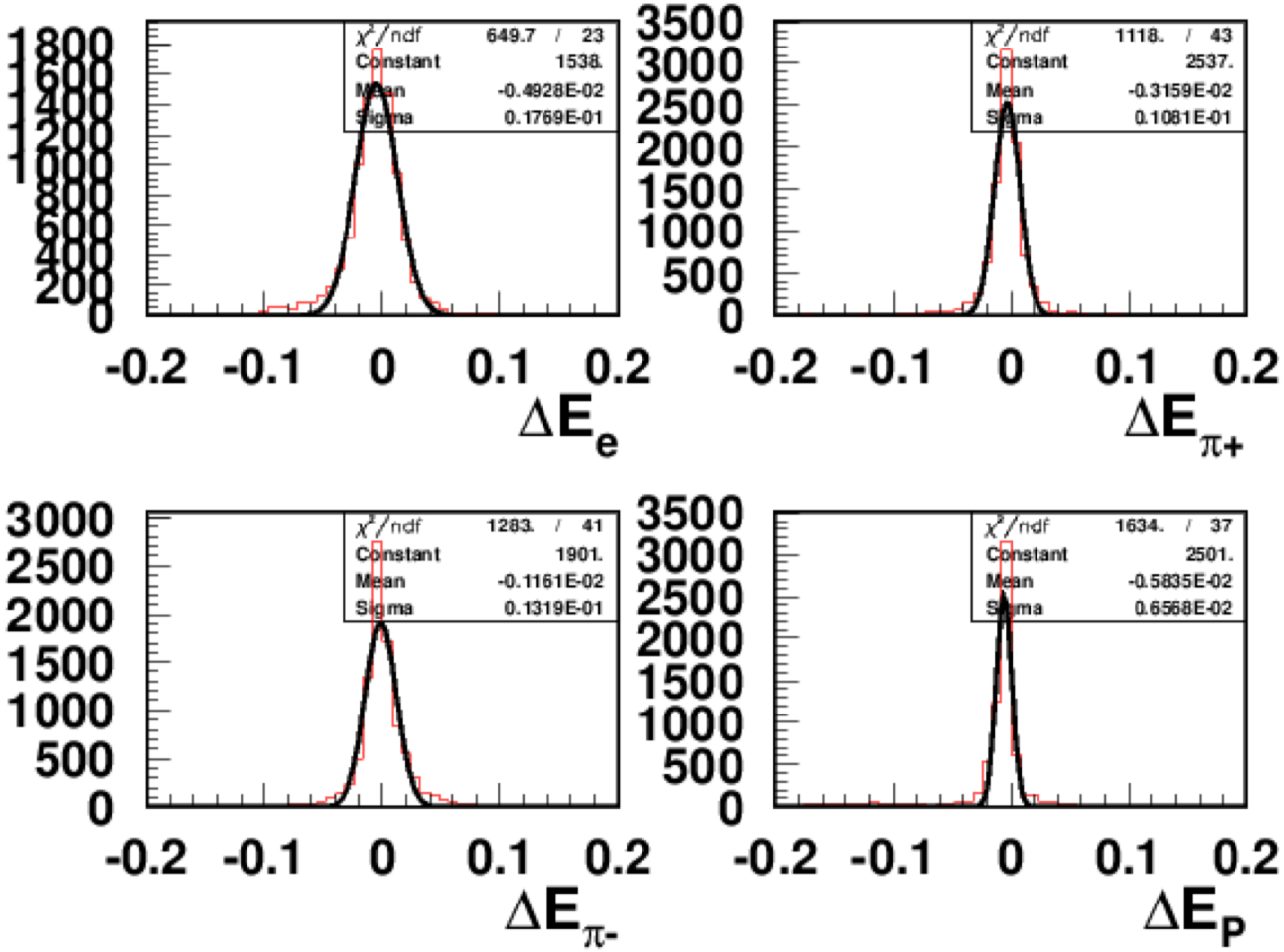




ep→e'π+π−pX has the most coverage in momenta and angles to test rec.eff. and resolutions

