Status of TPOL MC studies

R. Ciesielski (DESY)

TPOL MC tuning and systematic checks

- based on new horizontal and vertical table scans taken shortly before HERA shutdown
  - high precision data spanning the wide X and Y range on the calorimeter surface

- include the geometry update after visual inspection of the calorimeter
  - aluminium front plane thiner by 10% (1.1->1.0 cm)
  - additional space between SCIN & absorber plates

  - no changes for energy simulation but significant improvement for position reconstruction
  - generally MC gives the lower/higher values of η for higher/lower beam y position at cal

Status of TPOL MC studies

Checks done:

- influence of the calorimeter displacement (rotations along Z,Y, X axis) on η simulation
  negligible
- influence of Geant simulation parameters on η simulation
  lower values of energy cut-off parameters (CUTGAM,CUTELE,DCUT) move
  η distributions towards higher values (and worsen it around 0, not desired)
- the change of the presampler depth – negligible
- the change of the presampler distance from the cal – negligible
- the change of the DENSIMET density – negligible
- the cal table calibration with silicon detector (SI)
  improve slightely the η simulation at high y (table position *= 1.02)
  the angle between the cal and SI in XY plane measured to be ~4 deg.
  (additional factor for the table calibration)

Under study:

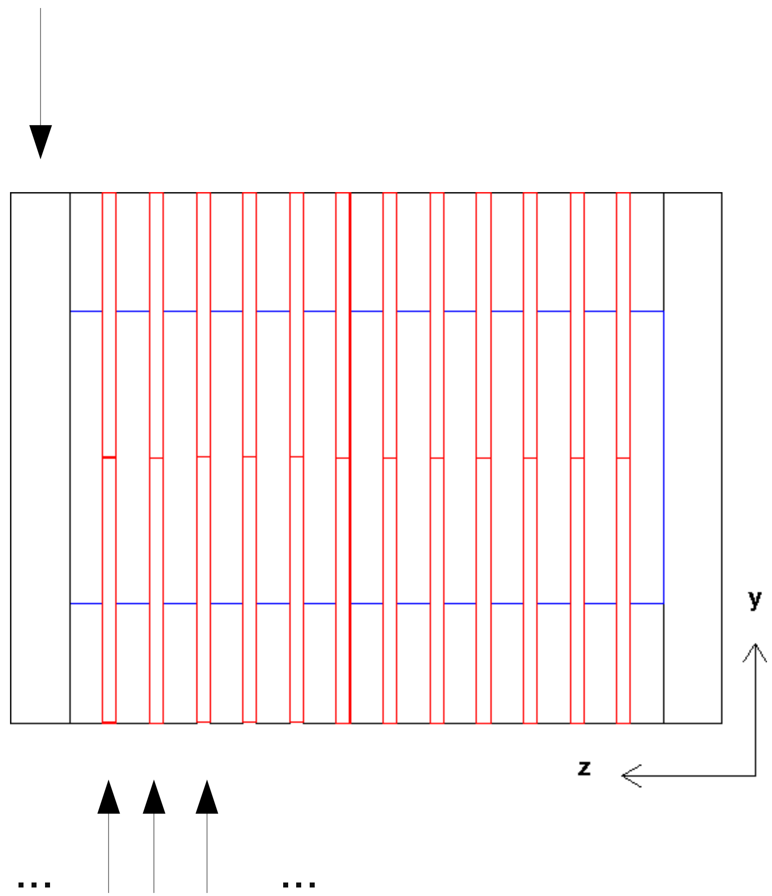
- the beam and gamma-e vertex simulation under study
  controlled by the beam spot at the SI surface,
  3 parameters used for the simulation (Twiss parameters, emittance), but can be reduced to 1
  (for any values of α, β there is one value of emittance which give the same η distribution at CAL
  the influence of the width of the laser beam – negligible

will improve the η simulation around y=0 (pol. measurement) and hopefully finish the work soon

Backup

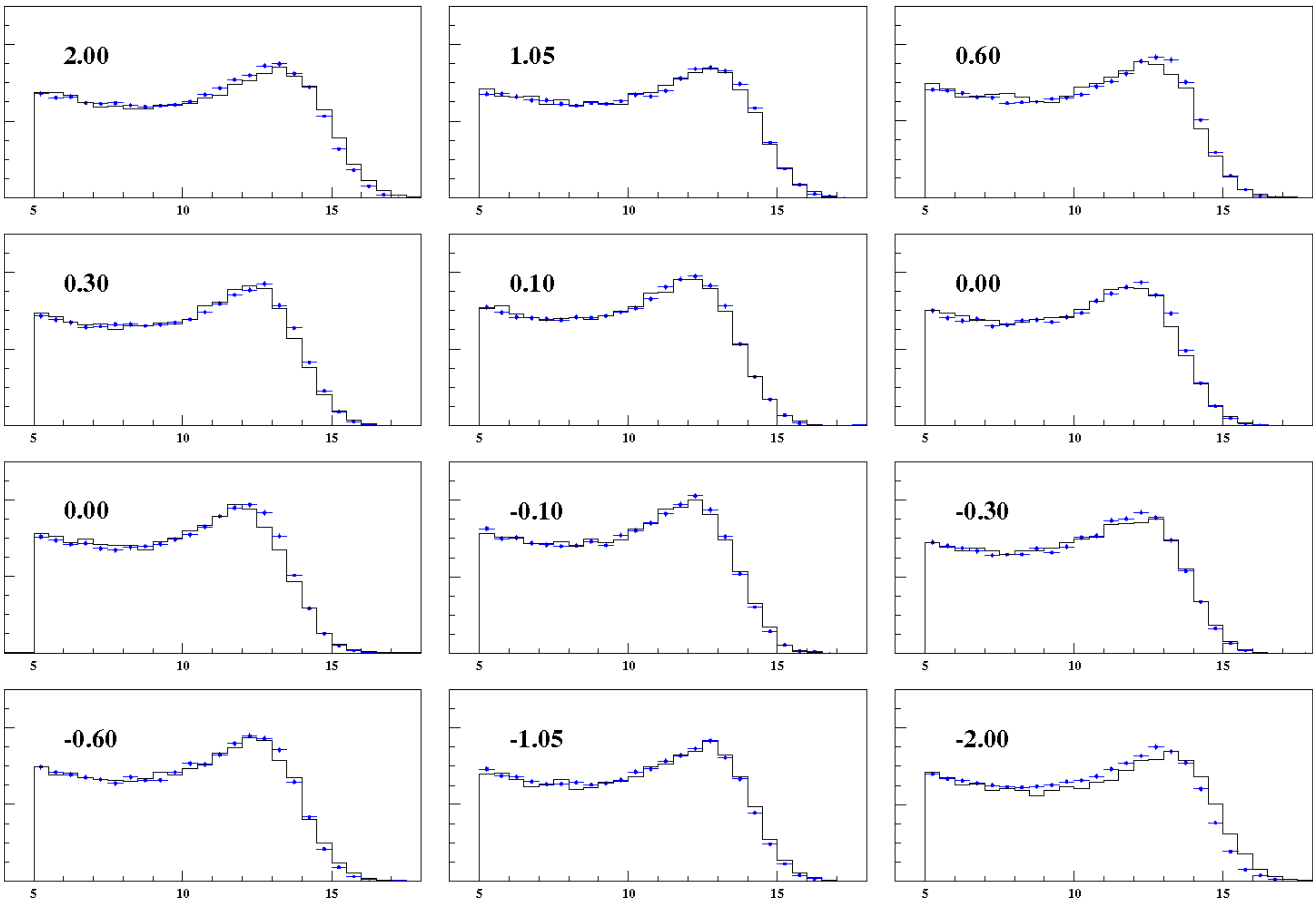
Changes to GEANT geometry after visual inspection of calorimeter

Aluminium front plate: 1.1 -> 1.0 cm (10% less)

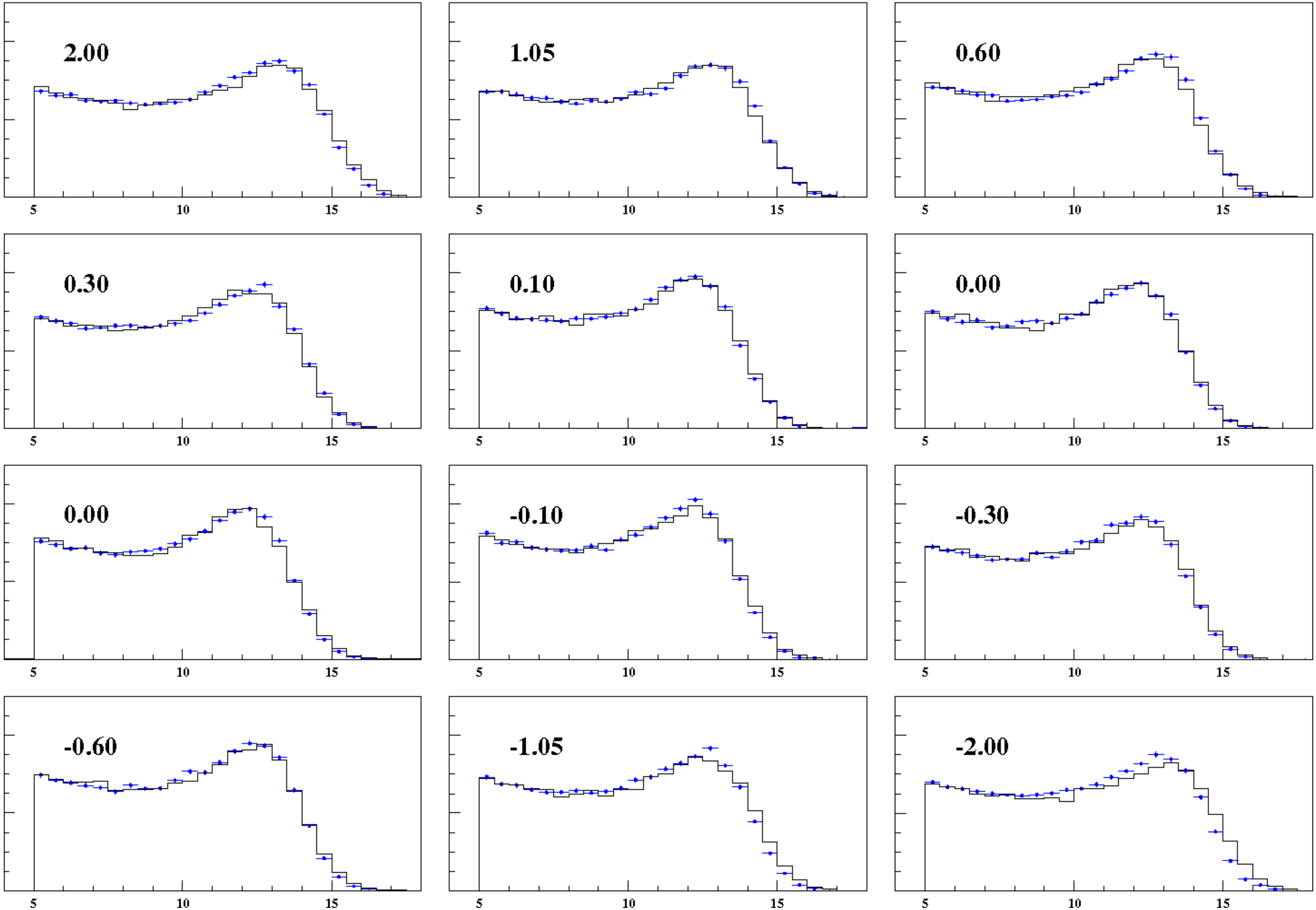


Additional space between SCIN & absorber plates:
SCIN plate of 2.62 mm -> SCIN plate of 2.62 mm inside spacers of 3 mm

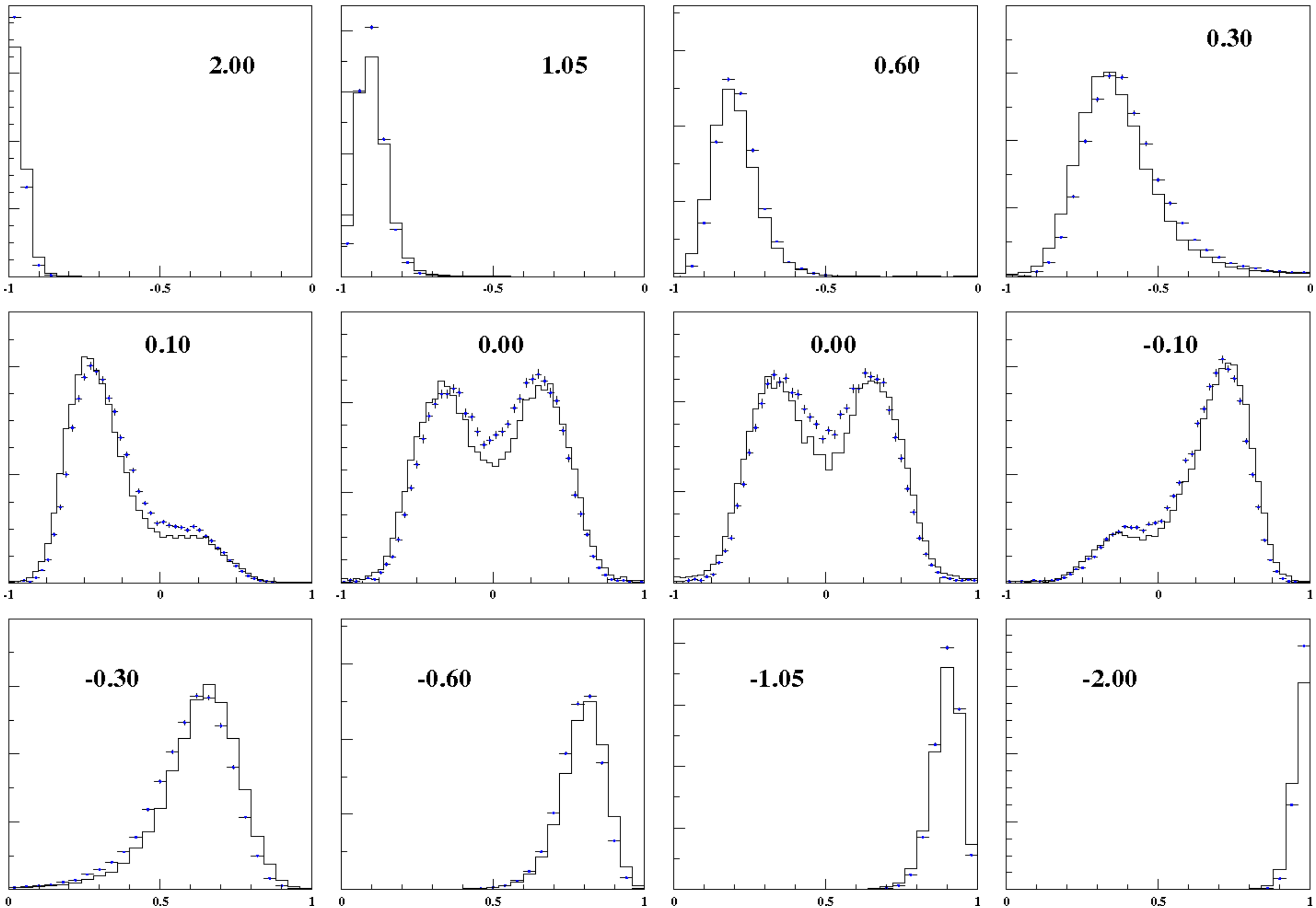
Before (energy)



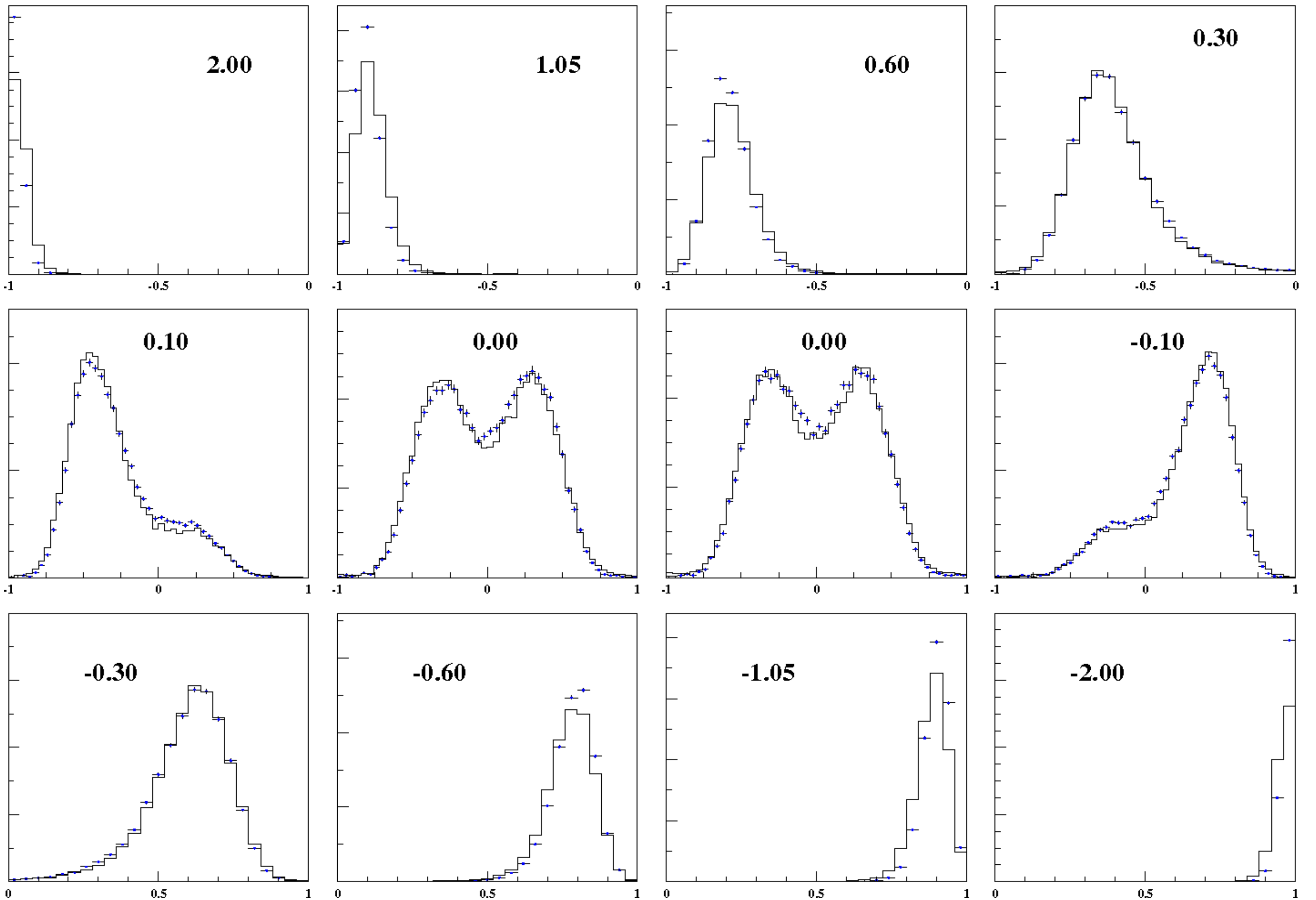
After (energy)



Before (eta)

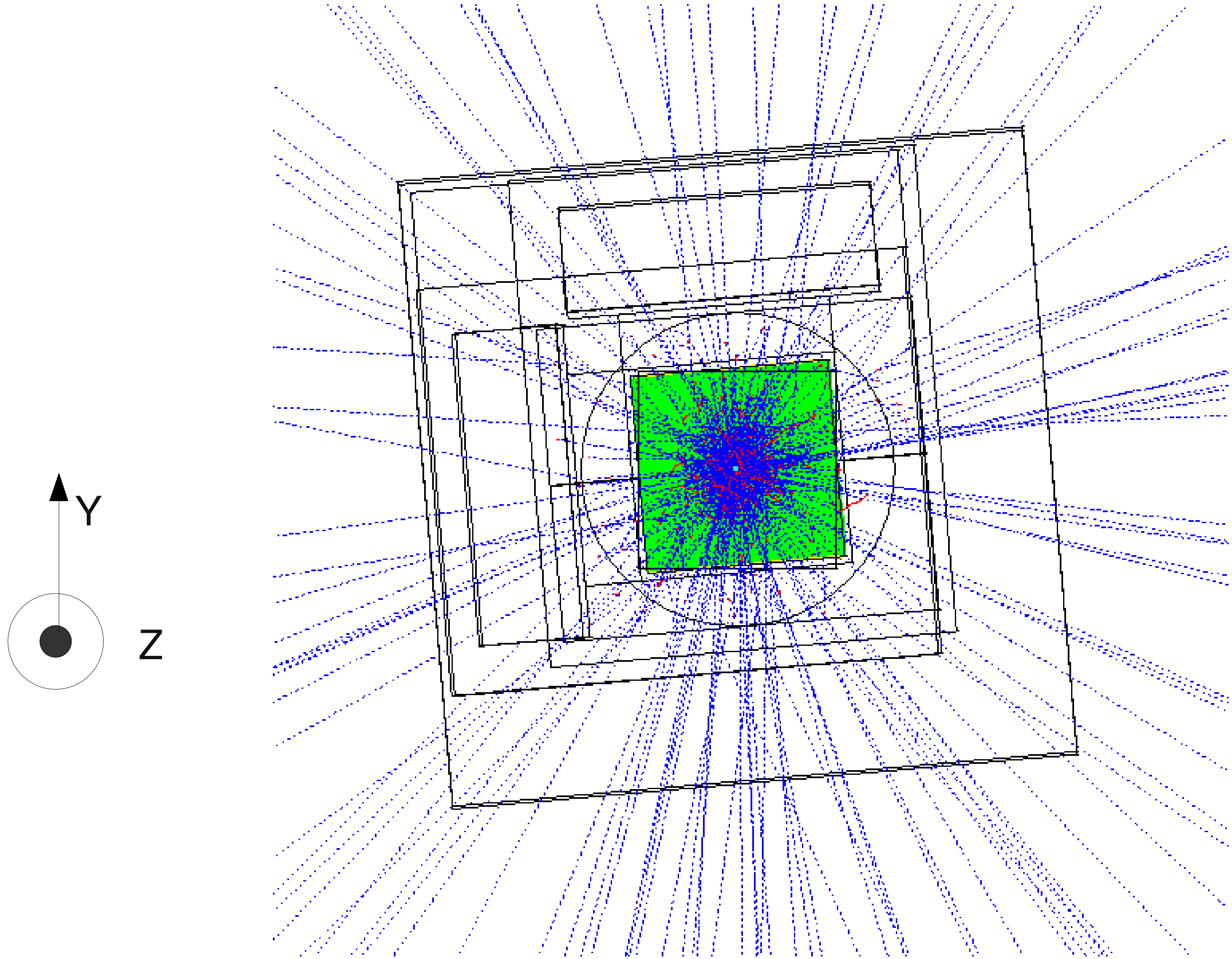


After (eta)

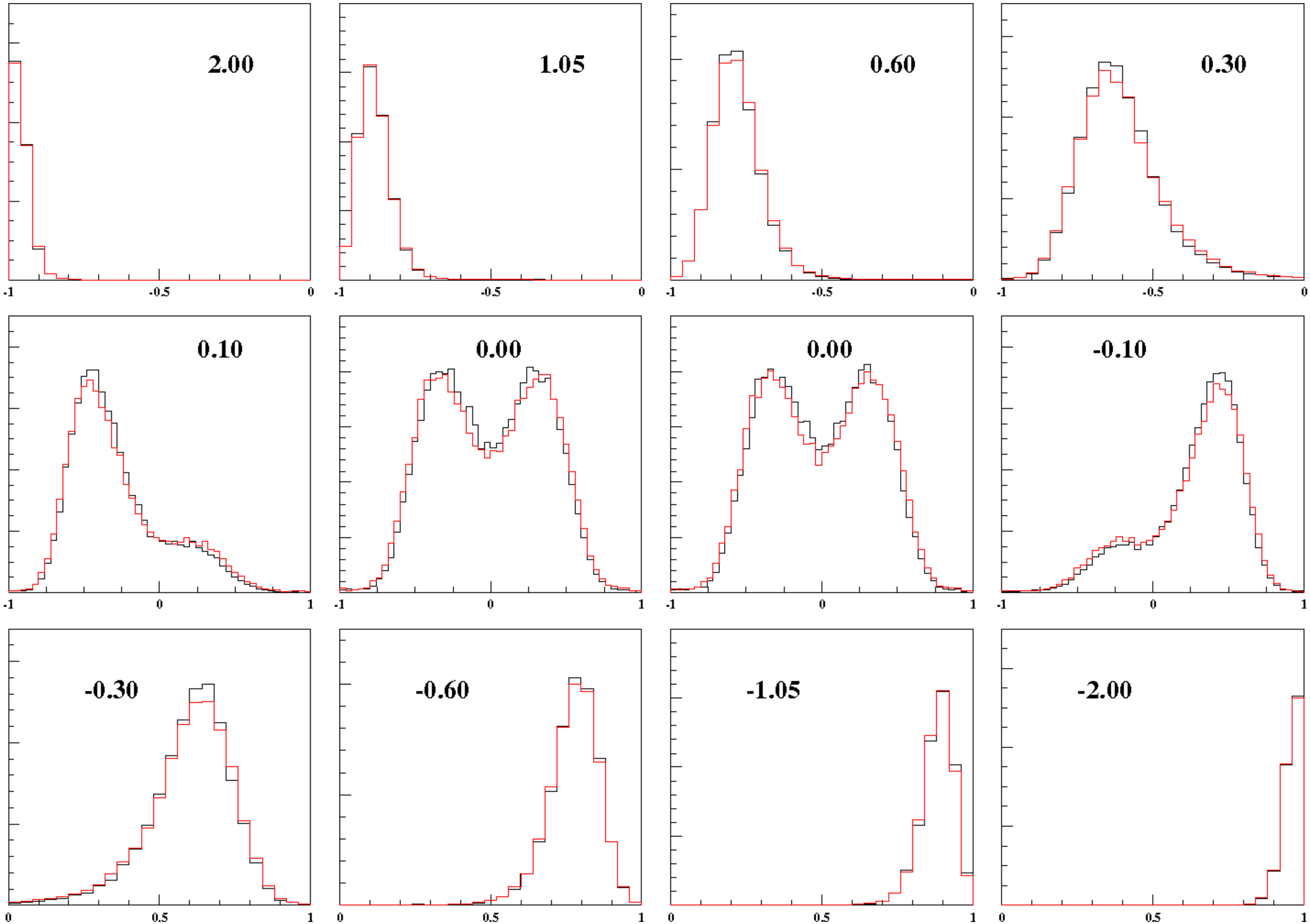


Rotations around Z axis?

