π^0 asymmetry

π^0 cross section:

$$\frac{d\sigma_\nu}{d\Omega_f dE_f d\Omega} = \frac{d\sigma_T}{d\Omega} + \epsilon\frac{d\sigma_L}{d\Omega} + \sqrt{2\epsilon(1+\epsilon)}\frac{d\sigma_{LT}\cos\phi}{d\Omega} + \epsilon\frac{d\sigma_{TT}}{d\Omega}\cos 2\phi + h\sqrt{2\epsilon(1-\epsilon)}\frac{d\sigma_{LT'}}{d\Omega}\sin\phi$$

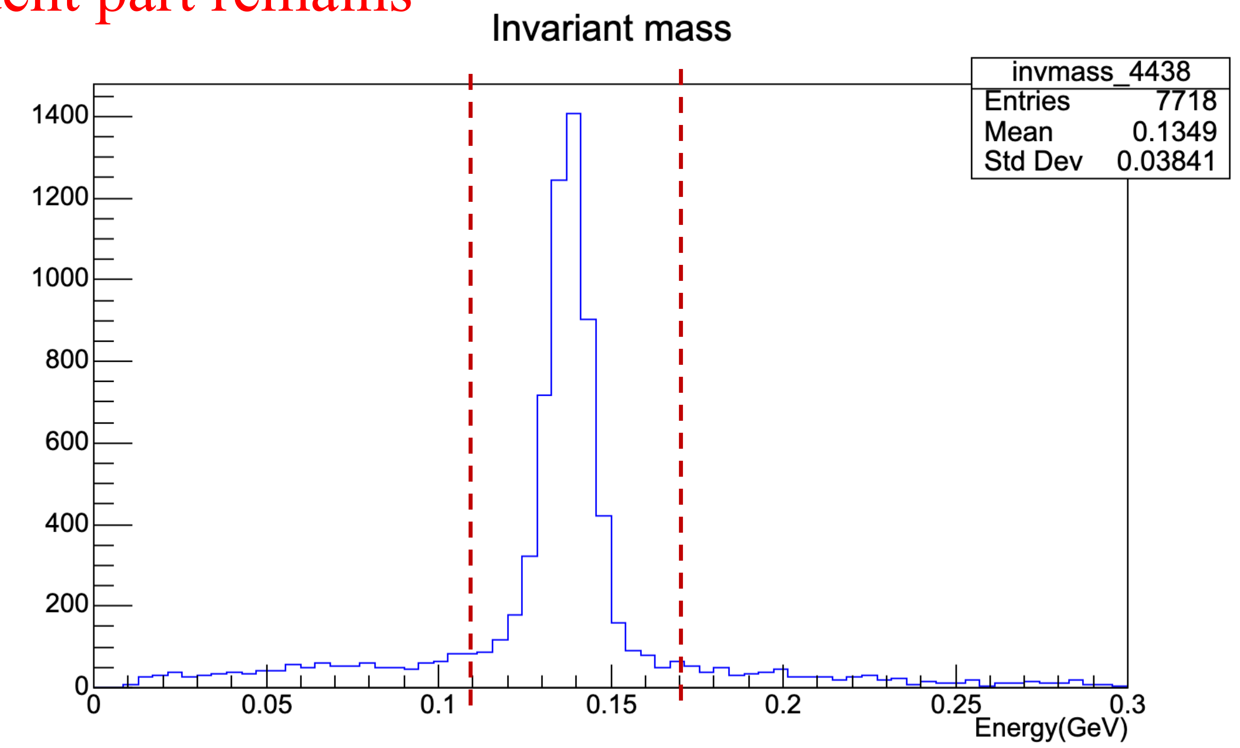
helicity dependent part

Only helicity dependent part remains

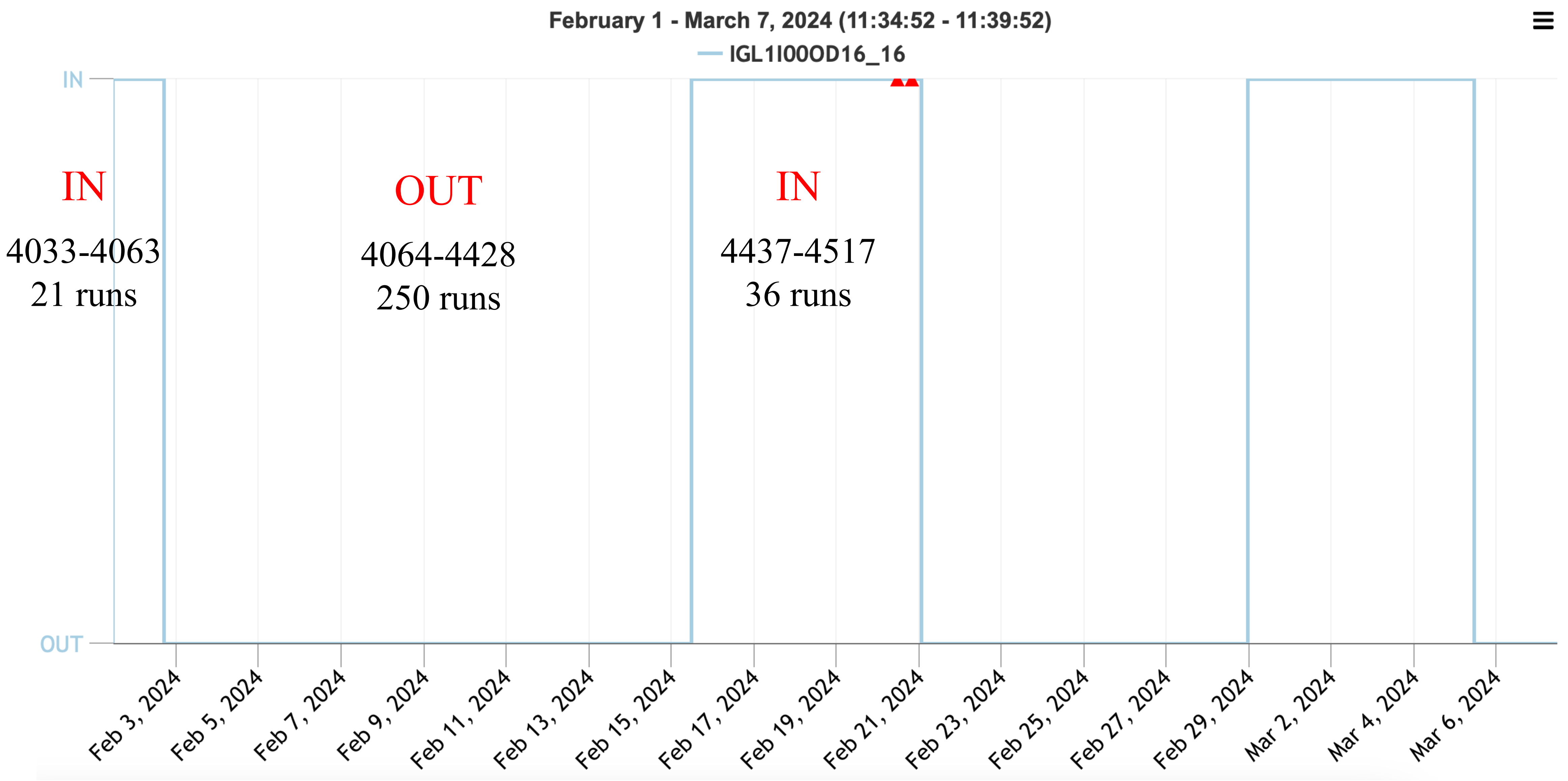
$$\pi^0\ Asymmetry = \frac{N_+ - N_-}{N_+ + N_-}$$