Contributions to energy shifts from gemc

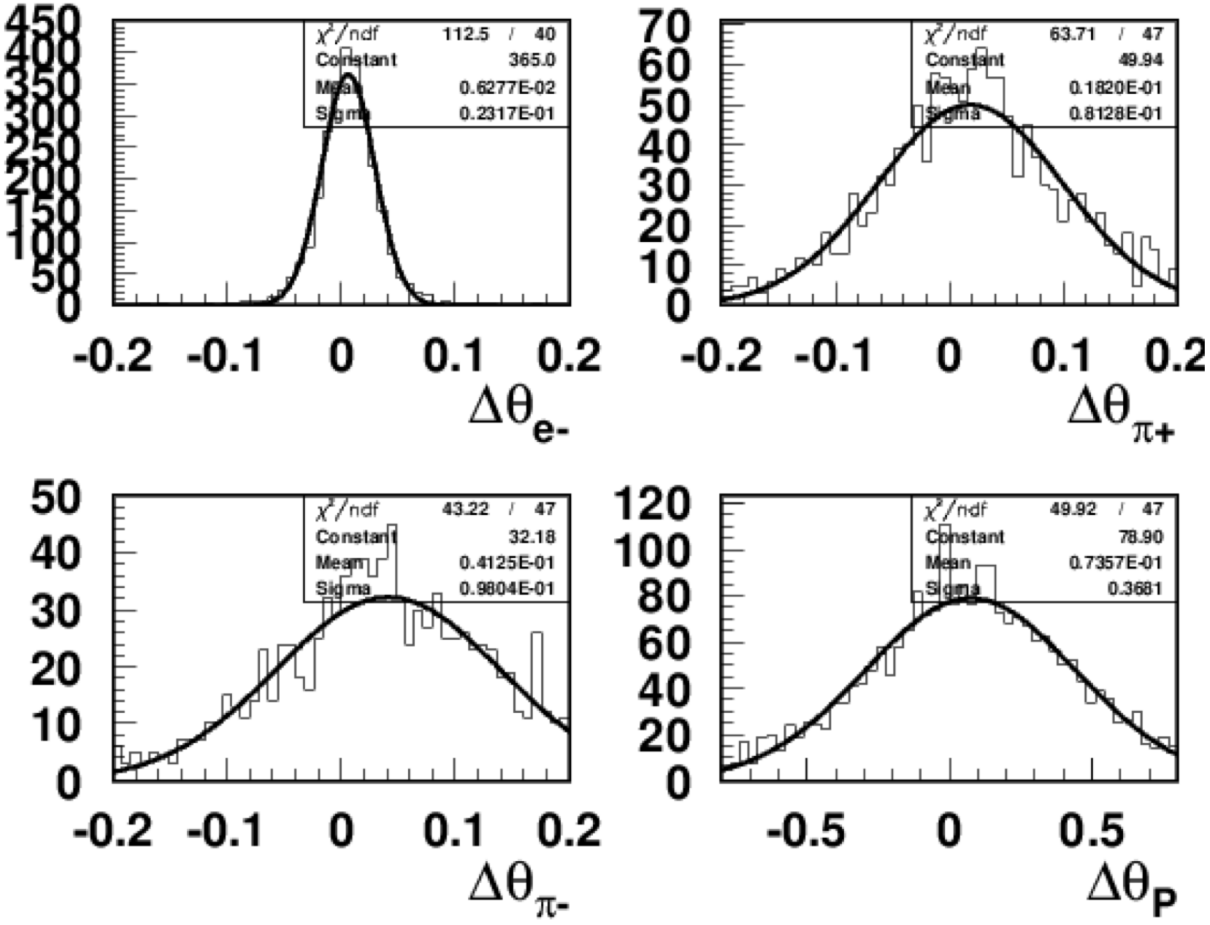
Look at ep→e'π+π−pX



Overall average energy loss if 3 particles is ~10 MeV

Contributions to theta shifts from gemc

Look at ep→e'π+π−pX

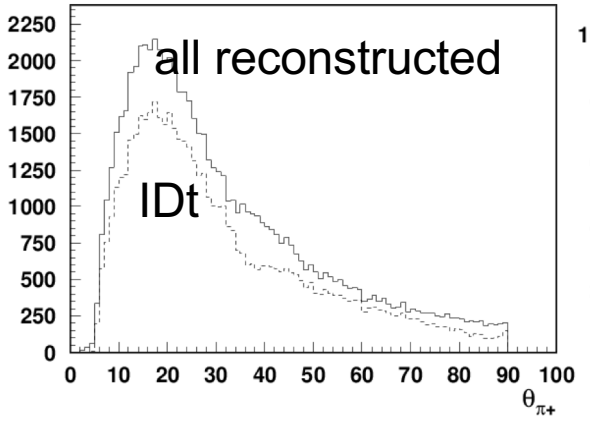


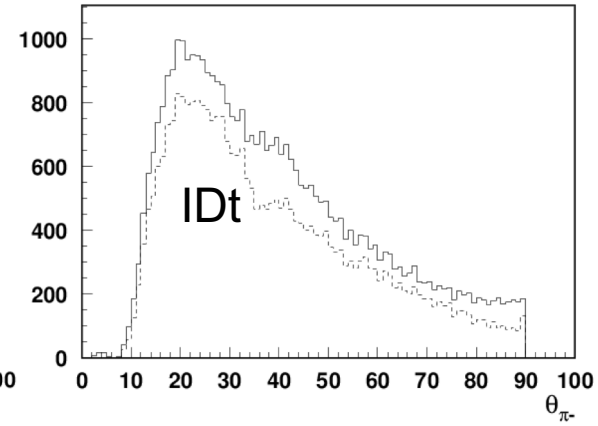
Using correct settings for reconstruction the shifts in angles are below 0.1 degree

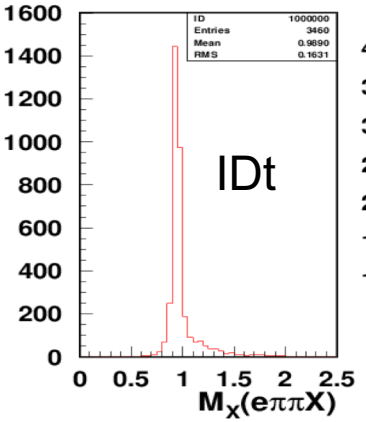
comparing exclusive distributions with MC

