Final report for misspoint study for XGT2 experiment

1. **Checking servey information for optics run**

   - Using **Run1212** (02/12/2011):

   Run type: Optics . **Target** : 13 foils C12, **angle** = 16.503

   - Using Servey : **A1379** (4-7/Feb/2011)

   Left arm : angle = 16.489

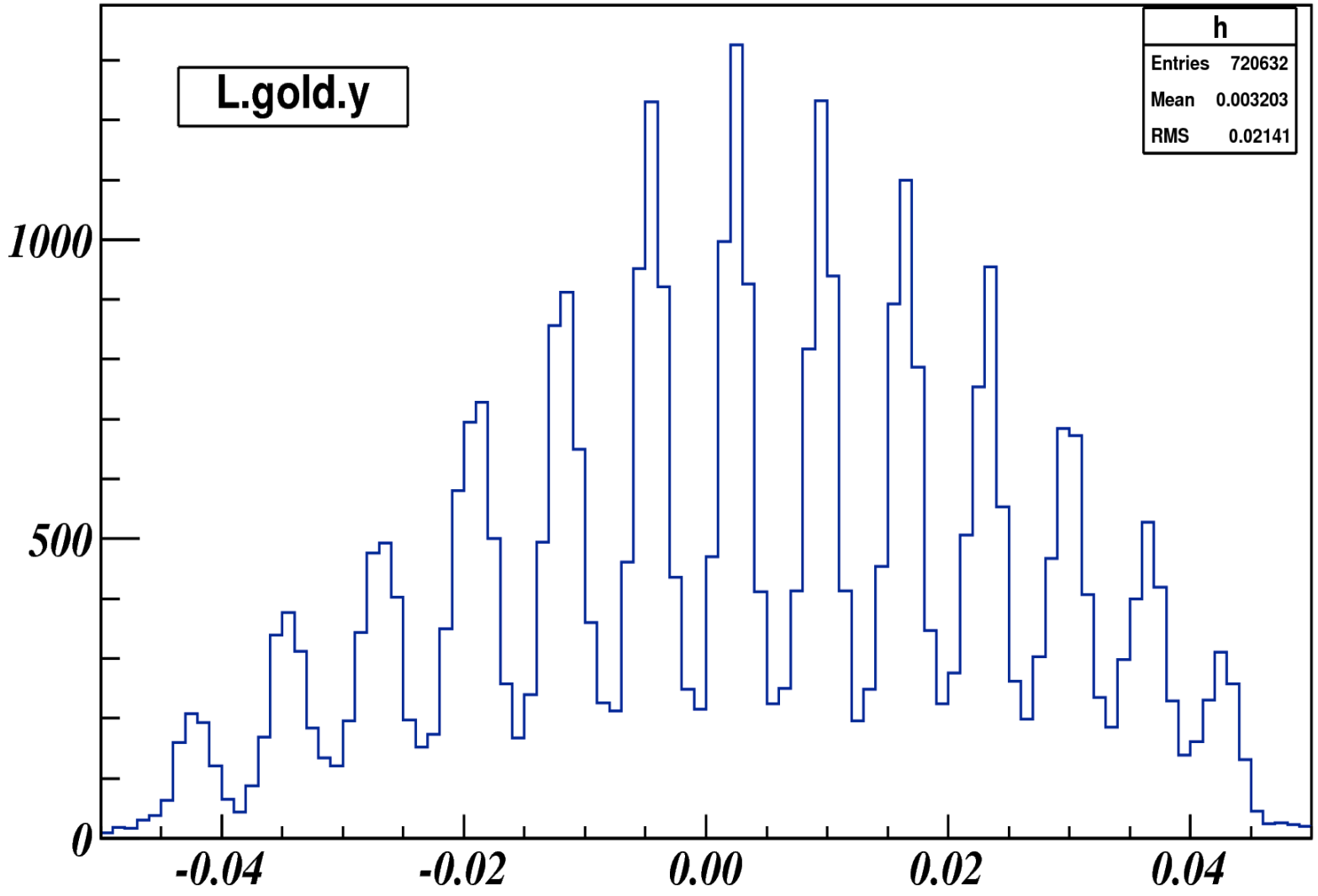
   Spectrometer offset : 2.31 mm (upstream)

