

π^0 asymmetry

π^0 cross section:

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

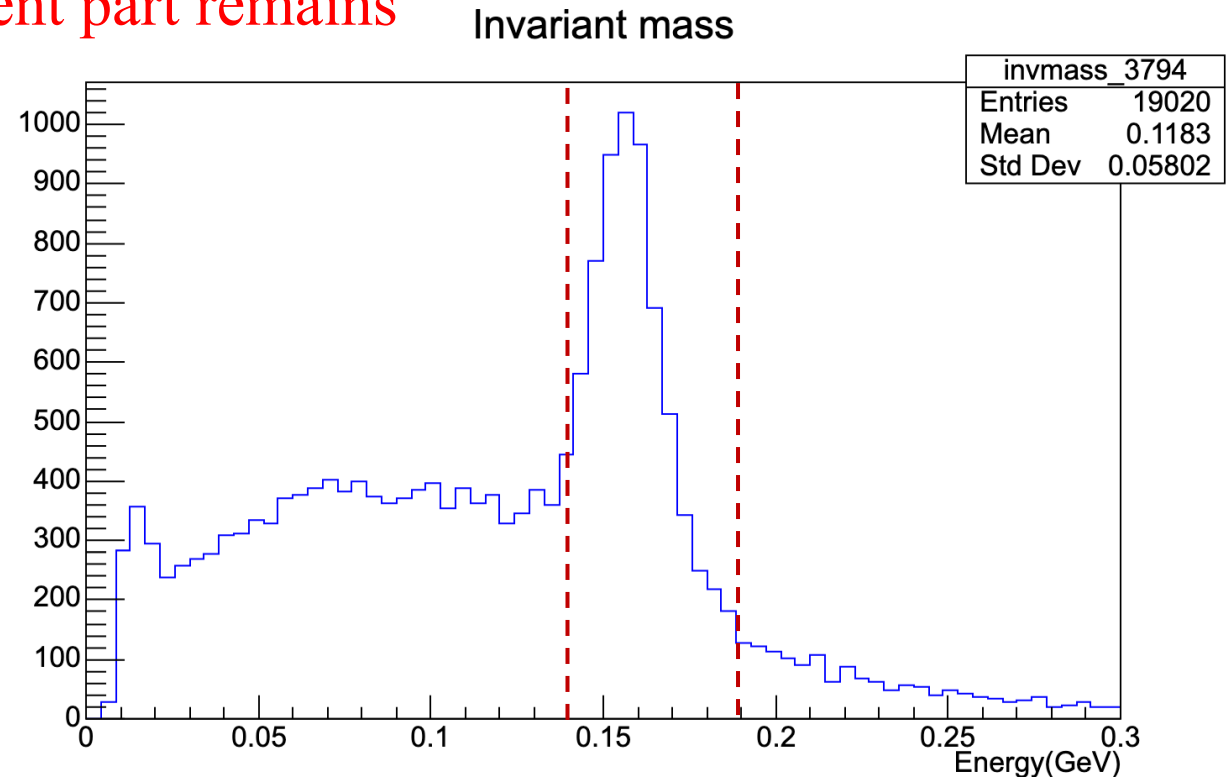
helicity dependent part

Only helicity dependent part remains

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

Cuts applied:

- π^0 invariant mass $\in [0.14, 0.19]$
- missing mass square $\in [1.1, 1.8]$

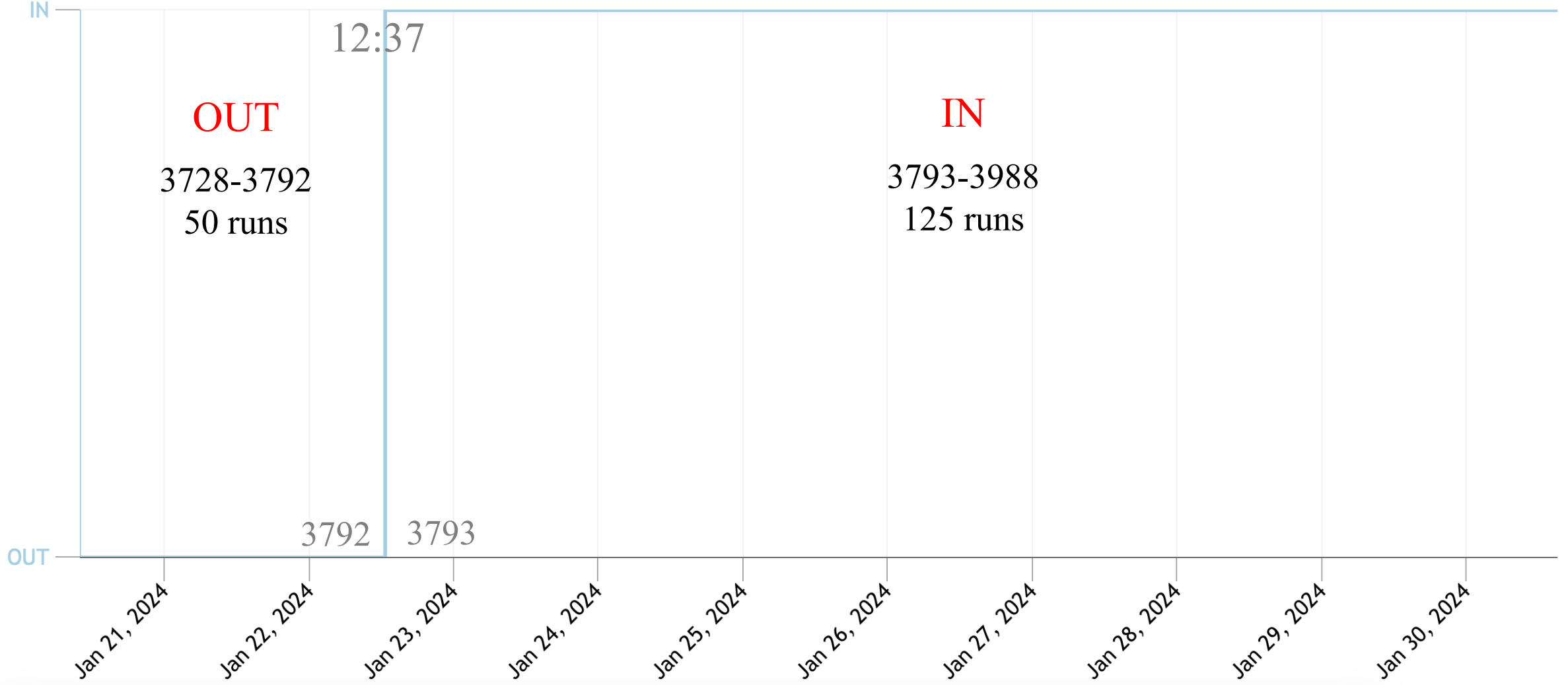


Half-wave Plate Status

January 20 - 30, 2024 (10:00:00 - 15:12:49)