+5 deg.

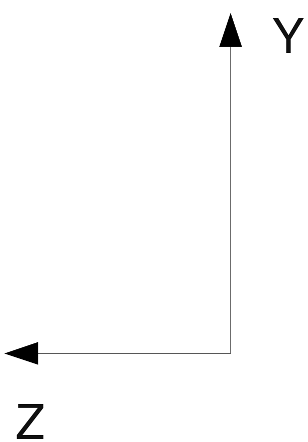


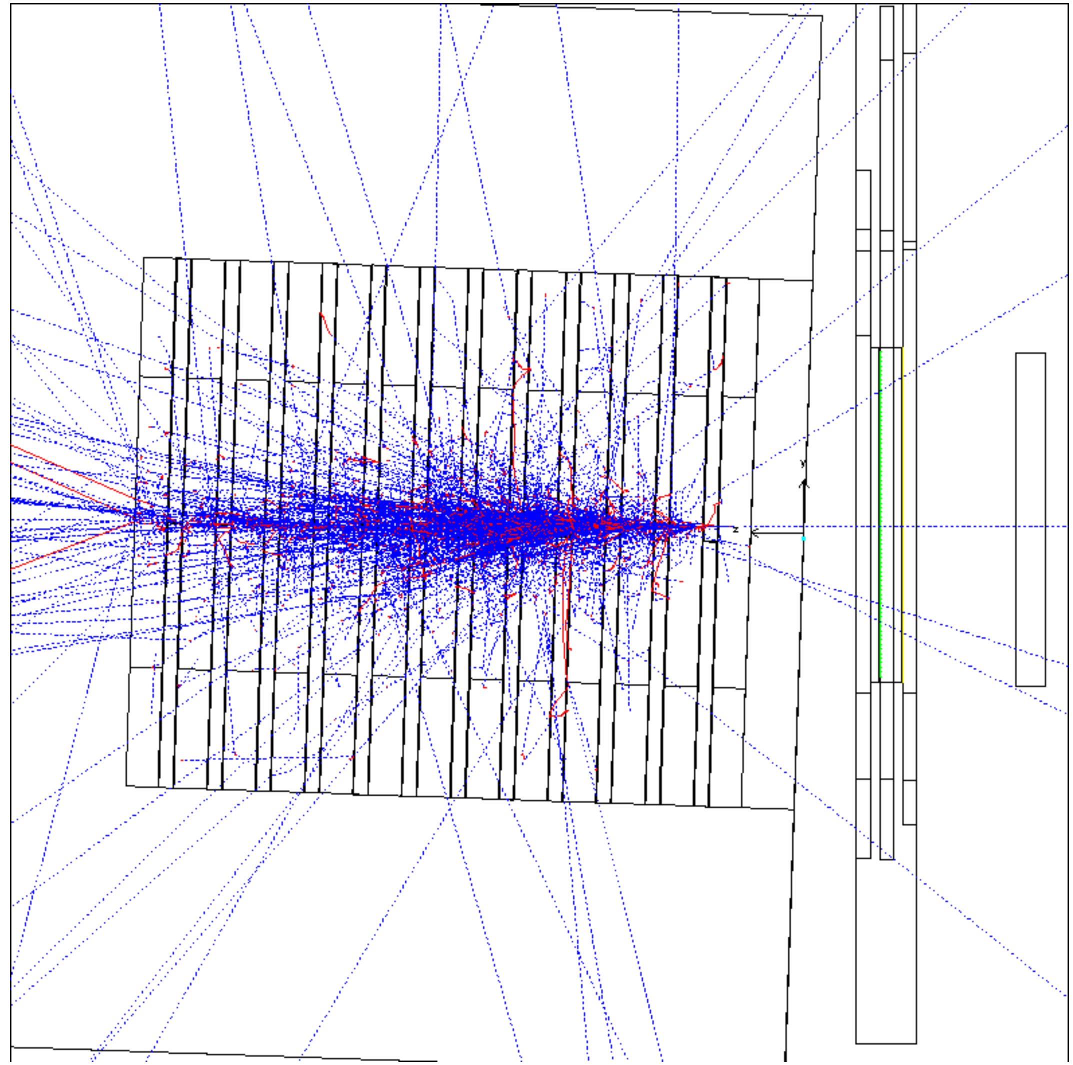
Rotations around Z axis?



nominal
+5 deg.

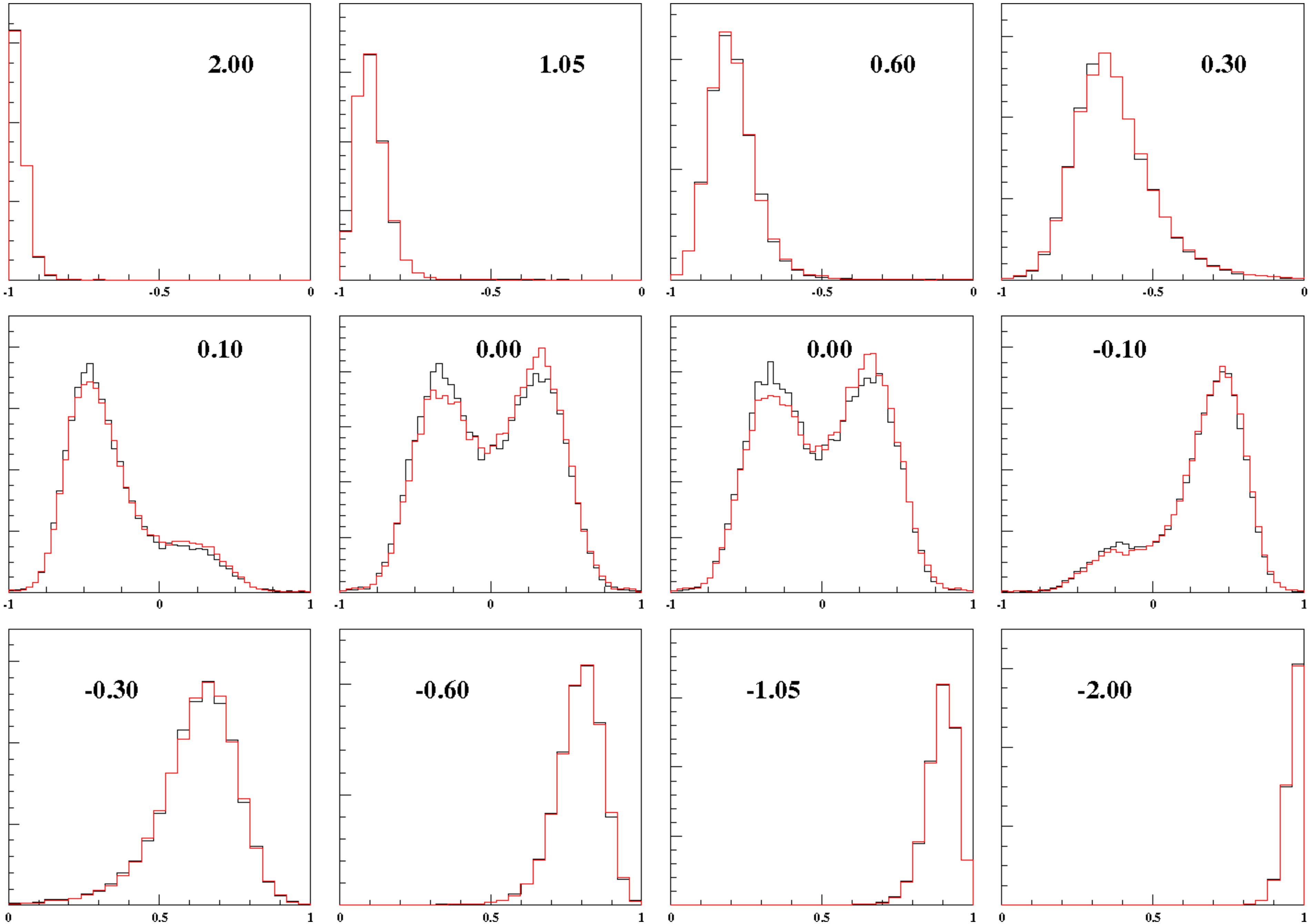
Rotations around X axis?





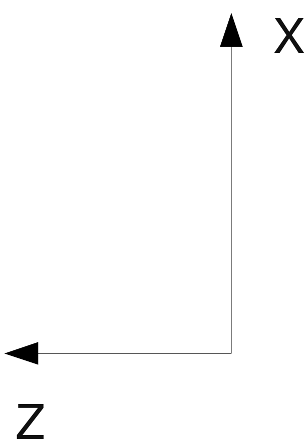
side view

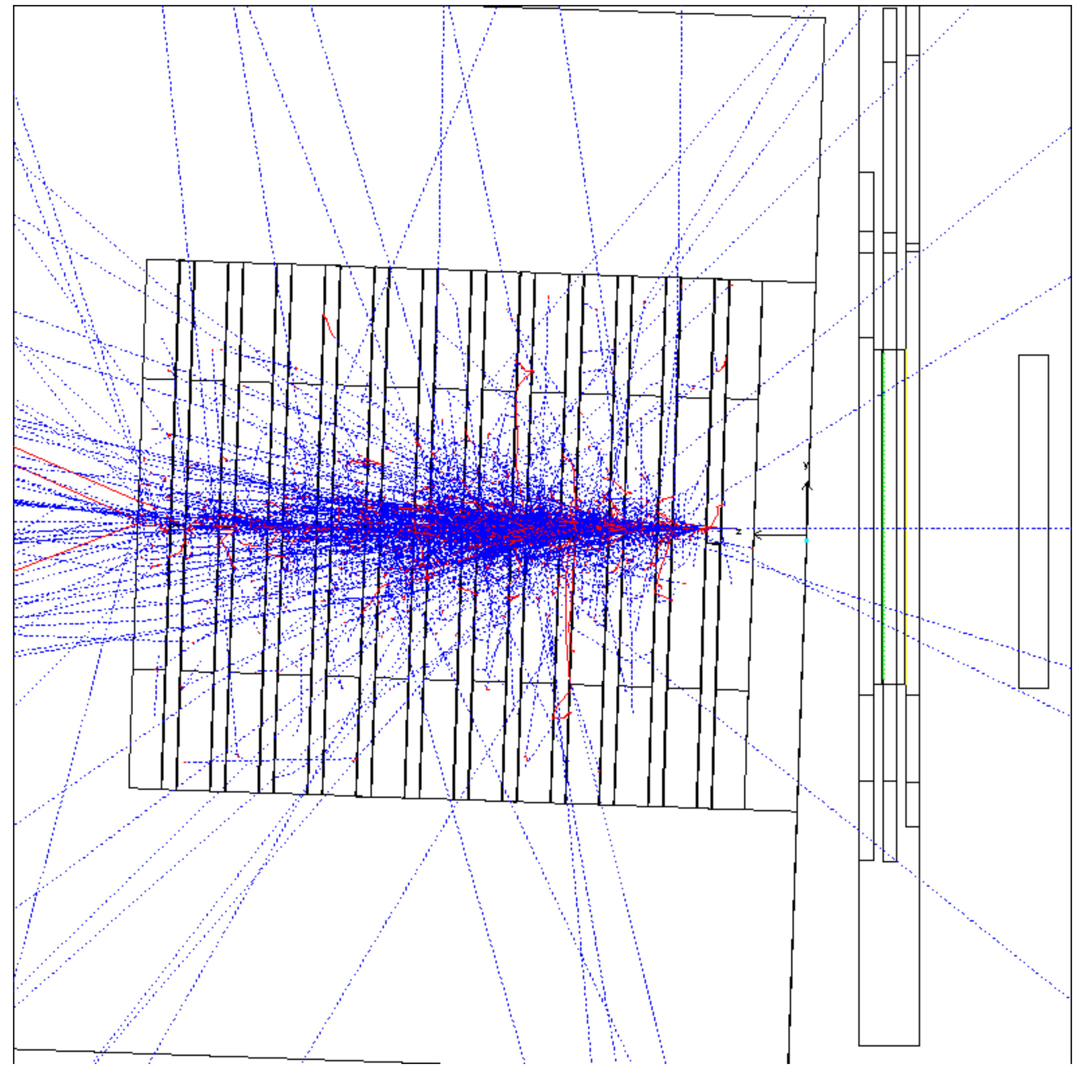
Rotations around X axis?



nominal
-0.3 deg.

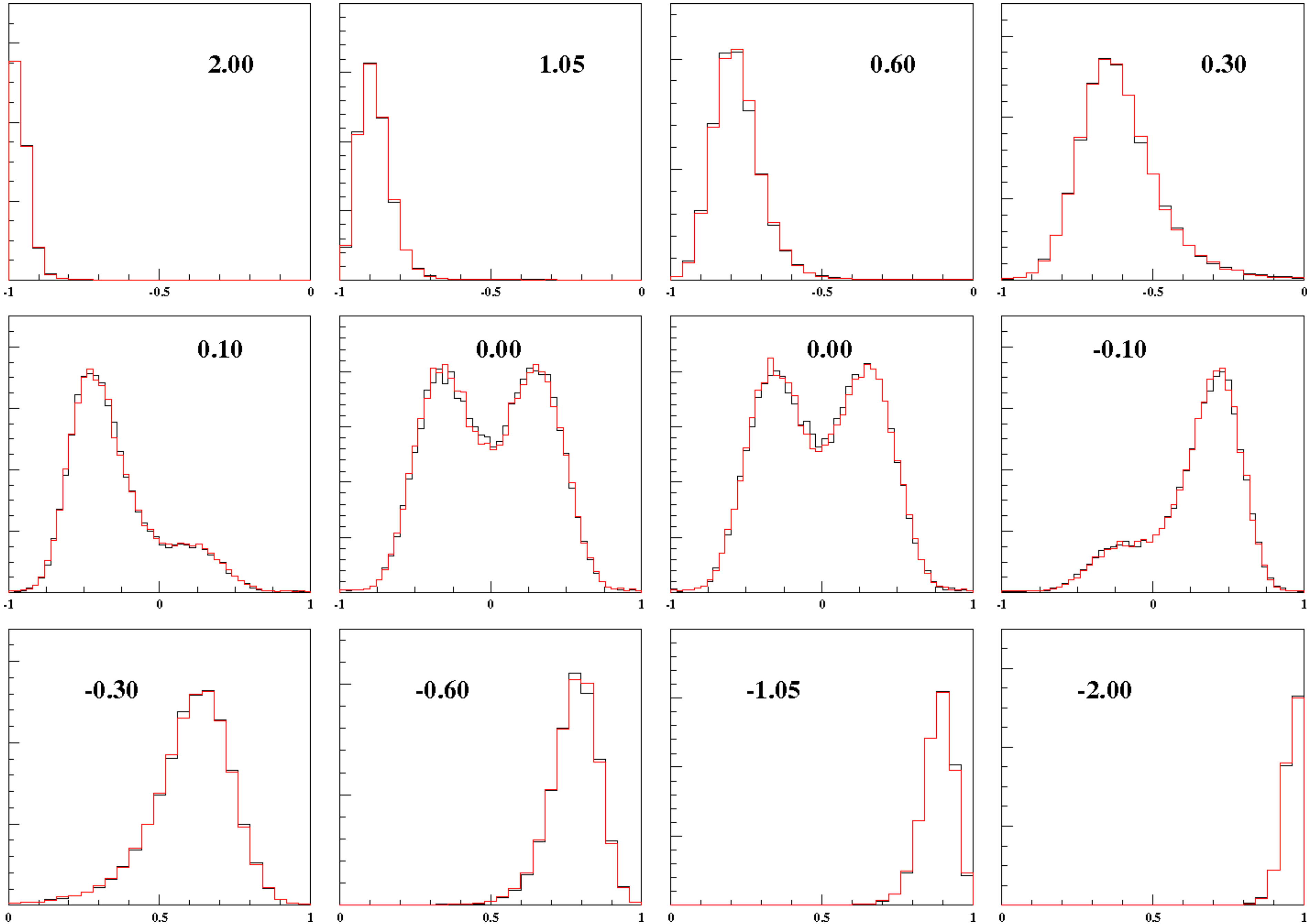
Rotations around Y axis?





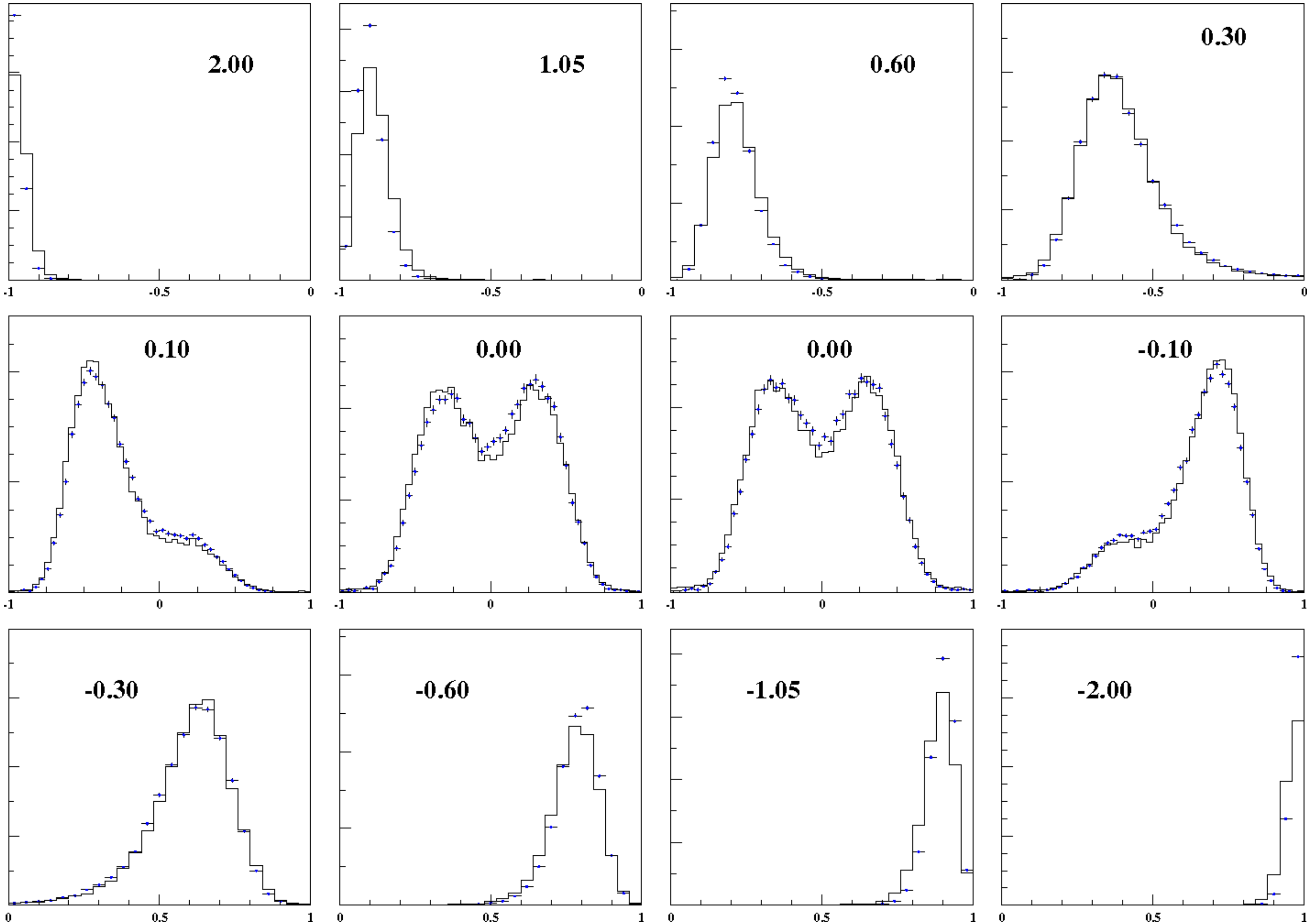
top view

Rotations around Y axis?



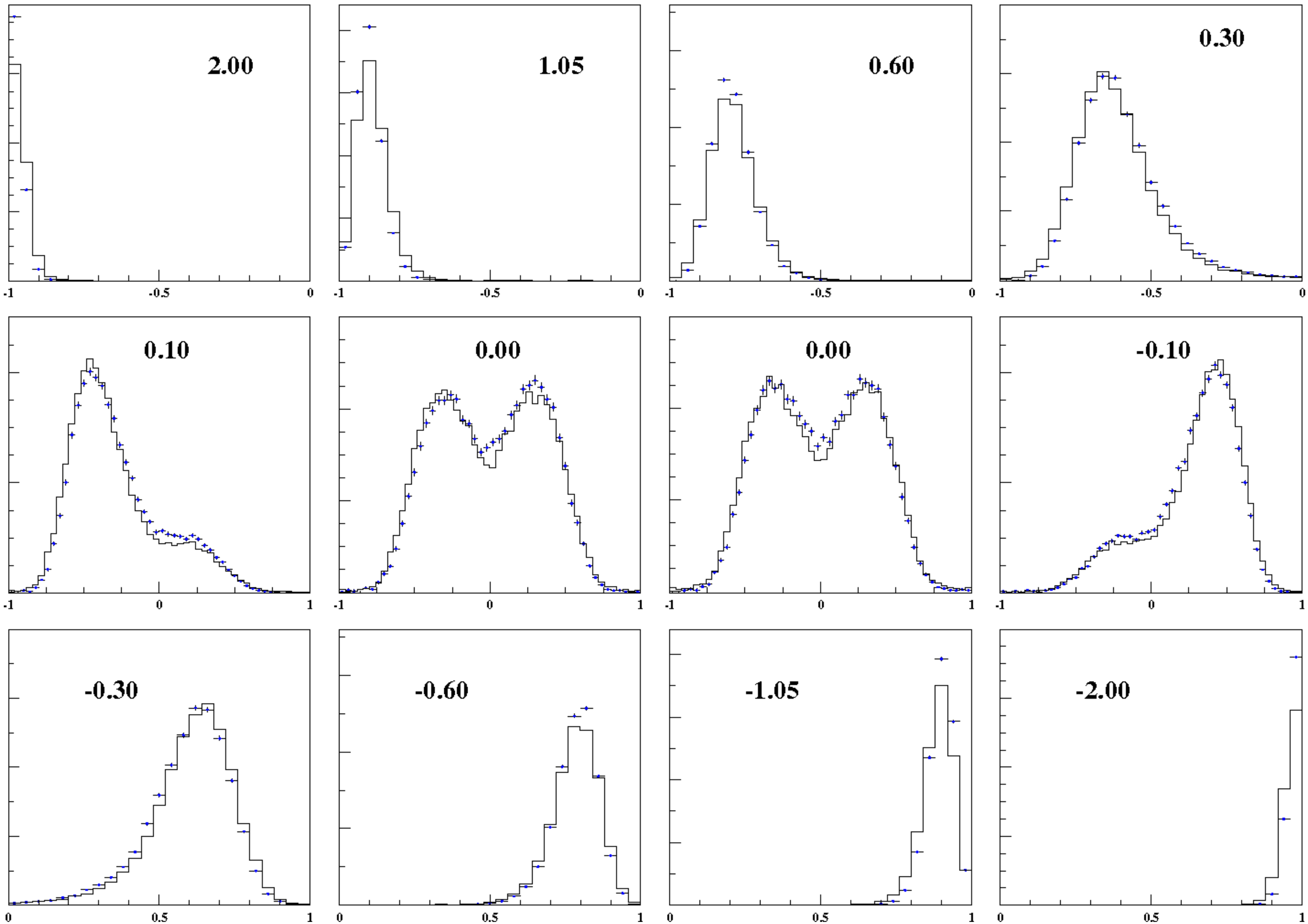
nominal
+2 deg.