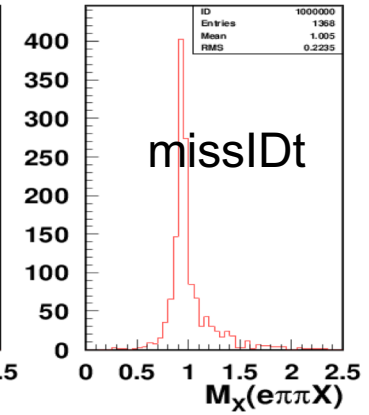
ep→e'π+π−pX

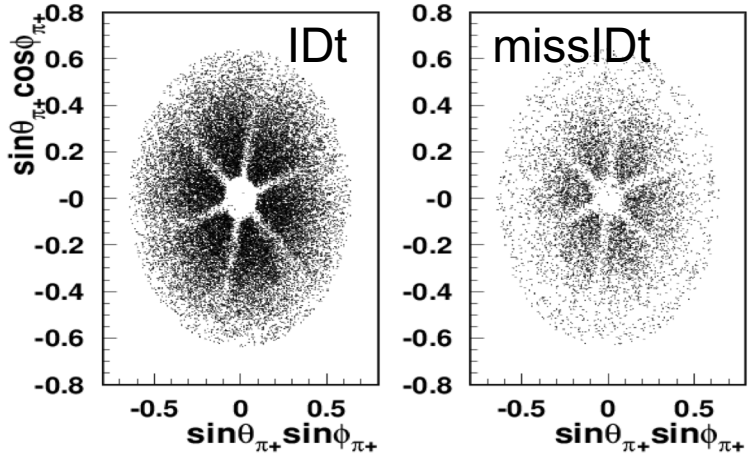
1.2<E_{pion}<3

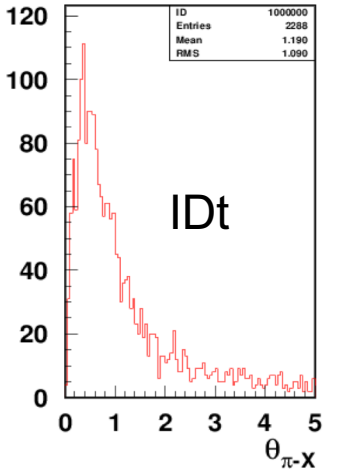


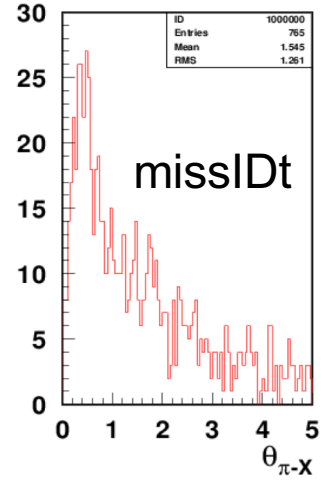








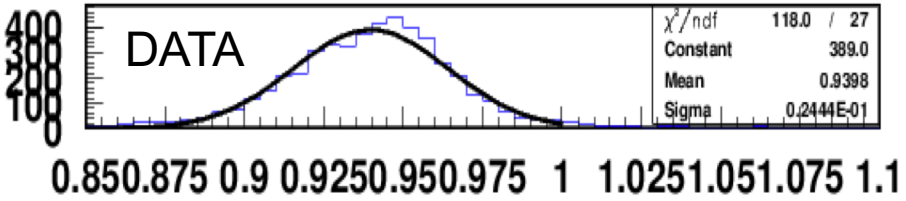




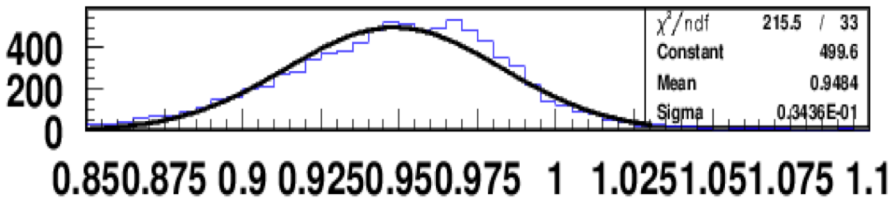
Significant part of charged pions reconstructed but not identified by EB (appear as something else)

