Optics Calibration for e'p (Round 1)

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HRS Optics matrix:

Reconstruct target variables (scattering angle and momentum) from focal plane variables (detected tracking and energy)

Assume x_tg is 0, then correct for the offset.

$$\begin{bmatrix} \delta \\ \theta \\ y \\ \phi \end{bmatrix}_{tg} = \begin{bmatrix} \langle \delta | x \rangle & \langle \delta | \theta \rangle & 0 & 0 \\ \langle \theta | x \rangle & \langle \theta | \theta \rangle & 0 & 0 \\ 0 & 0 & \langle y | y \rangle & \langle y | \phi \rangle \\ 0 & 0 & \langle \phi | y \rangle & \langle \phi | \phi \rangle \end{bmatrix} \begin{bmatrix} x \\ \theta \\ y \\ \phi \end{bmatrix}_{fp.}$$
want known

Optics Calibration:

- Find the mapping between focal plane and target variables (minimization)
 - Y_tg: fixed by multifoils
 - Theta, phi: fixed by sieve pattern
 - Delta: fixed by (quasi) elastic scattering

$$\begin{bmatrix} \delta \\ \theta \\ y \\ \phi \end{bmatrix}_{tg} = \begin{bmatrix} \langle \delta | x \rangle & \langle \delta | \theta \rangle & 0 & 0 \\ \langle \theta | x \rangle & \langle \theta | \theta \rangle & 0 & 0 \\ 0 & 0 & \langle y | y \rangle & \langle y | \phi \rangle \\ 0 & 0 & \langle \phi | y \rangle & \langle \phi | \phi \rangle \end{bmatrix} \begin{bmatrix} x \\ \theta \\ y \\ \phi \end{bmatrix}_{fp.}$$
want known

LHRS Sieve Runs:

- Marathon runs 2335 2340
- momentum=3.57 GeV, Q1 current = 770.34 A
- Target = 11 optics foils separated by 2.5 cm each
- From Rey's target offset study:
 - The central optics foil is at vertex z = 3 mm
- From survey A1855:
 - Angle = 17.578
 - Misspointing is 2.08 mm (target y), 1.38 mm (target x)



LHRS Y_tg with current tritium DB



LHRS Y_tg refitted



7







LHRS theta-phi with current tritium_db

2952















Sieve Plane Proj. (tg_X vs tg_Y) for Data set #4



Sieve Plane Proj. (tg_X vs tg_Y) for Data set #8 Entries 1785 E tean x-0.02643 Mean (0.004084 g.06 100 ALS + 0.03261 1785 0.04 0.02 아누 + 5 -0.02 ++++ +++ 0.5 -0.06 -0.08 Sieve H [m]



-0.04 -

-0.06

+ 0.5

0.06

Sieve H [m]

0.04

+ + +

+ +

Sieve H [m]

