Comparisons of Σ and G asymmetries with different data and formulas

T. Kageya for g14, May. 8th 2024

Numbers for 1.98 < fW < 2.06 GeV (Haiyun's formula)

From 10th figure and 10th point for TK's data (9th figure and phi ~ 0 for Haiyun's plot)

New !

P+ = 0.25, p- = 0.162
p1 = 0.785, p2 = 0.779, p3 = 0.78, p4 = 0.775
L1 = 8.621, L2 = 3.831, L3 = 8.685, L4 = 4.147

Cperp = 0.32055 Cpara = 0.322448
s1 = – 0.00469235 s2 = – 0.0164208 s3 = 0.00466129 s4 = 0.0151621
E = 0.321494 D = 0.369661
a1 = 0.00364576 a2 = 0.0127582 a3 = 0.00364209 a4 = 0.0118469
g1 = – 0.0290504 g2 = 0.0658764 g3 = 0.0286883 g4 = – 0.060469
DG = 0.00199611

Y1 = 121 Y2 = 62 Y3 = 217 Y4 = 114

numr1 = 1.15412
numr2 = – 0.0988777
denom = 3.37303

Sigma = nmr1/denom = 0.342162

G = numr2/denom = – 0.0313103

Yield table for 1.98 < W < 2.06 GeV (TK's data, 20 bins) (TK's 10th and HL's 9th cos θ bin) (see TK's G formulas at page 6 and 7)

F1: 699 F2: 708 F3: 242 F4:271 (used for flux ratios)

PER +	PAR +	PERP -	PARA -
80	171	34	75
33	73	27	34
138	160	56	70
138	103	58	52
125	84	61	43
18	13	7	6
19	8	6	4
28	28	13	22
13	26	6	13
130	237	68	123
114	263	55	119
47	78	23	33
19	20	2	8
16	4	6	3
29	11	7	3
29	22	18	6
44	29	18	13
30	33	12	19
16	35	12	14
130	240	46	106

Σ : four equations with different conditions: PERP ($\perp$), PARA (II) and Ptarget : + , -

$$N_{\perp}^{+}(\phi) = a(\phi)\, F_{\perp}^{+} \{ 1 + P_{\perp}^{+} \Sigma \cos(2\phi) - P_{+z} P_{\perp}^{+} G \sin(2\phi) \} \quad (1) \quad \text{PERP, + Target}$$

$$N_{||}^{+}(\phi) = a(\phi)\, F_{||}^{+} \{ 1 - P_{||}^{+} \Sigma \cos(2\phi) + P_{+z} P_{||}^{+} G \sin(2\phi) \} \quad (2) \quad \text{PARA, + Target}$$

$$N_{\perp}^{-}(\phi) = a(\phi)\, F_{\perp}^{-} \{ 1 + P_{\perp}^{-} \Sigma \cos(2\phi) + P_{-z} P_{\perp}^{-} G \sin(2\phi) \} \quad (3) \quad \text{PERP, - Target}$$

$$N_{||}^{-}(\phi) = a(\phi)\, F_{||}^{-} \{ 1 - P_{||}^{-} \Sigma \cos(2(\phi) - P_{-z} P_{||}^{-} G \sin(2\phi) \} \quad (4) \quad \text{PARA, -Target}$$

F: flux, $a(\phi)$: acceptance, $P_{\perp}^{+}$: Linear Pol., P_{+z} : target D pol.

$$\frac{(1)/F_{\perp}/P_{\perp}^{+}/P_{+z} - (2)/F_{||}^{+}/P_{||}^{+}/P_{+z} + (3)/F_{\perp}^{-}/P_{\perp}^{-}/P_{-z} - (4)/F_{||}^{-}/P_{||}^{-}/P_{-z}}{(1)/F_{\perp}/P_{\perp}^{+}/P_{+z} + (2)/F_{||}^{+}/P_{||}^{+}/P_{+z} + (3)/F_{\perp}^{-}/P_{\perp}^{-}/P_{-z} + (4)/F_{||}^{-}/P_{||}^{-}/P_{-z}}$$

$$= \frac{a(\phi) \times \{1/P_{+z}/P_{\perp}^{+} - 1/P_{+z}/P_{||}^{+} + 1/P_{-z}/P_{\perp}^{-} - 1/P_{-z}/P_{||}^{-} + 2/P_{+z} + 2/P_{-z}\,)\, \Sigma \cos 2\phi) \}}{(1/P_{+z}/P_{\perp}^{+}/ + 1/P_{+z}/P_{||}^{+} + 1/P_{-z}/P_{\perp}^{-} + 1/P_{-z}/P_{||}^{-}\,) \times a(\phi)} \rightarrow \frac{C_1 + C_2 \Sigma \cos(2\phi)}{C_3}$$

Σ Plot the following ratios for each θ

Input of N: yield, F: flux, a(ϕ): acceptance, $P_{\perp}^{+}$: Linear Pol., P_{+z} : target D pol. to make ratios

$$\frac{N_{\perp}^{+}/F_{\perp}/P_{\perp}^{+}/P_{+z} - N_{||}^{+}/F_{||}^{+}/P_{||}^{+}/P_{+z} + N_{\perp}^{-}/F_{\perp}^{-}/P_{\perp}^{-}/P_{-z} - N_{\perp}^{-}/F_{||}^{-}/P_{||}^{-}/P_{-z}}{N_{\perp}^{+}/F_{\perp}/P_{\perp}^{+}/P_{+z} + N_{||}^{+}/F_{||}^{+}/P_{||}^{+}/P_{+z} + N_{\perp}^{-}/F_{\perp}^{-}/P_{\perp}^{-}/P_{-z} + N_{\perp}^{-}/F_{||}^{-}/P_{||}^{-}/P_{-z}}$$

for each $\cos\theta$ bin

G : four equations with different conditions: PERP (⊥), PARA (II) and Ptarget : + , -

$N_{\perp}^{+}(\phi) = a(\phi)\, F_{\perp}^{+} \{ 1 + P_{\perp}^{+}\, \Sigma \cos(2\phi) - P_{+z}\, P_{\perp}^{+}\, G \sin(2\phi) \}$ (1) PERP, + Target

$N_{||}^{+}(\phi) = a(\phi)\, F_{||}^{+} \{ 1 - P_{||}^{+}\, \Sigma \cos(2\phi) + P_{+z}\, P_{||}^{+}\, G \sin(2\phi) \}$ (2) PARA, + Target

$N_{\perp}^{-}(\phi) = a(\phi)\, F_{\perp}^{-} \{ 1 + P_{\perp}^{-}\, \Sigma \cos(2\phi) + P_{-z}\, P_{\perp}^{-}\, G \sin(2\phi) \}$ (3) PERP, - Target

$N_{||}^{-}(\phi) = a(\phi)\, F_{||}^{-} \{ 1 - P_{||}^{-}\, \Sigma \cos(2(\phi) - P_{-z}\, P_{||}^{-}\, G \sin(2\phi) \}$ (4) PARA, -Target

F: flux, a(ϕ): acceptance, $P_{\perp}^{+}$: Linear Pol., P_{+z} : target D pol.

$$\frac{-(1)/F_{\perp}^{+}/P_{\perp}^{+} + (2)/F_{||}^{+}/P_{||}^{+} + (3)/F_{\perp}^{-}/P_{\perp}^{-} - (4)/F_{||}^{-}/P_{||}^{-}}{(1)/F_{\perp}^{+}/P_{\perp}^{+} + (2)/F_{||}^{+}/P_{||}^{+} + (3)/F_{\perp}^{-}/P_{\perp}^{-} + (4)/F_{||}^{-}/P_{||}^{-}}$$

Fit

$$= \frac{a(\phi) \times \{ -1/P_{\perp}^{+} + 1/P_{||}^{+} + 1/P_{\perp}^{-} - 1/P_{||}^{-} + 2\,(P_{+z} + P_{-z})\ G \sin(2(\phi) \}}{(1/P_{\perp}^{+} + 1/P_{||}^{+} + 1/P_{\perp}^{-} + 1/P_{||}^{-}) \times a(\phi)} \rightarrow \frac{C_1 + C_2\, G \sin(2\phi)}{C_3}$$

G : Plot the following ratios for each θ

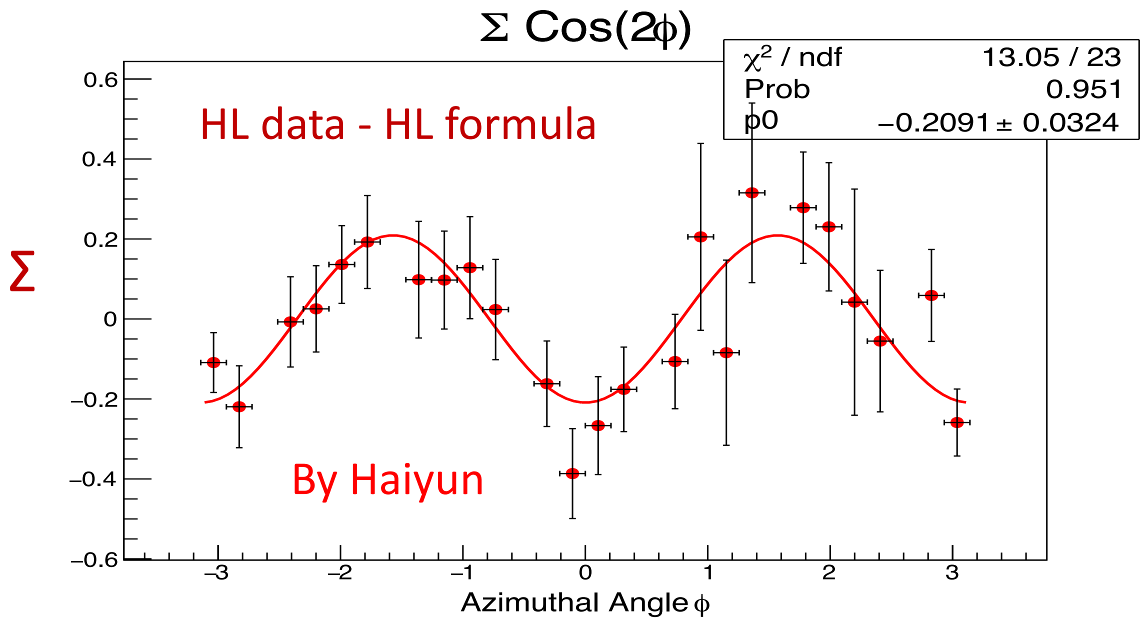
Input of N: yield, F: flux, a(ϕ): acceptance, $P_{\perp}^{+}$: Linear Pol., P_{+z} : target D pol. to make ratios

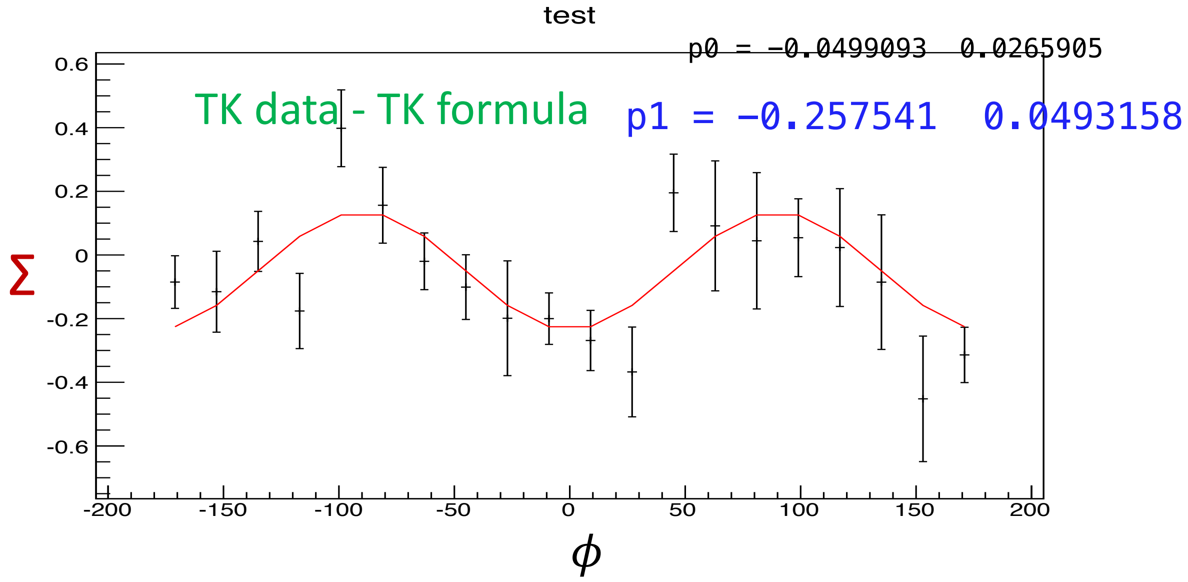
$$\frac{-N_{\perp}^{+}/F_{\perp}^{+}/P_{\perp}^{+} + N_{||}^{+}/F_{||}^{+}/P_{||}^{+} + N_{\perp}^{-}/F_{\perp}^{-}/P_{\perp}^{-} - N_{||}^{-}/F_{||}^{-}/P_{||}^{-}}{N_{\perp}^{+}/F_{\perp}^{+}/P_{\perp}^{+} + N_{||}^{+}/F_{||}^{+}/P_{||}^{+} + N_{\perp}^{-}/F_{\perp}^{-}/P_{\perp}^{-} + N_{||}^{-}/F_{||}^{-}/P_{||}^{-}}$$

