The current status of the FROST analysis

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Outline

Outline

The FROST Data

The FROST run period: Nov. 3, 2007 - Feb. 12, 2008

Data set: 35 TBytes

The longitudinal polarized target and the circularly polarized beam

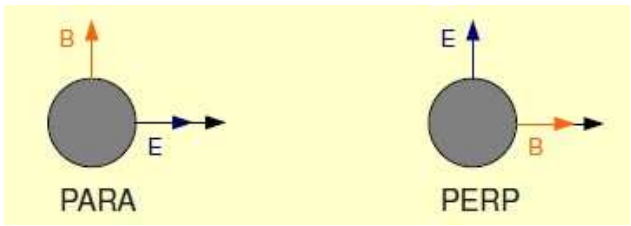
- Groups of runs with similar conditions

period	Electron Beam Energy	run range	Target Pol.	# files
1	1.645 GeV	55521 - 55536	L+- (<=)	266
2	1.645 GeV	55537 - 55555	L+- (<=)	377
3	1.645 GeV	55556 - 55595	L++ (=>)	806
4	2.478 GeV	55604 - 55625	L-+ (<=)	382
5	2.478 GeV	55630 - 55676	L– (=>)	971
6	2.478 GeV	56164 - 56193	L++ (=>)	681
7	2.478 GeV	56196 - 56233	L+- (<=)	766

The longitudinal polarized target and the linearly polarized beam

- PARA, PERP, AMO

Electron Beam Energy	run range
3.539 GeV	55678 - 55844
2.751 GeV	55854 - 55938
4.599 GeV	55945 - 56152



The Observable to measure

The differential cross section for $\gamma p \longrightarrow p\pi^+\pi^-$ (without measuring the polarization of the recoiling nucleon)

$$\frac{d\sigma}{dx_i} = \sigma_0 \{ (1 + \vec{\Lambda}_i \cdot \vec{P}) + \delta_\odot (I^\odot + \vec{\Lambda}_i \cdot \vec{P}^\odot) + \delta_l [\sin 2\beta (I^s + \vec{\Lambda}_i \cdot \vec{P}^s) + \cos 2\beta (I^c + \vec{\Lambda}_i \cdot \vec{P}^c)] \}$$

- σ_0: The unpolarized cross section
- β: The angle between the direction of polarization and the x-axis
- $\delta_{\odot, l}$: The degree of polarizaton of the photon beam $\Rightarrow \delta_\odot$, and δ_l
- $\vec{\Lambda}_i$: The polarization of the initial nucleon $\Rightarrow (\Lambda_x, \Lambda_y, \Lambda_z)$
- $I^{\odot, s, c}$: The observable arising from use of polarized photons $\Rightarrow I^\odot, I^s, I^c$
- $\vec{P}$: The polarization observable $\Rightarrow (P_x, P_y, P_z)$ $(P_x^\odot, P_y^\odot, P_z^\odot)$ (P_x^s, P_y^s, P_z^s) (P_x^c, P_y^c, P_z^c)

$\Downarrow$ The circularly-polarized beam
The longitudinally-polarized target

$$\frac{d\sigma}{dx_i} = \sigma_0 \{1 + \Lambda_z P_z + \delta_\odot I^\odot + \delta_\odot \Lambda_z P_z^\odot\}$$

The Observable $P_z^{\odot}$

$$P_z^{\odot} = \frac{S}{f \cdot \delta_{\odot} \cdot \Lambda_z} \left\{ \frac{\left(\frac{d\sigma(\rightarrow\Rightarrow)}{d\Omega} \frac{1}{Norm(\rightarrow\Rightarrow)} + \frac{d\sigma(\leftarrow\Leftarrow)}{d\Omega} \frac{1}{Norm(\leftarrow\Leftarrow)} \right) - \left(\frac{d\sigma(\rightarrow\Leftarrow)}{d\Omega} \frac{1}{Norm(\rightarrow\Leftarrow)} + \frac{d\sigma(\leftarrow\Rightarrow)}{d\Omega} \frac{1}{Norm(\leftarrow\Rightarrow)} \right)}{\left(\frac{d\sigma(\rightarrow\Rightarrow)}{d\Omega} \frac{1}{Norm(\rightarrow\Rightarrow)} + \frac{d\sigma(\leftarrow\Leftarrow)}{d\Omega} \frac{1}{Norm(\leftarrow\Leftarrow)} \right) + \left(\frac{d\sigma(\rightarrow\Leftarrow)}{d\Omega} \frac{1}{Norm(\rightarrow\Leftarrow)} + \frac{d\sigma(\leftarrow\Rightarrow)}{d\Omega} \frac{1}{Norm(\leftarrow\Rightarrow)} \right)} \right\}$$