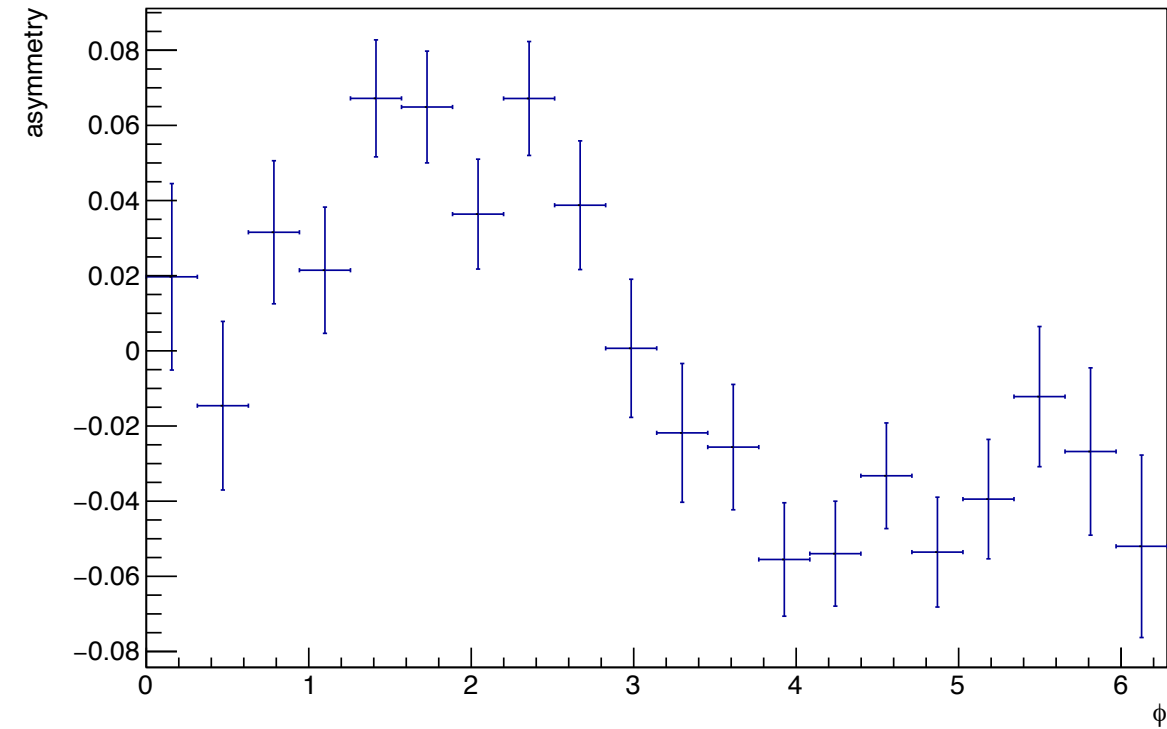


— IGL1100OD16_16



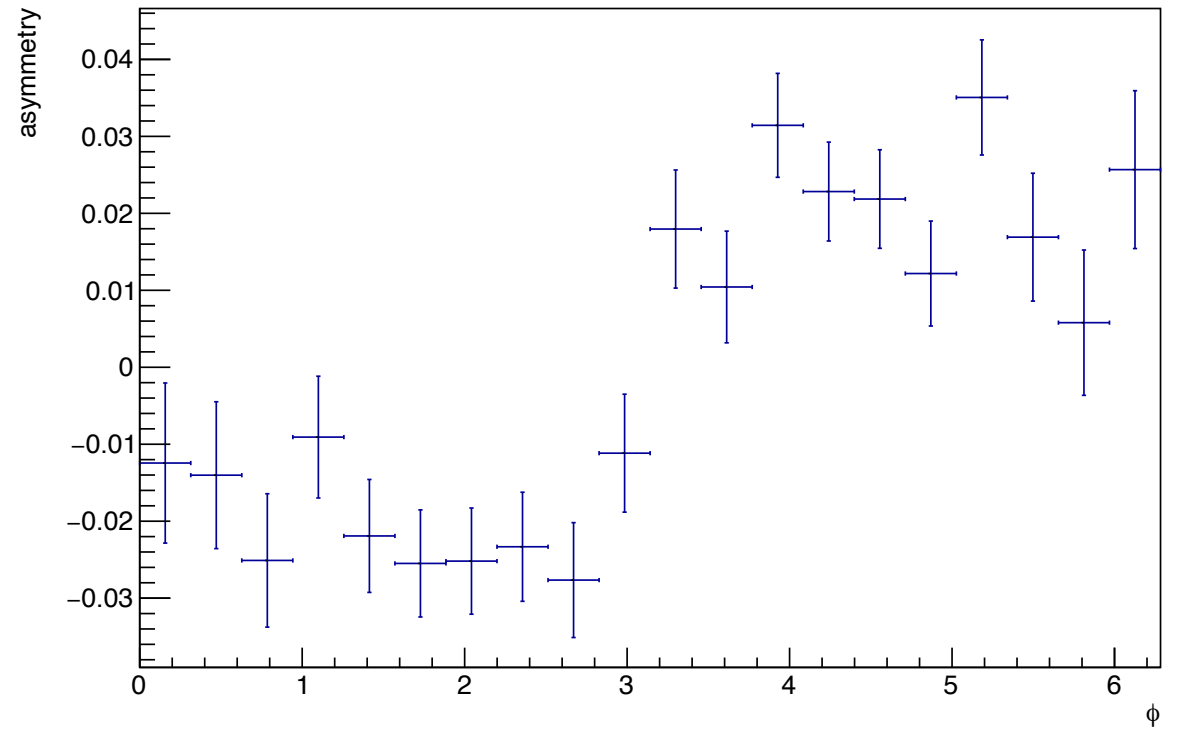
π^0 asymmetry vs. ϕ

π^0 asymmetry



OUT 3728-3792 50 runs

