SIDIS Rates and Projection for SoLID with CLEO (&CDF)

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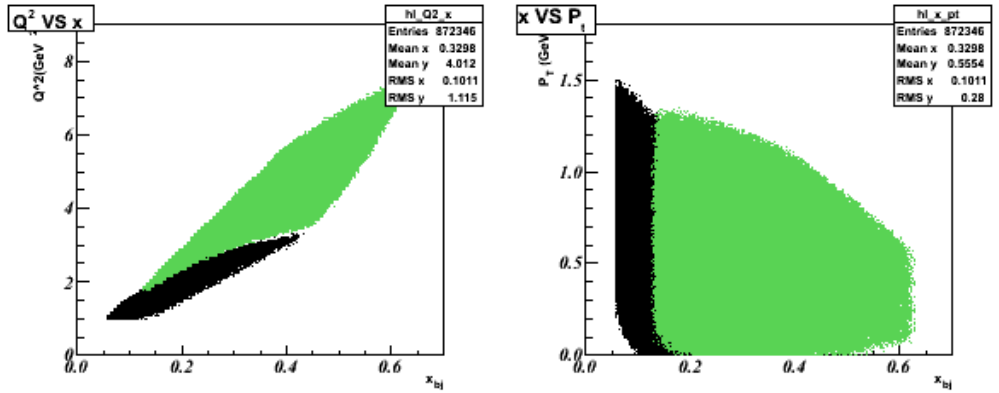
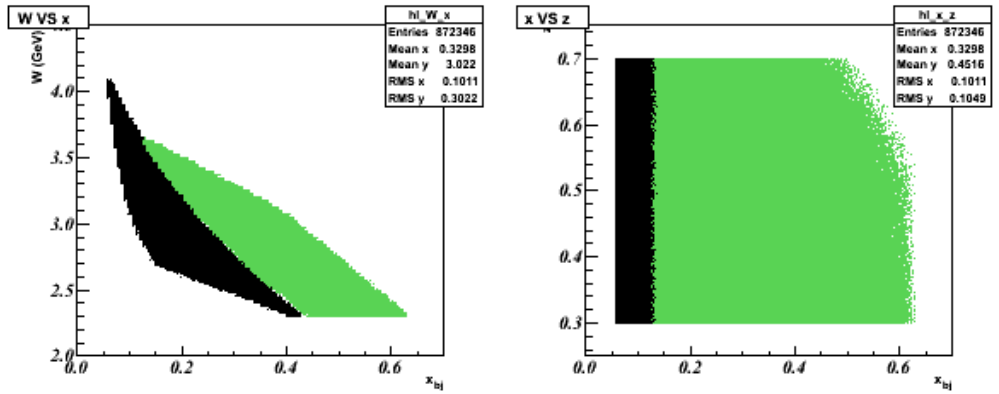
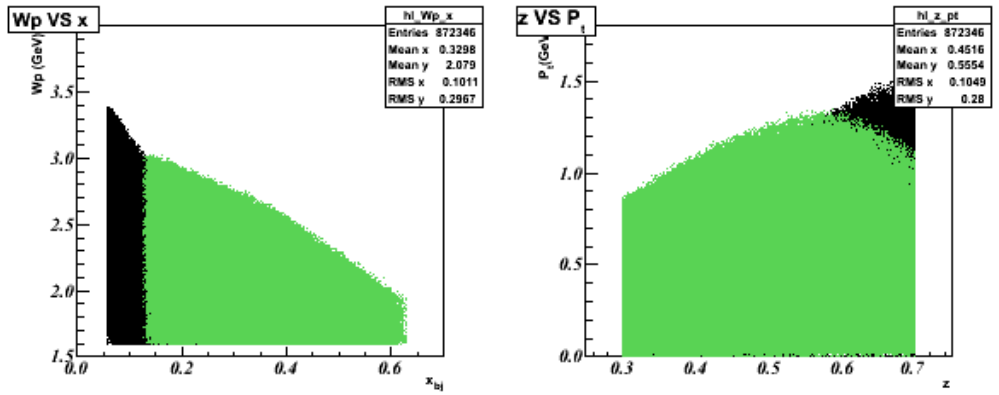
08/19/2014

Acceptance:





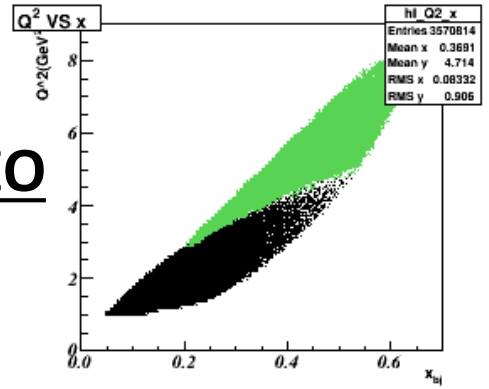


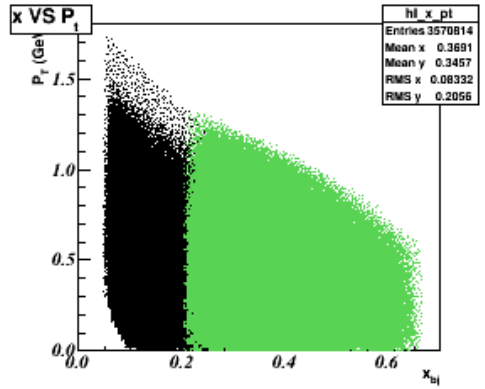
Black:
Forward Angle

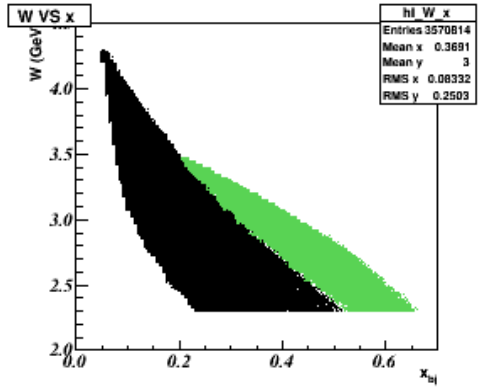
Green:
Large Angle

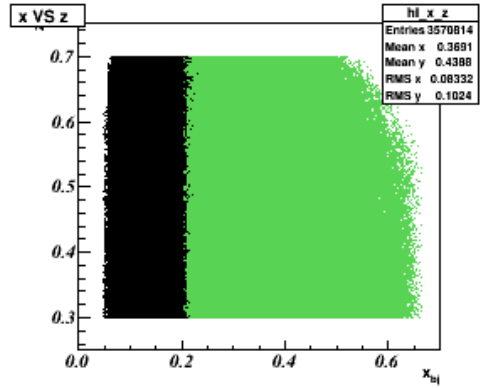
CDF

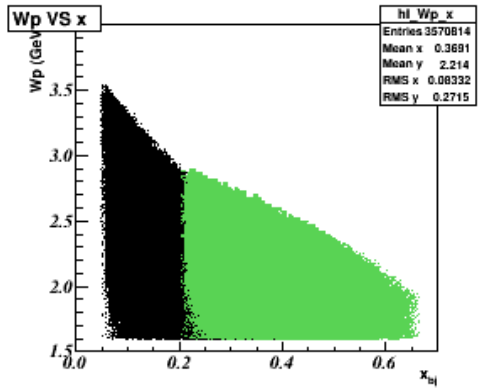
CLEO

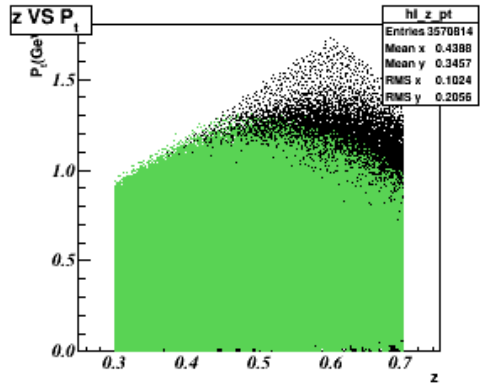












Simulation:

- **CDF with Geant3 by Xin:**

  (1) SIDIS cross section in FORTRAN, calculated both SIDIS XS and inclusive XS.