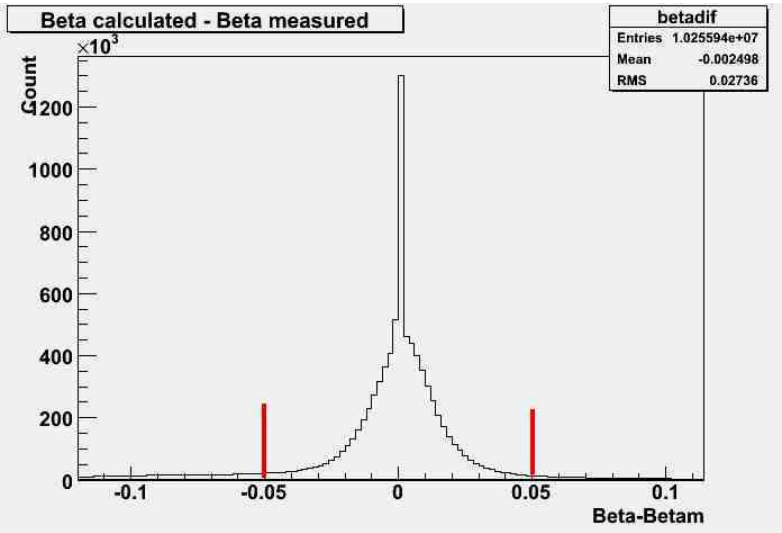
- If $\delta_{\odot}$ and Λ_z in each condition are same,
- S - overall sign
- f - dilution factor

We need to measure the following to make the asymmetry plot

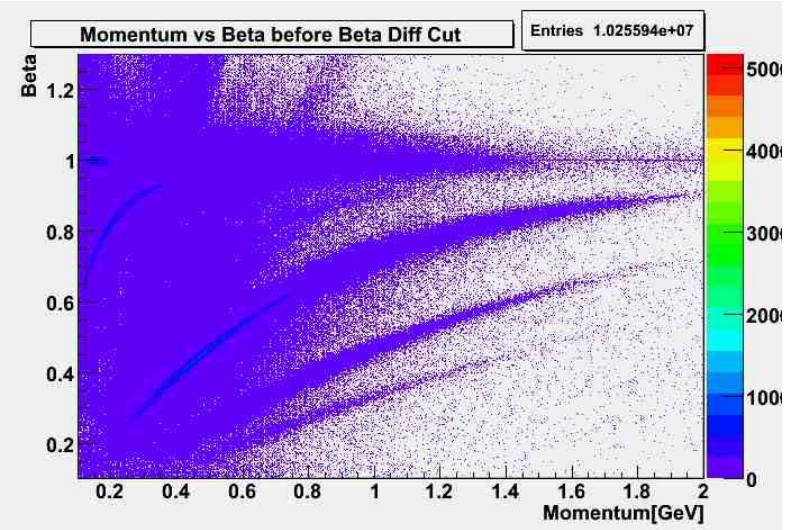
1. $\frac{d\sigma}{d\Omega}$ in each beam and target polarization situation
2. The dilution factor = $\frac{1}{scaling\ \ factor}$
3. The degree of the photon beam polarization, $\delta_{\odot}$
4. The degree of the target polarization, Λ_z
5. the data nomarization
6. The exact S sign