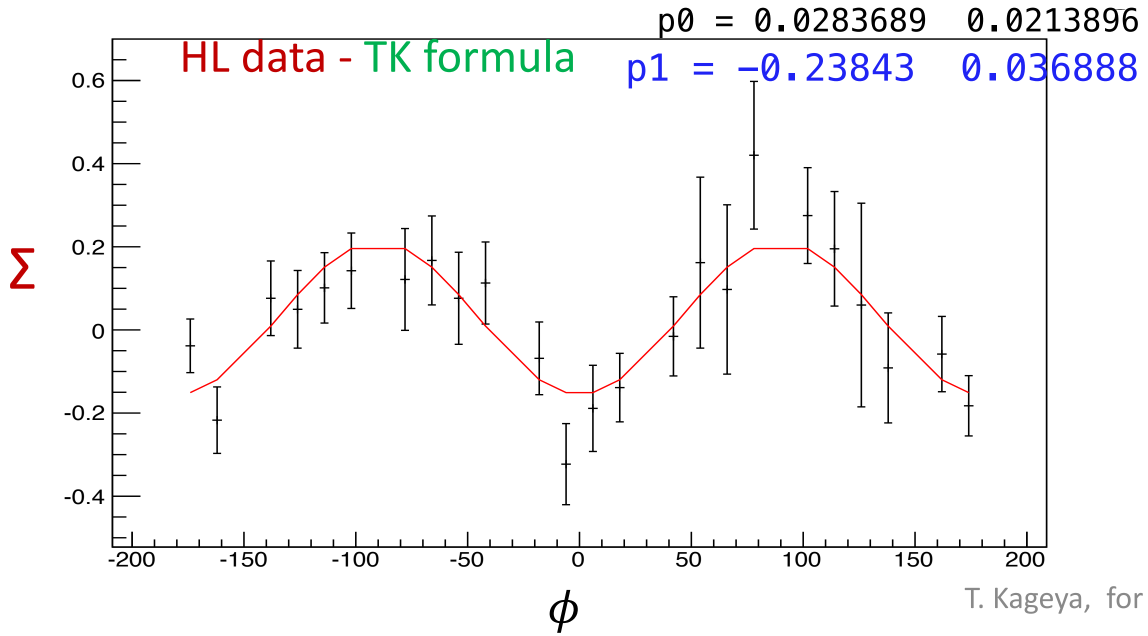
for each cos θ bin.

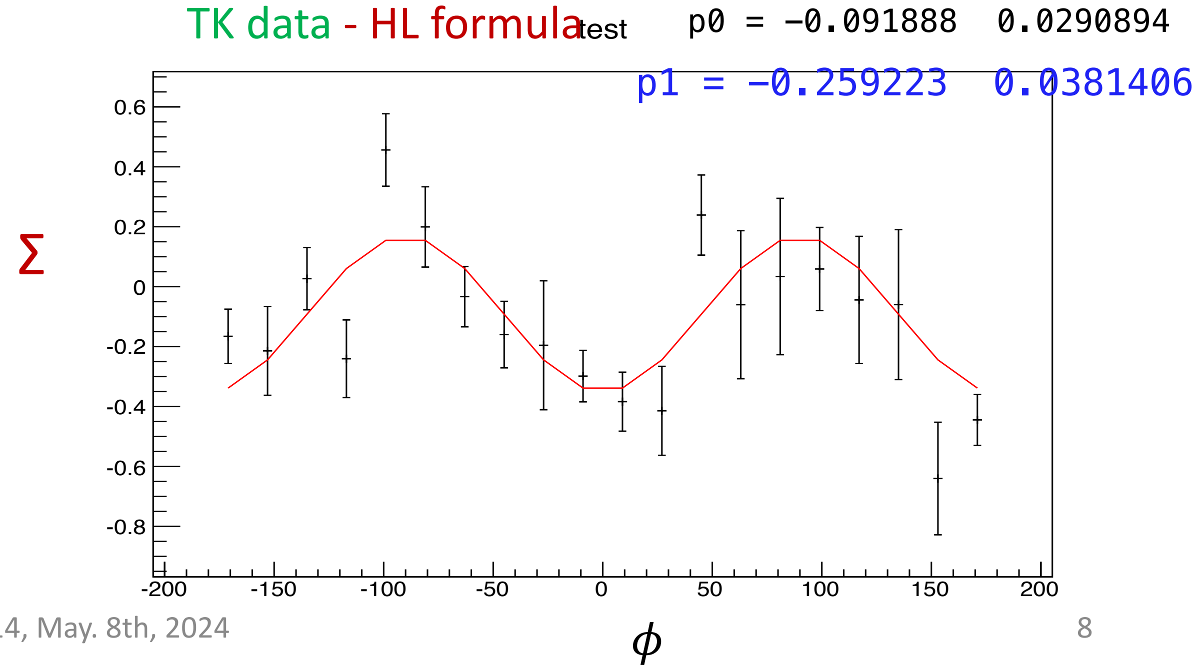
+

Comparisons of two data sets and two fomulas (Σ, HL's 8th bin)