Cuts applied:

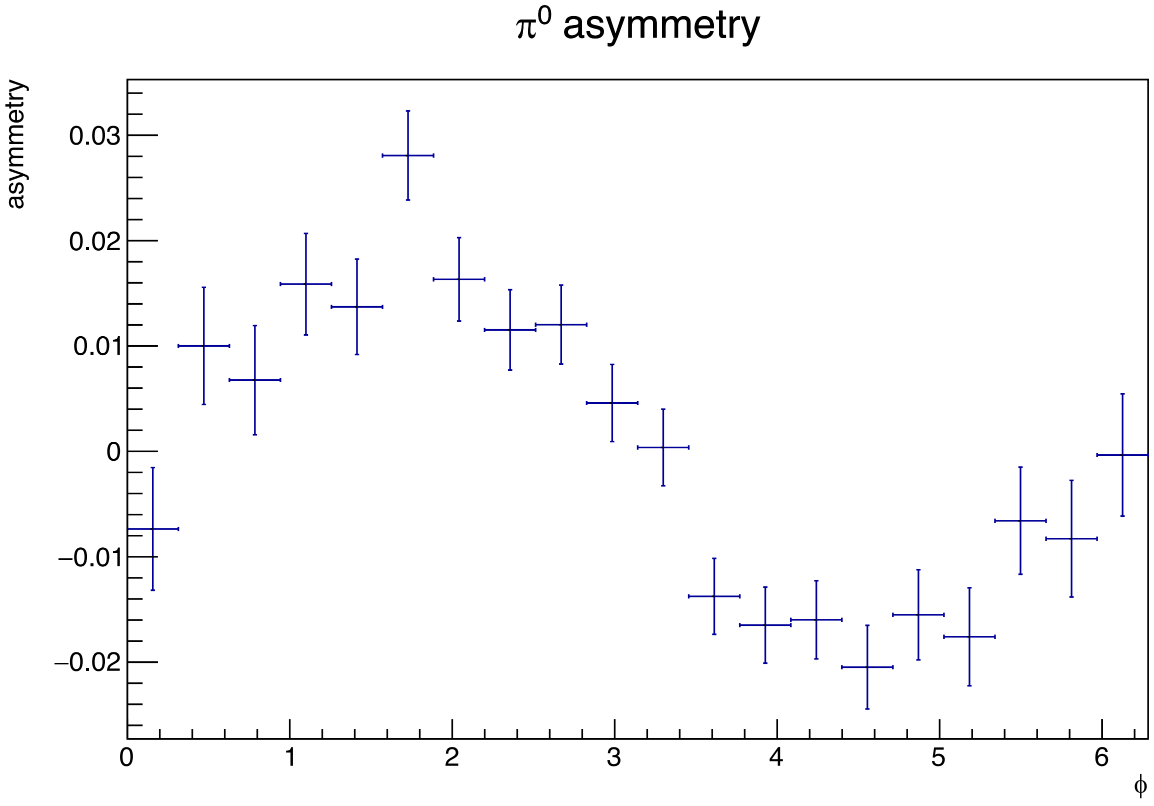
- π^0 invariant mass $\in [0.11, 0.17]$
- No missing mass cut