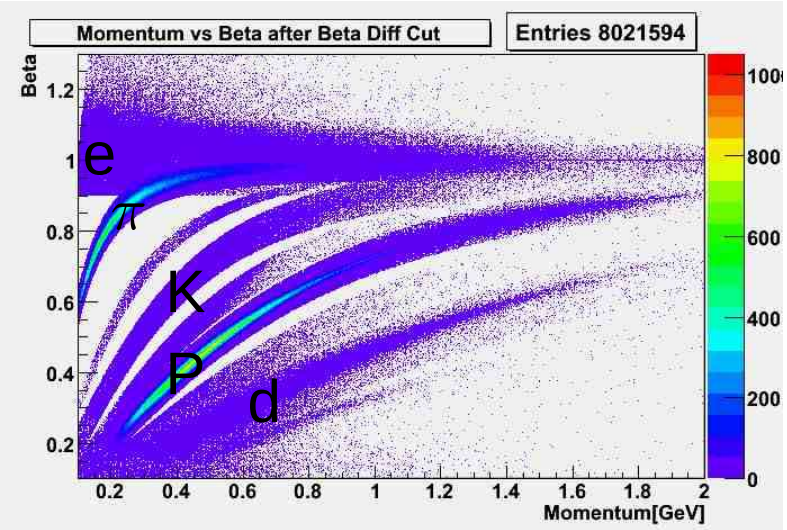
Outline

The beta difference cut



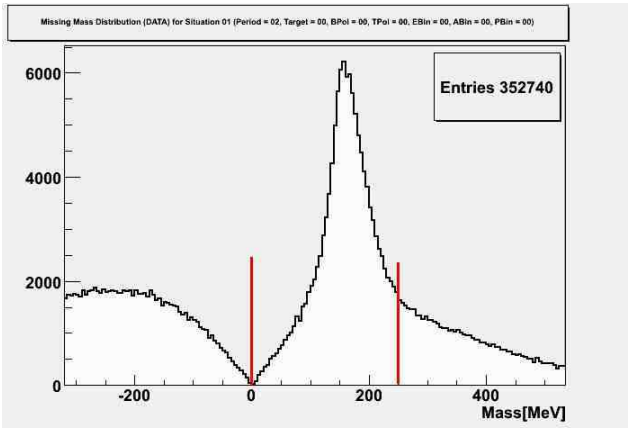
- The beta calculated(Pmag/E) - The beta measured from TOF
- -0.05 < Beta-Betam < 0.05
- After the beta different cut, we can find more clear particle peak.
- I need only Proton, π^+, and π^- for this analysis.



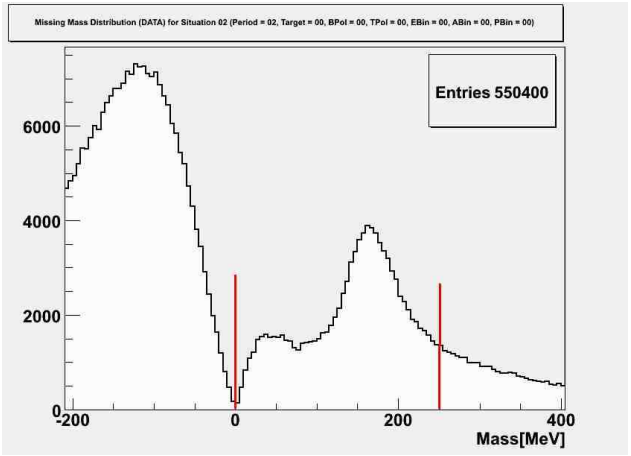


The my current topology

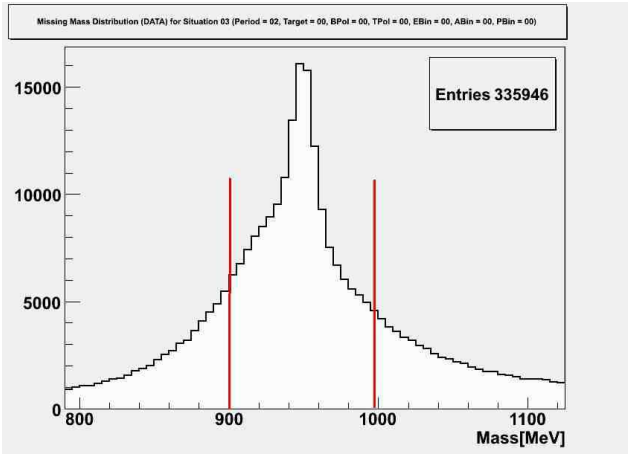
Topolosy $\gamma P \rightarrow P\pi^+(\pi^-)$



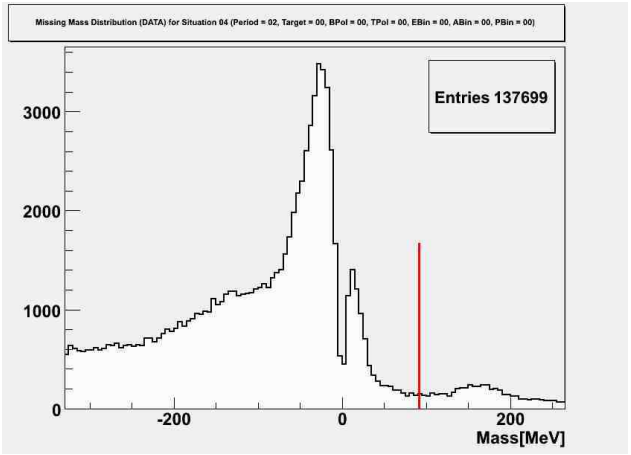
Topolosy $\gamma P \rightarrow P\pi^-(\pi^+)$



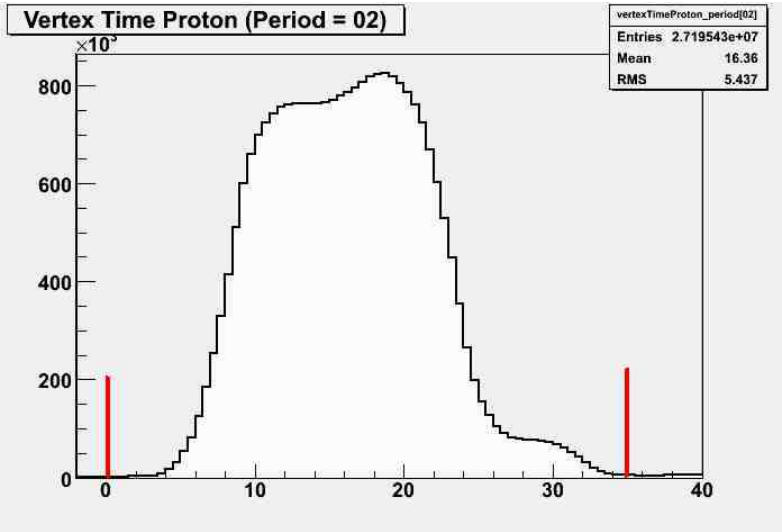
Topolosy $\gamma P \rightarrow \pi^+\pi^-(P)$



