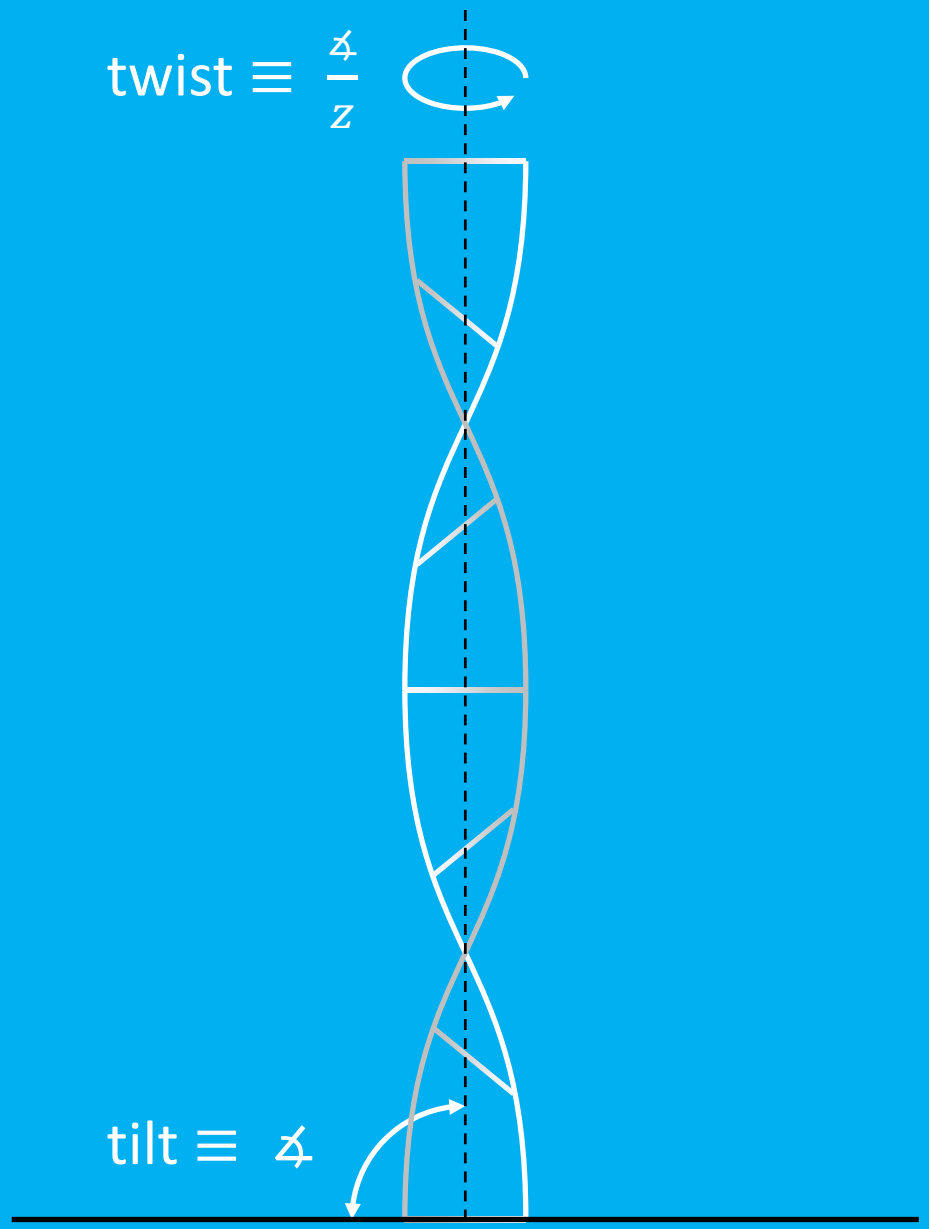
Fitting AHRS data

M. de Jong

String

- orientation of optical module
  - measured by AHRS or LSM device
    - yaw, pitch and roll
  - related through string mechanics
    - tilt
    - twist



Data

- Download AHRS data from database table “ahrs”
  - organise data per string
  - select data within predefined period (10 mins)
- Convert AHRS data to (yaw, pitch, roll)
  - apply AHRS calibration data from database table “ahrscalib”
- Convert (yaw, pitch, roll) to quaternion
  - implies definitions of signs¶

¶ The following procedures can work but may yield wrong values.

Model

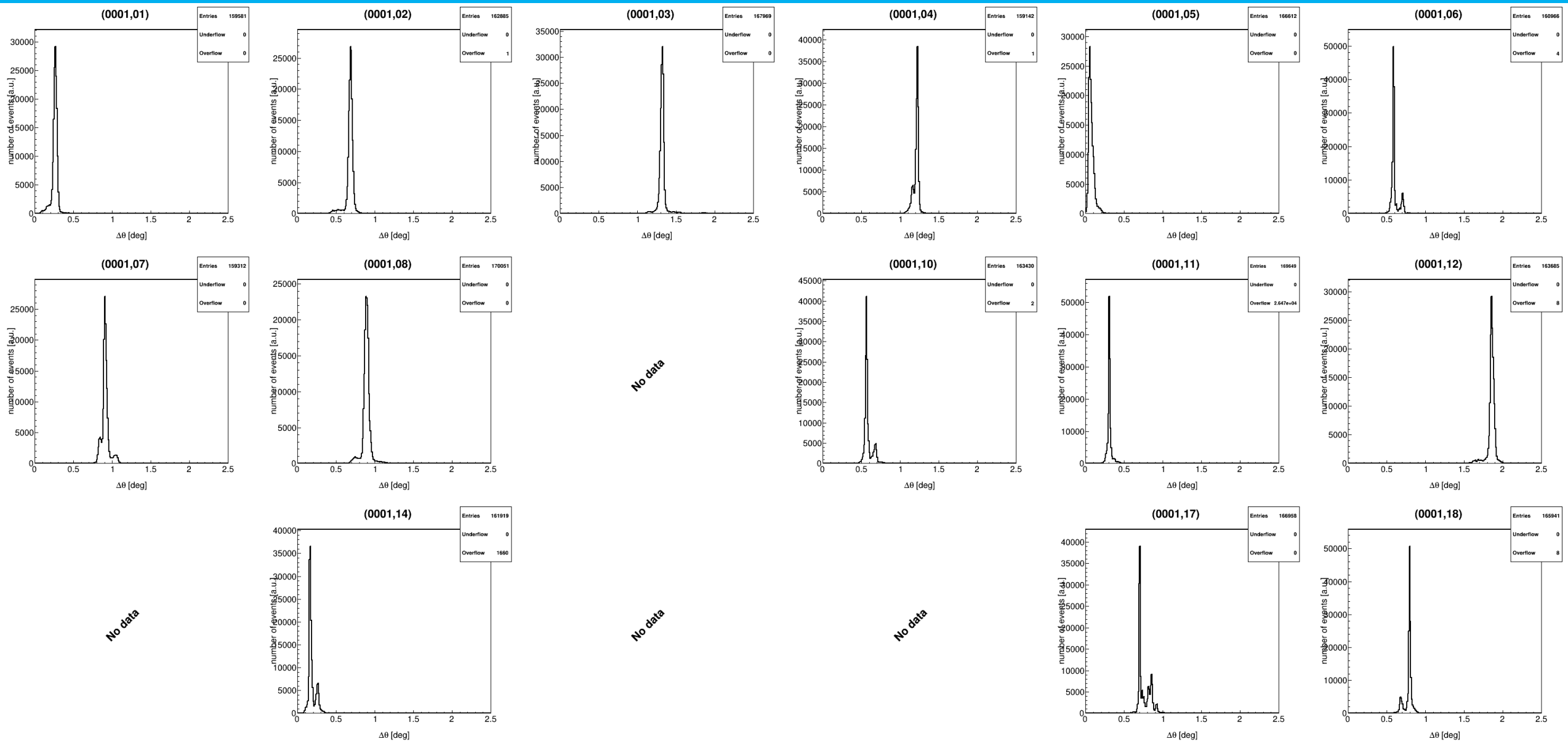
- Orientation of floor i at height z_i is defined as
  - $Q_i = Q_0 Q_1^{z_i}$
    - $Q_0 \Rightarrow$ tilt of the string
    - $Q_1 \Rightarrow$ twist of string

Fit

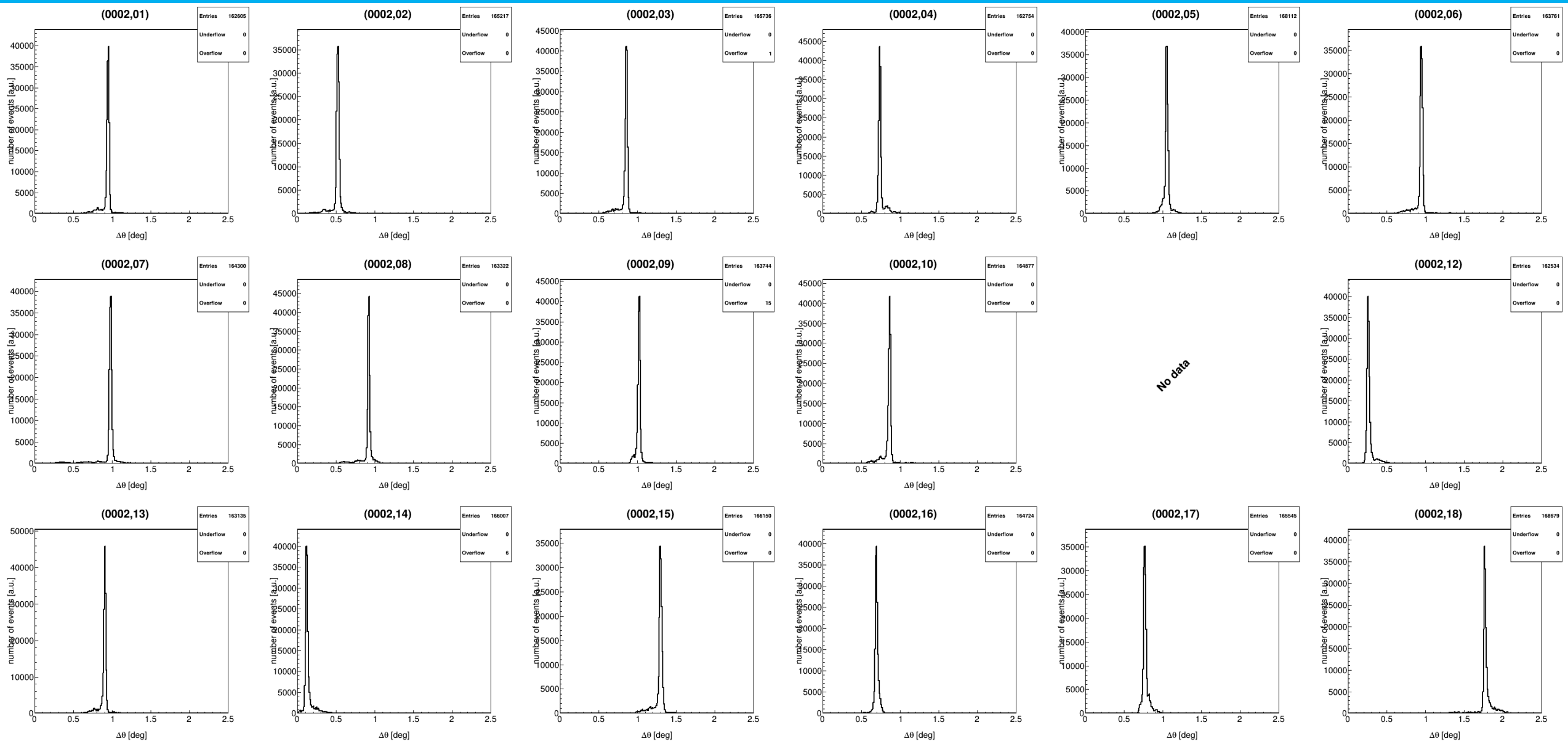
- Metric
  - geodesic distance between two quaternions
- Resolution (for χ^2 evaluation)
  - $\sigma \equiv 1°$
- Minimiser
  - JSimplex works out-of-the-box
    - step corresponds to multiplication $\quad \mathrm{Q} \pm \Delta Q \quad \Rightarrow \quad Q\ \Delta Q^{\pm 1}$
    - scaling corresponds to power $\quad \mathrm{Q} \times y \quad \Rightarrow \quad Q^{y}$

