Center of Momentum Reference Frame using LH2_58_pass4e

Shannon Ray
Wichita State University

- Check detector response by transforming proton – proton collisions in the center of momentum reference frame.
- In the CM frame momentum of post collision particles should be symmetric about the x-y plane. Assuming c = 1.

Before transformation

$$P_{beam,lab} = (0,0,P_z,E_{lab})$$

$$P_{target,lab} = (0,0,0,M_{proton})$$

After transformation

$$P_{beam,CM} = (0,0,P_z',E_{CM})$$

$$P_{target,CM} = (0,0,-P_z',E_{CM})$$

The net momentum in the center of momentum reference is defined as zero.

$$P_z' + (-P_z') = 0$$

- Applying Lorentz transform in the CM frame I get

$$P_z' = \gamma (P_z + \beta E_{lab})$$

$$-P_z' = \gamma (0 + \beta m)$$

Solving for beta we get

$$\beta = \frac{-P_z}{m_{proton} + E_{lab}} \qquad \gamma = \frac{1}{\sqrt{1-\beta^2}}$$

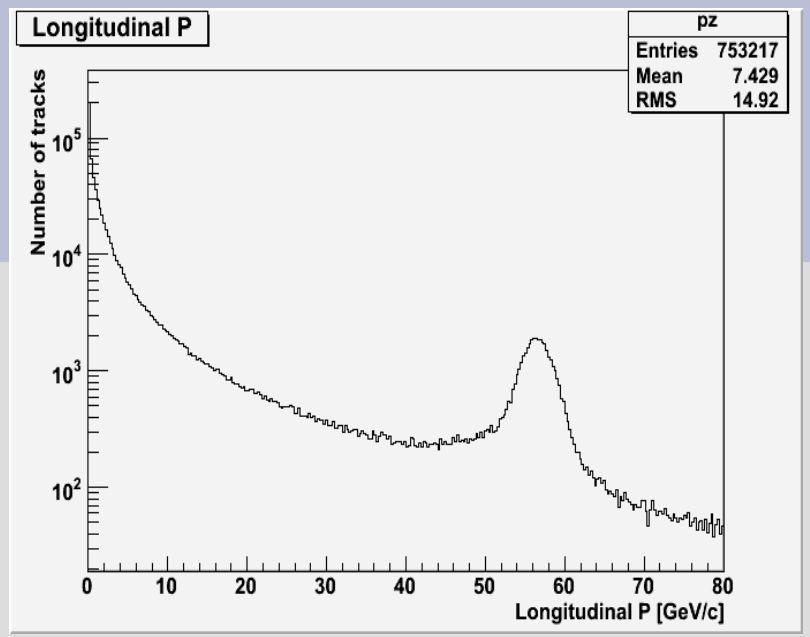
Transformation used in LH2CM.cc code

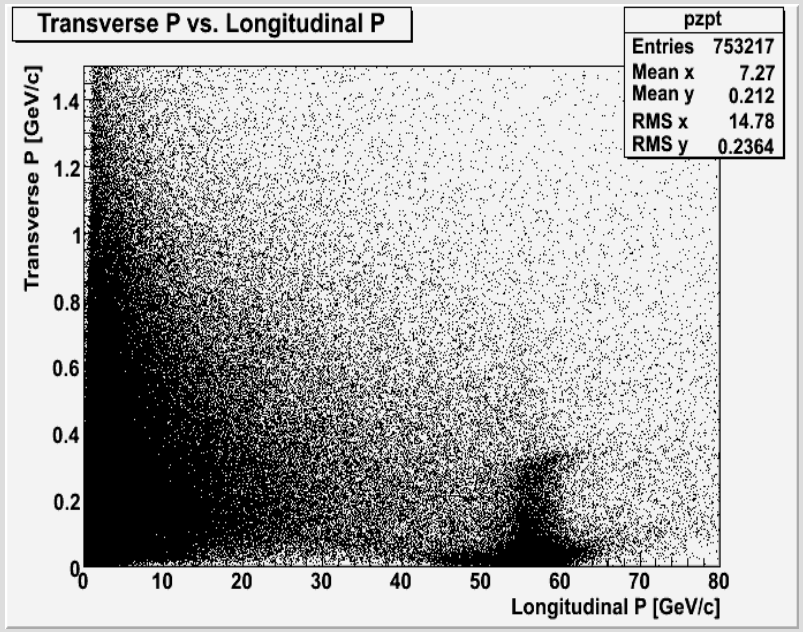
$$\begin{bmatrix} Px' \\ Py' \\ Pz' \\ E' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \gamma & \gamma\beta \\ 0 & 0 & \gamma\beta & \gamma \end{bmatrix} \begin{bmatrix} Px \\ Py \\ Pz \\ E \end{bmatrix}$$

Cuts used
-Events with more than one incident beam.
-Events with no reconstructed tracks.
-Events with zero incident beams.
-Beams that are not protons.
-Beams where the PID is undefined.