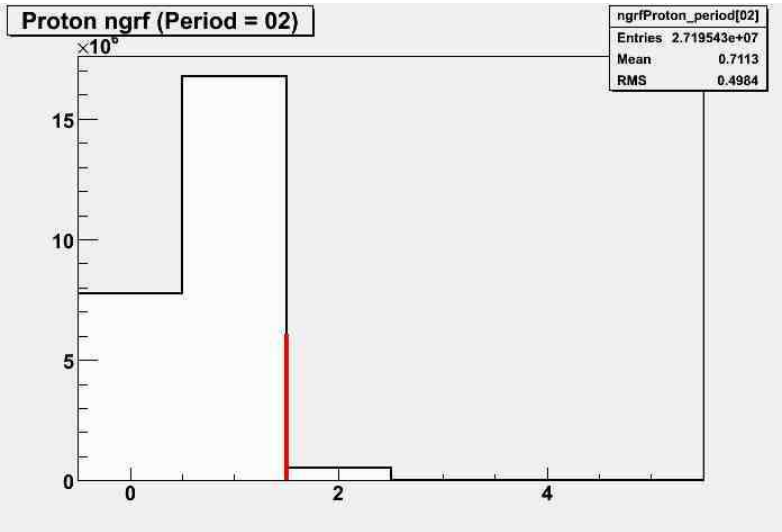
Topolosy $\gamma P \rightarrow P\pi^+\pi^-()$

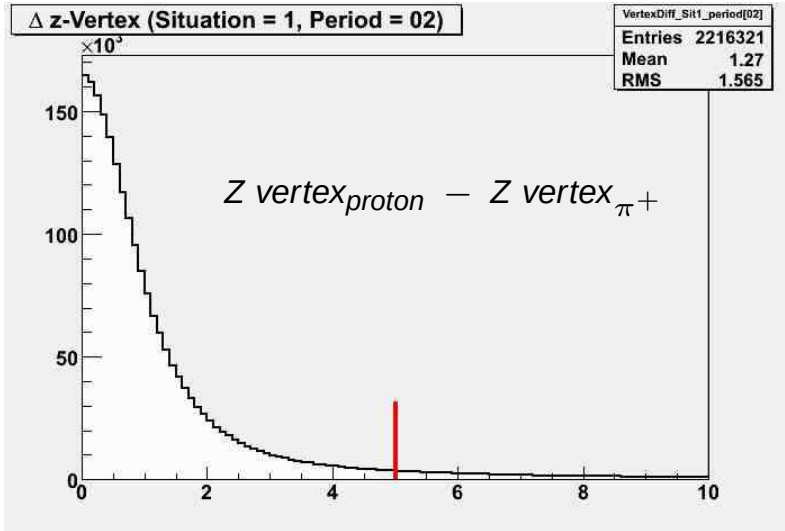


The other cuts



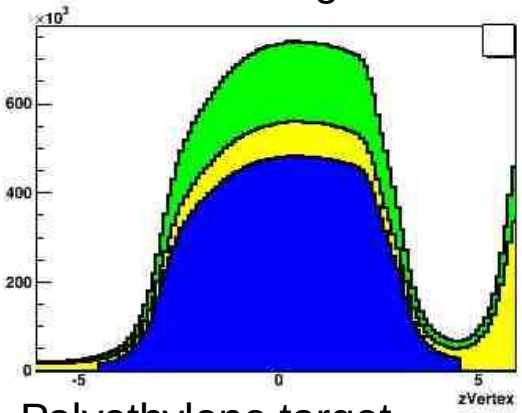
- 0 < SC calibrated time for this track (ns) < 35
- ngrf < 2
- The Z difference of the vertex in particles < 5 cm



