Monte Carlo Tools

THaSimpleRay Class

- Originally used to contain Mini-Monte Carlo output for debugging BigBite code
- Now holds information on a single Monte Carlo Track
    - Ray Direction
    - Ray Magnitude (Momentum)
    - Ray Origin
    - Particle ID Info

        Particle Label (e, p, n, π^-, π^+, π^0,Δ), Mass, Charge
    - "Information Valid" Boolean Variables

- Multiple storage/retrieval member functions
    - Ray Direction as TVector3, transport coordinates, spherical coordinates
    - Energy, Mass, Momentum Magnitude

- Kinematics Routines
    - 2 body-> 2body

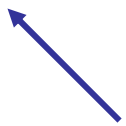
        Lab coords, CM coords
    - Monte Carlo event generation
    - Delta particle mass

Script for Elastic Events

```
THaSimpleRay* rElec1 = new THaSimpleRay(THaSimpleRay::electron,"incident");
THaSimpleRay* rNucleon1 = new THaSimpleRay(THaSimpleRay::proton,"target nucleon");
THaSimpleRay* rElec2= new THaSimpleRay(THaSimpleRay::electron,"secondary");
THaSimpleRay* rNucleon2= new THaSimpleRay(THaSimpleRay::proton,"secondary");

rNucleon1->SetVector(0.,0.,0.);
rElec1->SetVector(0.,0.,BEAM_ENERGY);

for (Int_t i=0; i<10000; i++){
  Int_t err=rElec1->Kin22r( rNucleon1, rElec2, rNucleon2,
                BB_THETA,  BB_DELTA_THETA,  BB_PHI,  BB_DELTA_PHI);
  rElec2->PrintRay("Scattered Electron");
}
```



BigBite central ray and acceptance

Weighted histograms should be used

Weight= (elastic cross section) / (central-ray cross section)

Π Production Events

Add line to select new delta mass for each event

```
for (Int_t i=0; i<10000; i++){
  rNucleon2->SetParticle(THaSimpleRay:delta_p);
  Int_t err=rElec1->Kin22r( rNucleon1, rElec2, rNucleon2,
                BB_THETA,  BB_DELTA_THETA,  BB_PHI,  BB_DELTA_PHI);
  rElec2->PrintRay("Scattered Electron");
}
```

Populates phase space with roughly correct distribution.
Need to fill histograms weighted by correct cross section.

Monte Carlo Tools

TPiProduction Class

- Produces Pion Production Cross Sections based on MAID
- ep$\rightarrow$ e' π^0 p, ep$\rightarrow$ e' π^+ n
- en$\rightarrow$ e' π^0 n, en$\rightarrow$ e' π^- p

- 5-fold differential cross sections
  - Electron energy, direction, pion direction

$$\frac{d^5\sigma}{dE_{e'}d\Omega_{e'}d\Omega_{\pi}}$$

Needed for n-detector tagged events

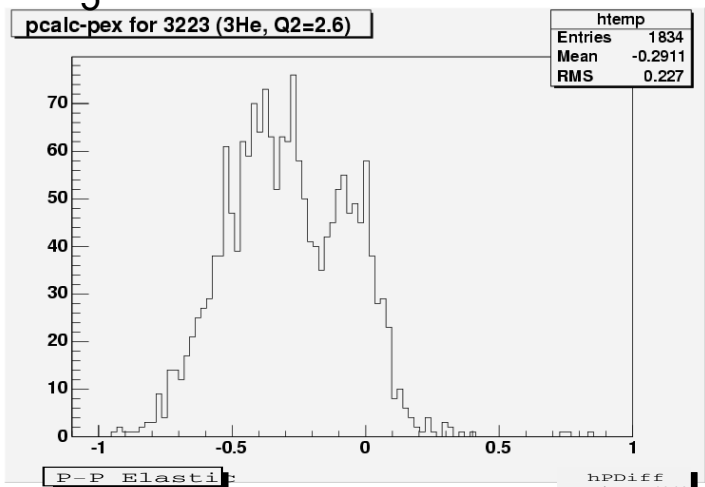
- 3-fold differential cross sections
  - Integrated over pion direction