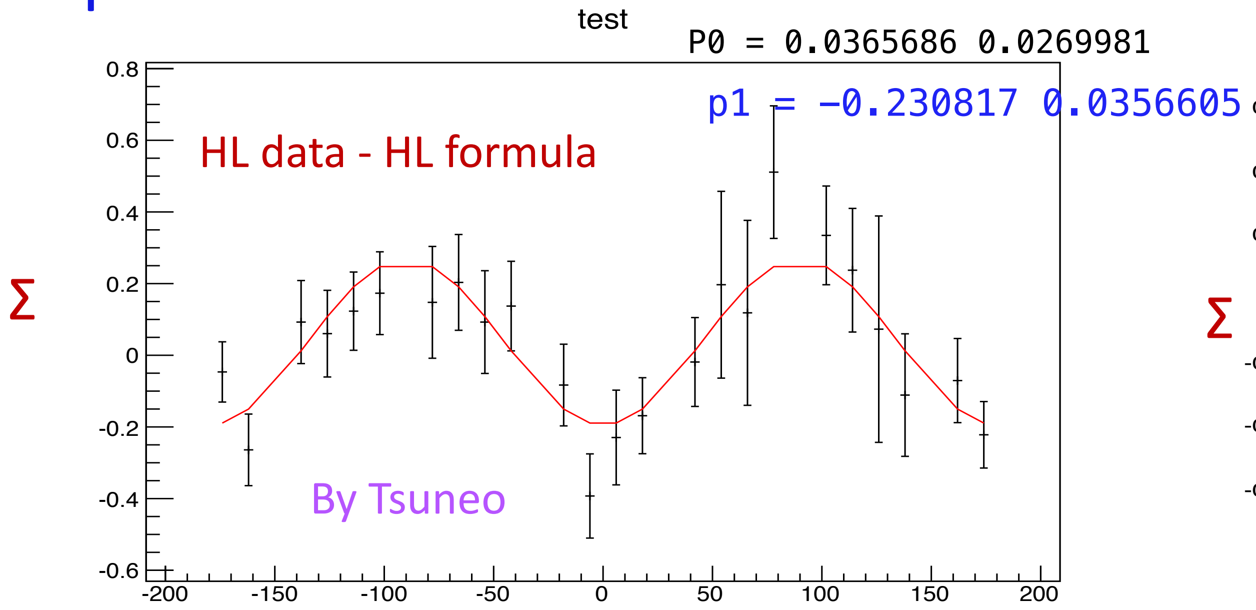


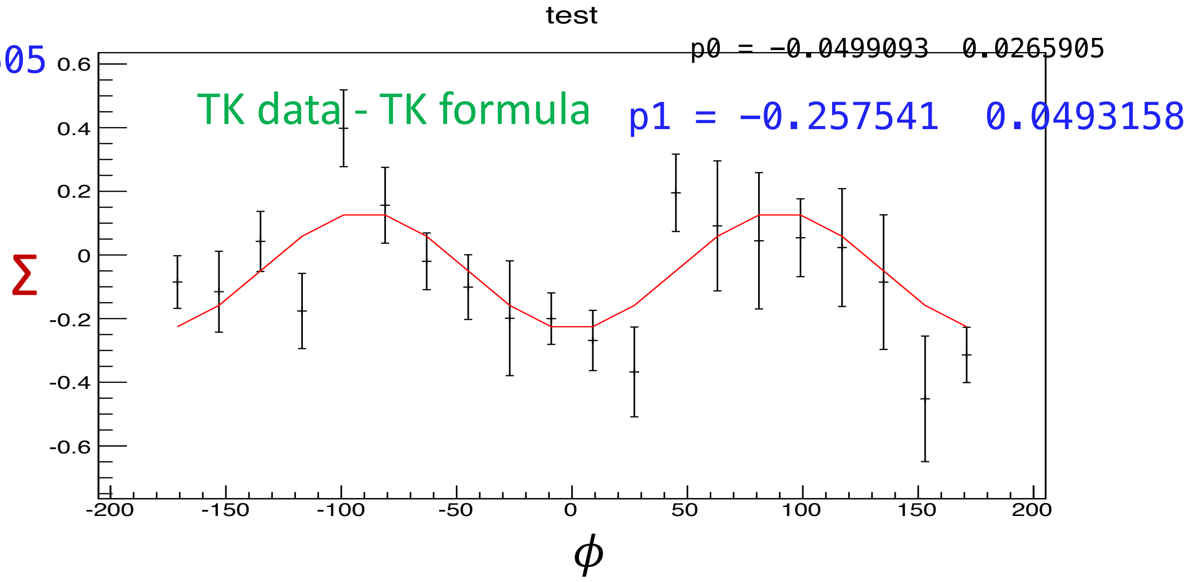


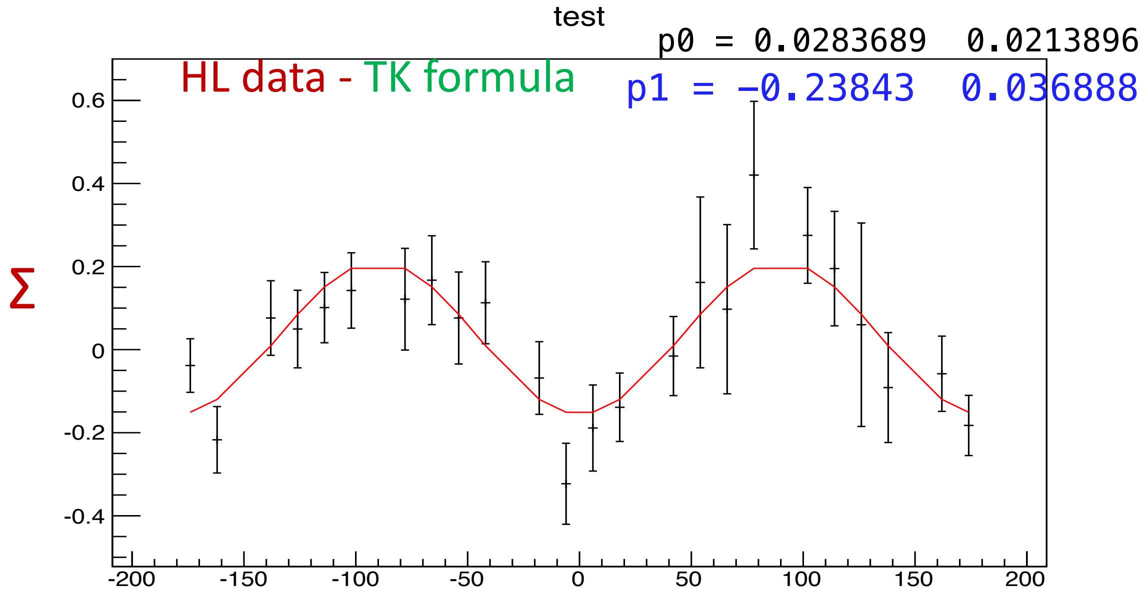


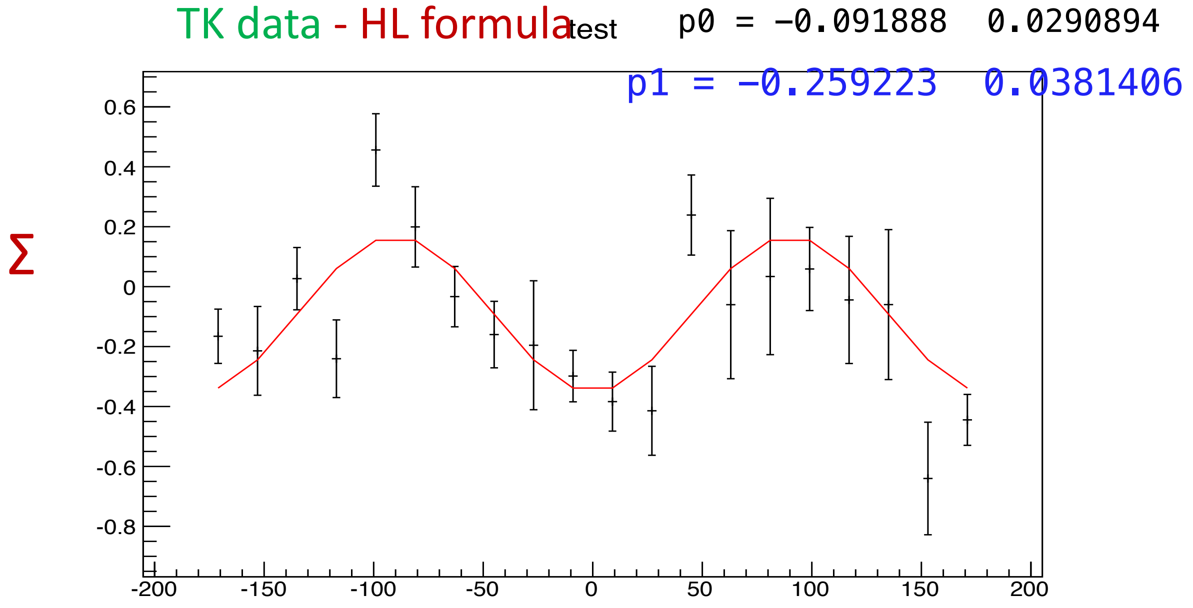


Comparisons of two data sets and two fomulas (Σ, HL's 8th bin)

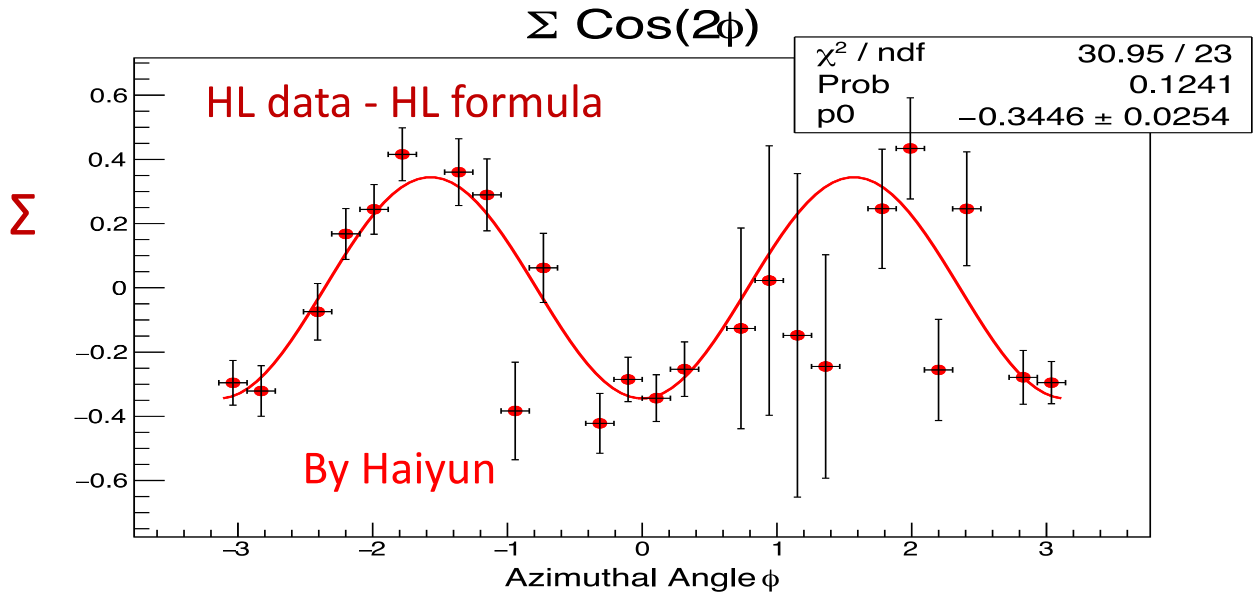


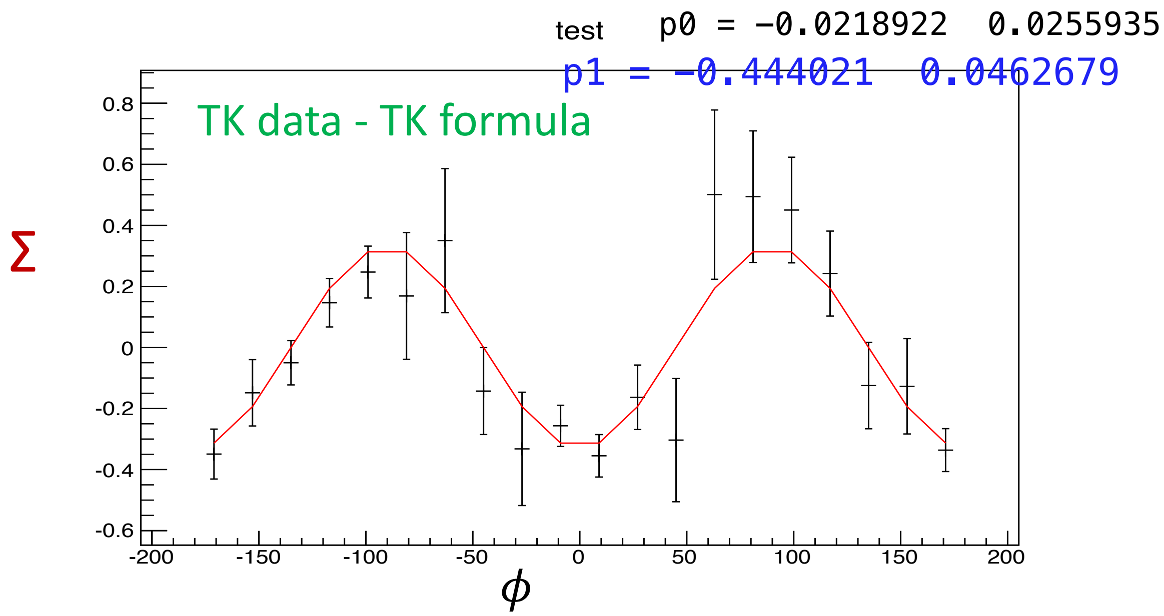


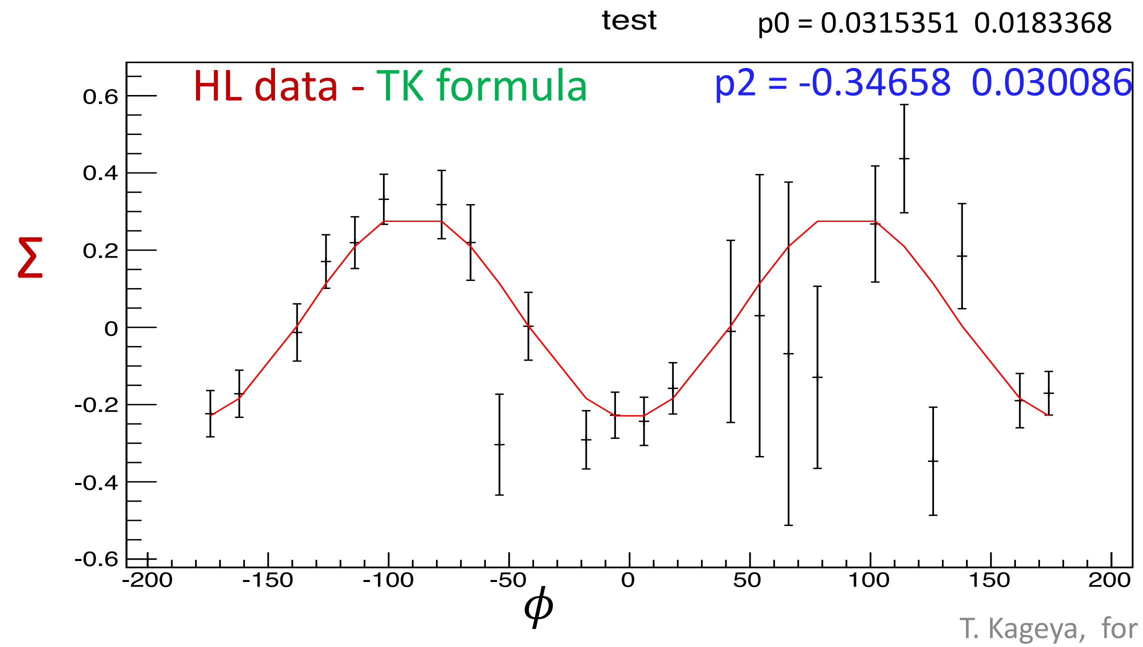


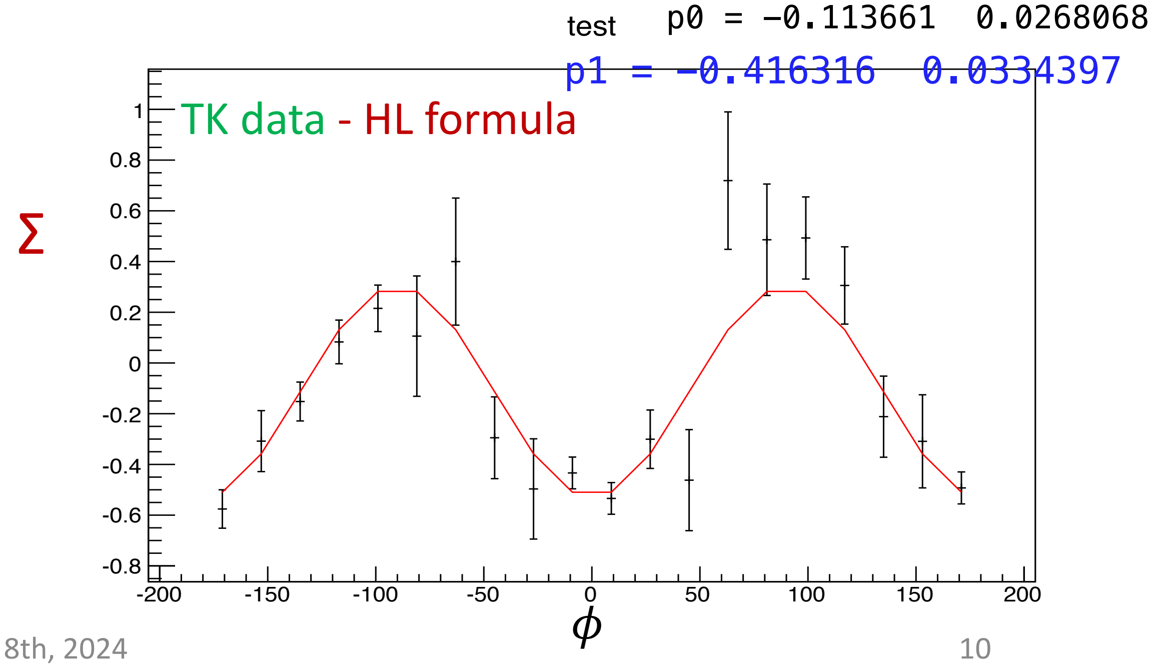


Comparisons of two data sets and two fomulas (Σ, HL's 9th bin)

