Inelastic Background study

Q^2=8.54GeV^2

--GEP-3 collaboration

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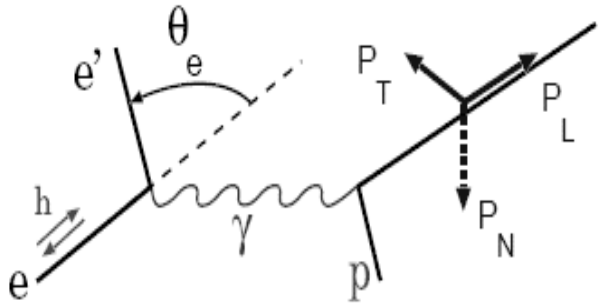
Outline

- Introduction
- π° events identification at BigCal
- Focal plane Inelastic background correction at $Q^2=8.54GeV^2$
- Focal plane asymmetry when ID π° events at BigCal
- Conclusion

Introduction

GEp interested reaction: $\vec{e} + p \rightarrow e' + \vec{p}$



Elastic cuts:
- **HMS ~ BigCal correlation**
- **HMS momentum**
- **Missing Energy**
- **Target walls**

What's in the background?

With the coincidence trigger of BigCal and HMS, we eliminated most of the other reaction. Reactions may pass our trigger are photon production reactions, like

$$\vec{\gamma} + p \rightarrow \pi^0 + \vec{p}$$
$$\hookrightarrow \gamma + \gamma$$

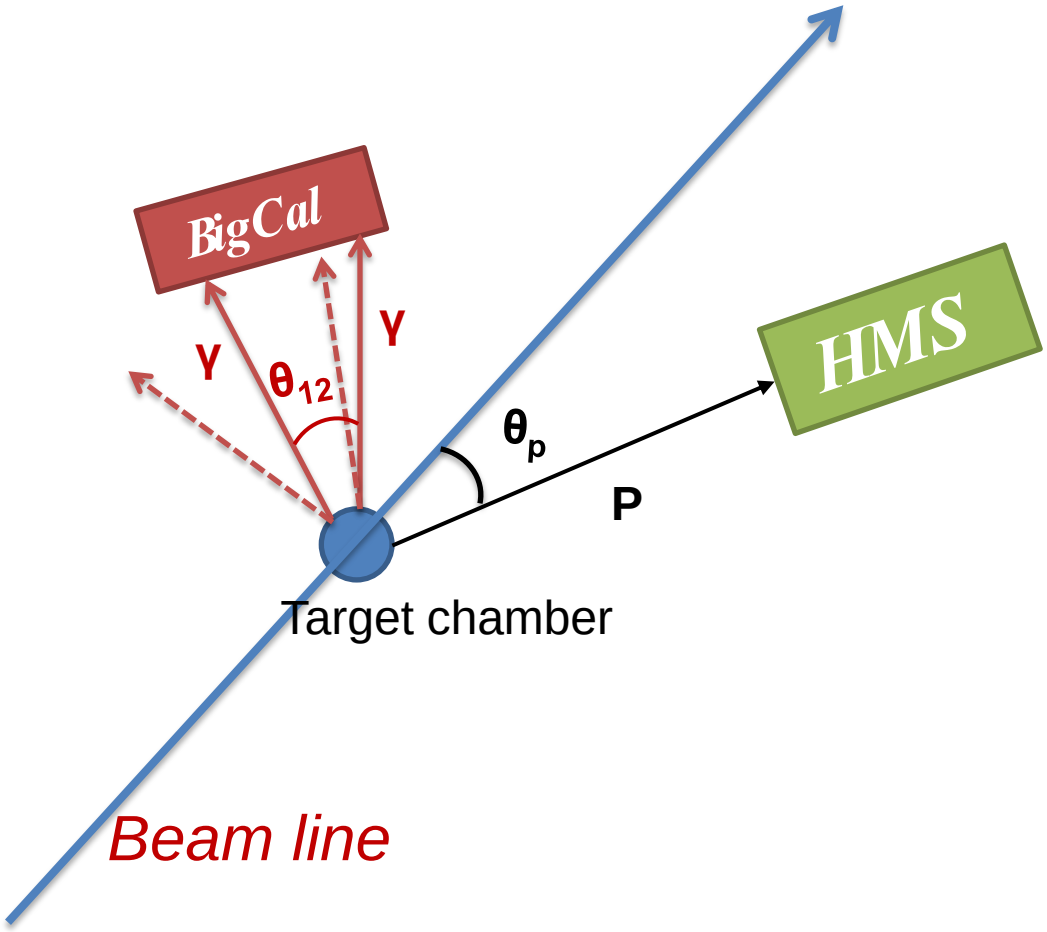
Most of events will NOT pass the HMS ~ BigCal correlation cut

