Measurement of single transverse-spin asymmetries in forward production of photons and neutrons in pp collisions at $\sqrt{s}$=200 GeV

Yoshinori Fukao for
the Local Polarimeter Collaboration

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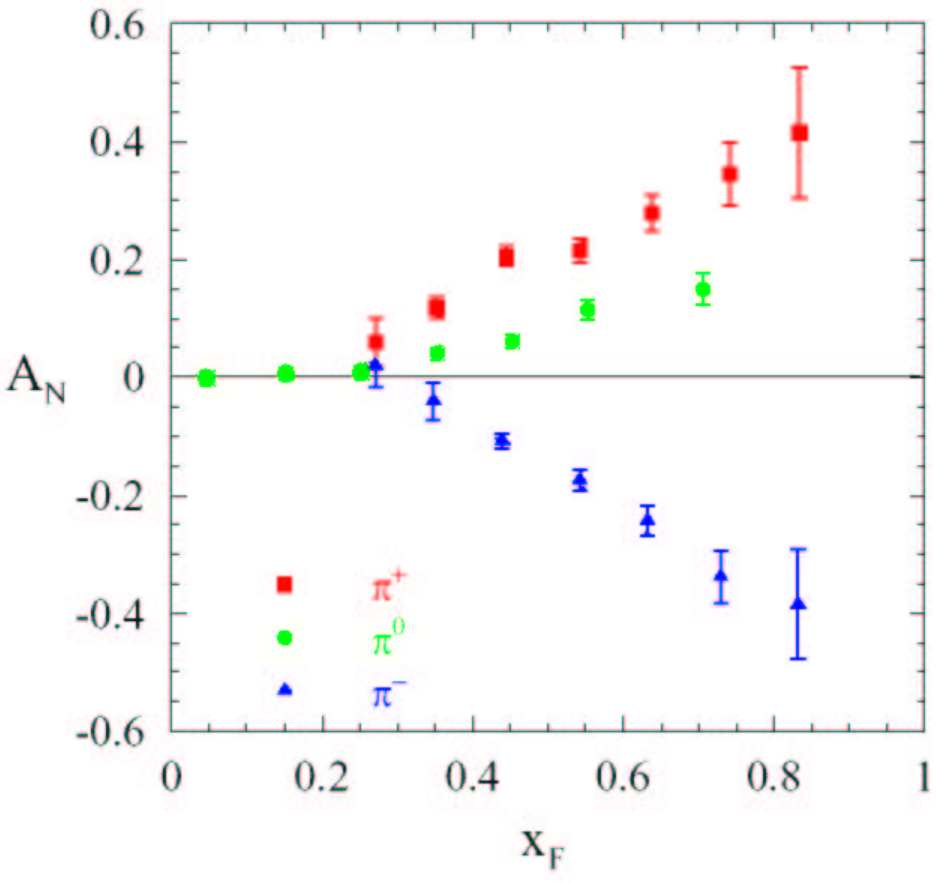
Introduction

Motivation

Many interesting measurements of single transverse-spin asymmetries especially in forward region in lower energies;...

...would like to see if such effects persists at High Energy $\sqrt{s}$ =200 GeV.