Tilt

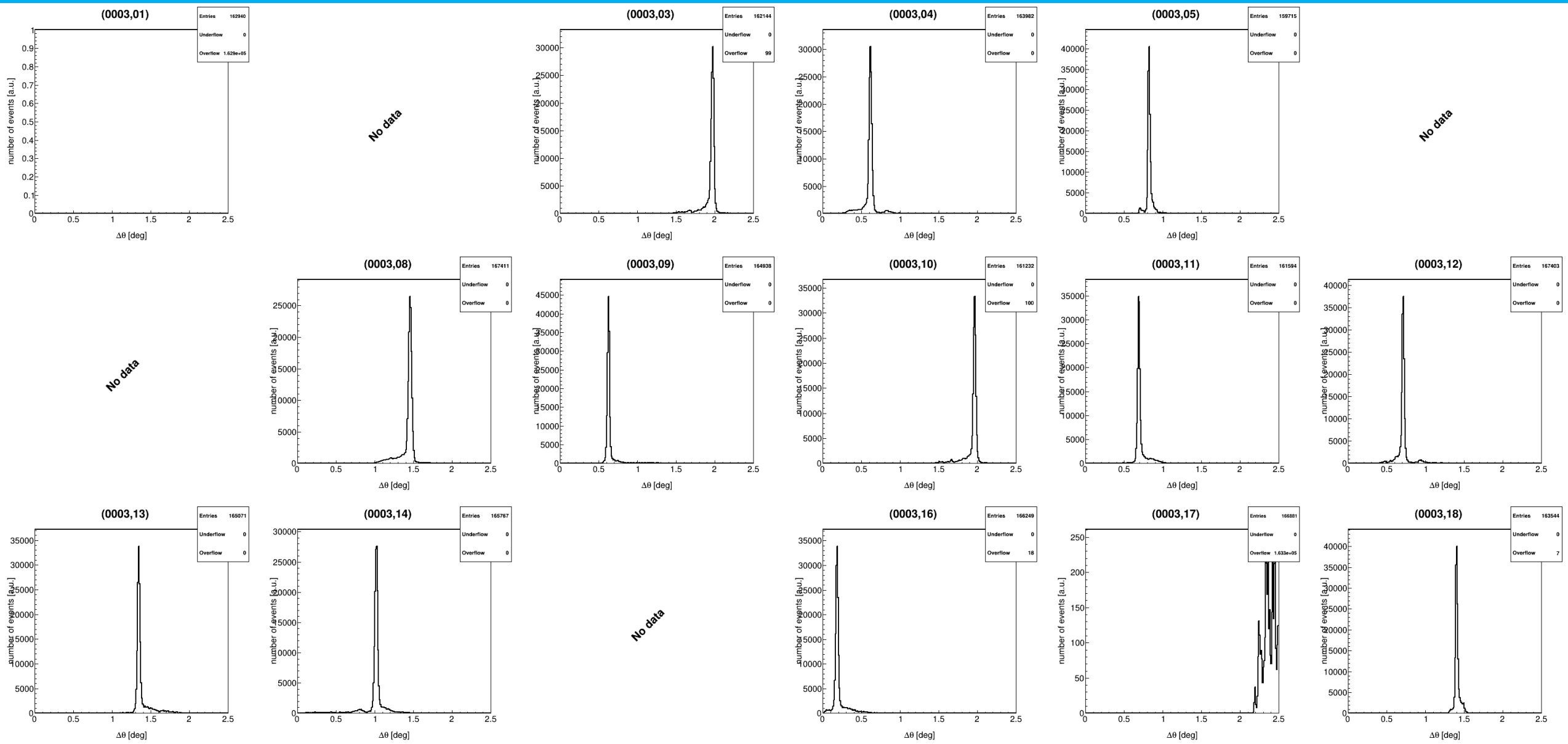
(detector 49 / runs 8000-8100)


(0001,01)
Entries 159581
Underflow 0
Overflow 0
(0001,02)
Entries 162885
Underflow 0
Overflow 1
(0001,03)
Entries 167969
Underflow 0
Overflow 0
(0001,04)
Entries 159142
Underflow 0
Overflow 1
(0001,05)
Entries 166612
Underflow 0
Overflow 0
(0001,06)
Entries 160966
Underflow 0
Overflow 4
(0001,07)
Entries 159312
Underflow 0
Overflow 0
(0001,08)
Entries 170051
Underflow 0
Overflow 0
No data
(0001,10)
Entries 163430
Underflow 0
Overflow 2
(0001,11)
Entries 169649
Underflow 0
Overflow 2.647e+04
(0001,12)
Entries 163685
Underflow 0
Overflow 8
No data
(0001,14)
Entries 161919
Underflow 0
Overflow 1660
No data
No data
(0001,17)
Entries 166958
Underflow 0
Overflow 0
(0001,18)
Entries 165941
Underflow 0
Overflow 8
number of events [a.u.]
Δθ [deg]

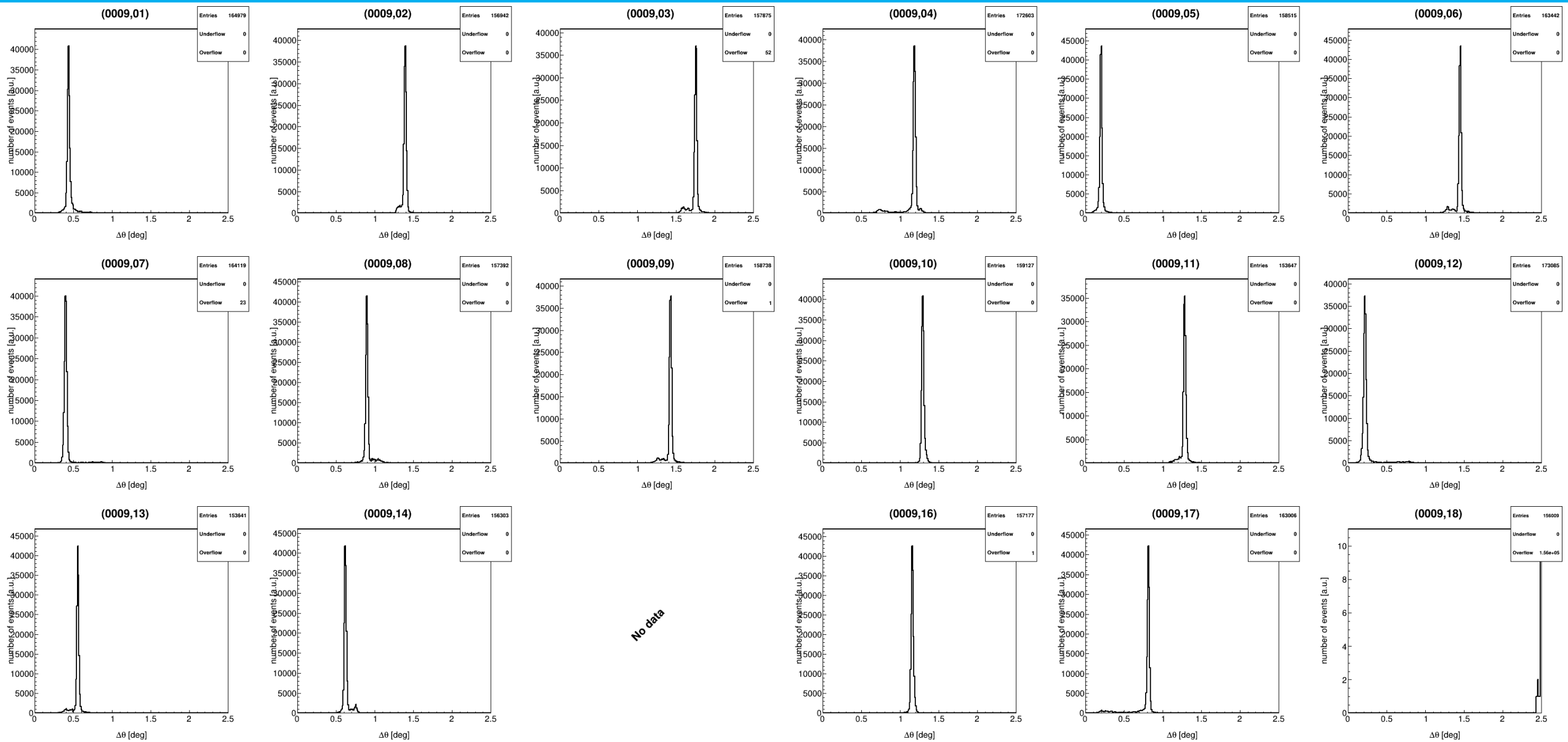
$\Delta\theta$ [°] →


(0002,01)
Entries 162605
Underflow 0
Overflow 0
(0002,02)
Entries 165217
Underflow 0
Overflow 0
(0002,03)
Entries 165736
Underflow 0
Overflow 1
(0002,04)
Entries 162754
Underflow 0
Overflow 0
(0002,05)
Entries 168112
Underflow 0
Overflow 0
(0002,06)
Entries 163761
Underflow 0
Overflow 0
(0002,07)
Entries 164300
Underflow 0
Overflow 0
(0002,08)
Entries 163322
Underflow 0
Overflow 0
(0002,09)
Entries 163744
Underflow 0
Overflow 15
(0002,10)
Entries 164877
Underflow 0
Overflow 0
No data
(0002,12)
Entries 162534
Underflow 0
Overflow 0
(0002,13)
Entries 163135
Underflow 0
Overflow 0
(0002,14)
Entries 166007
Underflow 0
Overflow 6
(0002,15)
Entries 166150
Underflow 0
Overflow 0
(0002,16)
Entries 164724
Underflow 0
Overflow 0
(0002,17)
Entries 165545
Underflow 0
Overflow 0
(0002,18)
Entries 168679
Underflow 0
Overflow 0
number of events [a.u.]
Δθ [deg]