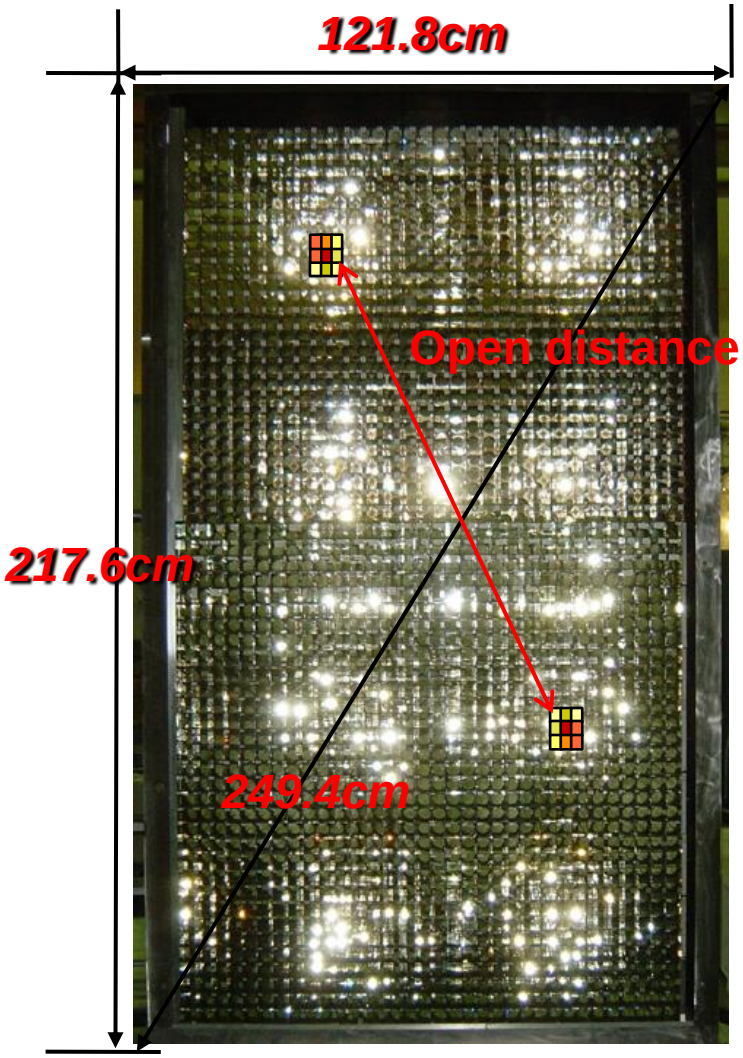
$$\vec{\gamma} + p \rightarrow \gamma' + \vec{p}$$

Cross section much smaller than the π° production
Will pass all the correlation cuts

π° events identification at BigCal

- Kinematics of π° production

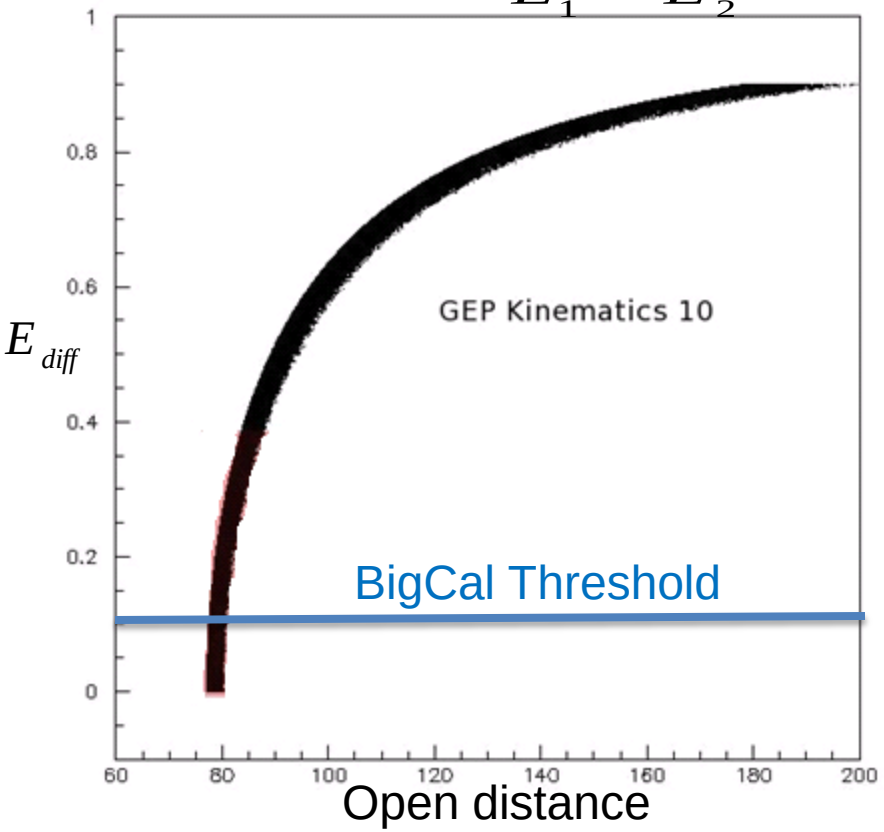




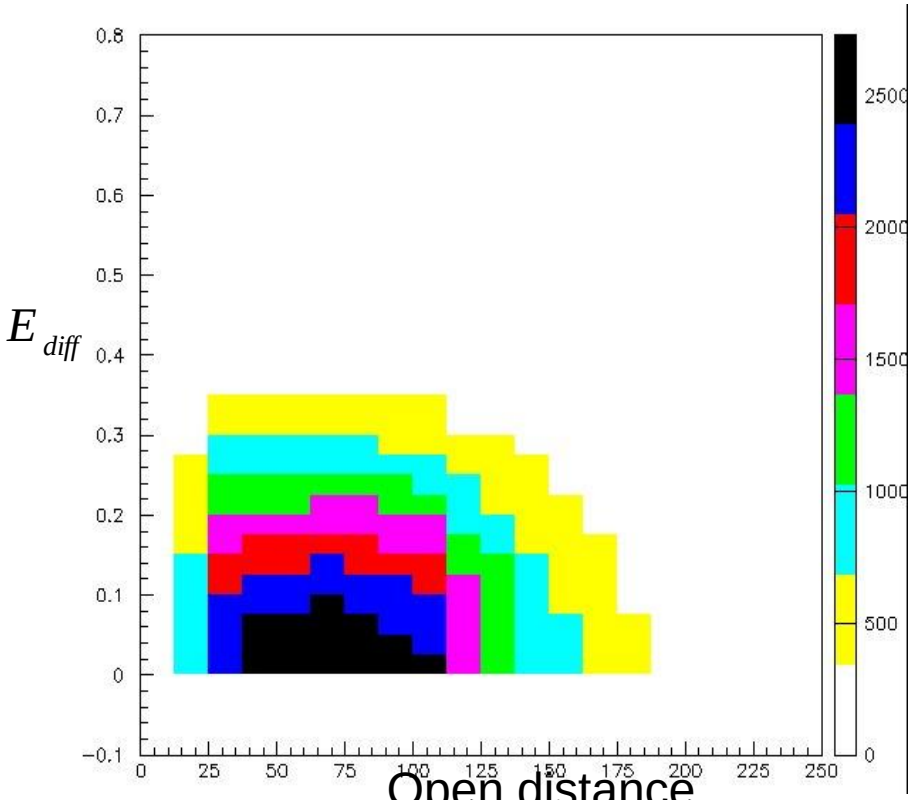
Simulation and data comparison Q^2=8.54GeV^2