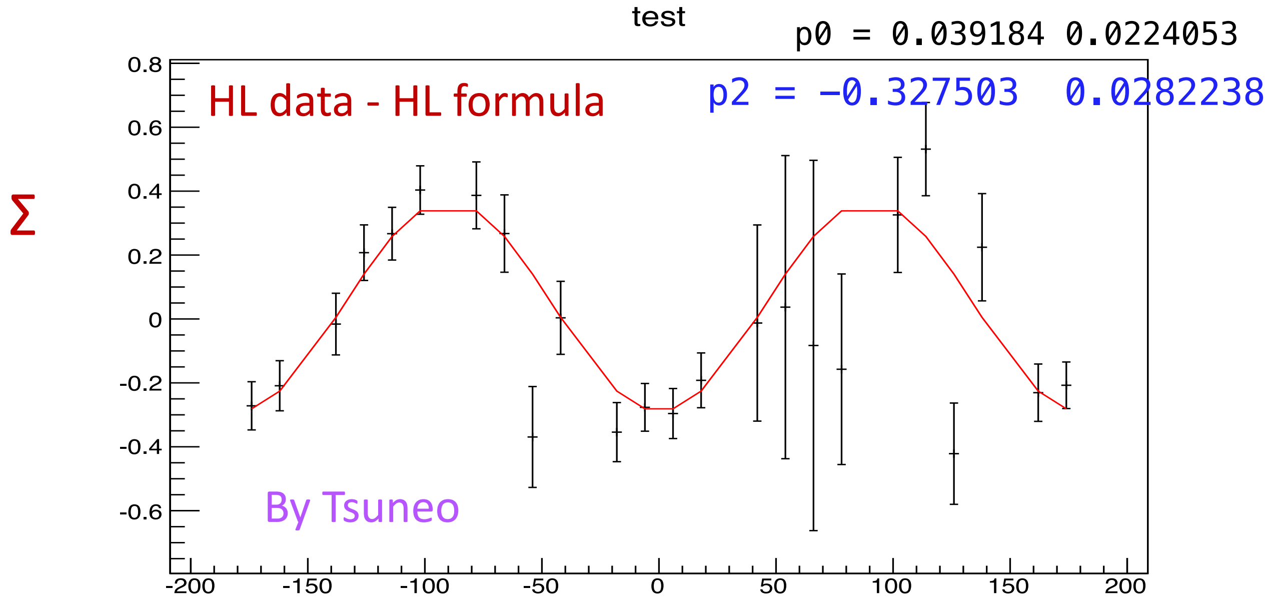


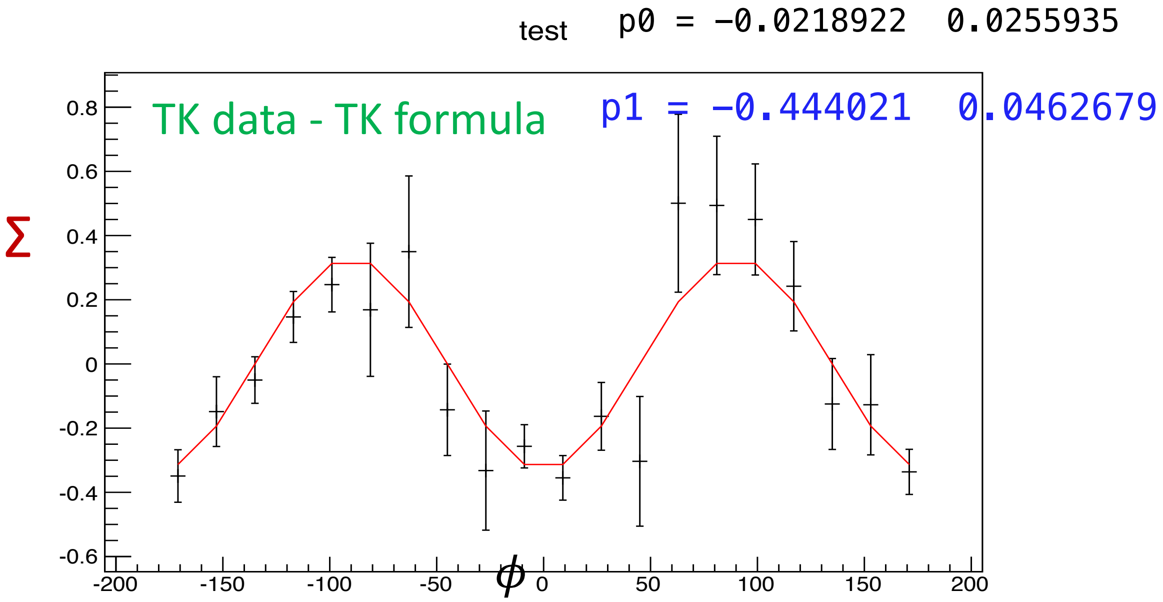


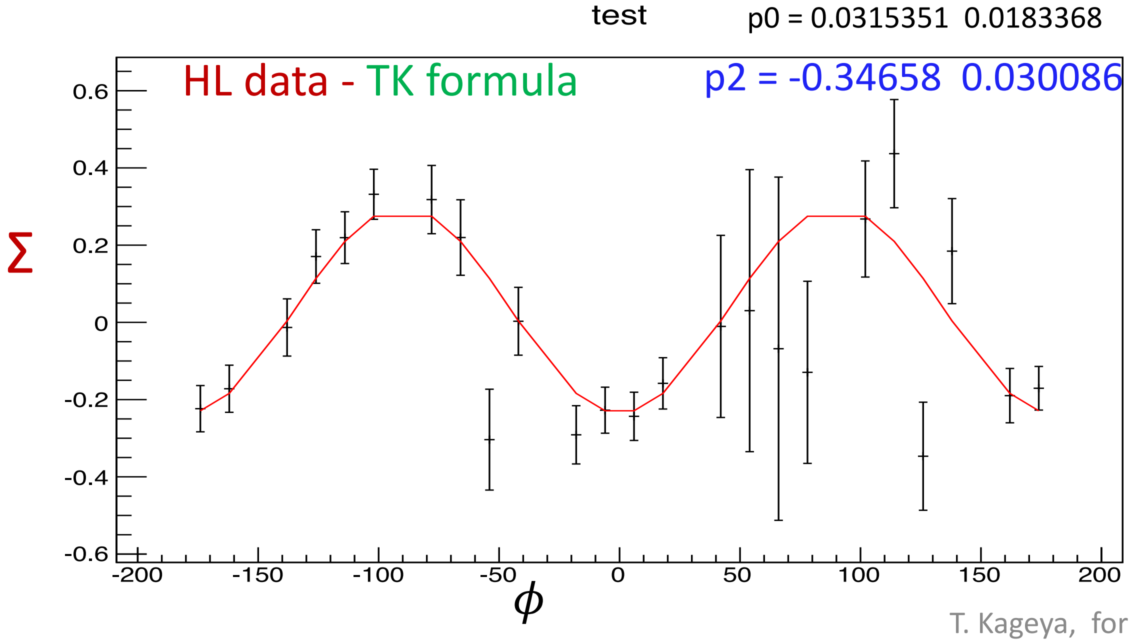


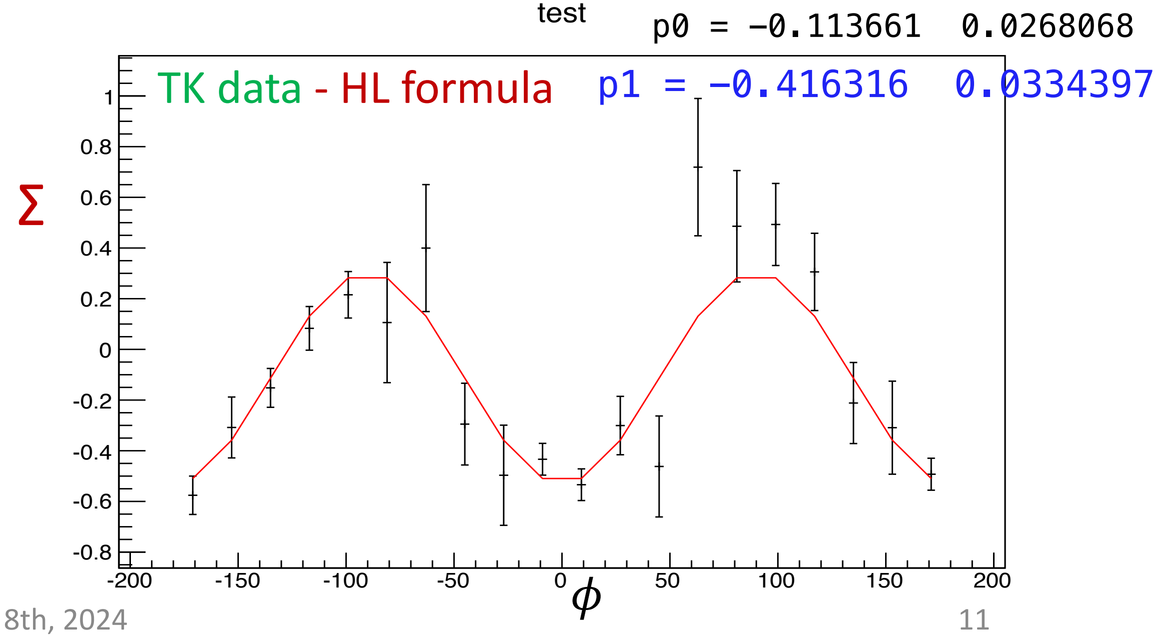


Comparisons of two data sets and two fomulas (Σ, HL's 9th bin)