2. **Using optics matrix 2009 for Left arm**

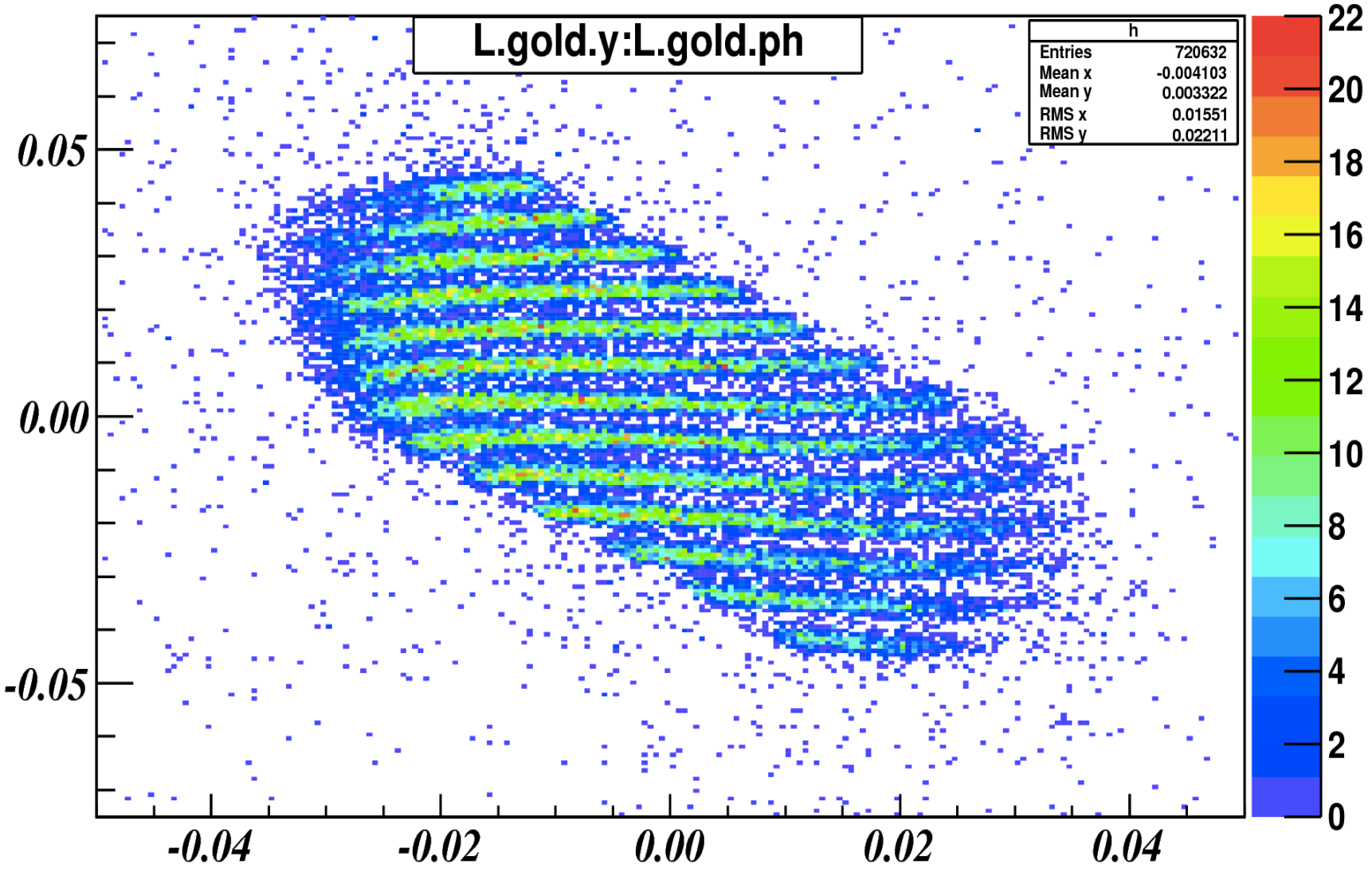
   - Replay data for run 1212.
   - Check Ytg distribution
   - Check scat plot Ytg : ph (in plane angle)

   ➡ Optics matrix reconstruct event pretty well. Now is time to consider about all offset contribute on Ytg

Ytg plot for 13 foils C12 target. Run 1212



Plot Ytg: ph_tg for 13 foils target run 1212



3. Misspointing Study.

Main point: Calculate the misspoint for every setting of XGT2

Step1: Study contribution of every offset to Ytg (one at a time)