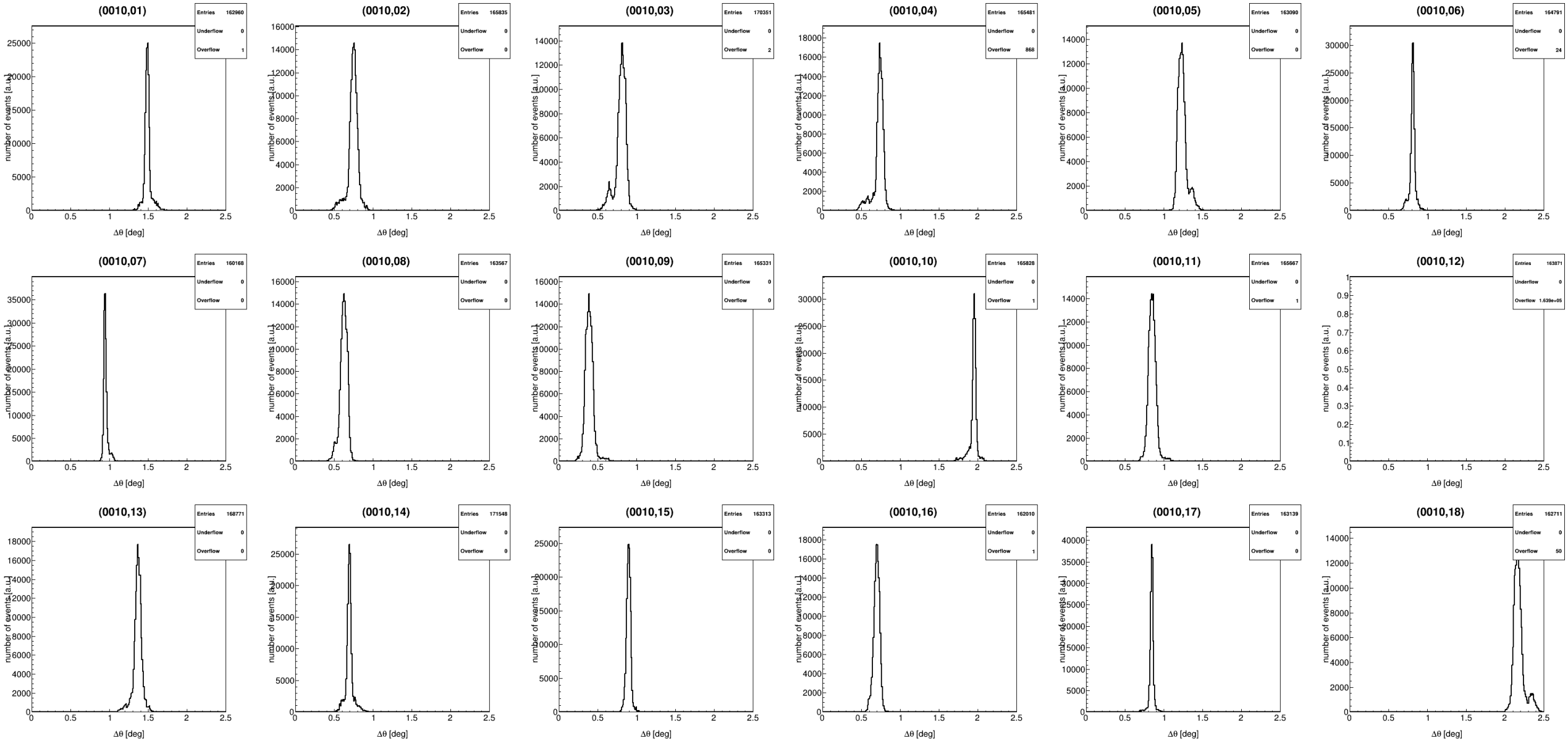
$\Delta\theta$ [°] →


(0003,01)
Entries 162940
Underflow 0
Overflow 1.629e+05
No data
(0003,03)
Entries 162144
Underflow 0
Overflow 99
(0003,04)
Entries 163982
Underflow 0
Overflow 0
(0003,05)
Entries 159715
Underflow 0
Overflow 0
No data
No data
(0003,08)
Entries 167411
Underflow 0
Overflow 0
(0003,09)
Entries 164938
Underflow 0
Overflow 0
(0003,10)
Entries 161232
Underflow 0
Overflow 100
(0003,11)
Entries 161594
Underflow 0
Overflow 0
(0003,12)
Entries 167403
Underflow 0
Overflow 0
(0003,13)
Entries 165071
Underflow 0
Overflow 0
(0003,14)
Entries 165767
Underflow 0
Overflow 0
No data
(0003,16)
Entries 166249
Underflow 0
Overflow 18
(0003,17)
Entries 166881
Underflow 0
Overflow 1.633e+05
(0003,18)
Entries 163544
Underflow 0
Overflow 7
number of events [a.u.]
Δθ [deg]

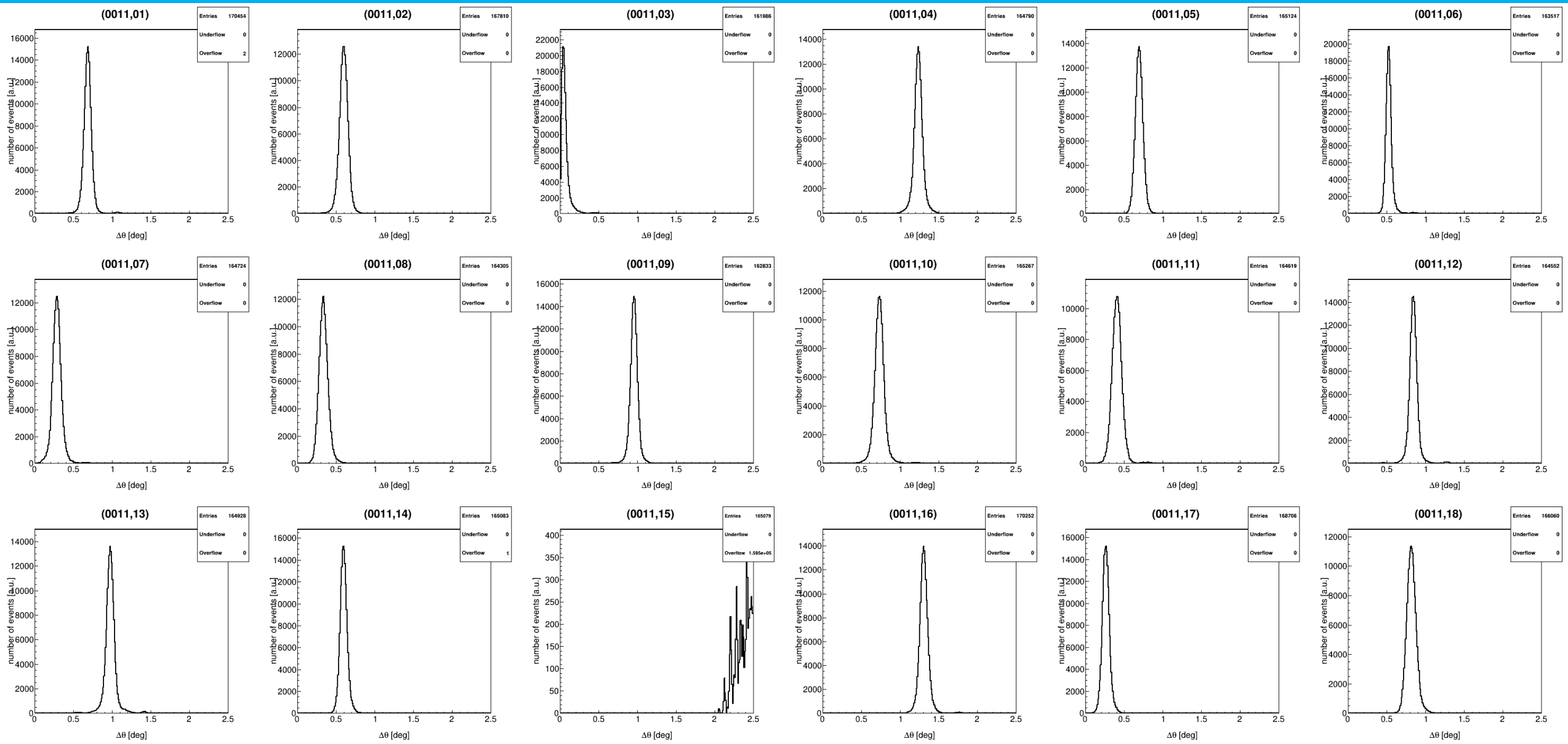
$\Delta\theta$ [°] →


(0009,01)
Entries 164979
Underflow 0
Overflow 0
(0009,02)
Entries 156942
Underflow 0
Overflow 0
(0009,03)
Entries 157875
Underflow 0
Overflow 52
(0009,04)
Entries 172603
Underflow 0
Overflow 0
(0009,05)
Entries 158515
Underflow 0
Overflow 0
(0009,06)
Entries 163442
Underflow 0
Overflow 0
(0009,07)
Entries 164119
Underflow 0
Overflow 23
(0009,08)
Entries 157392
Underflow 0
Overflow 0
(0009,09)
Entries 158738
Underflow 0
Overflow 1
(0009,10)
Entries 159127
Underflow 0
Overflow 0
(0009,11)
Entries 153647
Underflow 0
Overflow 0
(0009,12)
Entries 173085
Underflow 0
Overflow 0
(0009,13)
Entries 153641
Underflow 0
Overflow 0
(0009,14)
Entries 156303
Underflow 0
Overflow 0
No data
(0009,16)
Entries 157177
Underflow 0
Overflow 1
(0009,17)
Entries 163006
Underflow 0
Overflow 0
(0009,18)
Entries 156009
Underflow 0
Overflow 1.56e+05
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →


(0010,01)
Entries 162960
Underflow 0
Overflow 1
(0010,02)
Entries 165835
Underflow 0
Overflow 0
(0010,03)
Entries 170351
Underflow 0
Overflow 2
(0010,04)
Entries 165481
Underflow 0
Overflow 868
(0010,05)
Entries 163090
Underflow 0
Overflow 0
(0010,06)
Entries 164791
Underflow 0
Overflow 24
(0010,07)
Entries 160168
Underflow 0
Overflow 0
(0010,08)
Entries 163567
Underflow 0
Overflow 0
(0010,09)
Entries 165331
Underflow 0
Overflow 0
(0010,10)
Entries 165828
Underflow 0
Overflow 1
(0010,11)
Entries 165667
Underflow 0
Overflow 1
(0010,12)
Entries 163871
Underflow 0
Overflow 1.539e+05
(0010,13)
Entries 168771
Underflow 0
Overflow 0
(0010,14)
Entries 171548
Underflow 0
Overflow 0
(0010,15)
Entries 163313
Underflow 0
Overflow 0
(0010,16)
Entries 162010
Underflow 0
Overflow 1
(0010,17)
Entries 163139
Underflow 0
Overflow 0
(0010,18)
Entries 162711
Underflow 0
Overflow 50
number of events [a.u.]
Δθ [deg]