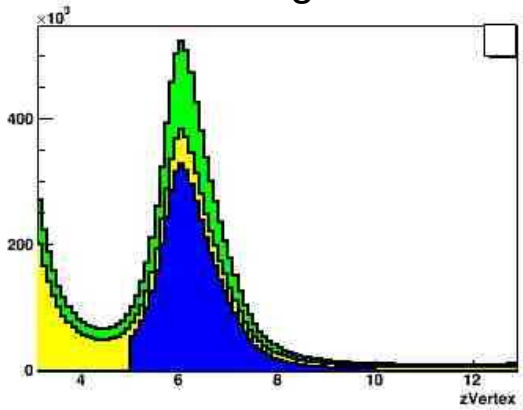


selecting the target

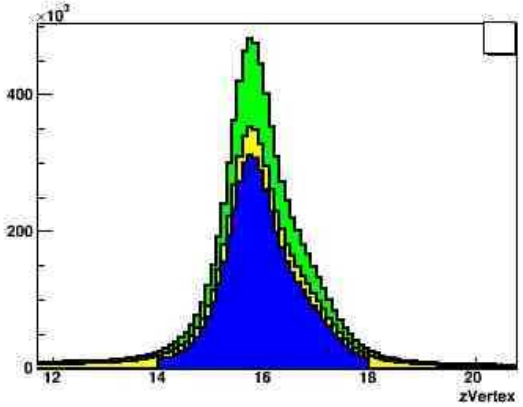
Butanol target

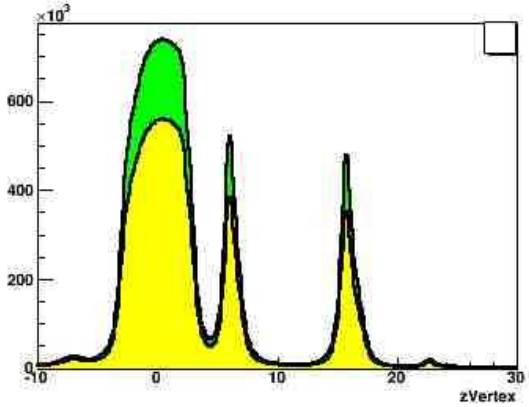


Carbon target



Polyethylene target





- The green part:

  the data after beta difference cut
- The yellow part:

  the data included in my topologies
- The blue part
  - the Z vertex difference cut
  - the three kinds of targets

The target	X and Y axis	Z axis
Butanol	radius 3	[-4.5,-4.5]
Carbon		[5,10]
Polyethylene		[14,18]

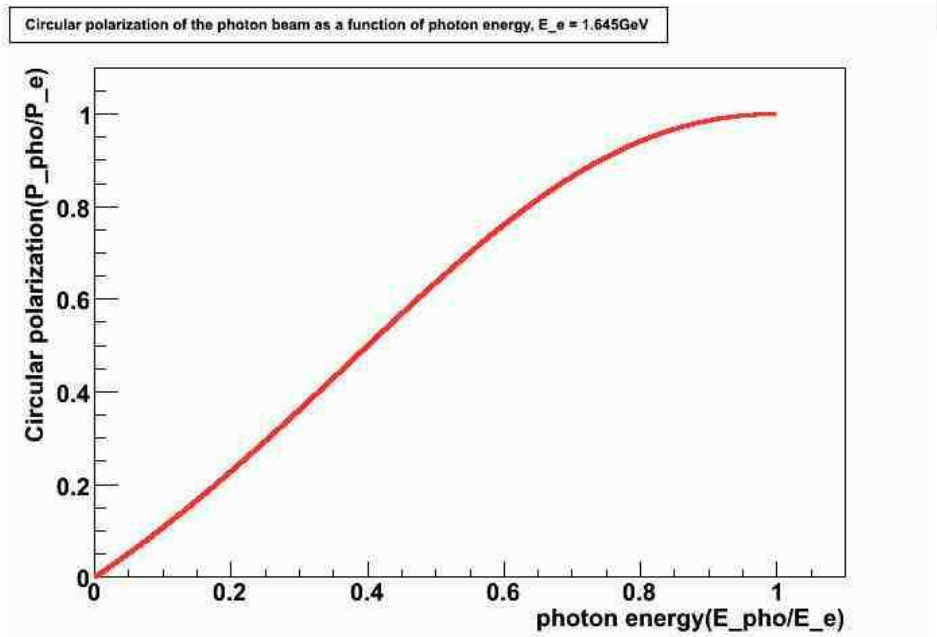
The photon beam polarization, $\delta_{\odot}$

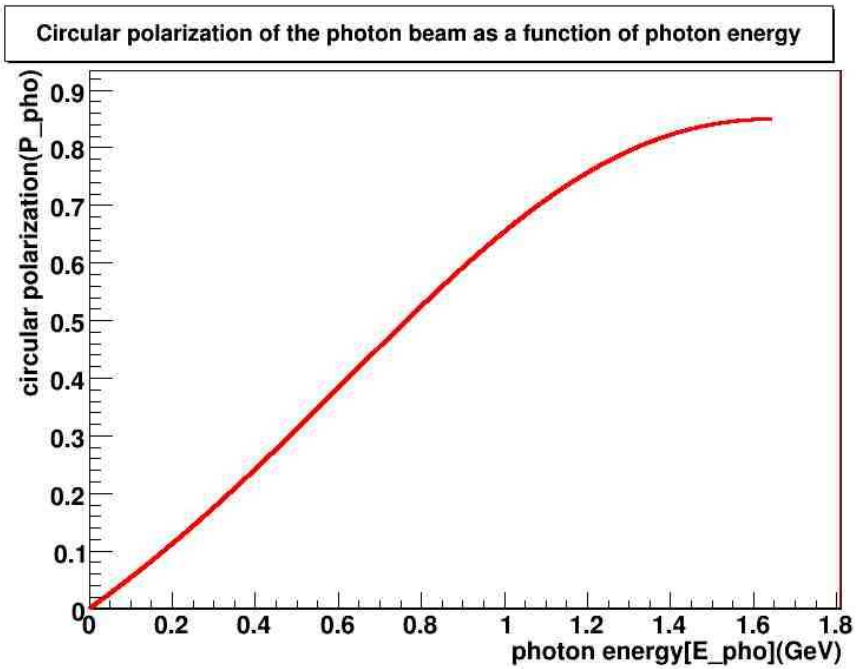
The degree of circularly polarization of the photon beam, $P_\gamma \propto$ the electron-beam polarization, P_e.