I. No physical offset only the offset built into reconstruction matrix element

First term: Ytg = Y_off

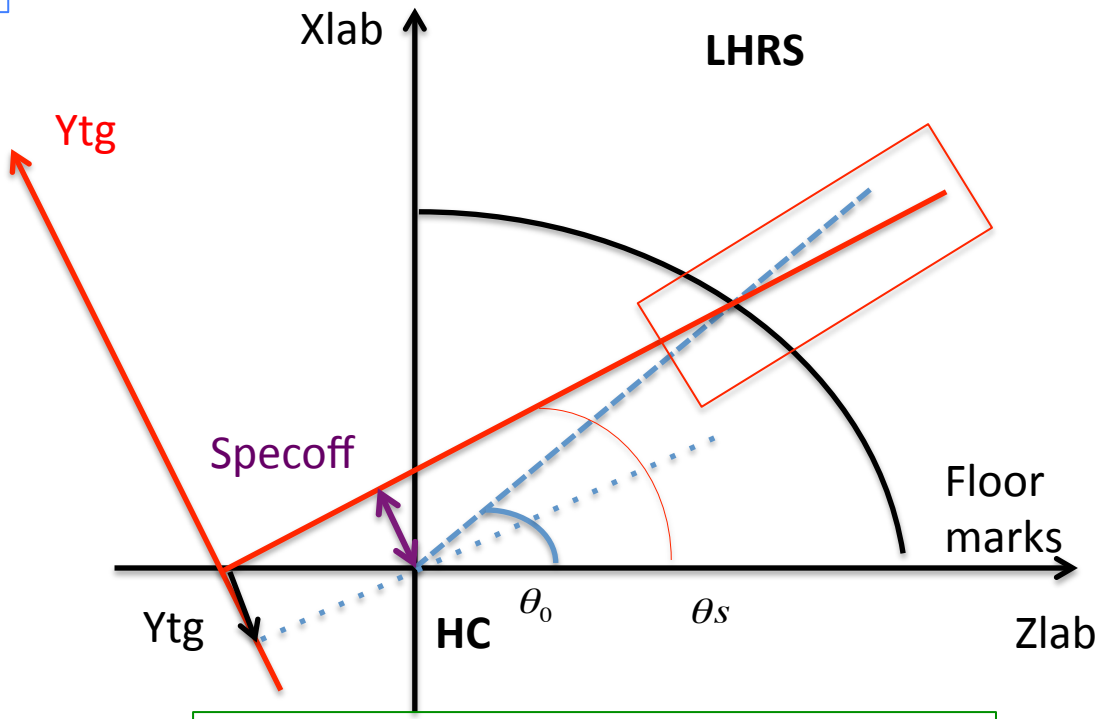
II. Spectrometer misspoint

Convention:

Zlab: + Downstream
Xlab: + Left
Ytg: + Left

Specoff: + Upstream
- Downstream

Second term: Ytg = - Specoff



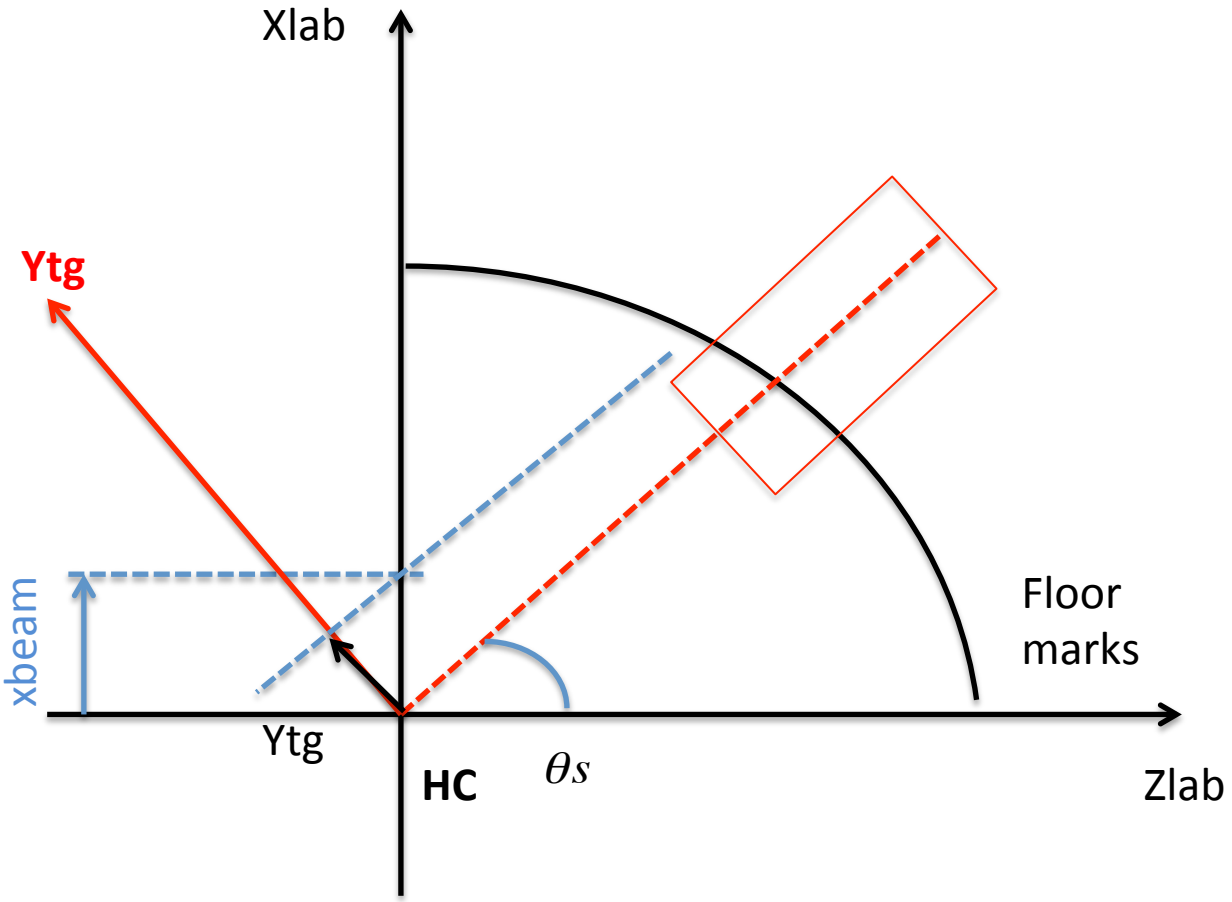
Angle: $\theta_s = \theta_0 - \Delta\theta$