$$\frac{d^3\sigma}{dE_{e'}d\Omega_{e'}}$$

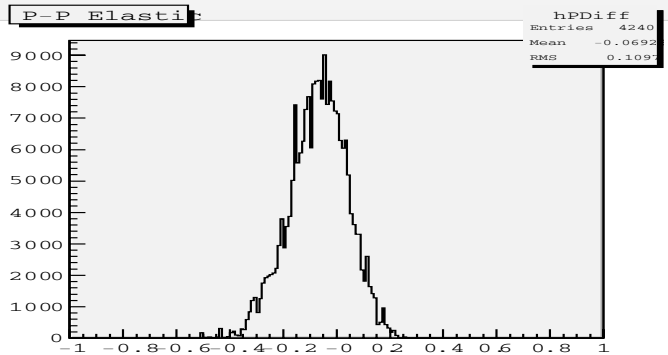
Good for single-arm events

P-P elastic

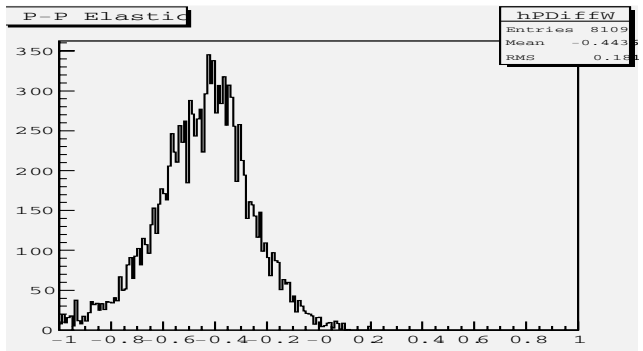
Shige Tajima's Q^2 = 2.6 GeV^2



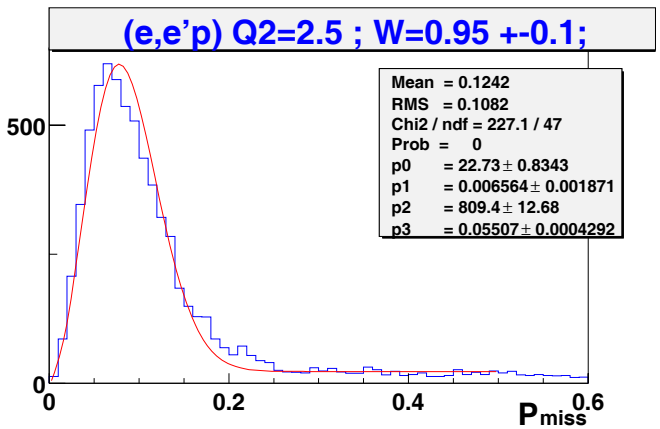