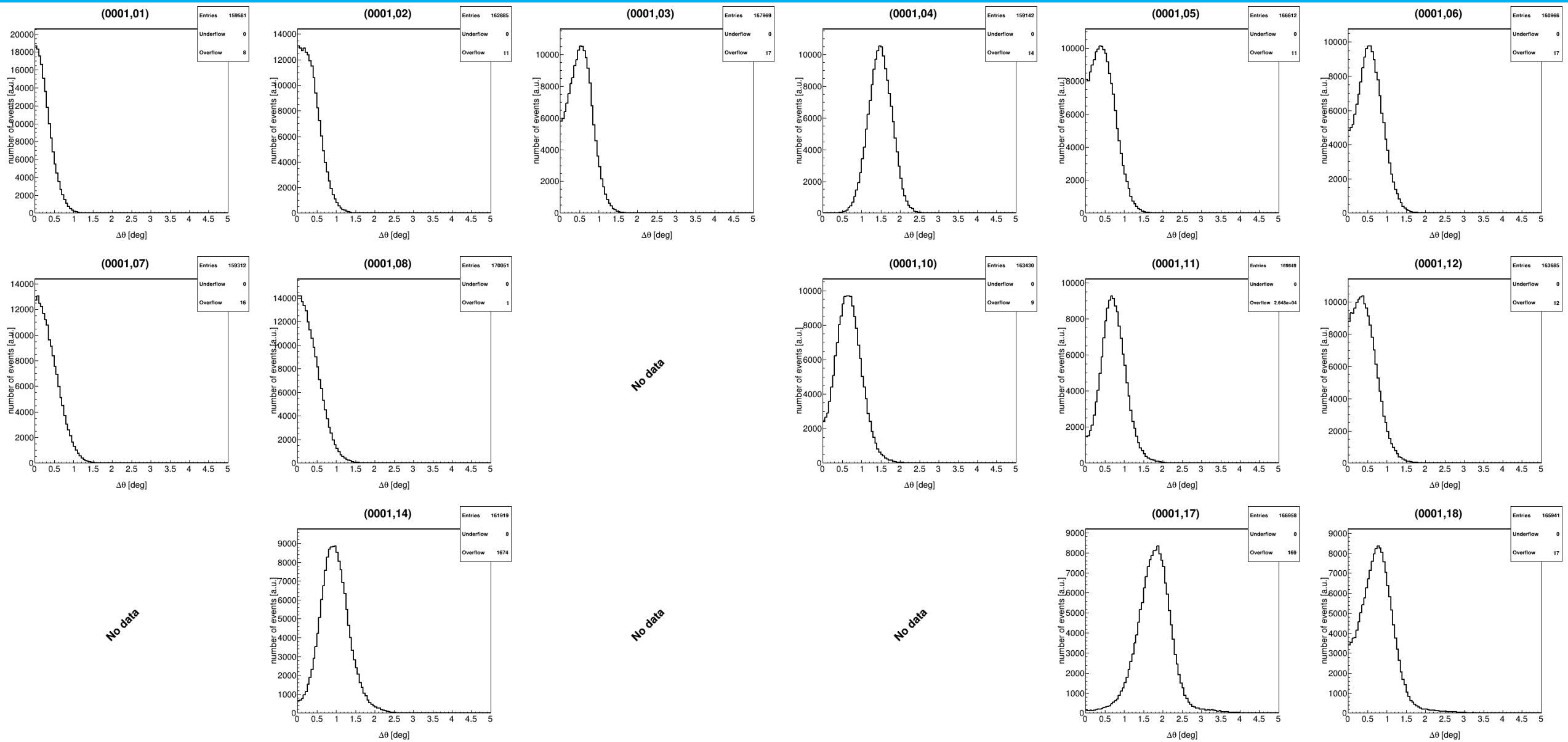
$\Delta\theta$ [°] →


(0011,01)
Entries 170454
Underflow 0
Overflow 2
(0011,02)
Entries 167810
Underflow 0
Overflow 0
(0011,03)
Entries 161986
Underflow 0
Overflow 0
(0011,04)
Entries 164790
Underflow 0
Overflow 0
(0011,05)
Entries 165124
Underflow 0
Overflow 0
(0011,06)
Entries 163517
Underflow 0
Overflow 0
(0011,07)
Entries 164724
Underflow 0
Overflow 0
(0011,08)
Entries 164305
Underflow 0
Overflow 0
(0011,09)
Entries 162833
Underflow 0
Overflow 0
(0011,10)
Entries 165267
Underflow 0
Overflow 0
(0011,11)
Entries 164619
Underflow 0
Overflow 0
(0011,12)
Entries 164552
Underflow 0
Overflow 0
(0011,13)
Entries 164928
Underflow 0
Overflow 0
(0011,14)
Entries 165083
Underflow 0
Overflow 1
(0011,15)
Entries 165079
Underflow 0
Overflow 1.595e+05
(0011,16)
Entries 170252
Underflow 0
Overflow 0
(0011,17)
Entries 168706
Underflow 0
Overflow 0
(0011,18)
Entries 166060
Underflow 0
Overflow 0
number of events [a.u.]
Δθ [deg]

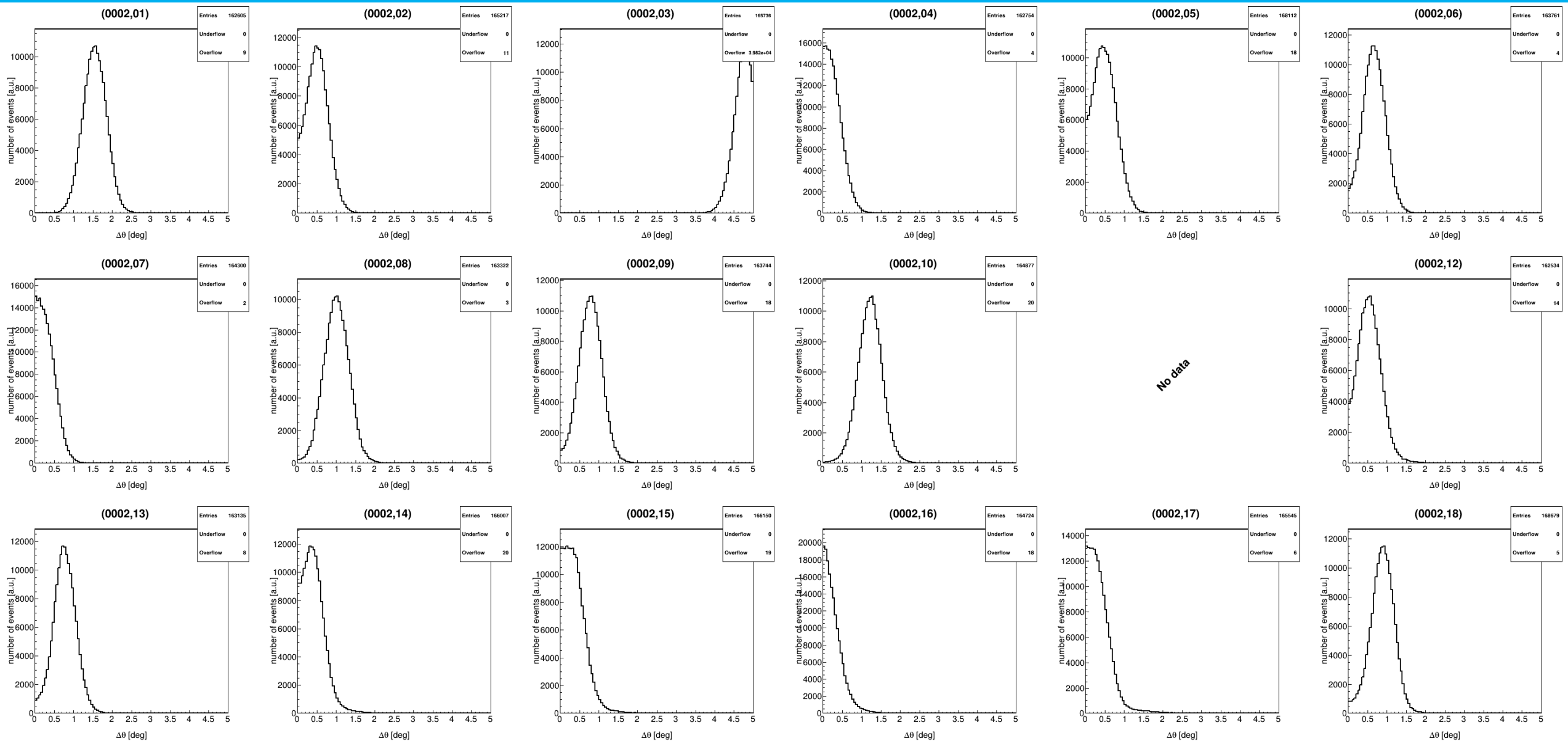
$\Delta\theta$ [°] →

Twist

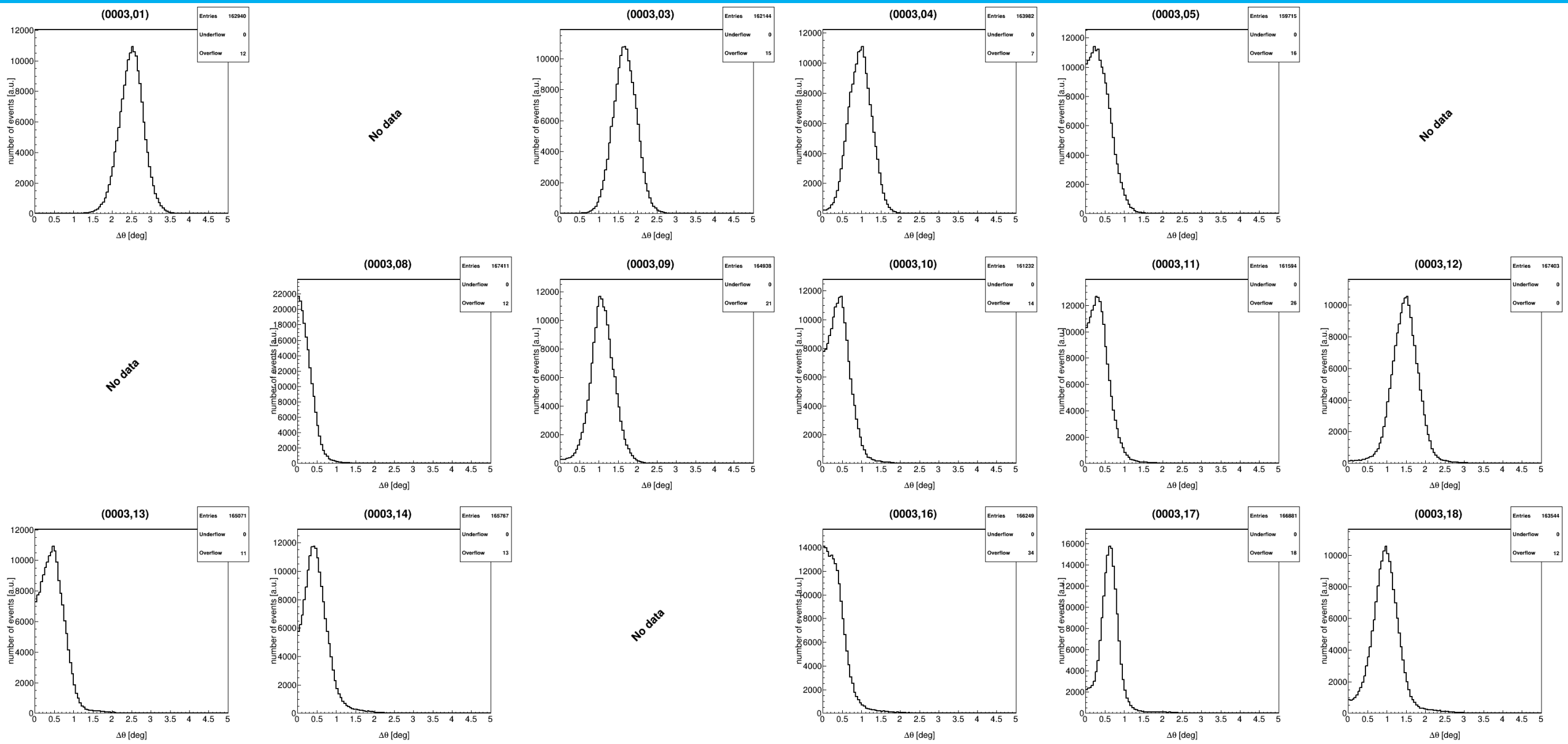
(detector 49 / runs 8000-8100)