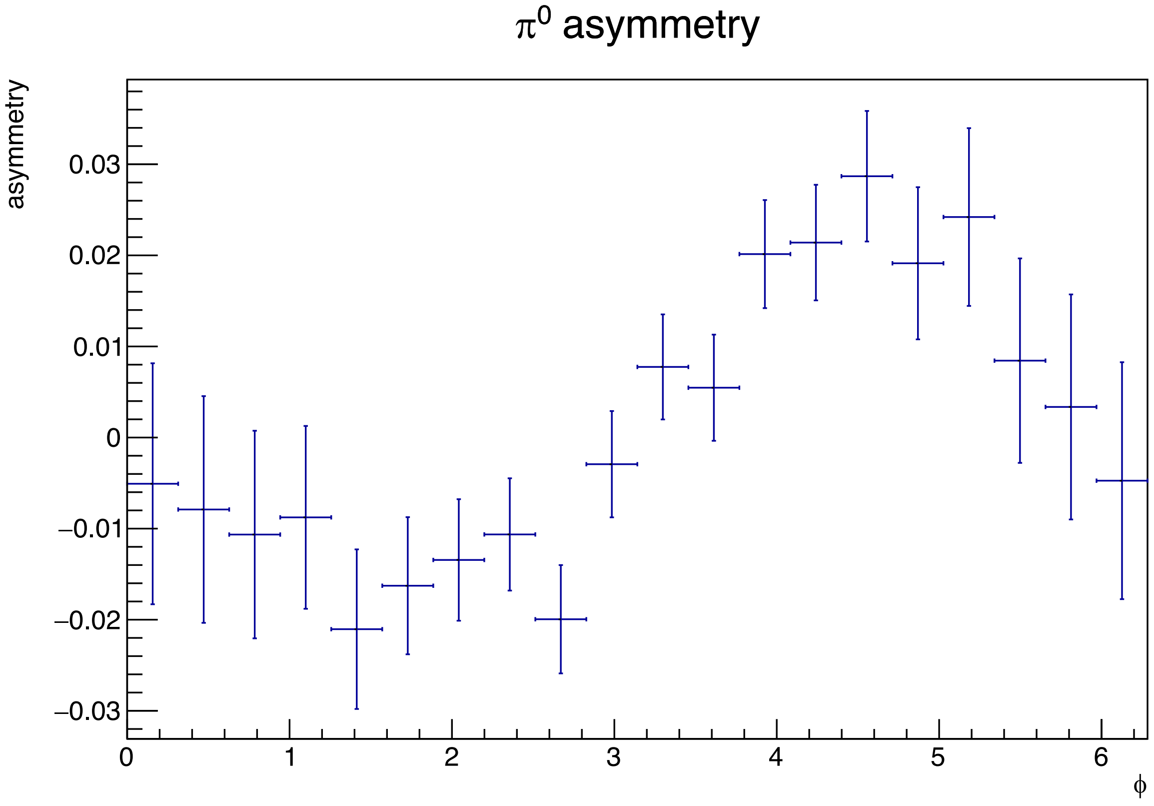
Half-wave Plate Status



π^0 asymmetry vs. ϕ

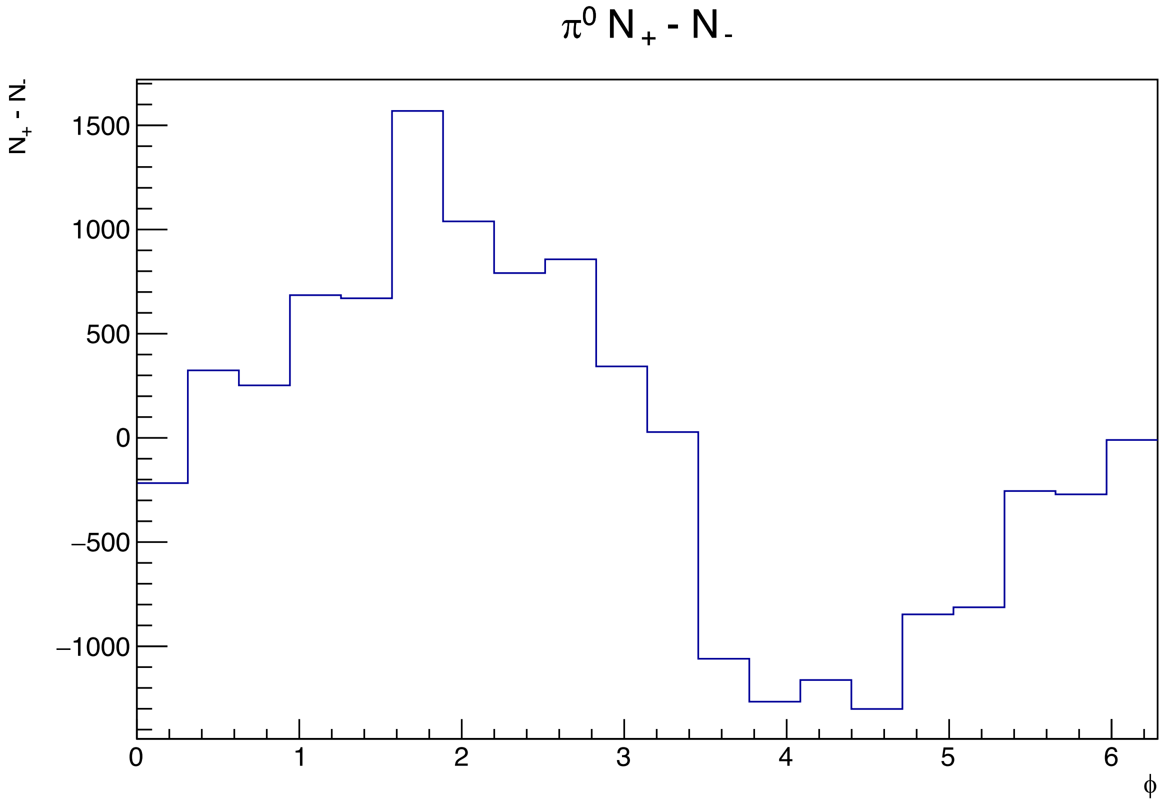


OUT 4064-4428 250 runs

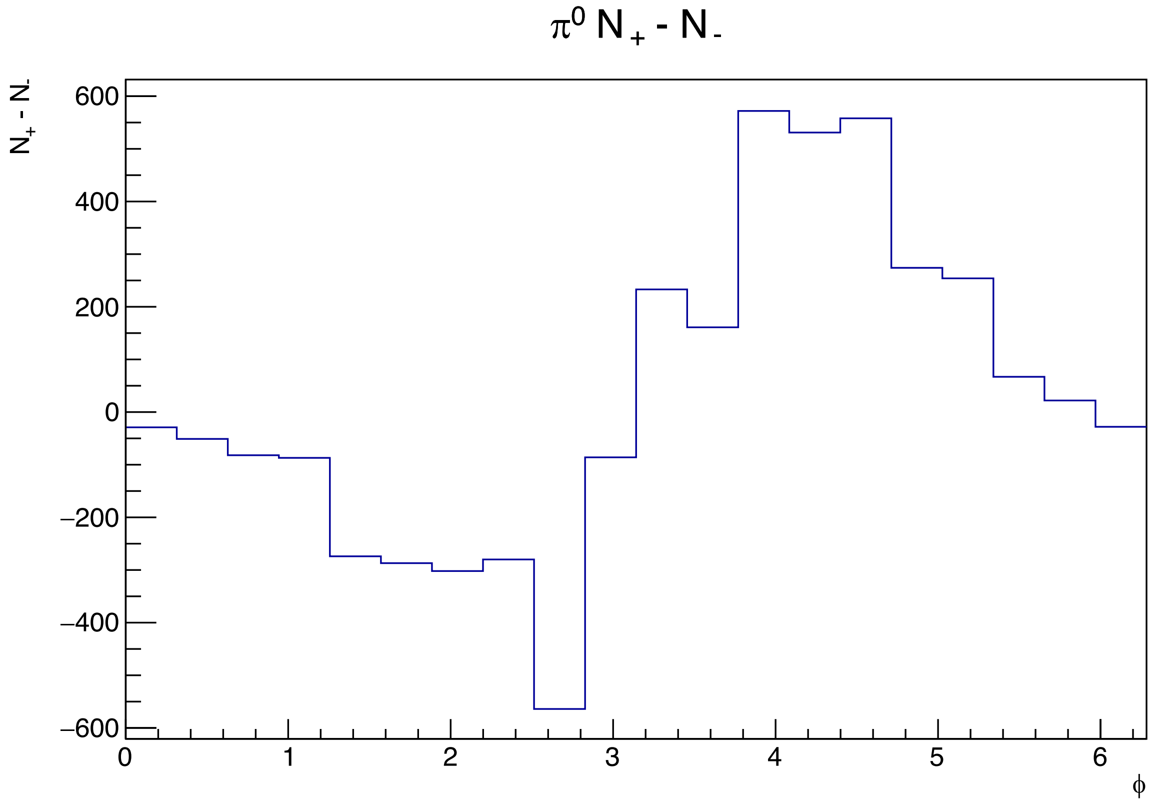


IN 4033-4063 4437-4517 57 runs

