

**Multipole Analysis of Recent
Pion Electro-production Data**

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Introduction

1- The problem[theory]

2- The Data[New and Old]

3- The Fit[s]

L=0	L=1	L=2	L=3	L=4	L=5
X	X	D33pE	F35pE	G37pE	H39pE
X	P31pM	D33pM	F35pM	G37pM	H39pM
X	X	D13pE	F15pE	G17pE	H19pE
X	P11pM	D13pM	F15pM	G17pM	H19pM
X	X	D13nE	F15nE	G17nE	H19nE
X	P11nM	D13nM	F15nM	G17nM	H19nM
X	P31pS	D33pS	F35pS	G37pS	H39pS
X	P11pS	D13pS	F15pS	G17pS	H19pS
X	P11nS	D13nS	F15nS	G17nS	H19nS
S31pE	P33pE	D35pE	F37pE	G39pE	H311pE
X	P33pM	D35pM	F37pM	G39pM	H311pM
S11pE	P13pE	D15pE	F17pE	G19pE	H111pE
X	P13pM	D15pM	F17pM	G19pM	H111pM
S11nE	P13nE	D15nE	F17nE	G19nE	H111nE
X	P13nM	D15nM	F17nM	G19nM	H111nM
S31pS	P33pS	D35pS	F37pS	G39pS	H311pS
S11pS	P13pS	D15pS	F17pS	G19pS	H111pS
S11nS	P13pS	D15nS	F17nS	G19nS	H111nS

$$M[Q^2] = M_0 \times f[Q^2] + [B - B_0] [1 + iT]$$

$$f = k/k^* / [1 + Q^2/0.71]^2 \times [1 + \beta Q^2 + \delta W \times Q^2] \times \exp[-\Lambda Q^2]$$

$$M_0 = [B_0 + \alpha_b] [1 + iT]$$

$$+ \alpha_r T$$

$$+ [\eta_r + i\eta_i] [\text{Im}T - T^2]$$

$$T = T[\pi N \rightarrow \pi N]$$

$$\sigma[\phi] = \sigma[360 - \phi] \quad z = e^2$$

$$\chi^2 = [s - s_1]^2 / z_1 + [s - s_2]^2 / z_2$$

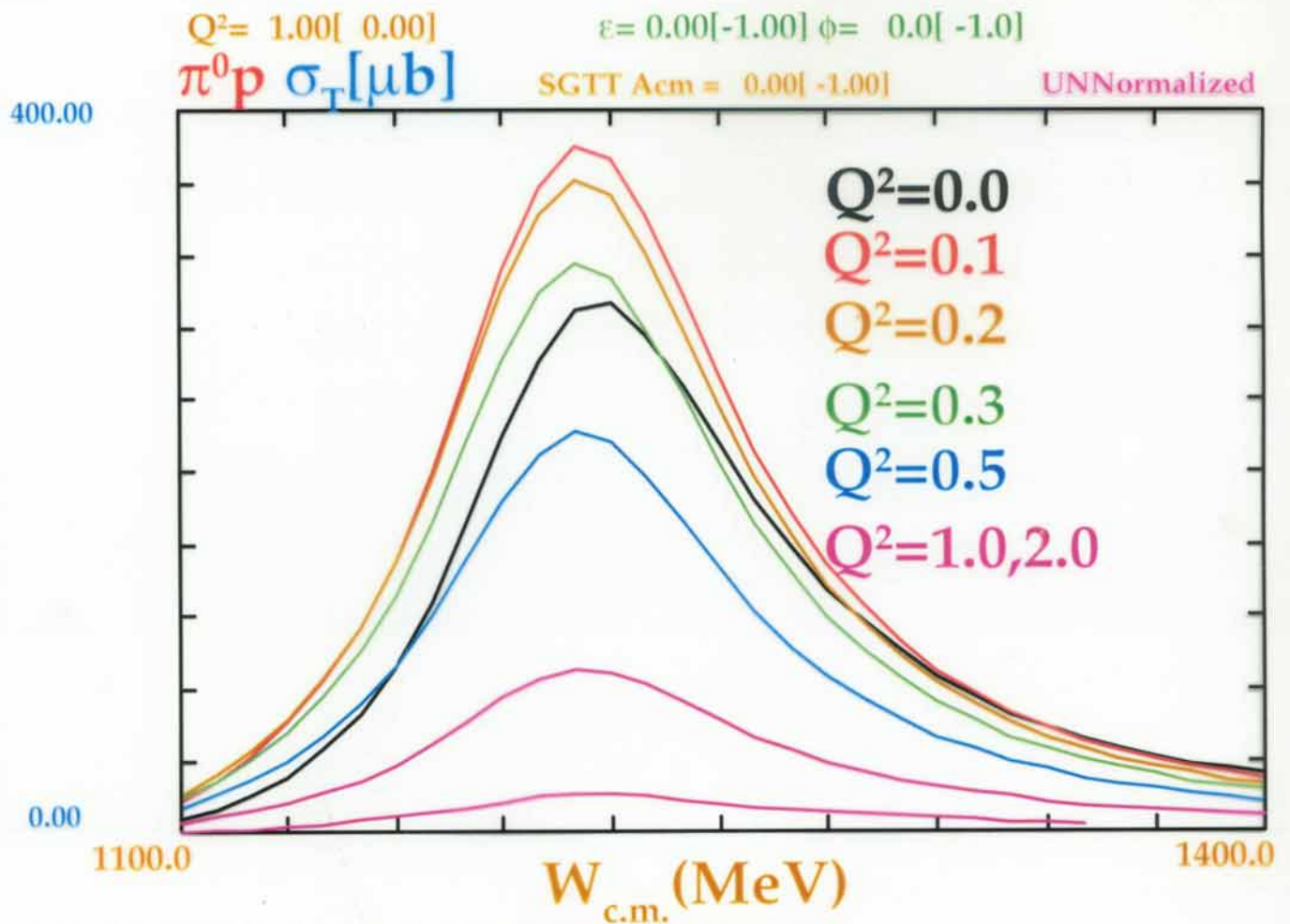
$$s_a = [z_2 s_1 + z_1 s_2] / [z_1 + z_2]$$

$$\chi^2 = [s_1 - s_2]^2 / [z_1 + z_2]$$

$$+ [s - s_a]^2 / z_a$$

$$1/z_a = 1/z_1 + 1/z_2$$

$$\chi^2 / N_p = 15040 / 12528$$



JF14K 1400 SP01[33787/17047]+ 53500/34051 [52 PRM] TE
 EP992 Electro-prod 06/01 Strakovsky/Arndt

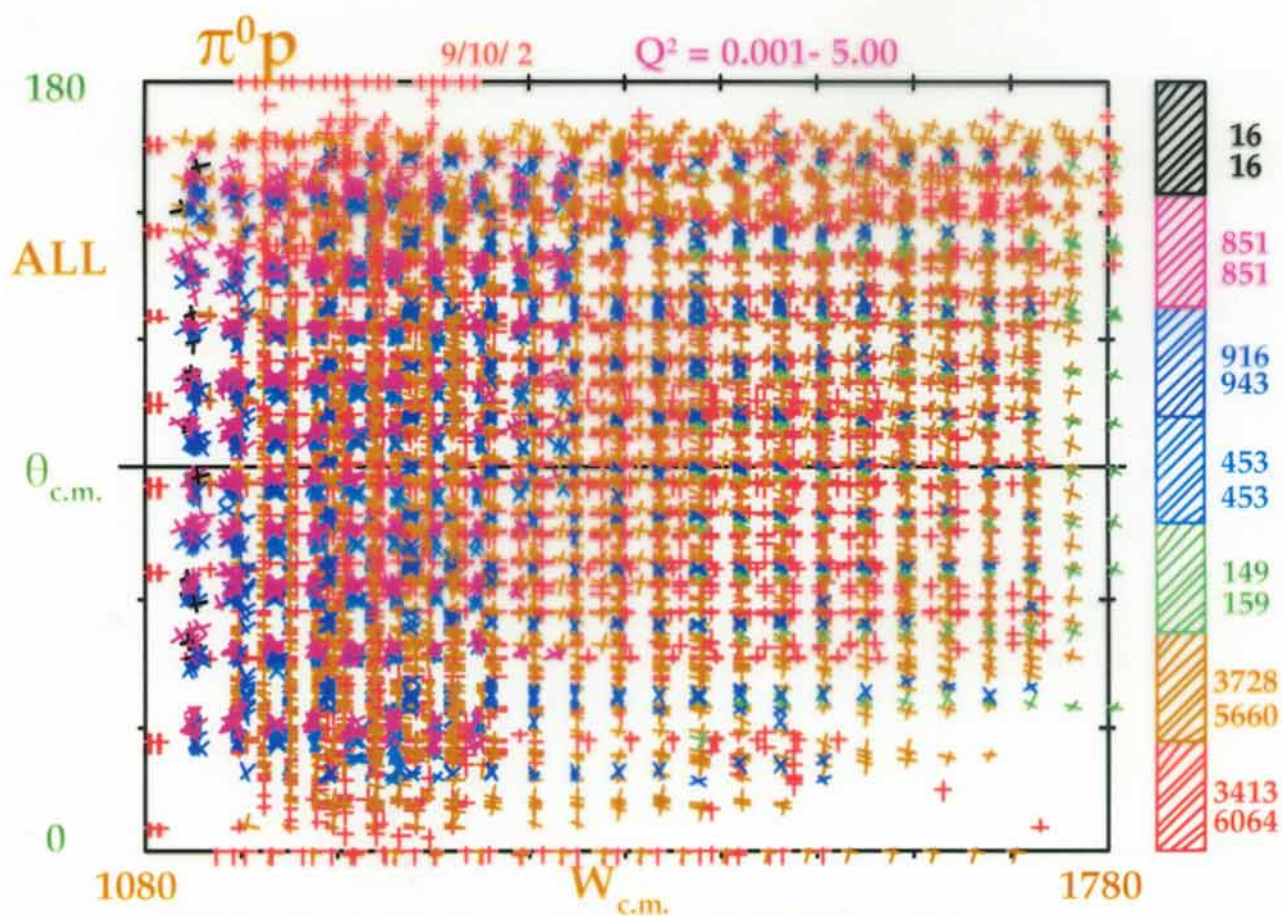
Threshold Approximation

$$\sigma = \sigma_T + \sigma_L \varepsilon + \sigma_{TT} \varepsilon \cos[2\phi] + \sigma_{TL} [2\varepsilon(\varepsilon + 1)]^{1/2} \cos[\phi]$$