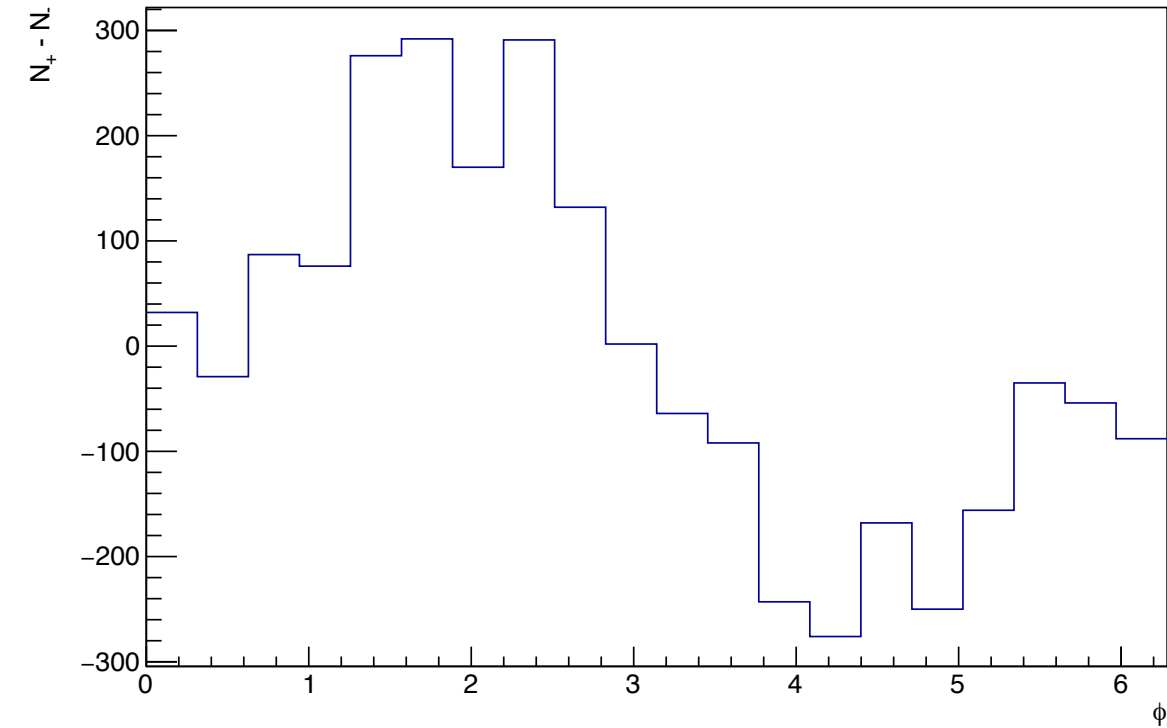
π^0 asymmetry



IN 3793-3988 125 runs

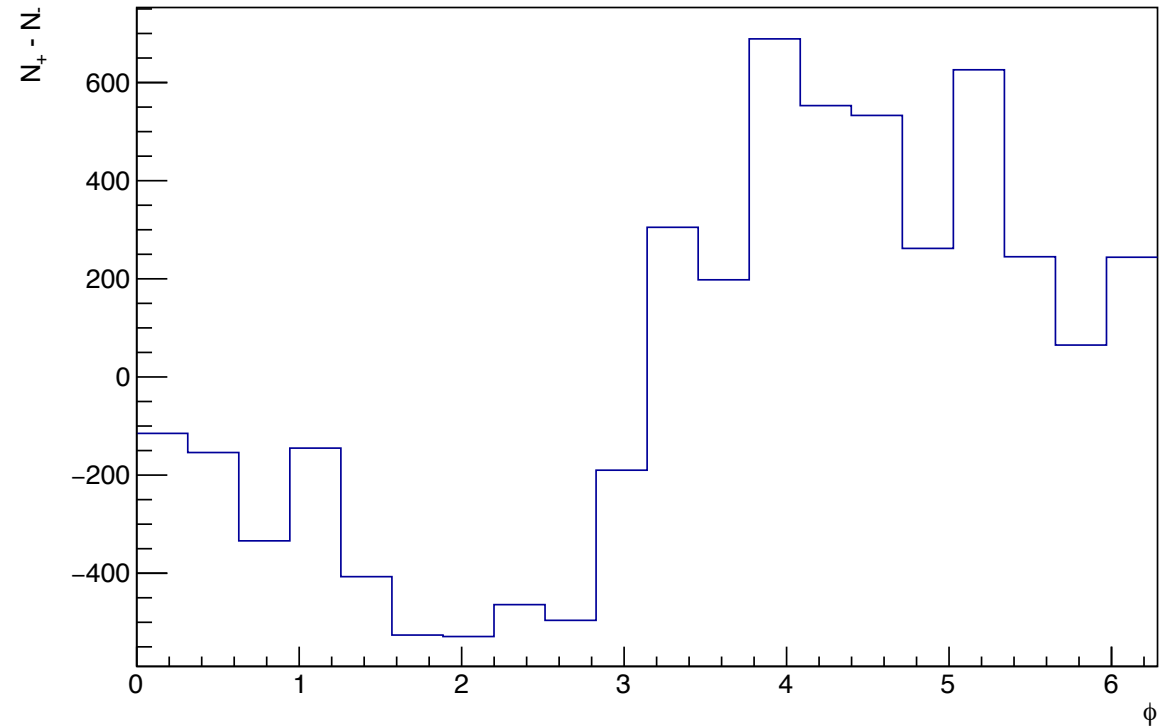
$\pi^0 N_+ - N_-$ vs. ϕ

$\pi^0 N_+ - N_-$



OUT 3728-3792 50 runs