GEANT parameters (CUTGAM, CUTELE, DCUTE)



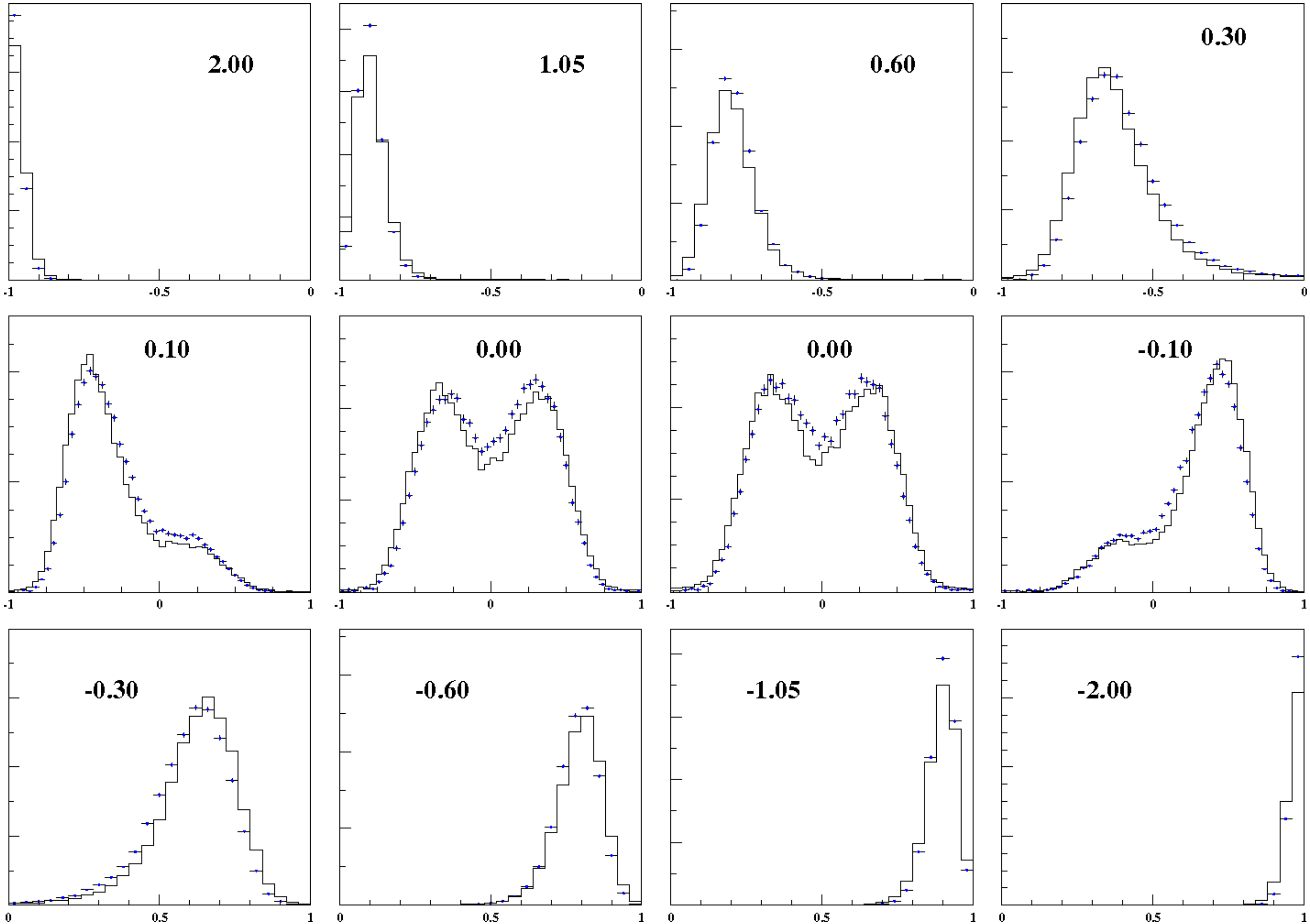
nominal - CUTGAM, CUTELE, DCUTE = 0.001 GeV = 1 MeV

GEANT parameters (CUTGAM, CUTELE, DCUTE)



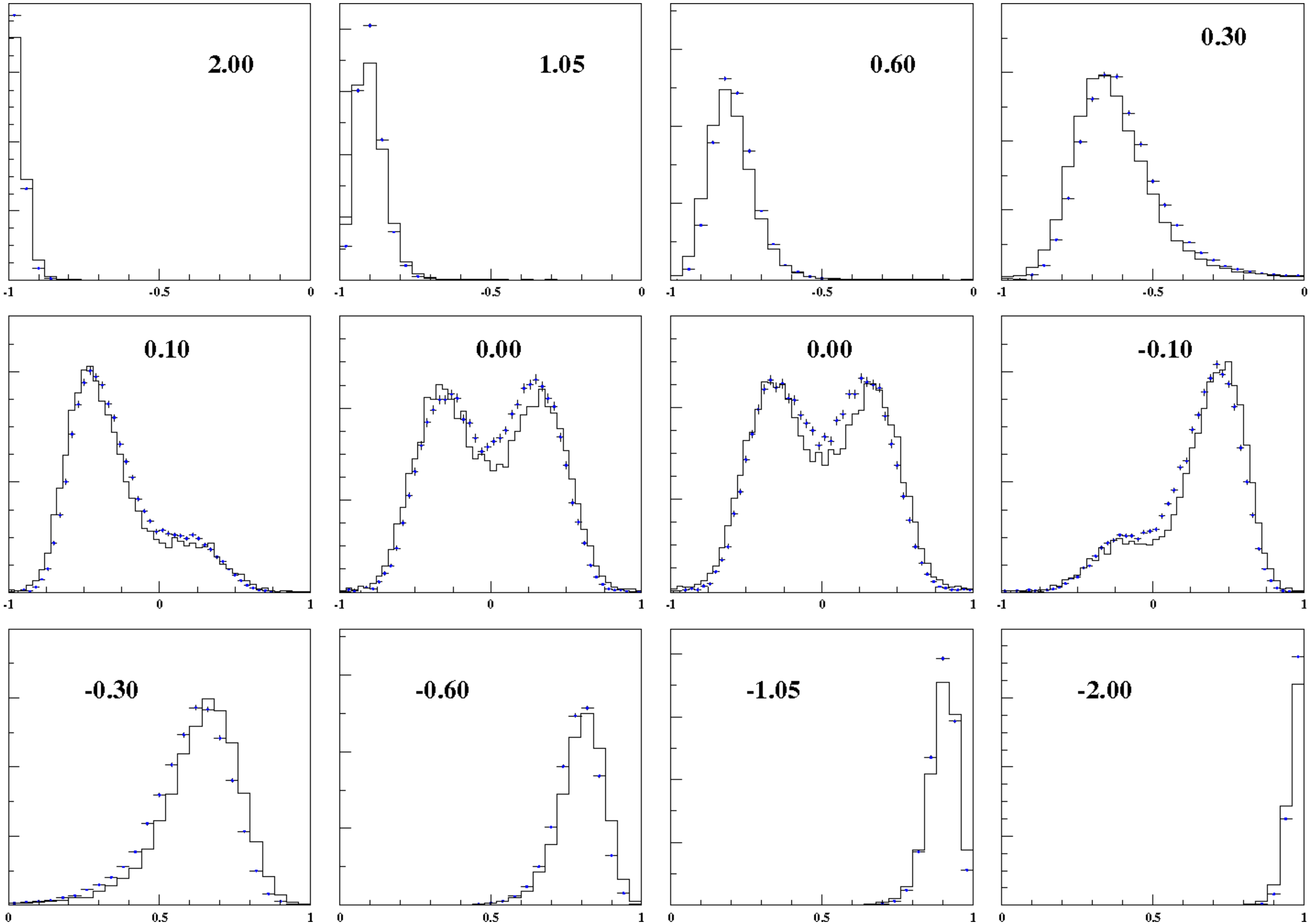
CUTGAM, CUTELE, DCUTE = 0.0008 GeV = 0.8 MeV

GEANT parameters (CUTGAM, CUTELE, DCUTE)



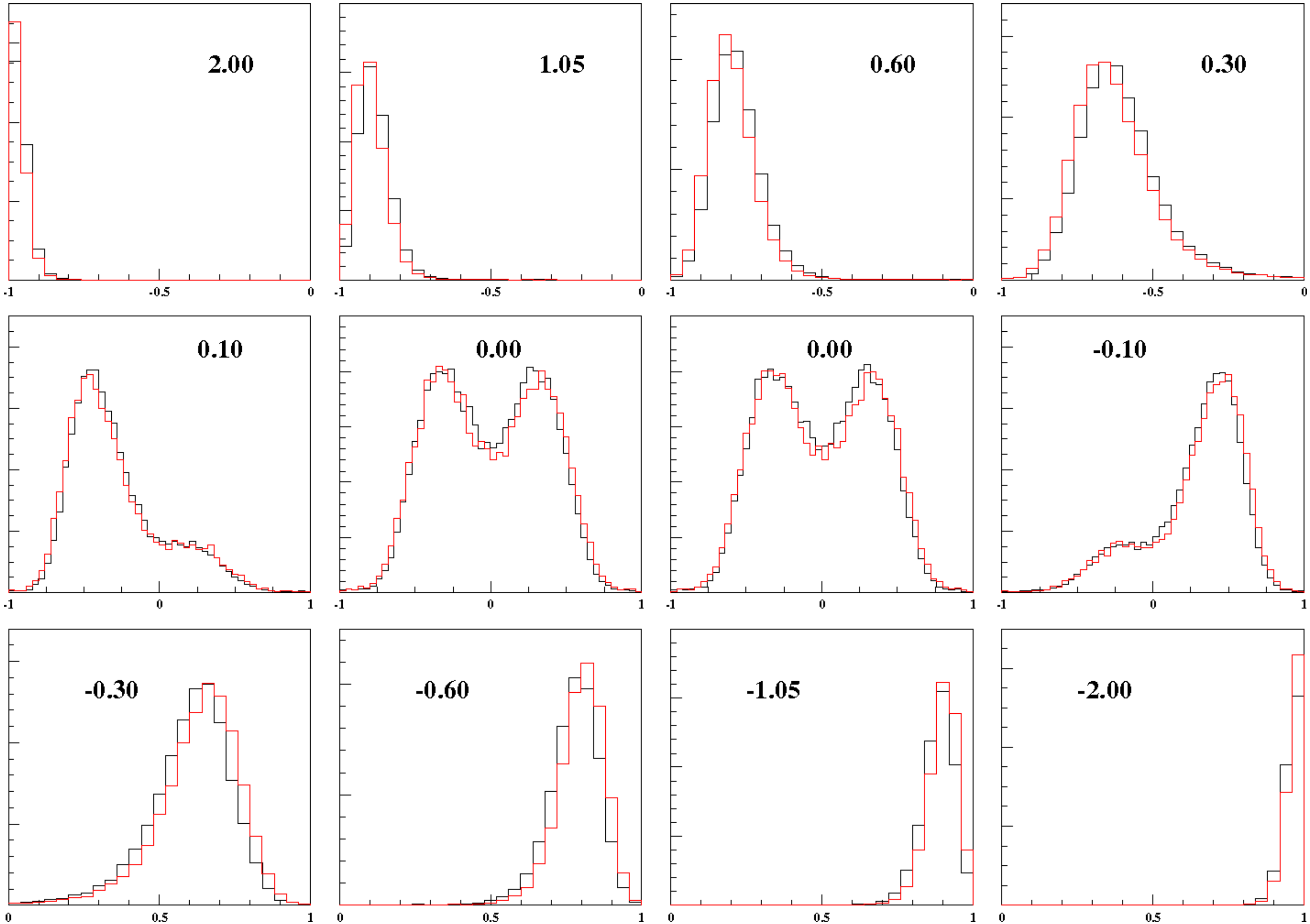
CUTGAM, CUTELE, DCUTE = 0.0005 GeV = 0.5 MeV

GEANT parameters (CUTGAM, CUTELE, DCUTE)



CUTGAM, CUTELE, DCUTE = 0.0002 GeV = 0.2 MeV

GEANT parameters (CUTGAM, CUTELE, DCUTE)

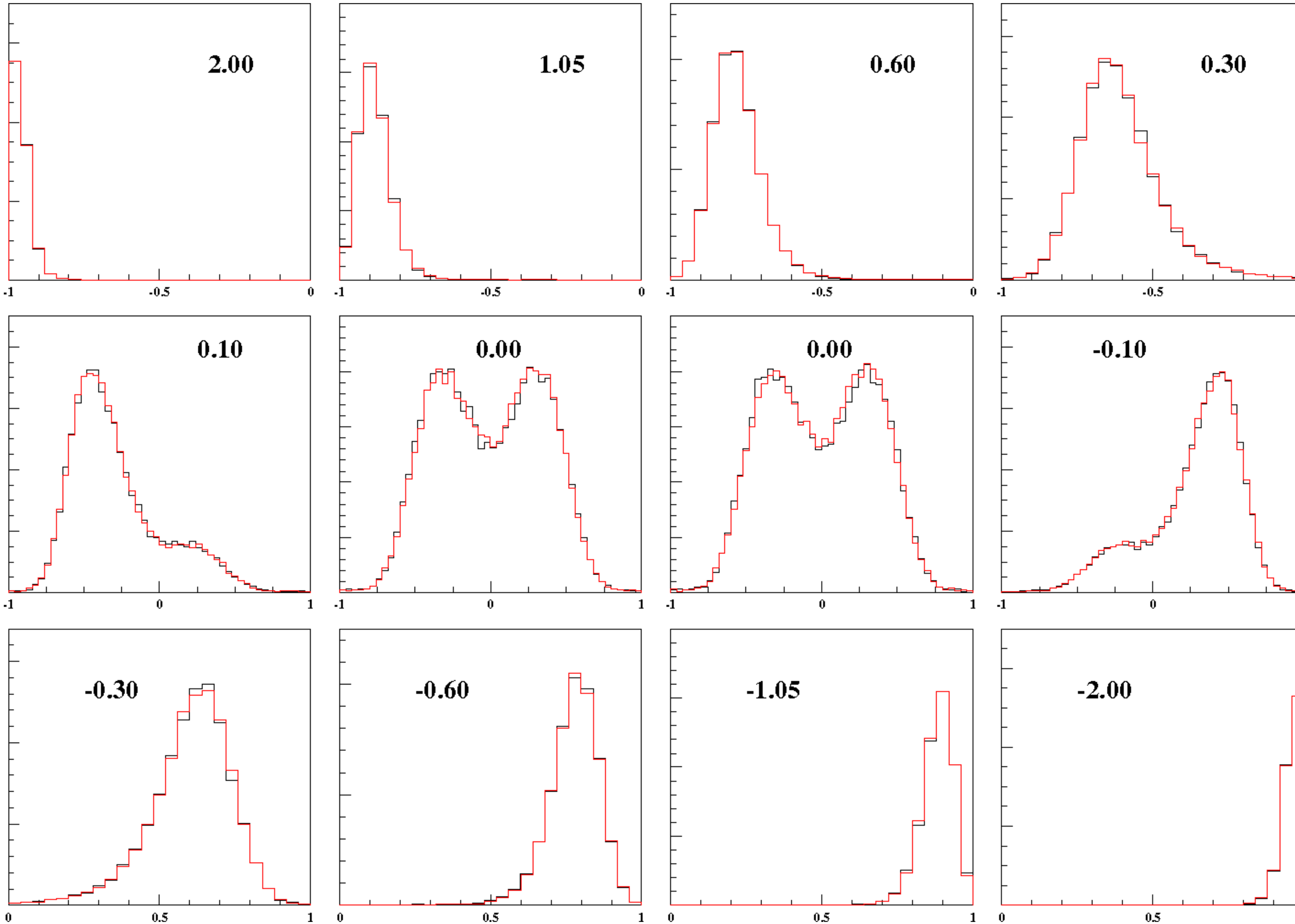


nominal - CUTGAM, CUTELE, DCUTE = 1 MeV

CUTGAM, CUTELE, DCUTE = 0.2 MeV

05 Feb 2008

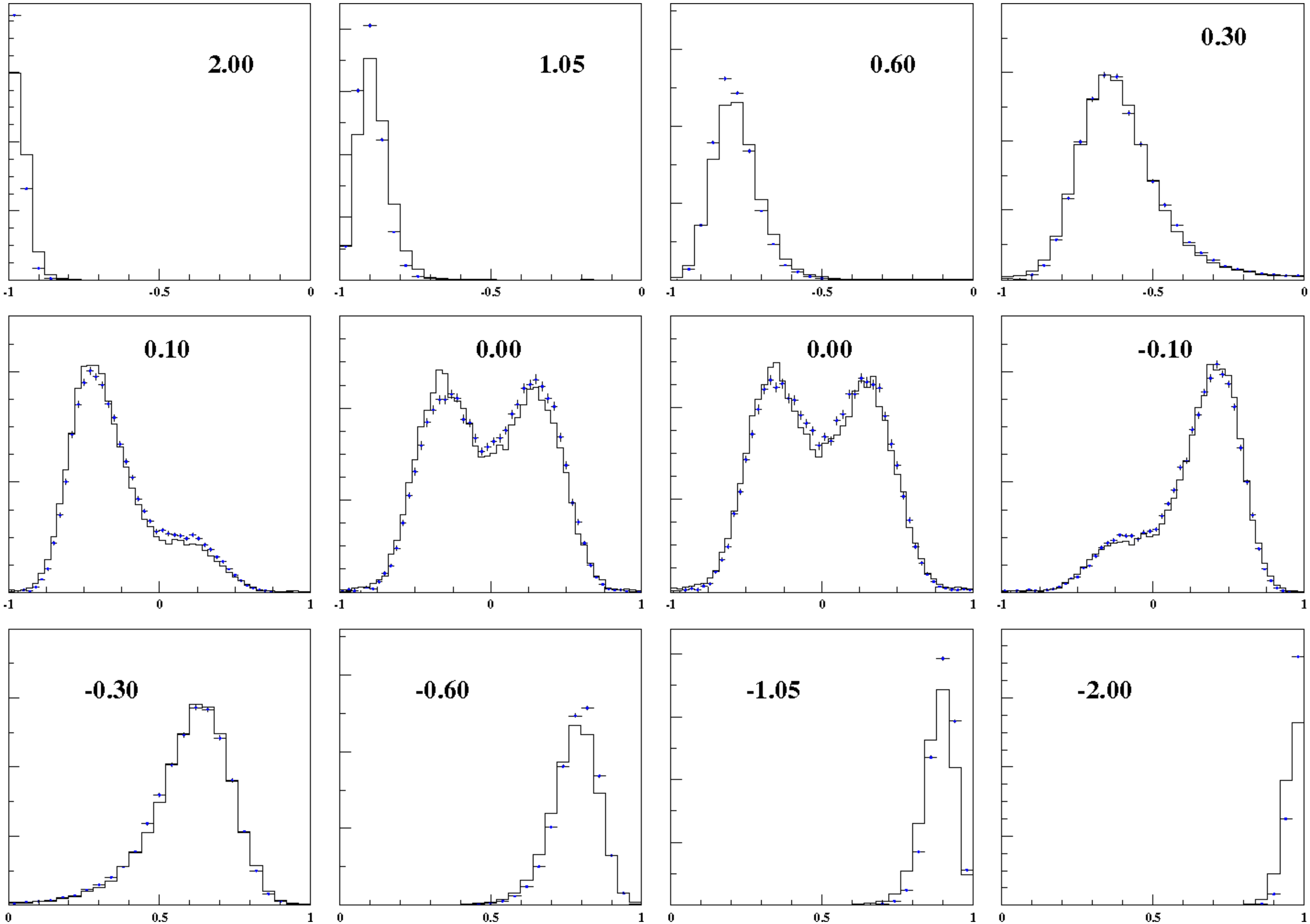
GEANT parameters (EPSIL)



nominal - EPSIL = 0.001 cm

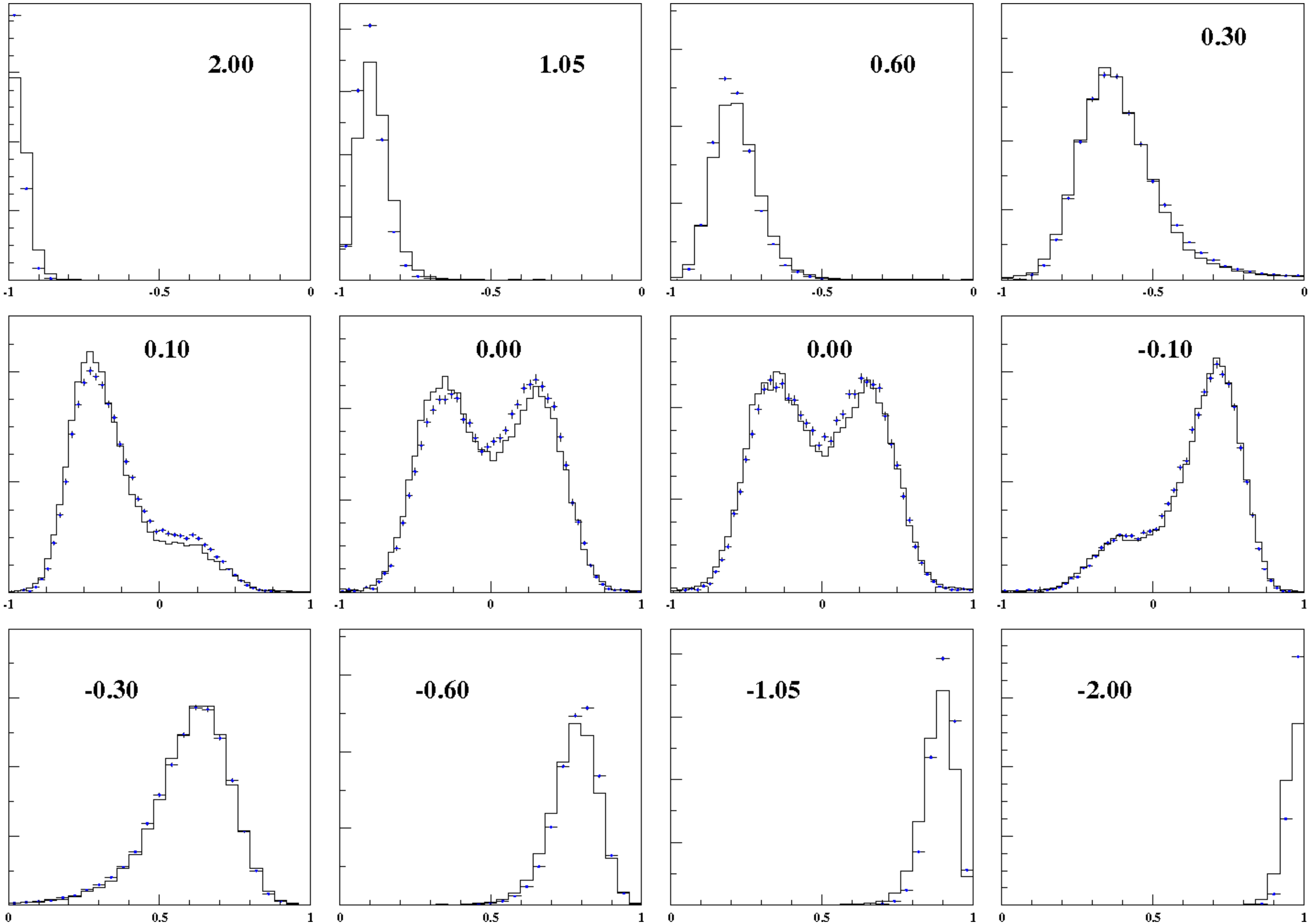
EPSIL = 0.0001 cm

SCIN plate alignement from control cards (rotations+offsets January 2001)



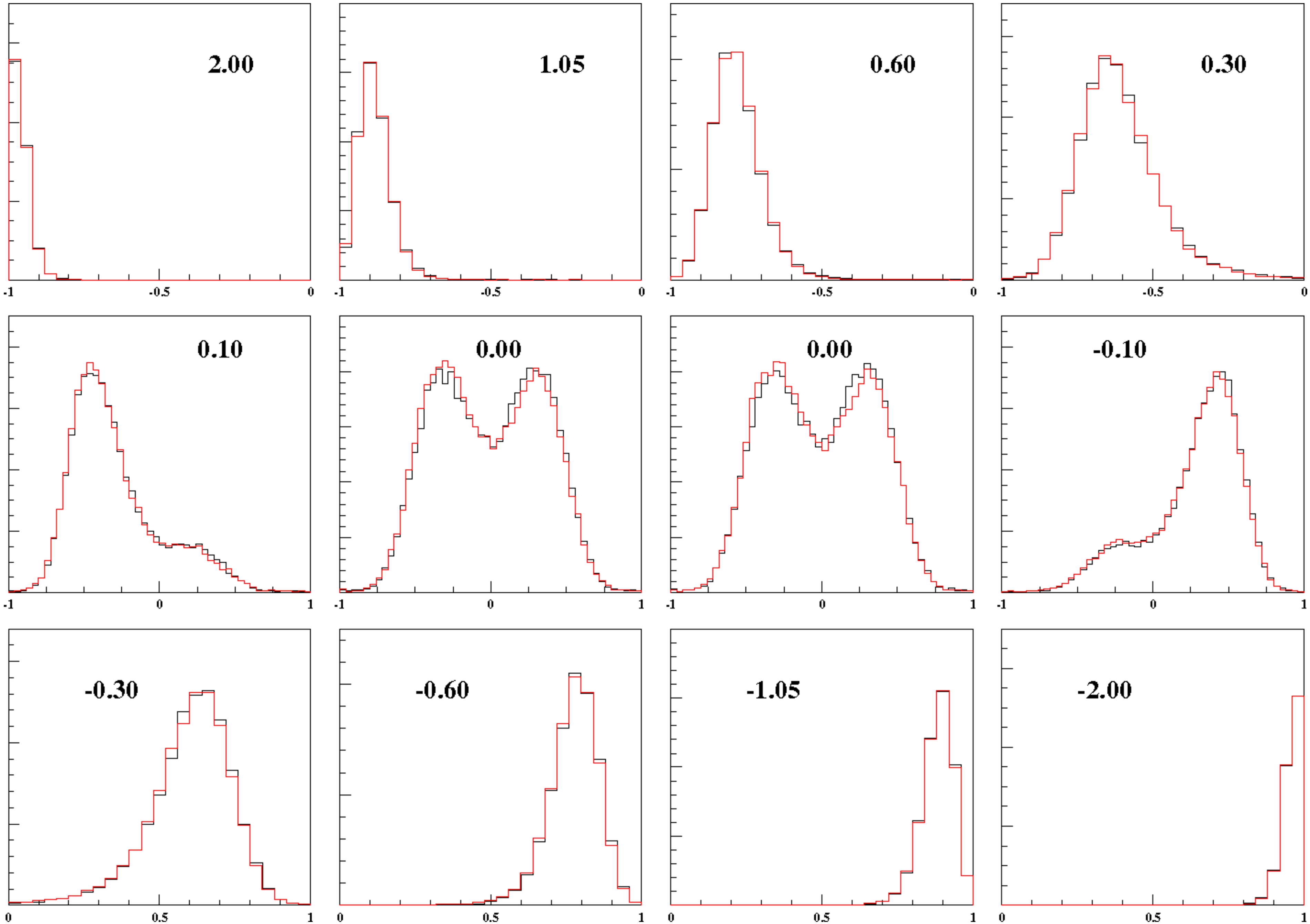
data vs MC with January 2001 alignement

SCIN plate alignement from control cards (rotations+offsets August 2001)



data vs MC with August 2001 alignement

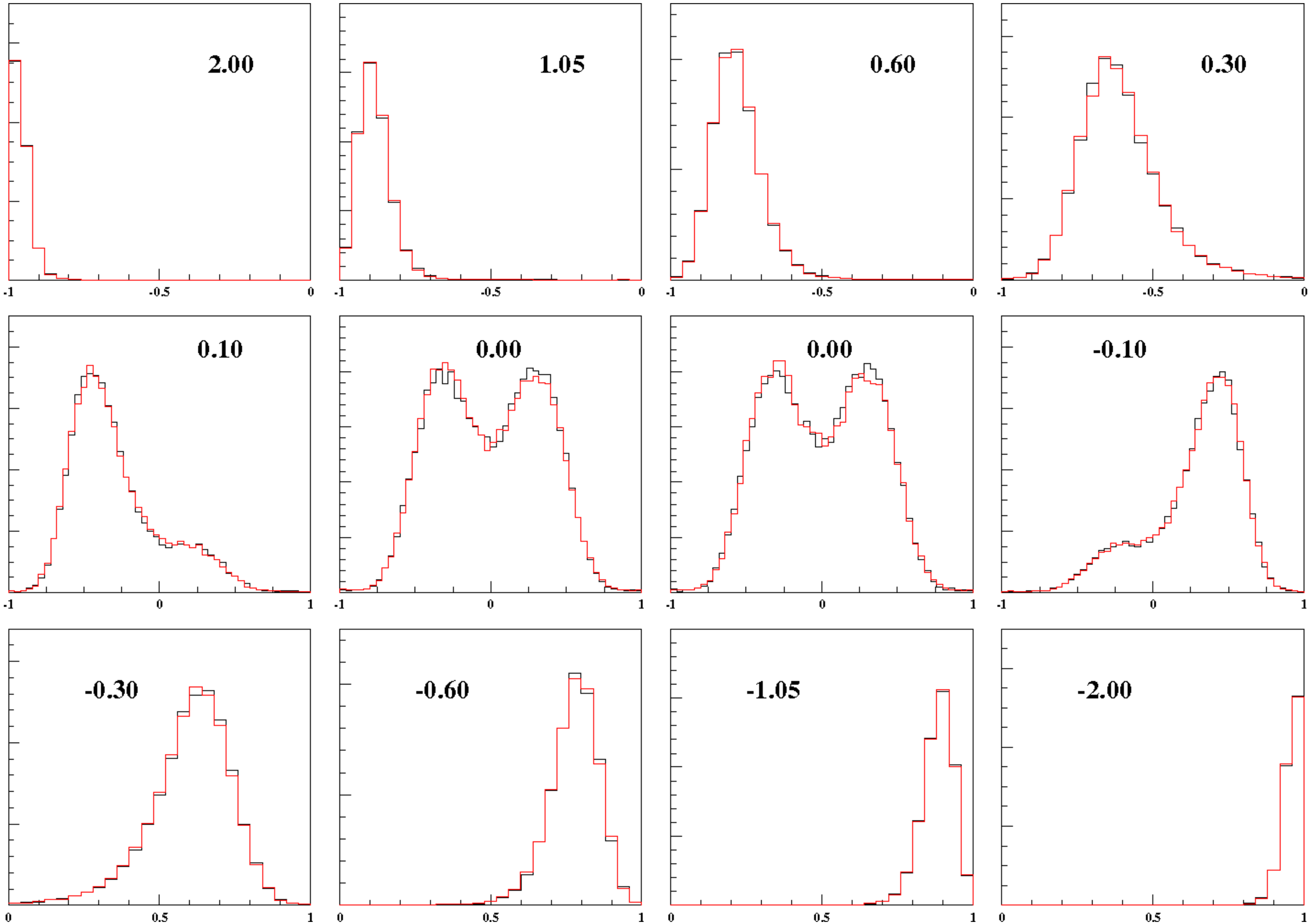
SCIN plate alignement from control cards (rotations+offsets August 2001)