(0001,01)
Entries 159581
Underflow 0
Overflow 8
(0001,02)
Entries 162885
Underflow 0
Overflow 11
(0001,03)
Entries 167969
Underflow 0
Overflow 17
(0001,04)
Entries 159142
Underflow 0
Overflow 14
(0001,05)
Entries 166612
Underflow 0
Overflow 11
(0001,06)
Entries 160966
Underflow 0
Overflow 17
(0001,07)
Entries 159312
Underflow 0
Overflow 16
(0001,08)
Entries 170051
Underflow 0
Overflow 1
No data
(0001,10)
Entries 163430
Underflow 0
Overflow 9
(0001,11)
Entries 169649
Underflow 0
Overflow 2.648e+04
(0001,12)
Entries 163685
Underflow 0
Overflow 12
No data
(0001,14)
Entries 161919
Underflow 0
Overflow 1674
No data
No data
(0001,17)
Entries 166958
Underflow 0
Overflow 169
(0001,18)
Entries 165941
Underflow 0
Overflow 17
number of events [a.u.]
Δθ [deg]

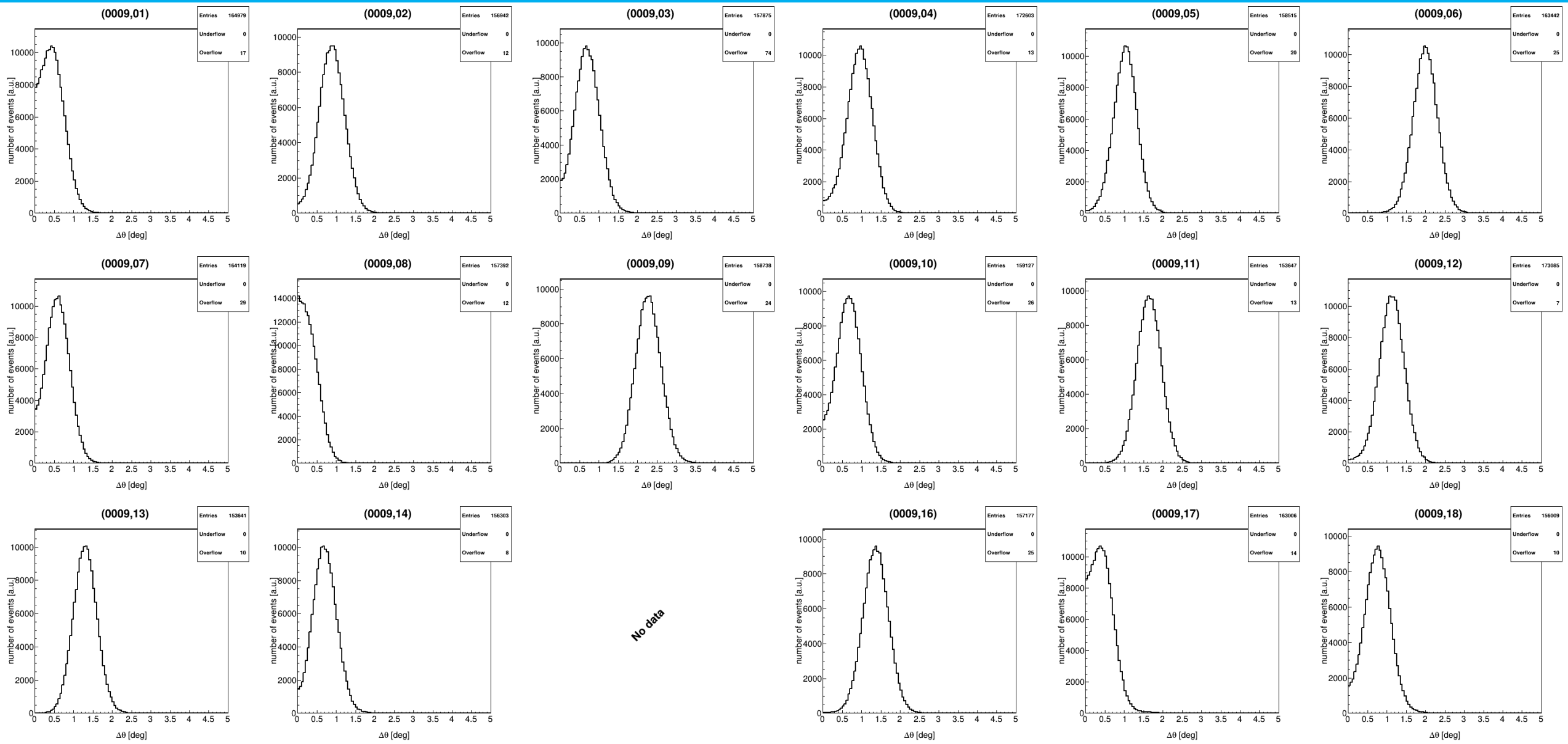
$\Delta\theta$ [°] →


(0002,01)
Entries 162605
Underflow 0
Overflow 9
(0002,02)
Entries 165217
Underflow 0
Overflow 11
(0002,03)
Entries 165736
Underflow 0
Overflow 3.982e+04
(0002,04)
Entries 162754
Underflow 0
Overflow 4
(0002,05)
Entries 168112
Underflow 0
Overflow 18
(0002,06)
Entries 163761
Underflow 0
Overflow 4
(0002,07)
Entries 164300
Underflow 0
Overflow 2
(0002,08)
Entries 163322
Underflow 0
Overflow 3
(0002,09)
Entries 163744
Underflow 0
Overflow 18
(0002,10)
Entries 164877
Underflow 0
Overflow 20
No data
(0002,12)
Entries 162534
Underflow 0
Overflow 14
(0002,13)
Entries 163135
Underflow 0
Overflow 8
(0002,14)
Entries 166007
Underflow 0
Overflow 20
(0002,15)
Entries 166150
Underflow 0
Overflow 19
(0002,16)
Entries 164724
Underflow 0
Overflow 18
(0002,17)
Entries 165545
Underflow 0
Overflow 6
(0002,18)
Entries 168679
Underflow 0
Overflow 5
number of events [a.u.]
Δθ [deg]

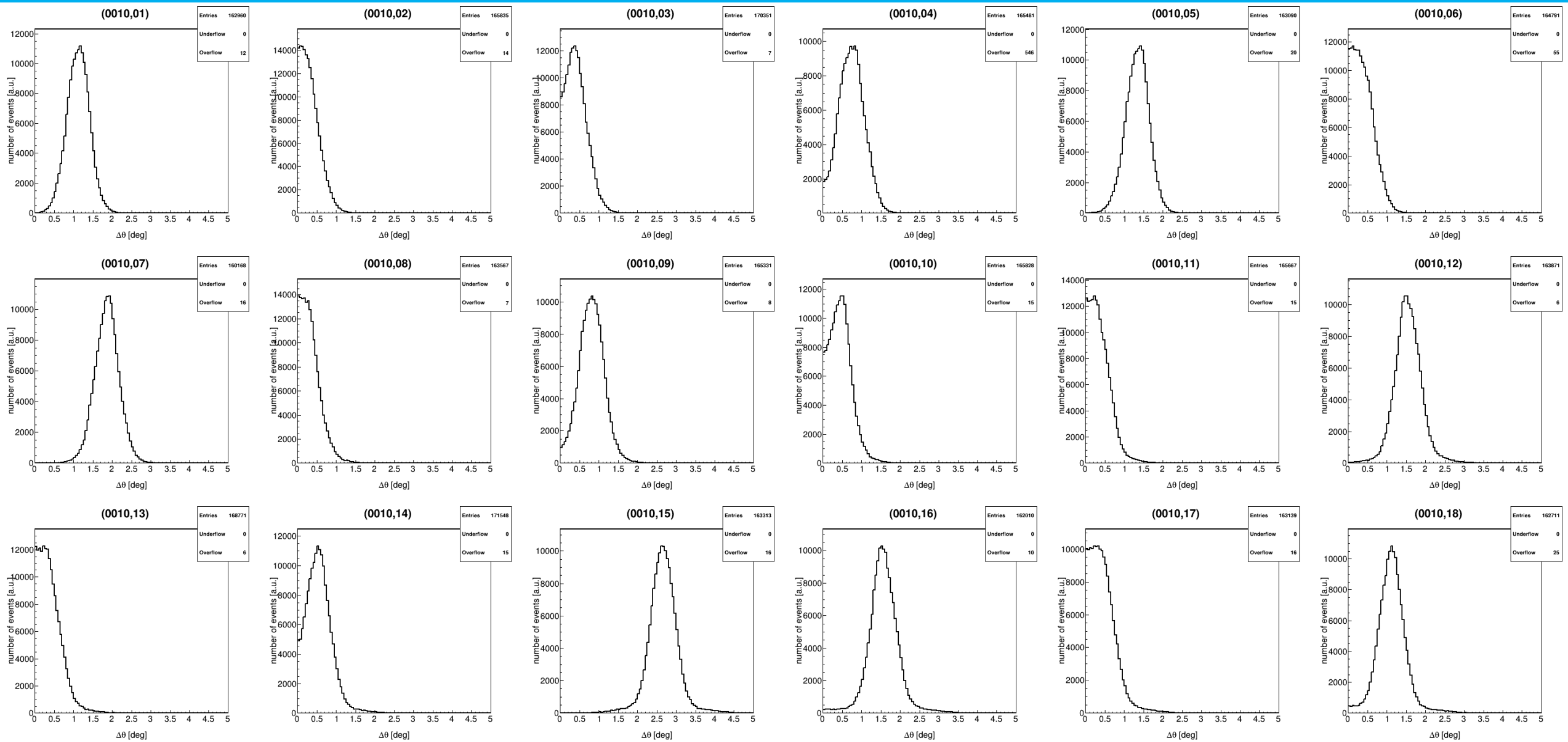
$\Delta\theta$ [°] →


(0003,01)
Entries 162940
Underflow 0
Overflow 12
No data
(0003,03)
Entries 162144
Underflow 0
Overflow 15
(0003,04)
Entries 163982
Underflow 0
Overflow 7
(0003,05)
Entries 159715
Underflow 0
Overflow 16
No data
No data
(0003,08)
Entries 167411
Underflow 0
Overflow 12
(0003,09)
Entries 164938
Underflow 0
Overflow 21
(0003,10)
Entries 161232
Underflow 0
Overflow 14
(0003,11)
Entries 161594
Underflow 0
Overflow 26
(0003,12)
Entries 167403
Underflow 0
Overflow 0
(0003,13)
Entries 165071
Underflow 0
Overflow 11
(0003,14)
Entries 165767
Underflow 0
Overflow 13
No data
(0003,16)
Entries 166249
Underflow 0
Overflow 34
(0003,17)
Entries 166881
Underflow 0
Overflow 18
(0003,18)
Entries 163544
Underflow 0
Overflow 12
number of events [a.u.]
Δθ [deg]