$\pi^0 N_+ - N_-$

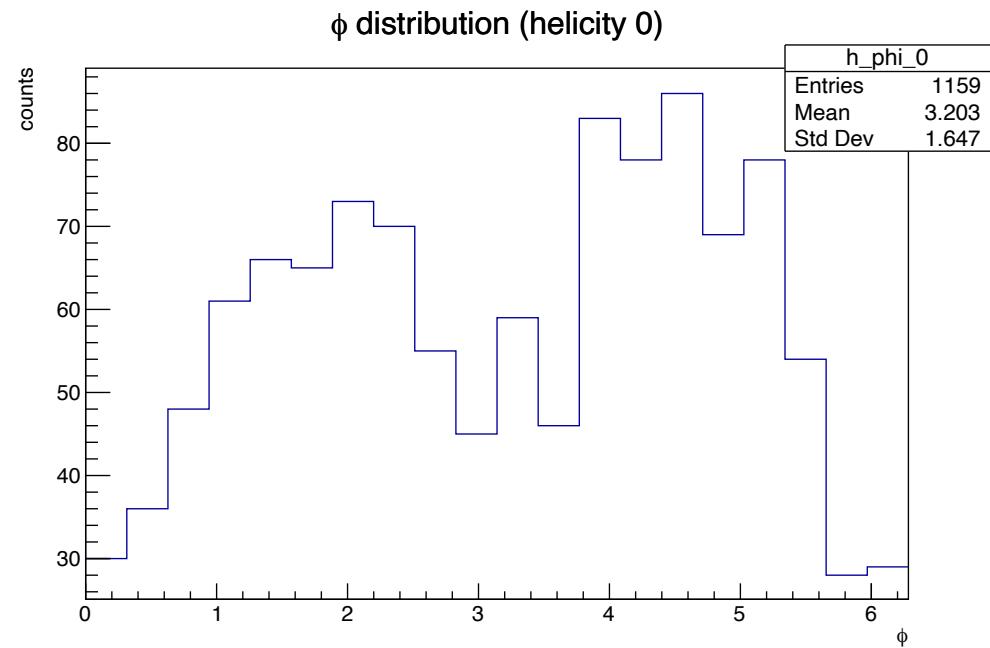
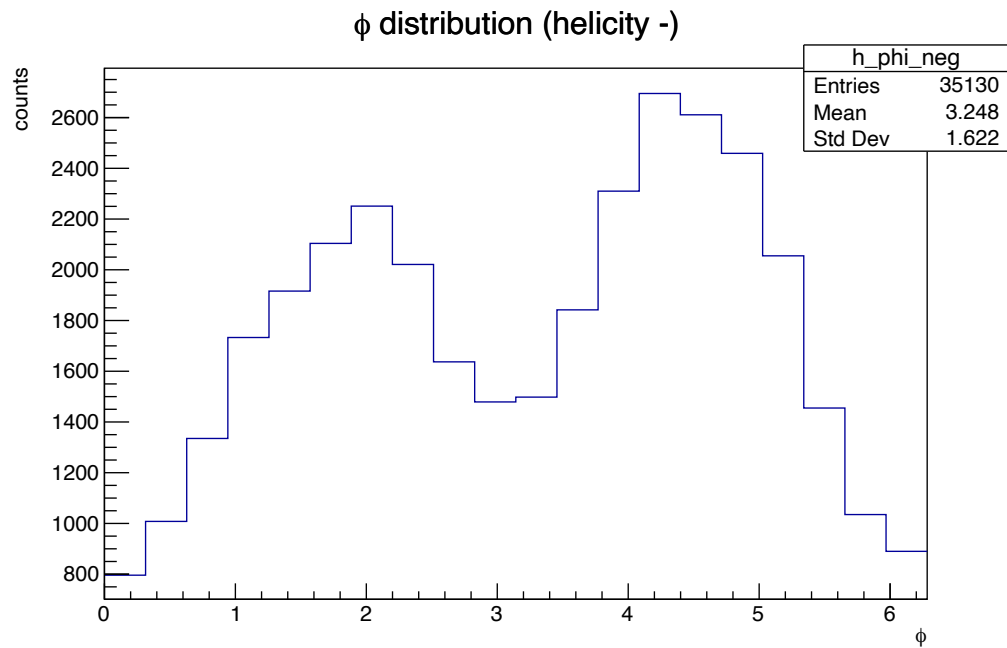
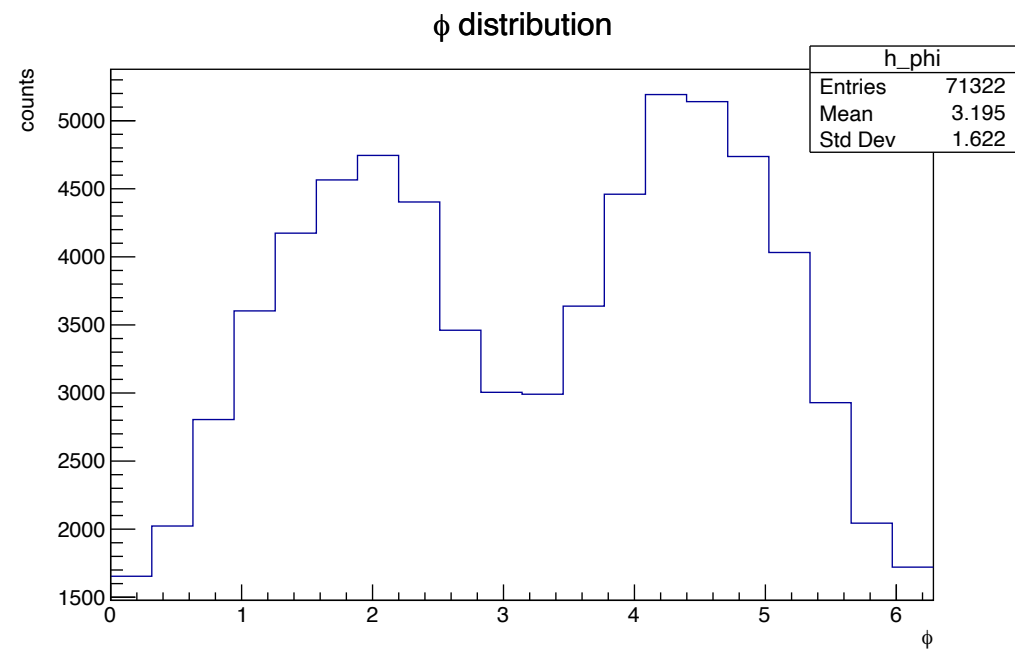
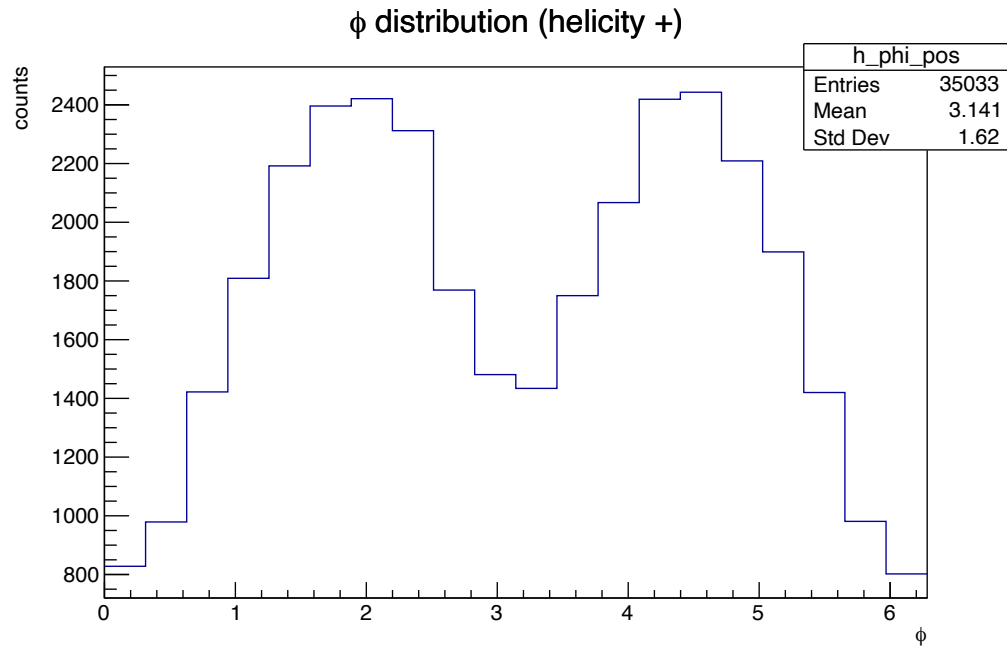