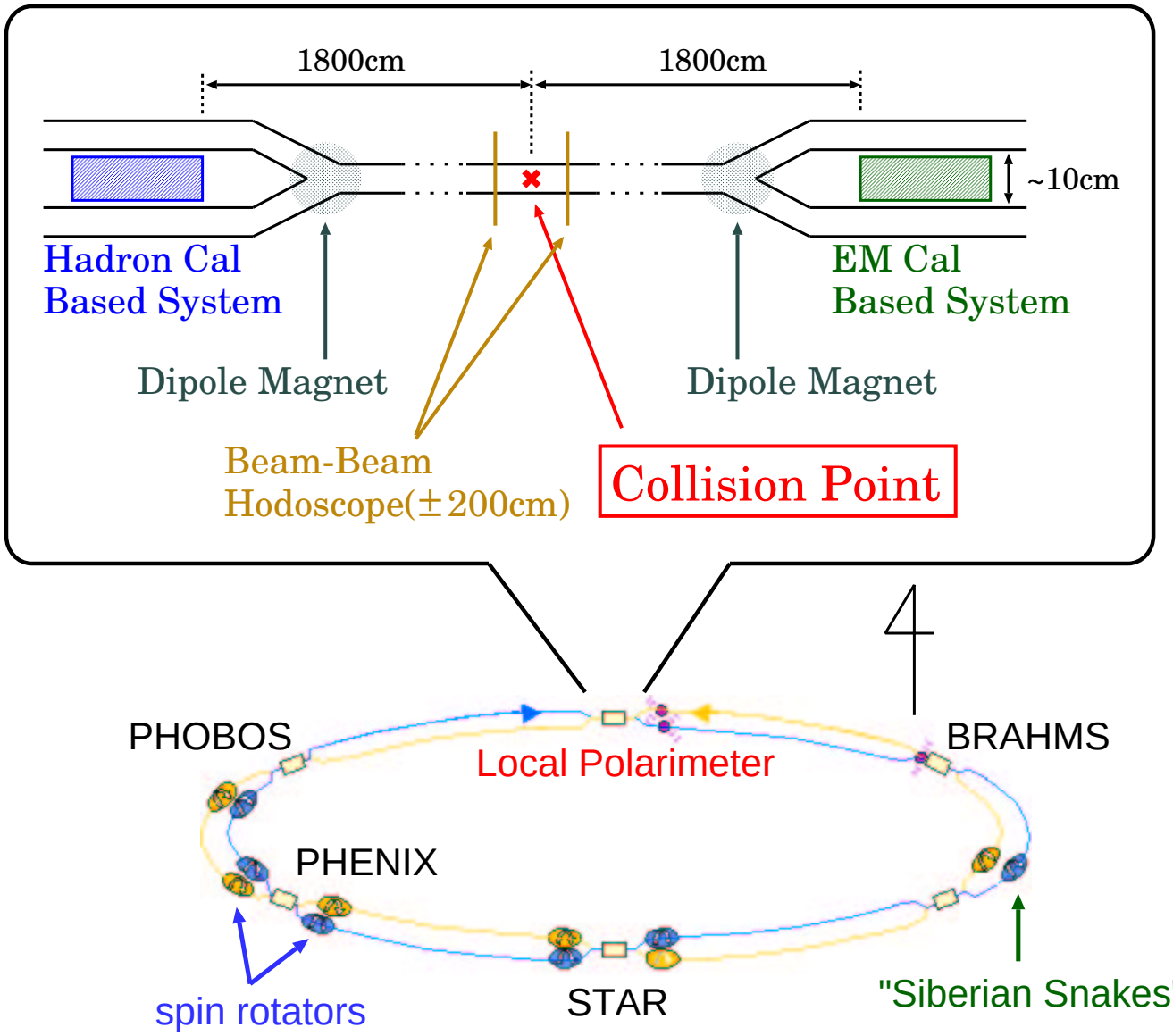


The E704 experiment at Fermilab

- pp -> $\pi^{\pm 0}$ X
- $\sqrt{s}$ = 19.4GeV
- p_T = 0.2~2.0 GeV/c

D.L. Adams *et al.*, *Phys. Lett.* **B264** (1991) 462

Experimental Setup



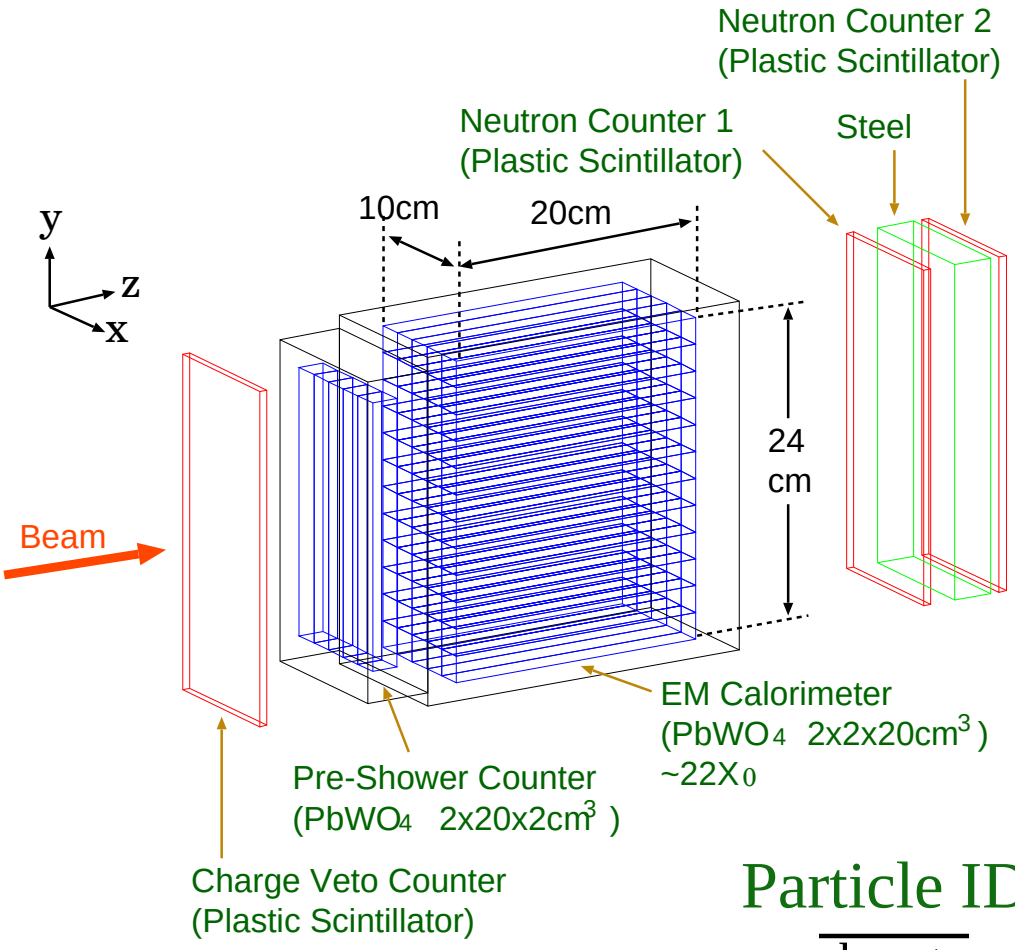
$0<\theta_{Lab}<3$mrad $0<p_T<0.3$ GeV/c $0<x_F<1$

Detect neutral particle in forward region

- EM Cal-Based System — Photon, π^0 , Neutron
- Hadron Cal-Based System — Neutron
- Beam-Beam Hodoscope — Separate beam collisions from beam gas events.

Experimental Setup

(EM Cal-Based System)



EM Cal Performance

Calibrated with
Beam Test at SLAC

$\Delta E/E \sim 10/\sqrt{E}$ %

noise~1.4GeV

$\Delta x = \Delta y \sim 0.15$cm ($\gamma$)

$\Delta x = \Delta y \sim 0.5$cm (n)
(simulation)