$\pi^0\ N_+ - N_-$ vs. ϕ



OUT 4064-4428 250 runs

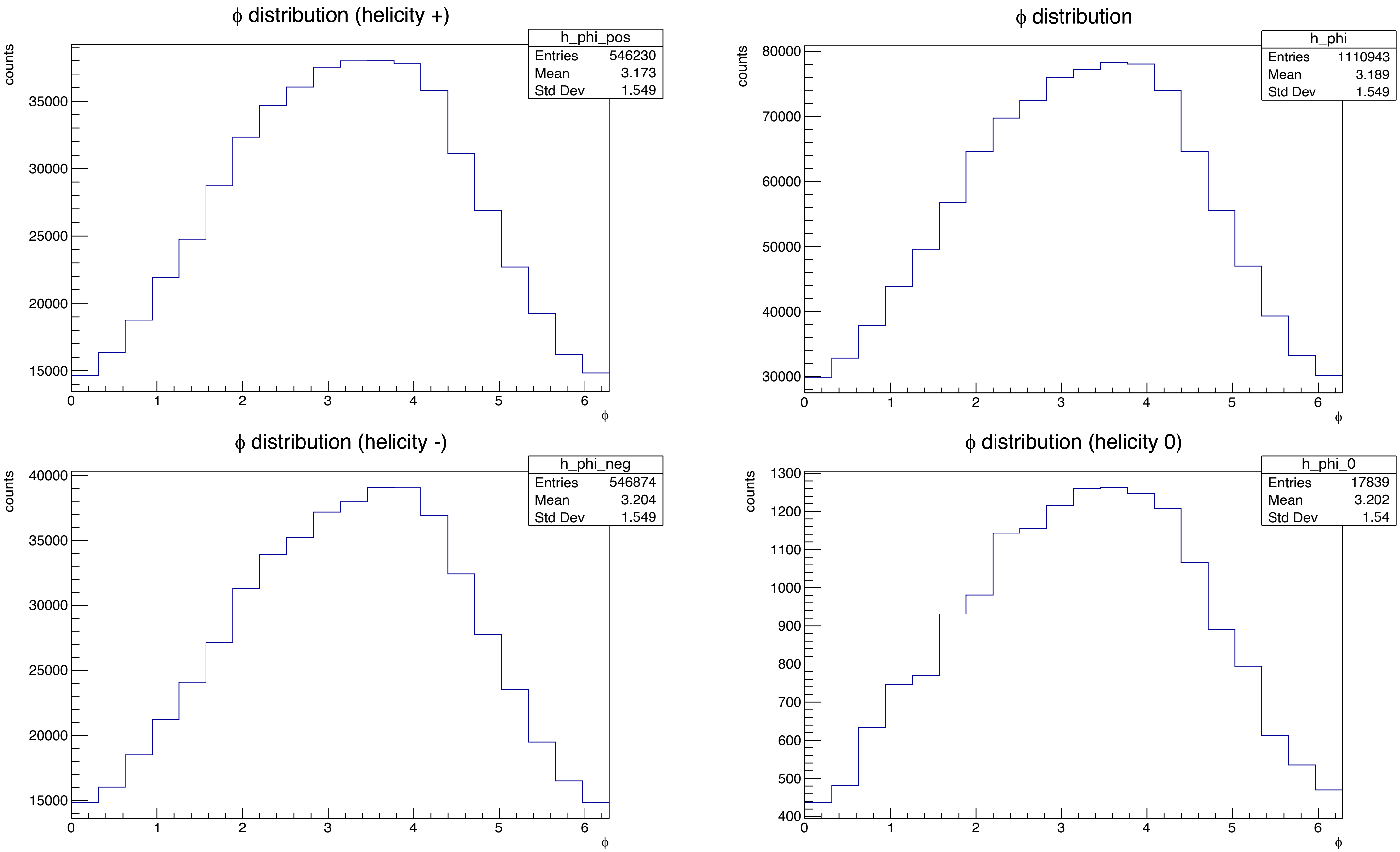


IN 4033-4063 4437-4517 57 runs

Half-wave Plate Status ---- OUT

π^0 events ϕ distribution

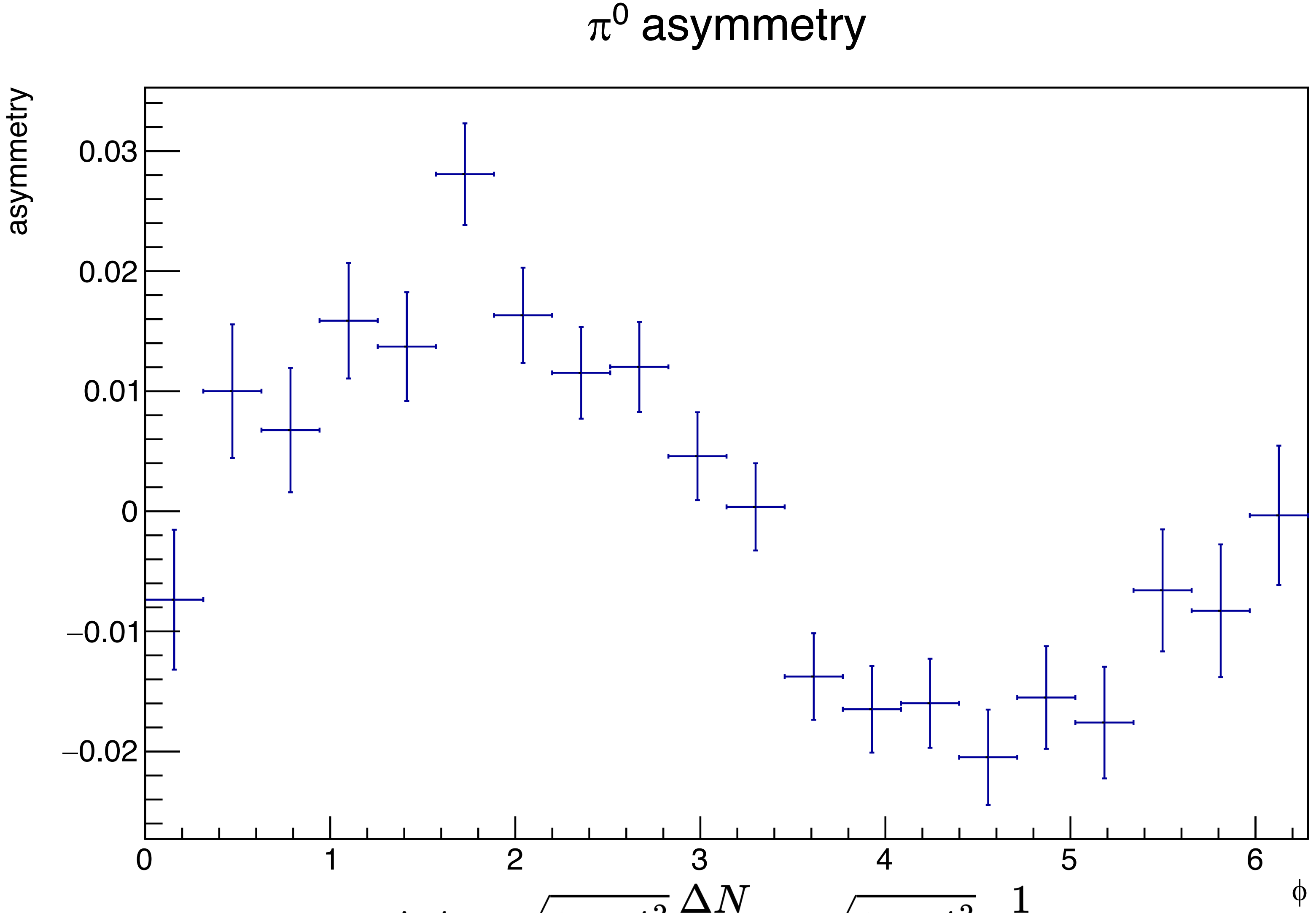
OUT 4064-4428 250 runs



