Simulation on ΛP Scattering

By Bishnu Pandey
Hampton University/Jlab
Advisor: Dr. Liguang Tang
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Outlines

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- Kinematics
- Result
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Introduction

The Λ particle was discovered in early 1950s but until today we don't have sufficient data to explain ΛP interaction.

The old data's are not sufficient enough to the nuclear Lambda model.

ΛN interaction is missing piece.

Purpose

- The purpose is to separate the recoil proton scattered by Λ particle from that produced from Λ decay.

Kinematics

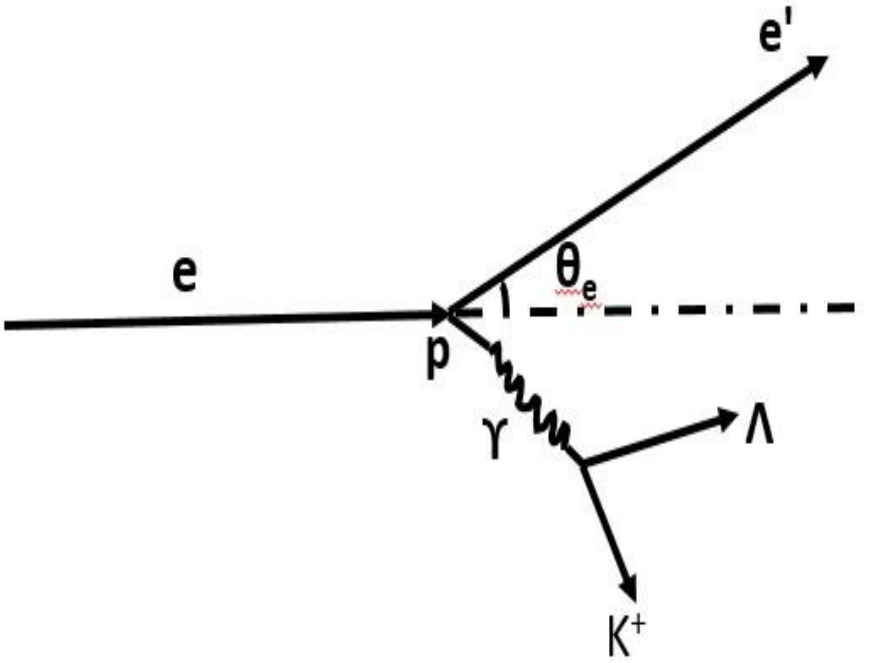
- An electron beam with fixed beam energy E = 4.524 GeV is incident on a proton target at rest.
- This will produce a virtual photon and then a Λ particle.
- The produced Λ particle either scattered or decay. It may decay before scattering or after scattering.
- Both the cases proton from decay of Λ particle is the background.
- Up to this point we will have the momentum and angle of proton.