  (2) He3 data was simulated by running Proton and Deuteron targets then summing them together.

  (3) I only has his simulated Ntuples and ROOT files. I am not able to trace the parameters he put into the simulation.

  (4) The simulation data in these Ntuples has the acceptance weight already.

  (5) Estimate noise from accidental coincidence with single- inclusive XS.

- **CLEO with GEMC by Zhiwen and me:**

  (1) Updated SIDIS model "collider", no inclusive XS.

  (2) CLEO acceptance is simulated by GEMC w/o SIDIS physics

  (3) Events were generated with "collider" and weighted by SIDIS cross sections+CLEO acceptance

SIDIS Rate

- CDF: values in the PAC35 proposal

KHz	11GeV (FA/LA)	8.8GeV (FA/LA)	Total
(e, e'pi+)	1.467 / 0.192	0.810 / 0.117	(2.586kHZ)
(e, e'pi-)	1.010 / 0.120	0.554 / 0.073	(1.757kHZ)

CLEO: (does not include detector efficiencies)

CLEO has about 39%(pi+) and 41%(pi-) more

KHz	11GeV (FA/LA)	8.8GeV (FA/LA)	Total
(e, e'pi+):	2.305 / 0.083	1.788 / 0.053	
(85% det eff)	1.959 / 0.071	1.520 / 0.045	(3.595kHZ)
(e, e'pi-):	1.600 / 0.051	1.224 / 0.033	
(85% det eff)	1.360 / 0.043	1.040 / 0.028	(2.471kHz)

Projections:

- Method:

(a) Bin in Z, Q2, pt and x:

1, Z-binning: 0.30 ~ 0.70, bin-size = 0.05 (8 bins)

2, Q2-bining: 1.0 ~ 8.0, bin-size = 1, (6 bins, last bin from 6~8 GeV^2)

3, pt-binning: 0.0 ~ 1.6, bin-size = 0.2 (<=8 bins, double bin-size when total event < 5e6)

4, x-binning: depending on statistics : ~max(2e6, Sum_in_pt_bin/8.0)

(b) Calculation:

Astats = 1/sqrt(N_x)

N_x = N_raw * weight * Acceptance * Lumi * time * (pol*target_factor/sqrt(2))^2 * dilution^2 *det_eff

weight = cs * Phase_Space /N_simulated * 1e-33(cm^2), Phase_Space= Phase_Space_e * Phase_Space_h

where, Phase_Space_e = (cos Th_min – cos Th_max)*2*Pi*(11-0.5), Phase_Space_e = (cos Th_min – cos Th_max)*2*Pi*(6-0.5),

Th_min --Th_max, 11—0.5GeV/c and 6—0.5GeV/c are the phase ranges in the generator.

Acceptance = (Accept_FA_e*Accept_FA_h+Accept_LA_e*Accept_LA_h)

Lumi = 1e36 (cm^-2 * s^-1)

time = 48 days * 24 *3600 s for 11GeV or 21 days *24 * 3600s for 8.8GeV

pol = 60%, target_factor = 0.865, dilution = dxs_n / dxs_He3

det_eff = det_eff_e * det_eff_h, assume to be overall 85% for e and pi.

Projections:

- Compared Xin's results and my results:

N_x = N_raw * weight * Acceptance * Lumi * time * (pol*target_factor/sqrt(2))^2 * dilution^2 *det_eff

(1) My x-bining method:

Each xbj bin much has the events, N_bin ~ max (2e6/det_eff, Sum/8.), where

N_bin = N_raw * weight * Acceptance * Lumi * time, Sum = all event in one pt bin

and Xin's x-binning method:

N_bin = N_raw * weight * Acceptance * Lumi * time * det_eff,

So his x-binning condition is actually ~ max (2e6, Sum/8.).

(2) Dilution Factors are calculated differently:

Mine → directly from "collider", in the code, di = dxs_p/dxs_n, so for He3, dilute = 1/(1+2*di)

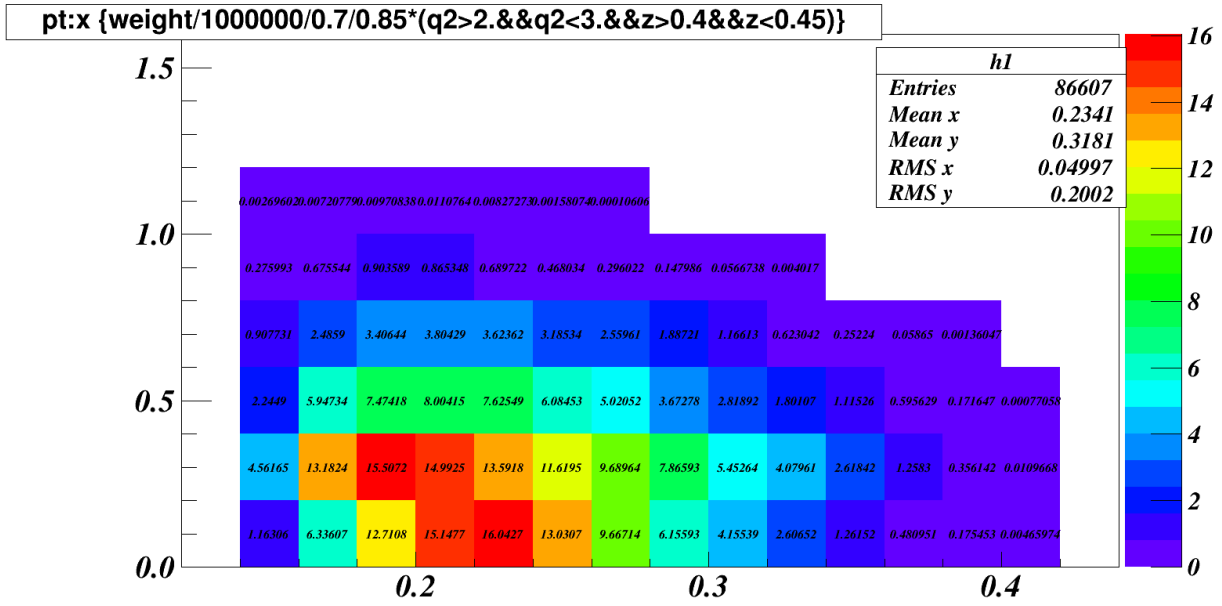
For Xin → dilution=(di_mean_D2 – di_mean_P)/di_mean_He3, "mean" means the mean value in each x-bin.