$$\sigma_T + \sigma_L \varepsilon = A_0 + A_1 Z + A_2 P_2[Z]$$

$$\sigma_{TT} = C_0$$

$$\sigma_{TL} = D_0 + D_1 Z$$



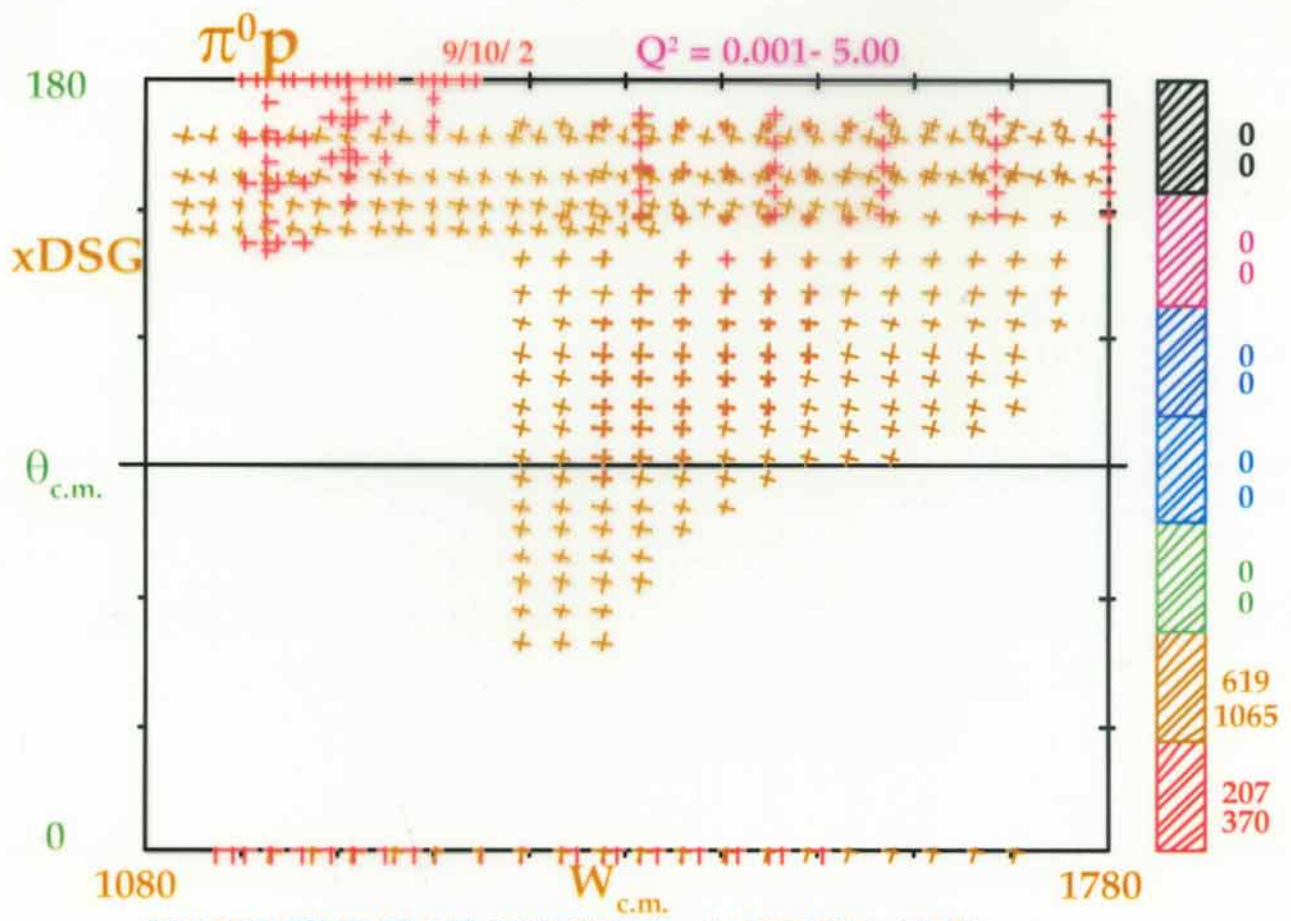
EPPI0PNC[NO CLAS] 9/02/02 RAA add 375/231 to Chi2

9526 Expts, 14146 Data

0.020

$< Q^2 <$

4.342



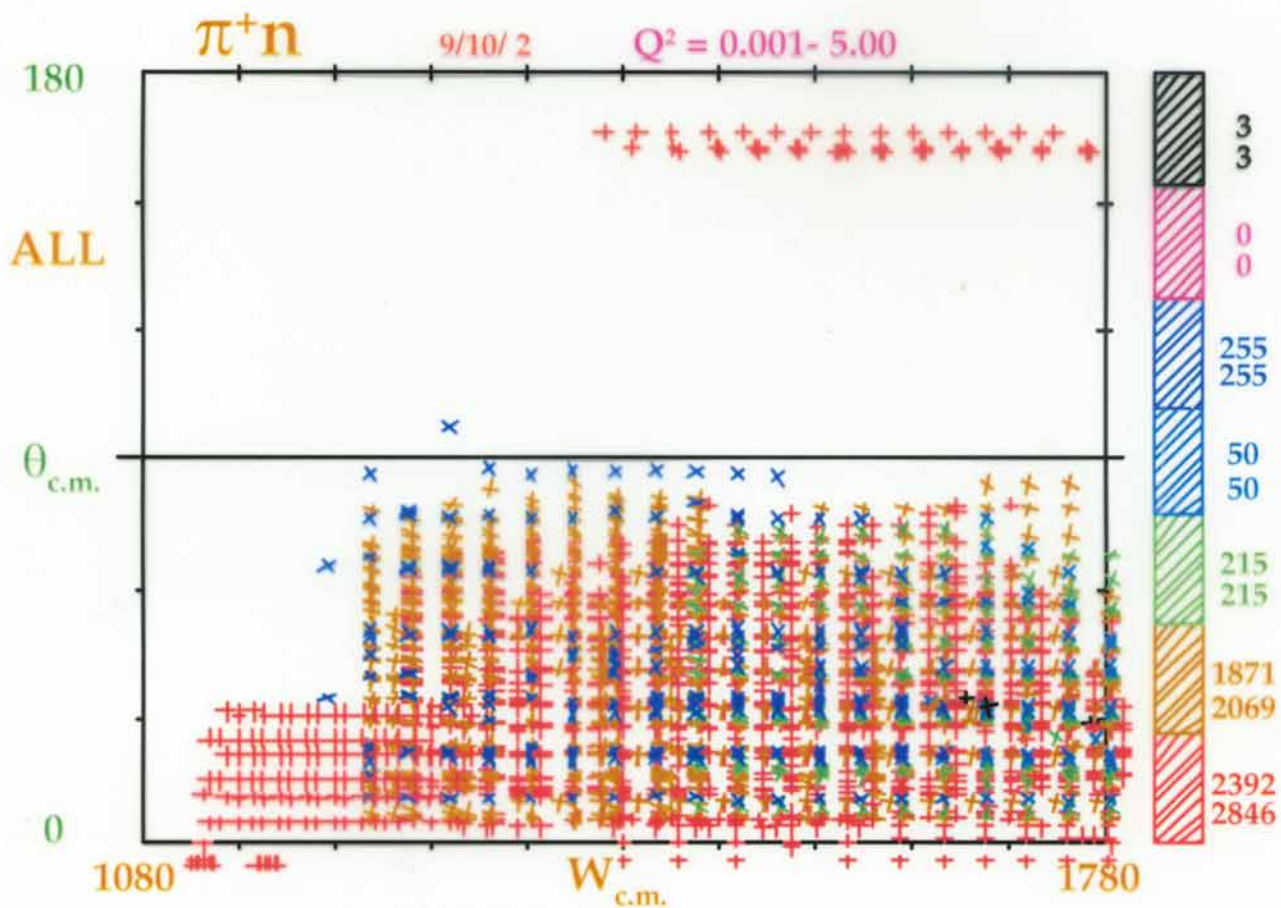
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826 Expts, 1435 Data