^{3}He Mini Monte QF events

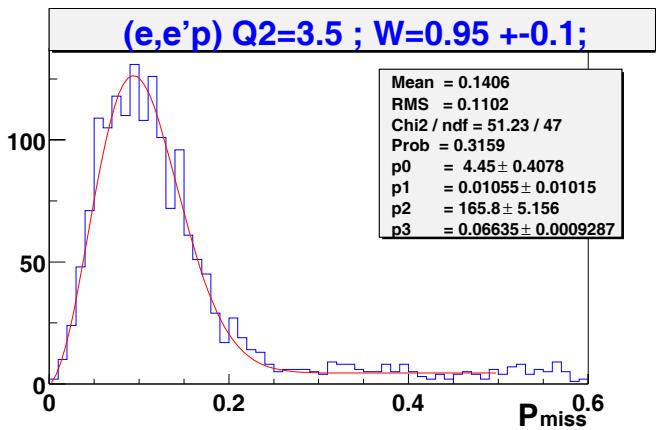


^{3}He Mini Monte Delta events (first version) No Cuts

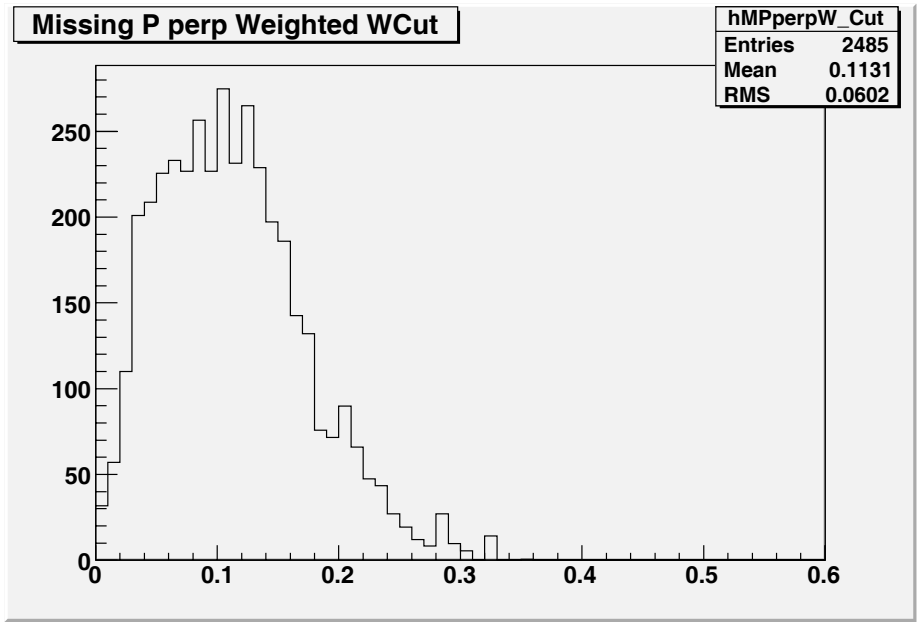


Missing P_{perp}



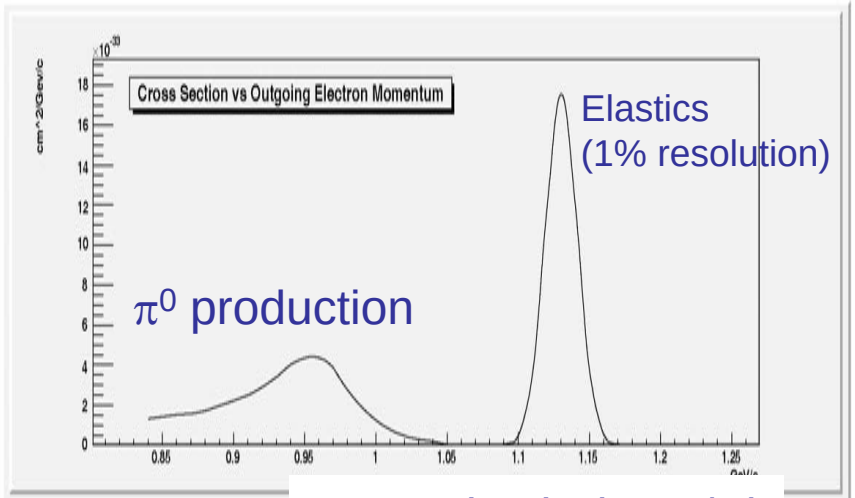


Data (from Gen proposal)