(3) and I don't know how he calculated weight * Acceptance

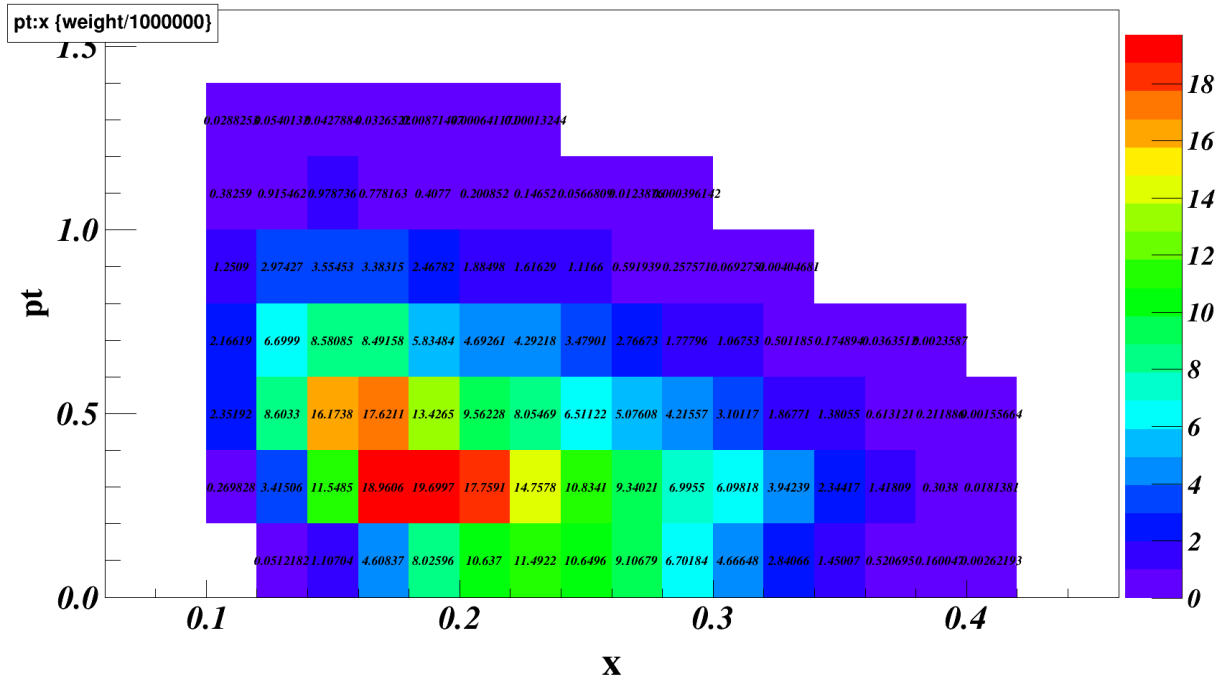
(4) Xin estimated the Signal/Noise but did not apply on the projection plots. I don't calculate Signal/Noise since I need inclusive XS models with is not included in "collider"

Projections:

Z-bining and Q2-binning should have no problem, so I check the events distribution in one particular (Z,Q2) bin and check how it depends on pt and x.



CDF



CLEO

(e,e'pi-)

Projections: -- Results

For all results please click the link:

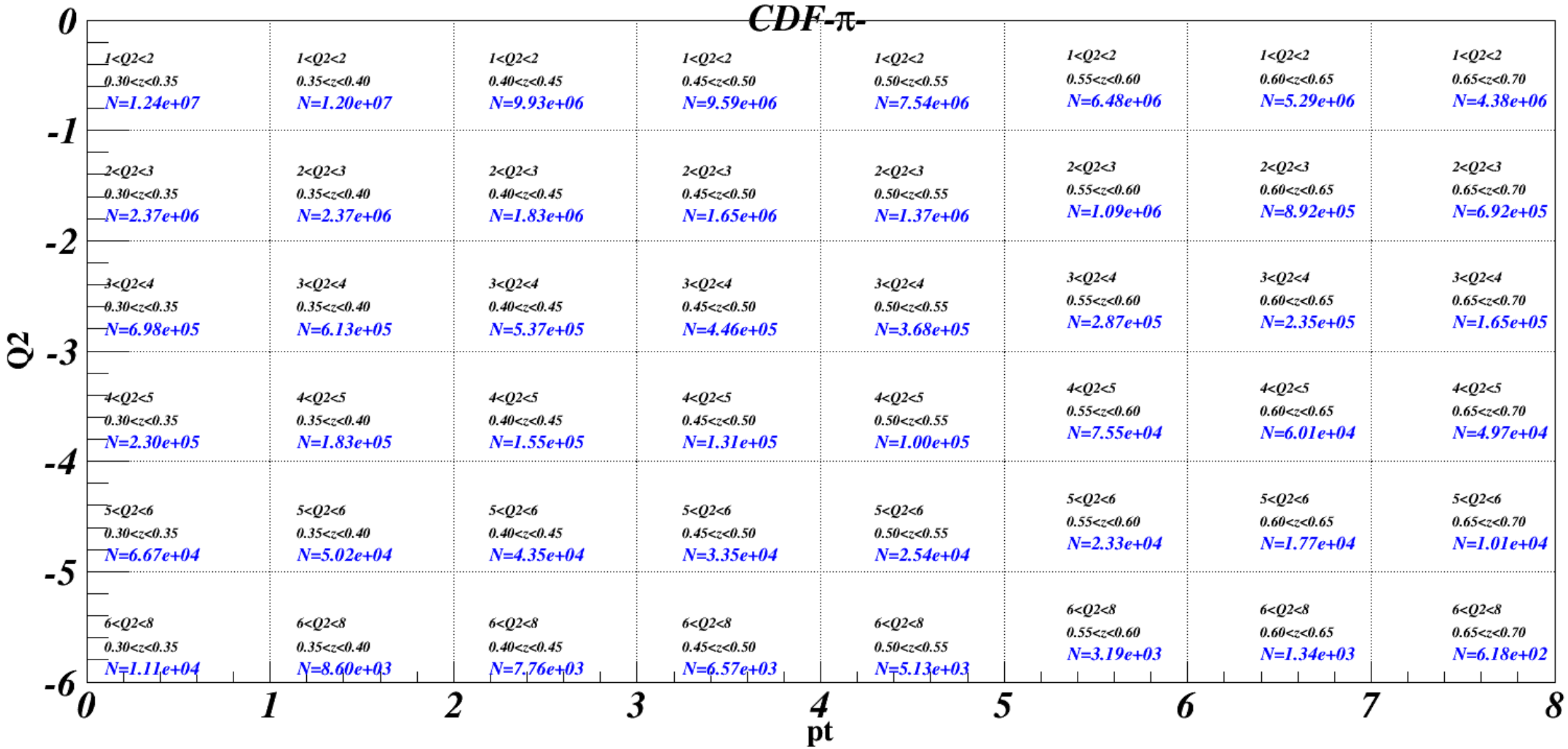
https://userweb.jlab.org/~yez/Work/solid/CDF_Projection/

https://userweb.jlab.org/~yez/Work/solid/CLEO_Projection/

Next Step, check the “Counts” (1/Astat/Astat) for each (Z,Q) bin for CDF and CLEO,
And also count the total events