MC nominal - no alignement

with August 2001 alignement

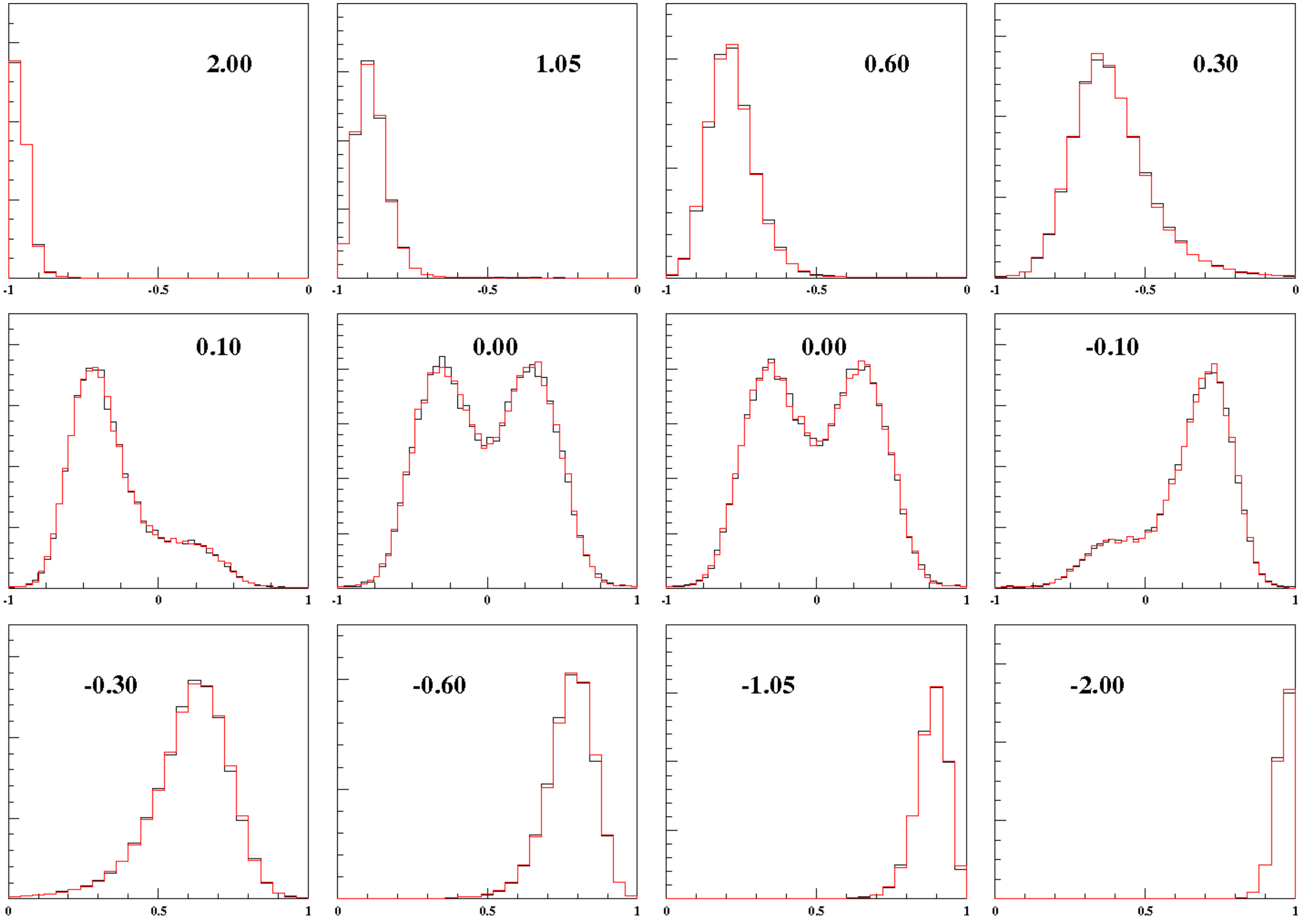
SCIN plate shifts: odds - 0.01cm down, even – 0.01cm up



MC nominal - no shifts (gap=0.01cm)

with shifts

Presampler depth

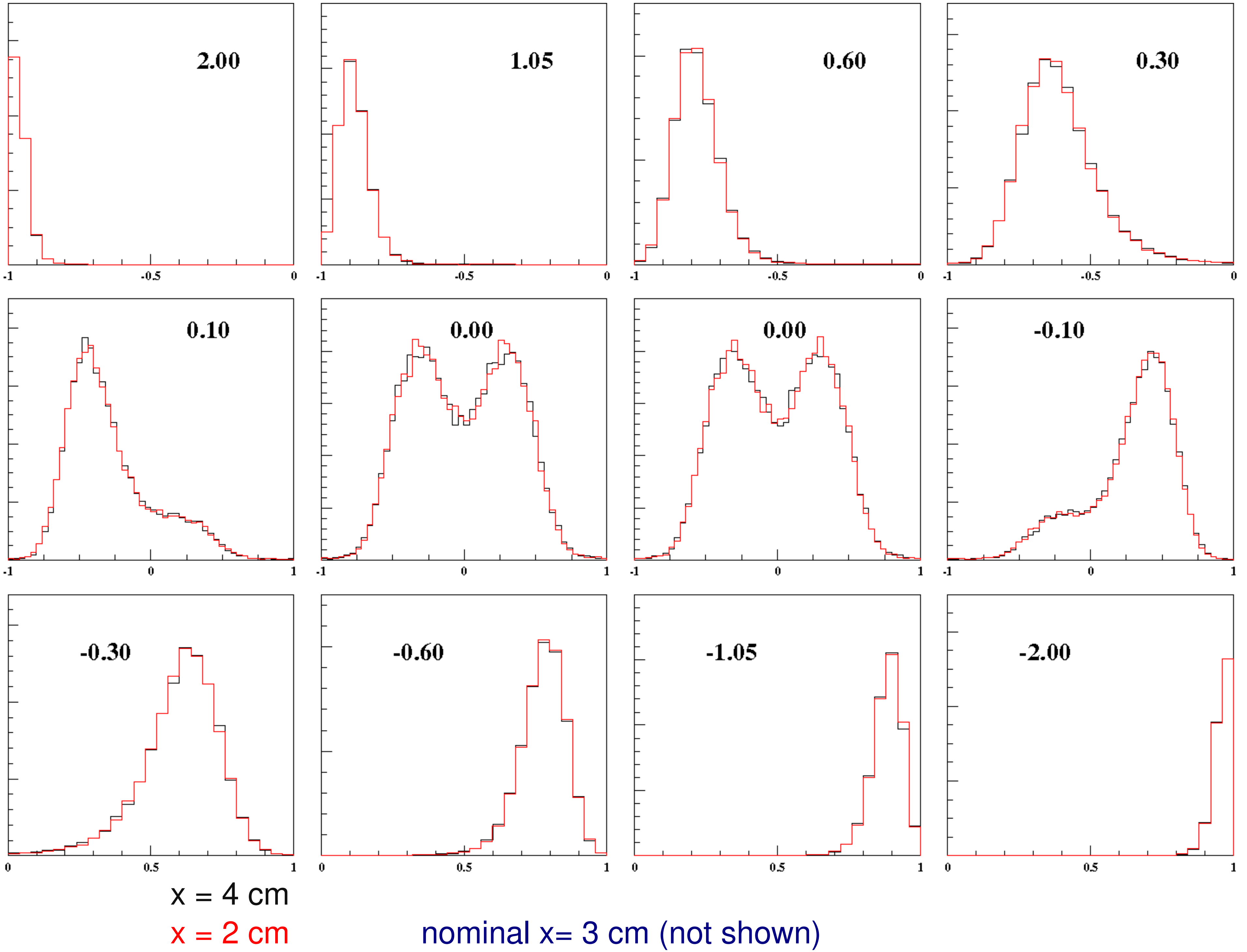


d = 1.1X0

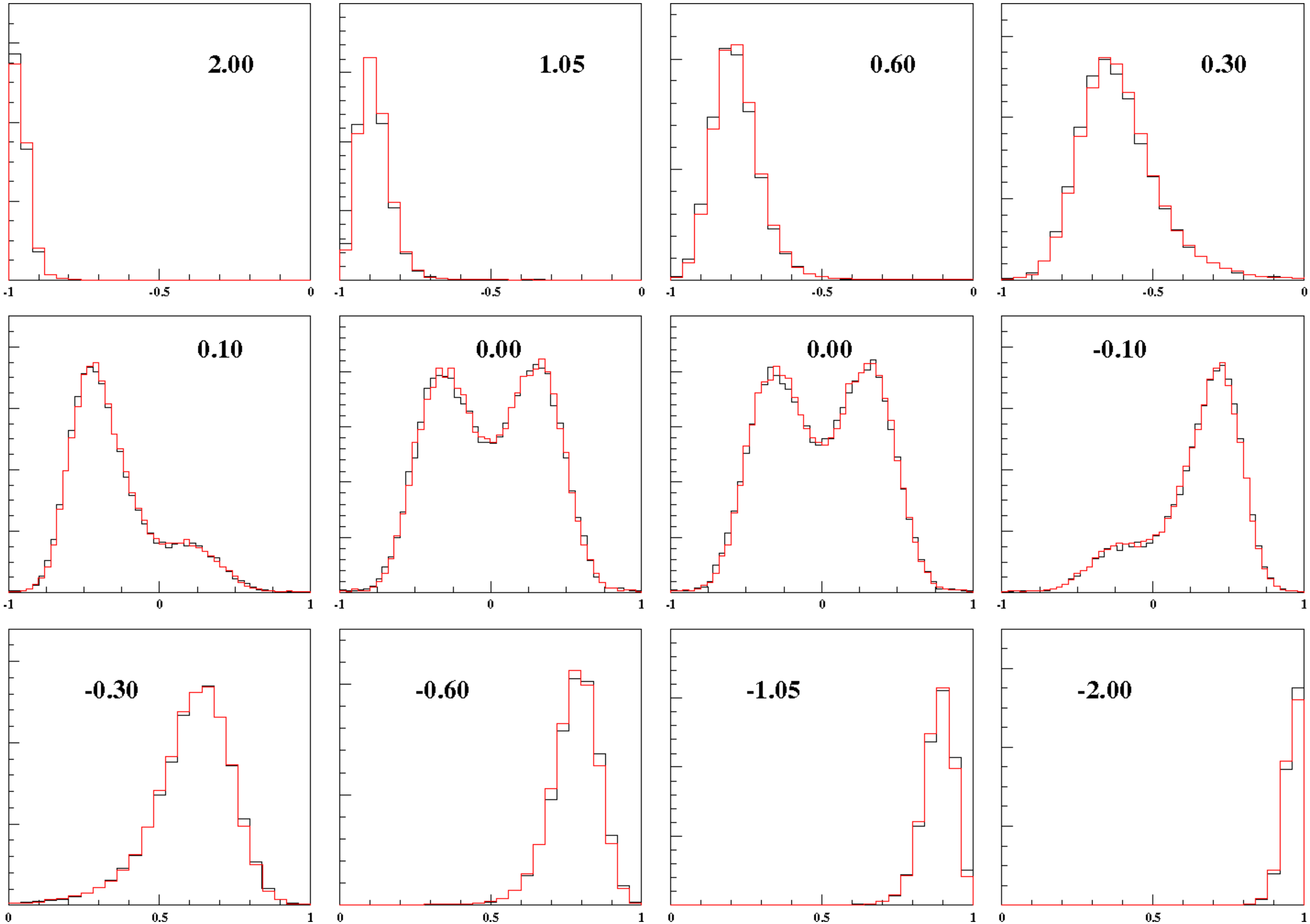
d = 0.9X0

nominal d = X0 = 0.56 cm (not shown)

Presampler position wrt. silicon front



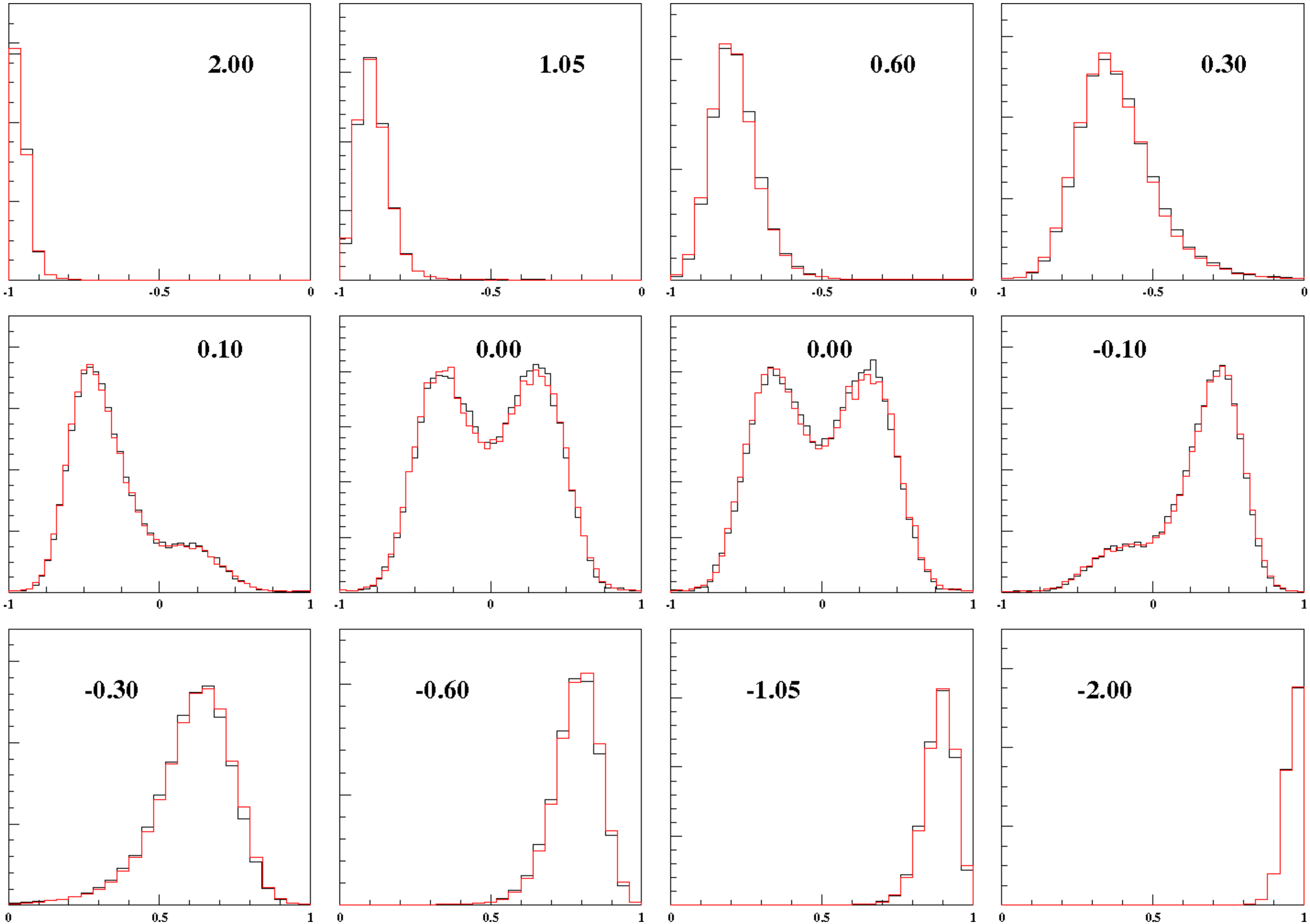
DENSIMET17 density: 17 → 16 g/cm3



nominal

densimet density =16 g/cm3

DENSIMET17 density: 17 → 18 g/cm3

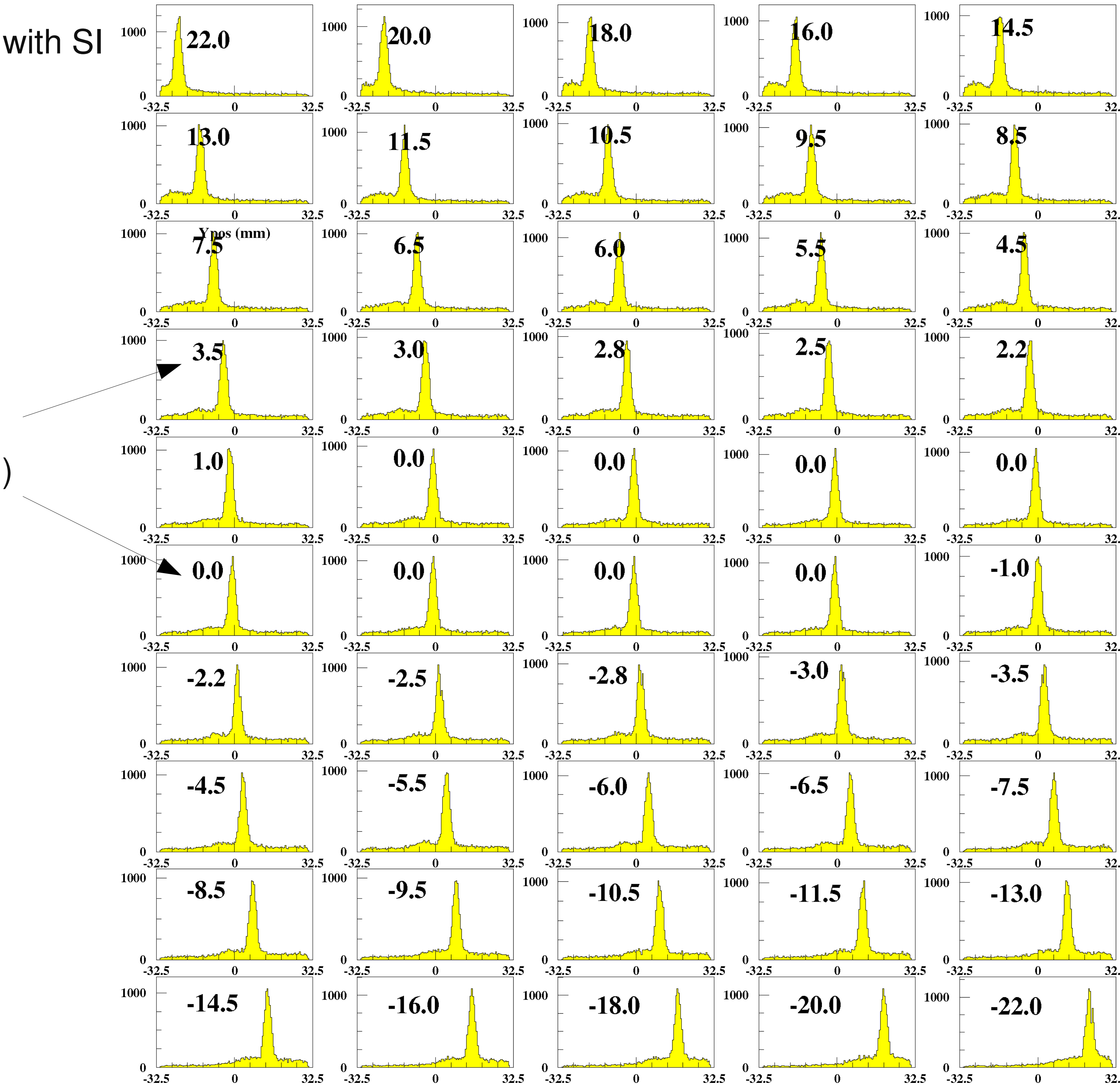


nominal

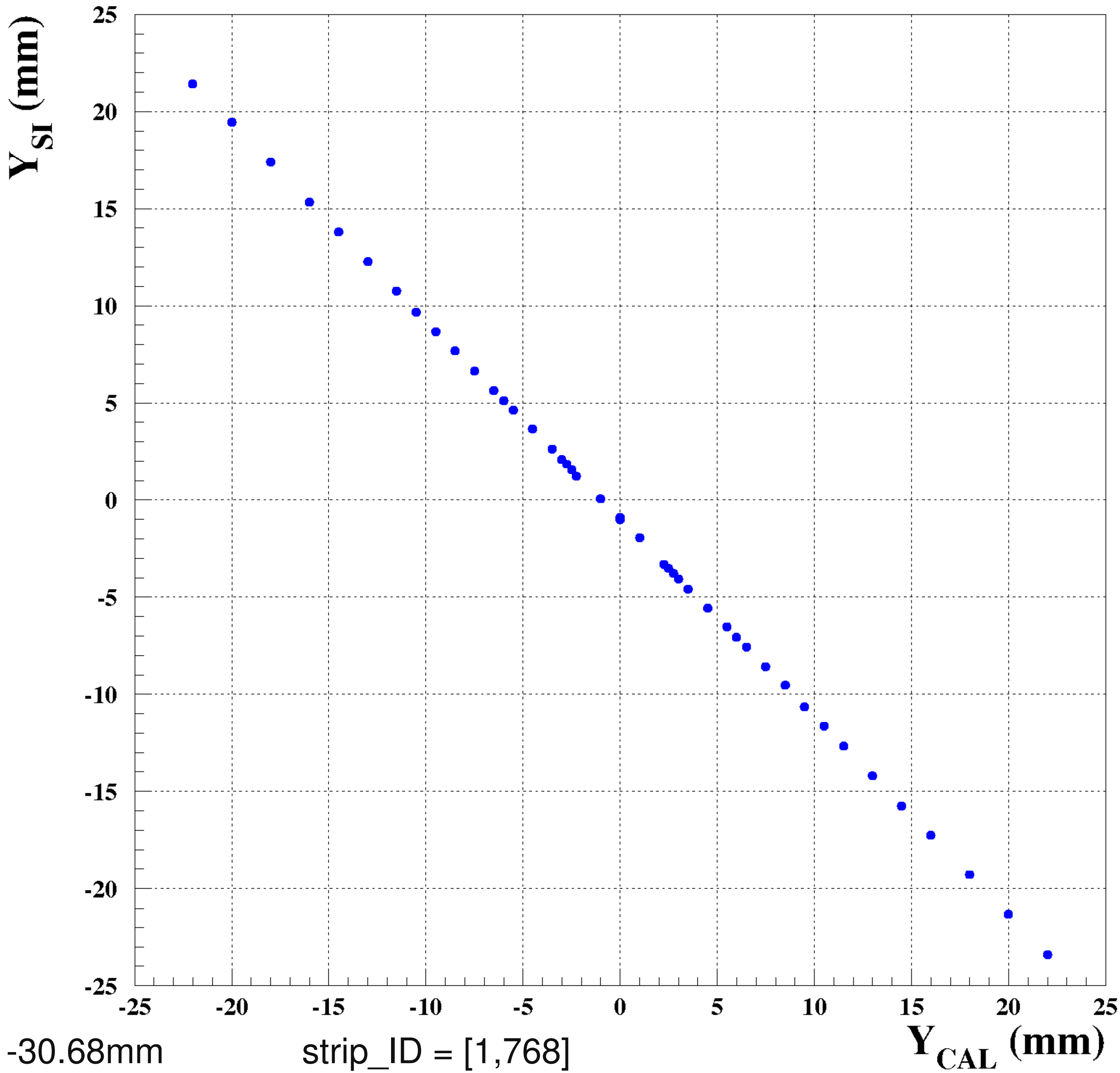
densimet density =18 g/cm3

CAL motor calibration with SI

Y_CalTable (mm)