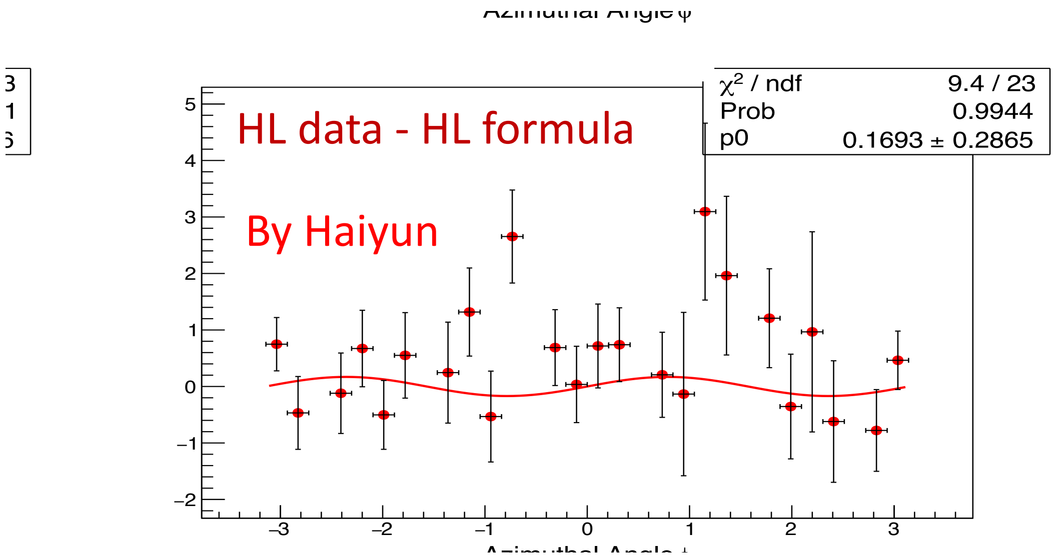


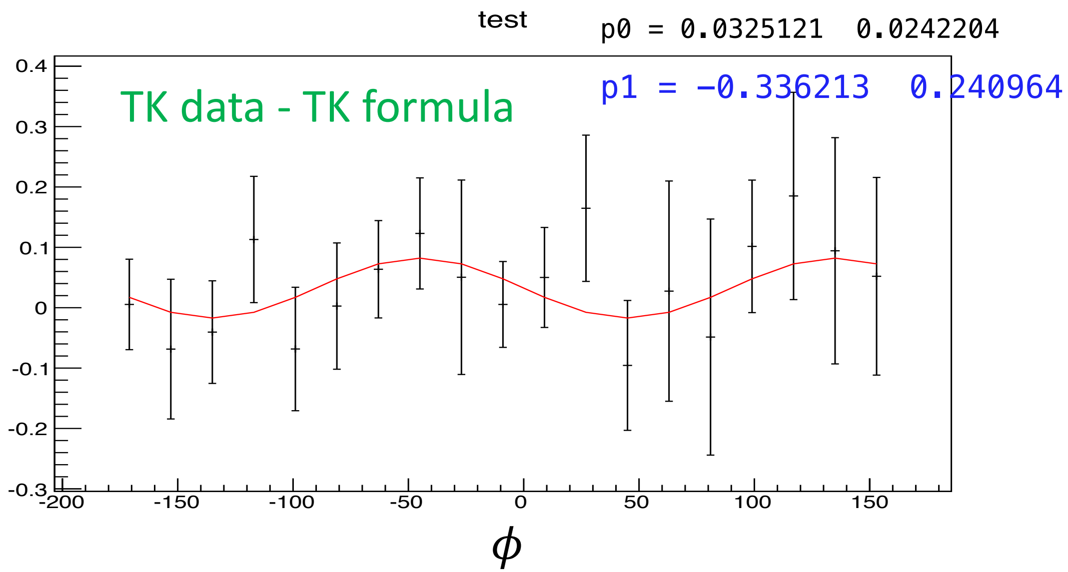


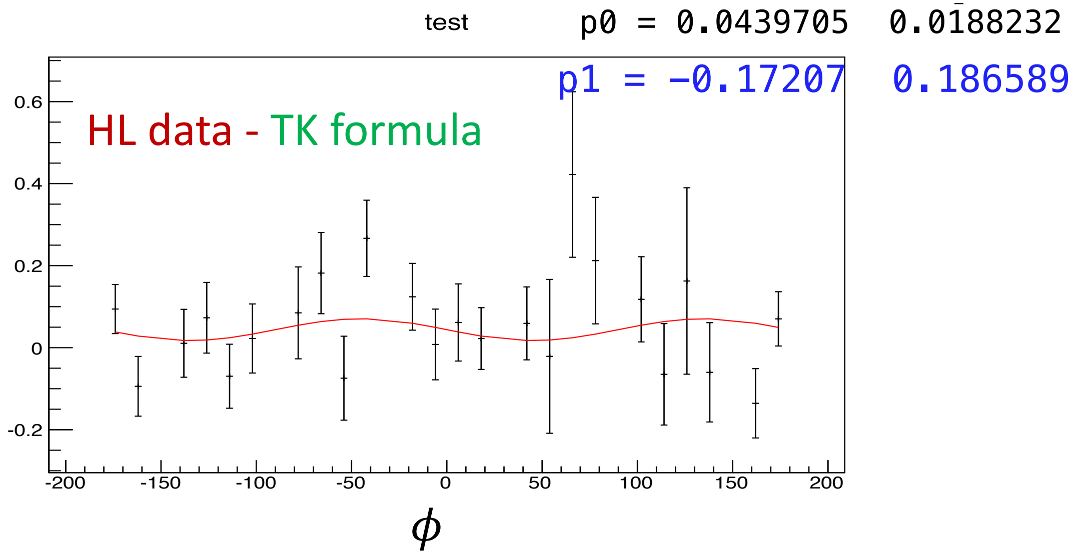


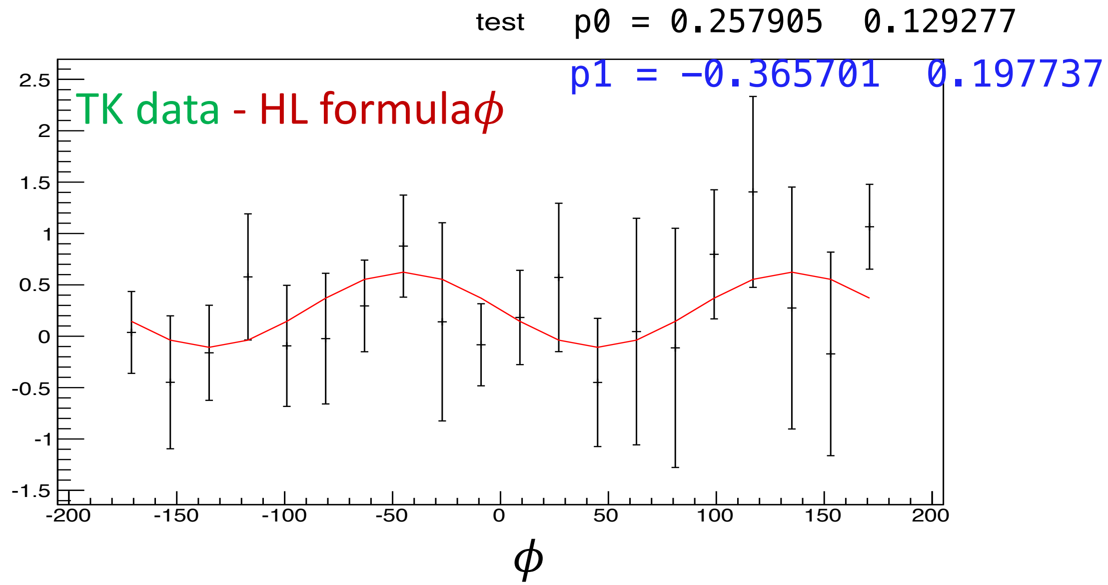


Comparisons of two data sets and two fomulas (G, HL's 8th bin)

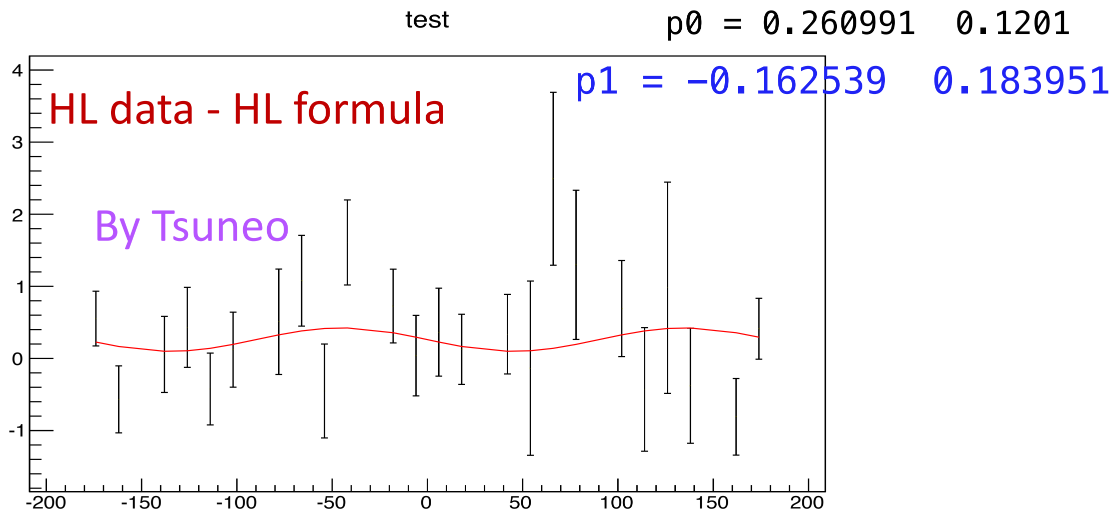


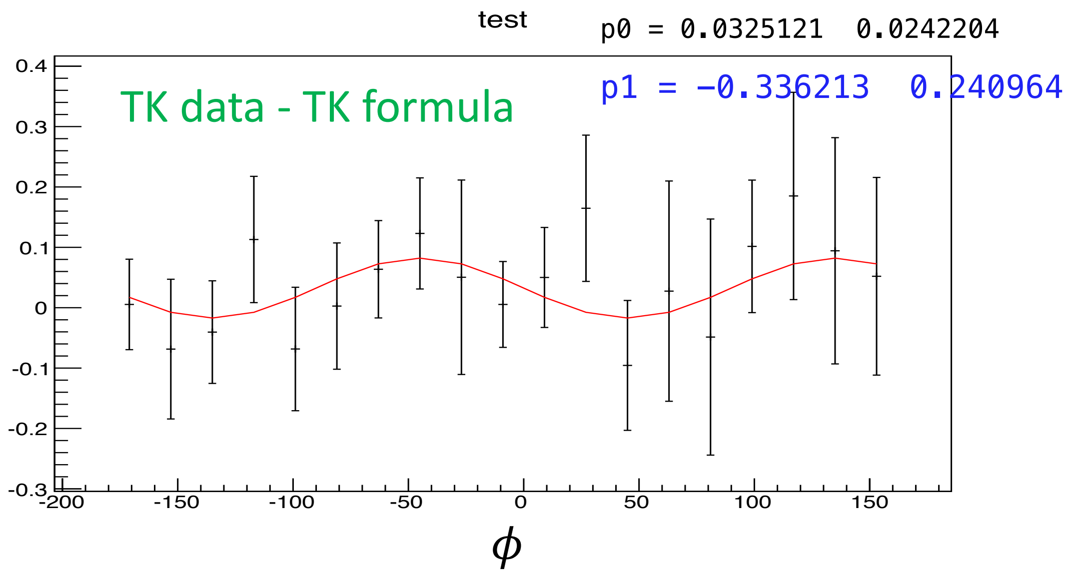


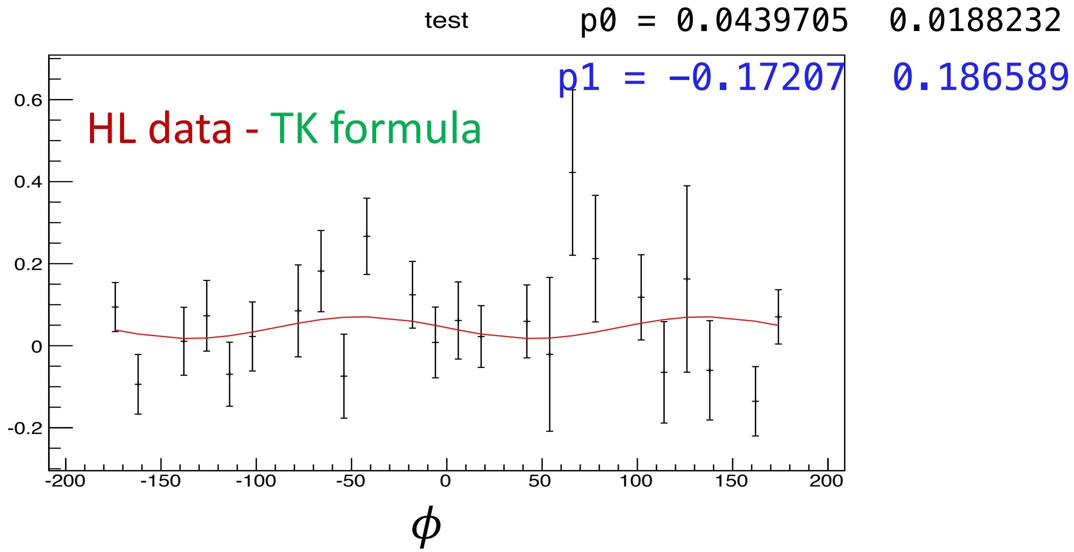


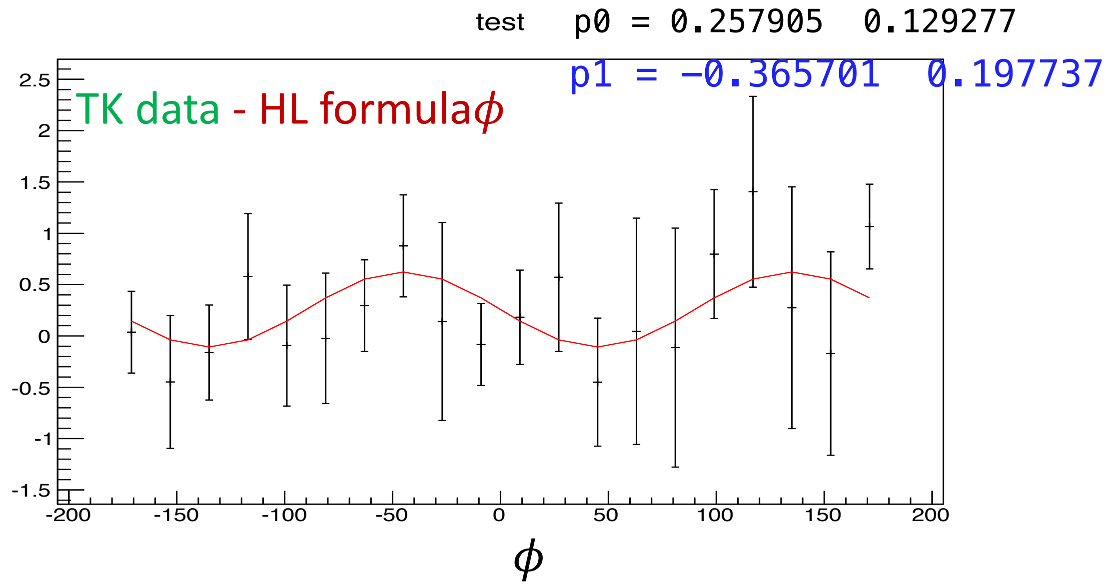


Comparisons of two data sets and two fomulas (G, HL's 8th bin)