0.040

$< Q^2 <$

1.163



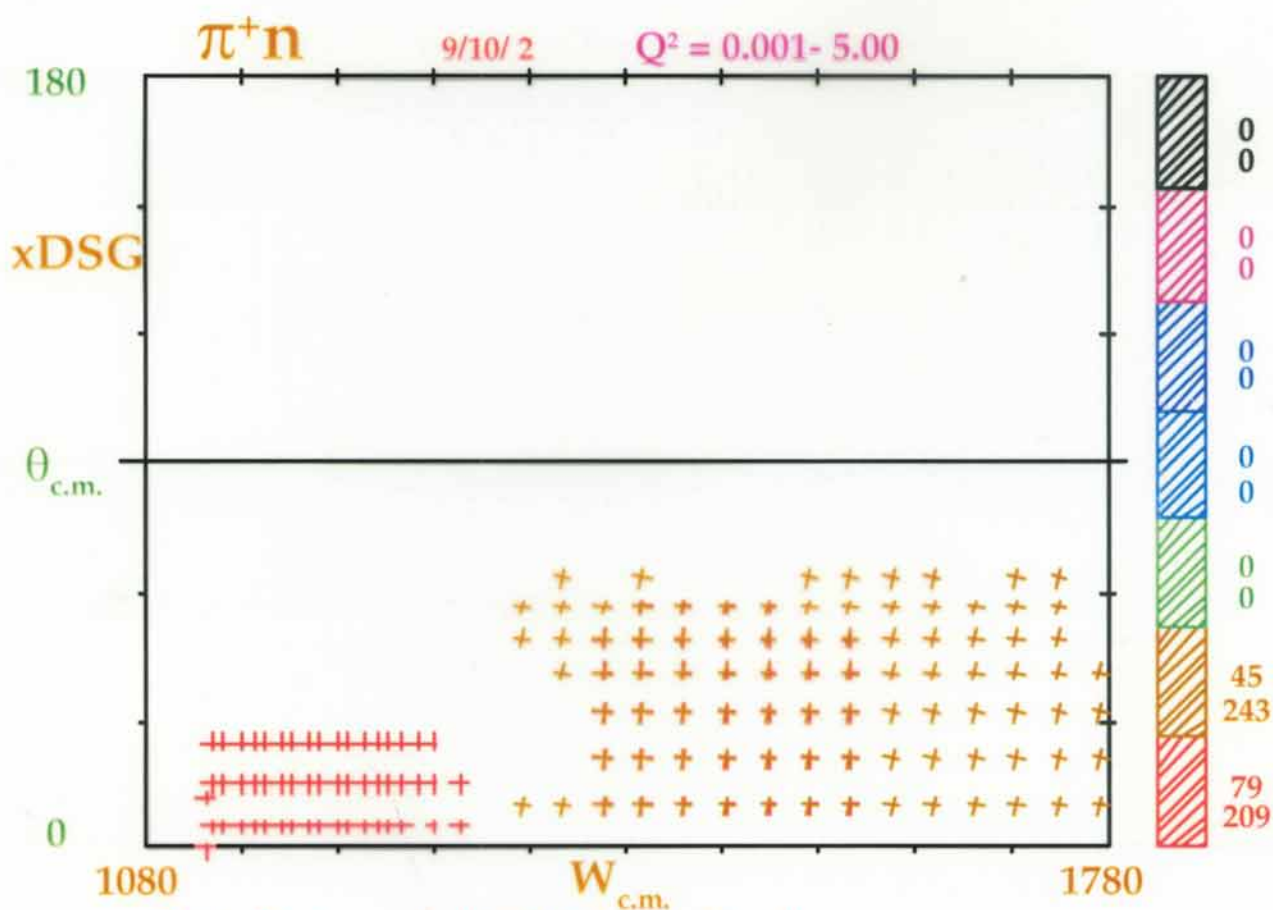
EP991 Electro-prod 10/99 Strakovsky/Arndt

4786 Expts, 5438 Data

0.040

$< Q^2 <$

4.420



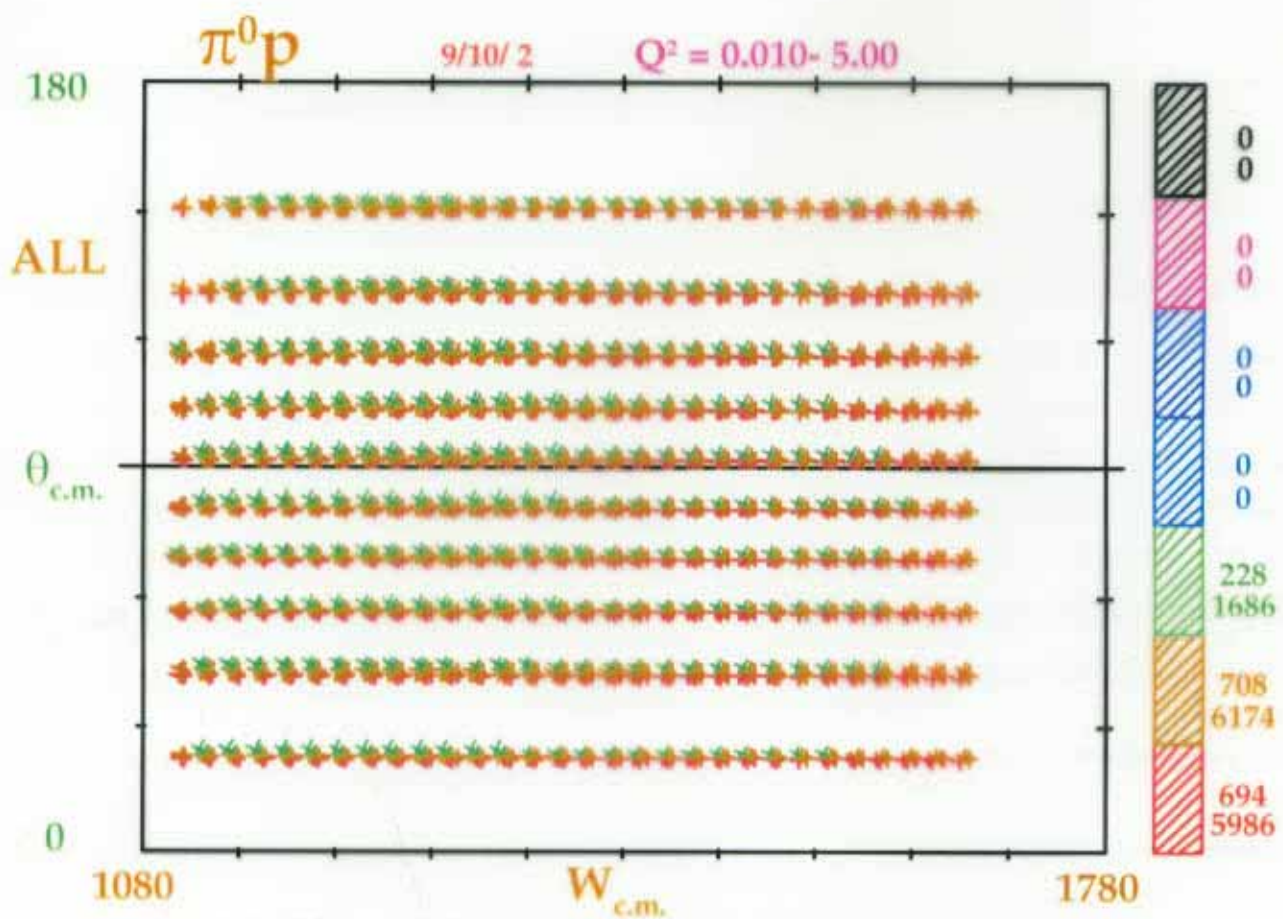
EP991 Electro-prod 10/99 Strakovsky/Arndt

124 Expts, 452 Data

0.117

$< Q^2 <$

1.050



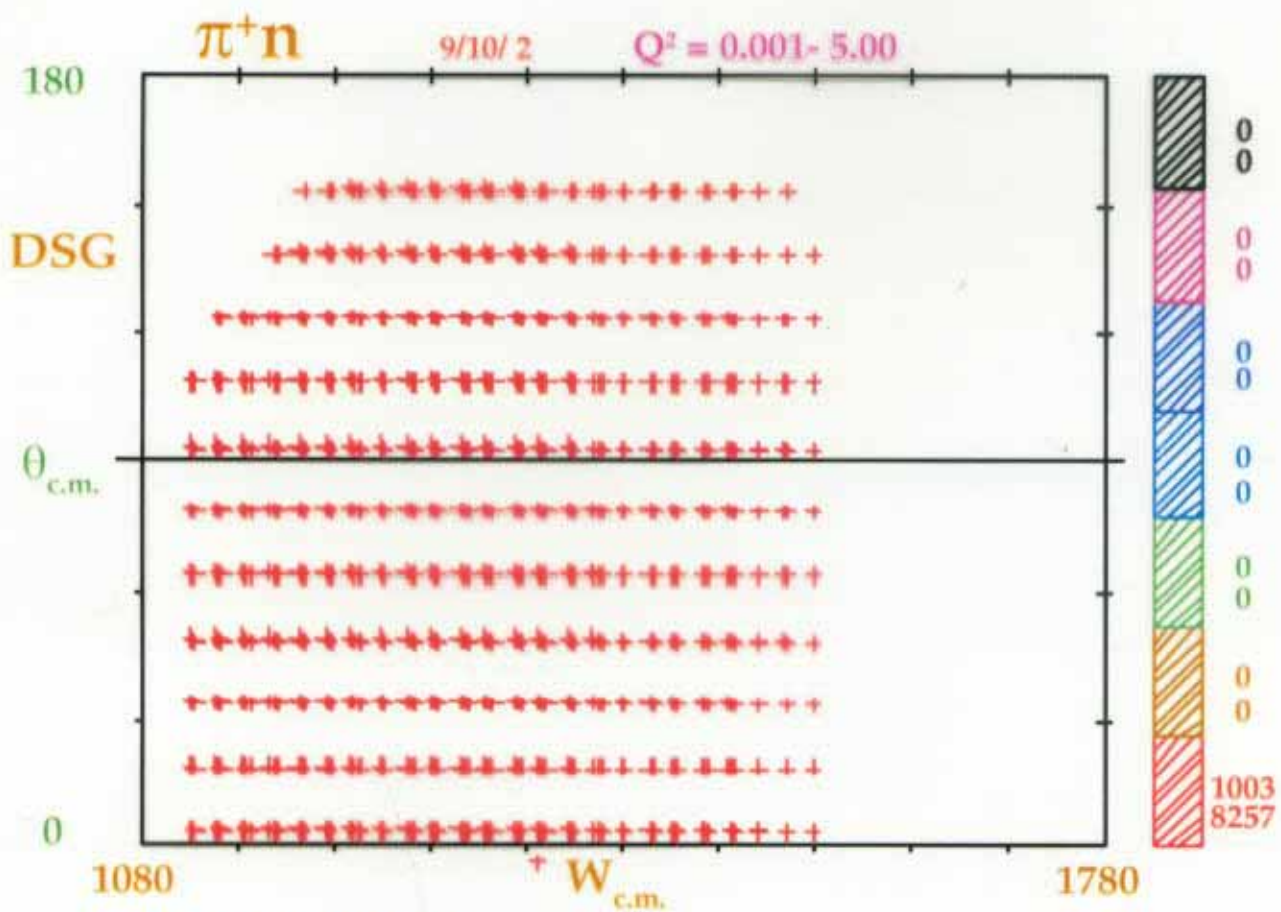
CLAS Pi0P [6+ cut], QUAD reduce add 14044/11596 R

