Progress Report
Fall Quarter 2009

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Outline

- Project
- UrQMD Simulation
- Root
- Plots
- Outlook

Project: Low Energy Collisions

- Nuclear Matter
  - Study the Equation of State
    - QGP?
  - Investigate Phase Transition
    - First or Second Order Transitions
    - Critical Point
- Distinguishing Collisions from Background
  - Collisions with the beampipe material, Al
  - What distributions of eta and phi will we see?
  - Can we distinguish Au+Au from Au+Al?

UrQMD

- Ultra-relativistic Quantum Molecular Dynamics
- Used to study
  - Hadron-Hadron
  - Hadron-Nucleus
  - Heavy Ion
- Uses propagation of color strings, constituent quarks and diquarks, and mesonic and baryonic degrees of freedom to model interactions

UrQMD

- Sample Input and Output Files
- Still Learning All the Output Data
  - 4-momentum
  - 4-position
  - Charge, mass, particle type
- Made Simulations of Both Au+Au and Au+Al

```
pro 197 79
tar 27  13

nev 5000
imp -11.5

ene 12.5
tim 200 200

eos 0

xxx
```

```
 UQMD   version:      20030   1000  20030  output_file  14
projectile:  (mass, char)  197  79   target:  (mass, char)   27  13
transformation betas (NN,lab,pro)     0.0000000  0.9324724 -0.9324724
impact_parameter_real/min/max(fm):   10.03  0.00 11.50  total_cross_section(mbarn):    4154.76
equation_of_state:    0  E_lab(GeV/u): 0.1250E+02  sqrt(s)(GeV): 0.5193E+01  p_lab(GeV/u): 0.1341E+02
event#        1 random seed:  1258831269 (auto)   total_time(fm/c):      200 Delta(t)_O(fm/c):      200.000
op  0    0    0    0    1    0    0    0    0    0    0    0    0    0    0    0
op  0    0    0    0    0    0    1    0    1    0    0    0    0    2    1
op  0    0    0    1    1    0    0    0    0    0    0    0    0    1    0
pa 0.1000E+01  0.5200E+00  0.2000E+01  0.3000E+00  0.0000E+00  0.3700E+00  0.0000E+00  0.9300E-01  0.3500E+00  0.2500E+00  0.0000E+00  0.5000E+00
pa 0.2700E+00  0.4900E+00  0.2700E+00  0.1000E+01  0.1600E+01  0.8500E+00  0.1550E+01  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
pa 0.9000E+00  0.5000E+02  0.1000E+01  0.1000E+01  0.1000E+01  0.1500E+01  0.1600E+01  0.0000E+00  0.2500E+01  0.1000E+00  0.3000E+01  0.2750E+00
pa 0.4200E+00  0.1080E+01  0.8000E+00  0.5000E+00  0.0000E+00  0.5500E+00  0.5000E+01  0.8000E+00  0.5000E+00  0.8000E+06  0.1000E+01  0.2000E+01
pvec: r0          rx          ry          rz          p0          px          py          pz          m        ityp 2i3 chg lcl#  ncl or
 230 200
    47     29     13      5     10     13      0      0
 0.20000000E+03 0.18379887E+01 -0.38382241E+01 0.18645556E+03 0.26839229E+01 0.37113327E-01 0.11344383E+00 0.25177674E+01 0.92197745E+00       1  1  1      0   0   0
 0.20000000E+03 0.81370345E+01 -0.74045467E+00 0.18542144E+03 0.21386647E+01 0.16028859E+00 0.46906646E-01 0.19365362E+01 0.89208816E+00       1  1  1      0   0   0
 0.20000000E+03 0.17651760E+01 -0.22018337E+01 0.18656266E+03 0.30625942E+01 0.48354269E-01 -0.19825725E-01 0.29224682E+01 0.91429280E+00       1  1  1      0   0   0
 0.20000000E+03 0.30327617E+01 -0.10249801E+02 0.18498255E+03 0.29245236E+01 -0.28735848E-01 -0.15820413E+00 0.27653463E+01 0.93800002E+00       1  1  1    180   1   0
```