IN 3793-3988 125 runs

Half-wave Plate Status ---- OUT

π^0 events ϕ distribution

OUT 3728-3792 50 runs

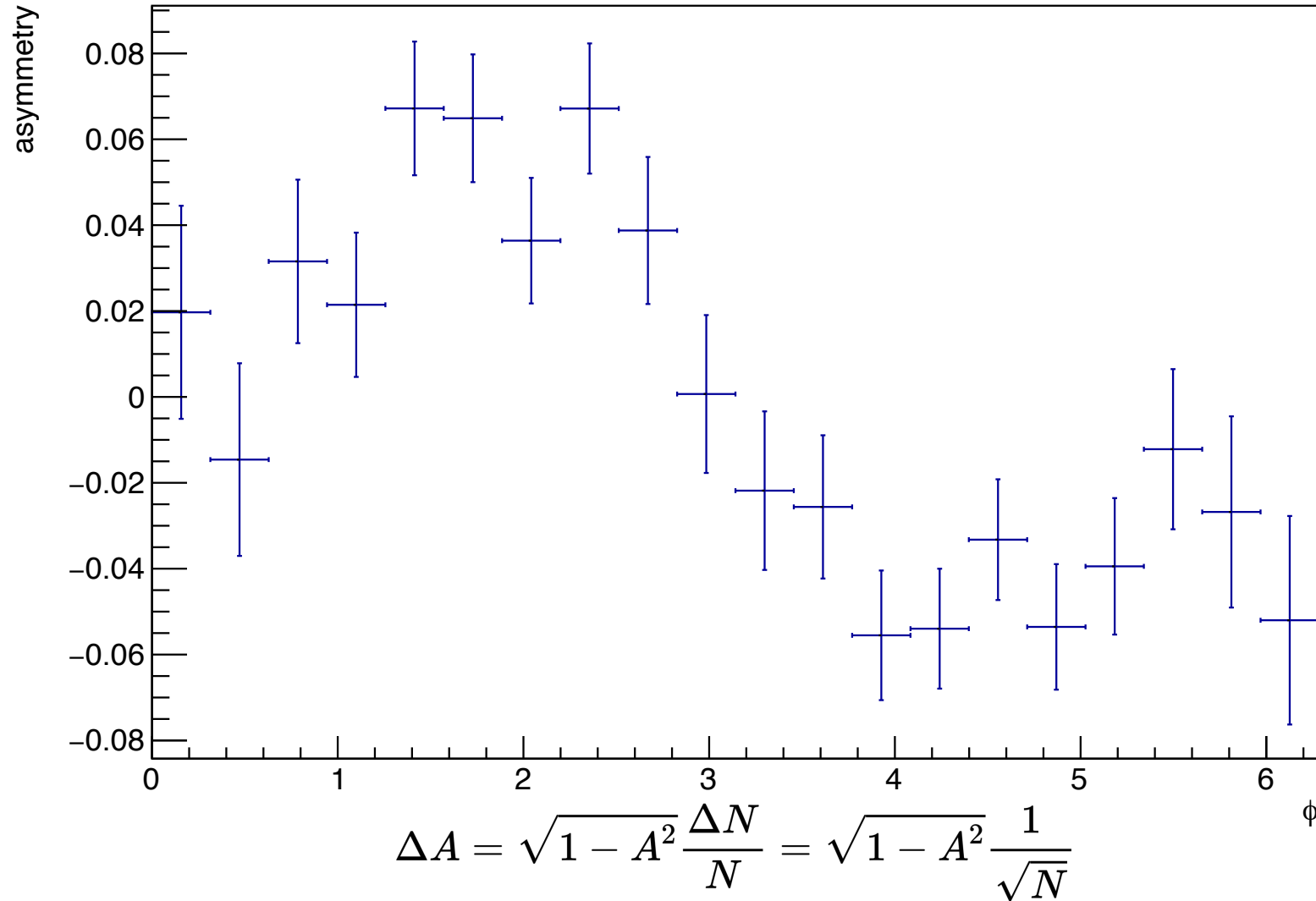


π^0 asymmetry vs. ϕ

OUT 3728-3792 50 runs

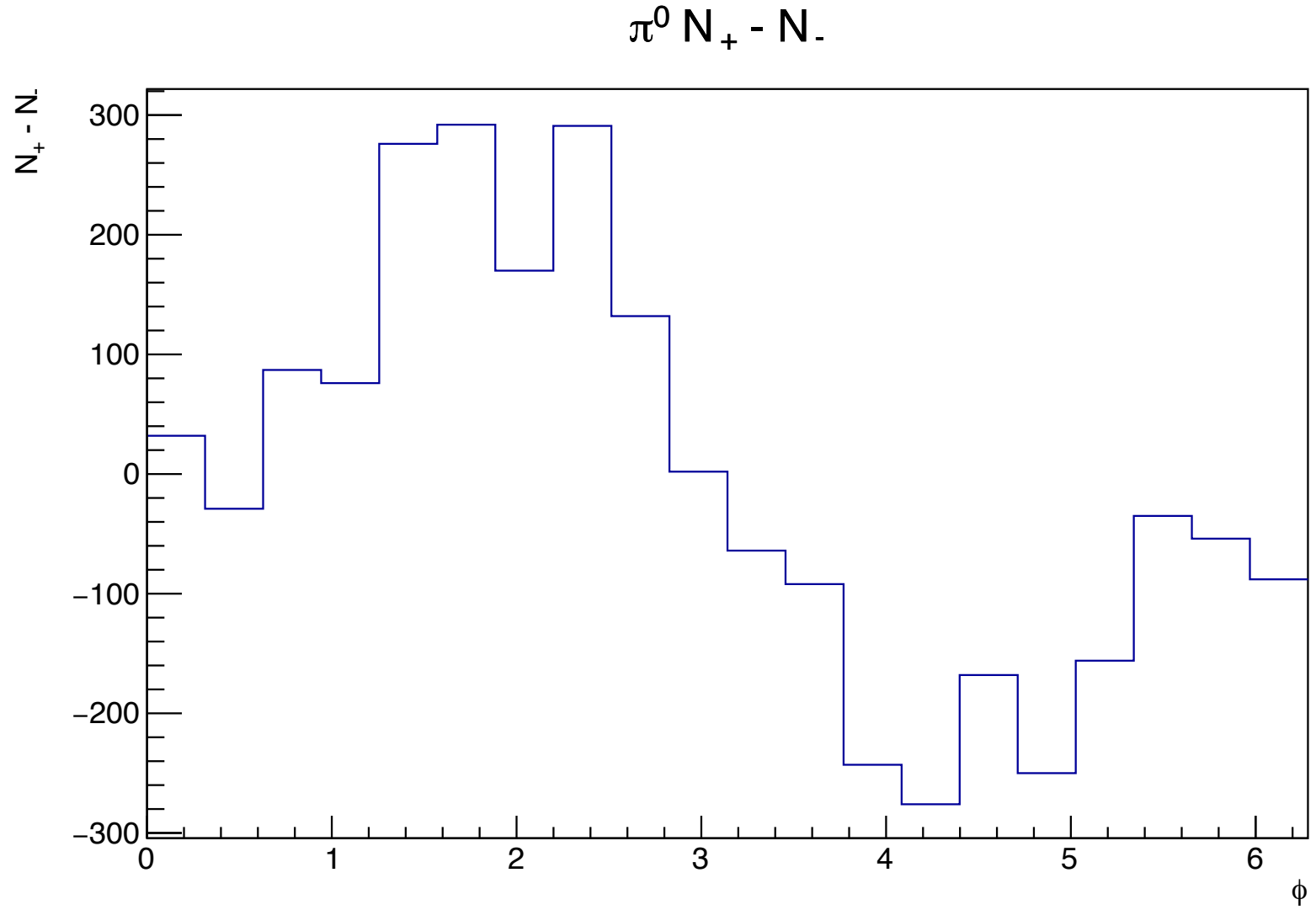
$$\pi^0 \text{ Asymmetry} = \frac{N_+ - N_-}{N_+ + N_-}$$