Comparisons of two data sets and two fomulas (G, HL's 9th bin)

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4
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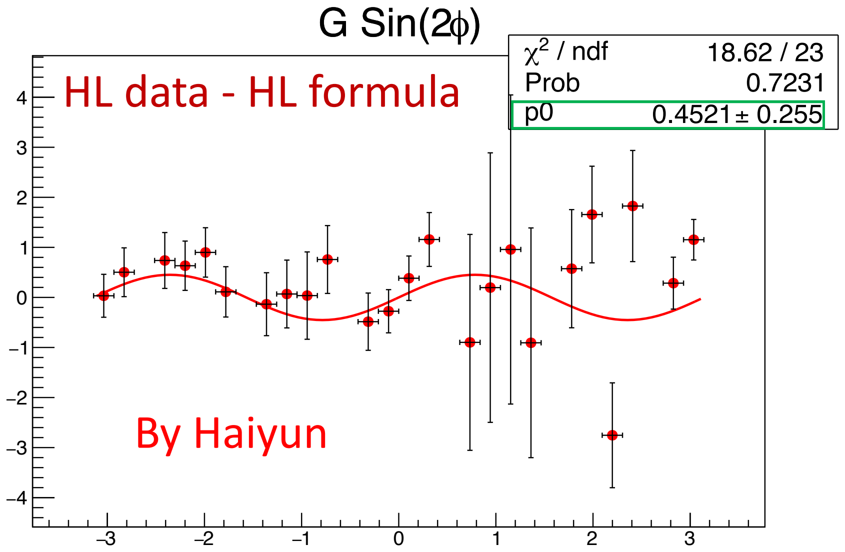
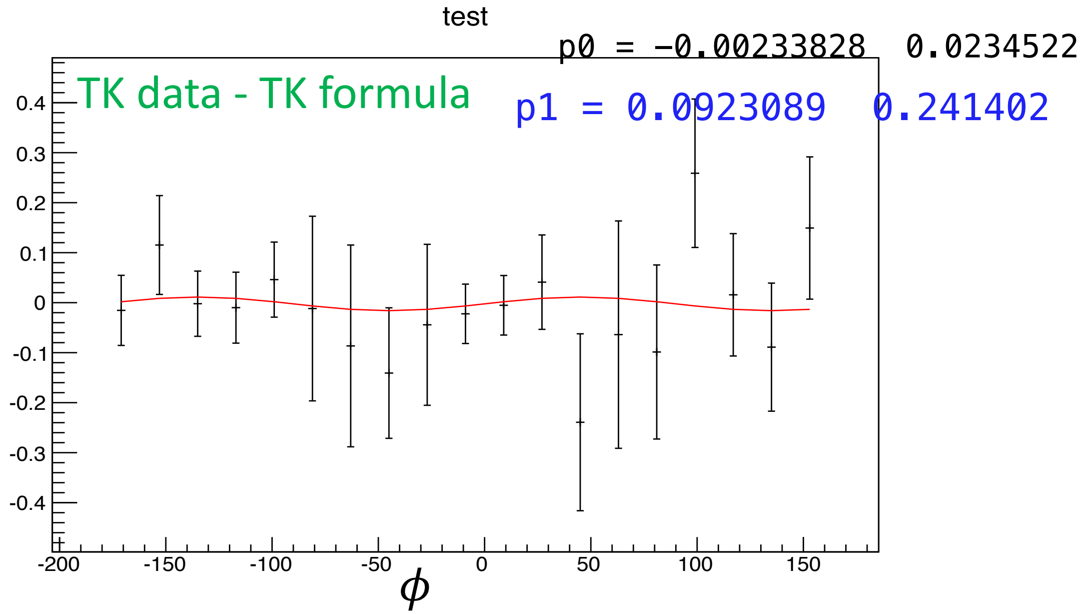
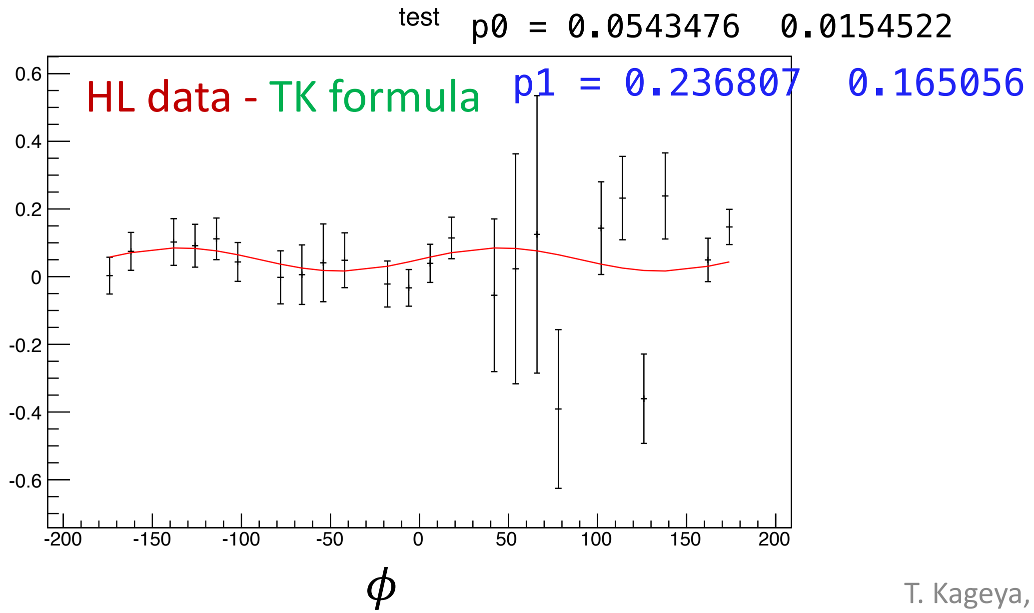
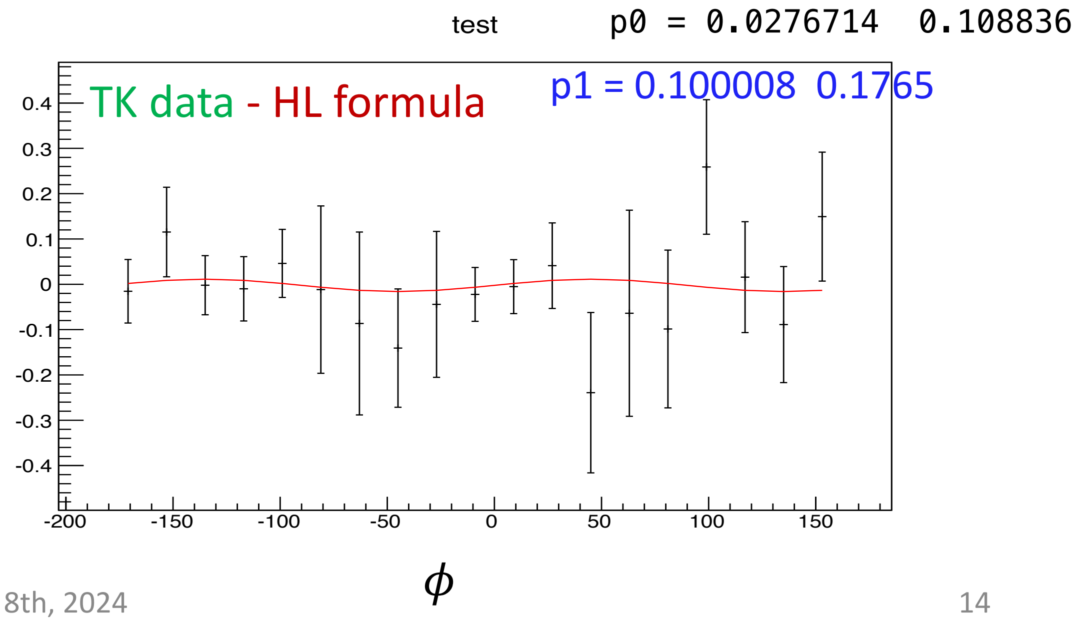
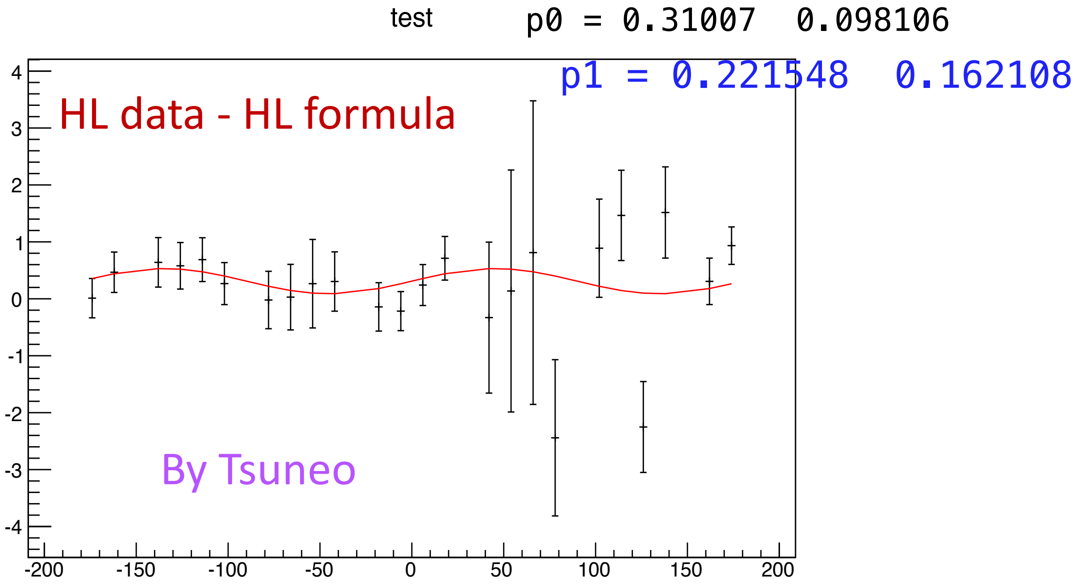