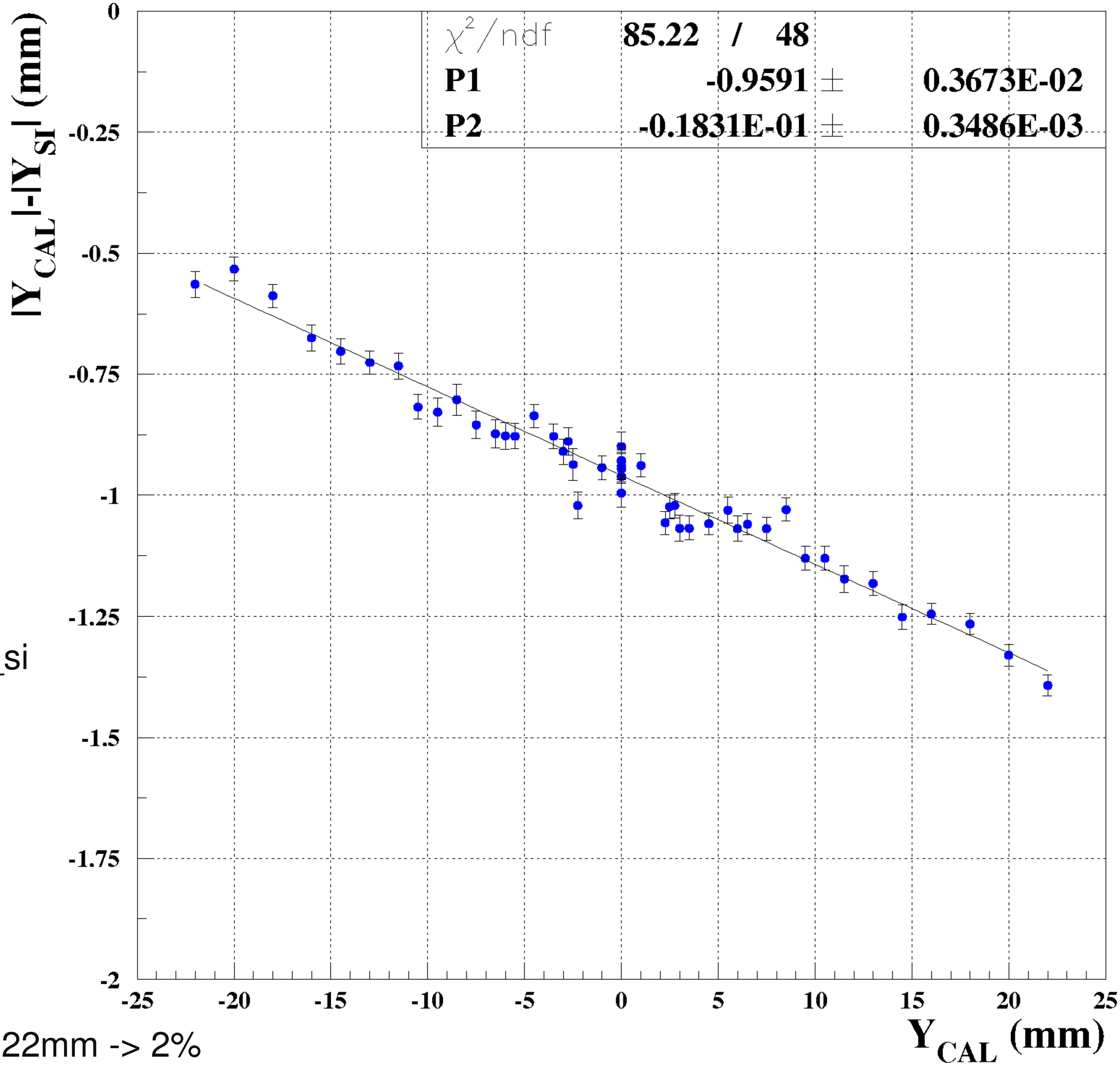


CAL motor calibration with SI



Y_si=strip_ID*0.08mm -30.68mm strip_ID = [1,768]

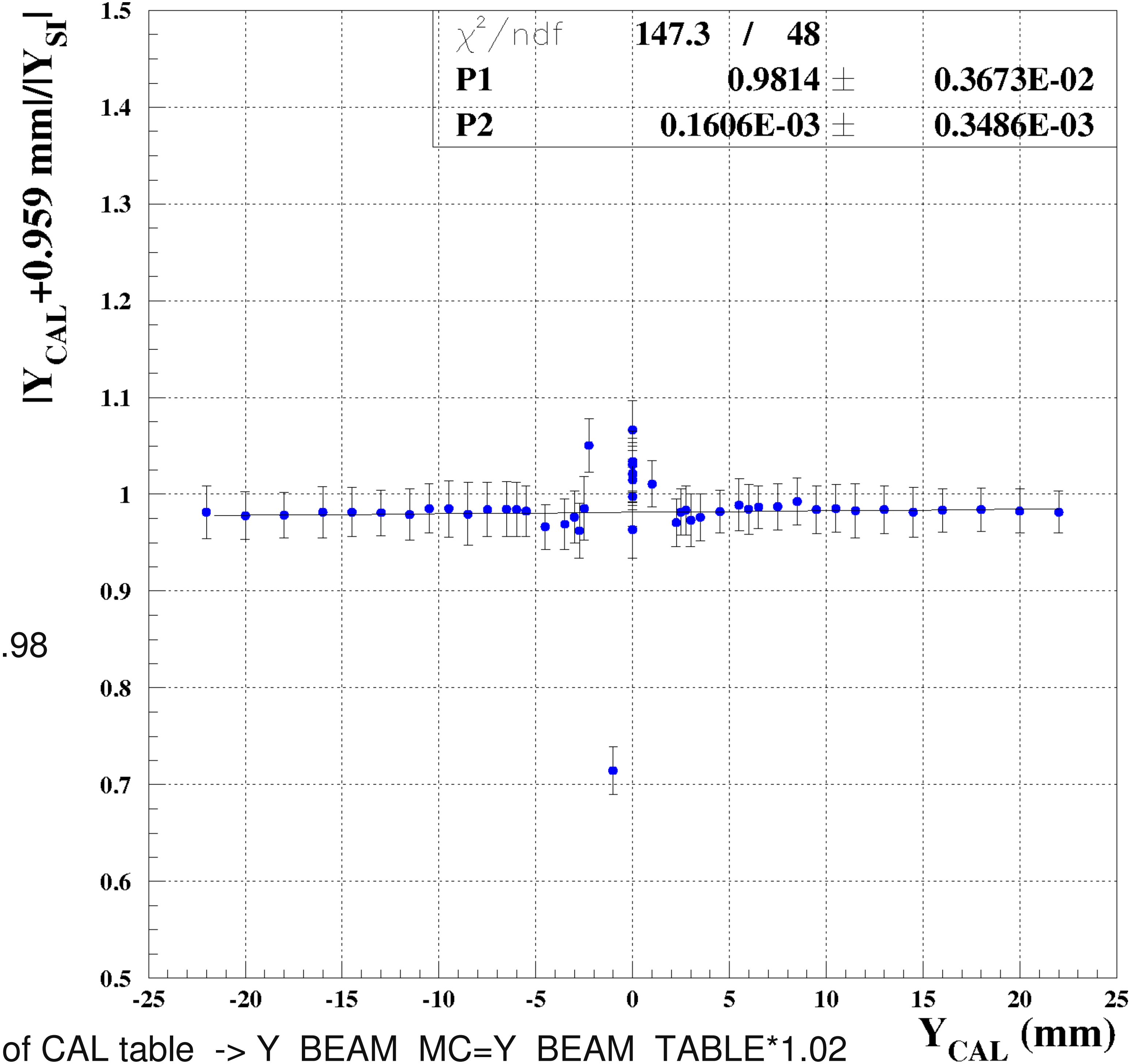
CAL motor calibration with SI



shift: Y_cal+0.959=Y_si
+ linear scaling

~0.5mm difference @ 22mm -> 2%

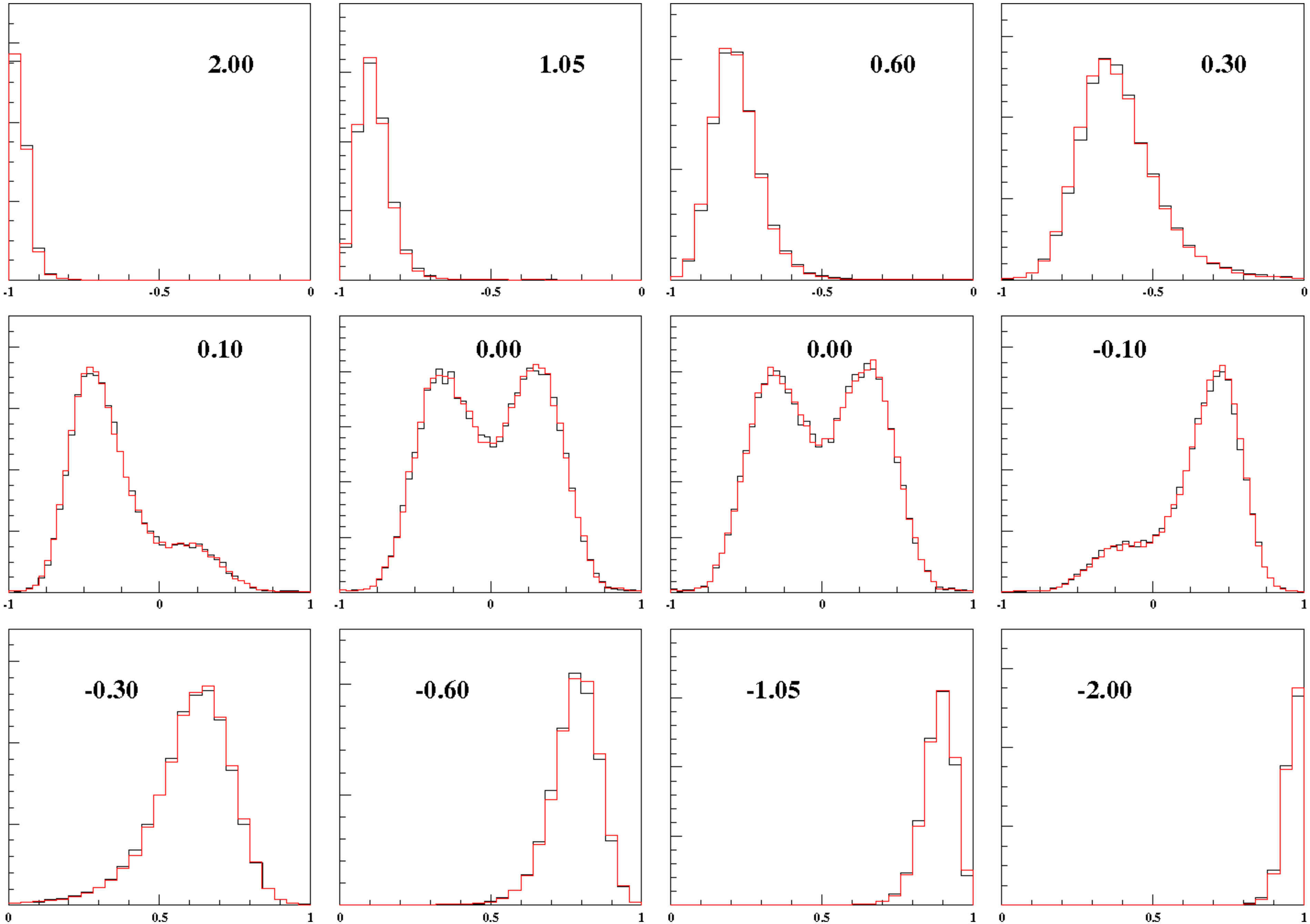
CAL motor calibration with SI



|Y_cal+0.959|/|Y_si|=0.98

1 unit of SI = 0.98 unit of CAL table -> Y_BEAM_MC=Y_BEAM_TABLE*1.02

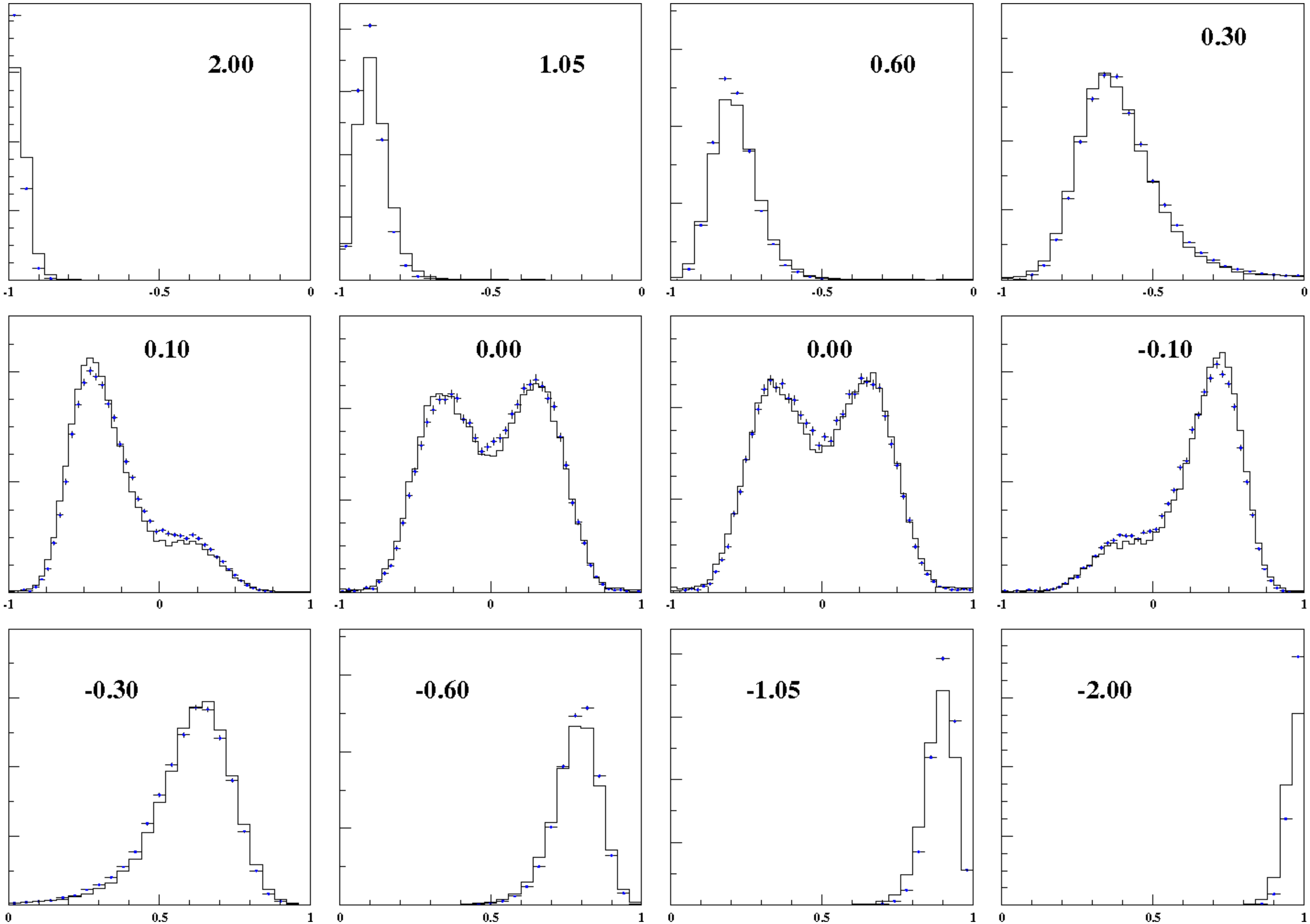
Beam position on the CAL surface y_beam → y_beam*1.02



nominal

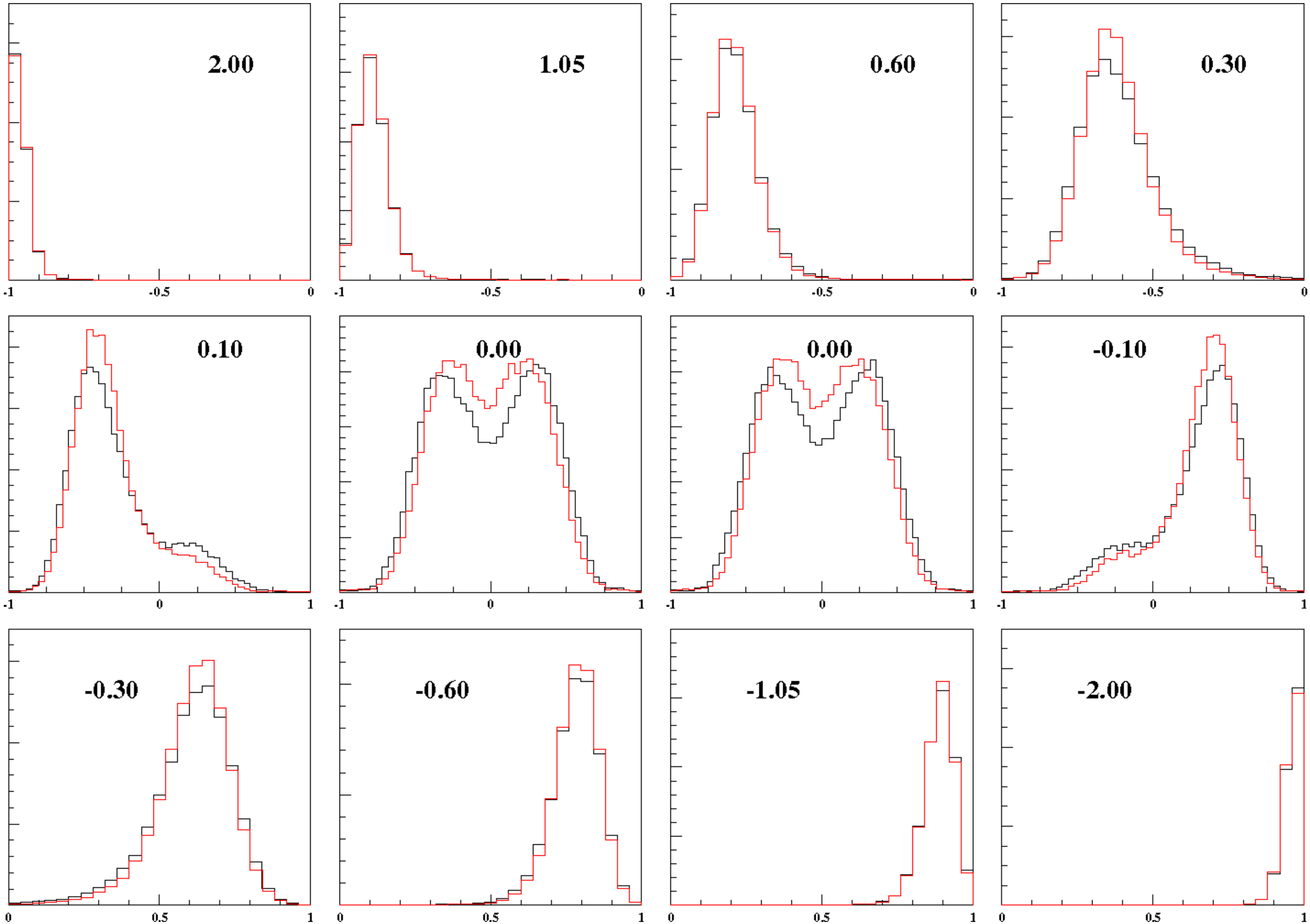
y_beam = y_beam*1.02 (becomes nominal)

Beam position on the CAL surface y_beam ➔ y_beam*1.02



data vs. MC with y_beam = y_beam*1.02 (becomes nominal)

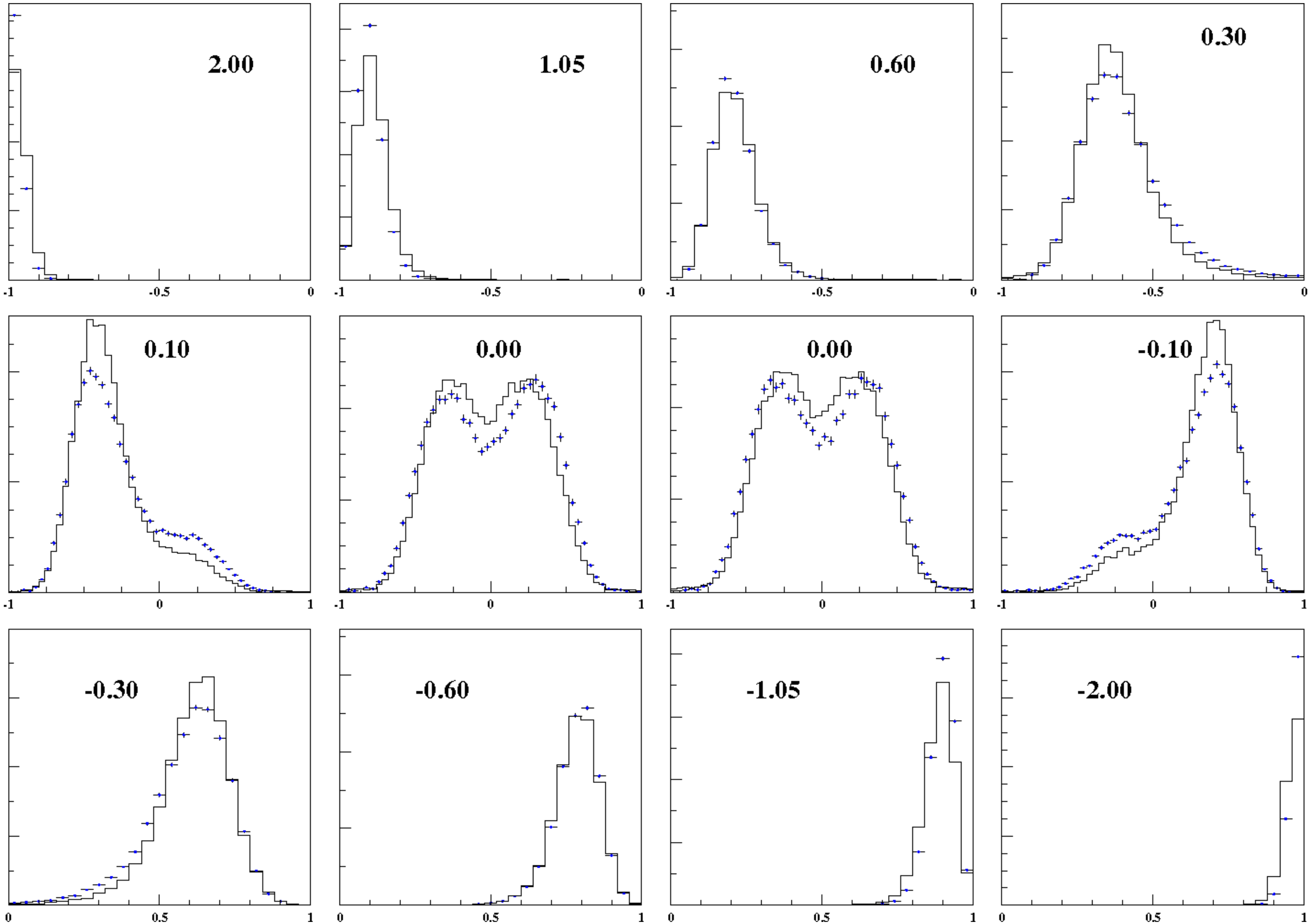
Vertex simulation: Compton angular distribution with/without e-beam effects



nominal (with e-beam effects, α=1.45, β=5621 cm, ϵ=3.67e-7 cm•mrad)

switched off (pure Compton angular distribution, no convolution with beam parameters)

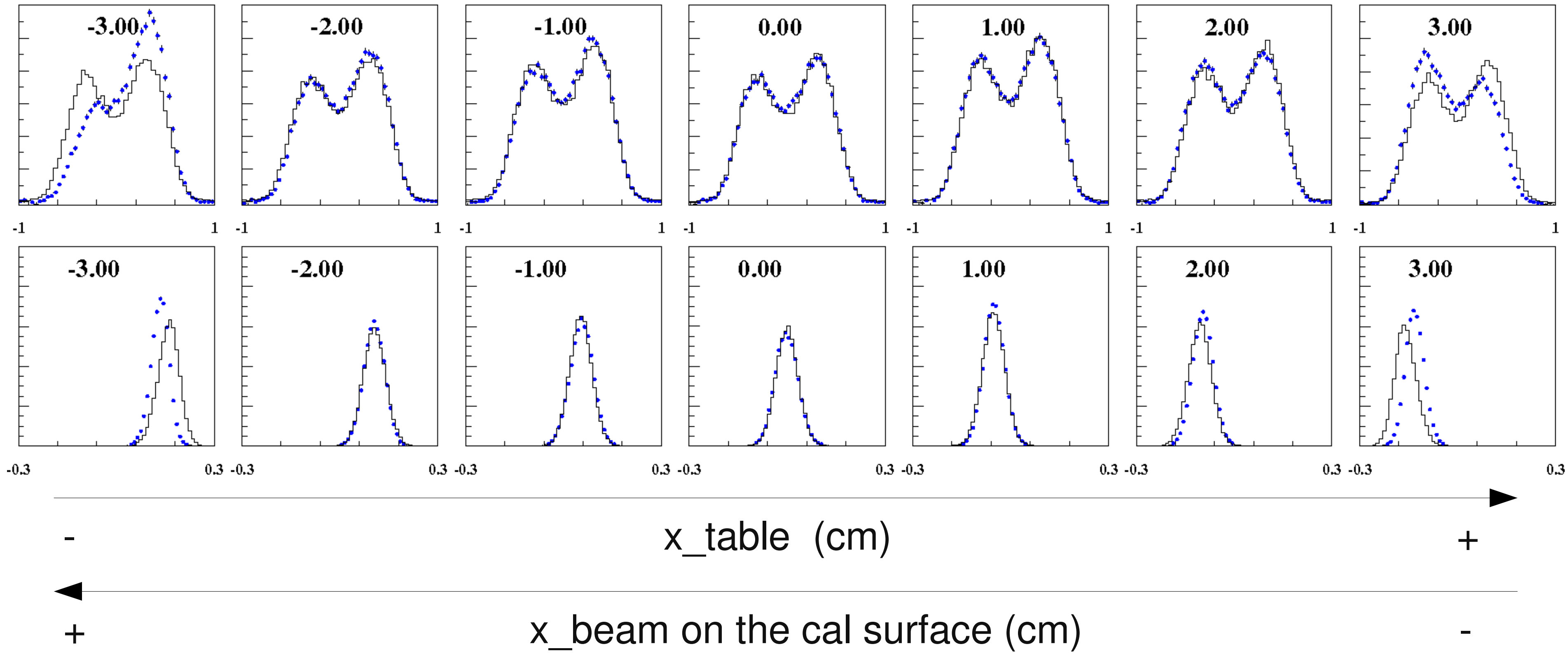
Vertex simulation without e-beam effects



data vs MC with pure Compton angular distributions

X table scan and SI position wrt. CAL (for table calibration)

Use X table scan data taken by Vahagn on 24 June 2007 (a week before HERA shutdown)



Check the angle between the cal and the silicon? (additional contribution to table calibration?)