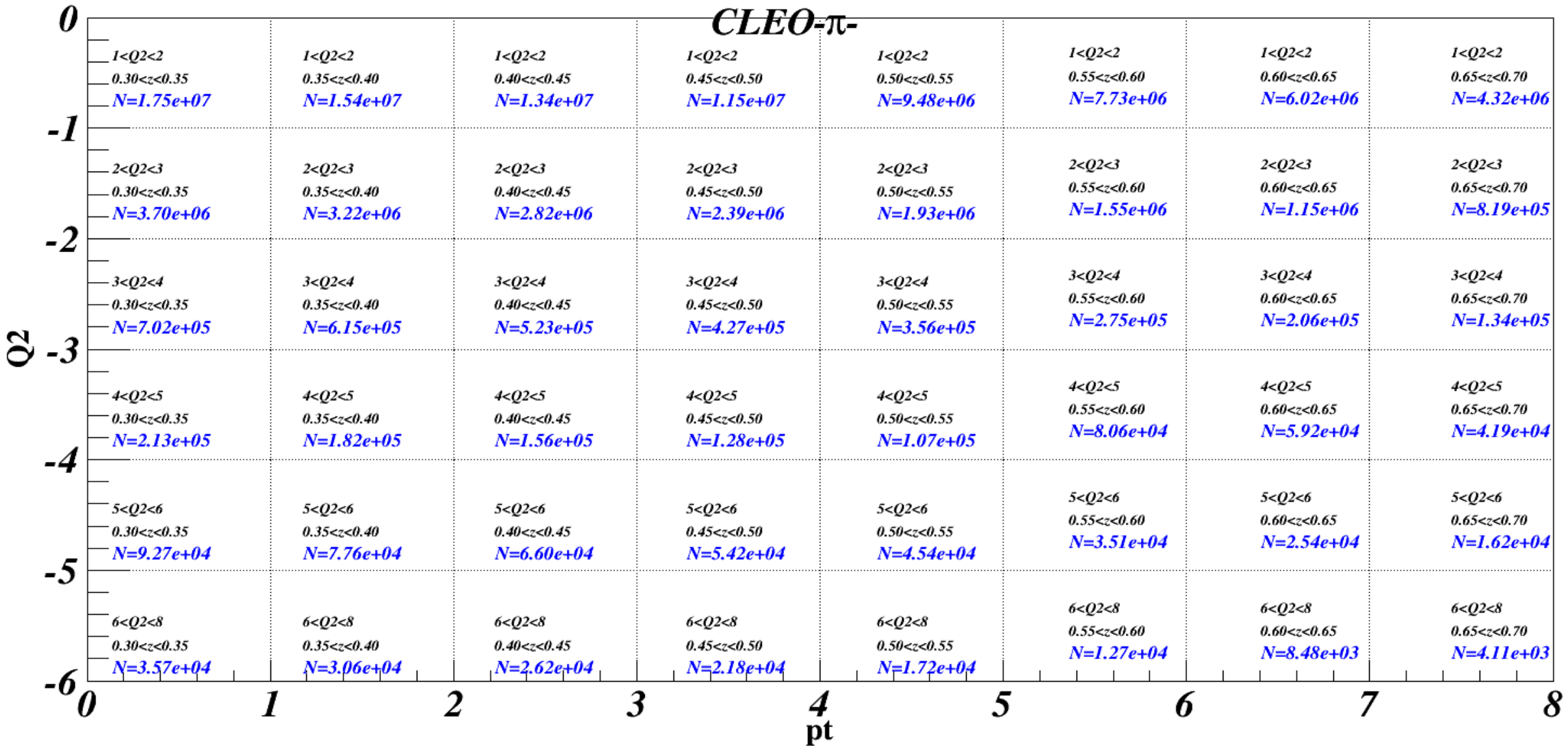
Projections: -- Results

N=6.2 x 10^9

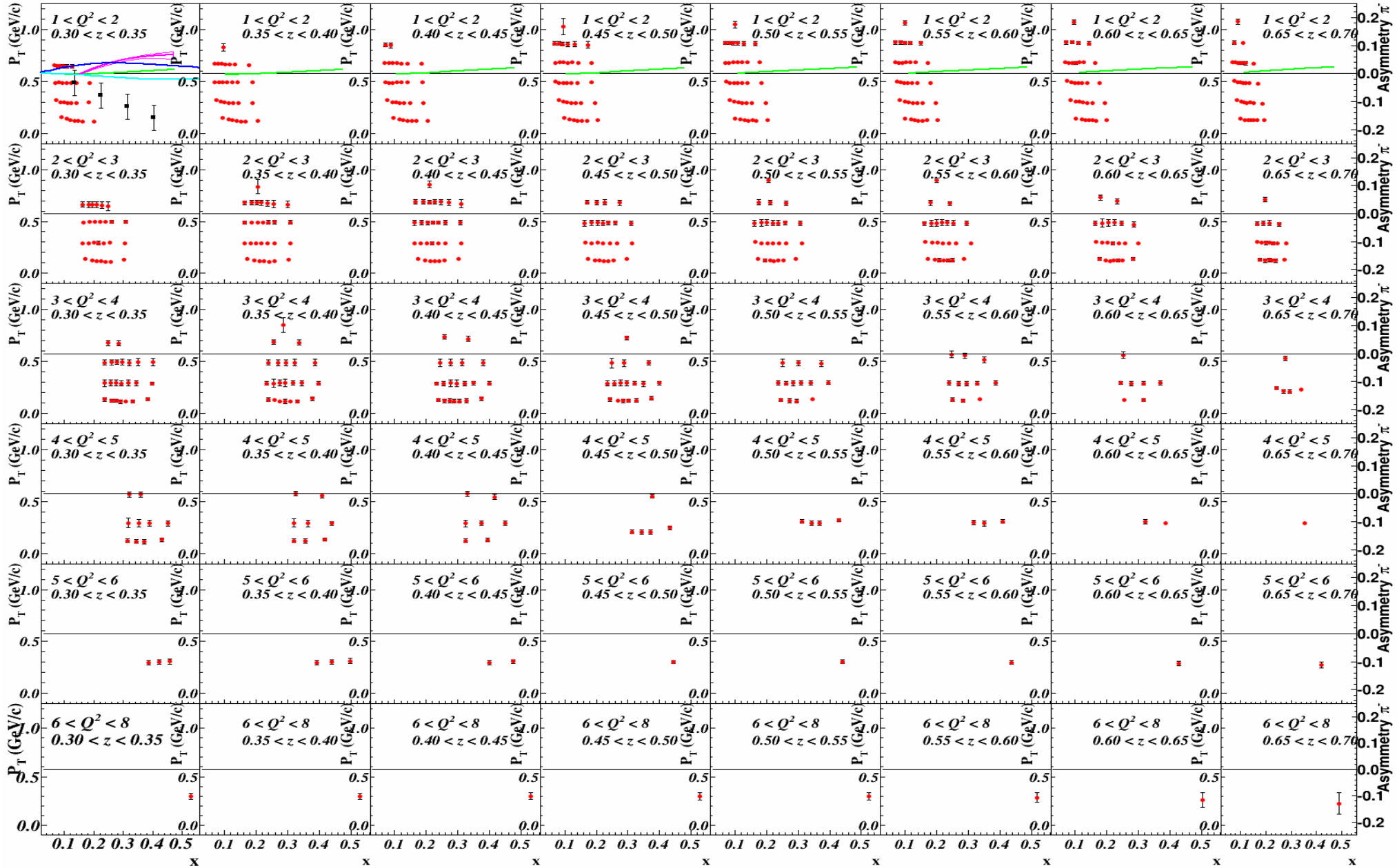


Projections: -- Results

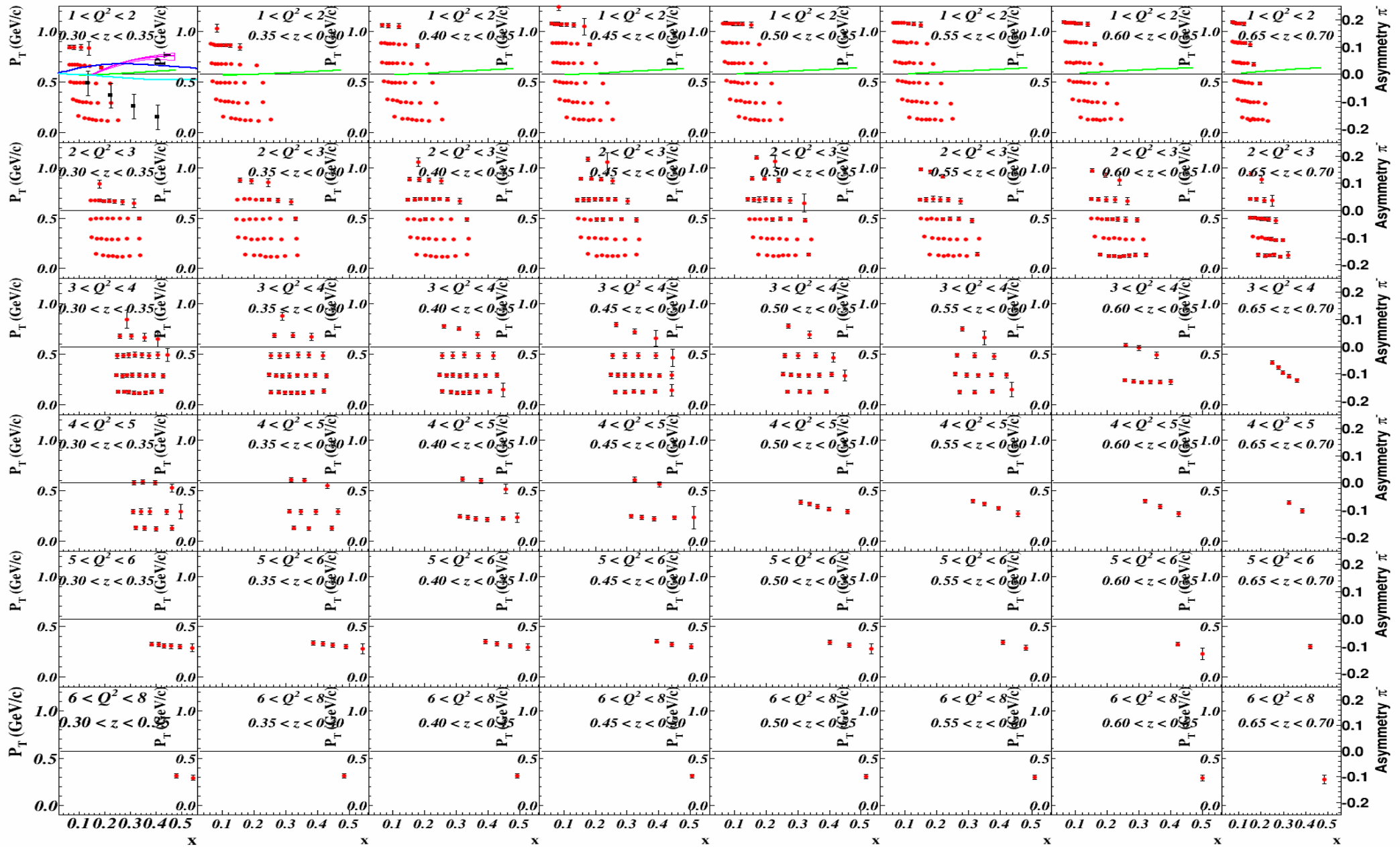
N=9.1 x 10^9