comparing MC with RGB data

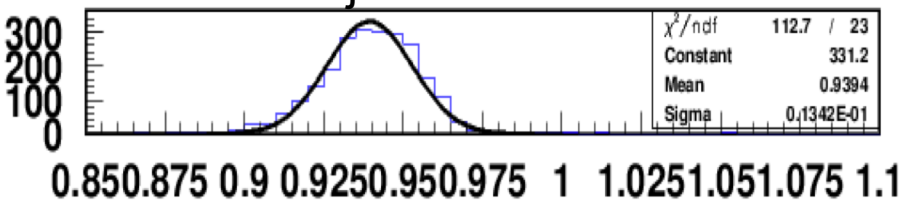
cut on energy balance <0.05 GeV

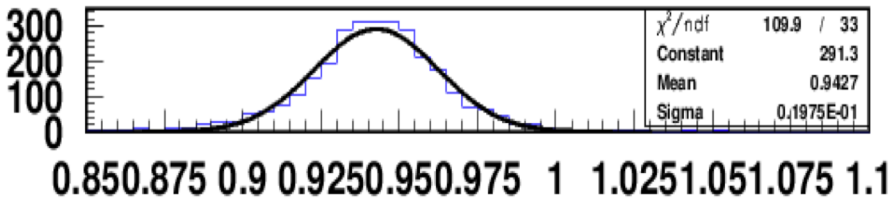


cut on energy balance <0.1 GeV

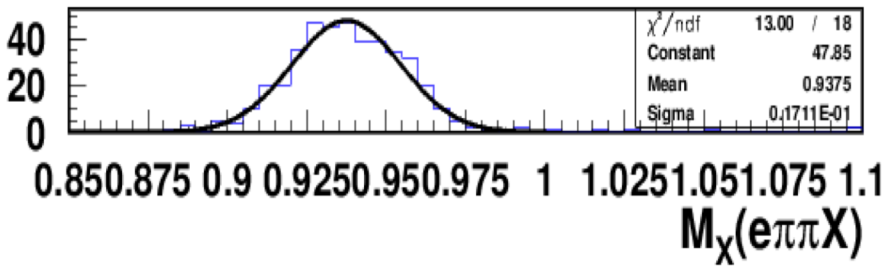


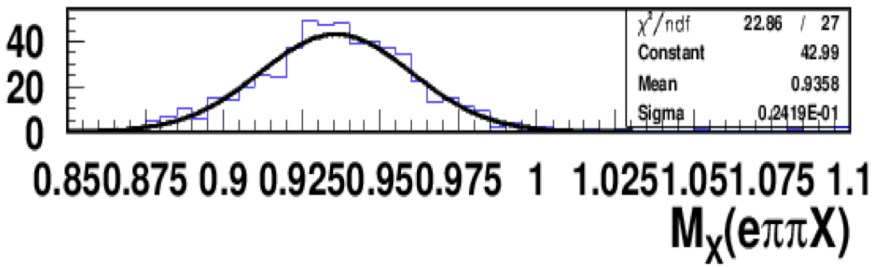
GEMC+Coatjava





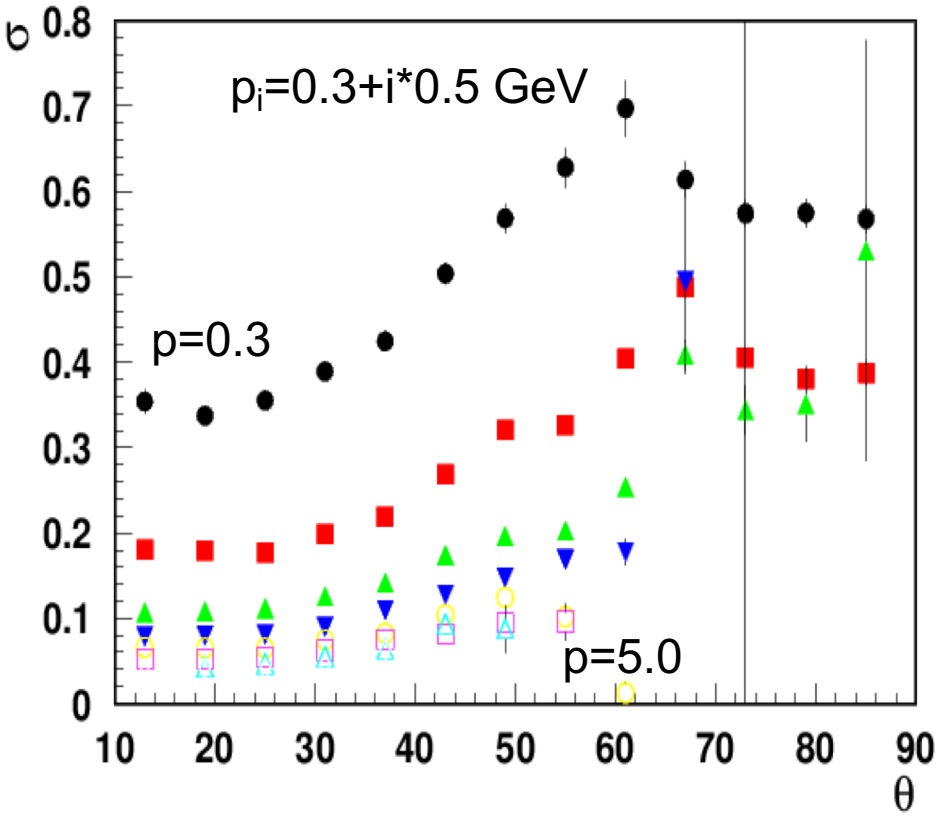
FASTMC (old)