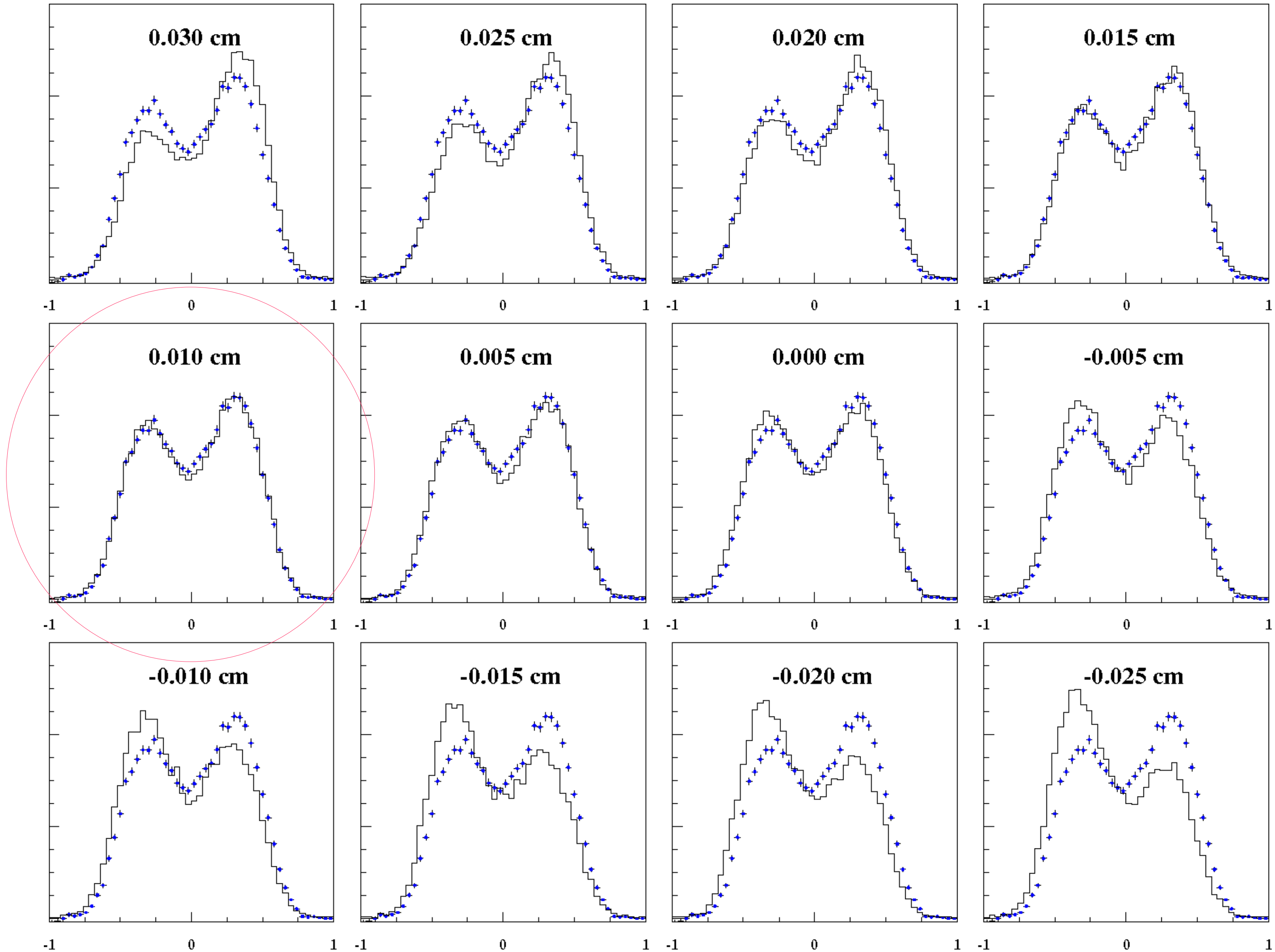
1) the cal wrt. the beam

-> measure from the η distributions at y=0 and different x

2) the silicon wrt. the beam

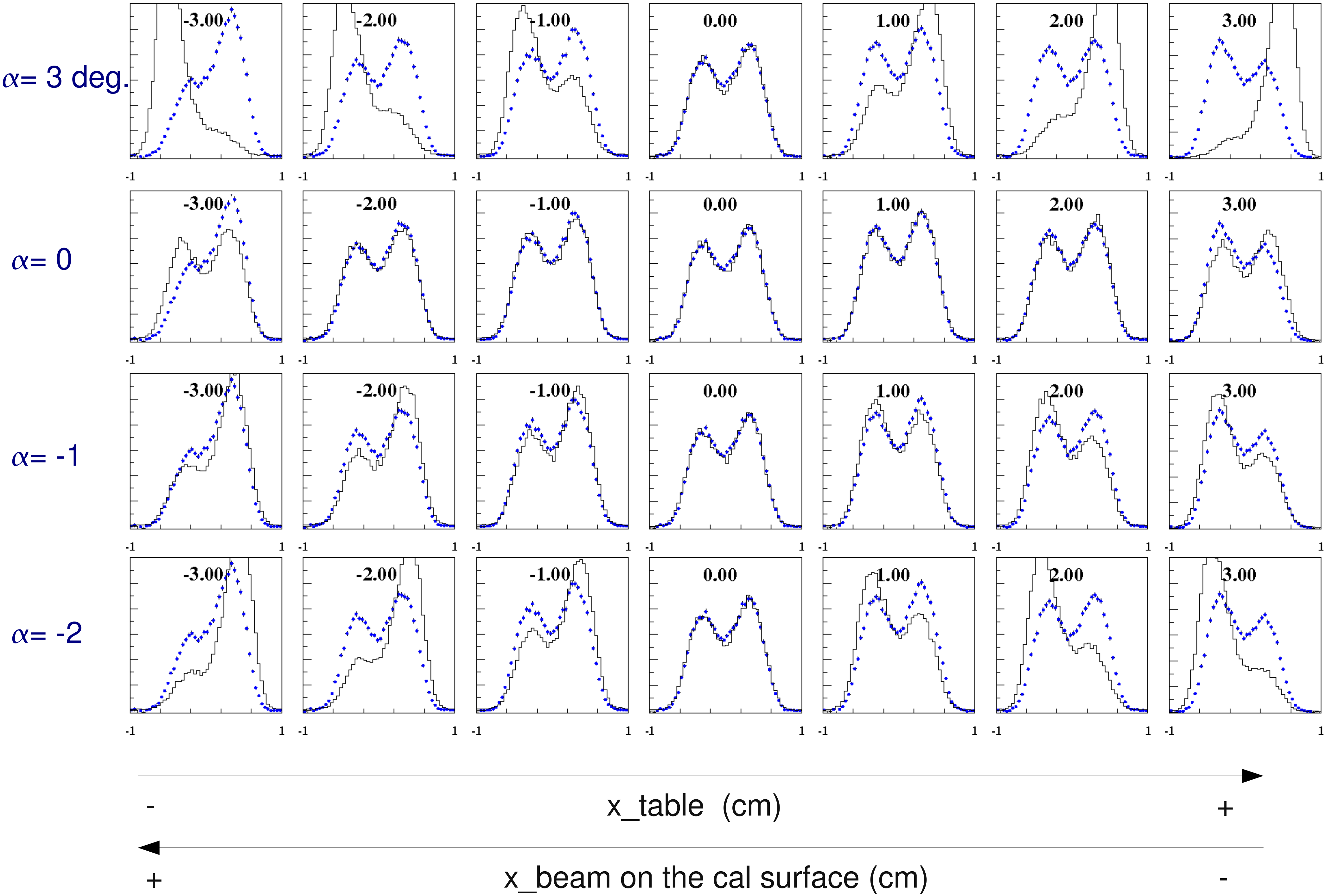
-> measure from fit to 2dim beam profile on the silicon surface

Intermezzo:



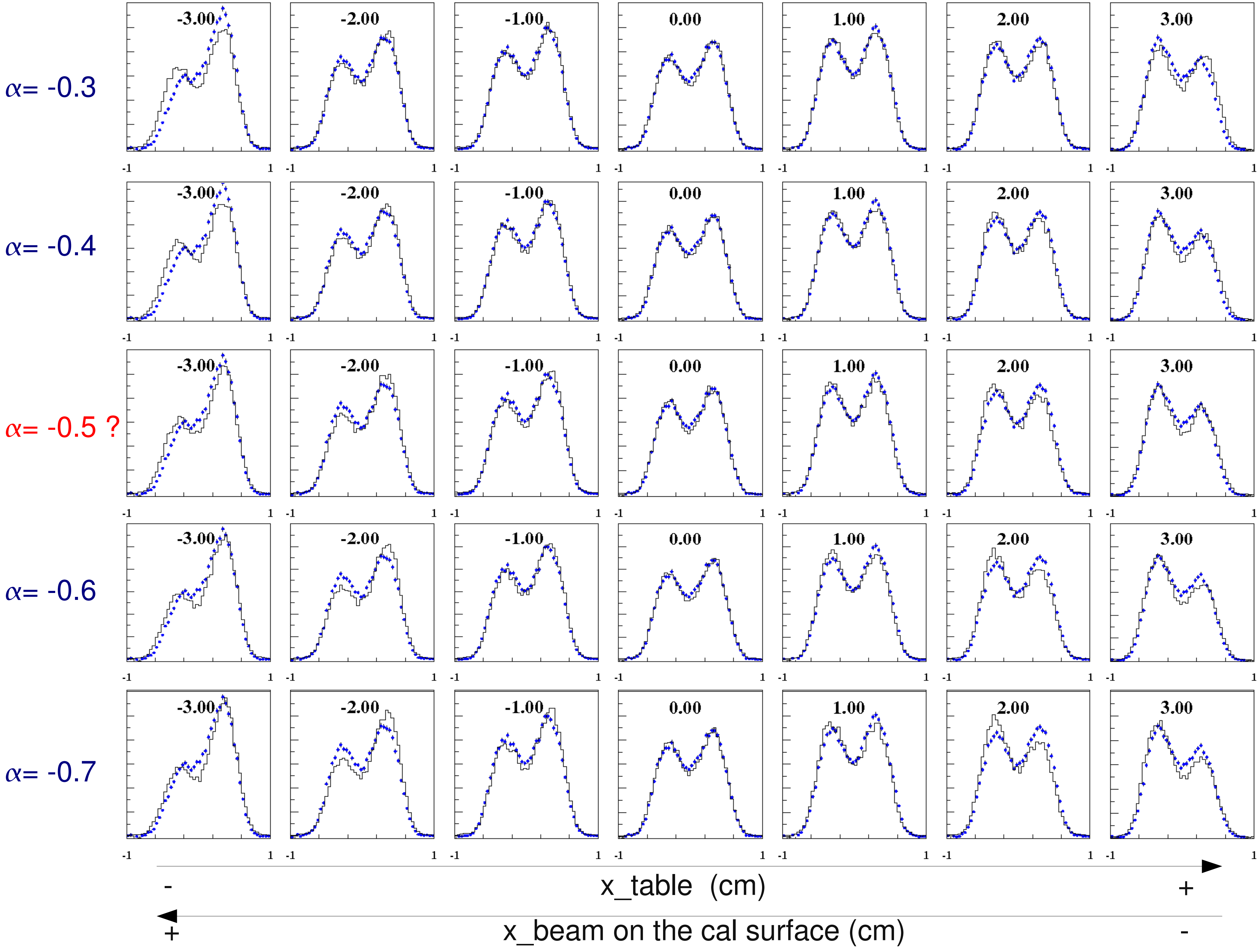
MC scan for different values of y_table at x_table=0

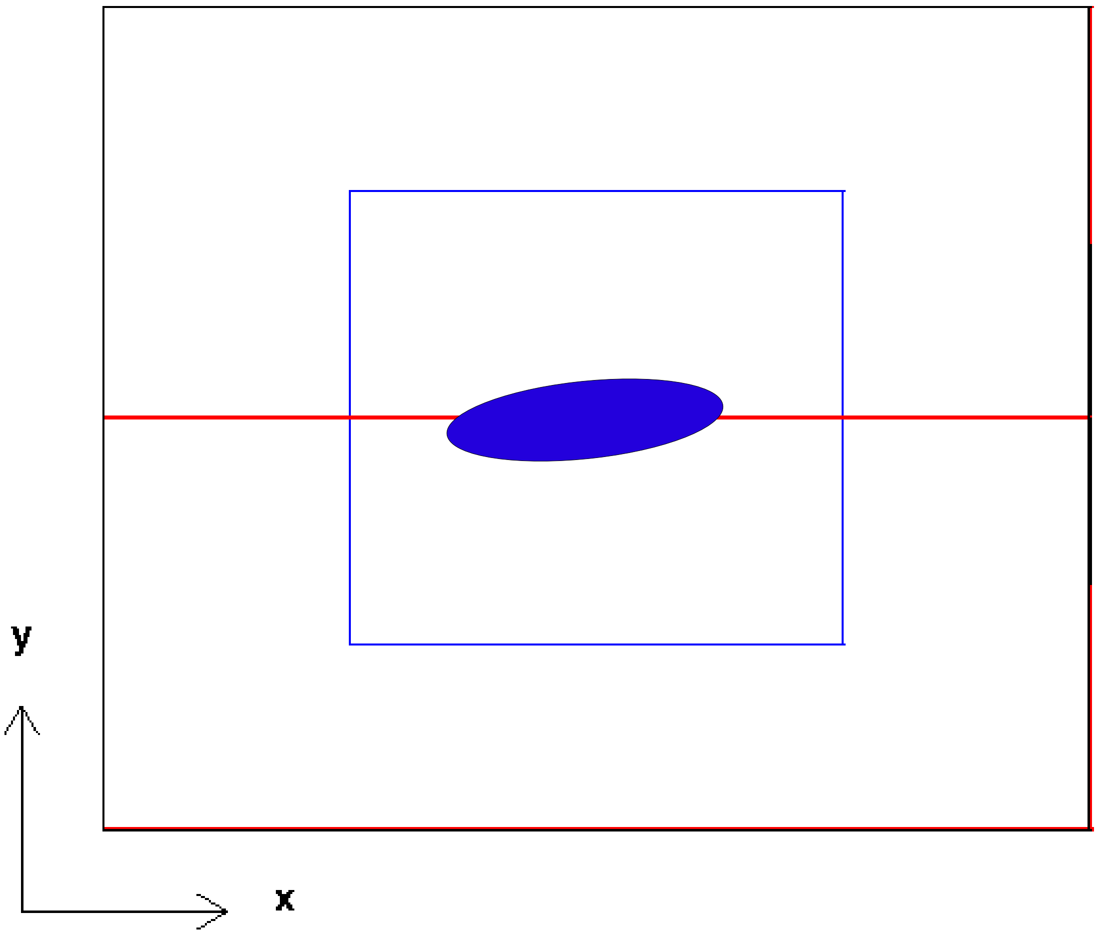
-> y_table shifted by 0.01 cm for this X table scan



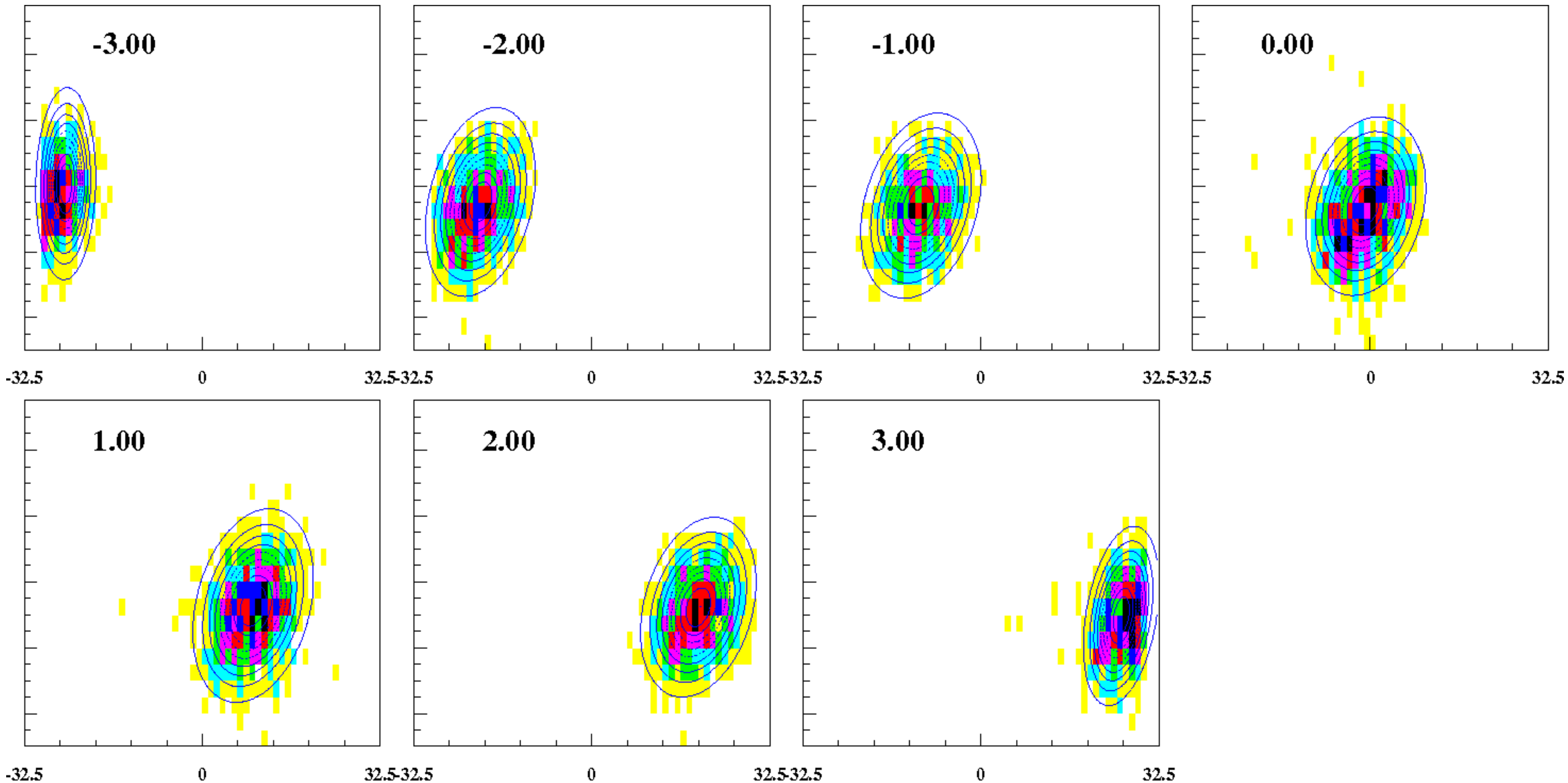
1) the cal wrt. the beam

y_table=0.01 cm (not centered)


α= -0.3
α= -0.4
α= -0.5 ?
α= -0.6
α= -0.7
-3.00
-2.00
-1.00
0.00
1.00
2.00
3.00
-1
1
x_table (cm)
-
+
x_beam on the cal surface (cm)
+
-



the cal -0.5 deg. wrt. the beam
(the beam +0.5 deg. wrt. the cal)

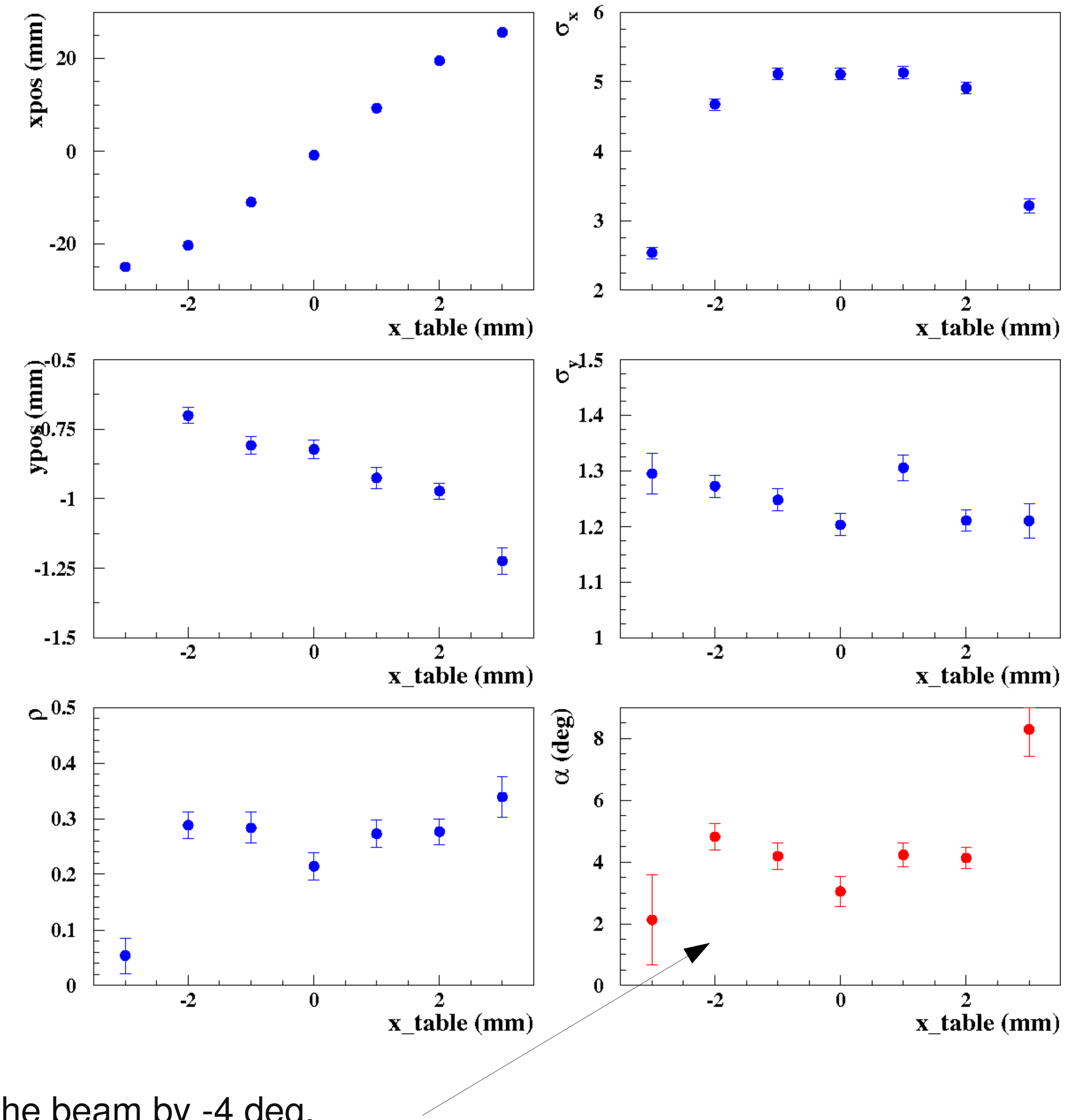


Y vs X silicon at different x_table (cm)
(following Blanka's online simon fits)

y_table=0.01 cm

2) the silicon wrt. the beam

Results of the 2-dim fit



the silicon rotated wrt. the beam by -4 deg.

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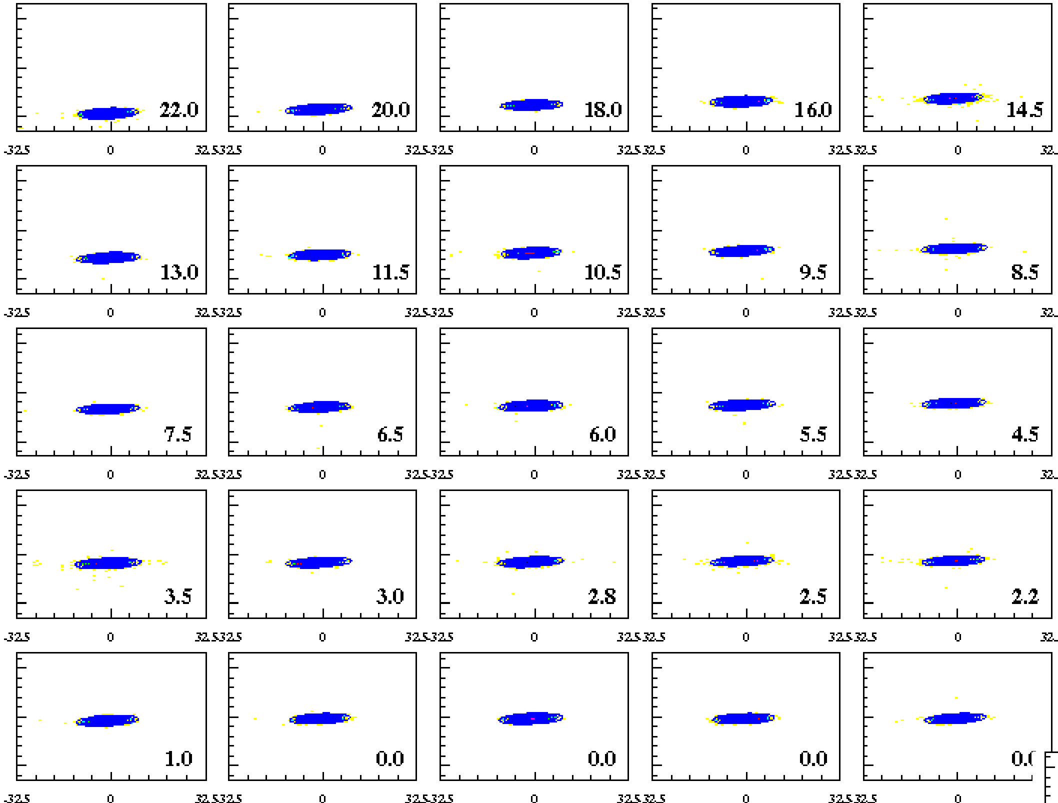
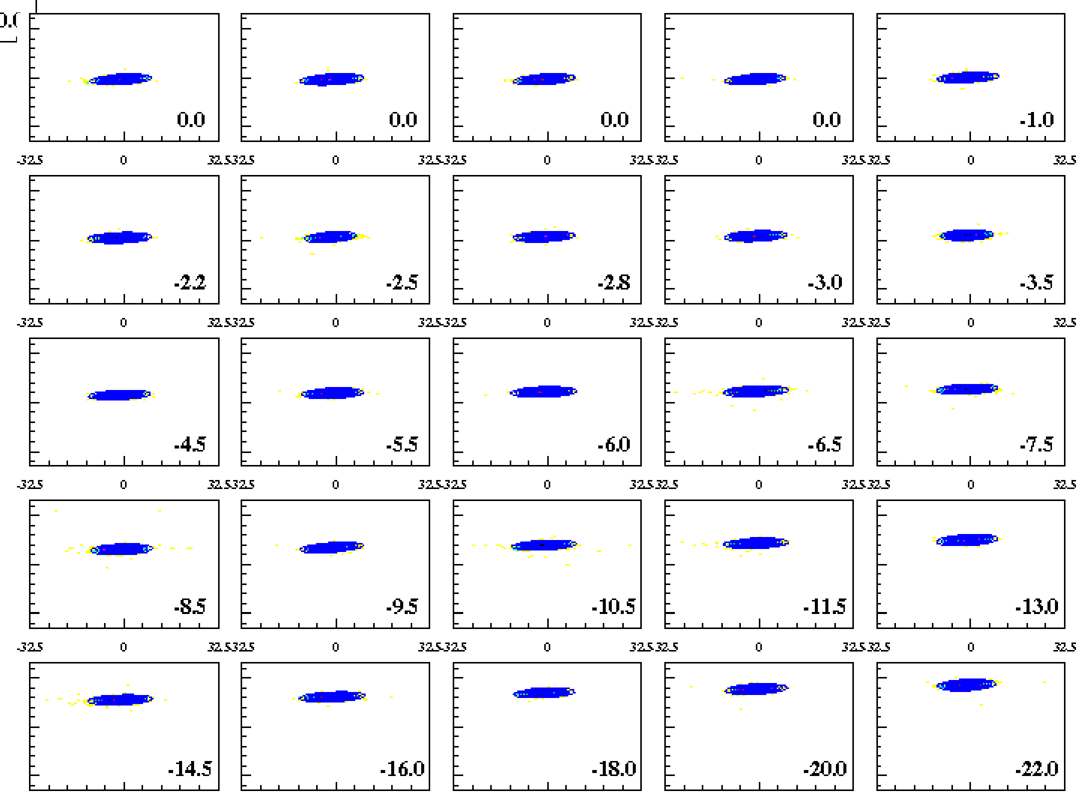
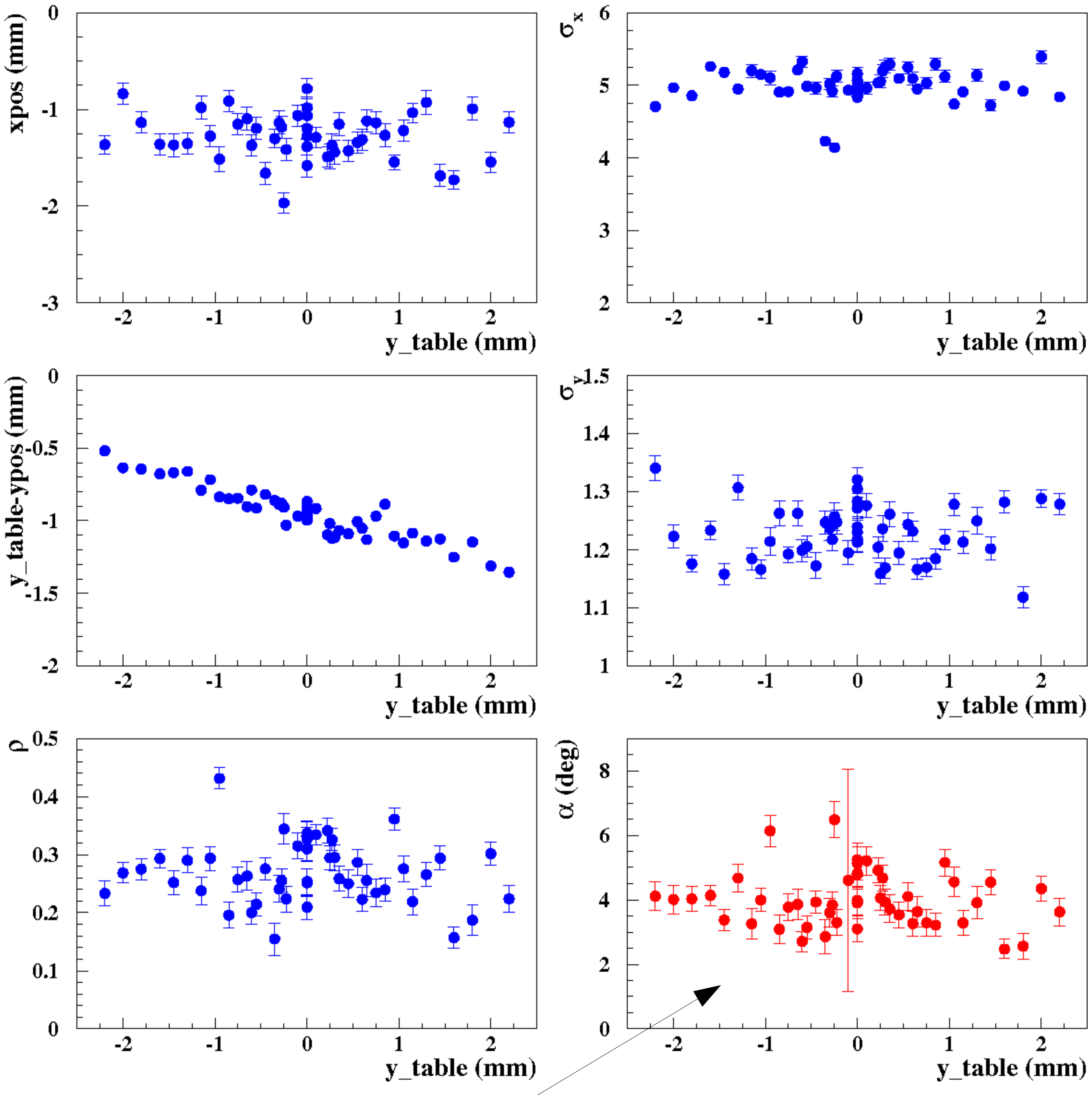