Simulation of π° decay on BigCal (assuming π° energy is the same as elastic electron)

$$E_{diff} = \frac{|E_1 - E_2|}{E_1 + E_2}$$



Data of two clusters found on BigCal (Threshold was set high and rejected most of large E_{diff} events)



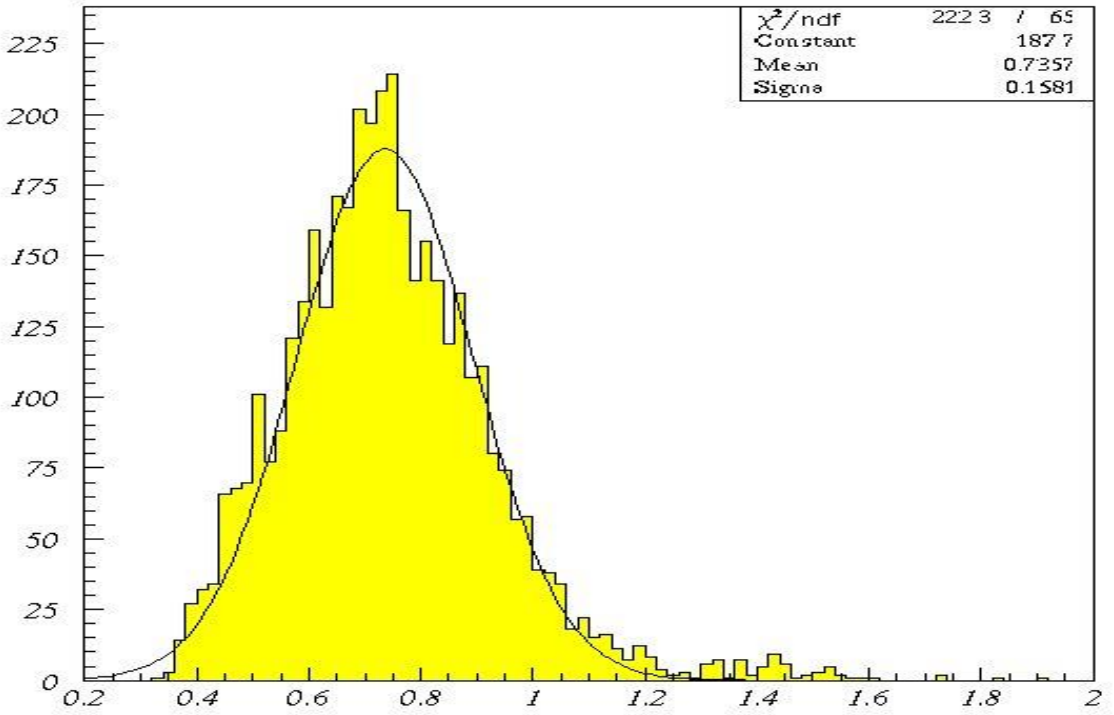
π° events identification at BigCal

π° mass reconstruction:

$$m_{\pi^o} = \sqrt{2E_1E_2(1-\cos(\theta_{12}))}$$

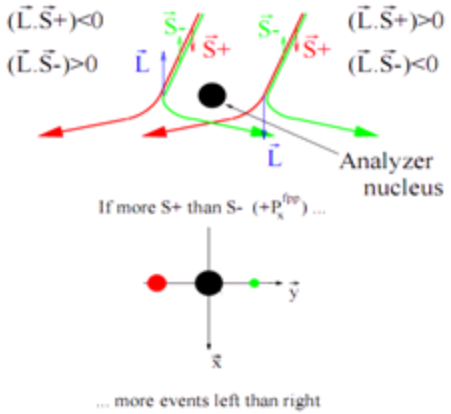
The gain and energy resolution of BigCal calculated by π° are almost the same as using elastic electron.

Within the BigCal acceptance we can identify two photons decayed from π° only at Q^2=8.54GeV^2 and Q^2=2.5GeV^2(lowest ϵ)



$m_{\pi 0}$ / 0.135

Asymmetry at FPP



$f^{\pm}(\theta,\varphi)$ is the azimuthally distribution with two beam helicity state;