π^0 asymmetry vs. ϕ

OUT 4064-4428 250 runs

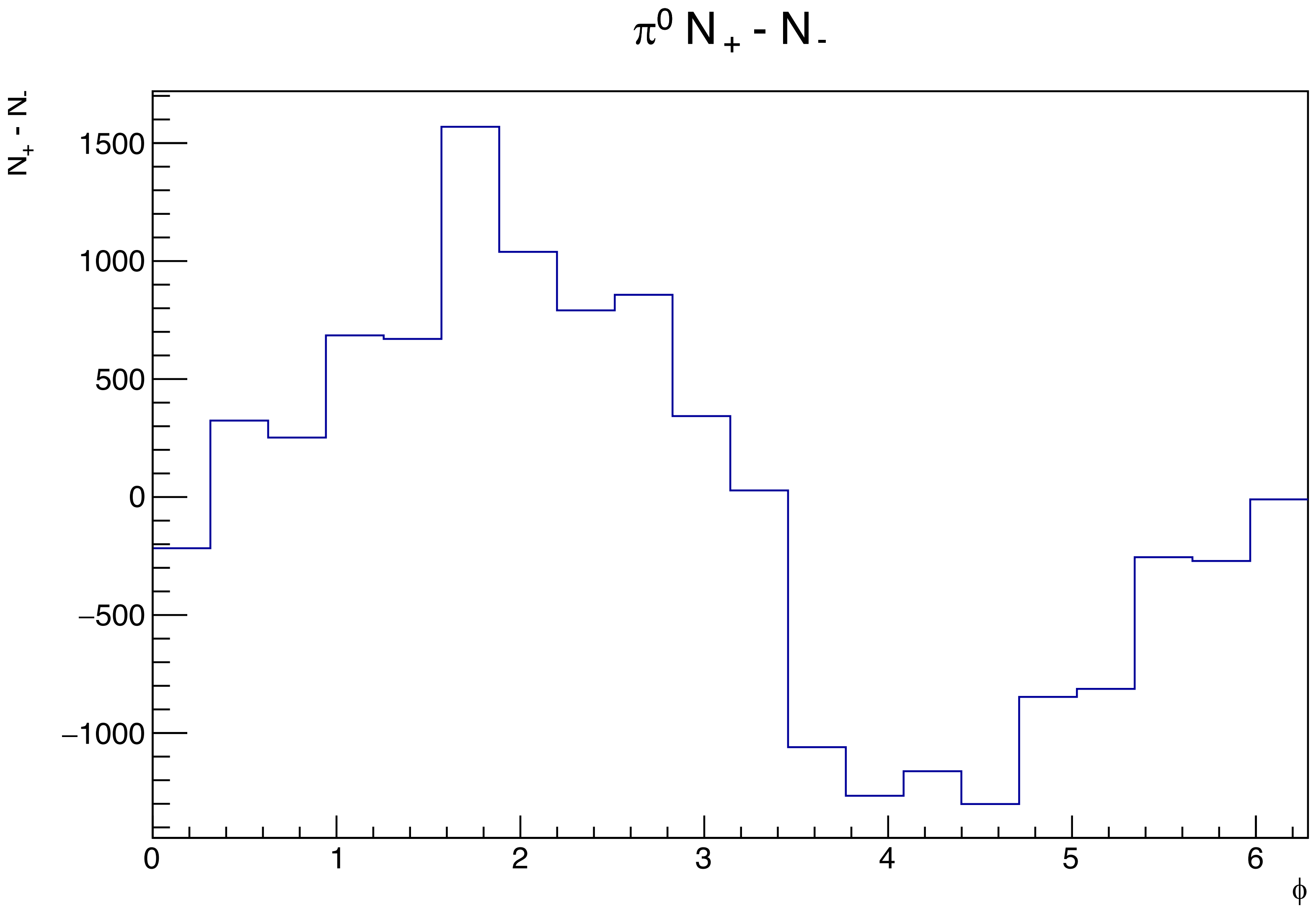
$$\pi^0\ Asymmetry = \frac{N_+ - N_-}{N_+ + N_-}$$



$$\Delta A = \sqrt{1 - A^2}\frac{\Delta N}{N} = \sqrt{1 - A^2}\frac{1}{\sqrt{N}}$$