Y vs X silicon at different y_table (cm)

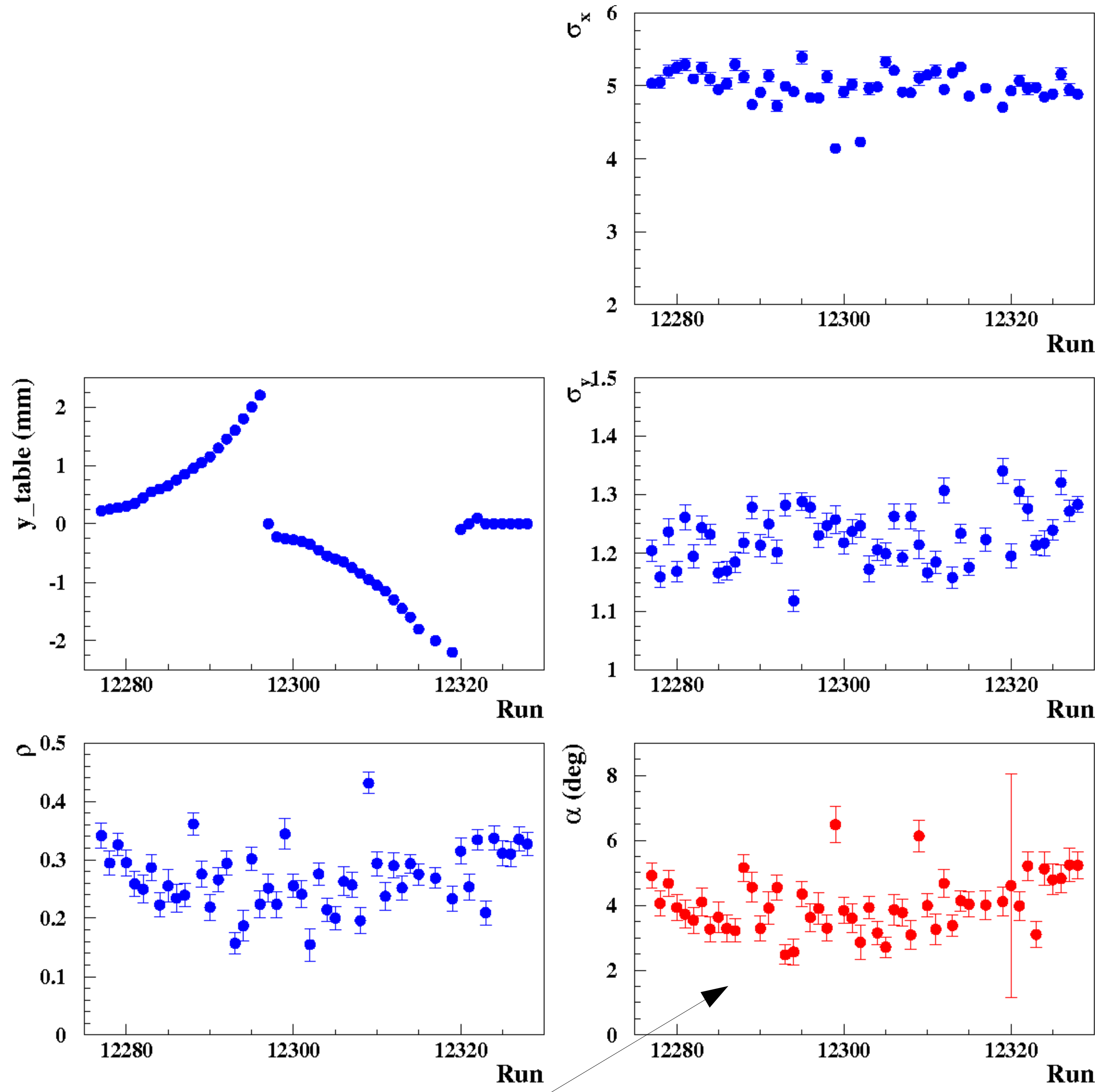
x_table=0 cm

Results of the 2-dim fit



the silicon rotated wrt. the beam by -4 deg.

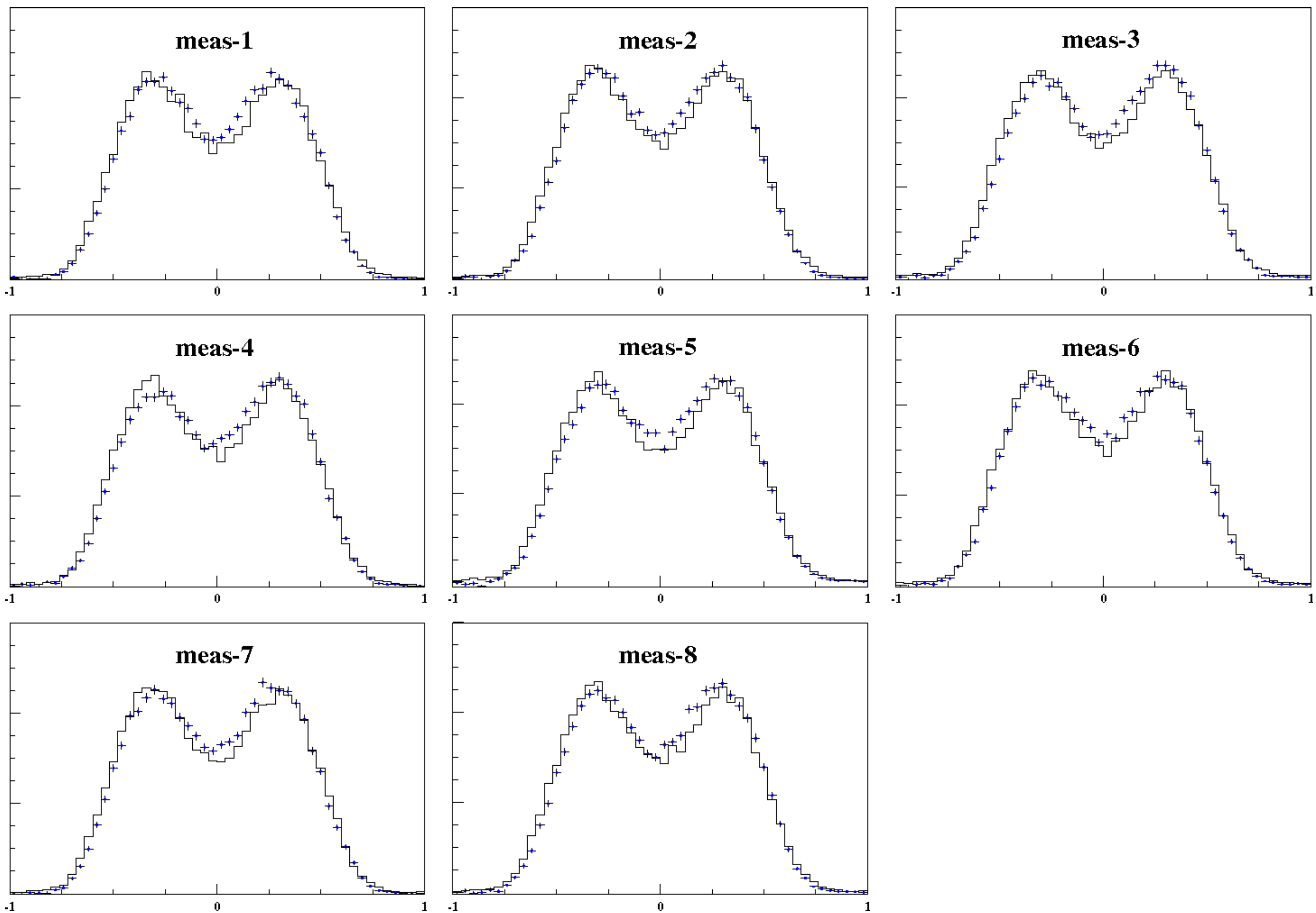
Results of the 2-dim fit

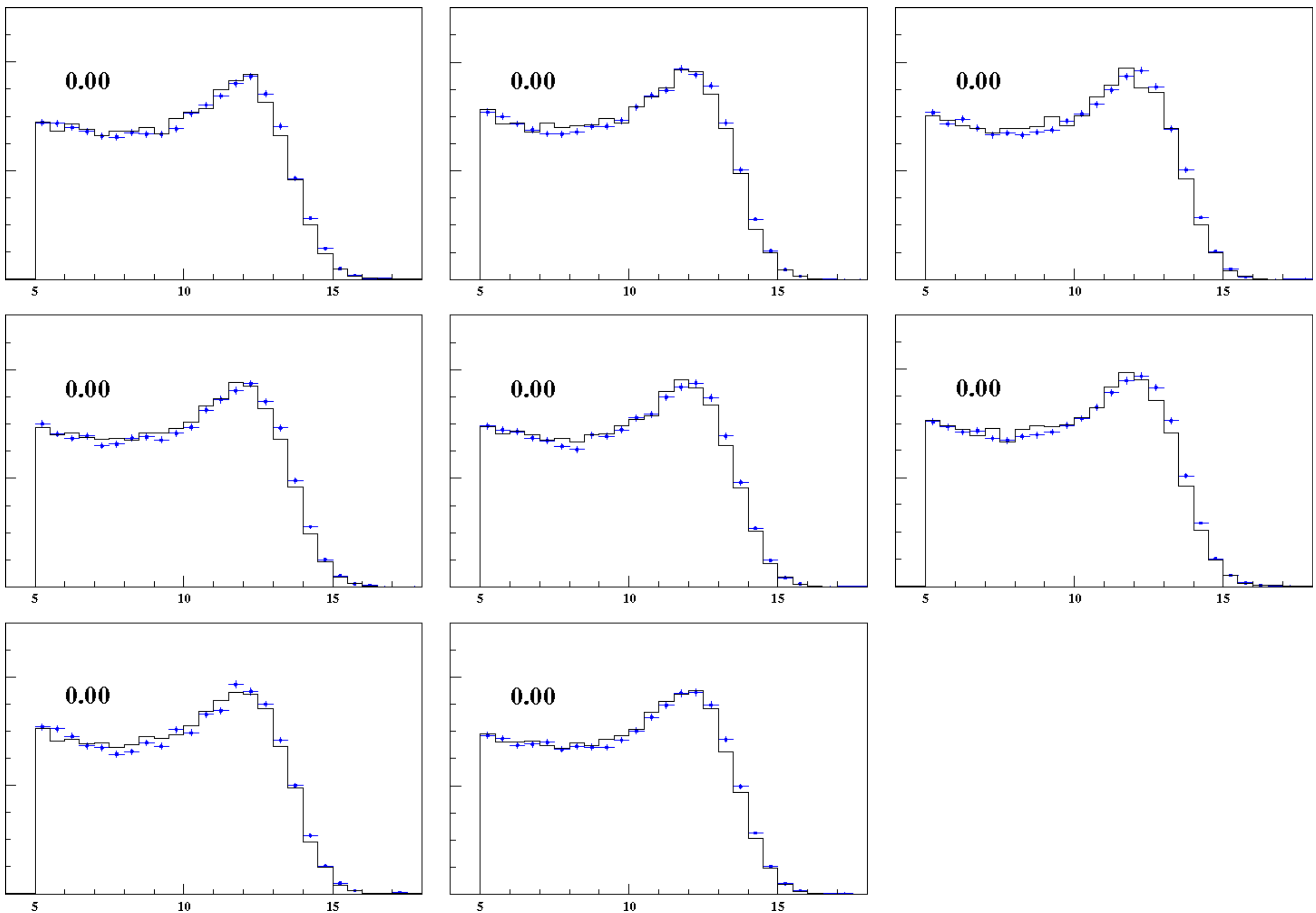


the silicon rotated wrt. the beam by -4 deg.

the beam simulation and the beam spot at SI

8 runs at x_table=y_table=0 -> look at beam spot at SI




0.00
5
10
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0.00
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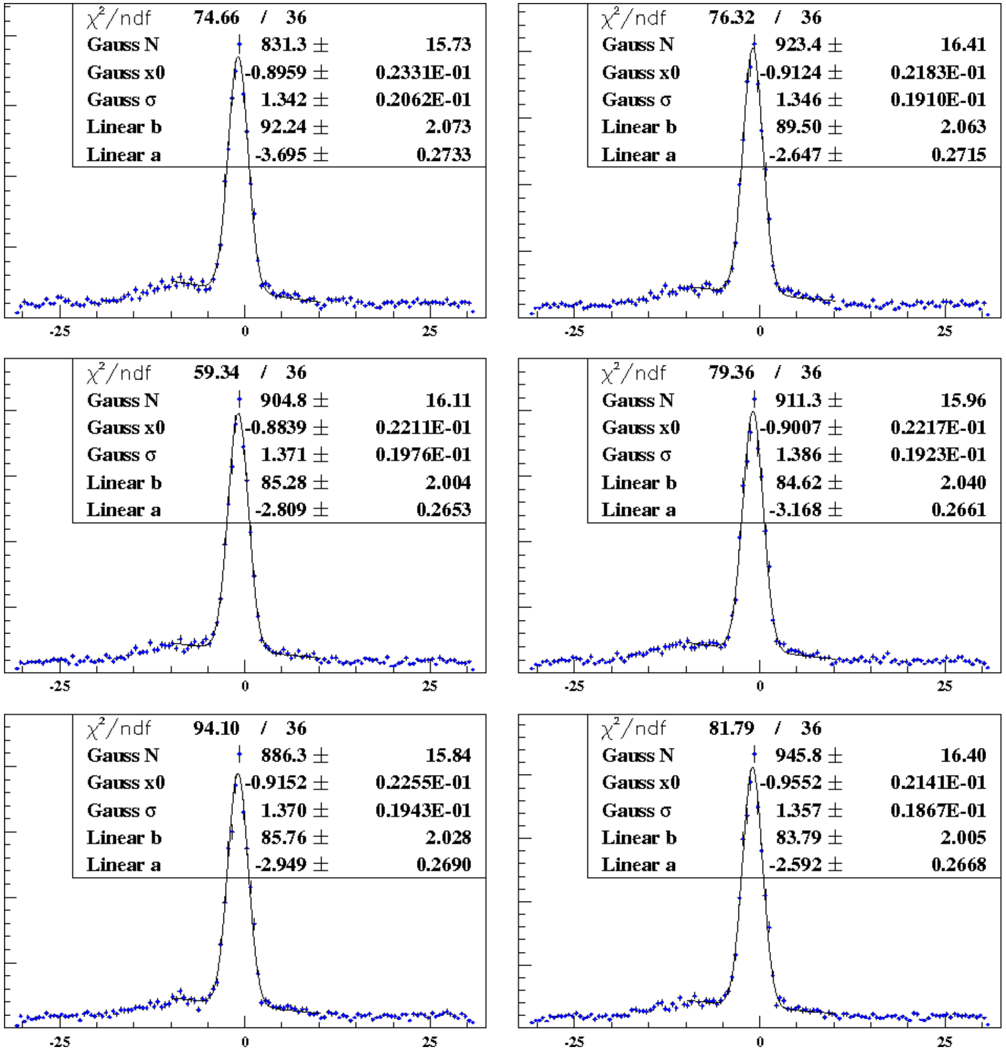
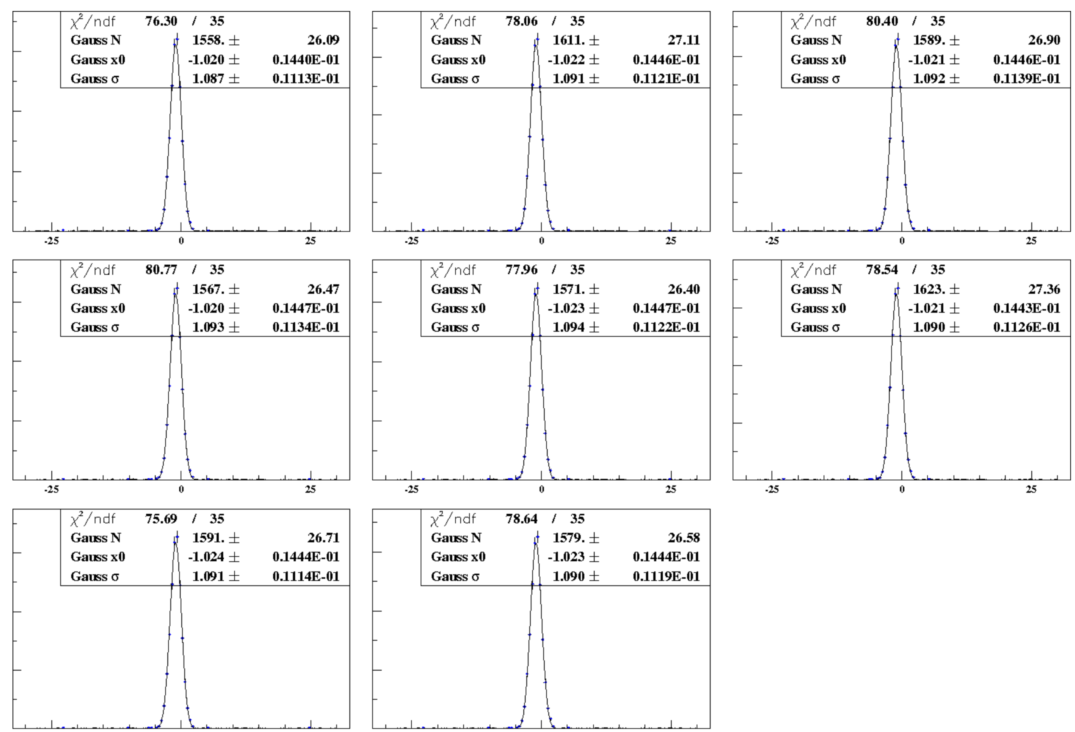
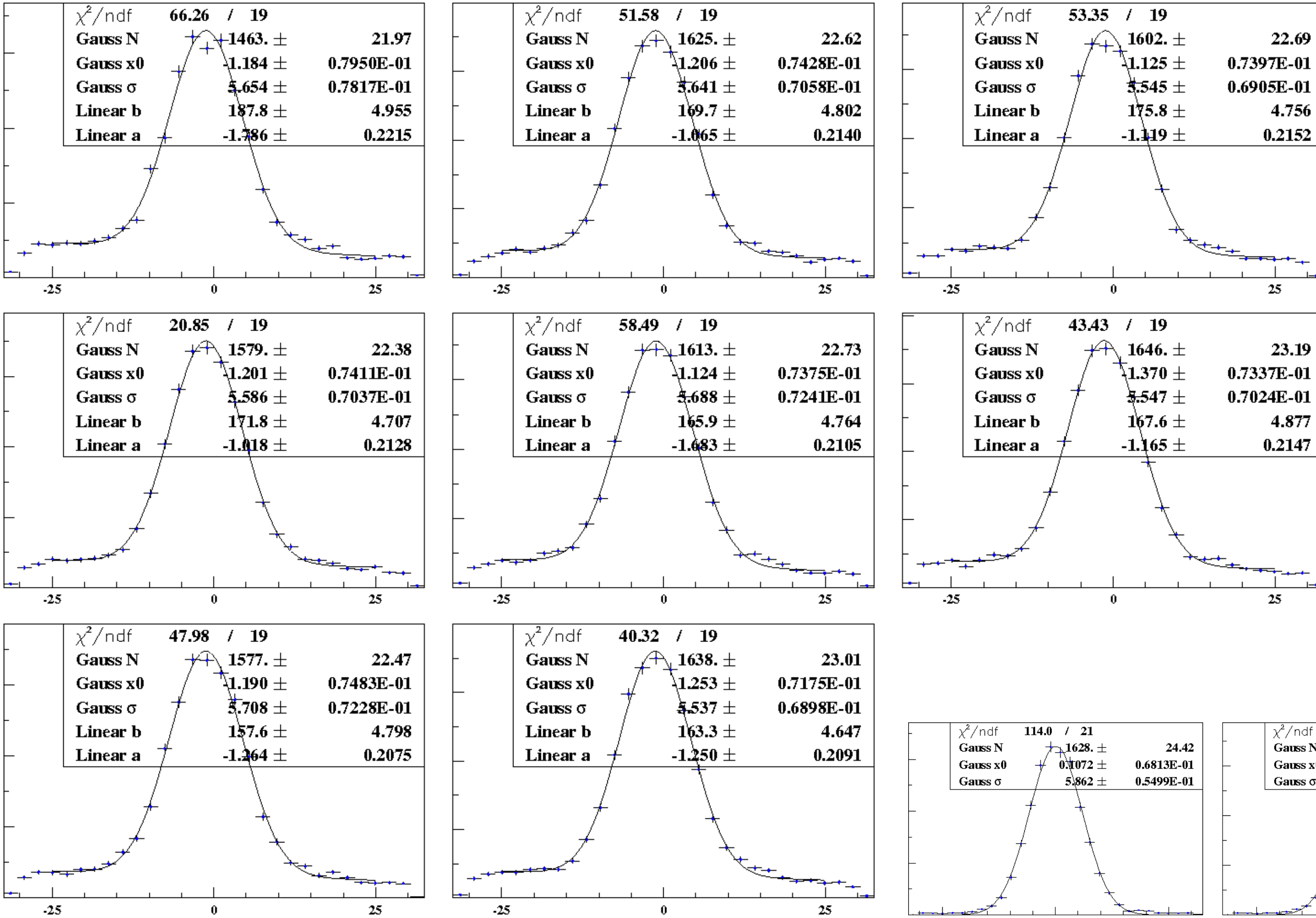
15
0.00
5
10
15