LHRS theta-phi refitted



Έ

0,06





4 4 4

4 4 + +

Lower Order Optics from GMp

< >	new.argon_db.dat.y ×	•		new.longwu_db.dat	×				-
31	t 0 0 0 -1.001135e+00 -3.313373e-01 -4.290819e-02 4.470852e-03	and the second second	2 t	0 0 0 -1.001124E+00	-3.340060E-01	-4.288178E-02	2.191335E-03		
	y 0 0 0 -8.060915e-03 1.071977e-03 9.019102e-04 -3.239615e-04	Conference on the second secon		0 0 0 -8.296927E-03	1.507282E-03	1.886011E-03 -	2.276948E-03		
33	p 0 0 0 -2.861912e-03 -2.469069e-03 8.427172e-03 2.274635e-03	NUTTER AND ADDRESS OF TAXABLE ADDRESS	4 p	0 0 0 -2.015241E-03	-2.549668E-03	7.894894E-04	1.443433E-03		
34	D 0 0 0 5.1118113E-04 8.5227/5E-02 6.346834E-03 -4.637195E-03 1.476364E-02	Contraction of the second	5 D	0 0 0 8.408810E-04	8.442057E-02	9.449486E-03	1.401268E-03	5.804766E-03	
	D 1 0 0 -4.24/550E-02 2.41//00E-01 5./06905E-02 -4.025159E-03	Degradura warma-	6 D	1 0 0 -6.863472E-02	2.633/18E-01	1.096637E-02 -	-/.253321E-02		
37		Management and	á h	3 0 0 5 8676375.00	1.003691E+00	1.003629E+00			
38	D 4 0 0 -8.475406E+03		9 D	4 0 0 1.229877E+03	-1.510/5/2+00				
	D 0 0 2 1.657123E-01 -8.826997E-01 3.245634E+00		10 D	0 0 2 -2.154263E-01	3.749098E-01	8.287139E-01			
	D 0 2 0 8.754870E-01 5.443126E-01 4.792556E+00	2 m=:	11 D	0 2 0 3.897802E-01	-3.943080E-01	-8.283024E-01			118
	D 0 1 1 -1.486998E-01 1.204271E+00 6.101041E-01			0 1 1 5.347850E-01	4.966573E-01	1.093291E-01			
42	D 1 2 0 -6.488178E+01 2.017449E+00		13 D	1 2 0 -2.046162E+01	8.346116E+00				
43	D 1 0 2 6.270685E400 -6.204080E401		14 D	1 0 2 -2.524674E+01	1.185899E+01				
44			15 D	2 0 2 9 6838585102	-3.0741652+01				
46	D 2 1 1 -2.466951E+01		17 D	2 1 1 6 7181915+01					
	D 2 2 0 -3.635787E+02		18 D	2 2 0 1.350897E+01					
	D 0 1 3 2.868957E+02	l Mar I	19 D	0 1 3 2.050327E+02					
	D 0 3 1 1.584274E+03	100 (100) (100) (100) (100)	20 D	0 3 1 3.290653E+02					
	D 0 0 4 -4.392377E+01	101.05	21 D	0 0 4 4.718722E+01					
	D 0 4 0 -4.708602E+02		22 D	0 4 0 -7.064057E+01					
	D = 0 = 2 = -1.7062592403		23 D	0 2 2 -2.394/4/E+02					
54	T 1 1 1 -1 7315545-02 1.1509021-02 5.7602491-01		24 1	0 1 1 2 761228E 01					
	T 0 0 2 4.859896E-01 2.281832E-01 -2.116492E-01		26 T	0 2 0 1.437412F-01					
	T 1 0 2 -5.997432E+00		27 T	1 0 0 -2.483065E+00	5.734509E-01				
	T 0 2 0 6.071349E-02 1.765667E-01		28 T	2 0 0 -6.033555E+00					
	T 1 2 0 -4.071820E+00		29 P	0 0 1 -6.453163E-01	-1.370498E-01	2.407263E-01 -	5.863077E-02		
	T 0 4 0 8.343406E+01		30 P	0 1 0 -3.387389E-01	3.545635E-01	-6.087352E-02	1.131828E-02		
60	1 0 0 4 -1.414436E+02		31 P	1 0 1 5.183242E+00	-1.452658E+00	1.679792E+00			
	1 0 2 2 -1.59/336E+02		32 P	1 I 0 2.848368E+00	8.1/60/8E-01	-3.509288E-01			
63	T 0 1 3		30 P	2 0 1 -1.076504E+01	6 858845E101				
64	T 0 0 0 -1.781180E-05 1.861739E-03 -5.857662E-03 6.576220E-03 1.734984E-02		35 P	3 0 1 -2.798525E+01	0.0000452401				
	T 1 0 0 -2.4955559E+00 5.845019E-01 -4.126369E-02 2.319888E-02		36 P	3 1 0 -4.910034E+02					
	T 2 0 0 -5.160508E+00 3.238597E+00 -1.188220E+00		37 P	0 0 3 1.229476E+01	-1.116647E+01				
	T 3 0 0 7.645210E+01 -7.471848E+01		38 P	0 1 2 -1.425811E+01	-2.742787E+01				
68	P 0 0 1 -6.416418E-01 -1.516061E-01 2.376793E-01 -7.524555E-02		39 P	0 2 1 -6.825084E-01	-1.498114E+01				
59	P 0 I 0 - 5, 554223E-01 3,461923E-01 - 6,407068E-02 4,204996E-02		40 P	0 3 0 -5.884300E+00	-1.023068E+01				
	P 1 0 1 3.063905400 -1.0103314400 1.34407440		41 P	1 1 2 1 1186485.02					
	P 2 0 1 -1.471478E+01 -1.285734E+02		43 P	1 2 1 -1.238305E+02					
	P 2 1 0 -1.109194E+02 5.348928E+01		44 P	1 3 0 -2.082886E+02					
	P 3 0 1 3.620597E+02			0 0 0 1.095769E-04	1.389117E-05	-7.951811E-04	2.789273E-04		
	P 0 0 3 1.281770E+01 4.706476E+00		46 P	1 0 0 4.855840E-03	-2.132031E-03	3.582788E-03			
76	P 0 1 2 -1.453998E+01 -3.866965E+01		47 P	2 0 0 2.107254E-01	-4.528732E-01				
	P 0 2 1 7.41/100E-02 -1.332939E+00		48 P	3 0 0 -2.132567E+00	1 0017405.00	F 4701CCF 01			
79	P 0 5 0 - 6,16346442400 -7,733362400 P 1 0 3 -1 733495407		49 T	0 0 1 0.070566E-01	-1.091740E+00	-5.4/0100E-01			
80	P 1 1 2 -1. 3245 30F+02		51 ¥	1 0 1 .3 923683E-01	-7 549986E+00	1.2011552-01			
	P 1 2 1 -1.108132E+02			1 1 0 -1.283210E+01	1.354363E+00				
	P 1 3 0 -3.740639E+01			2 0 1 4.260619E+02					
	P 0 0 0 3.272442E-04 2.741277E-04 -3.420950E-03 -1.728306E-03			2 1 0 3.069844E+02					
84	P 1 0 0 -1.474144E-03 -5.326865E-03 3.790039E-02			0 1 2 6.471905E+00					
85	P 2 0 0 2.3449/IE-01 -4.981099E-01		56 Y	0 2 1 1.554728E+01					
87	Y 0 0 1 8 092990F-01 -1 167929F100 -5 895361F-01 7 600874F 02		27 😲	0 3 0 1.451858E+01					
88	Y 0 1 0 -1,169248E+00 -7,862431E-01 1,309174E-01 4,636294E-02		59	0000 9.0478992400					
89	Y 1 0 1 -6.250697E-01 -7.839682E+00 -1.870098E+00		60 L	1 0 0 0 0,1650					
	Y 1 1 0 -1.228098E+01 -7.547900E-01 -9.910216E-01		61 L	2 0 0 0 -0.05					
	Y 2 0 1 4.202017E+02 2.384554E+02			0 1 0 0 -11.6554					
	Y 2 1 0 3.491839E+02 -1.316841E+02		63 L	0 2 0 0 -9.4951					

Thanks Eric, Longwu, Thir, Dien for useful discussions.