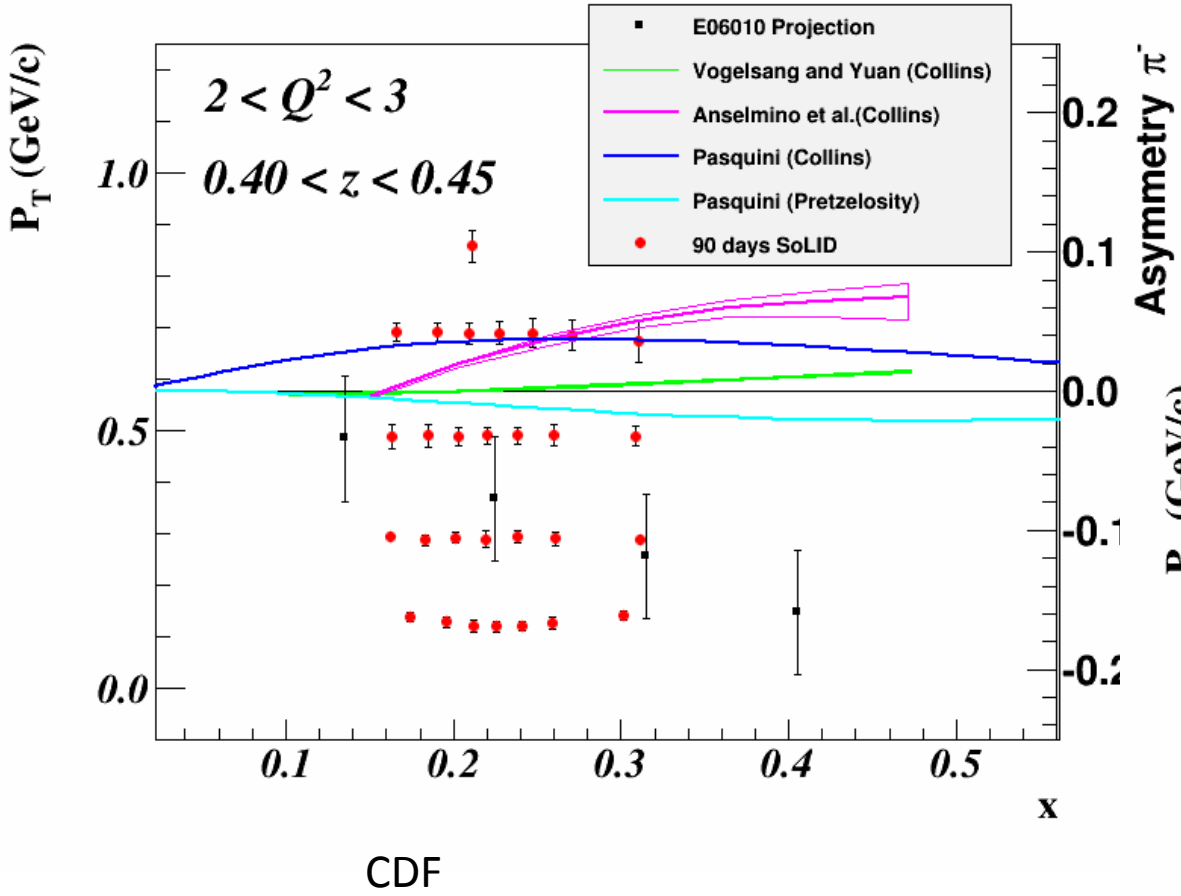
Projections: -- Results (pi-, Collins, CDF)



Projections: -- Results (pi-, Collins, CLEO)

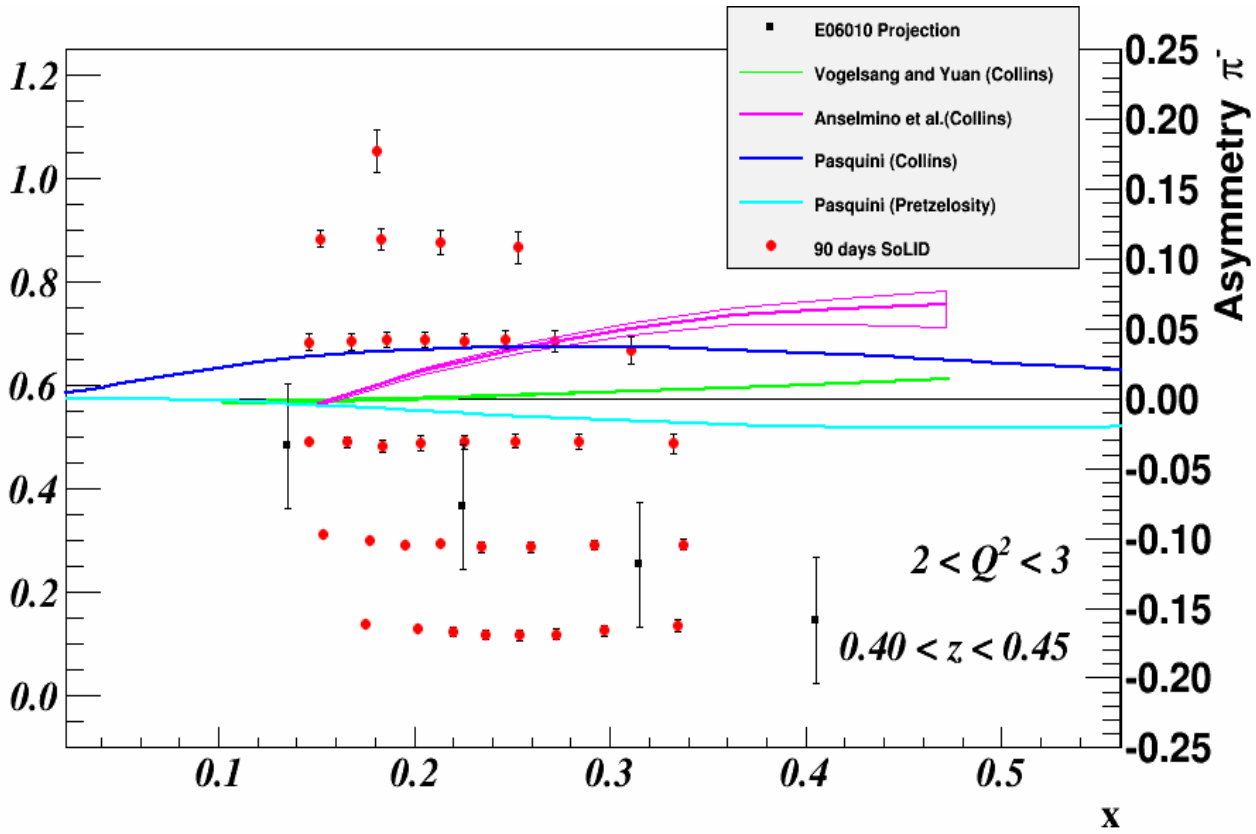


Projections: -- Results (pi-, collins)