π^0 asymmetry



$\pi^0 N_+ - N_-$ vs. ϕ

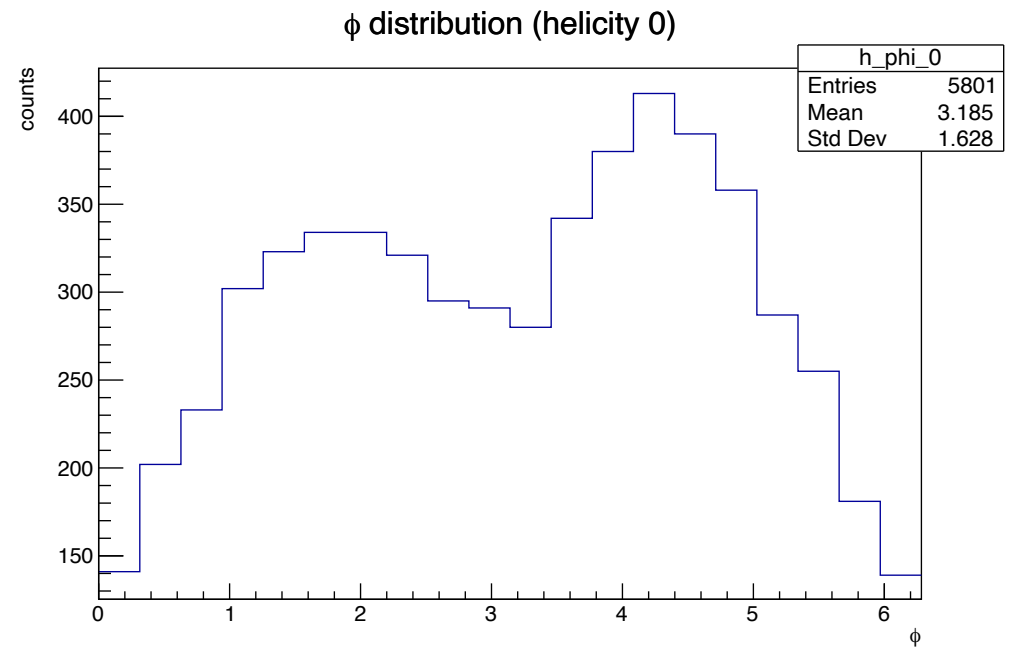
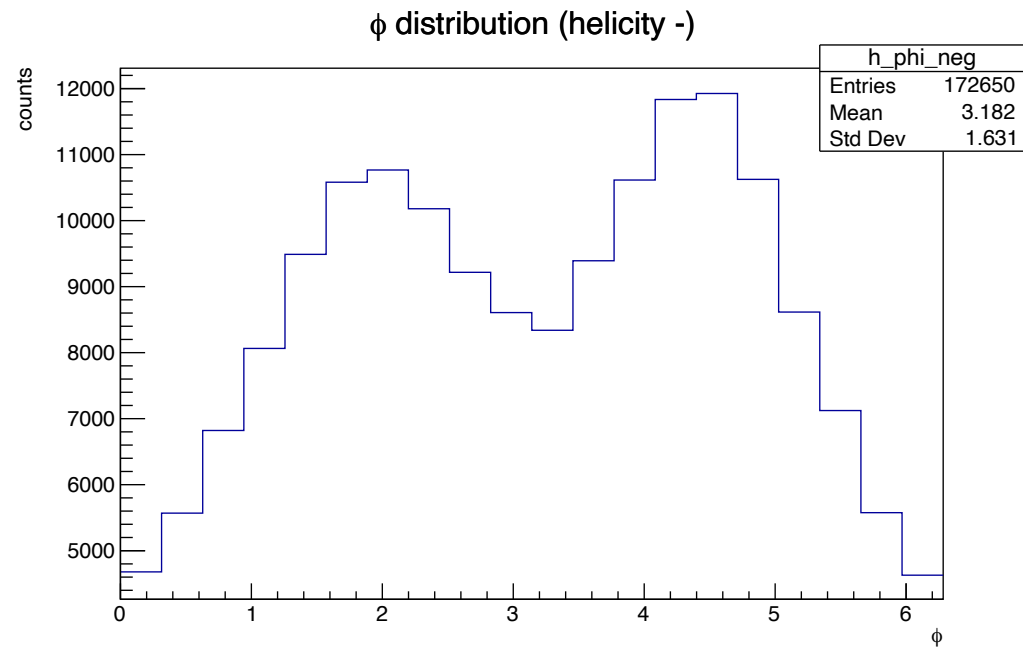
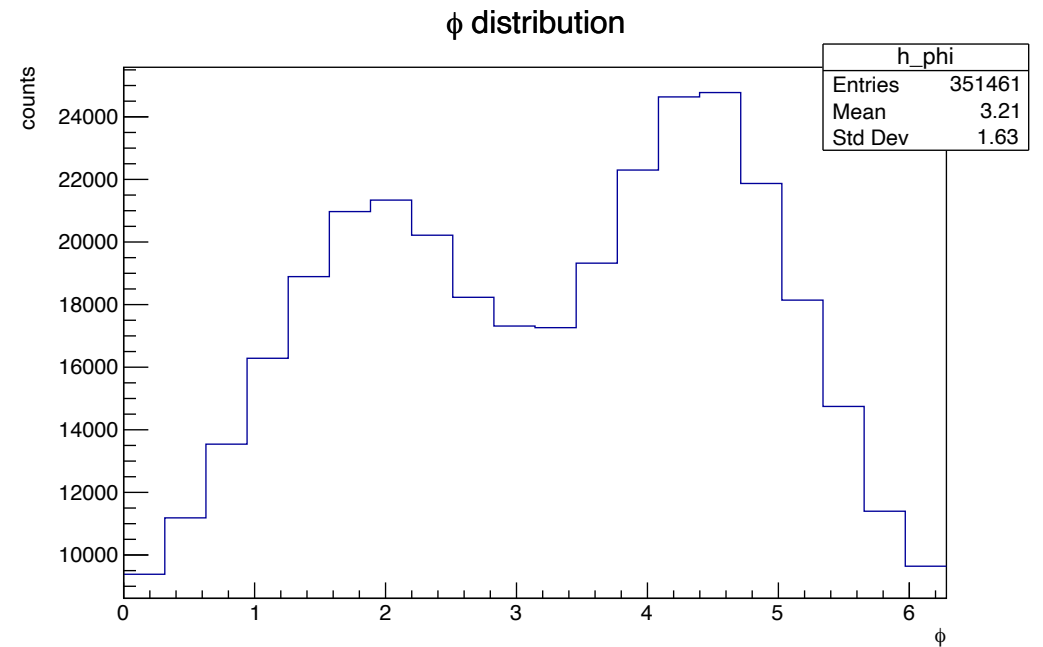
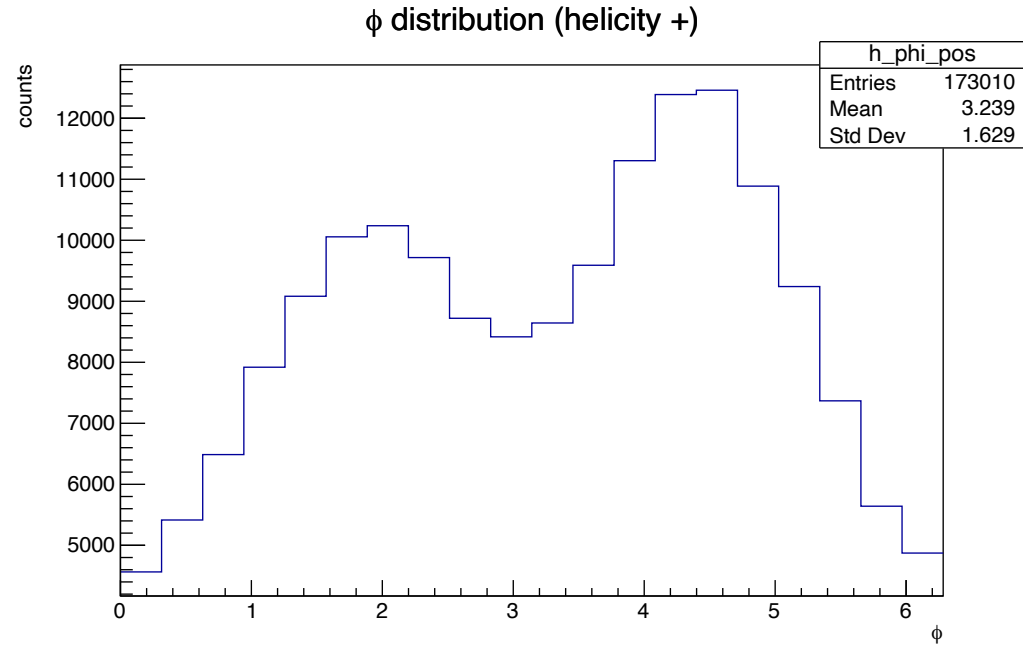
OUT 3728-3792 50 runs