$\pi^0\ N_+ - N_-$ vs. ϕ

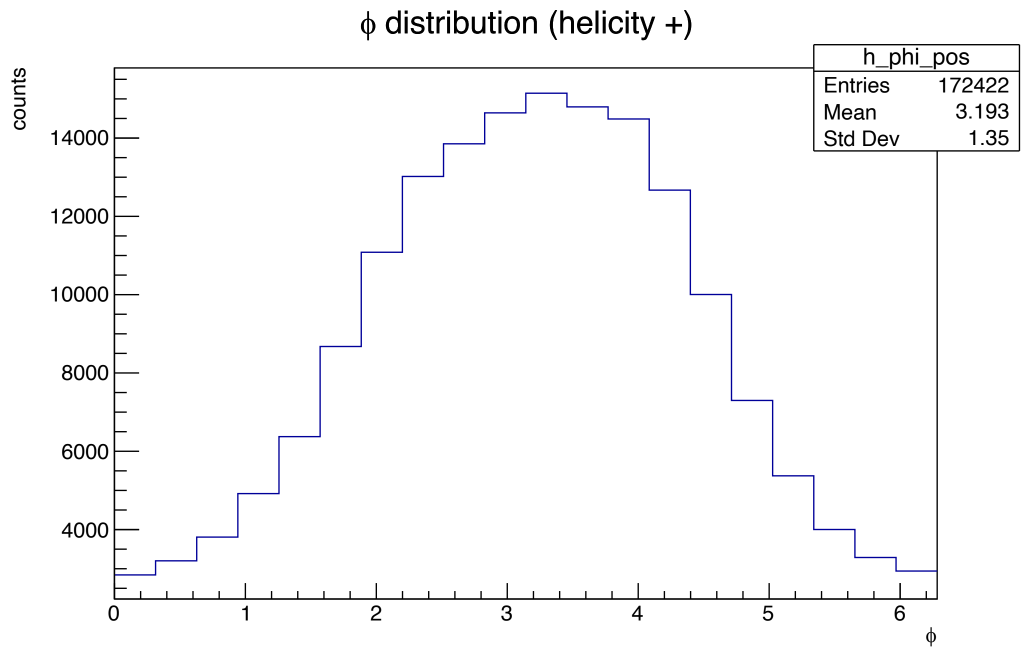
OUT 4064-4428 250 runs

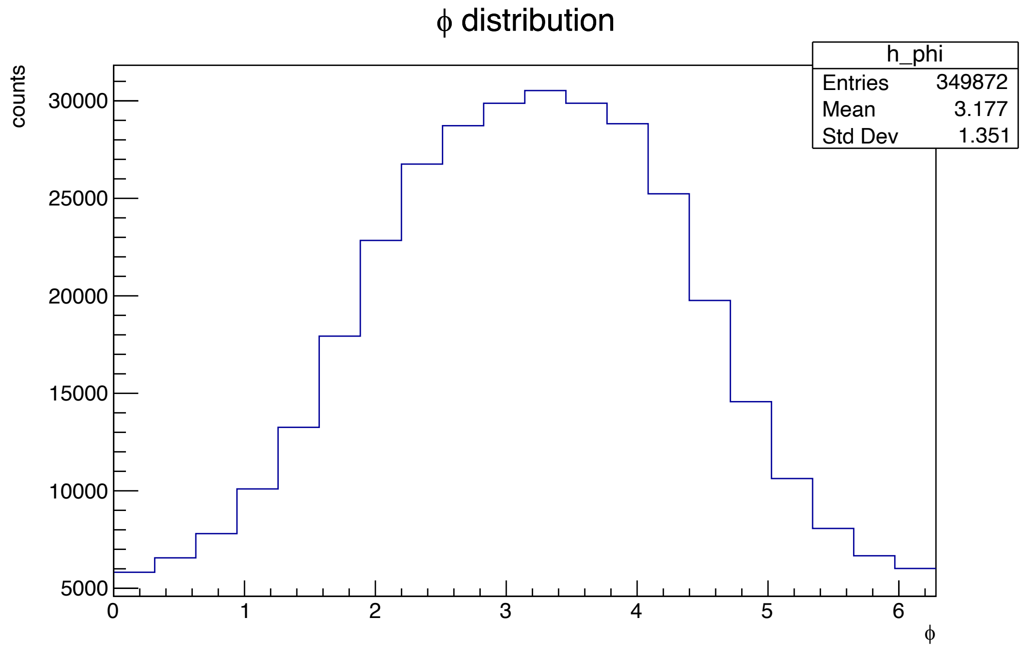


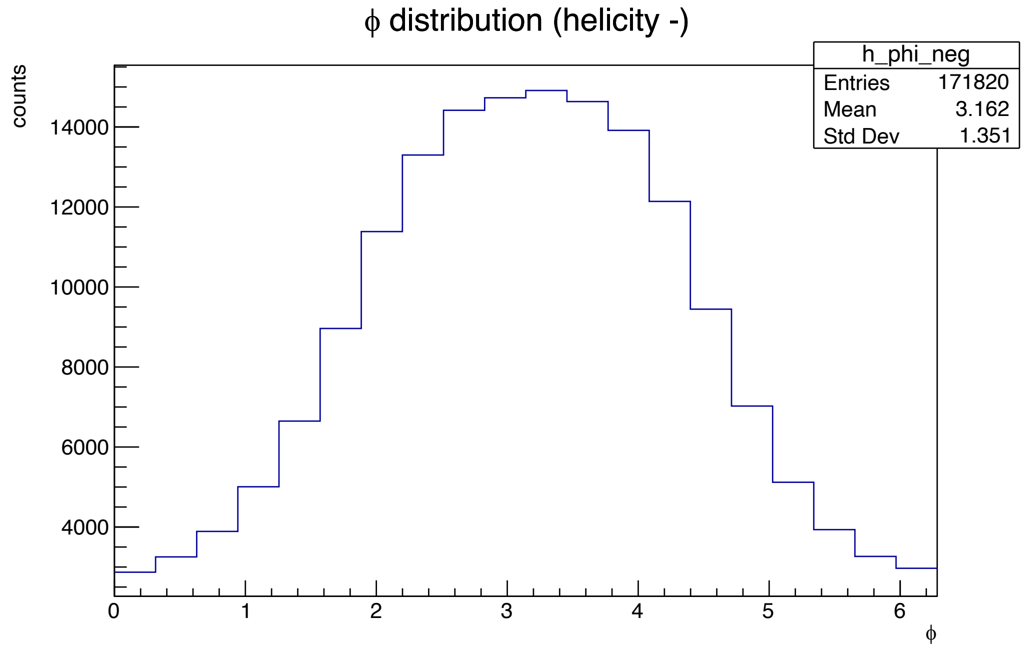
Half-wave Plate Status ---- IN

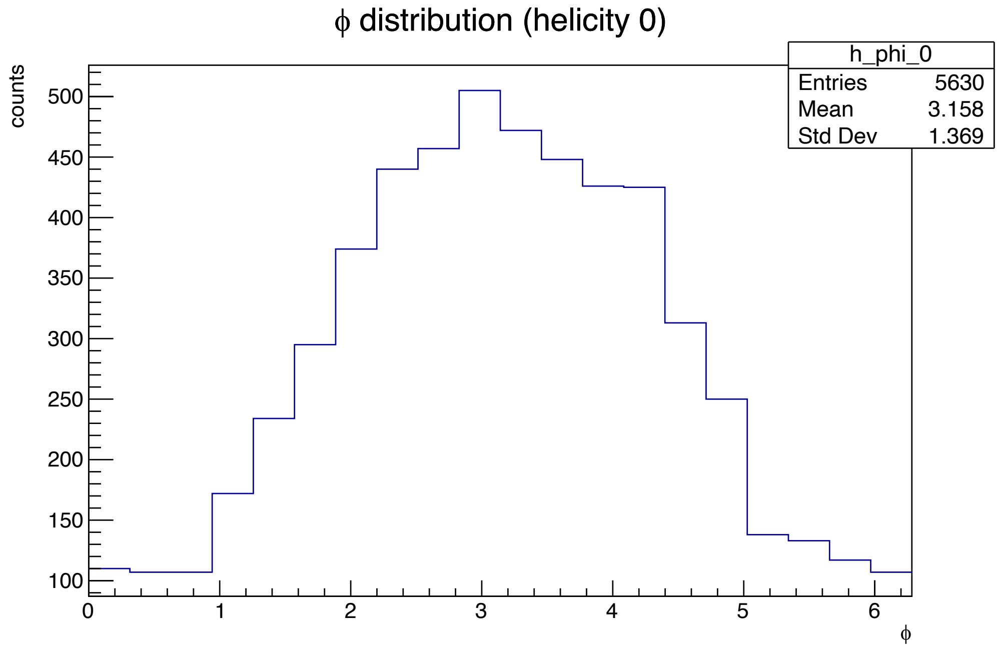