1630 Expts, 13846 Data

0.400

$< Q^2 <$

1.800



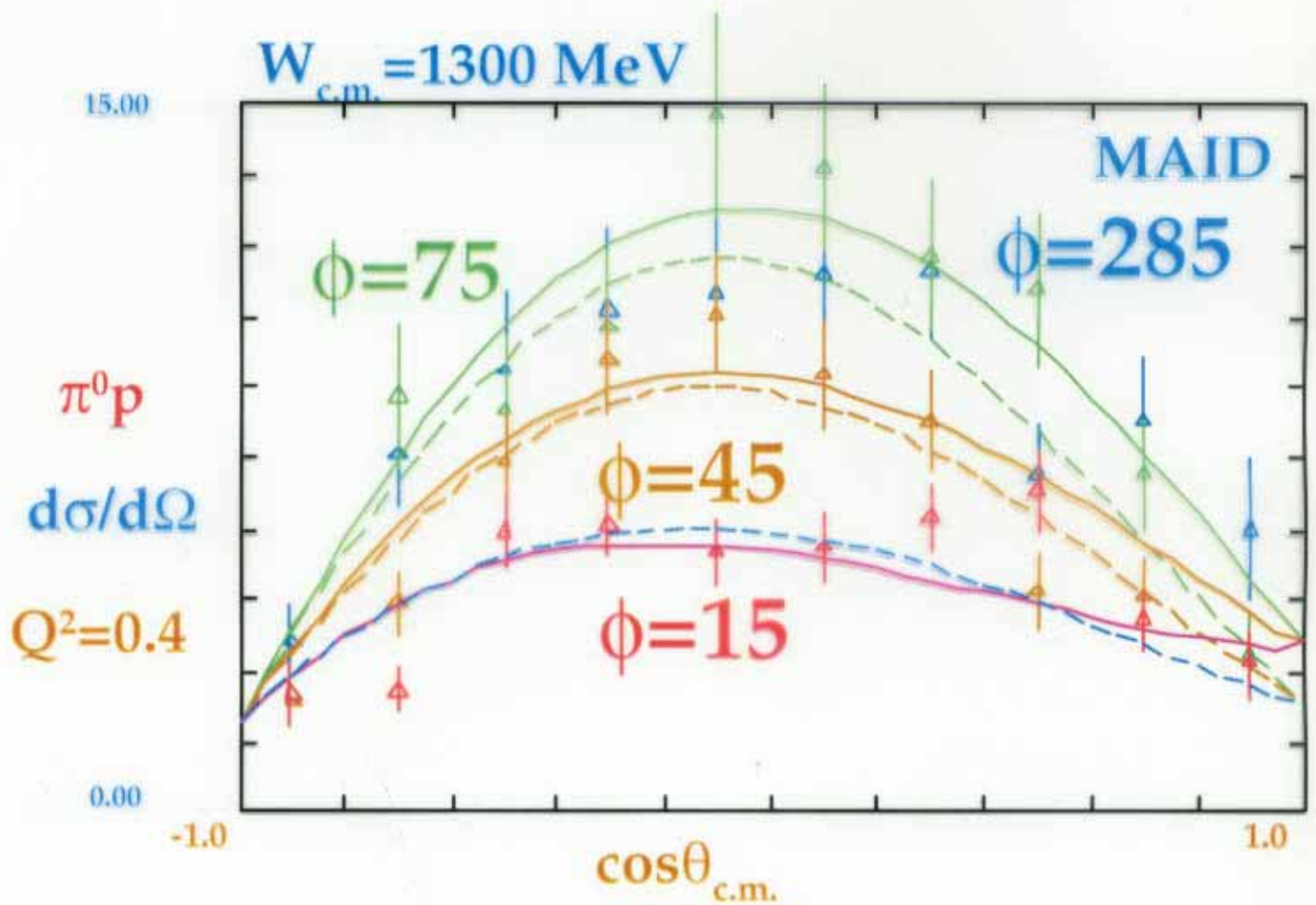
CLAS Pi+N data 3/01

1003 Expts, 8257 Data

0.300

$< Q^2 <$

0.600



U217K 1700 FA02[31022/15927]+112033/54517 [82] UNORM FA
 EPP10P202 9/02/02 RAA [CLAS in Quadratu 9/ 3/ 2

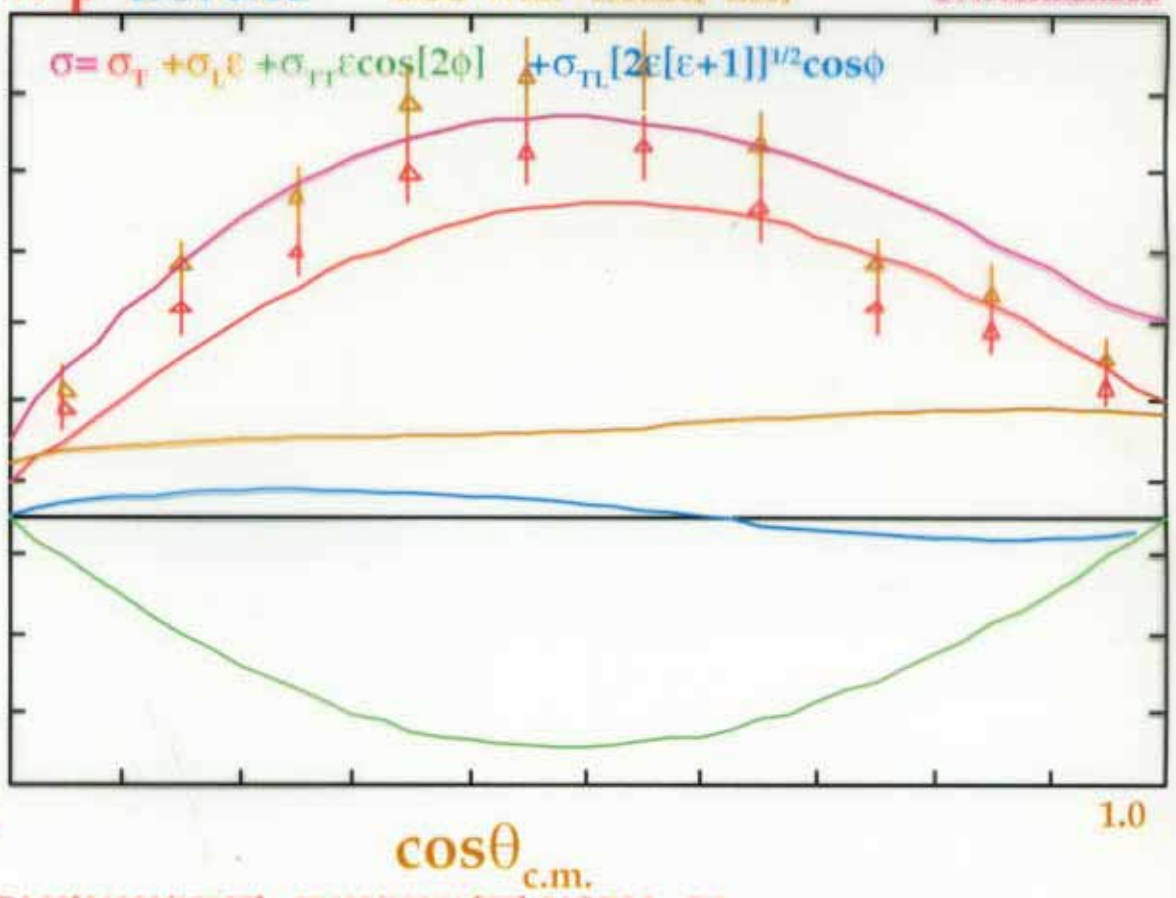
$Q^2 = 0.40 [0.10]$
 $\pi^0 p \ d\sigma/d\Omega$