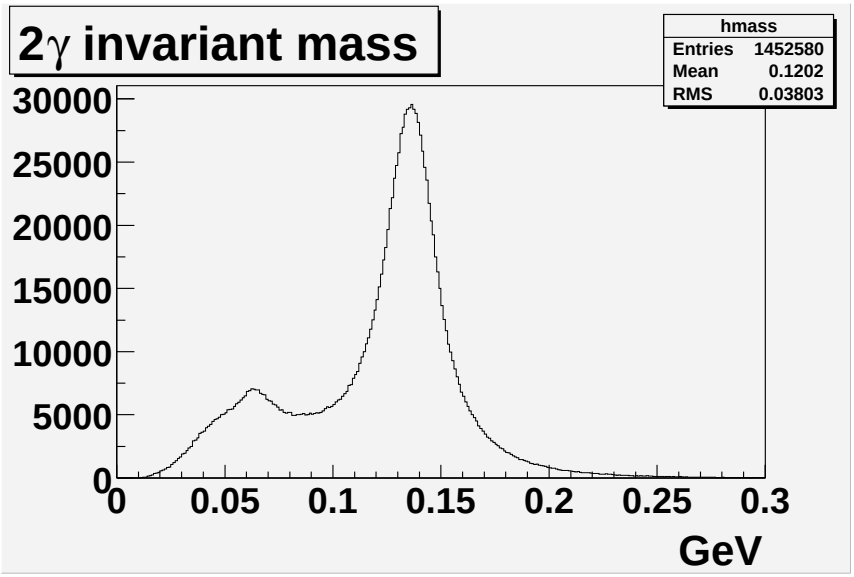
Particle ID Logic

$\gamma = \overline{\text{ch-veto}} \times \overline{\text{n-counter1}} \times \overline{\text{n-counter2}}$

Purity ~ 98%

$n = \overline{\text{ch-veto}} \times \text{n-counter1} \times \text{n-counter2}$

Purity ~ 89%



Succeed in π^0 Reconstruction

$\Delta M/M = 9.3\%$

Experimental Setup
(Hadron Cal-Based System)