$$\frac{P_\gamma}{P_e} = \frac{4x - x^2}{4 - 4x + 3x^2} \qquad x = \frac{E_\gamma}{E_e}$$

If P_e : 0.85, E_e : 1.645 GeV

$$P_\gamma = P_e \cdot \frac{(\frac{4}{E_e})E_\gamma - (\frac{4}{E_e})^2 E_\gamma^2}{4 - (\frac{4}{E_e})E_\gamma + 3(\frac{4}{E_e})^2 E_\gamma^2}$$

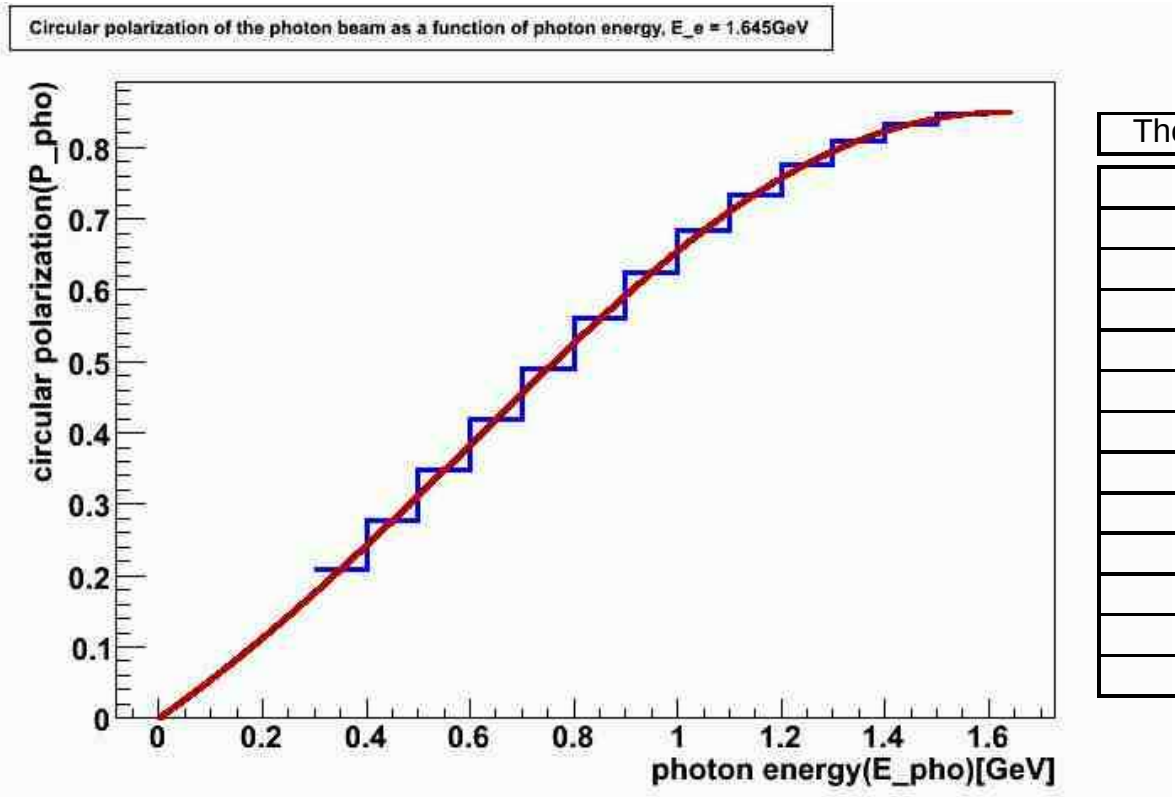




the photon beam polarization, $\delta_{\odot}$

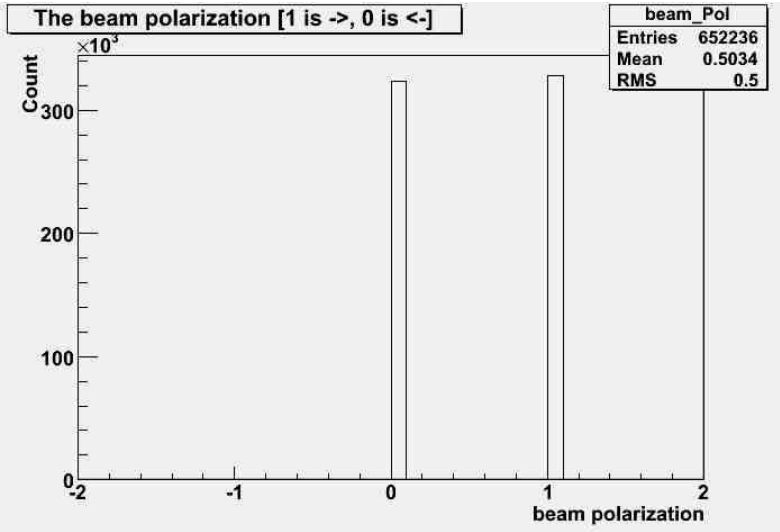
Whenever the photon energy changes, the circular polarization of the photon beam is changed.

We find the average circular polarization of the photon beam from each section of the photon energy.



The photon energy [GeV]	The photon polarization
[0.3,0.4]	0.209
[0.4,0.5]	0.277
[0.5,0.6]	0.348
[0.6,0.7]	0.419
[0.7,0.8]	0.490
[0.8,0.9]	0.559
[0.9,1.0]	0.624
[1.0,1.1]	0.683
[1.1,1.2]	0.734
[1.2,1.3]	0.777
[1.3,1.4]	0.810
[1.4,1.5]	0.833
[1.5,1.6]	0.846

The overall sign, S problem



The overall sign, S is related to the beam polarization.

If S is positive,