$\epsilon = 0.79 [1.00] \ \phi = 45.0 [1.0]$

DSG $W_{cm} = 1300.00 [1.00]$

UNNormalized

13.00
 $\Delta SM[02]$
 0.40 0.79 45



-7.00

-1.0

$\cos\theta_{c.m.}$

1.0

X217K 1700 FA02[31022/15927]+ 35688/19051 [77] NORM FA

EPPI0P102 8/15/02 RAA

8/23/ 2

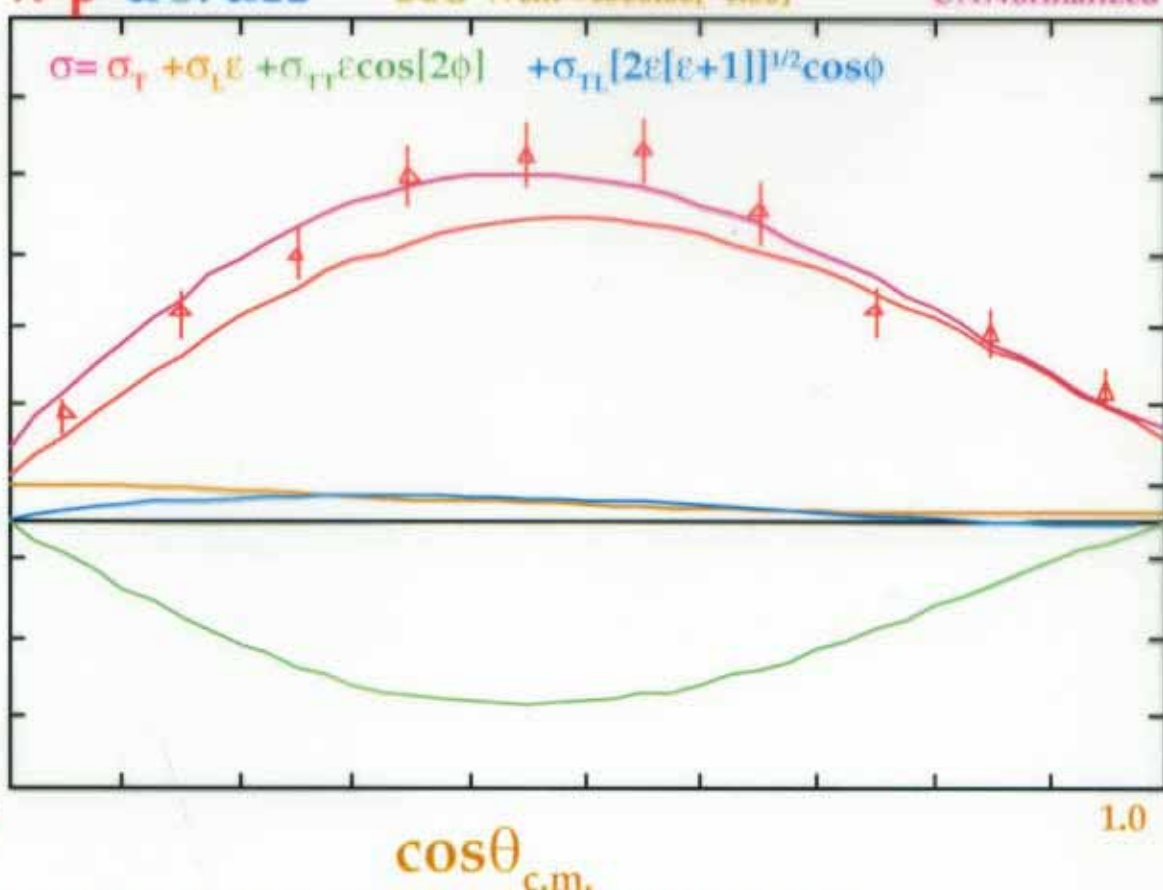
$Q^2 = 0.40 [0.10]$
 $\pi^0 p \frac{d\sigma}{d\Omega}$

$\epsilon = 0.79 [1.00]$ $\phi = 45.0 [1.0]$

DSG $W_{cm} = 1300.00 [1.00]$

UNNormalized

13.00
 $\Delta SM[02]$
0.40 0.79 45



MAID2K 1800 MEV[C.M.] NPA645[99]45, DRECHSEL MAINZ SM
EPP10P102 8/15/02 RAA 8/23/ 2

$Q^2 = 0.40 [0.10]$

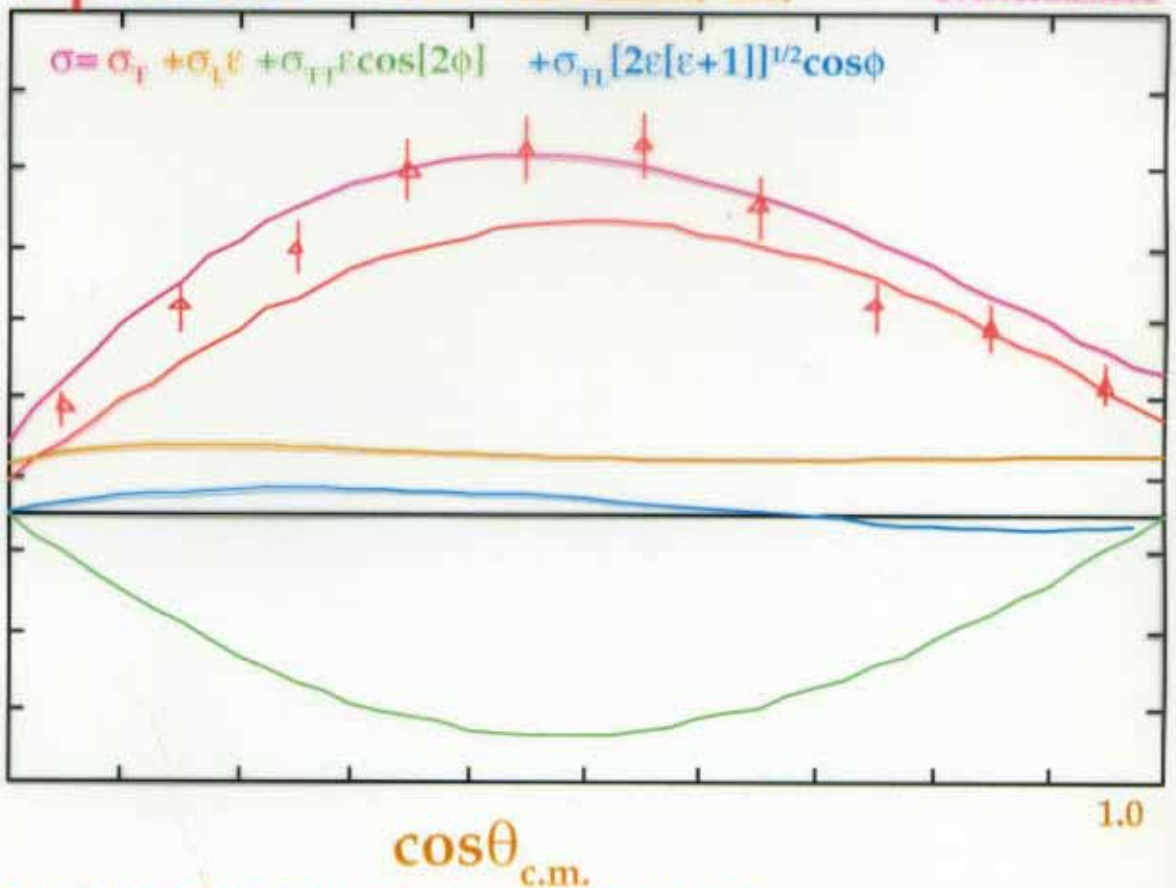
$\epsilon = 0.79 [1.00] \quad \phi = 45.0 [1.0]$