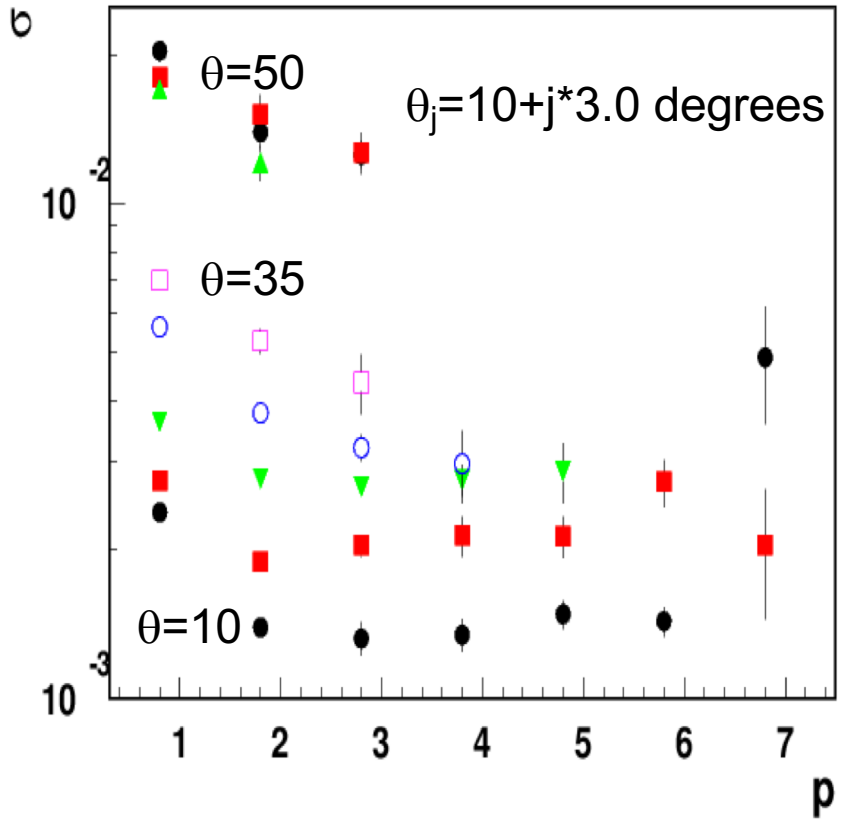




Resolution of FASTMC (specifications) missing mass is worse than gemc and better than in data (~30%)

resolutions from gemc





Resolutions can be fitted by some curves, but in the transition region dependence is complicated

Suggestion: use fine grids with small steps in p,θ,ϕ

Preparing grids for FASTMC

Data on resolutions and energy loss can be prepared in a form of a JSON file to be used by FASTMC

```
"MC-resolutions": "set-SIDIS"
"Torus":"Inbending/Fall-2018 "
"Beam":"10.6 GeV"
"Version":"gemc 4.3.1/coatjava 6.3.1"
"variables":["N"," σΔp","Δσ (Δp)", " σΔθ ",   Δ(σθ) "
    "axis":[
        {"name":"p","bins": 45,"min": 1.0, "max": 10.0, "scale":"lin","description":"momentum"}
        {"name":" θ ","bins": 85,"min":  5.0,"max": 90.0,"scale":"lin","description":"theta angle"
        {"name":" ϕ ","bins": 60,"min":  0.,"max": 60.0,"scale":"lin","description":"phi-angle"}],
```

```
1 1 1 1272 0.0175 0.0135 0.3541 0.0142
1 2 1 1842 0.0532 0.0098 0.3371 0.0092
1 3 1 2525 0.0861 0.0085 0.3555 0.0079
1 4 1 2900 0.0917 0.0085 -0.3892 0.0083
1 5 1 3094 0.1162 0.0150 0.4243 0.0097
1 6 1 3101 0.1223 0.0122 0.5038 0.0126
1 7 1 2995 0.0849 0.0158 0.5683 0.0169
1 8 1 2708 0.0186 0.0186 0.6278 0.0231
1 9 1 2421 -0.1006 0.0241 -0.6969 0.0329
```

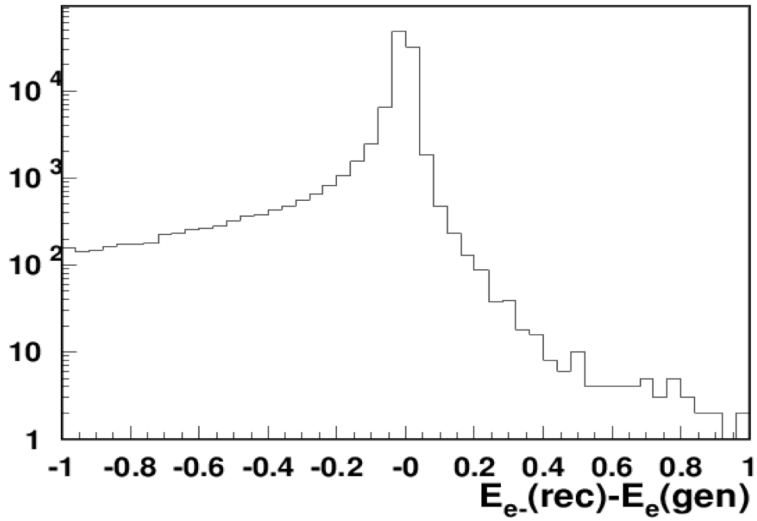
So far SIDIS data was used, single particle gemc events were processed using gemc internal generator

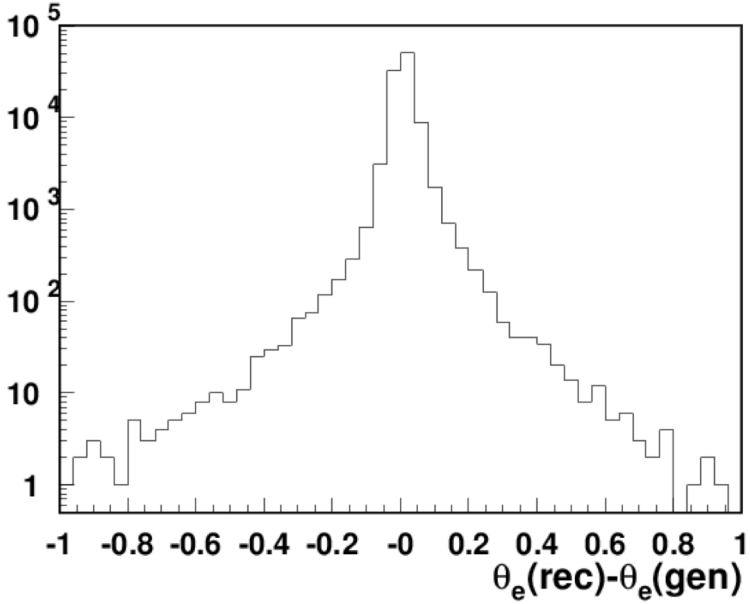
gemc command line for single particles pi+/pi-/proton/ e-

```
-BEAM_P="pi-, 5.0*GeV, 20.0*deg, 180*deg" -SPREAD_P="4.8*GeV, 15*deg, 180*deg" -BEAM_V="(0,0,-3)cm" -SPREAD_V="(0.01,2.5)cm"
```