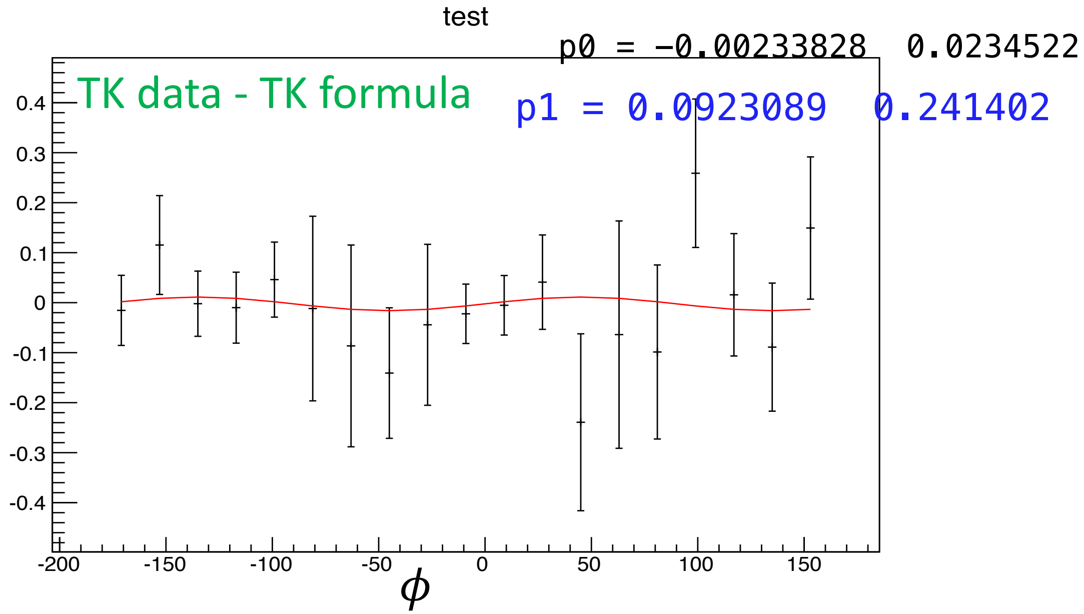


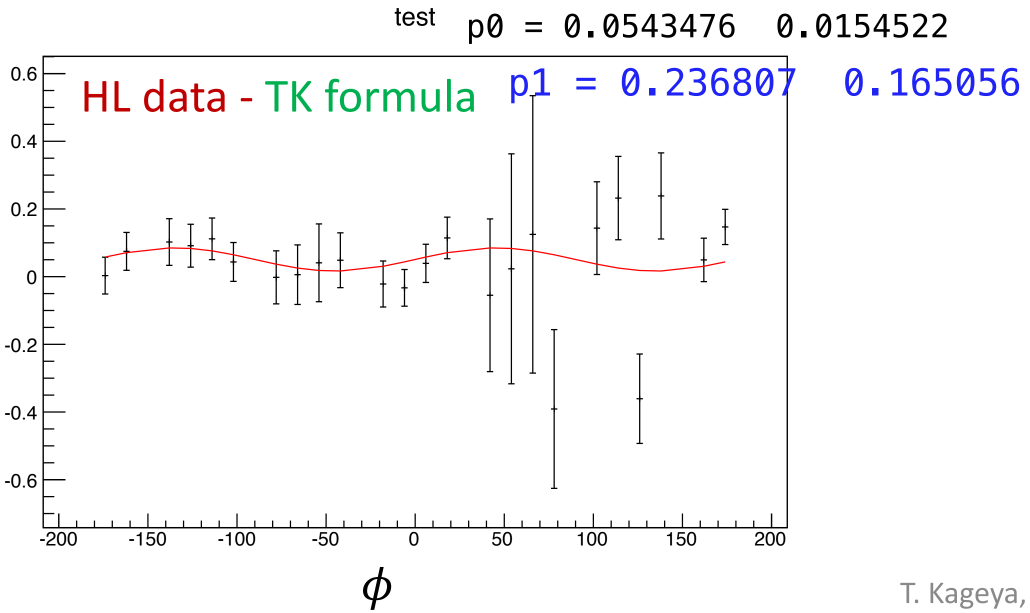


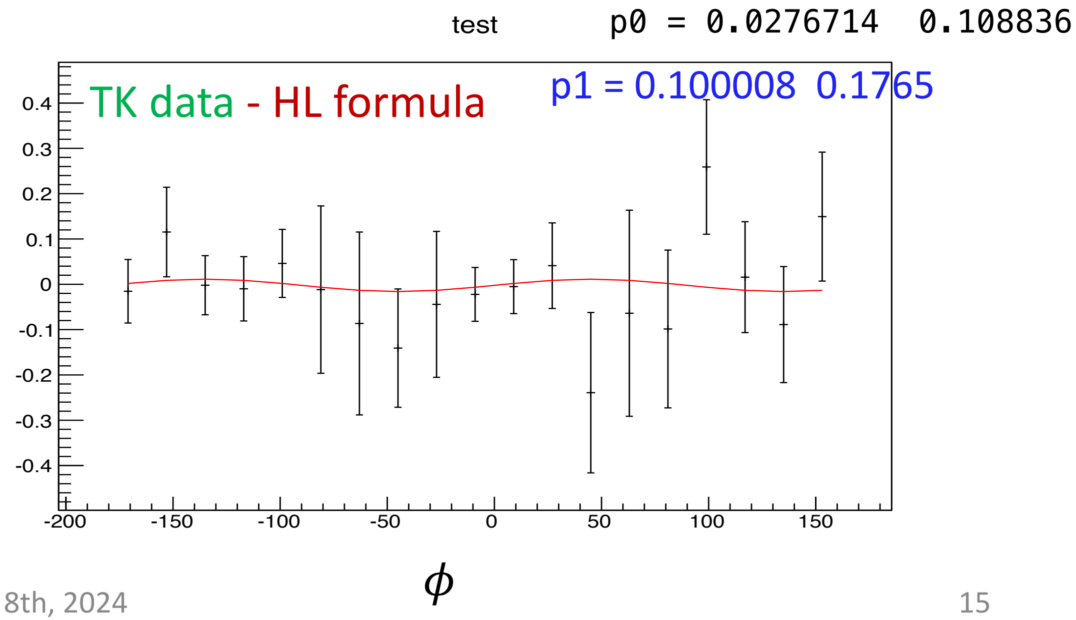


Comparisons of two data sets and two fomulas (G, HL's 9th bin)









Annalisa’s formulas

$$G \sin 2\varphi = \frac{1}{P_+ + P_-}\left[\frac{\frac{y_3}{L_3} - \frac{y_1}{L_1}}{P_1\frac{y_3}{L_3} + P_3\frac{y_1}{L_1}} - \frac{\frac{y_4}{L_4} - \frac{y_2}{L_2}}{P_2\frac{y_4}{L_4} + P_4\frac{y_2}{L_2}}\right]$$

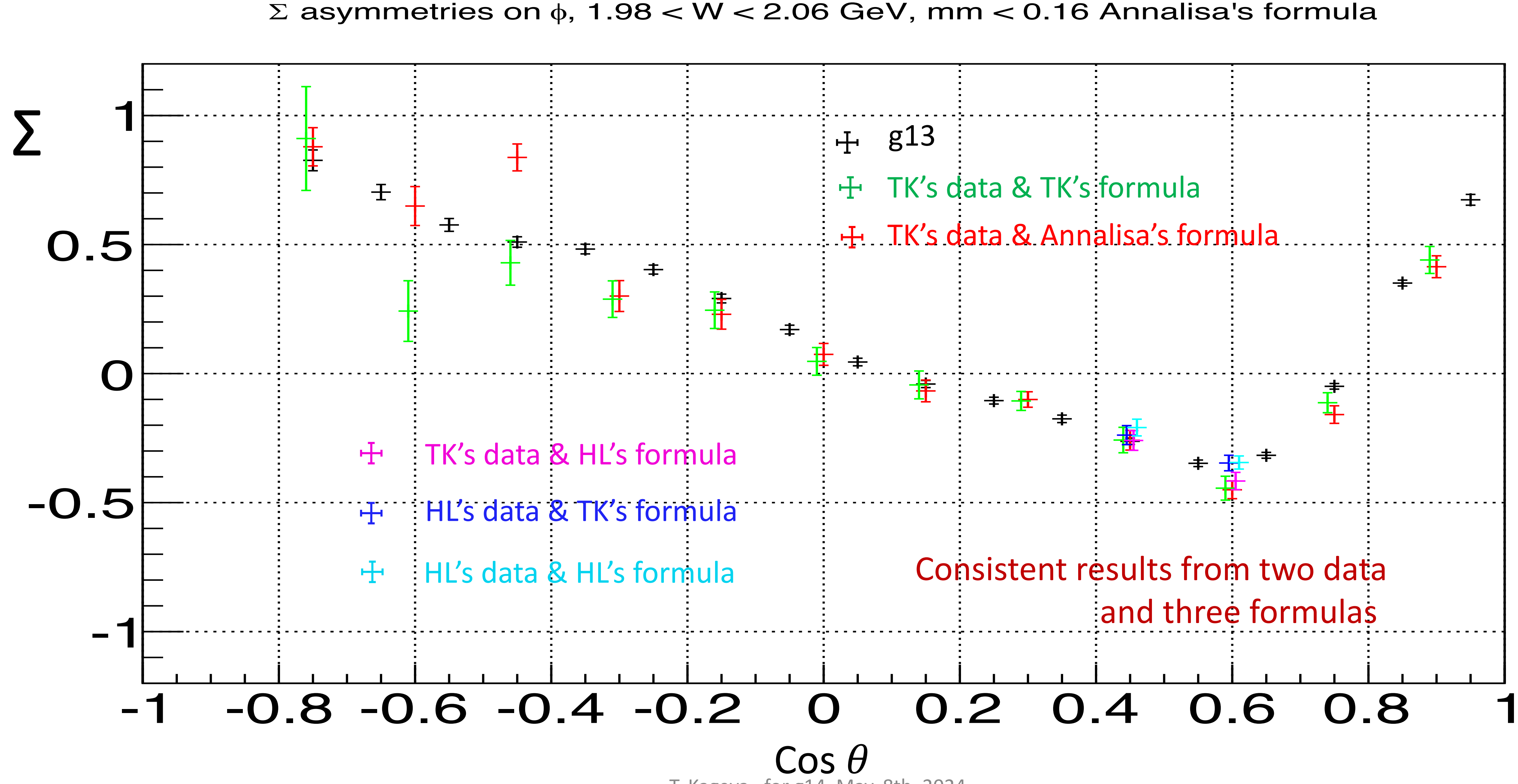
Target + Target −

$$\Sigma \cos 2\varphi = \frac{P_-}{P_+ + P_-}\left[\frac{\frac{y_3}{L_3} - \frac{y_1}{L_1}}{P_1\frac{y_3}{L_3} + P_3\frac{y_1}{L_1}}\right] + \frac{P_+}{P_+ + P_-}\left[\frac{\frac{y_4}{L_4} - \frac{y_2}{L_2}}{P_2\frac{y_4}{L_4} + P_4\frac{y_2}{L_2}}\right]$$