i. Production of Λ particle

$e+P = e' + \Lambda + k^+$

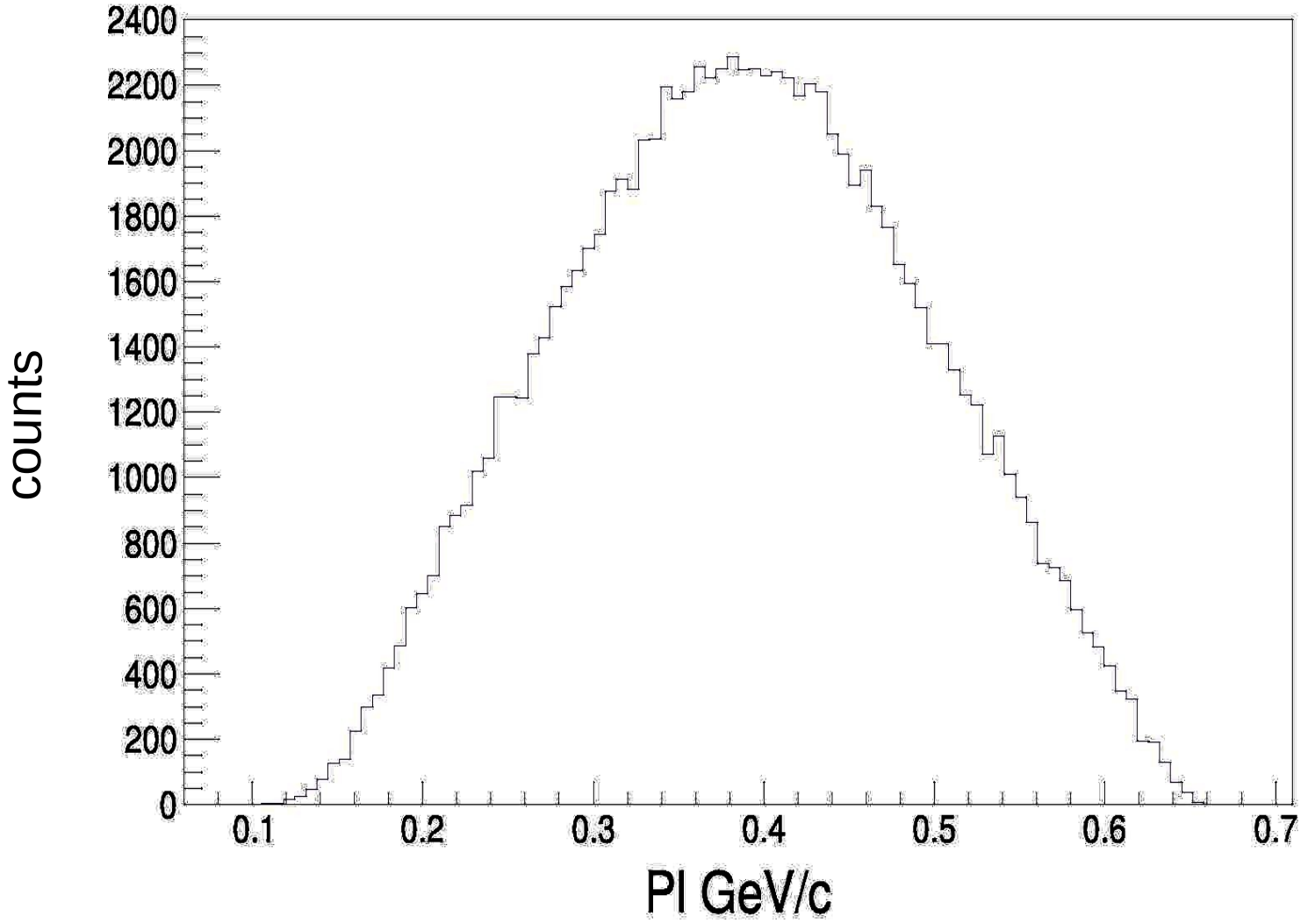
$\mathbf{P_e = P_{e'} + P_{\Lambda} + P_{k+}}$