Performance

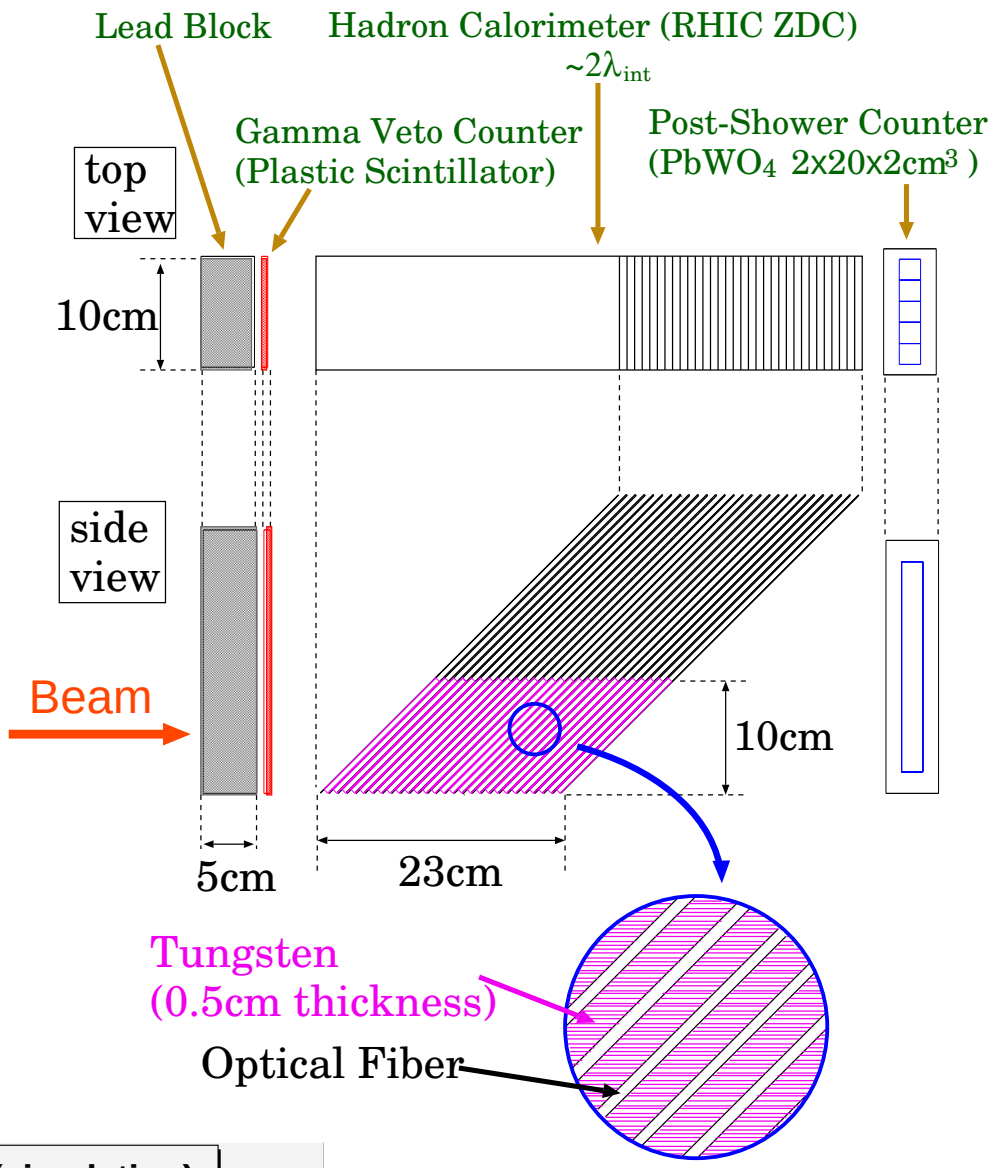
ΔE/E~40% to 50%
at E>20GeV

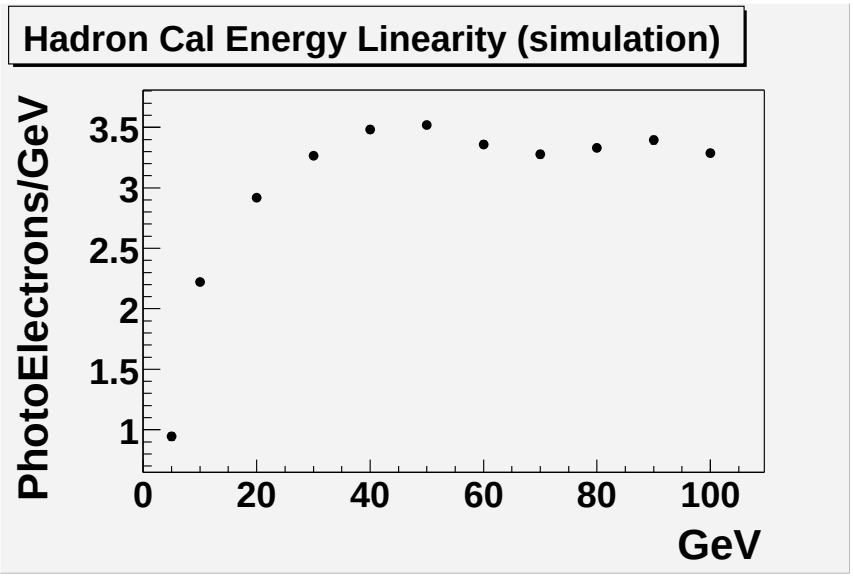
Δx~3 to 4cm
(post-shower)