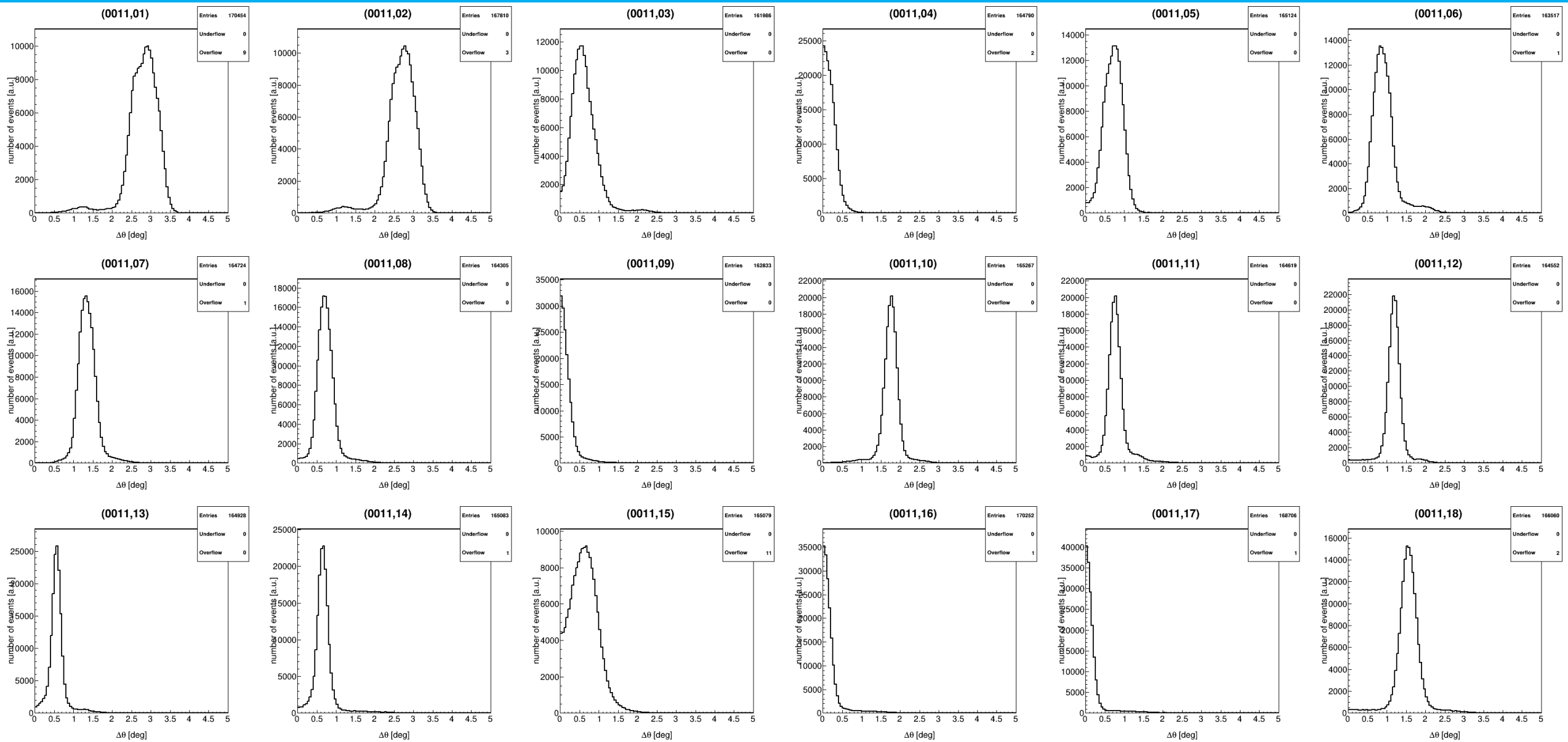
$\Delta\theta$ [°] →


(0009,01)
Entries 164979
Underflow 0
Overflow 17
(0009,02)
Entries 156942
Underflow 0
Overflow 12
(0009,03)
Entries 157875
Underflow 0
Overflow 74
(0009,04)
Entries 172603
Underflow 0
Overflow 13
(0009,05)
Entries 158515
Underflow 0
Overflow 20
(0009,06)
Entries 163442
Underflow 0
Overflow 25
(0009,07)
Entries 164119
Underflow 0
Overflow 29
(0009,08)
Entries 157392
Underflow 0
Overflow 12
(0009,09)
Entries 158738
Underflow 0
Overflow 24
(0009,10)
Entries 159127
Underflow 0
Overflow 26
(0009,11)
Entries 153647
Underflow 0
Overflow 13
(0009,12)
Entries 173085
Underflow 0
Overflow 7
(0009,13)
Entries 153641
Underflow 0
Overflow 10
(0009,14)
Entries 156303
Underflow 0
Overflow 8
No data
(0009,16)
Entries 157177
Underflow 0
Overflow 25
(0009,17)
Entries 163006
Underflow 0
Overflow 14
(0009,18)
Entries 156009
Underflow 0
Overflow 10
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →


(0010,01)
Entries 162960
Underflow 0
Overflow 12
(0010,02)
Entries 165835
Underflow 0
Overflow 14
(0010,03)
Entries 170351
Underflow 0
Overflow 7
(0010,04)
Entries 165481
Underflow 0
Overflow 546
(0010,05)
Entries 163090
Underflow 0
Overflow 20
(0010,06)
Entries 164791
Underflow 0
Overflow 55
(0010,07)
Entries 160168
Underflow 0
Overflow 16
(0010,08)
Entries 163567
Underflow 0
Overflow 7
(0010,09)
Entries 165331
Underflow 0
Overflow 8
(0010,10)
Entries 165828
Underflow 0
Overflow 15
(0010,11)
Entries 165667
Underflow 0
Overflow 15
(0010,12)
Entries 163871
Underflow 0
Overflow 6
(0010,13)
Entries 168771
Underflow 0
Overflow 6
(0010,14)
Entries 171548
Underflow 0
Overflow 15
(0010,15)
Entries 163313
Underflow 0
Overflow 16
(0010,16)
Entries 162010
Underflow 0
Overflow 10
(0010,17)
Entries 163139
Underflow 0
Overflow 16
(0010,18)
Entries 162711
Underflow 0
Overflow 25
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →


(0011,01)
Entries 170454
Underflow 0
Overflow 9
(0011,02)
Entries 167810
Underflow 0
Overflow 3
(0011,03)
Entries 161986
Underflow 0
Overflow 0
(0011,04)
Entries 164790
Underflow 0
Overflow 2
(0011,05)
Entries 165124
Underflow 0
Overflow 0
(0011,06)
Entries 163517
Underflow 0
Overflow 1
(0011,07)
Entries 164724
Underflow 0
Overflow 1
(0011,08)
Entries 164305
Underflow 0
Overflow 0
(0011,09)
Entries 162833
Underflow 0
Overflow 0
(0011,10)
Entries 165267
Underflow 0
Overflow 0
(0011,11)
Entries 164619
Underflow 0
Overflow 0
(0011,12)
Entries 164552
Underflow 0
Overflow 0
(0011,13)
Entries 164928
Underflow 0
Overflow 0
(0011,14)
Entries 165083
Underflow 0
Overflow 1
(0011,15)
Entries 165079
Underflow 0
Overflow 11
(0011,16)
Entries 170252
Underflow 0
Overflow 1
(0011,17)
Entries 168706
Underflow 0
Overflow 1
(0011,18)
Entries 166060
Underflow 0
Overflow 2
number of events [a.u.]
Δθ [deg]