$\mathbf{P_{\Lambda} = P_e - P_{e'} - P_{k+}}$



Where Momentum of k^+ is given in the range 1.05 GeV/c to 1.35 GeV/c

Momentum of Λ Particle

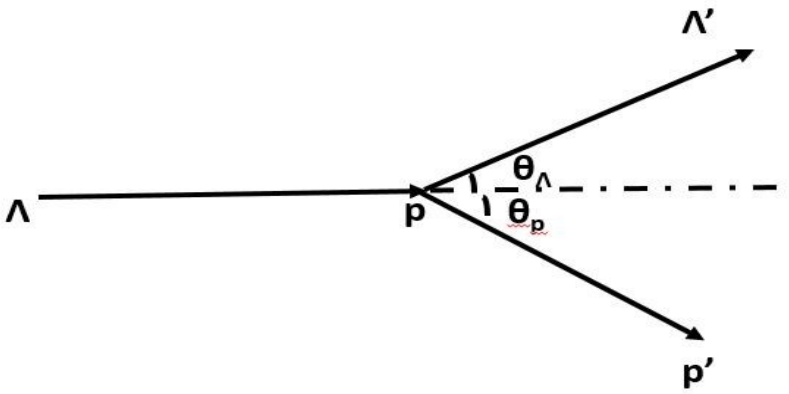


ii. Elastic Scattering

$\Lambda + P = \Lambda' + P'$

$\mathbf{P_\Lambda + P_p = P_{\Lambda'} + P_{p'}}$

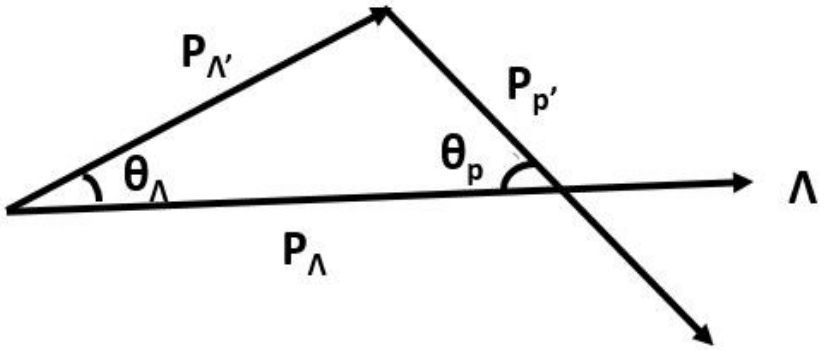
$E_\Lambda + E_P = E_{\Lambda'} + E_{P'}$



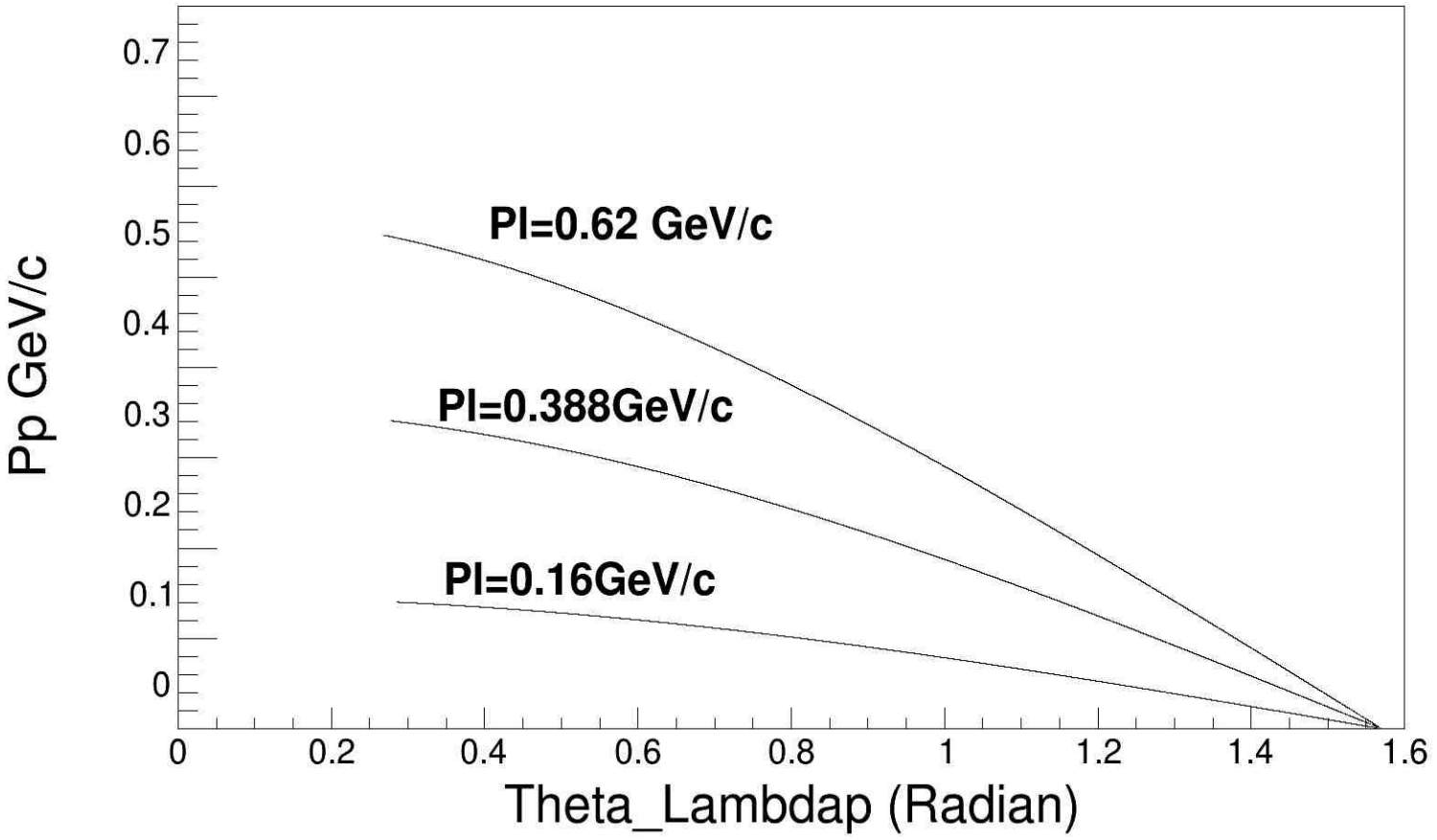
Here, momentum of scattered lambda (Λ') particle is calculated.