the helicity bit, 1 means that the beam polarization is parallel to the beam.

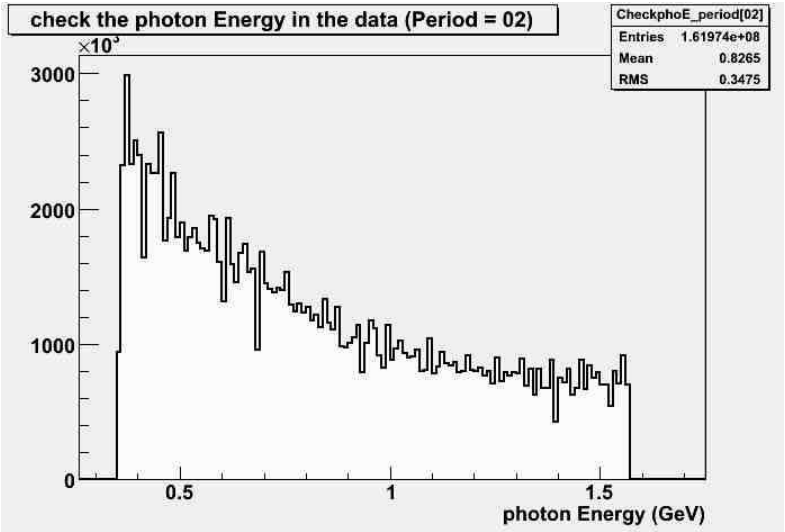
If S is negative,

the helicity bit, 0 means that the beam polarization is parallel to the beam.

period	period 1	period 2	period 3	period 4	period 5	period 6	period 7
Sungkyun	-	+	-	+	+	+	+
Brian	-	+	+	+	-	-	+
Liam	+	-	-	+	-	-	+
Steffen				+	-	-	+

Selecting the data

The character of the files I used



- The electron beam energy: 1.645 [GeV]
- The photon energy: 0.329 - 1.563 [GeV]
- The electron beam polarization, $P_e \sim 0.85$
- The averge target polarization, $\Lambda_z \sim 0.8$
- using the 484 files, 11% of the data with the circular polarized beam
  - The period 2 (The target polarization: <=, 242 files)
    Normal($\leftarrow\Leftarrow$) = 81,276,895 and Normal($\rightarrow\Leftarrow$) = 80,697,118
  - The period 3 (The target polarization: =>, 242 files

    Normal($\leftarrow\Rightarrow$) = 79,718,043 and Normal($\rightarrow\Rightarrow$) = 79,370,992