Particle ID

$n = \overline{\gamma\text{-veto}}$

purity~100%





Energy is calibrated by using cosmic-ray test and simulation

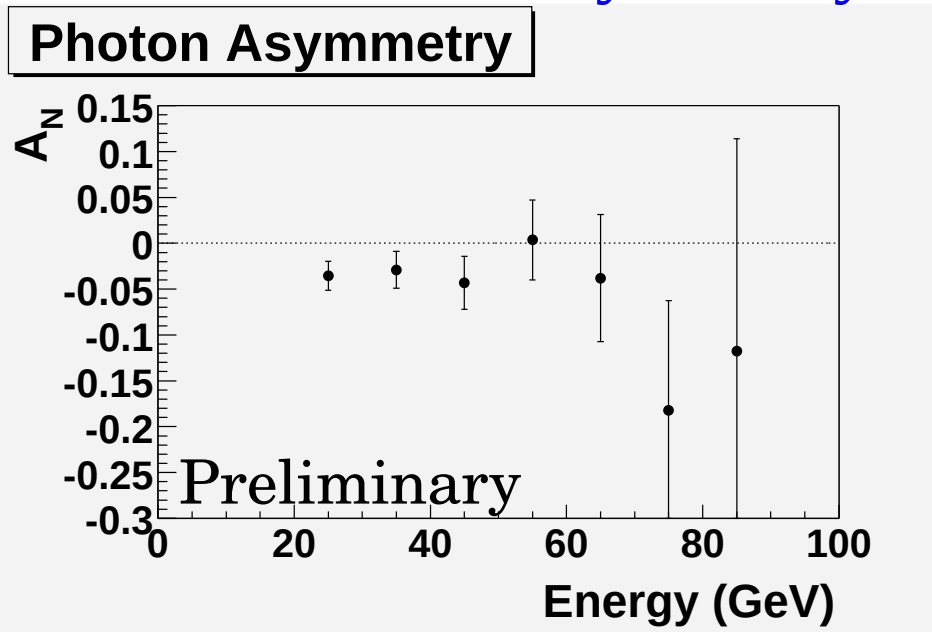
Flat Responce E>20 GeV

π^0 and Inclusive Photon Asymmetry

$$A_N = \frac{1}{P_B} \frac{\sqrt{N_{\uparrow L} N_{\downarrow R}} - \sqrt{N_{\uparrow R} N_{\downarrow L}}}{\sqrt{N_{\uparrow L} N_{\downarrow R}} + \sqrt{N_{\uparrow R} N_{\downarrow L}}}$$

calculated using square root formula

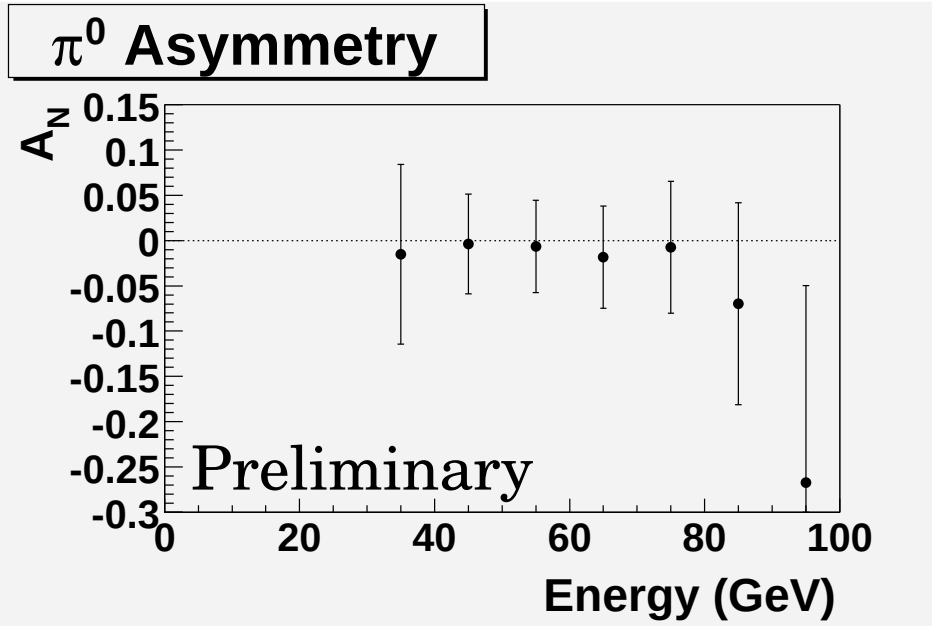
Inclusive Photon Asymmetry



Average beam polarization is
~11% for EM Cal
~18% for Hadron Cal

Analyzing Power is small.