By using the Cosine law, momentum of scattered proton is calculated.

$$P_{p'}^2 = P_\Lambda^2 + P_{\Lambda'}^2 - 2P_\Lambda P_{\Lambda'} \cos\theta$$

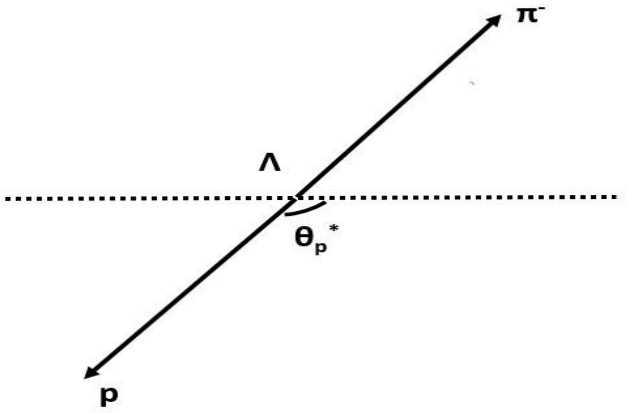


Proton momentum Vs proton angle(Elastic Scattering)



iii. Decay of Λ particle

Center of mass frame

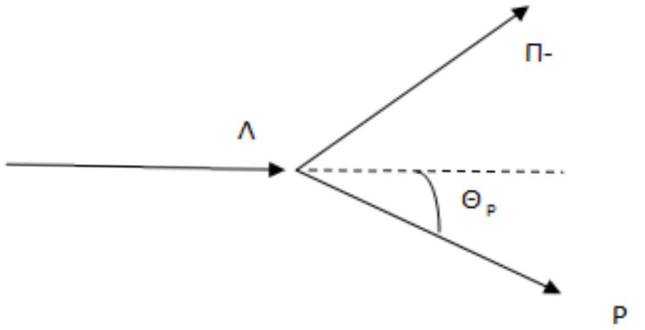


$$E_{\Lambda}^{*} = \frac{m_{\Lambda}^{2} + m_{P}^{2} - m_{\pi}^{2}}{2m_{\Lambda}}$$