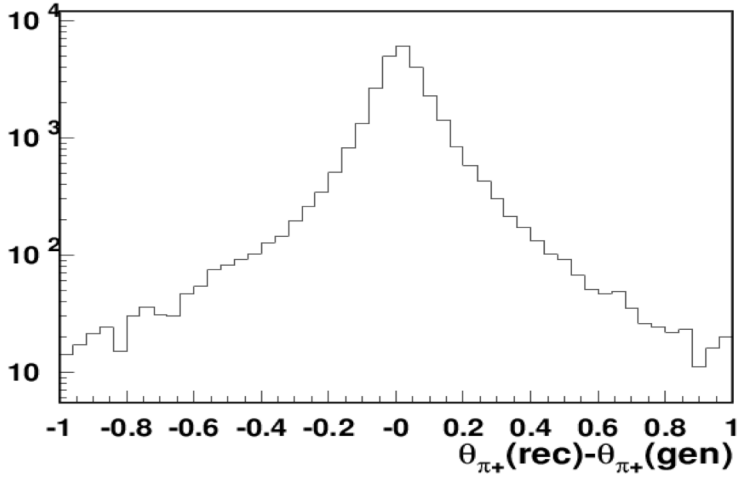
Handling of tails in FASTMC

Look at ep→e'π+π−pX





Tails may be accounted in FASTMC by using q-gauss (Tsallis distributions) instead of Gauss, allowing to simulate tails



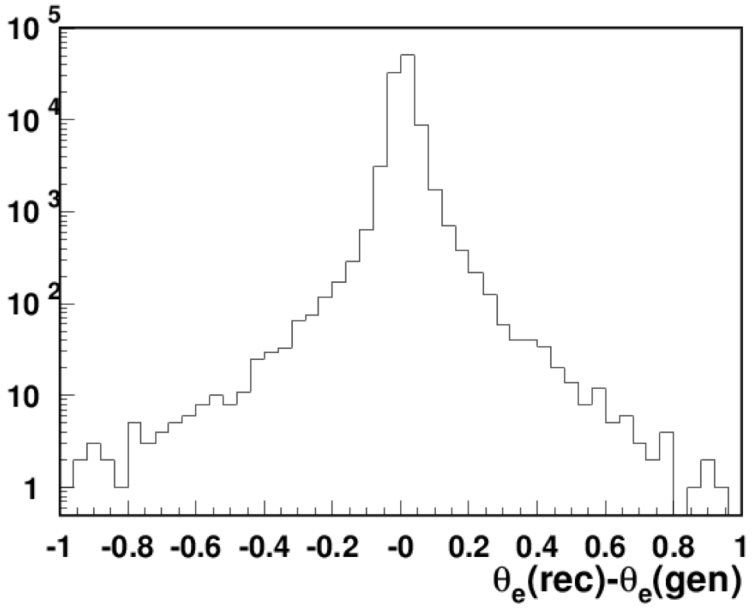
SUMMARY

- Resolutions compared in MC and Data for exclusive ep→e'$\pi\pi$p events
- Resolutions in gemc are more "optimistic" than original specs
- For new fastmc version we may use old parameterizations, or table of values
- Account of tails may be relevant for rare events

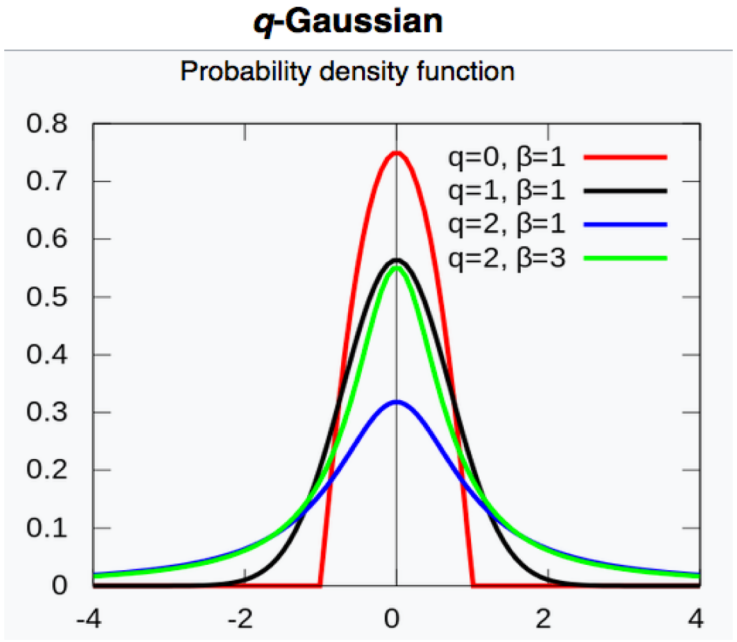
Studies performed with RGA DSTs.
Will need more low lumi runs for efficiency studies