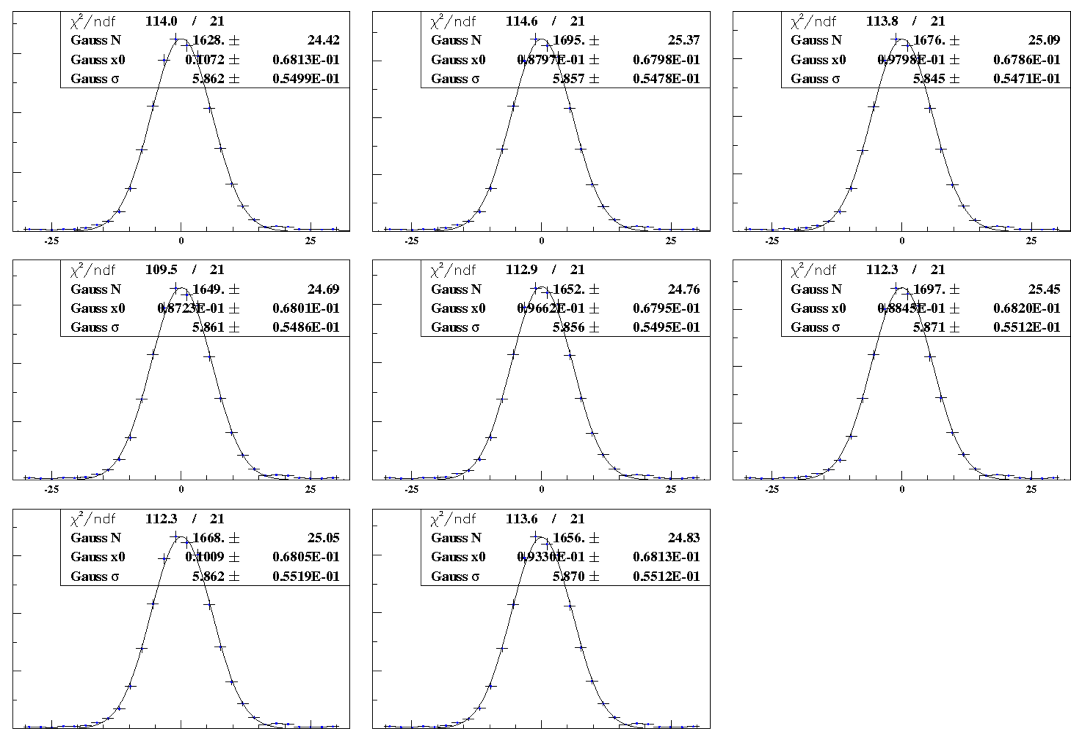


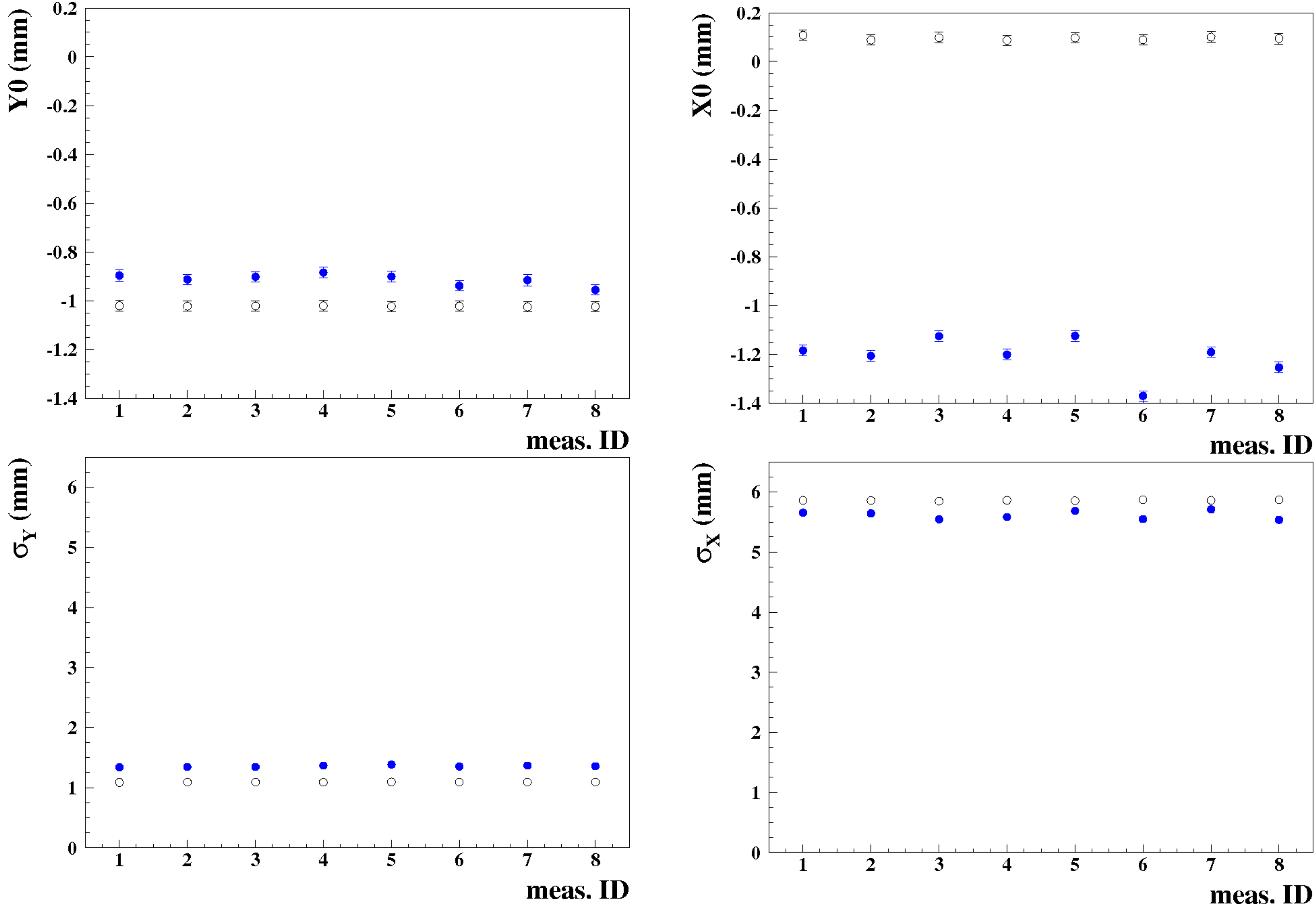


Y silicon   data vs MC



X silicon data vs MC





blue – data, black – MC for 8 runs at x_table=y_table=0

Beam spot at SI vs beam parameters

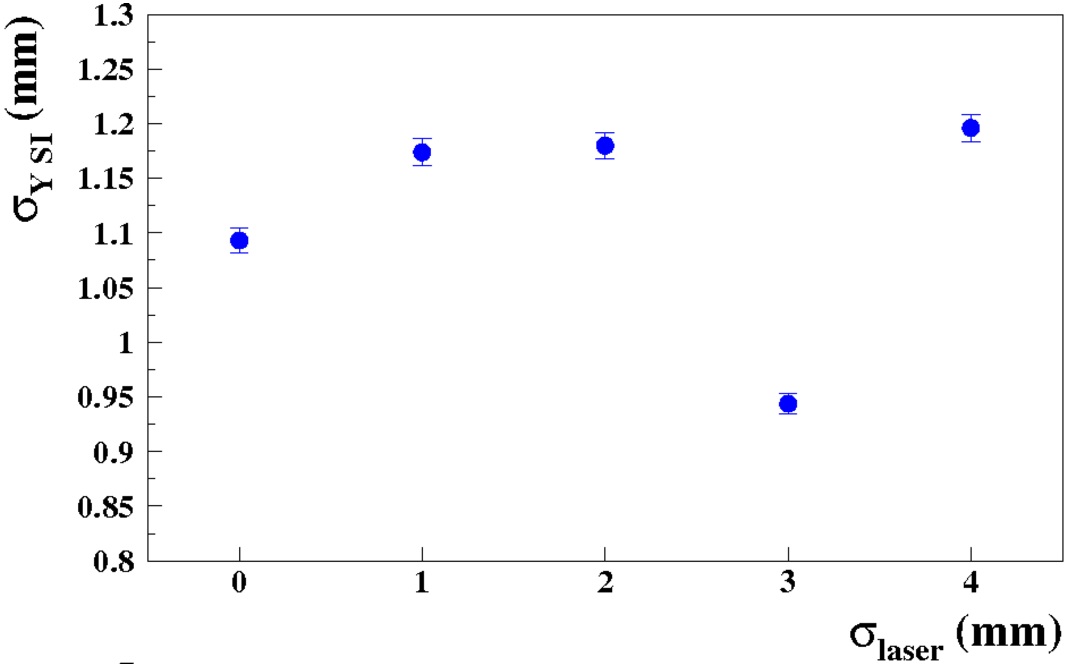
0) Y: α= 1.45, β=5621 cm, ϵ=3.6E-7 cm*rad
X: α=-0.41, β=848 cm, ϵ=5.4E-6 cm*rad

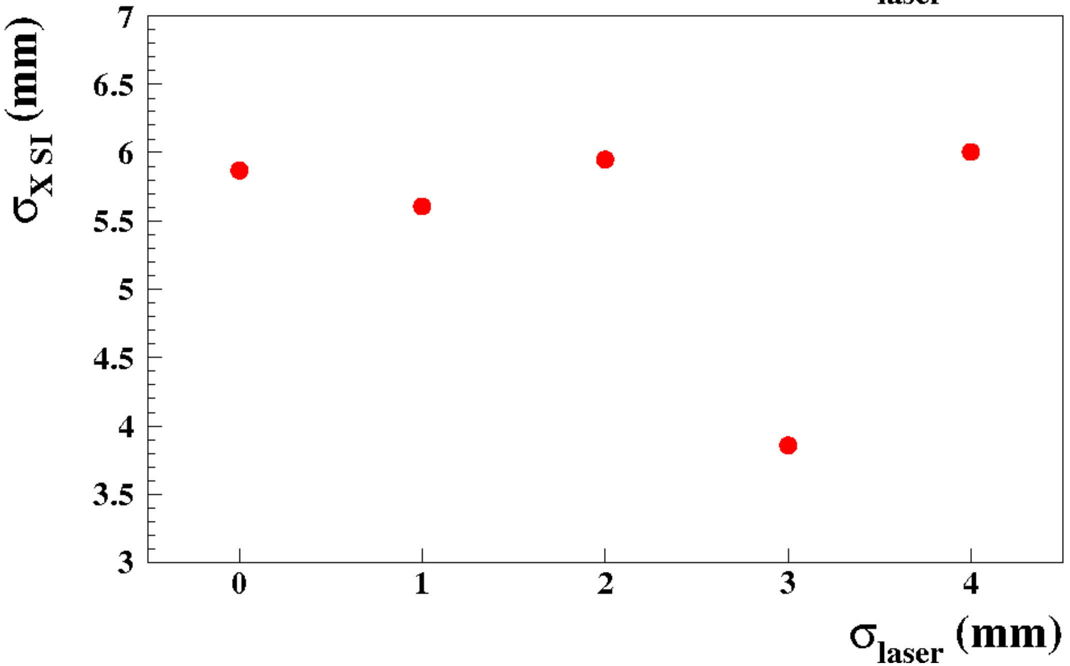
1) Y: α= 1.45, β=5621 cm, ϵ=5.6E-7 cm*rad
X: α=-0.41, β=848 cm, ϵ=4.7E-6 cm*rad

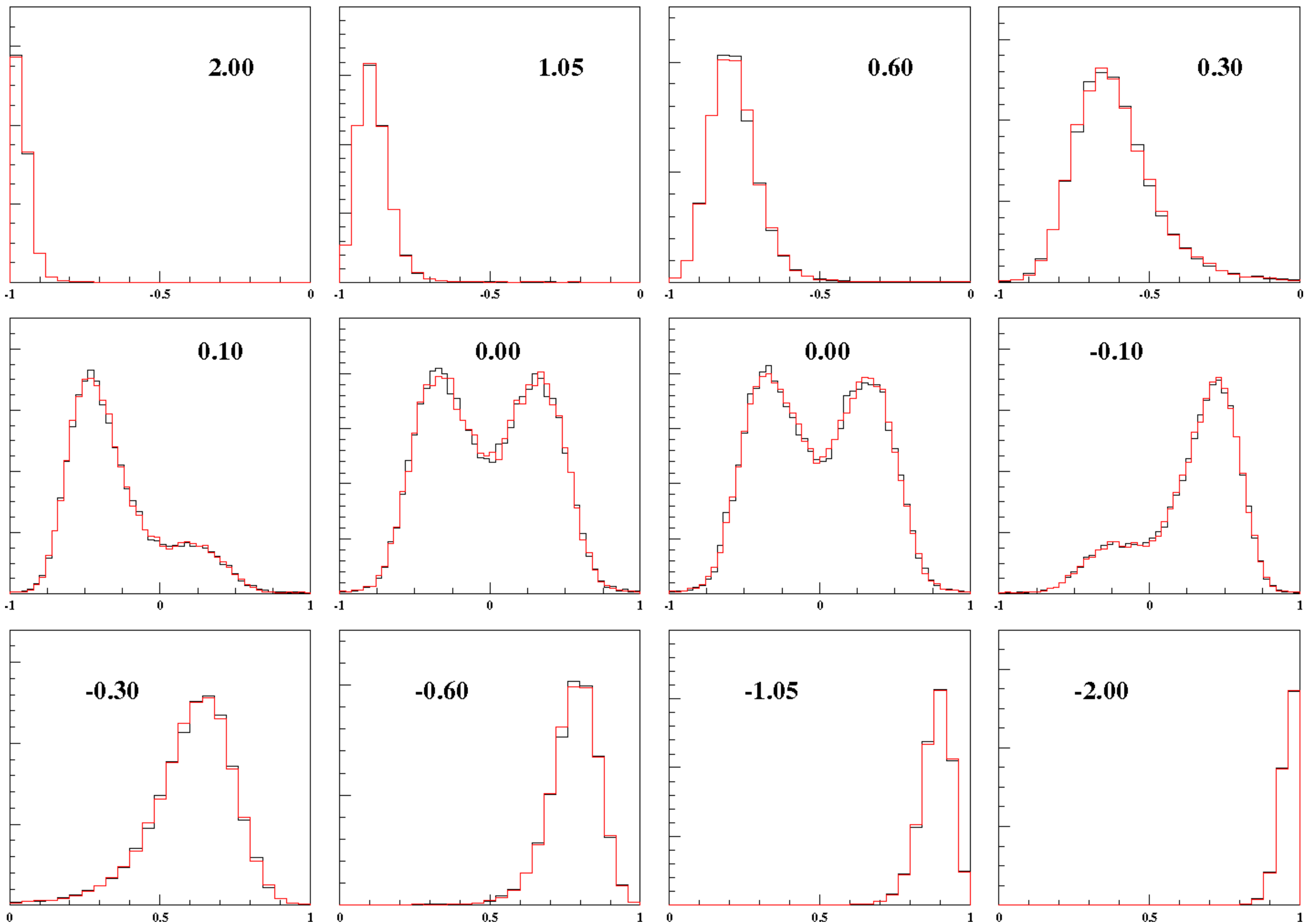
2) Y: α= 1.39, β=4674 cm, ϵ=4.3E-7 cm*rad
X: α=-0.10, β=922 cm, ϵ=6.3E-6 cm*rad

3) Y: α= 0.68, β=4340 cm, ϵ=1.2E-7 cm*rad
X: α=-0.04, β=1480 cm, ϵ=4.0E-6 cm*rad

4) Y: α= 0.68, β=4340 cm, ϵ=5.8E-7 cm*rad
X: α=-0.04, β=1480 cm, ϵ=9.9E-6 cm*rad

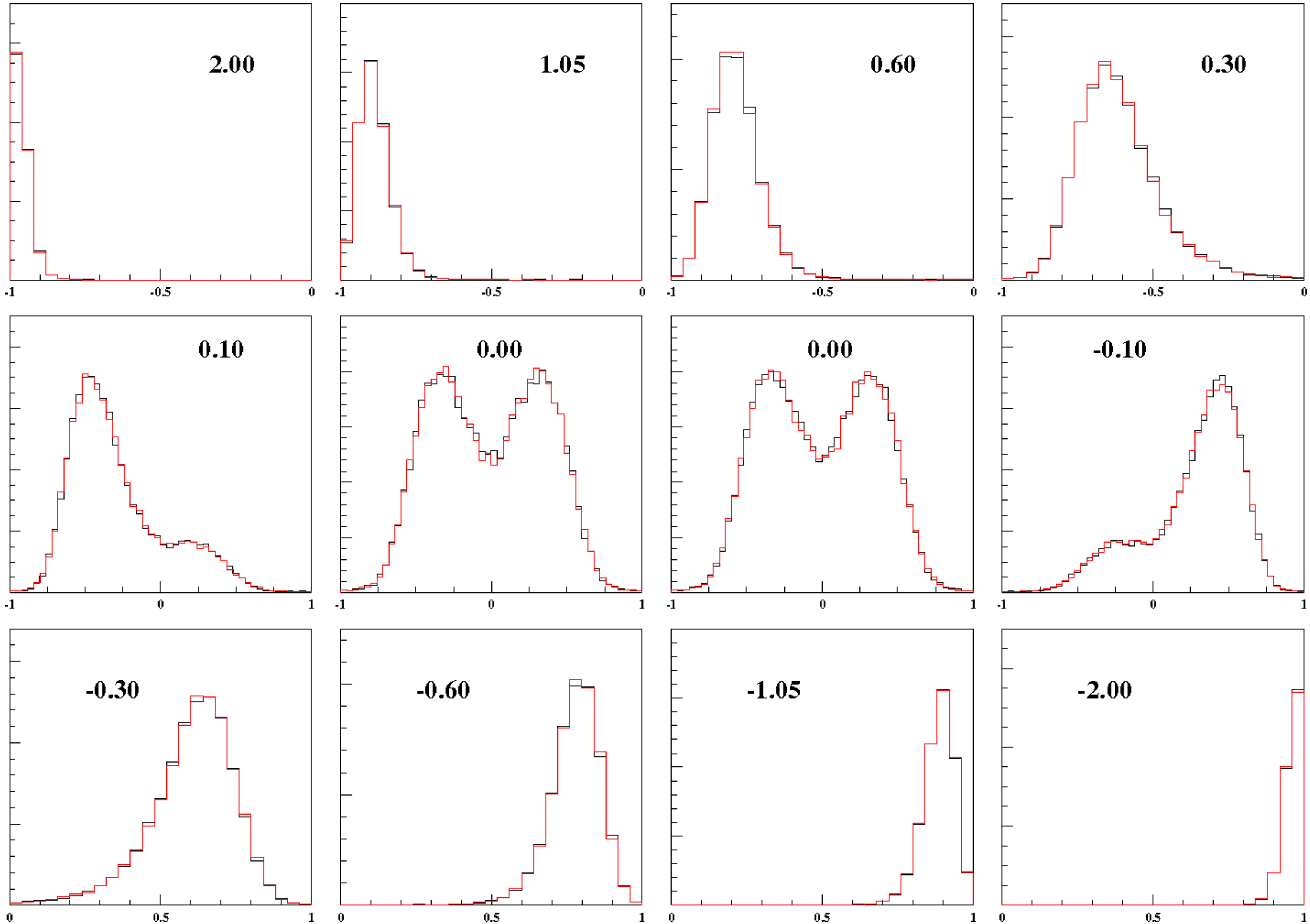






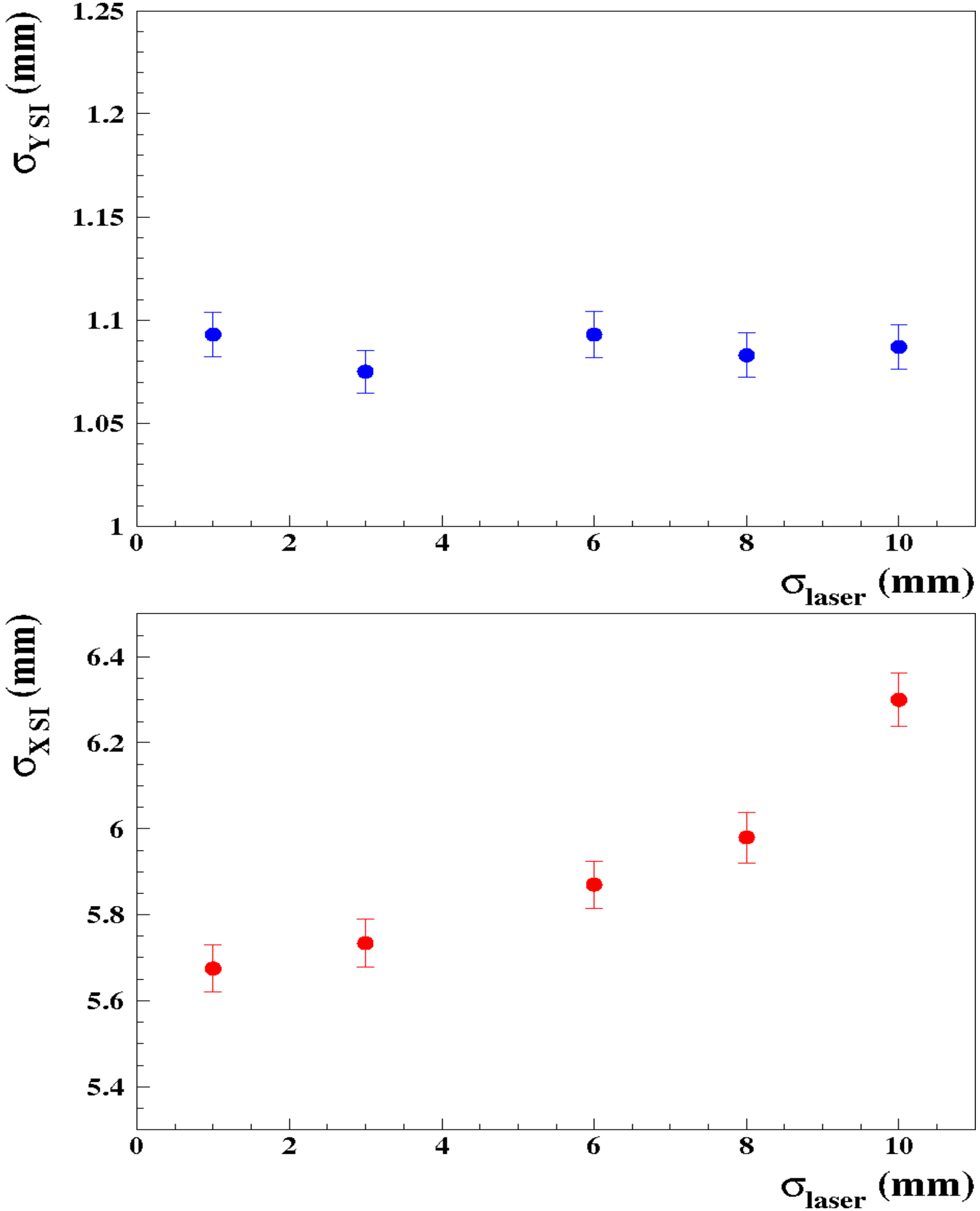
1) α= 1.45, β=5621 cm, ϵ=5.6E-7 cm*rad

2) α= 1.39, β=4674 cm, ϵ=4.3E-7 cm*rad

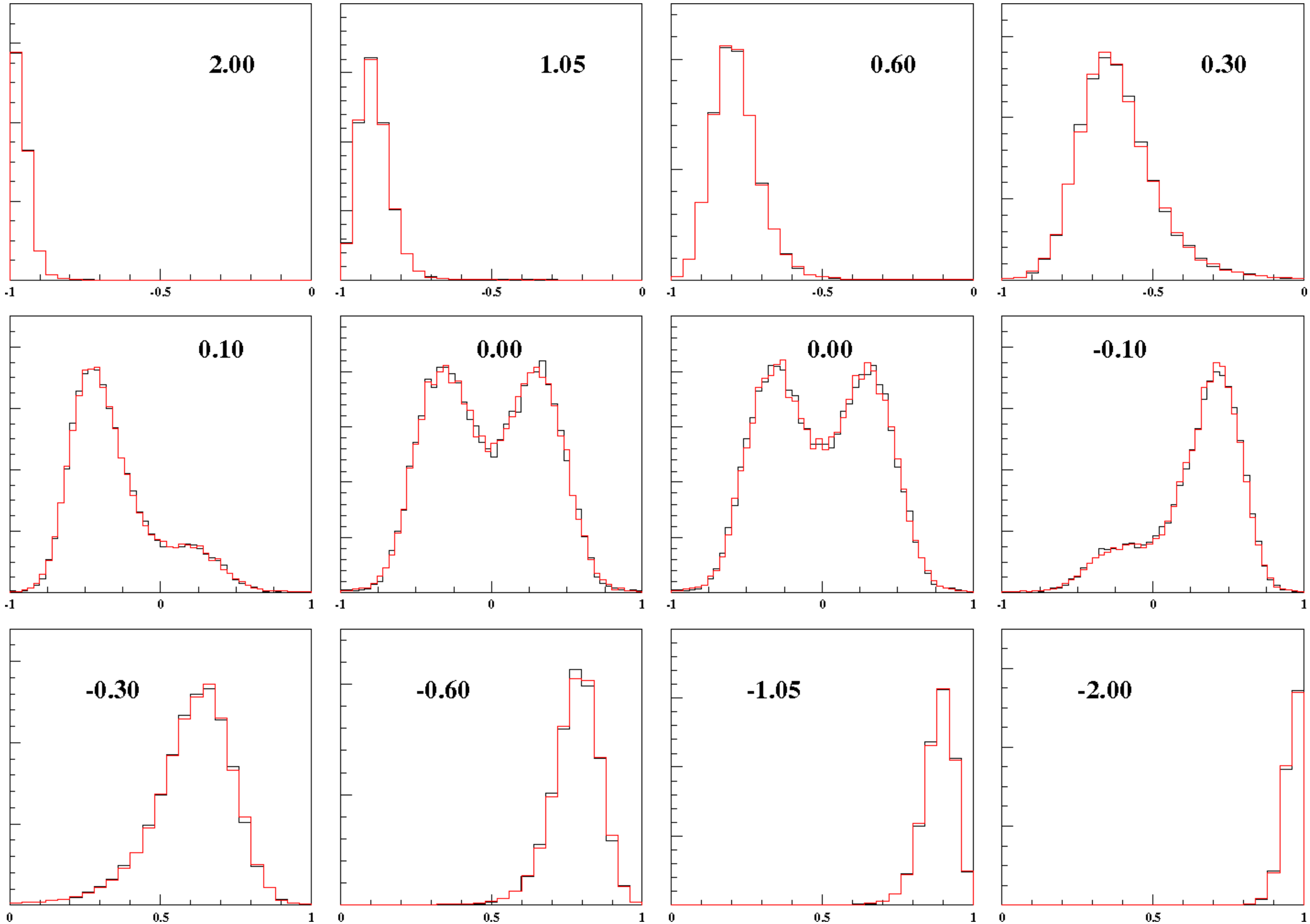


2) α= 1.39, β=4674 cm, ϵ=4.3E-7 cm*rad

4) α= 0.68, β=4340 cm, ϵ=5.8E-7 cm*rad



$\sigma_{Y\,SI}$ (mm)
1.25
1.2
1.15
1.1
1.05
1
0
2
4
6
8
10
σ_{laser} (mm)
$\sigma_{X\,SI}$ (mm)
6.4
6.2
6
5.8
5.6
5.4
0
2
4
6
8
10
σ_{laser} (mm)



σ laser = 1.0 mm

σ laser = 0.1 mm

influence from laser beam size negligible in Y plane