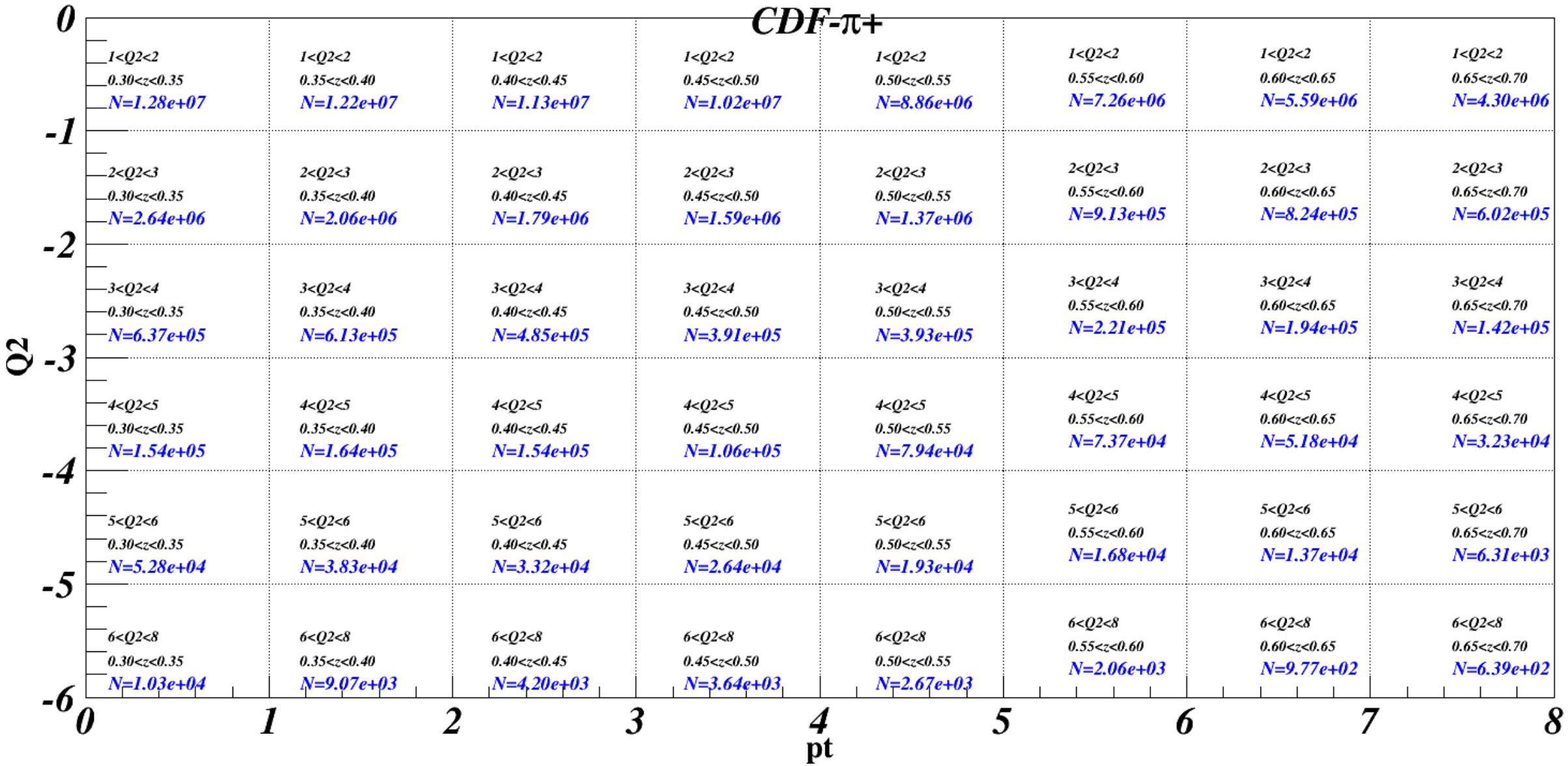
CDF

CLEO



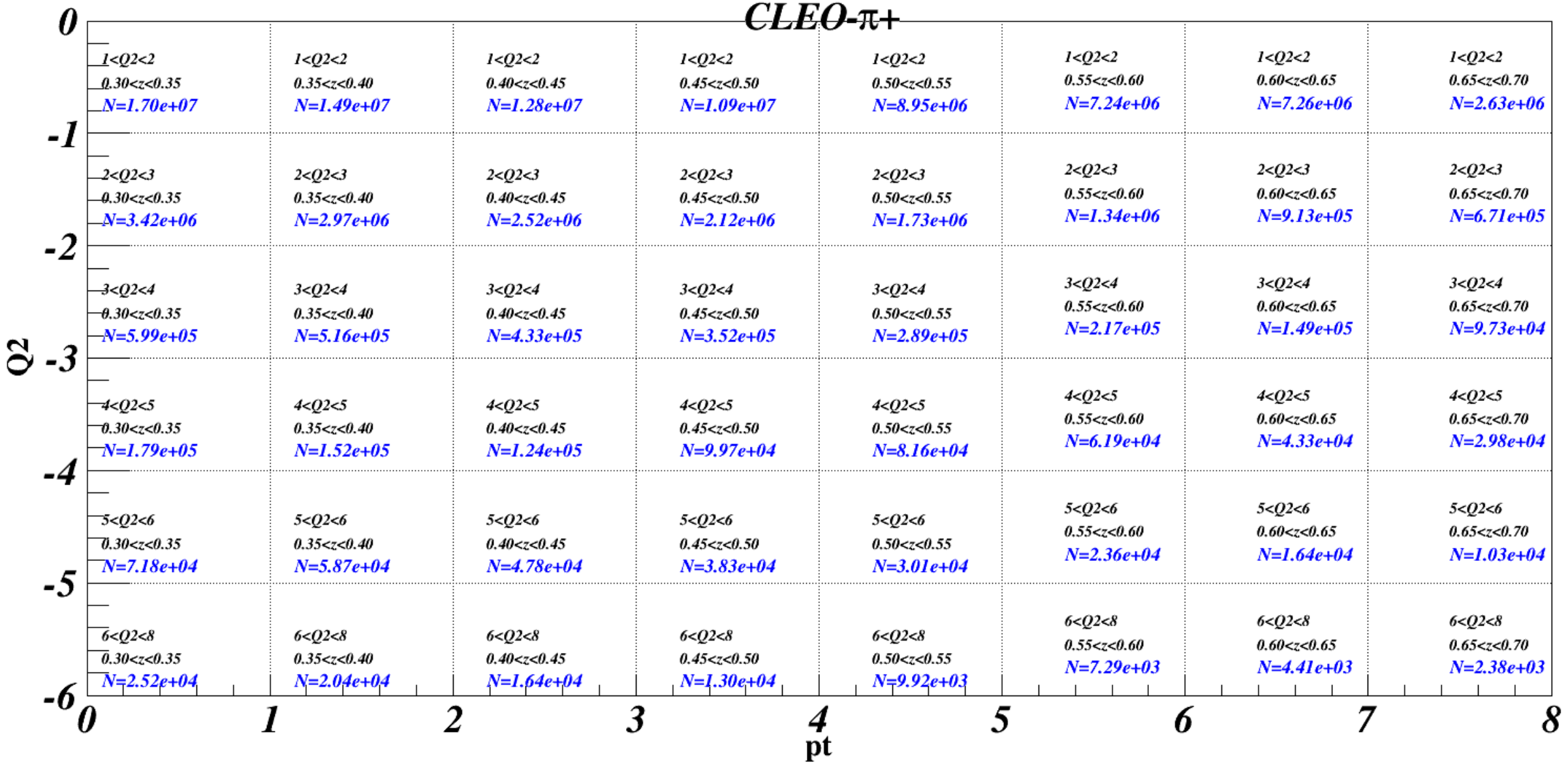
Projections: -- Results

N=9.16 x 10^9

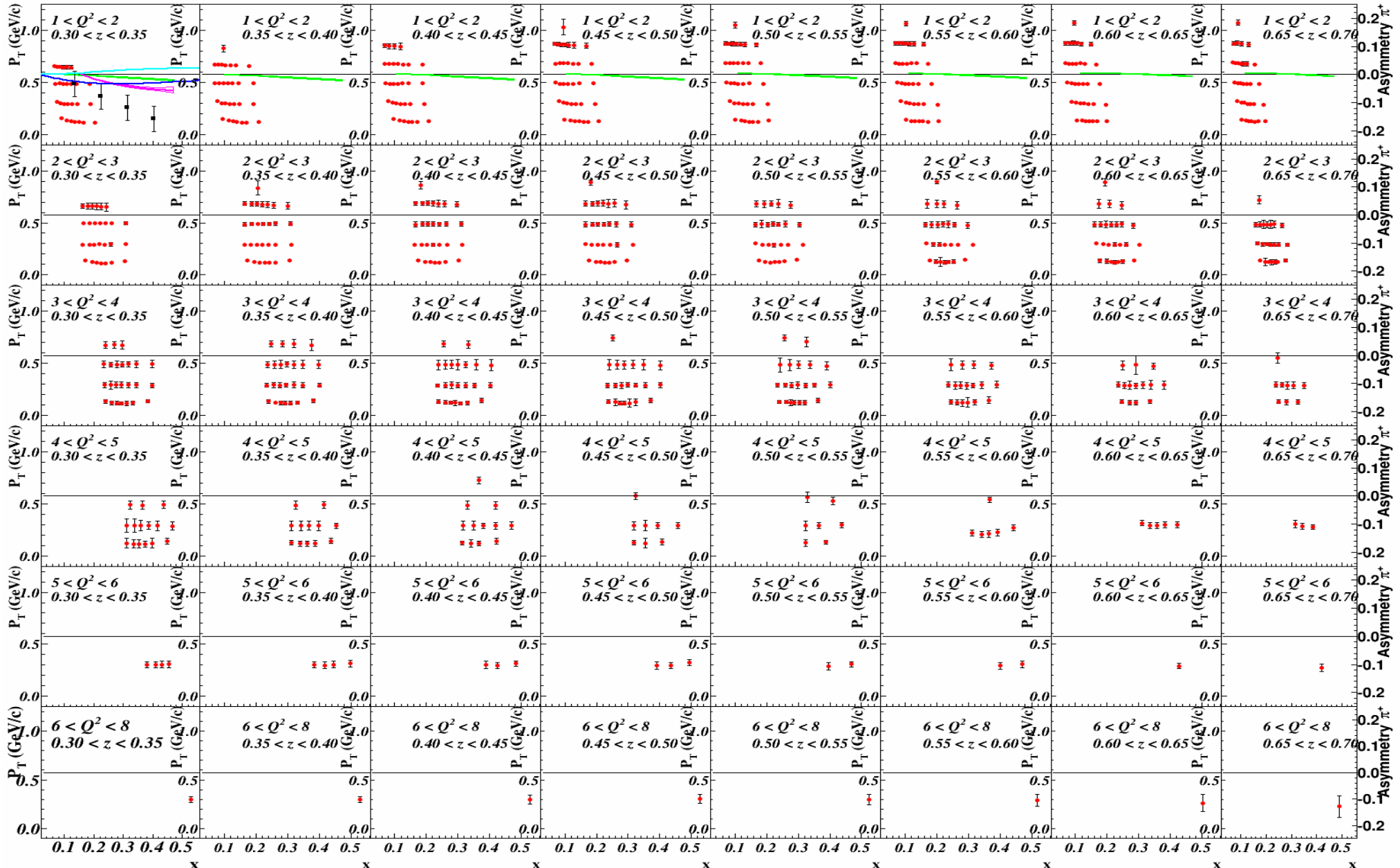


Projections: -- Results

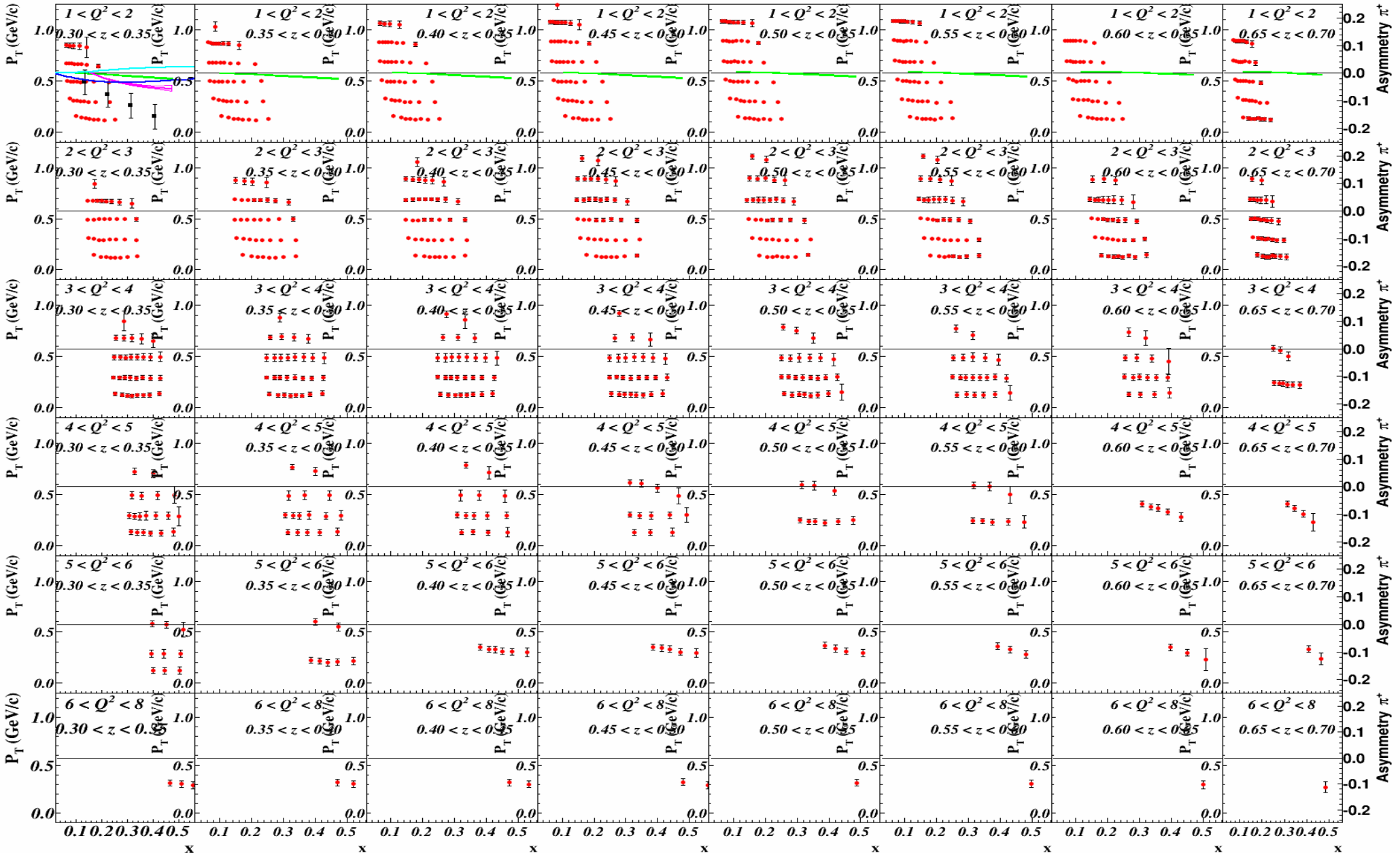