Half-wave Plate Status ---- IN

π^0 events ϕ distribution

IN 3793-3988 125 runs

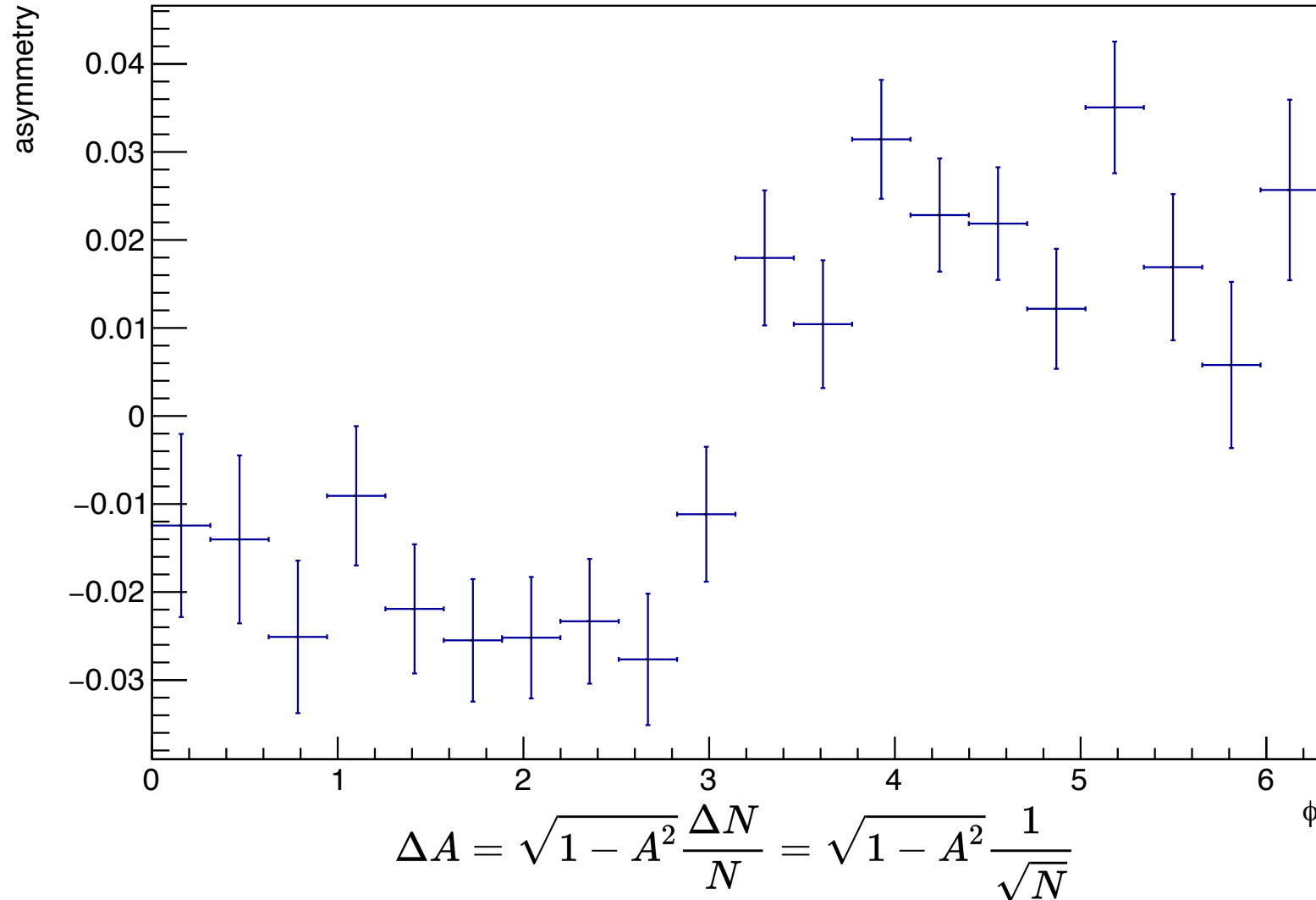


π^0 asymmetry vs. ϕ

IN 3793-3988 125 runs

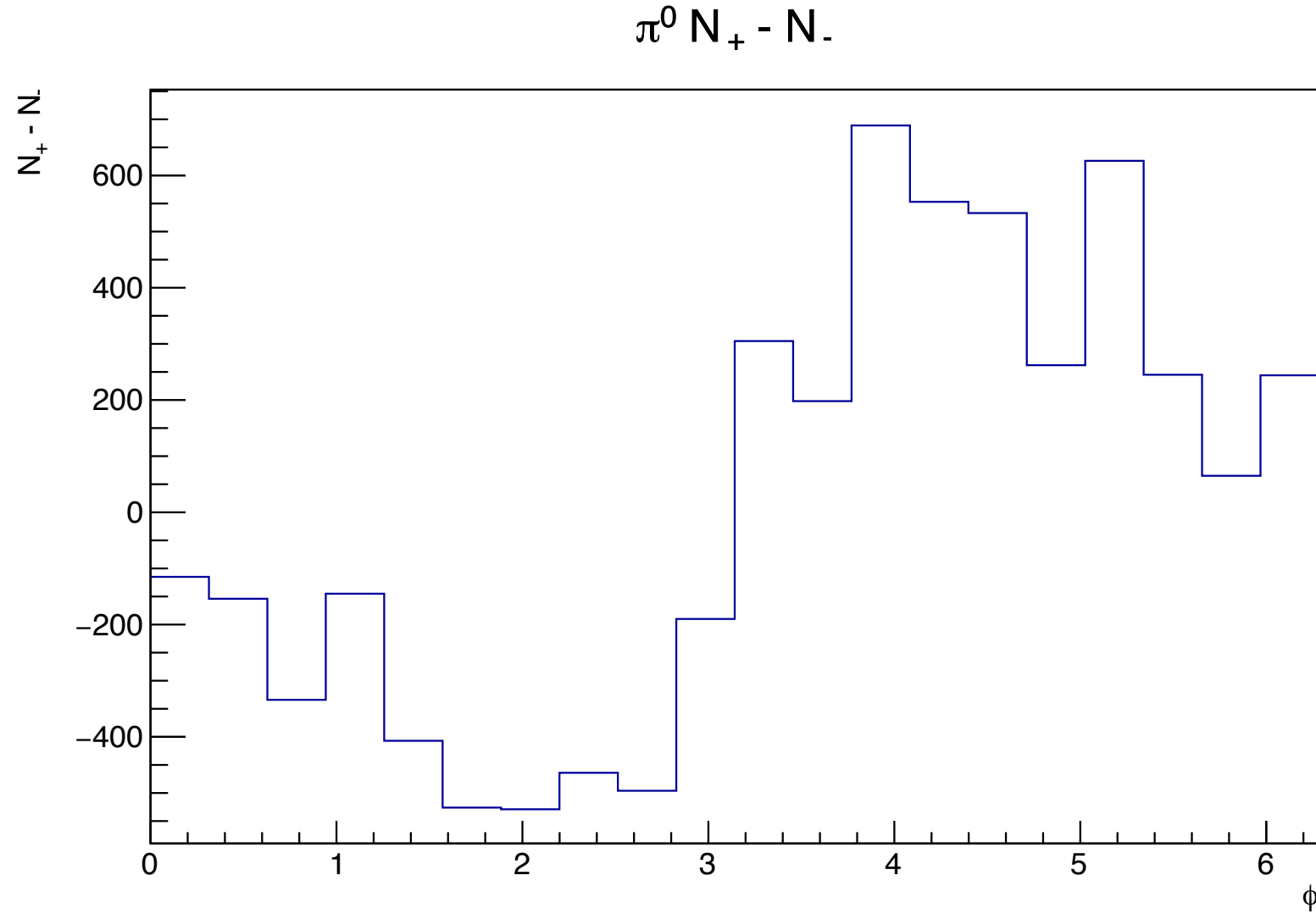
$$\pi^0 \text{ Asymmetry} = \frac{N_+ - N_-}{N_+ + N_-}$$

π^0 asymmetry



$\pi^0 N_+ - N_-$ vs. ϕ

IN 3793-3988 125 runs



π^0 asymmetry uncertainty

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

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

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

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

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

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

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