π^0 events ϕ distribution

IN 4033-4063 4437-4517 57 runs





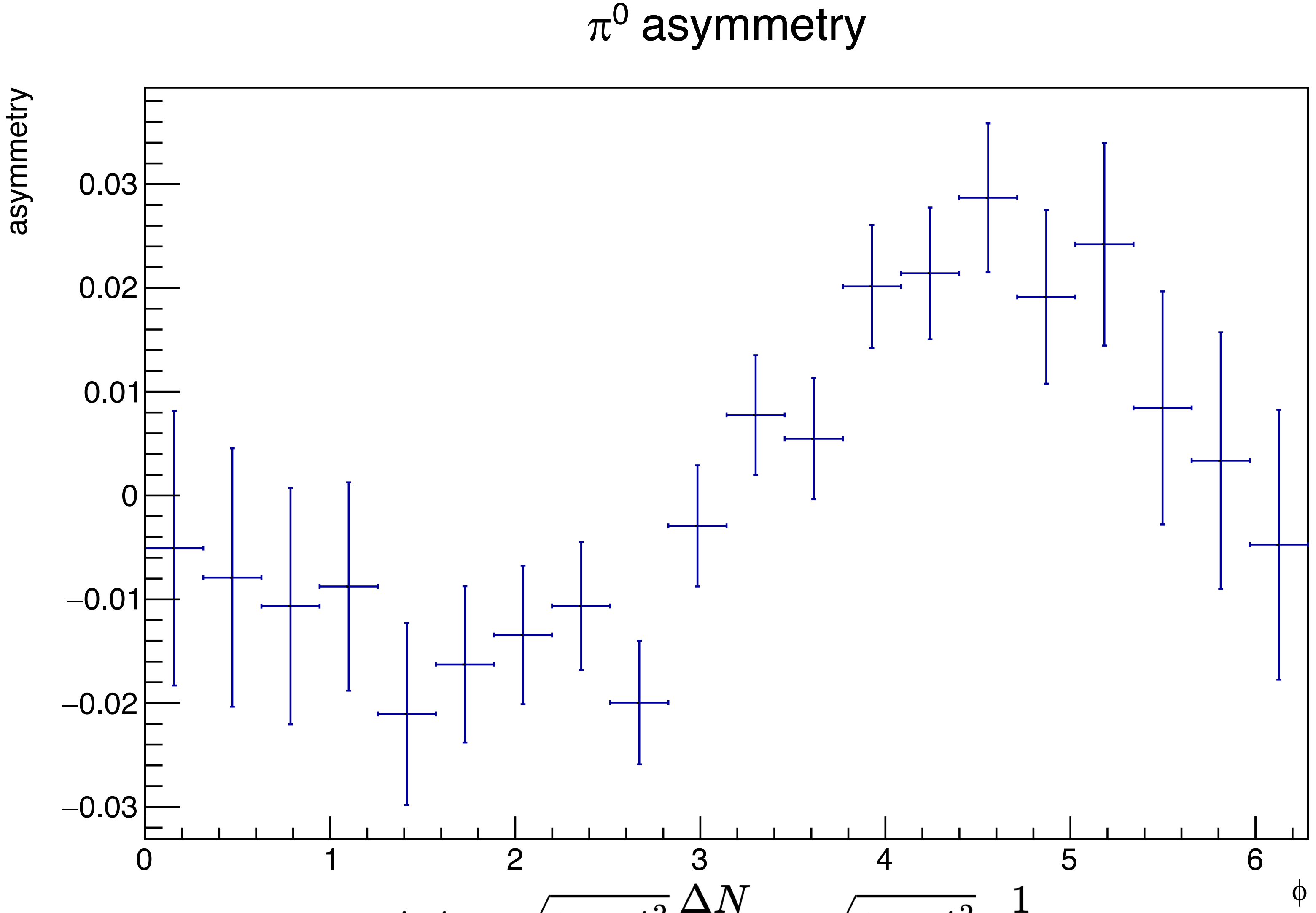




π^0 asymmetry vs. ϕ

IN 4033-4063 4437-4517 57 runs

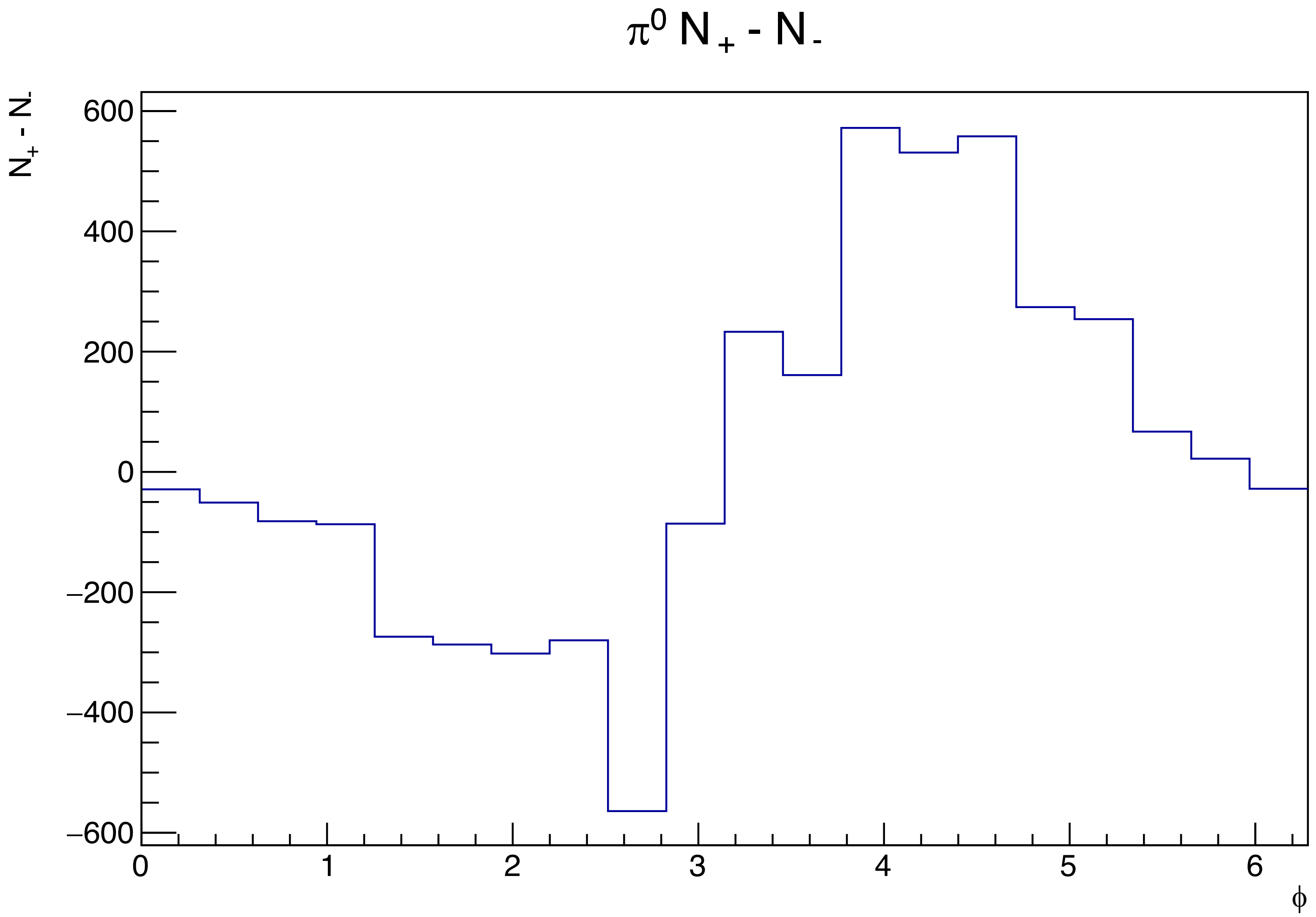
$$\pi^0\ Asymmetry = \frac{N_+ - N_-}{N_+ + N_-}$$