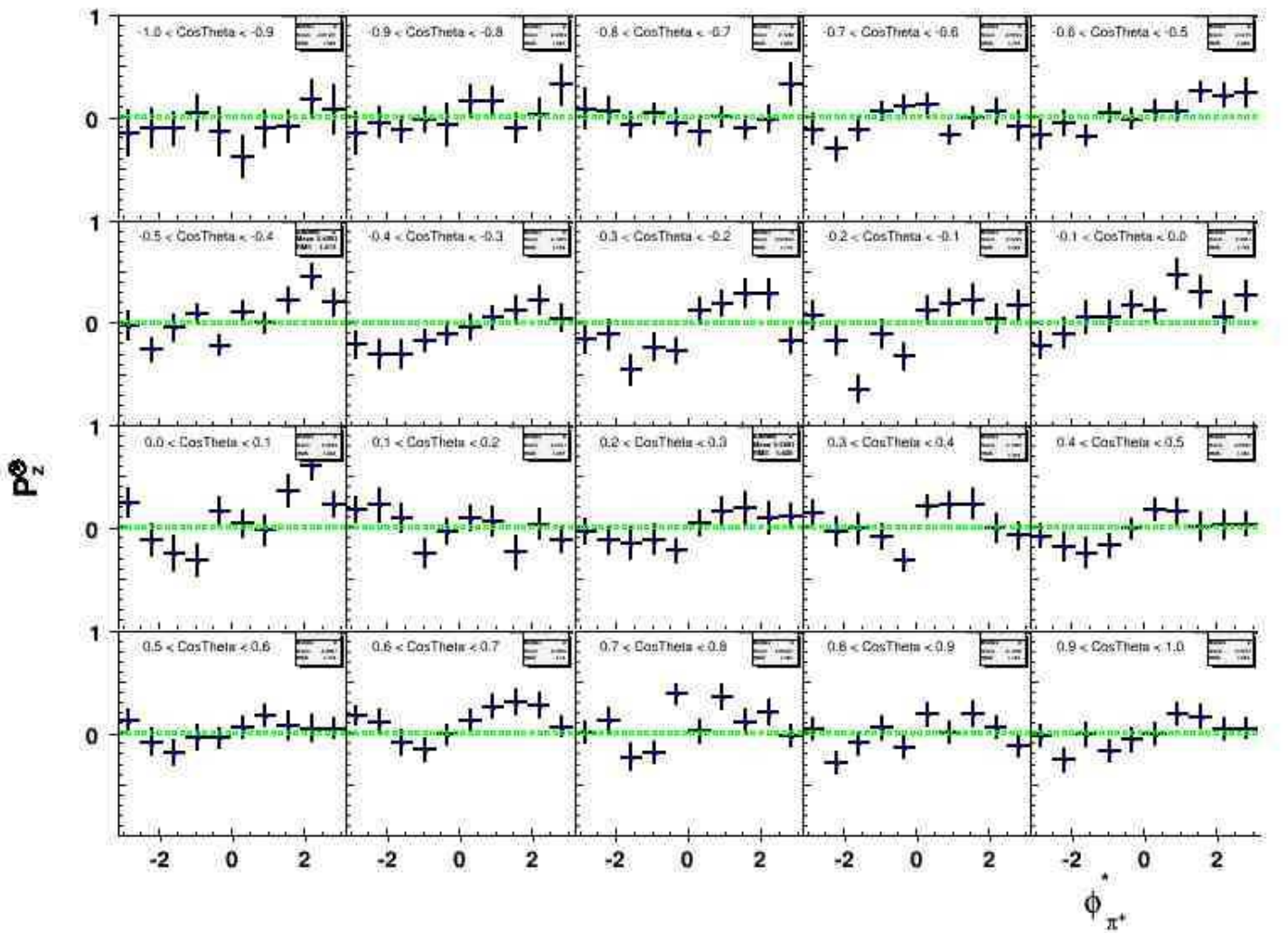
My equation I used to find the asymmetry plot for $P_z^{\odot}$

- The overall sign, S
  period 2: + and period 3: +
- I do not use the filution factor, f. so f = 1
- The target polarization, $\Lambda_z \sim 0.8$

$$P_z^{\odot} = \frac{S}{\delta_{\odot} \cdot (0.8)} \left\{ \frac{\left(\frac{d\sigma(\rightarrow\Rightarrow)}{d\Omega}_{(79,370,992)} + \frac{d\sigma(\leftarrow\Leftarrow)}{d\Omega}_{(81,276,895)} \right) - \left(\frac{d\sigma(\rightarrow\Leftarrow)}{d\Omega}_{(80,697,118)} + \frac{d\sigma(\leftarrow\Rightarrow)}{d\Omega}_{(79,718,043)} \right)}{\left(\frac{d\sigma(\rightarrow\Rightarrow)}{d\Omega}_{(79,370,992)} + \frac{d\sigma(\leftarrow\Leftarrow)}{d\Omega}_{(81,276,895)} \right) + \left(\frac{d\sigma(\rightarrow\Leftarrow)}{d\Omega}_{(80,697,118)} + \frac{d\sigma(\leftarrow\Rightarrow)}{d\Omega}_{(79,718,043)} \right)} \right\}$$

The asymmetry plot for $P_z^{\odot}$

The topology $\gamma P \rightarrow P\pi^+(\pi^-)$ with period 2 & 3 (Energy Bin 1100 MeV - 1200 MeV)



Outline

The work to do

1. Finding the exact overall sign, S
2. Finding the degree of polarization, $\delta_{\cdot}$ and Λ_z
3. Finding the proper normalization constant.
4. Finding the dilution factor.