$$P_{\Lambda}^{*} = \sqrt{E_{p}^{*} - m_{p}^{2}}$$

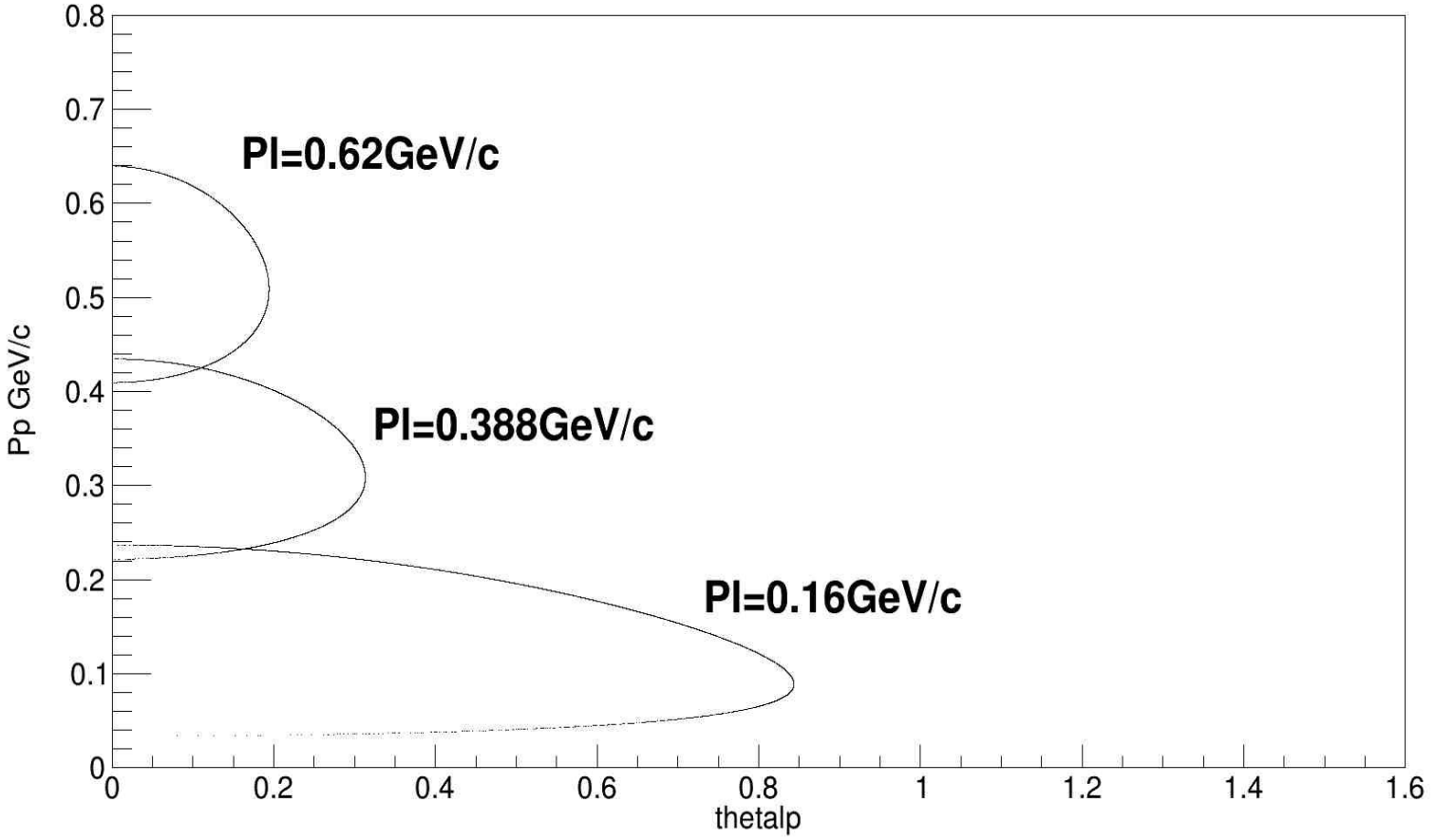
By Lorentz transformation the center of mass momentum is changed in to lab momentum.