Support slides

q-Gaussian (Tsallis distribution)



The q-Gaussian is a probability distribution arising from the maximization of the Tsallis entropy under appropriate constraints.



$$f(x) = \frac{\sqrt{\beta}}{C_q} e_q(-\beta x^2)$$

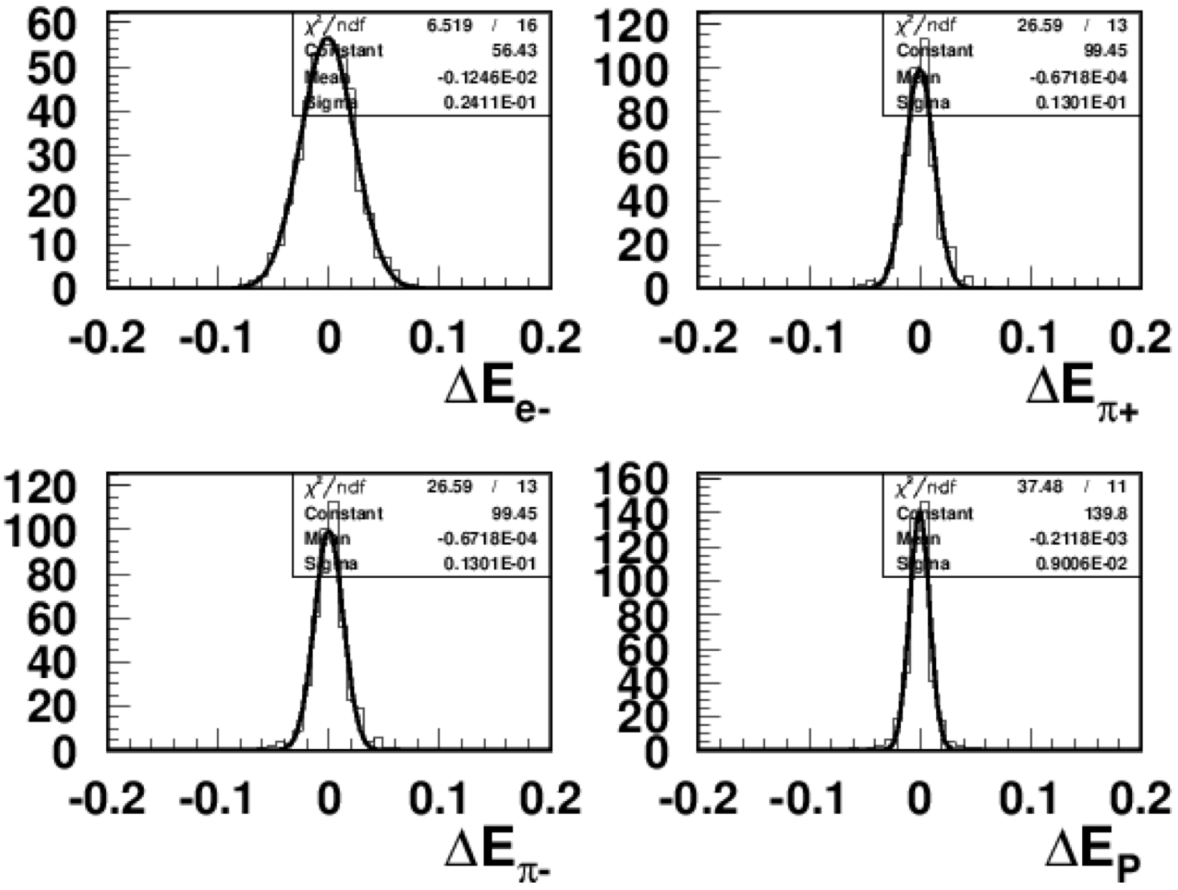
where

$$e_q(x) = [1 + (1-q)x]_+^{\frac{1}{1-q}}$$

The normal distribution is recovered as q → 1.