Target + Target −

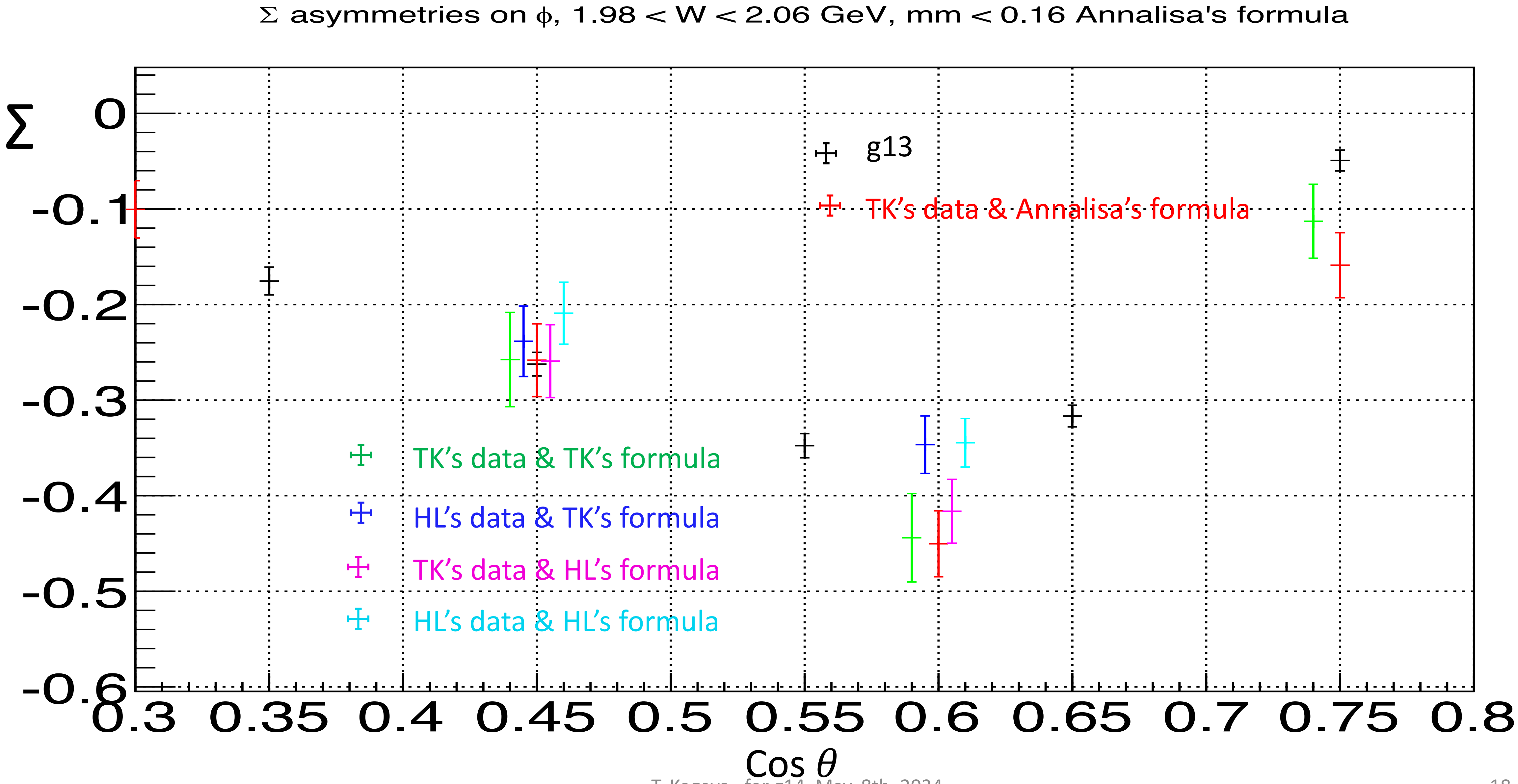
Comparisons of two data sets and different formulas for Σ

(High lighted for HL's 8th and 9th bins)

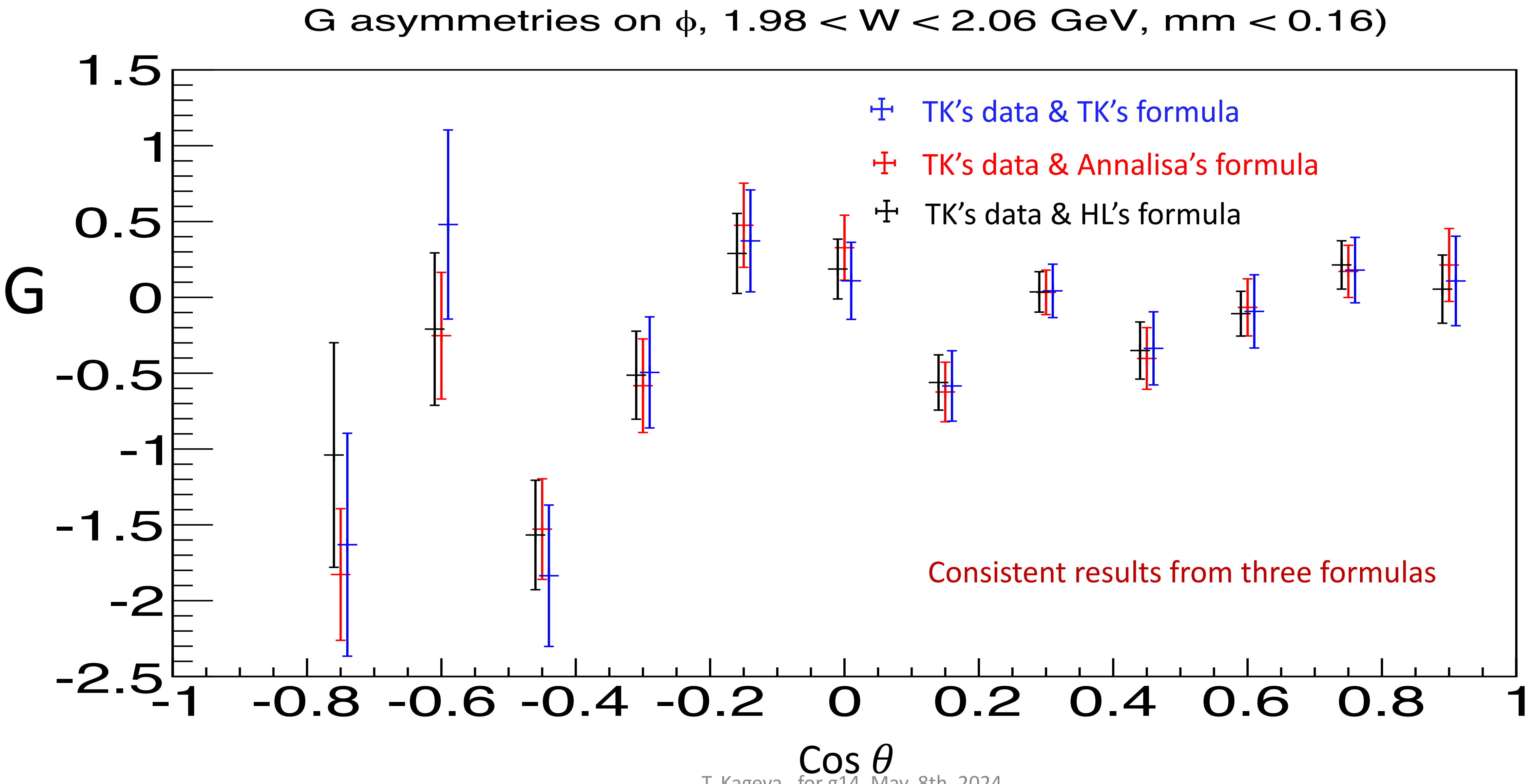


Comparisons of two data sets and two formulas for Σ

(Expanded view for HL's 8th and 9th bins)



Comparisons of three formulas for G -- Consistent results from three formulas



Summary

1. For Σ, on $1.98 < W < 2.06$ bin, results for HL's 8th and 9th bins are consistent for HL and TK'data and different formulas and reproduce g13 results.

Asymmtries do not depend on formulas.

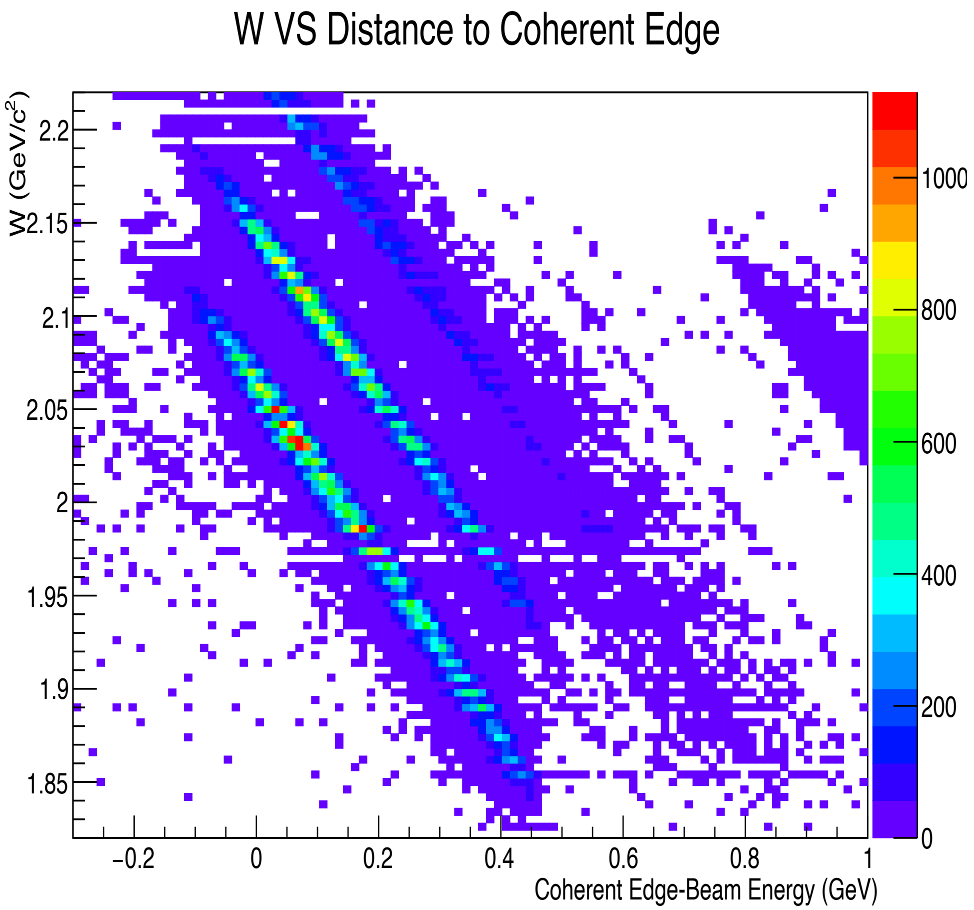
2. For G, on $1.98 < W < 2.06$ bin, asymmtries don't depend on formulas.

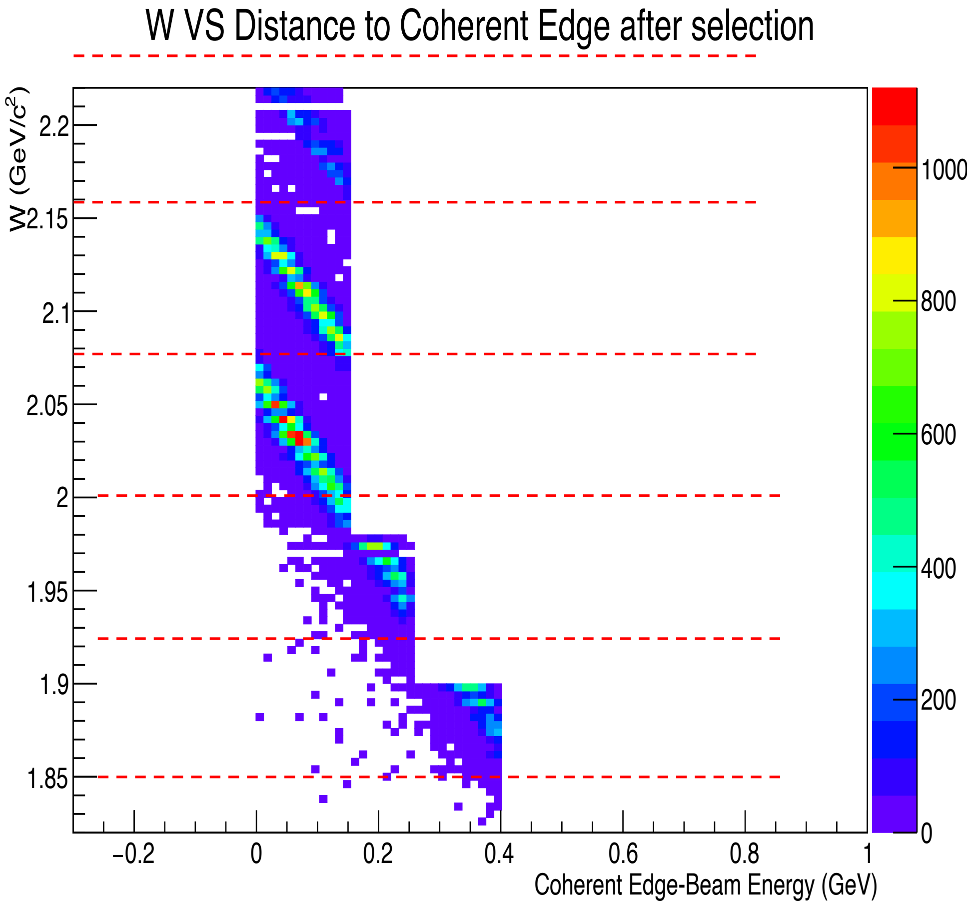
3. Expect Haiyun's final results including constant parameters in the fits.

- Comments

1. Systematic error bands in HL's results could be on different location.

2. To rebin for W could be a possible option.





(b) W versus the difference between coherent edge and photon energy for the selected photon ranges

(a) W versus the difference between coher-