Lab Frame



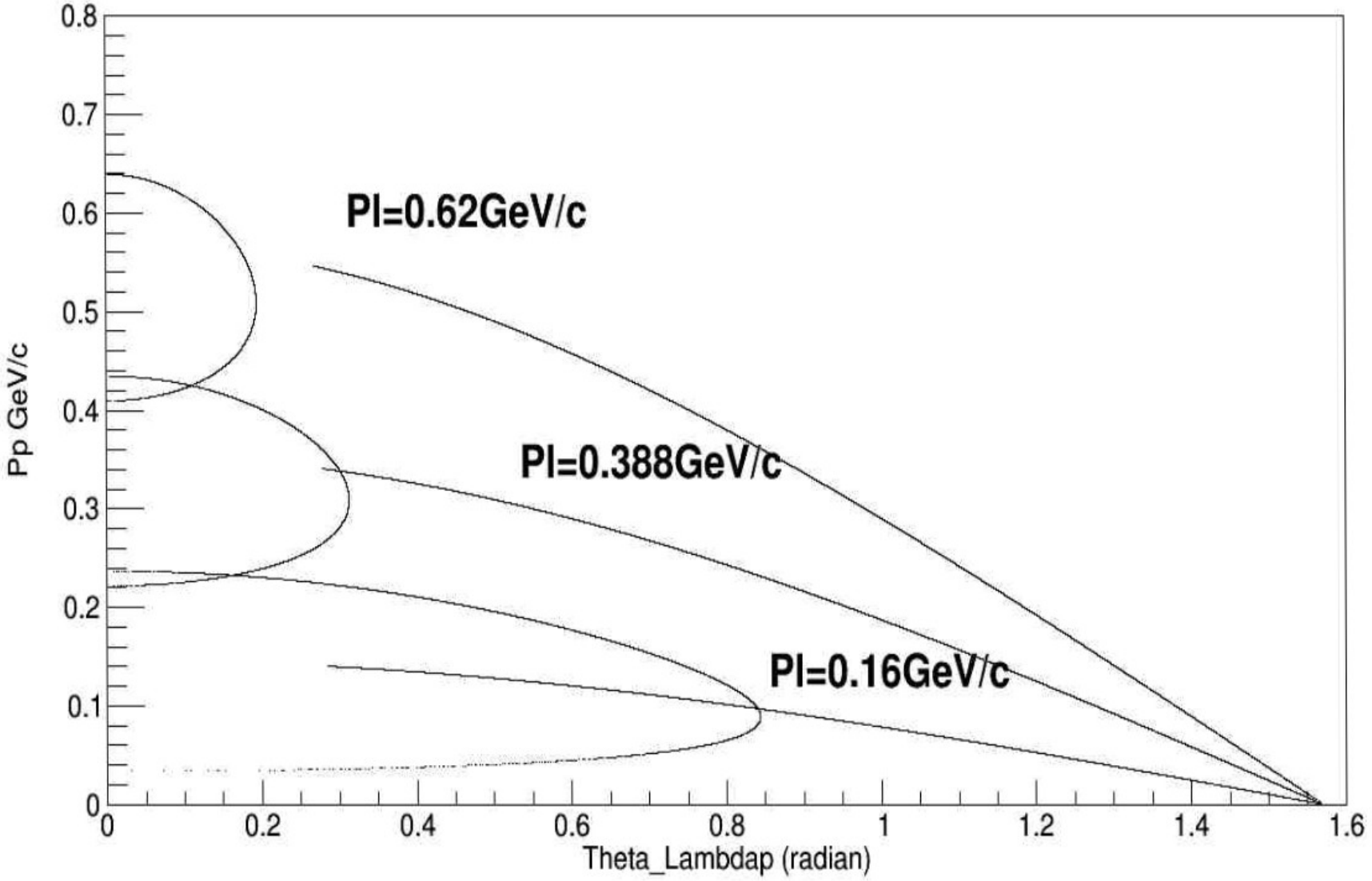
$$P_{p} = \sqrt{P_{L}^{2} + P_{T}^{2}}$$

Proton momentum Vs proton angle(Lambda Decay)



Result

Elastic Scattering Vs Decay



Conclusion

- From this simulation, we can proceed the experiment.

Future Work

Λ N interaction

Thank You