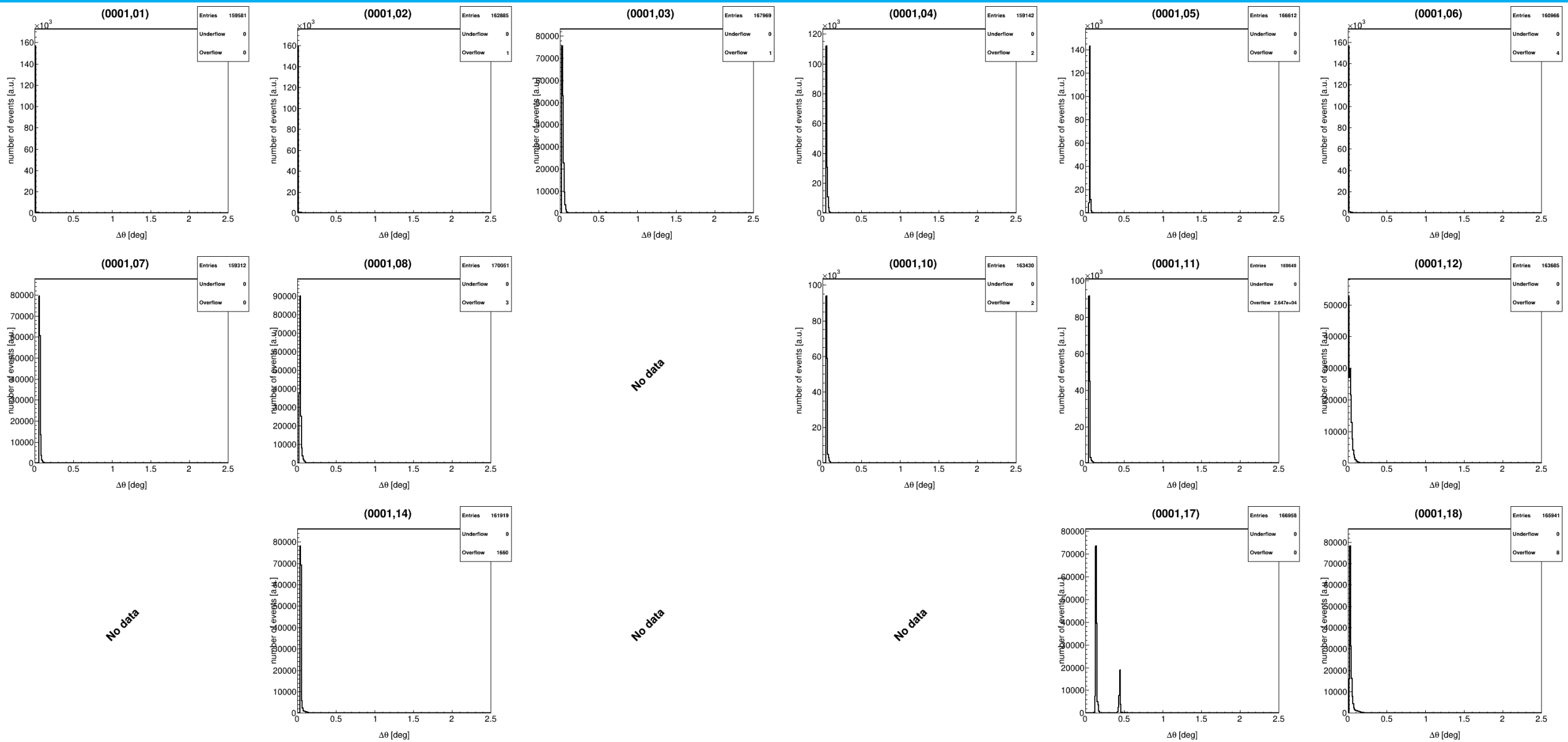
$\Delta\theta$ [°] →

Calibration

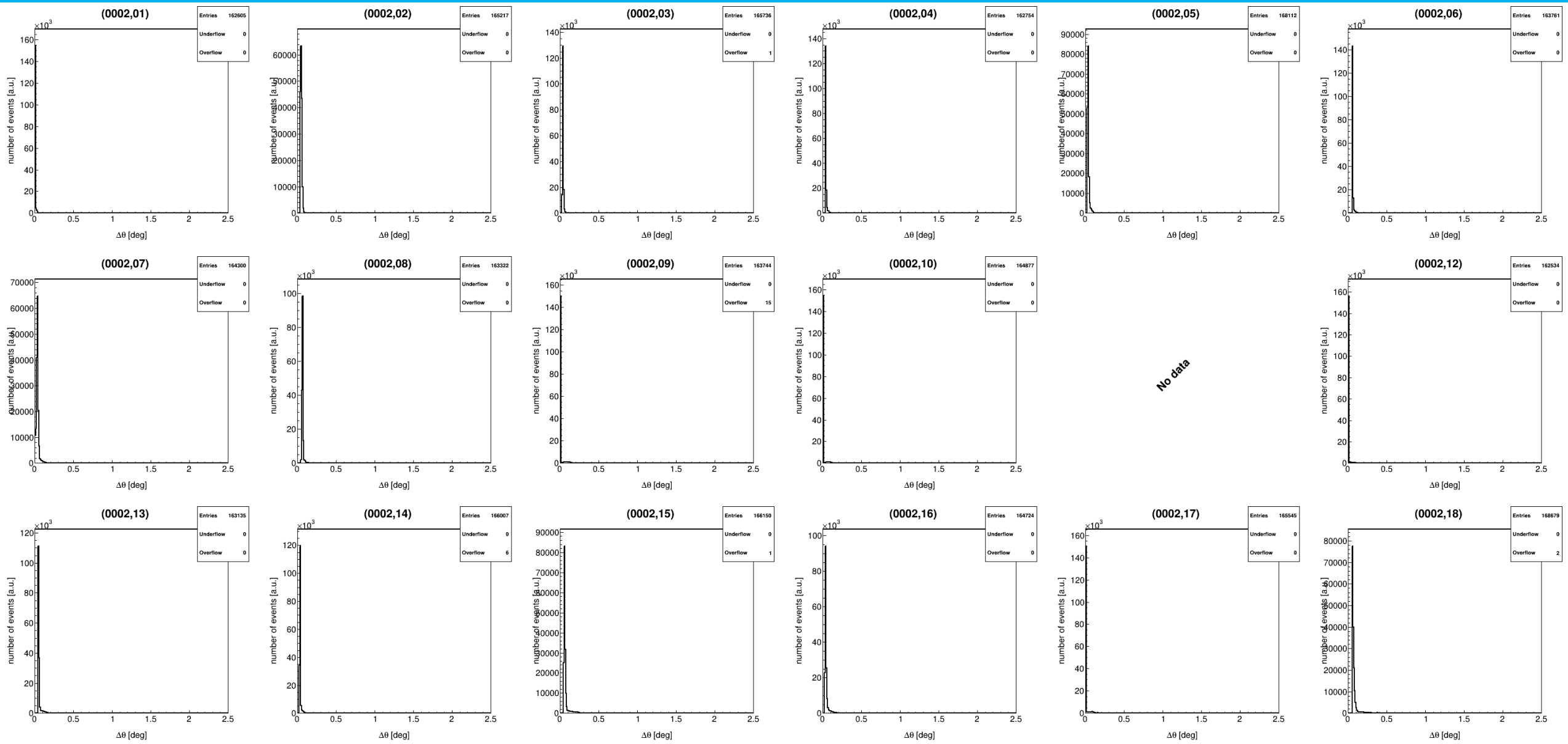
- Determine residuals
  - residual = quaternion = average between measured and fitted quaternions
- Store residuals in ASCII file
- Load residuals from ASCII file
- Re-run

Tilt

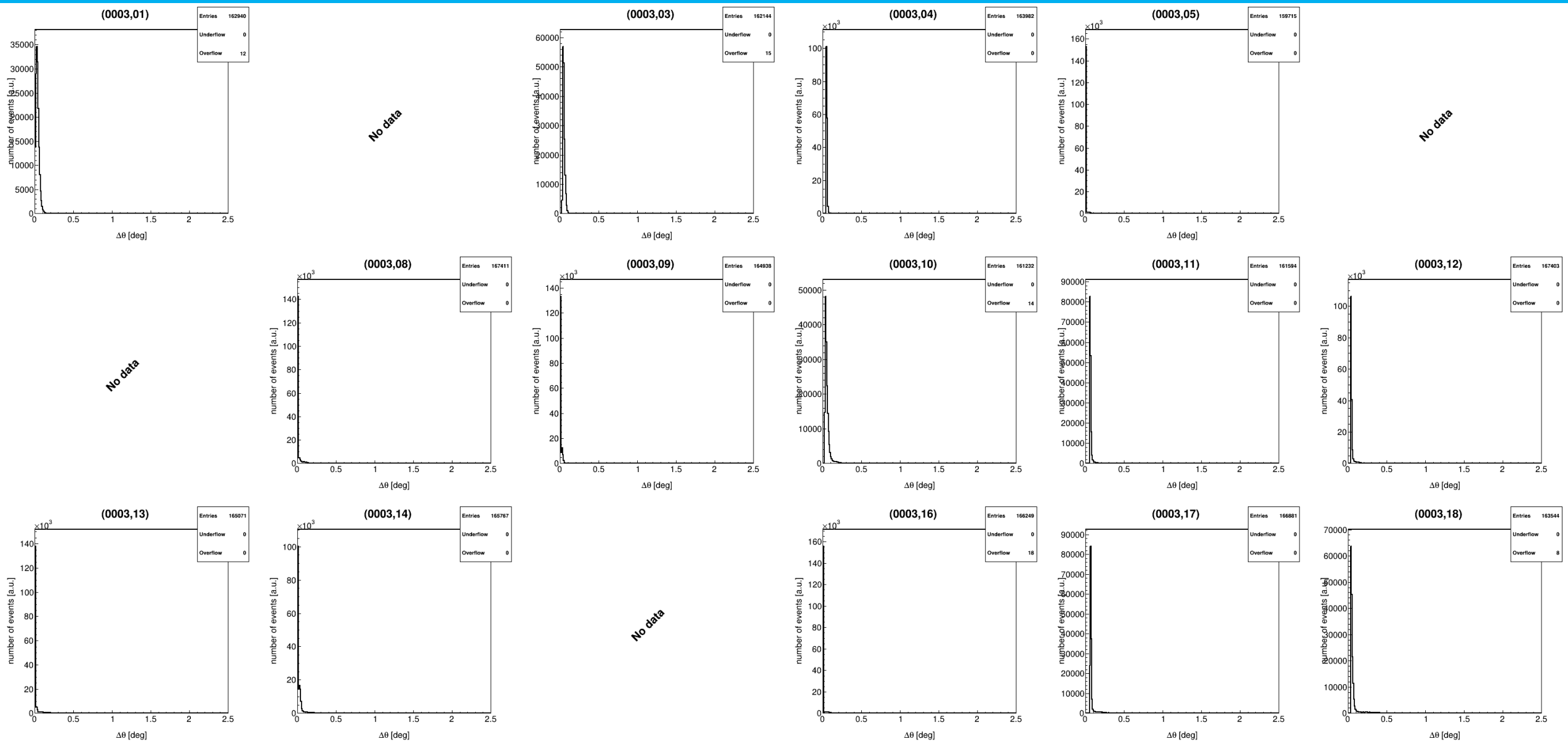
(after calibration)


(0001,01)
Entries 159581
Underflow 0
Overflow 0
(0001,02)
Entries 162885
Underflow 0
Overflow 1
(0001,03)
Entries 167969
Underflow 0
Overflow 1
(0001,04)
Entries 159142
Underflow 0
Overflow 2
(0001,05)
Entries 166612
Underflow 0
Overflow 0
(0001,06)
Entries 160966
Underflow 0
Overflow 4
(0001,07)
Entries 159312
Underflow 0
Overflow 0
(0001,08)
Entries 170051
Underflow 0
Overflow 3
No data
(0001,10)
Entries 163430
Underflow 0
Overflow 2
(0001,11)
Entries 169649
Underflow 0
Overflow 2.647e+04
(0001,12)
Entries 163685
Underflow 0
Overflow 0
No data
(0001,14)
Entries 161919
Underflow 0
Overflow 1660
No data
No data
(0001,17)
Entries 166958
Underflow 0
Overflow 0
(0001,18)
Entries 165941
Underflow 0
Overflow 8
number of events [a.u.]
Δθ [deg]