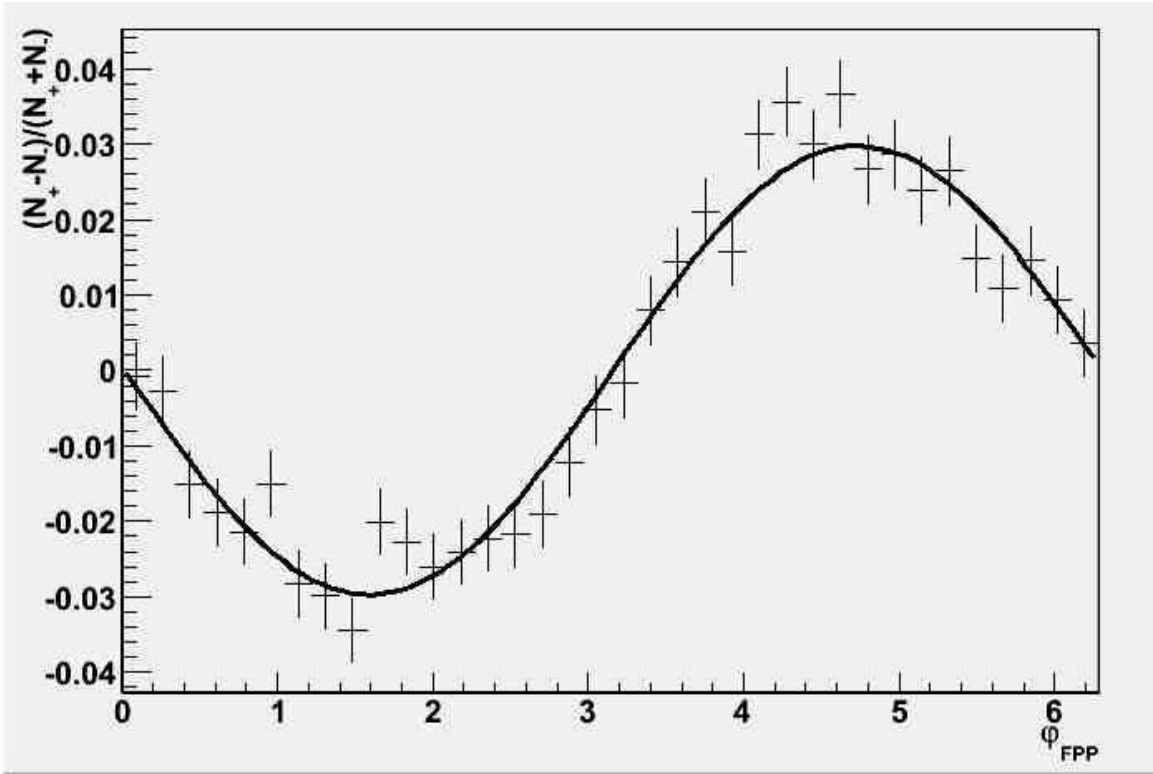
$$f(\theta,\varphi) = \frac{N^{+}(\theta,\varphi) - N^{-}(\theta,\varphi)}{N^{+}(\theta,\varphi) + N^{-}(\theta,\varphi)}$$

Part of elastic events of 8.5GeV^2
Fit function:

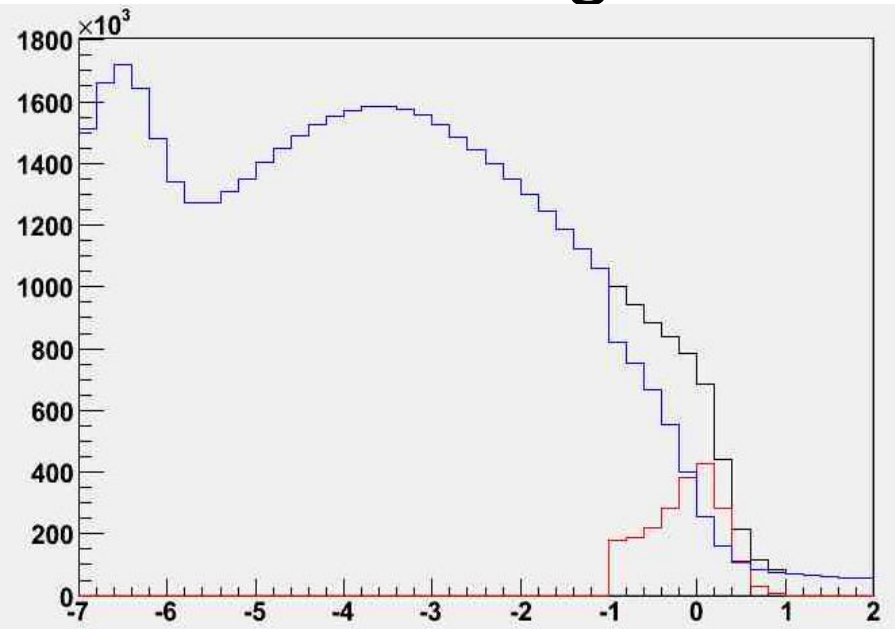
$$f(\varphi) = p_1 \sin(\varphi) + p_2 \cos(\varphi)$$

$$p_1 \propto A_y p_x^{fpp}$$

$$p_2 \propto A_y p_y^{fpp}$$



Inelastic background correction at Q^2=8.54GeV^2



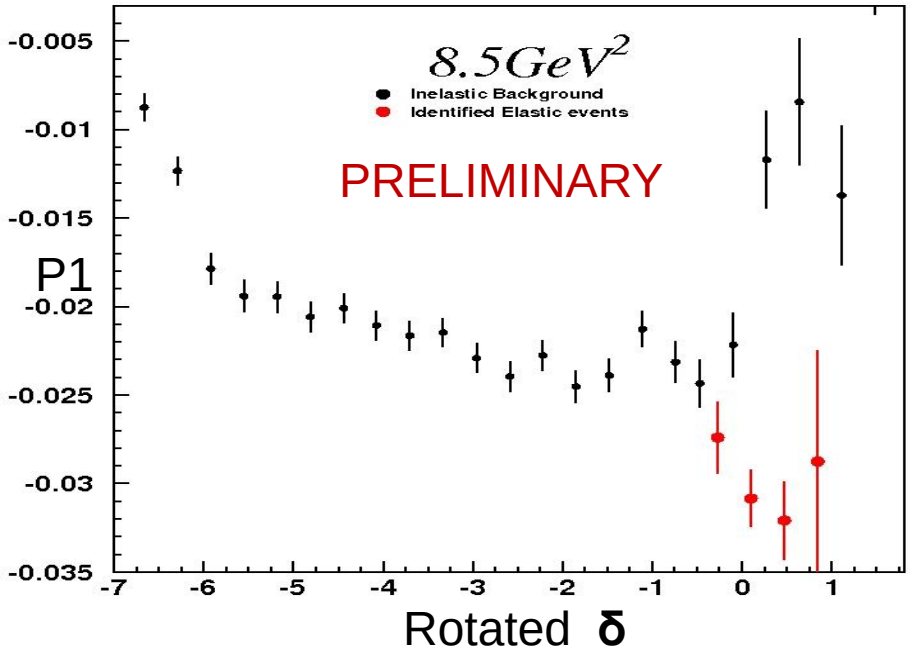
One of most important data point of GEp3 and also the worst point to identify elastic events. Applied e-p elastic cut(2.5σ) and plot the δ~θ_{HMS} correlation cut.