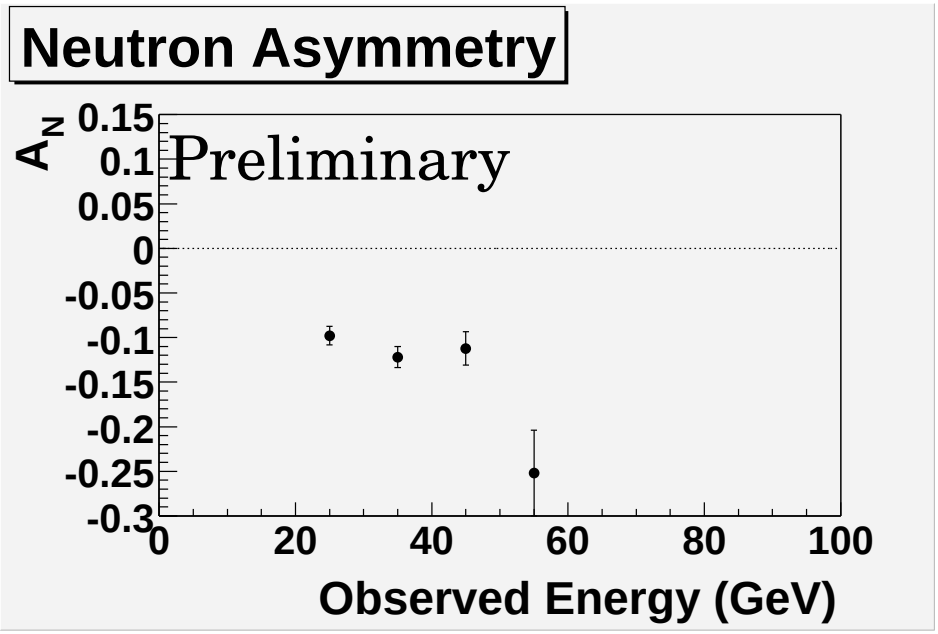
π^0 Asymmetry



Analyzing Power is consistent with 0

Neutron Asymmetry

EM Cal

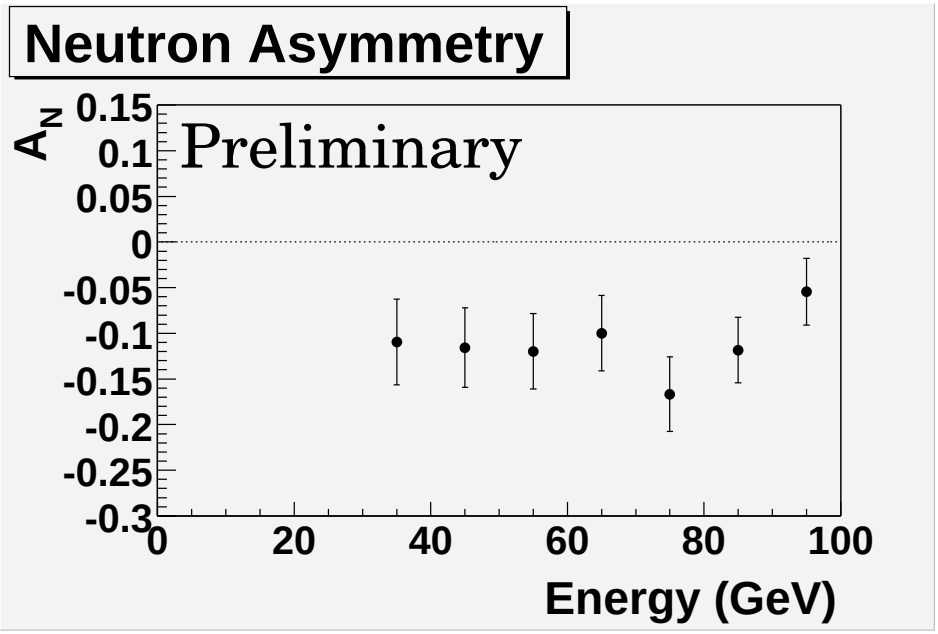


Calibrated for photon only

$\langle A_N \rangle = -0.109 \pm 0.0072$

additional scale error (due to beam pol error)