Where : $\Delta\theta = Specoff / R$

R : 8.458 m

appliy for both specoff upstream and downstream, and true angle smaller or bigger

III. Beam offset



Convention:

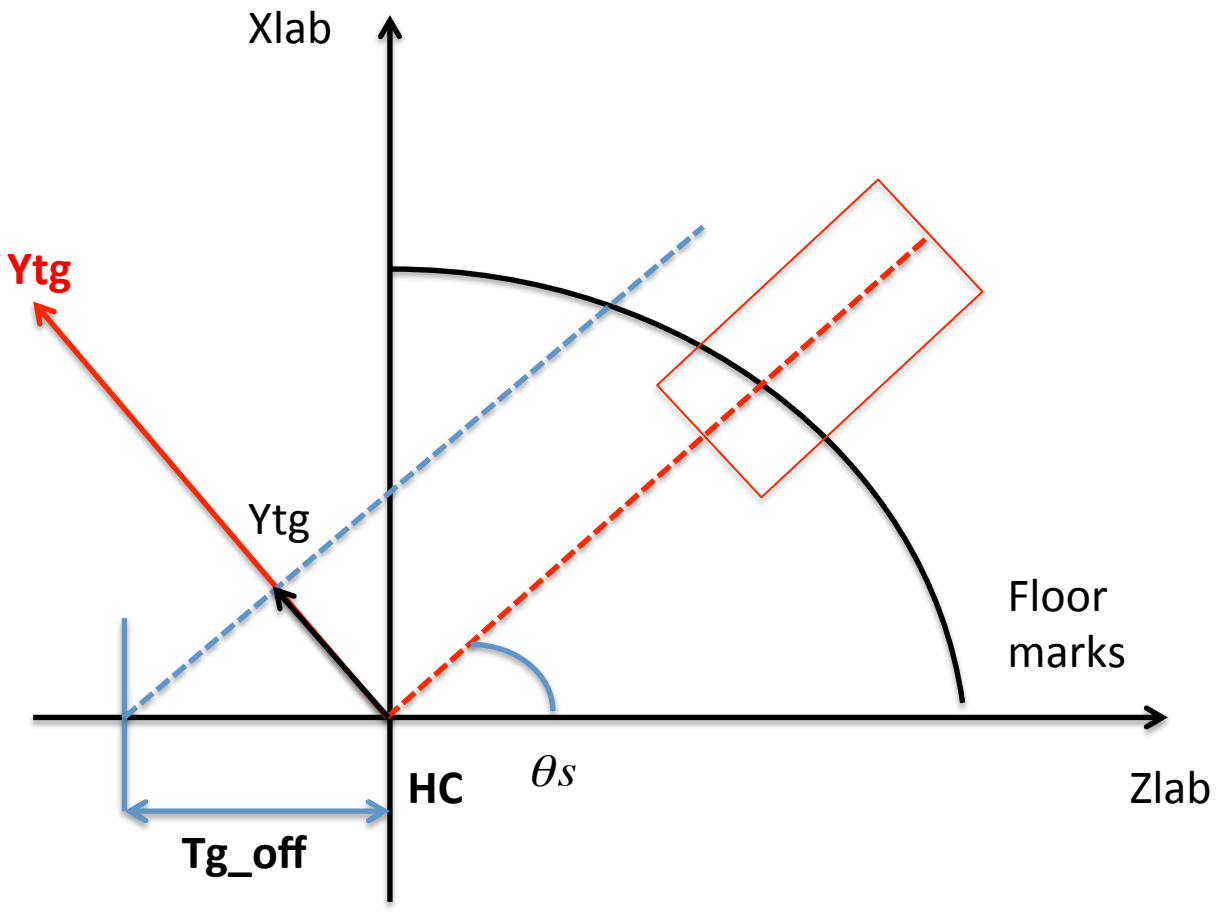
Xbeam : + Left

Xbeam : - Right

Third term : Ytg = $xbeam * \cos(\theta_s)$

This applies for both xbeam left and right

IV. Target offset



Convention:

Tg_off : + downstream

Tg_off : - upstream

Fourth Term : Ytg = - Tg_off *sin θs

Applies for both tg_off upstream and downstream

Final corrected formula for misspoint study:

$$Ytg = - specoff - Tg\_off * \sin\theta_S + xbeam * \cos\theta_S + Y\_off$$

4. Using misspointing method to reproduce the servey data

This to make sure we can reproduce the servey information and misspointing method can be used to calculate the misspoint for different set up for XGT2

- Ytg : we take the location of central foil for 13 foils run 1212: + 2.40 mm
- Specoff: From servey of the same setting for run 1212: upstream: + 2.31 mm
- Tg_off: From target servey of Meekin: downstream: + 1.00 mm
- Angle : From servey : 16.489

Xbeam : more tricky to find the sign. Using harp scan results and bulleyes scan (run 3880, 3881) We have confirmation for convention.

Harp scan and my convention

Xbeam : + Left

Xbeam: - Right

BPM convention

Xbeam: + Right

Xbeam: - Left

We just have xbeam at two BPM (A and B). But we know the distance from A and B to target. So we can project them to target to get xbeam at target

Run 1212 : BPMA : Xbeam = -1.576 mm
BPMB: Xbeam = -3.49 mm

Distance: BPMA ->Target : 7.348 m
BPMB ->Target: 2.214 m