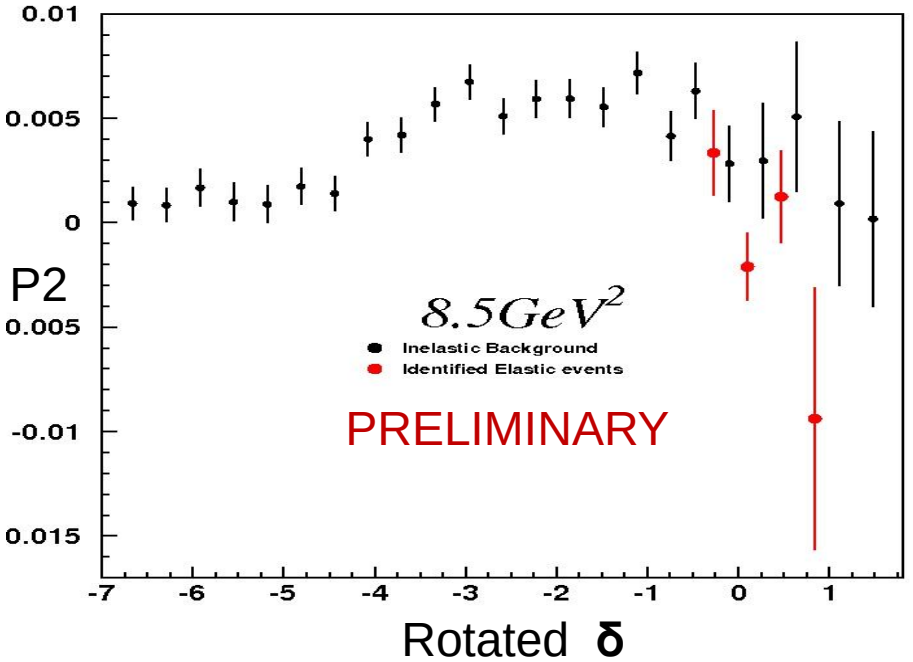
Black all the events

Blue inelastic events

Red elastic events

Separate background and elastic events into groups and fit the asymmetry at FPP. Plots of fitting parameter P1 and P2





Inelastic background correction at Q^2=8.54GeV^2

Estimated about 10% background under elastic peak, corrected the P1 and P2 with formulas:

$$P_{1m} = (1-x)P_{1el} + xP_{1inel}$$

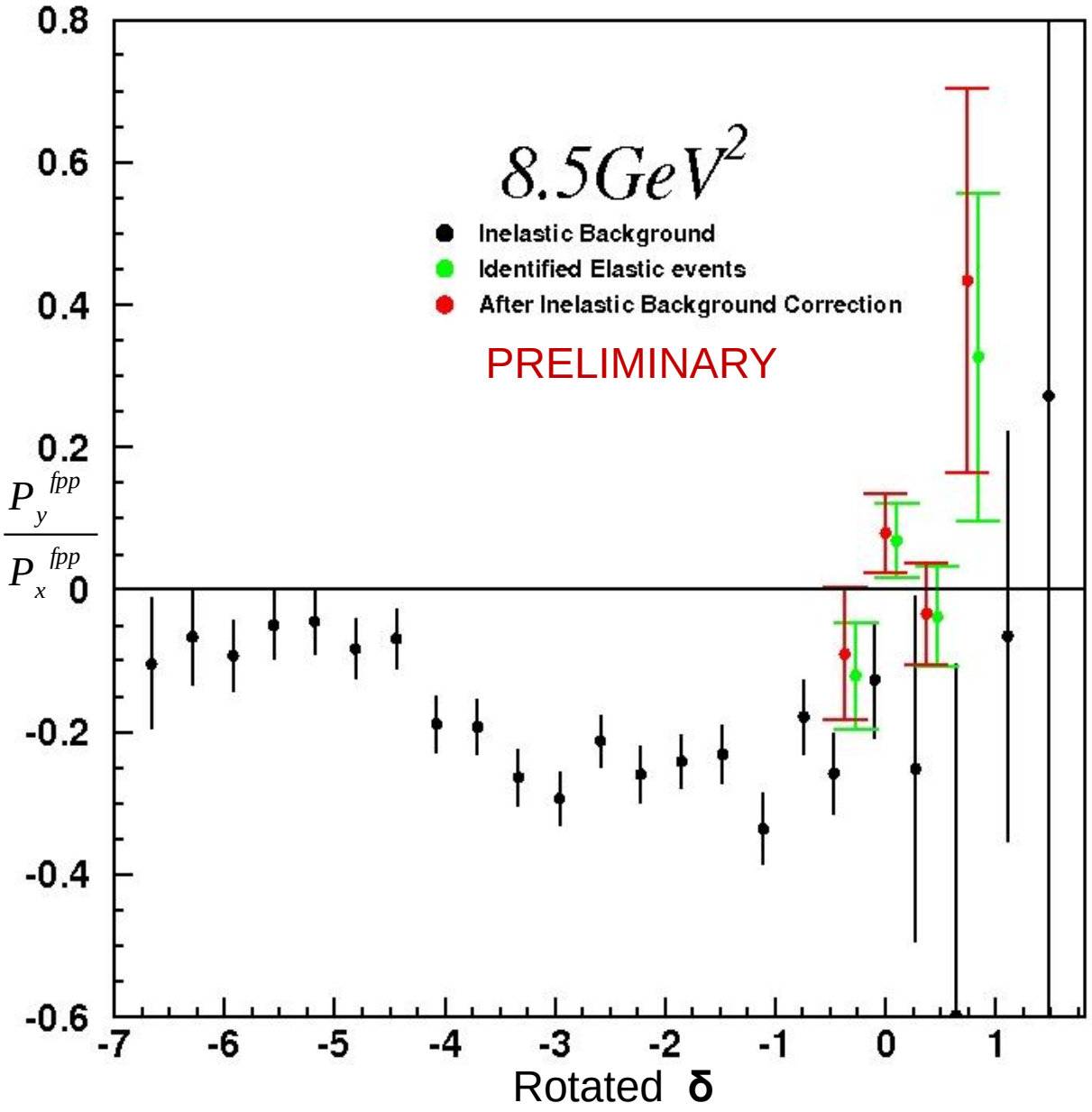
$$P_{2m} = (1-x)P_{2el} + xP_{2inel}$$

X- ratio of background/elastic

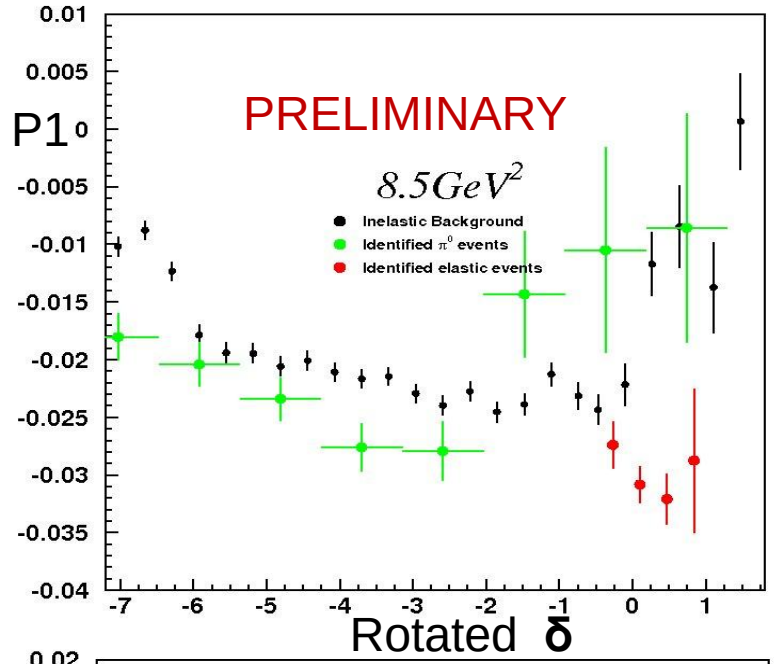
P_m-indentified elastic polarization

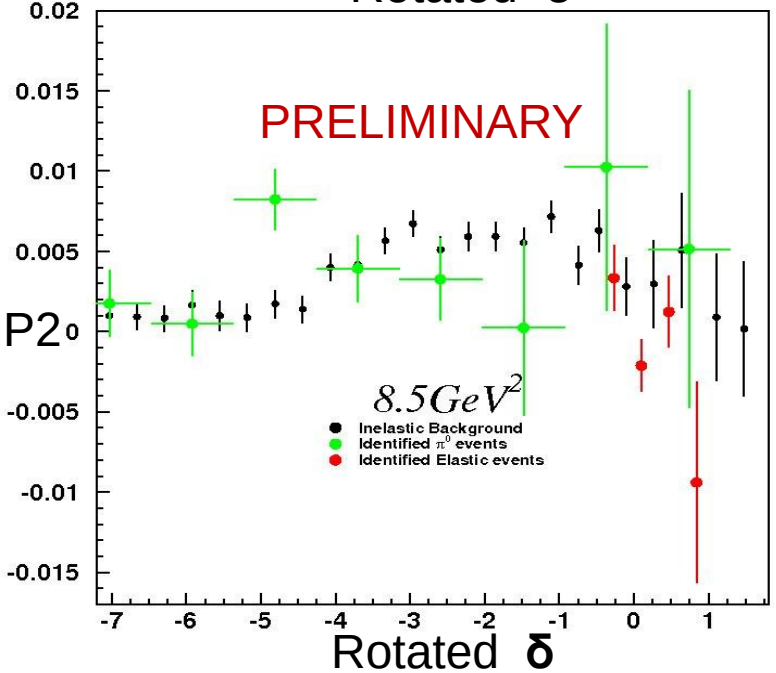
And plot the P2/P1.

The correction of background is important to reconstruct the polarization of elastic events at Q^2=8.54GeV^2



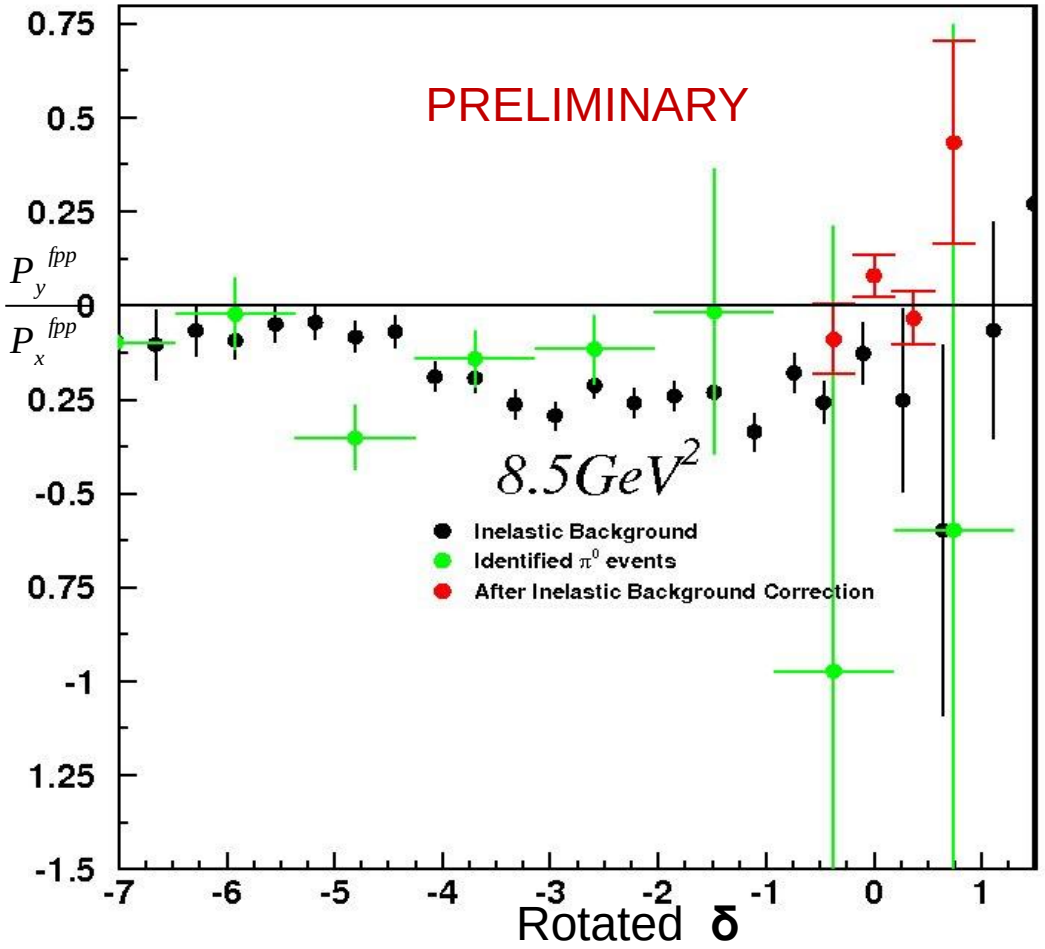
FPP asymmetry when identifying π° events at BigCal