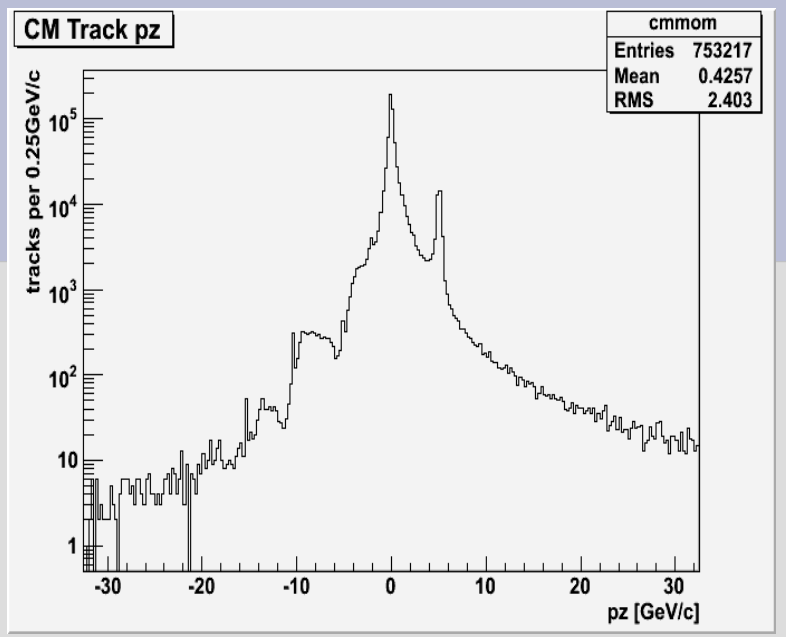
Max likelihood are used for particle track identification.

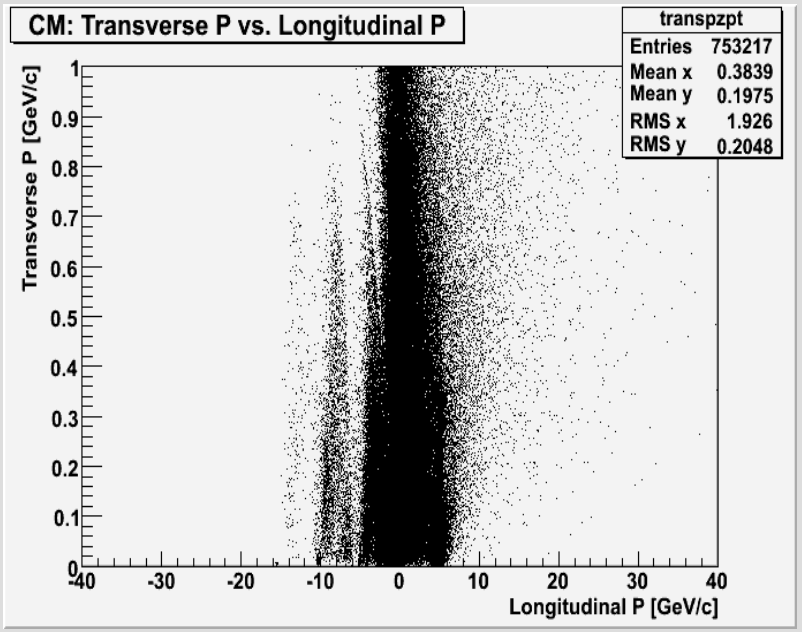
Momentum before transformation





Momentum after transformation





Summary

-Look at proton proton collisions in the CM frame to check response of MIPP detector.

-Transformation in CM frame gives promising results with longitudinal momentum symmetric about zero.

-Future plan of applying acceptance using Monte Carlo.

-Next step get cross section results and compare with past experiments.