$\pi^0 p \quad d\sigma/d\Omega$

DSG $W_{cm} = 1300.00 [1.00]$

UNNormalized

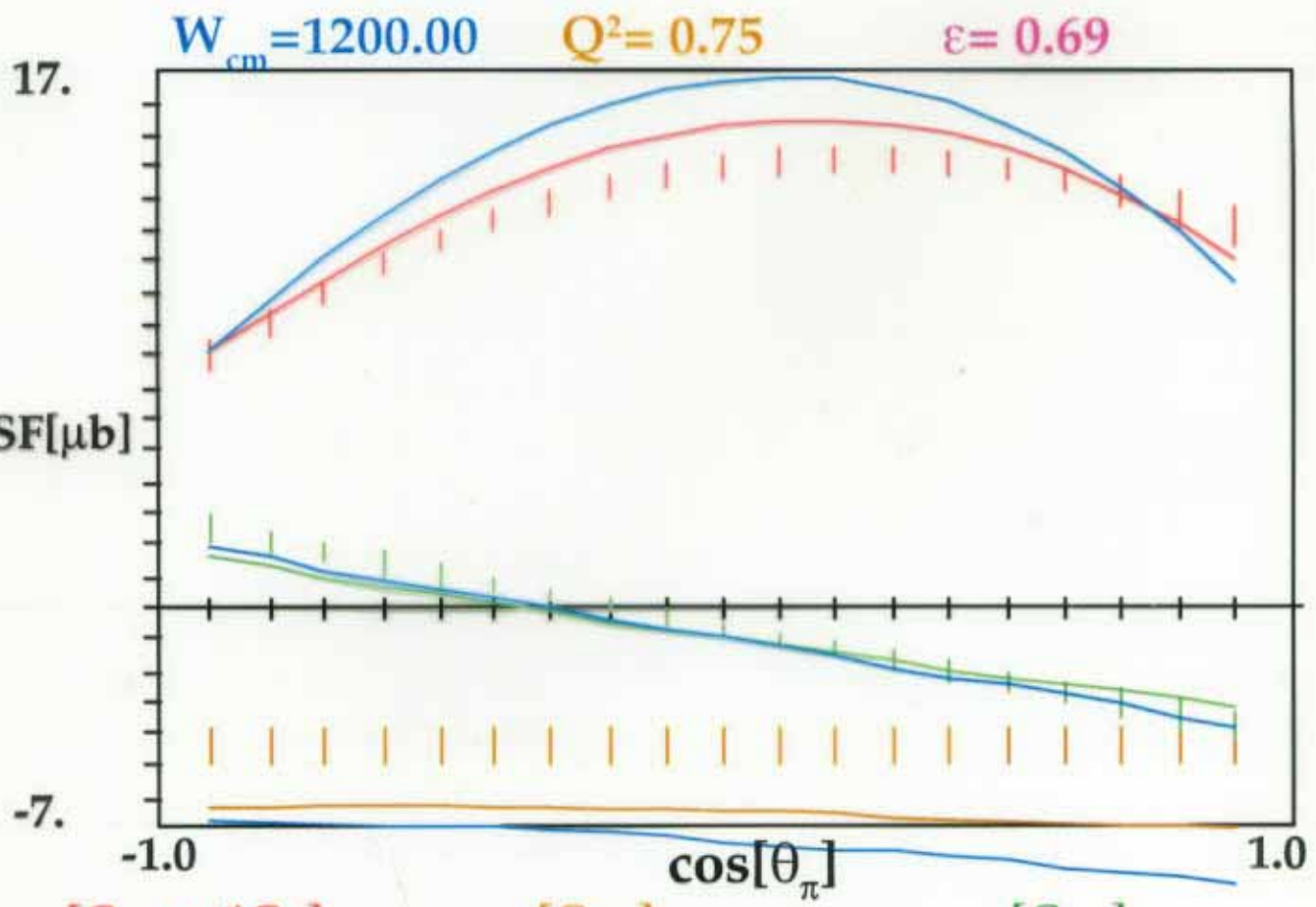
13.00
 $\Delta SM[02]$
0.40 0.79 45



U217K 1700 FA02[31022/15927]+113905/55798 [83] UNORM FA

EPP10P102 8/15/02 RAA

8/23/2



$[S_T + \epsilon_L * S_L]$

$[S_{TT}]$

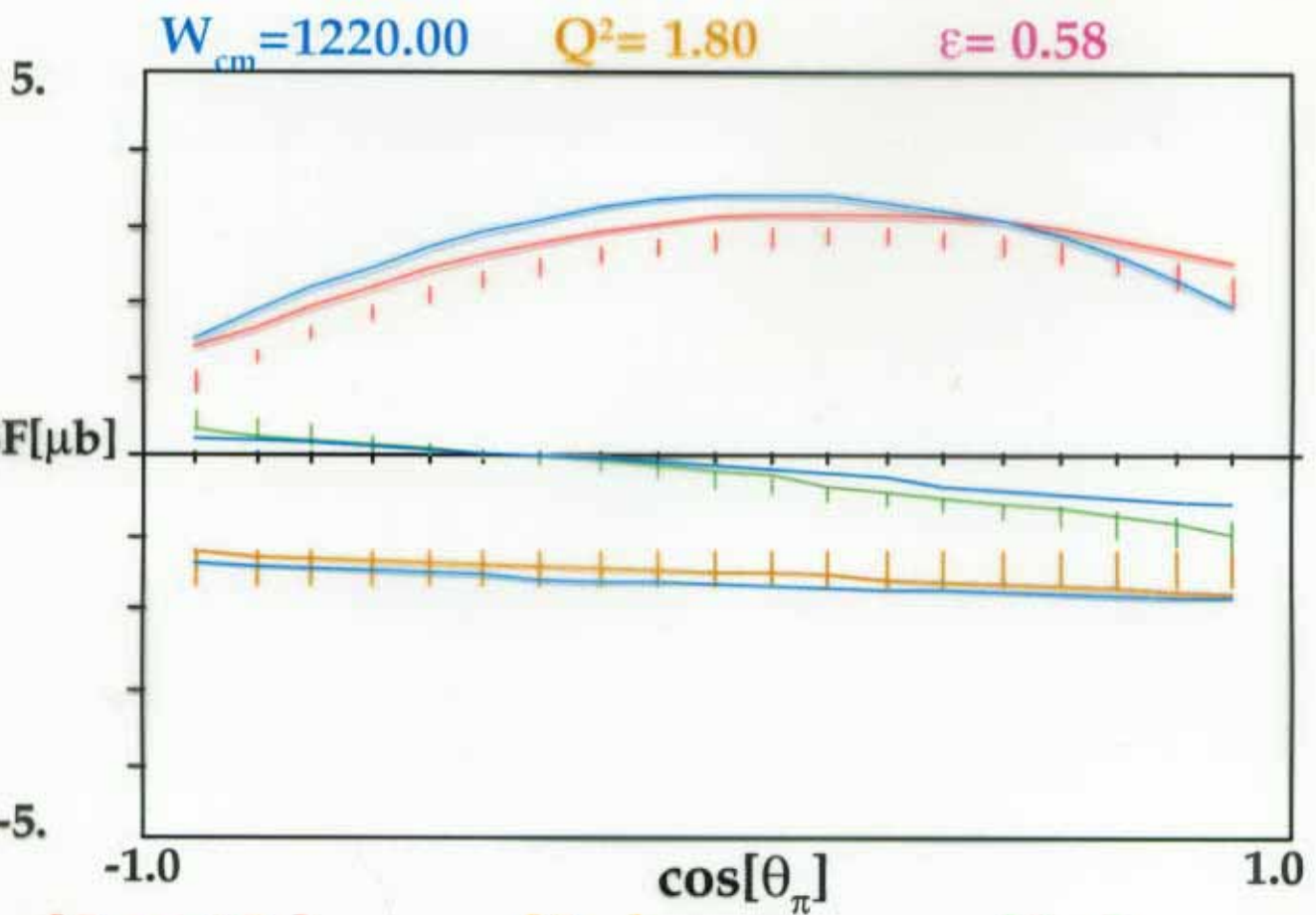
$[S_{TL}]$

N217K 1700 FA02[31022/15927]+ 96911/55798 [83] NO

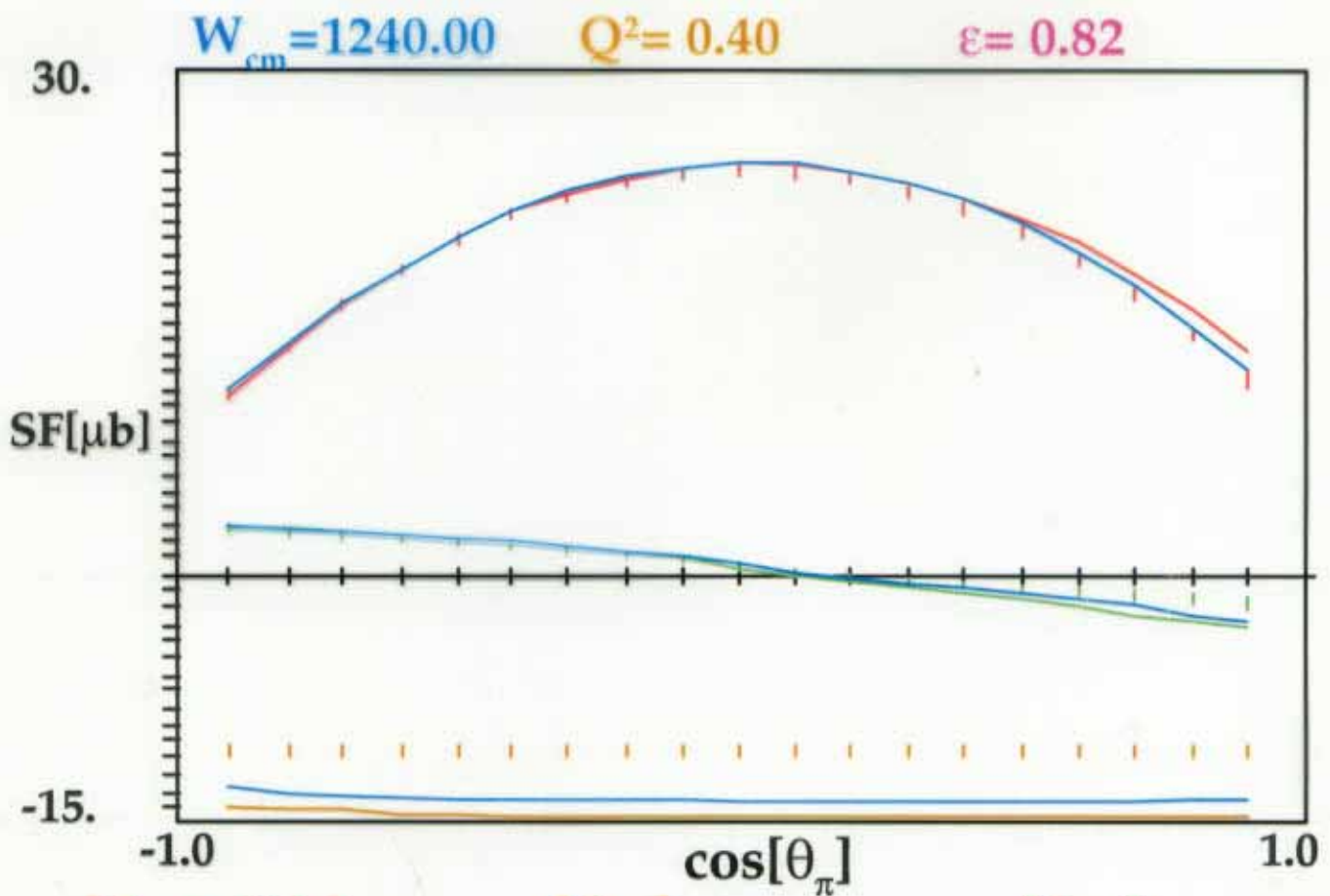
MAID2K 1800 MEV[C.M.] NPA645[99]45, DRECHSEL MA