$$\Delta A = \sqrt{1 - A^2}\frac{\Delta N}{N} = \sqrt{1 - A^2}\frac{1}{\sqrt{N}}$$

$\pi^0 \ N_+ - N_-$ vs. ϕ

IN 4033-4063 4437-4517 57 runs



π^0 asymmetry uncertainty

$$A = \frac{N_+ - N_-}{N_+ + N_-}$$

$$N = N_+ + N_-, \quad N_+ = \frac{1}{2}N(1+A), \quad N_- = \frac{1}{2}N(1-A)$$

$$\Delta N = \sqrt{N} = \sqrt{N_+ + N_-}$$

$$\Delta N_+ = \sqrt{\frac{1}{2}(1+A)N} = \sqrt{\frac{1}{2}(1+A)}\Delta N$$

$$\Delta N_- = \sqrt{\frac{1}{2}(1-A)N} = \sqrt{\frac{1}{2}(1-A)}\Delta N$$

$$\frac{\partial A}{\partial N_+} = \frac{2N-}{(N_+ + N-)^2} = \frac{N(1-A)}{N^2} = \frac{1}{N}(1-A)$$

$$\frac{\partial A}{\partial N_-} = \frac{-2N+}{(N_+ + N-)^2} = -\frac{1}{N}(1+A)$$

$$\Delta A^2 = \left(\frac{\partial A}{\partial N_+}\Delta N_+\right)^2 + \left(\frac{\partial A}{\partial N_-}\Delta N_-\right)^2$$

$$= \left[\frac{1}{N}(1-A)\sqrt{\frac{1}{2}(1+A)}\Delta N\right]^2 + \left[-\frac{1}{N}(1+A)\sqrt{\frac{1}{2}(1-A)}\Delta N\right]^2$$

$$= \left(\frac{\Delta N}{N}\right)^2 \left[\frac{1}{2}(1-A)^2(1+A) + \frac{1}{2}(1+A)^2(1-A)\right]$$

$$= \frac{1}{2}\left(\frac{\Delta N}{N}\right)^2 \left(1-A^2\right)(1-A+1+A)$$

$$= \left(\frac{\Delta N}{N}\right)^2 \left(1-A^2\right)$$

$$\Delta A = \sqrt{1-A^2}\frac{\Delta N}{N} = \sqrt{1-A^2}\frac{1}{\sqrt{N}}$$

$$\Delta A = \sqrt{1-A^2}\frac{\Delta N}{N} = \sqrt{1-A^2}\frac{1}{\sqrt{N}}$$

ϕ definition

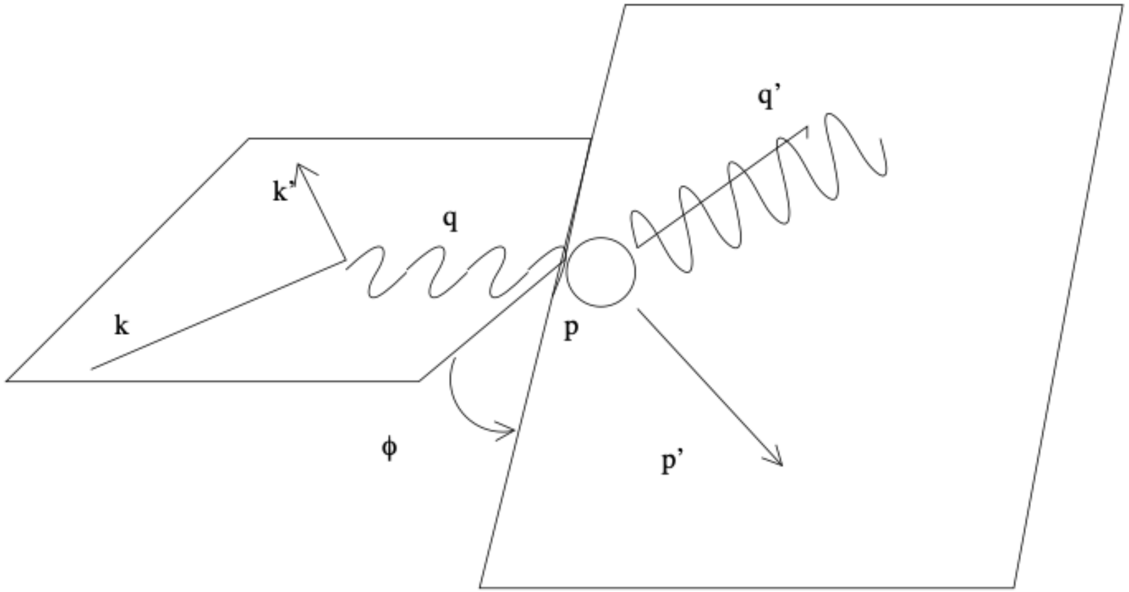


Figure 2.7: Definition of ϕ the angle between the leptonic and hadronic plane