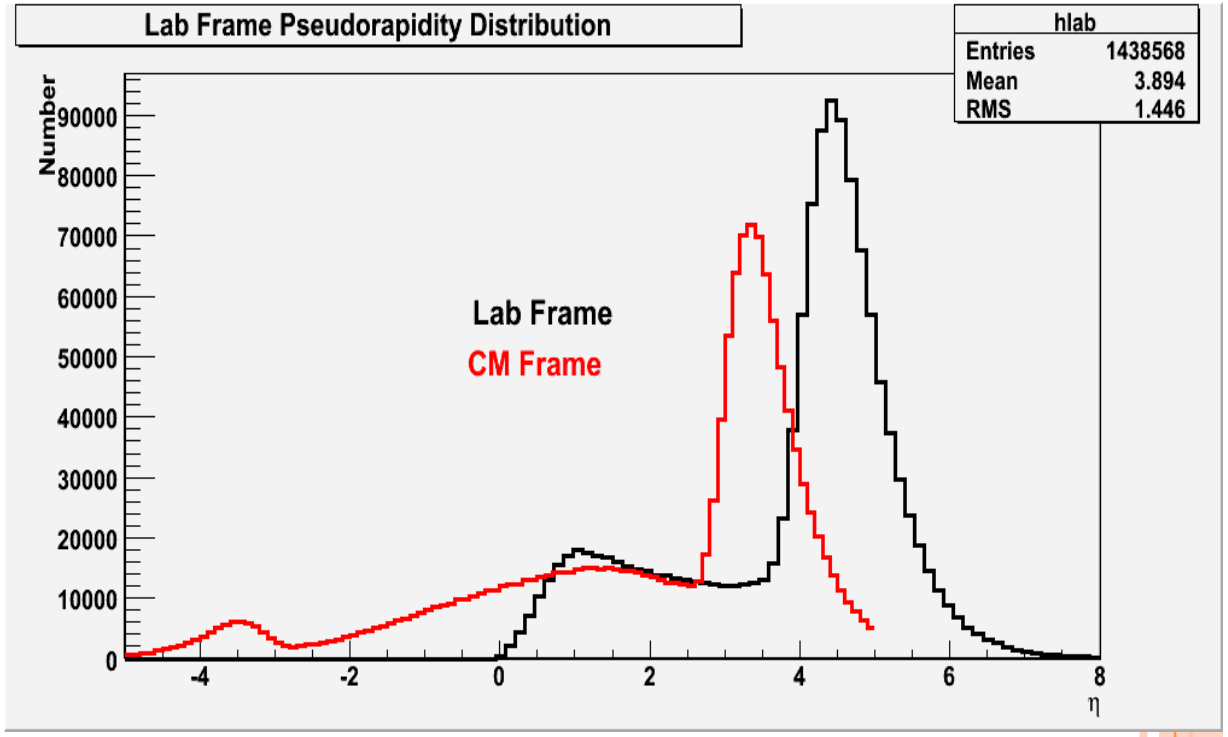
ROOT

- Using a Macro to Analyze UrQMD output file
  - First converting .f14 to .root
- In Loop Over Events
  - Adding in Center of Mass Frame Pseudorapidity calculation
  - Calculations to Shift to Lab Frame
- Section of code:

```
cout << "Event: " << Nevents <<endl;
                }
                //New Track
                double tot_momentum = sqrt(px*px + py*py + pz*pz);
                h->Fill(0.5*log((tot_momentum + pz)/(tot_momentum - pz)));
                double rapidity = 0.5*log((energy + pz)/(energy - pz));
                double lab_rapidity = rapidity + rapidity_trans;
                double m_trans = sqrt(energy*energy - pz*pz);
                double energy_lab = 0;//get this taken care of
                double momentum_lab = tot_momentum*energy/nucleon_mass;
                double k = (exp(2*lab_rapidity) - 1)/(exp(2*lab_rapidity) + 1);
                double pz_lab = energy_lab*k;
                hlab->Fill(0.5*log((momentum_lab + pz_lab)/(momentum_lab - pz_lab)));
```

Plots

- Incorrect Plot
  - Sign of p_z



- Correct Plot?
  - Of course. Just not yet.
  - Issue with the code.

Outlook

- Algorithm at Level 2 Trigger
  - Distinguish between Au+Al background and Au+Au collisions