Hadron Cal

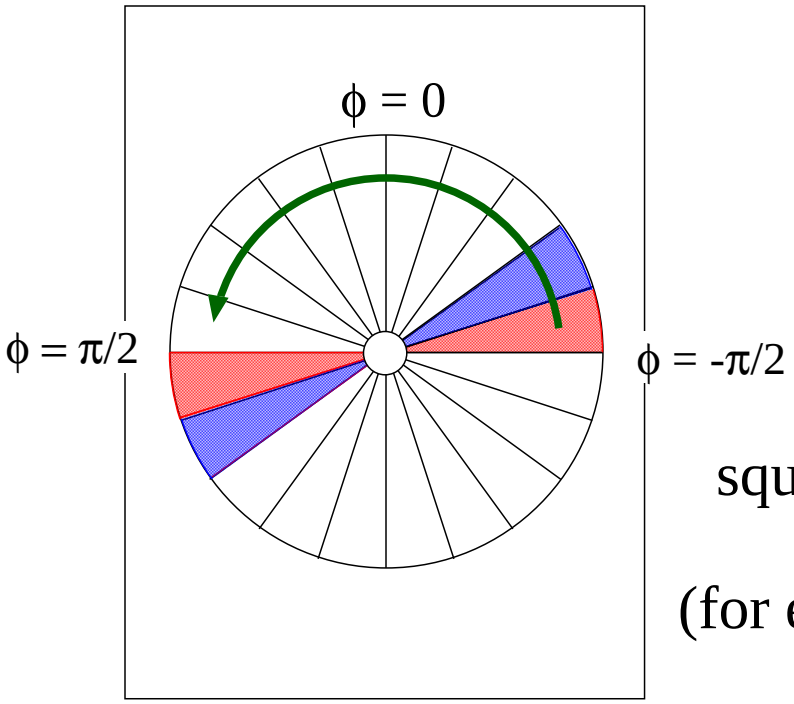


$\langle A_N \rangle = -0.110 \pm 0.015$

additional scale error

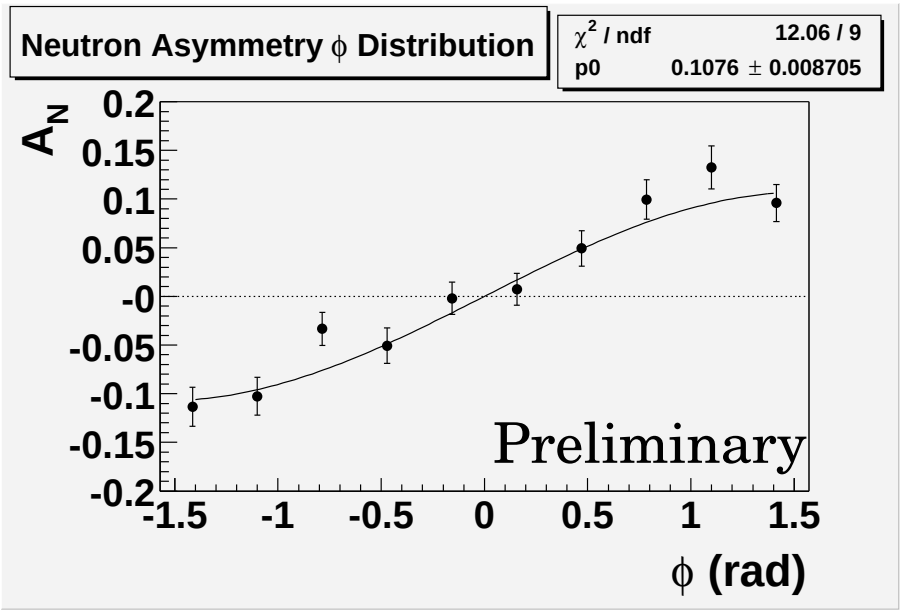
EM Cal and Hadron Cal are consistent

Neutron Asymmetry
ϕ distribution



square root formula is used for
ϕ dependent asymmetry
(for example red area, blue area)

EM Calorimeter



$\langle A_N \rangle = -0.108 \pm 0.0087$
additional scale-error

ϕ-dependence is consistent with sin ϕ

Summary

1) We measured single transverse-spin asymmetry in forward production of photons and neutrons in $\vec{p}p$ collision at $\sqrt{s}$ = 200 GeV.

> π^0 Asymmetry :
consistent with 0 within error.

> Inclusive photon Asymmetry : small.

> Neutron Asymmetry :
observed and its analyzing power is
-0.109 ± 0.0072 for EM Cal
-0.110 ± 0.015 for Hadron Cal
(additional scale error).

2) Modified Hadron-Cal Based System will be installed at PHENIX Collision Point for Spin Rotater Commissioning.