$$\begin{aligned} \Delta A^2 &= \left(\frac{\partial A}{\partial N_+} \Delta N_+ \right)^2 + \left(\frac{\partial A}{\partial N_-} \Delta N_- \right)^2 \\ &= \left[\frac{1}{N}(1 - A) \sqrt{\frac{1}{2}(1 + A)\Delta N} \right]^2 + \left[-\frac{1}{N}(1 + A) \sqrt{\frac{1}{2}(1 - A)\Delta N} \right]^2 \\ &= \left(\frac{\Delta N}{N} \right)^2 \left[\frac{1}{2}(1 - A)^2(1 + A) + \frac{1}{2}(1 + A)^2(1 - A) \right] \\ &= \frac{1}{2} \left(\frac{\Delta N}{N} \right)^2 (1 - A^2)(1 - A + 1 + A) \\ &= \left(\frac{\Delta N}{N} \right)^2 (1 - A^2) \end{aligned}$$

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

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ϕ definition

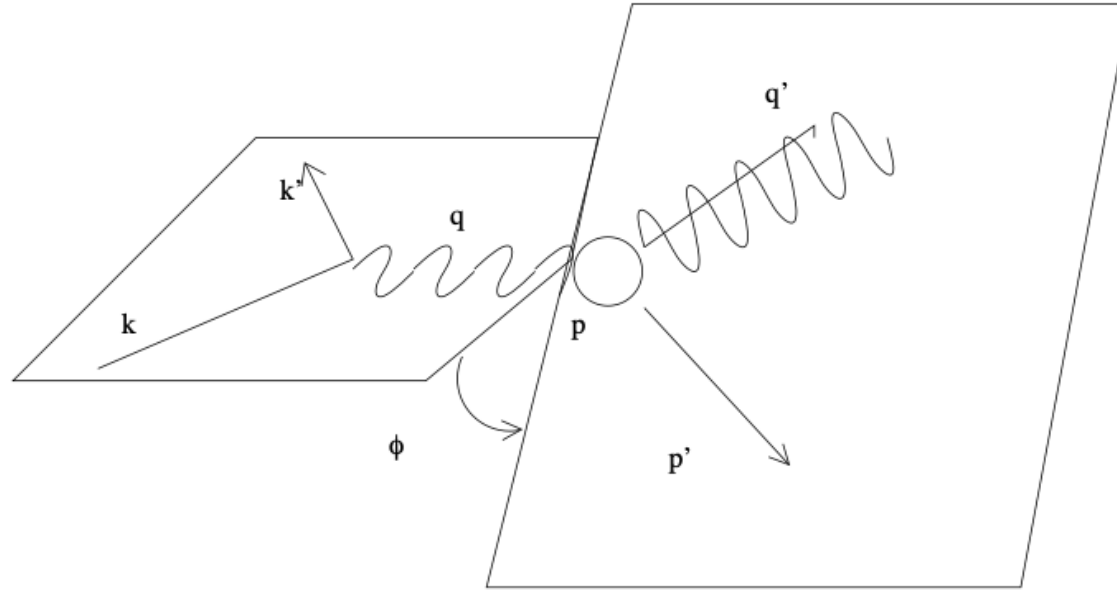


Figure 2.7: Definition of ϕ the angle between the leptonic and hadronic plane