→ Xbeam_target = -4.31 mm

(In BPM convention)

→ In my convention which will follow the misspoint formula: xbeam = + 4.31 mm

Put everything in formula

$$Ytg = - specoff - Tg\_off * \sin\theta_S + xbeam * \cos\theta_S + Y\_off$$

$$+2.4 = -2.31 - 1 * \sin(16.489) + 4.31 * \cos(16.489) + Y\_off$$

↓

Y_off ~ 0.9 mm

Conclusion:

- We can reproduce the servey information very well with 0.9 mm offset in Ytg from optics matrix.

- This optics matrix (from 2009) work very well to reconstruct Ytg.

- And Misspointing method works now

- We can use this misspointing method and include the offset from optics matrix to calculate the misspoint for all other setting of XGT2 data

Results:

XGT2 has 4 kinematic setting with 4 different angle : 21, 23, 25, 28 degree.

Tg_off: taking the number from Meekin for whole run : upstream: +1 mm

Xbeam: at target : +2.6 mm (BPM show -2.6 mm)

Ytg: taking from Ytg reconstruct using optics matrix.

Using the single C12 foil runs for all kinematic setting

Table results in following page

Run No	Setting Left angle	Corrected left angle
3565->3656	25	24.98
3657->3683	21	20.98
3684->3708	23	22.98
3735->3891	25	24.98
3892->3916	---no left----	---no Left------
3917->4071	28	27.98
4073->4103	21	20.99
4112->4179	23	22.98
4181->4241	25	24.97
4242->4250	21	20.99
4251->4299	28	27.98

Using XEMC to have quick check in cross section:

Kin 3.1 : E0 = 3.356 GeV, Po = 2.905 GeV , angle 21 ->XS_QE = 6.05 ,XS_born = 6.959
----------, 20.98 ->XS_QE = 6.18, XS_born = 7.11

This angle correction make cross section different from each other around 2% (rough check)