EPPI0P102 8/15/02 RAA

8/23/ 2



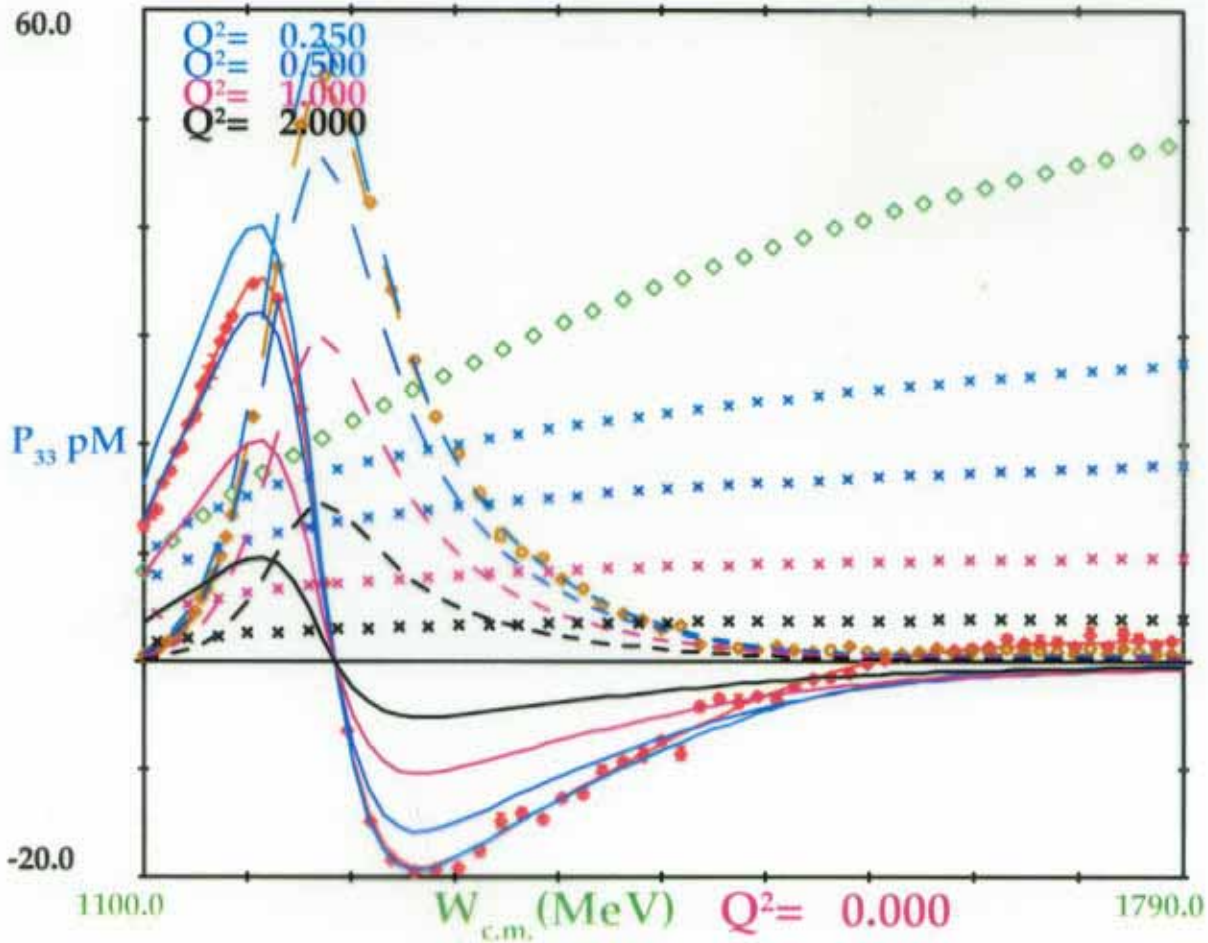
$[S_T + \epsilon_L * S_L]$ $[S_{TT}]$ $[S_{TL}]$
 N217K 1700 FA02[31022/15927]+ 96911/55798 [83] NO
 MAID2K 1800 MEV[C.M.] NPA645[99]45, DRECHSEL MA
 EPPI0P102 8/15/02 RAA 8/23/ 2



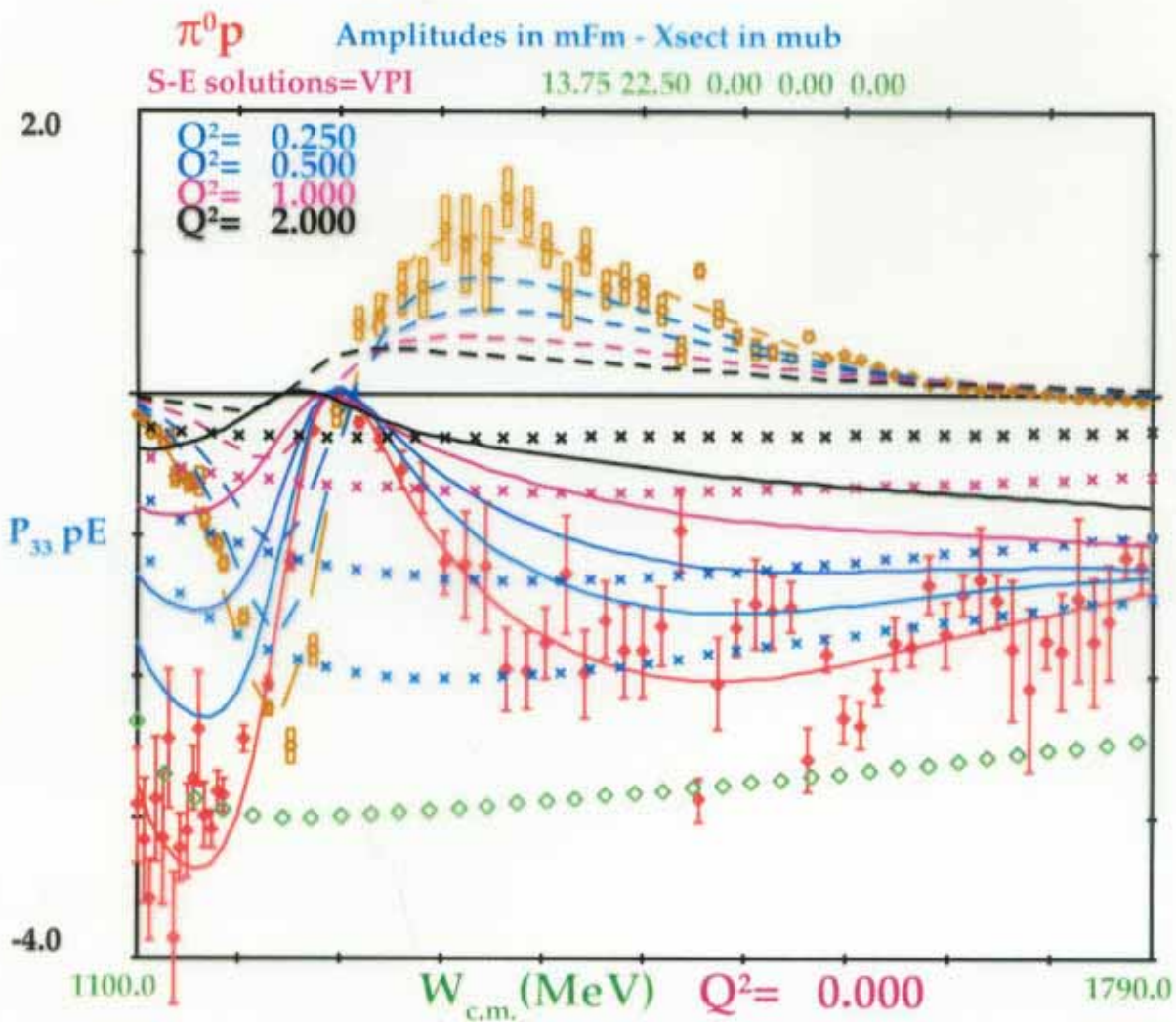
$[S_T + \epsilon_L * S_L]$ $[S_{TT}]$ $[S_{TL}]$
 N217K 1700 FA02[31022/15927]+ 96911/55798 [83] NO
 MAID2K 1800 MEV[C.M.] NPA645[99]45, DRECHSEL MA
 EPPI0P102 8/15/02 RAA 8/23/ 2

$\pi^0 p$ Amplitudes in mFm - Xsect in mb

S-E solutions=VPI 13.75 22.50 0.00 0.00 0.00



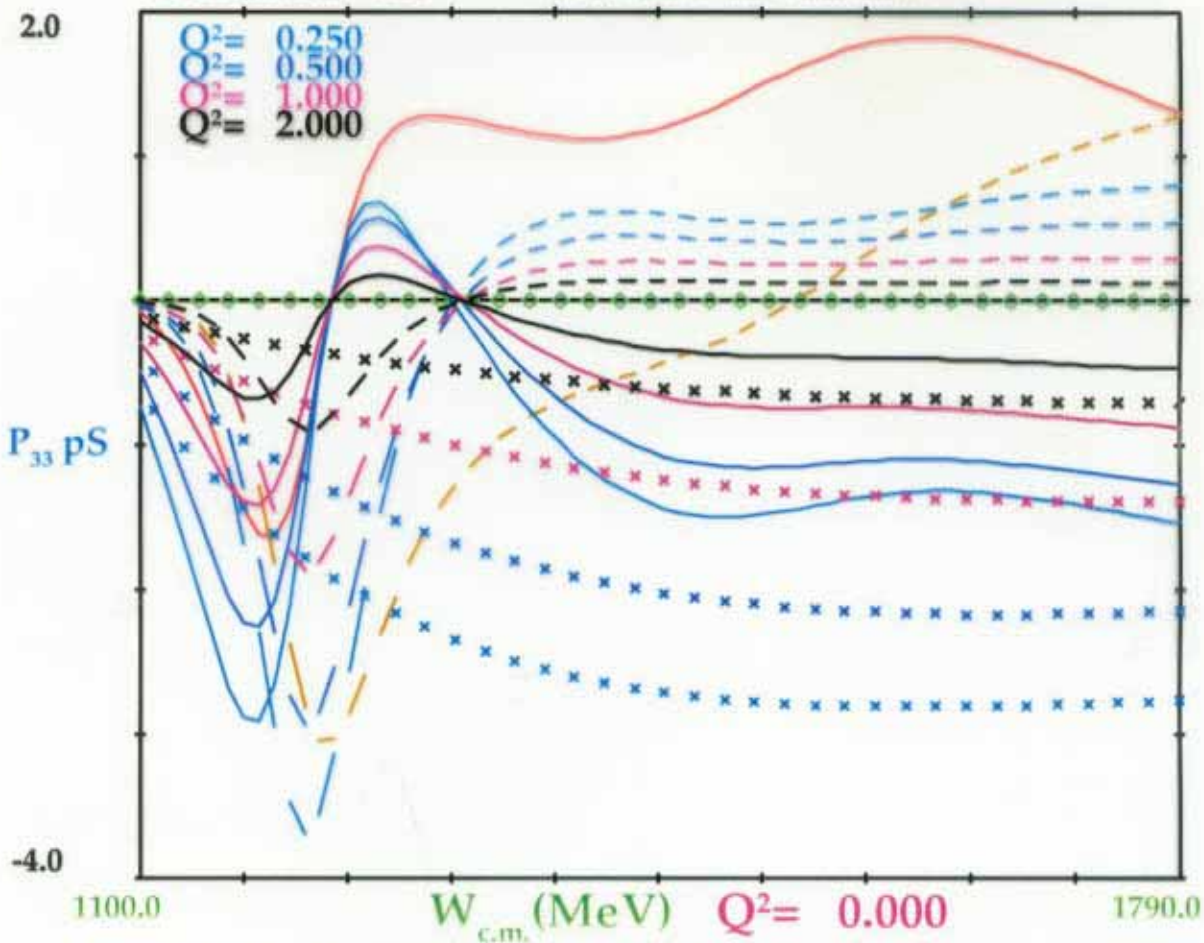
GF18K 1800 SP01[33787/17047]+ 38873/20182 [86 PRM] TE
EP992 Electro-prod 06/01 Strakovsky/Arndt