With BigCal π° cuts, plot the $\delta \sim \theta_{HMS}$ correlation cut.

The π° production has similar trend to background. Need SIMC simulation to confirm the results.

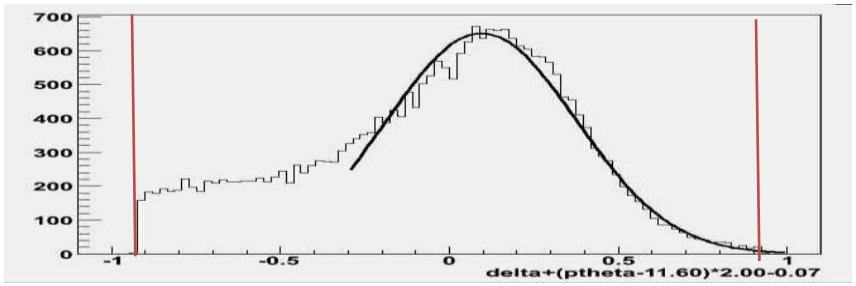


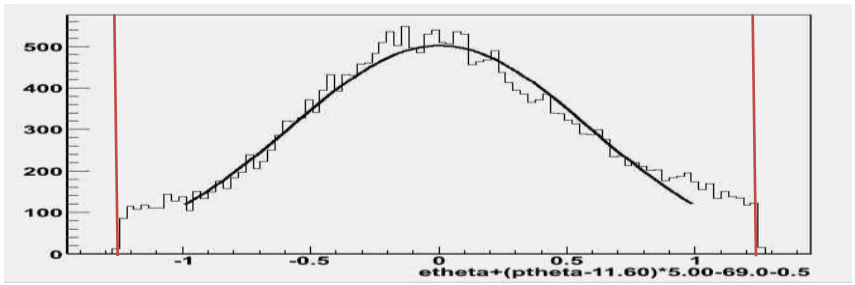
Conclusion

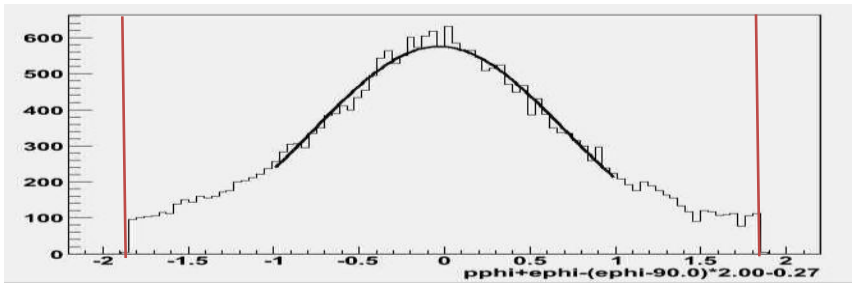
- The asymmetry of inelastic background is different to the elastic events.
- The correction of inelastic contribution under elastic peak is important.
- Clearly identified π° production reaction has similar asymmetry to the inelastic background.
- Need SIMC simulation to understand the π° production contribution in inelastic background.

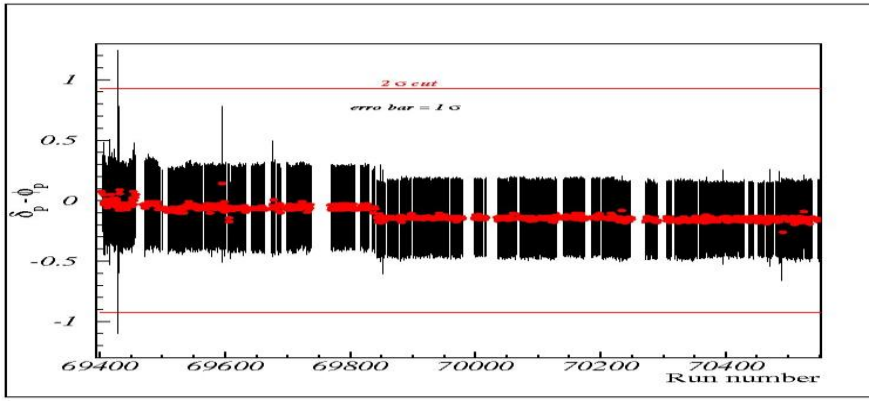
Inelastic background correction at Q^2=8.54GeV^2