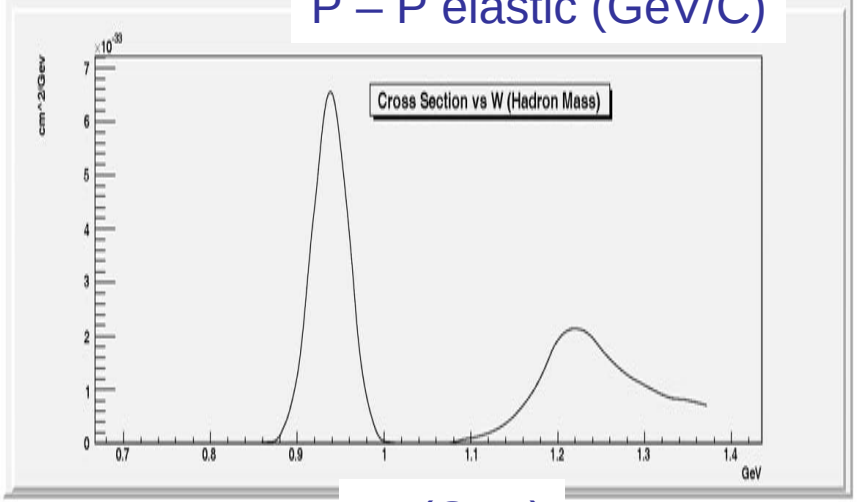


^{3}He Mini Monte

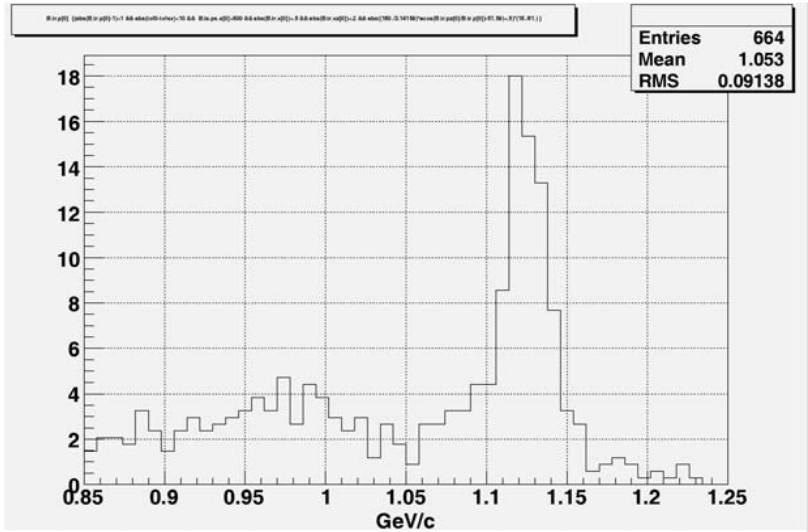
Pion Production + Elastics



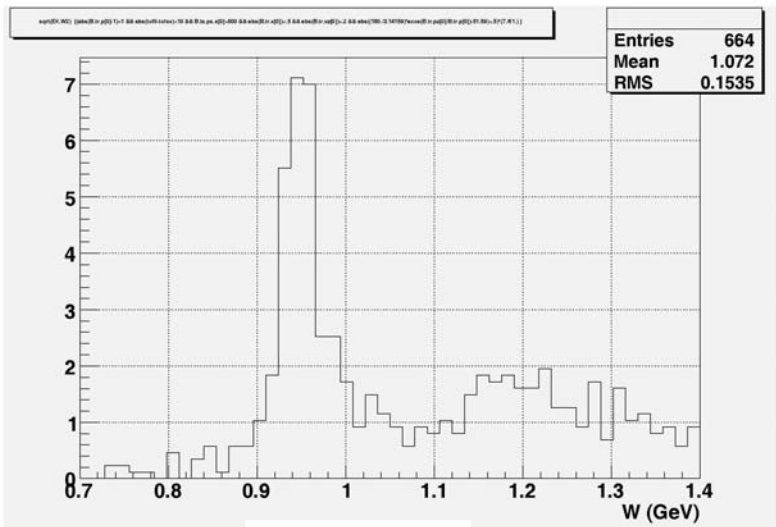
P – P elastic (GeV/C)



W (GeV)



P – P elastic (GeV/C)



W (GeV)

Radiative Correction