N=13.2 x 10^9



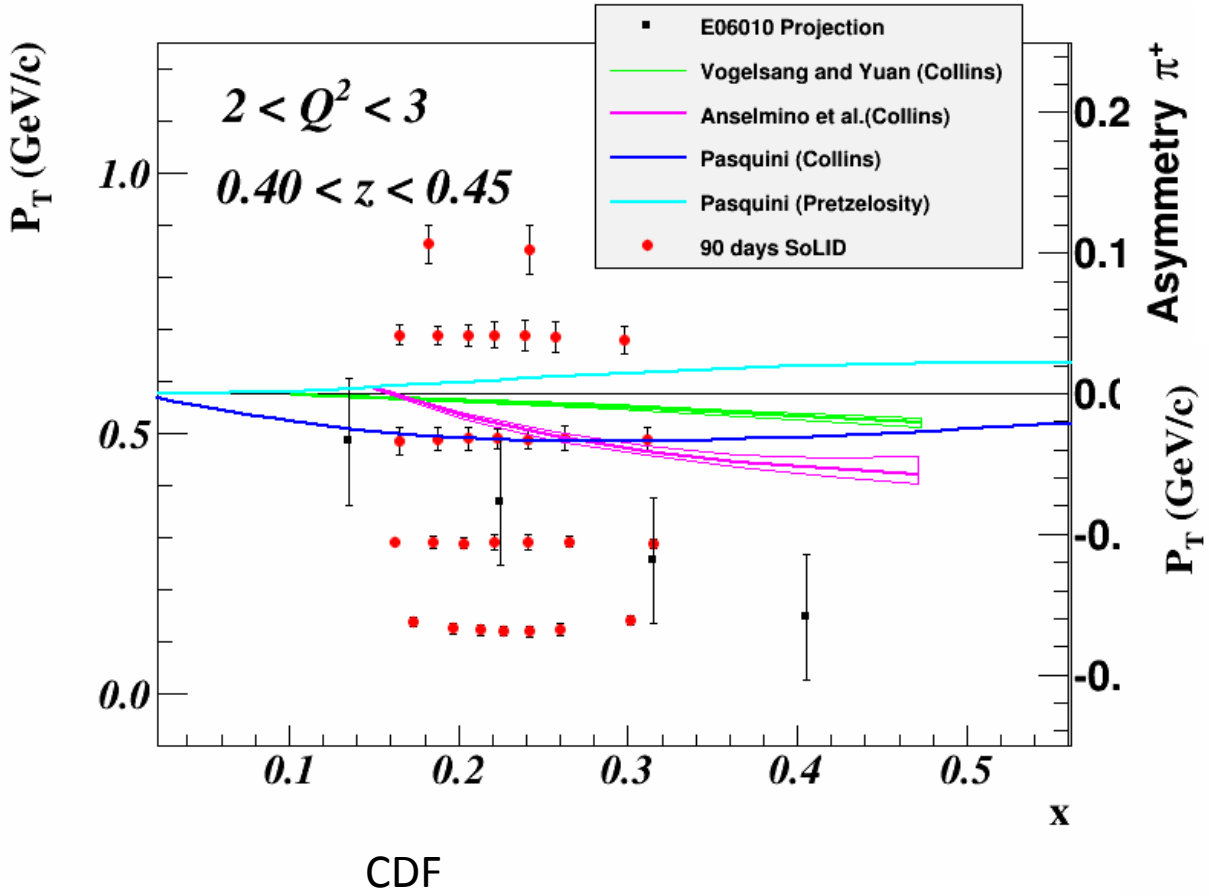
Projections: -- Results (pi+, Collins, CDF)



Projections: -- Results (pi+, Collins, CLEO)

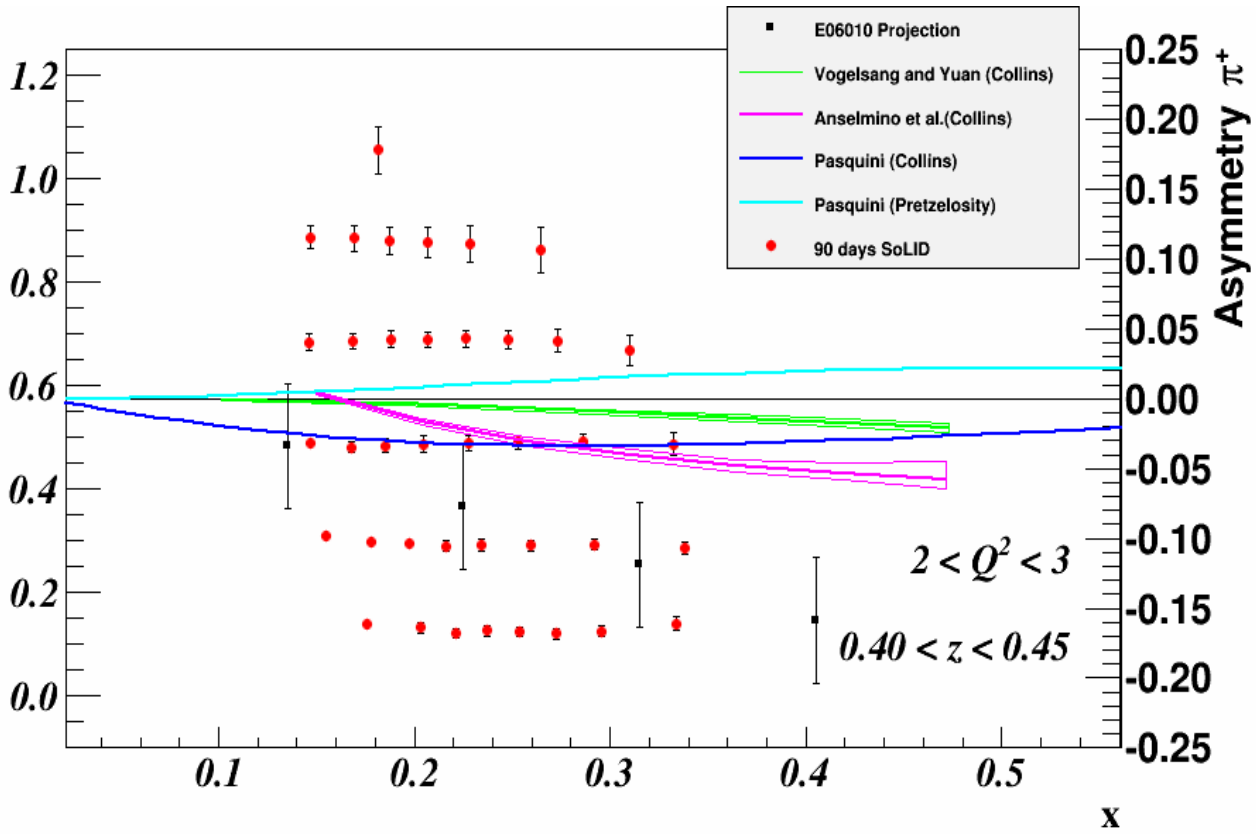


Projections: -- Results (pi+, collins)



CDF

CLEO



Projections: -- Results

The total number of events for the entire bins:

	Pi+	Pi-
CDF:	9.16e9	6.20e9
CLEO:	13.20e9	9.12e9
Difference:	44%	47%
Rate difference:	39%	41%

(events in one bin will be discarded if Astat in this bin is >0.05)