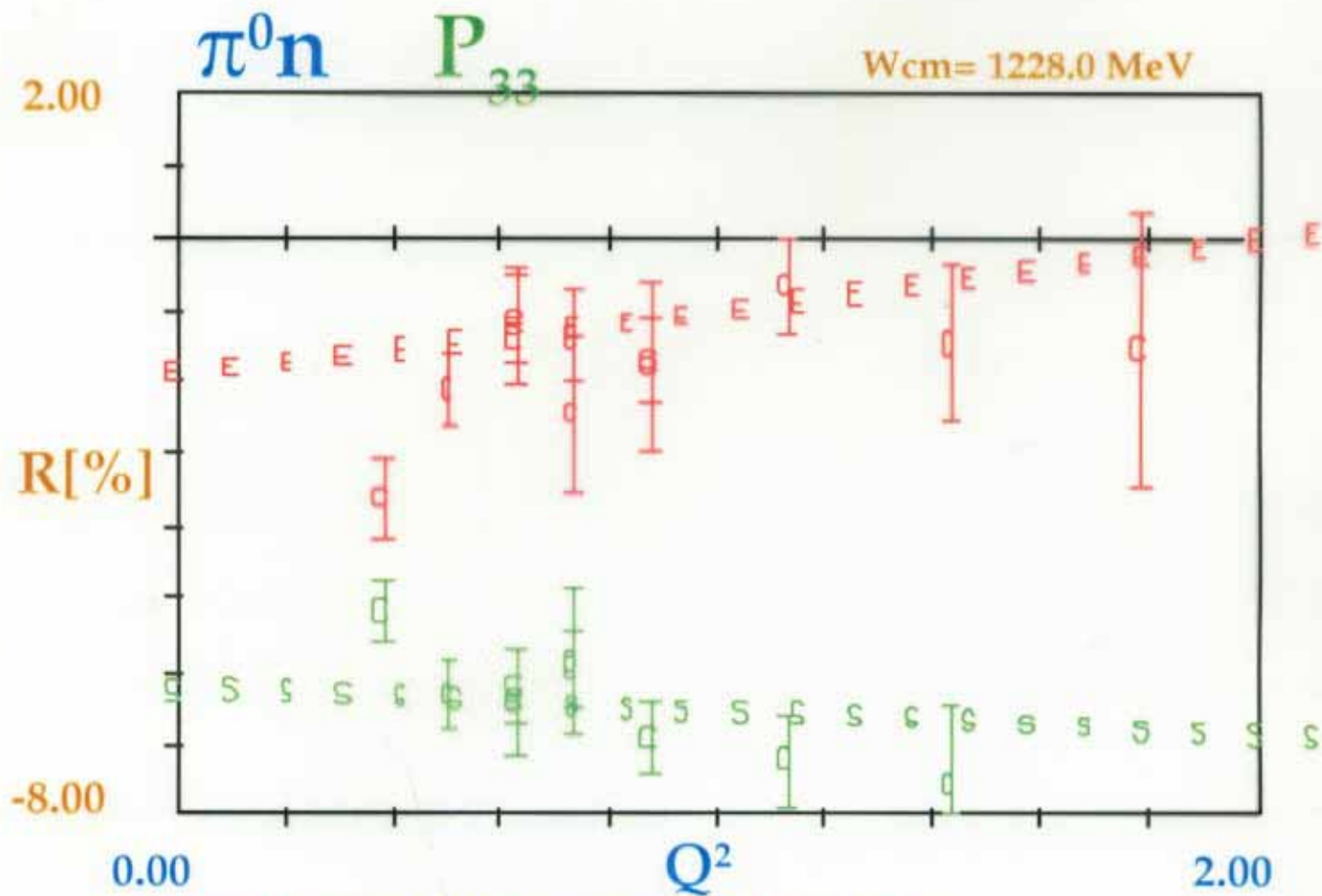
GF18K 1800 SP01[33787/17047]+ 38873/20182 [86 PRM] TE
 EP992 Electro-prod 06/01 Strakovsky/Arndt

$\pi^0 p$ Amplitudes in mFm - Xsect in mb

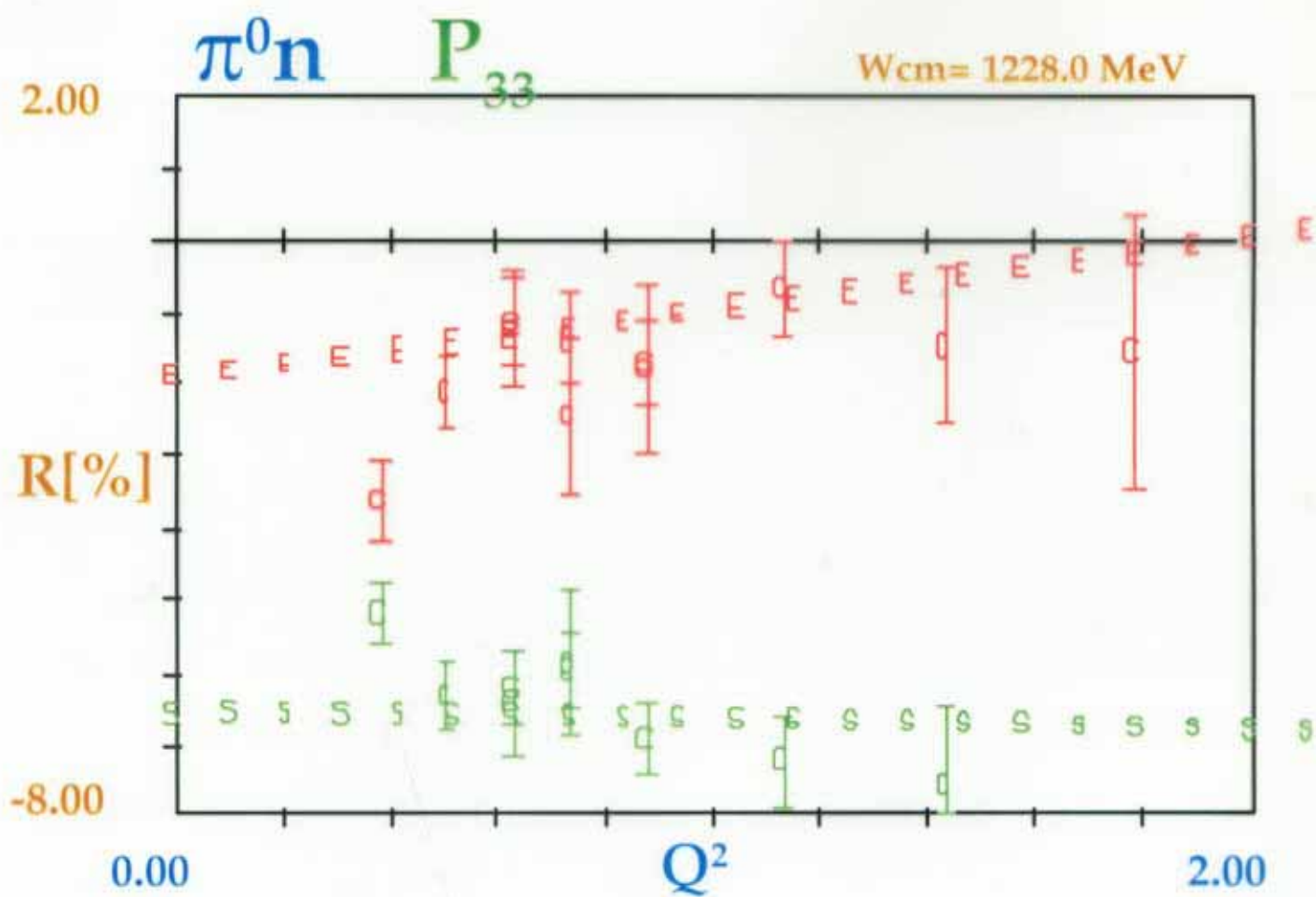
S-E solutions=VPI 13.75 22.50 0.00 0.00 0.00



GF18K 1800 SP01[33787/17047]+ 38873/20182 [86 PRM] TE
EP992 Electro-prod 06/01 Strakovsky/Arndt



N217K 1700 FA02[31022/15927]+ 96911/55798 [83] NORM FA



X217K 1700 FA02[31022/15927]+ 35688/19051 [77] NORM FA