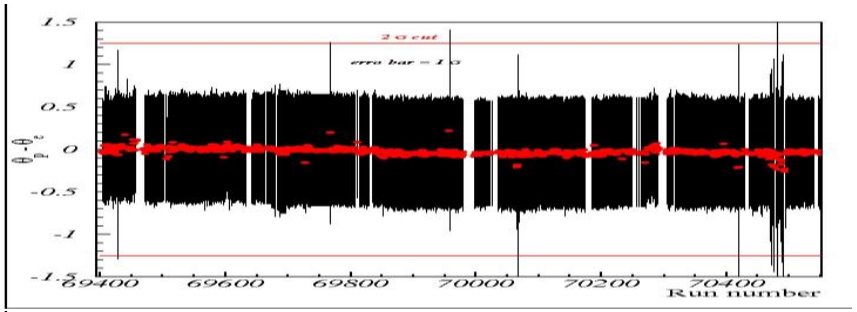
- The most import data point of GEp3 and the worst case for elastic events selection.
- Stabilization of cuts:

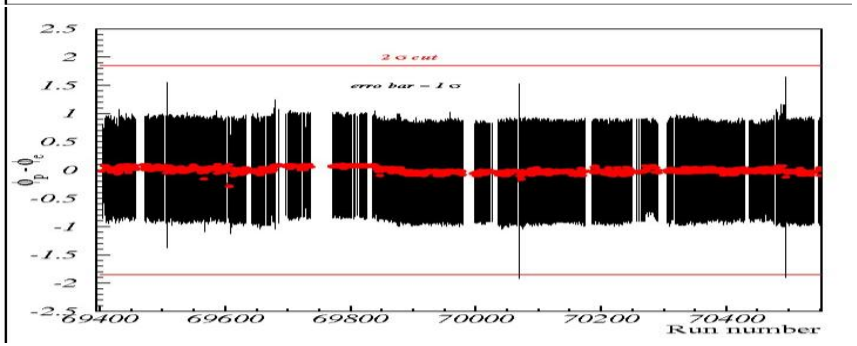


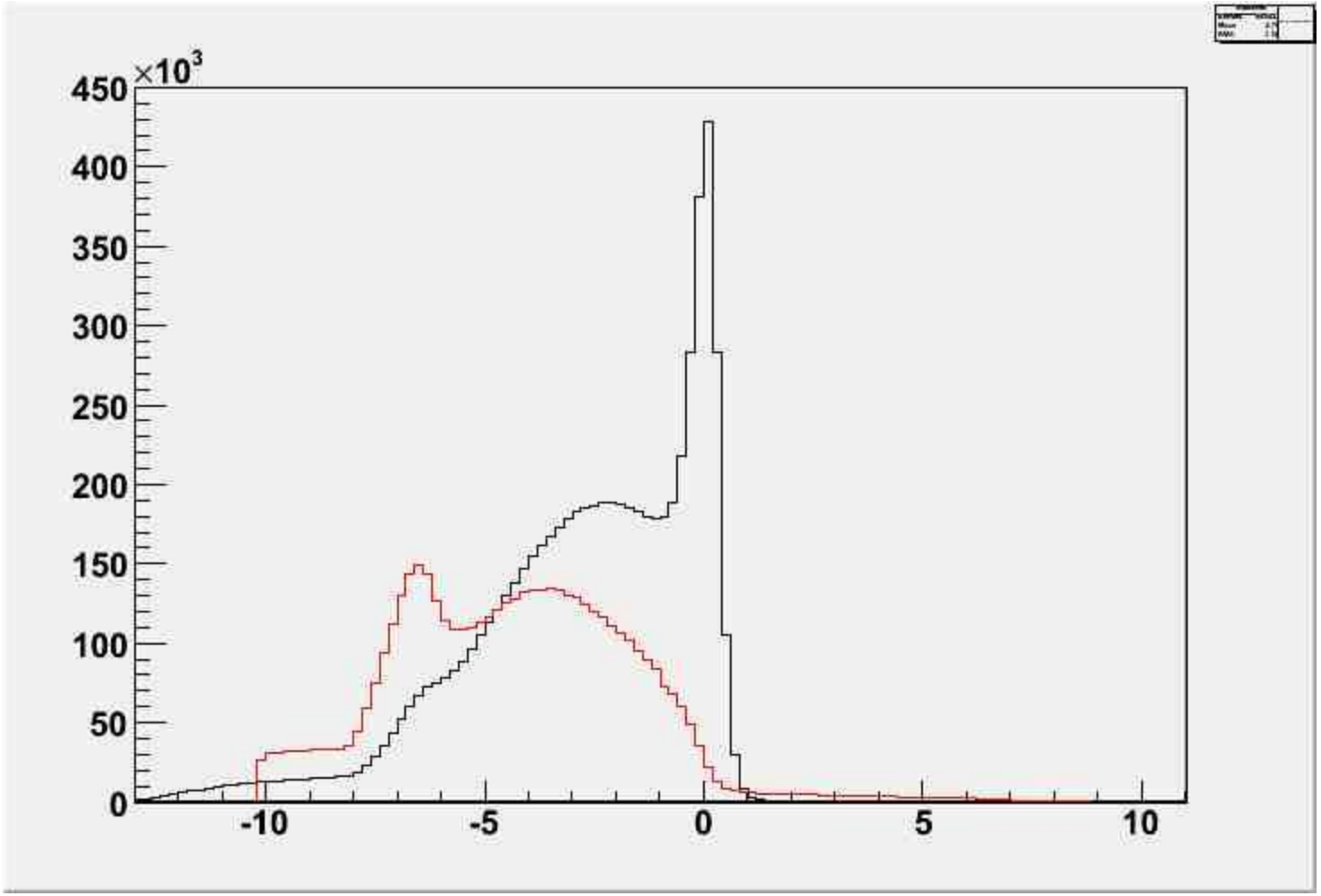











×10^3
450
400
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300
250
200
150
100
50
0
-10
-5
0
5
10