Contributions to energy shifts from FASTMC

Look at ep→e'π+π−pX



Contributions to energy shifts from FASTMC

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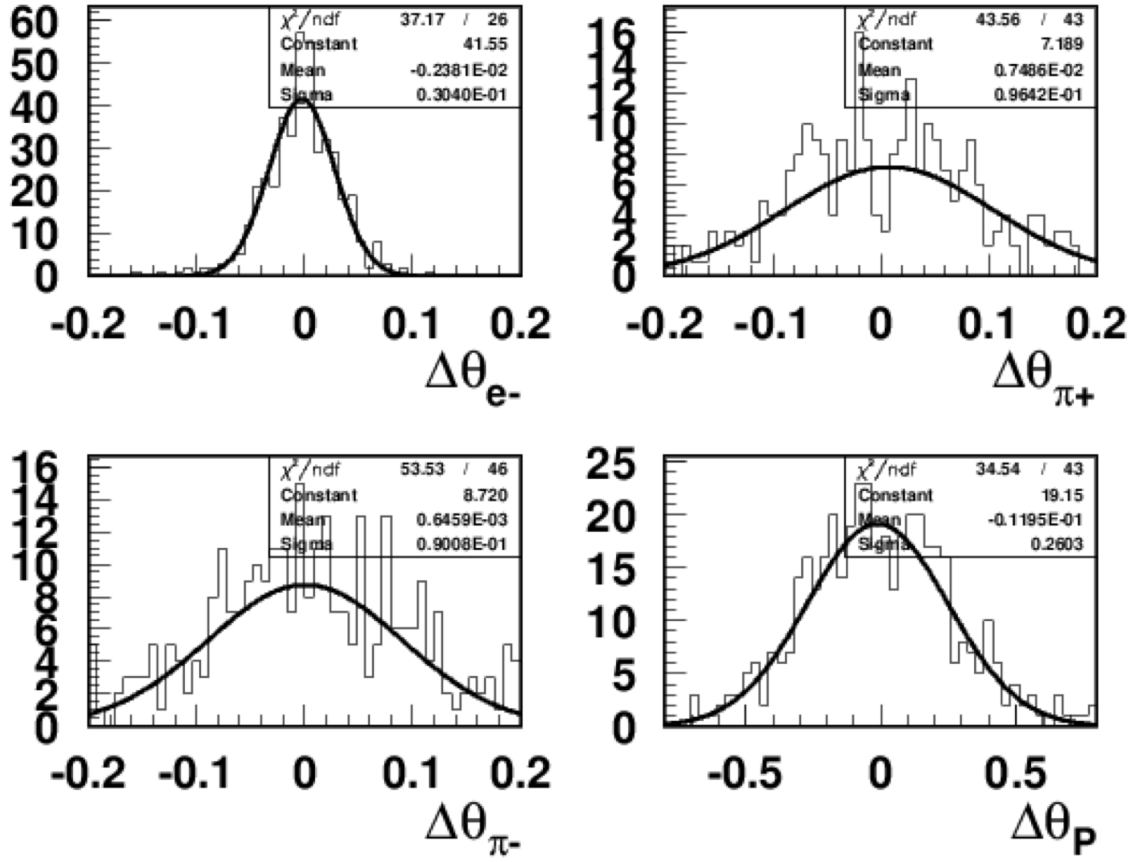
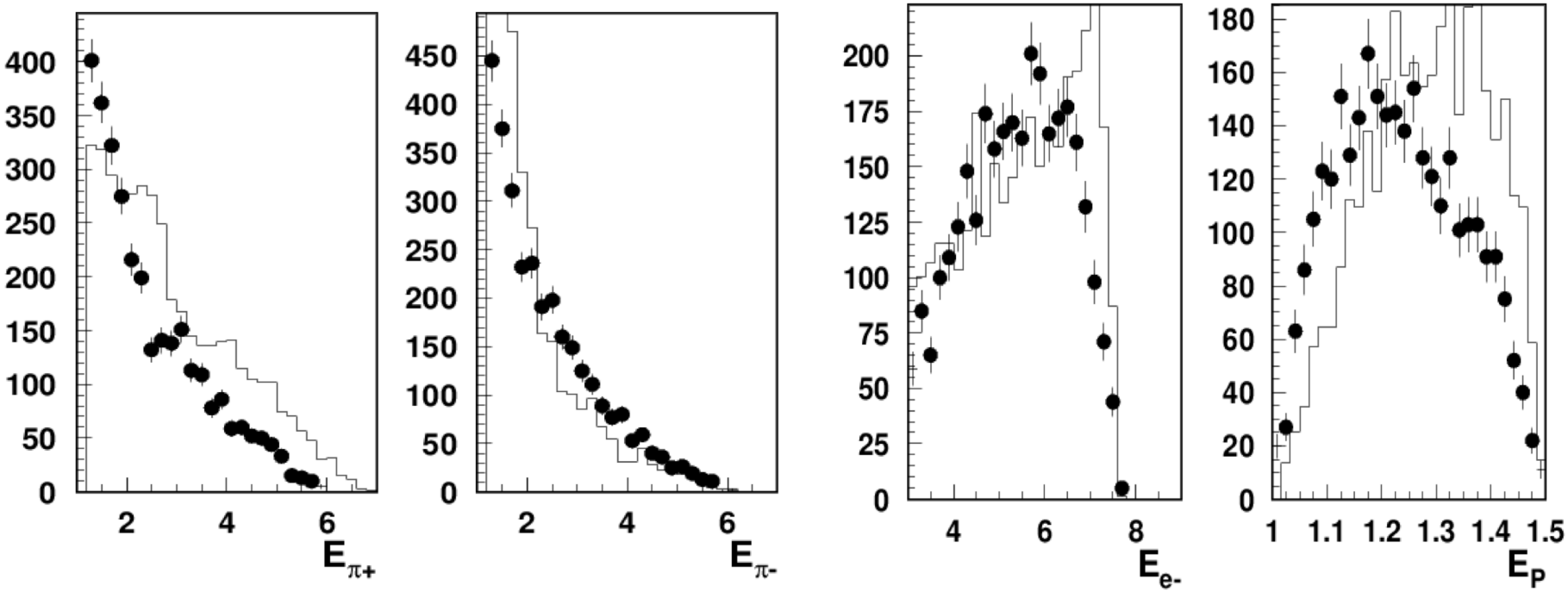


comparing exclusive distributions with MC

ep→e'π+π−pX



LUND MC in principle is not supposed to describe the exclusive events, but the agreement is reasonable

Contributions to energy shifts from gemc

Look at ep→e'$\pi^+\pi^-$pX