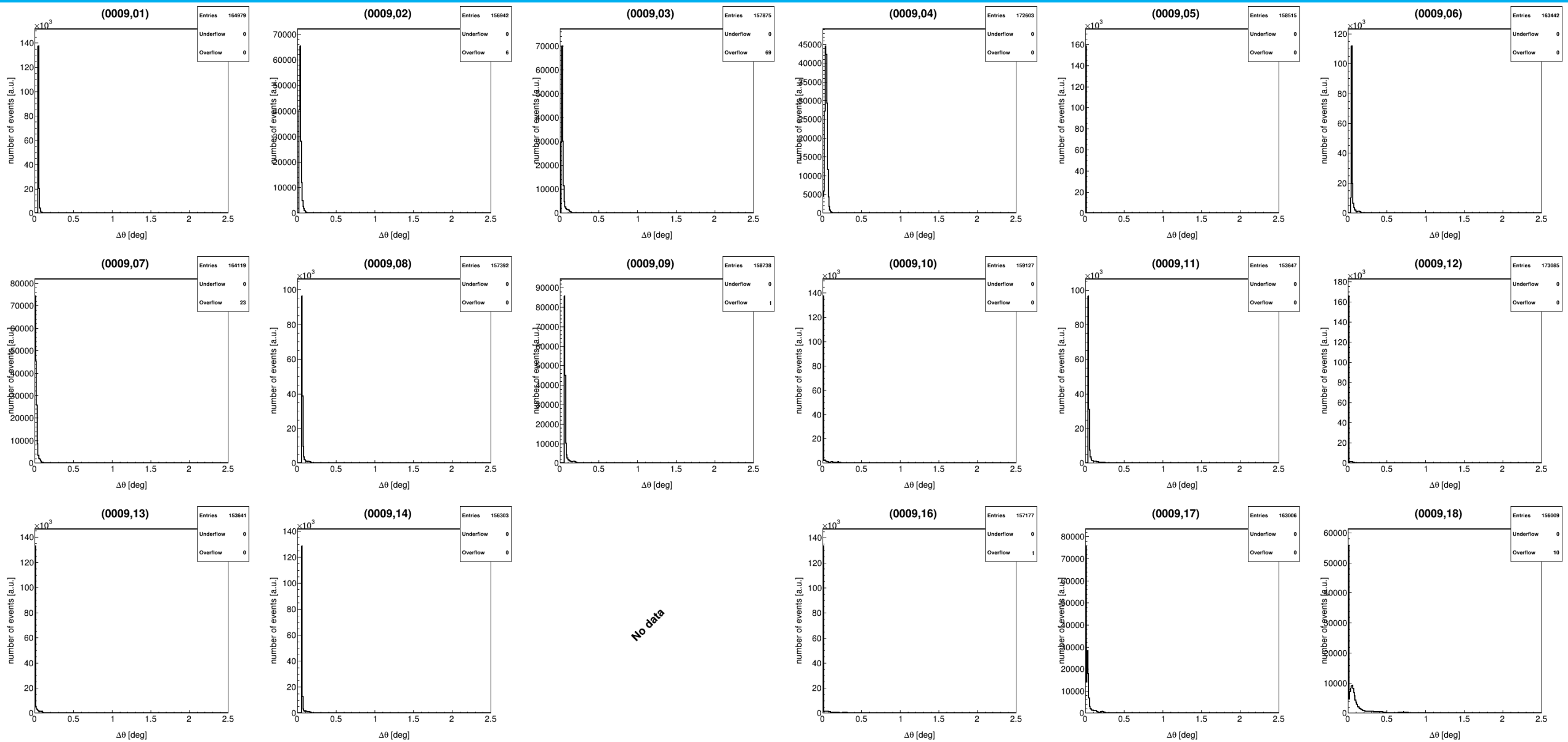
$\Delta\theta$ [°] →


(0002,01)
Entries 162605
Underflow 0
Overflow 0
(0002,02)
Entries 165217
Underflow 0
Overflow 0
(0002,03)
Entries 165736
Underflow 0
Overflow 1
(0002,04)
Entries 162754
Underflow 0
Overflow 0
(0002,05)
Entries 168112
Underflow 0
Overflow 0
(0002,06)
Entries 163761
Underflow 0
Overflow 0
(0002,07)
Entries 164300
Underflow 0
Overflow 0
(0002,08)
Entries 163322
Underflow 0
Overflow 0
(0002,09)
Entries 163744
Underflow 0
Overflow 15
(0002,10)
Entries 164877
Underflow 0
Overflow 0
No data
(0002,12)
Entries 162534
Underflow 0
Overflow 0
(0002,13)
Entries 163135
Underflow 0
Overflow 0
(0002,14)
Entries 166007
Underflow 0
Overflow 6
(0002,15)
Entries 166150
Underflow 0
Overflow 1
(0002,16)
Entries 164724
Underflow 0
Overflow 0
(0002,17)
Entries 165545
Underflow 0
Overflow 0
(0002,18)
Entries 168679
Underflow 0
Overflow 2
number of events [a.u.]
Δθ [deg]

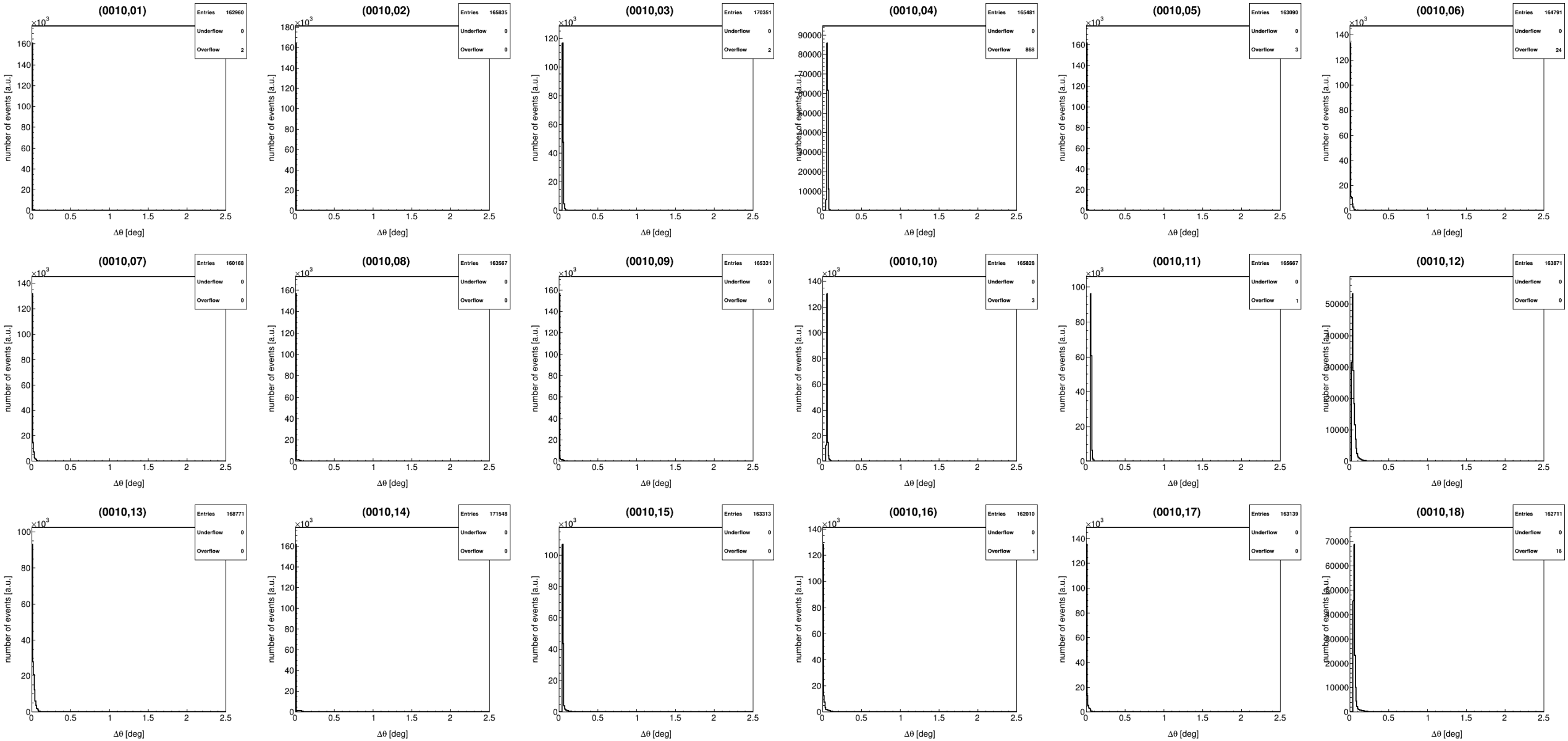
$\Delta\theta$ [°] →


(0003,01)
Entries 162940
Underflow 0
Overflow 12
No data
(0003,03)
Entries 162144
Underflow 0
Overflow 15
(0003,04)
Entries 163982
Underflow 0
Overflow 0
(0003,05)
Entries 159715
Underflow 0
Overflow 0
No data
No data
(0003,08)
Entries 167411
Underflow 0
Overflow 0
(0003,09)
Entries 164938
Underflow 0
Overflow 0
(0003,10)
Entries 161232
Underflow 0
Overflow 14
(0003,11)
Entries 161594
Underflow 0
Overflow 0
(0003,12)
Entries 167403
Underflow 0
Overflow 0
(0003,13)
Entries 165071
Underflow 0
Overflow 0
(0003,14)
Entries 165767
Underflow 0
Overflow 0
No data
(0003,16)
Entries 166249
Underflow 0
Overflow 18
(0003,17)
Entries 166881
Underflow 0
Overflow 0
(0003,18)
Entries 163544
Underflow 0
Overflow 8
number of events [a.u.]
Δθ [deg]

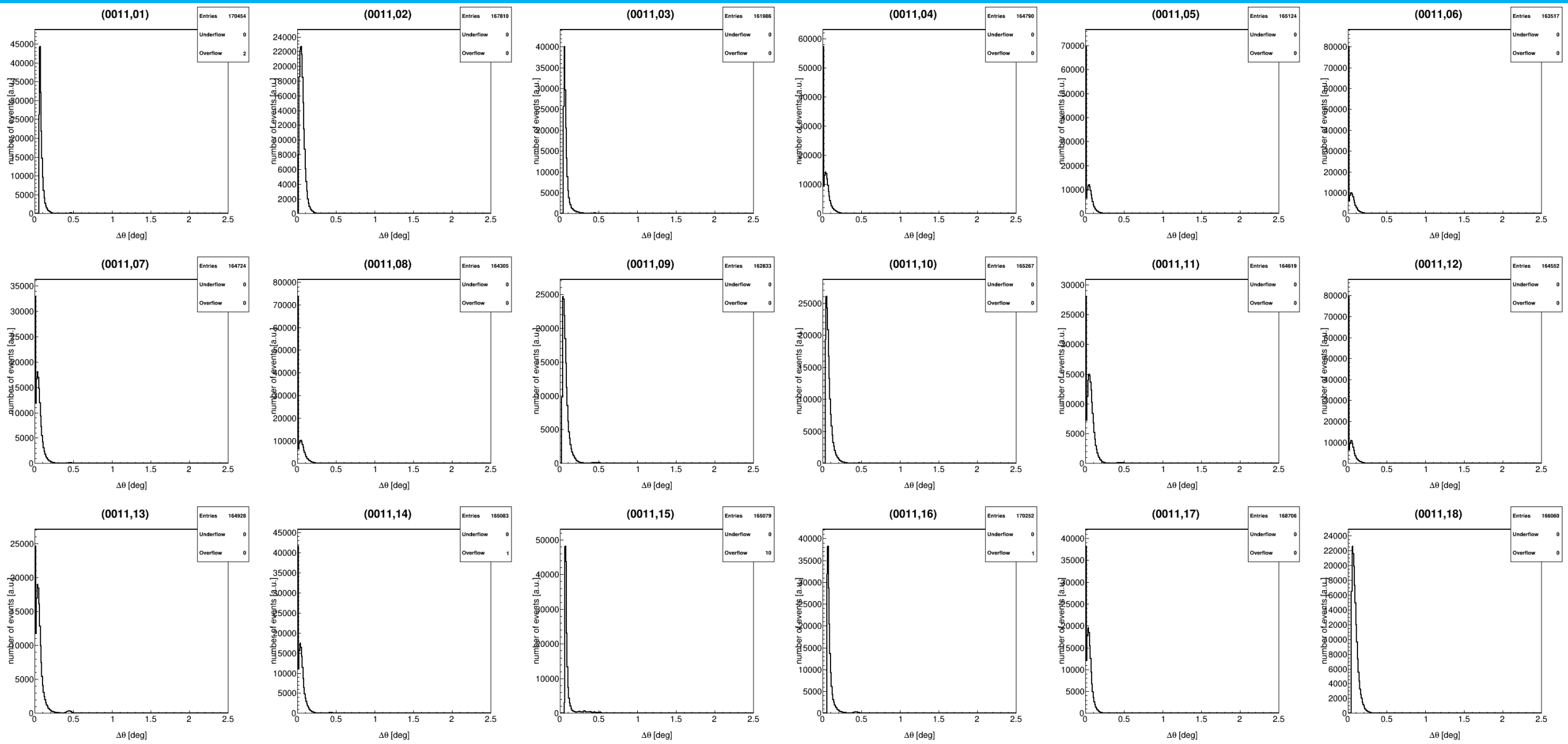
$\Delta\theta$ [°] →


(0009,01)
Entries 164979
Underflow 0
Overflow 0
(0009,02)
Entries 156942
Underflow 0
Overflow 6
(0009,03)
Entries 157875
Underflow 0
Overflow 69
(0009,04)
Entries 172603
Underflow 0
Overflow 0
(0009,05)
Entries 158515
Underflow 0
Overflow 0
(0009,06)
Entries 163442
Underflow 0
Overflow 0
(0009,07)
Entries 164119
Underflow 0
Overflow 23
(0009,08)
Entries 157392
Underflow 0
Overflow 0
(0009,09)
Entries 158738
Underflow 0
Overflow 1
(0009,10)
Entries 159127
Underflow 0
Overflow 0
(0009,11)
Entries 153647
Underflow 0
Overflow 0
(0009,12)
Entries 173085
Underflow 0
Overflow 0
(0009,13)
Entries 153641
Underflow 0
Overflow 0
(0009,14)
Entries 156303
Underflow 0
Overflow 0
No data
(0009,16)
Entries 157177
Underflow 0
Overflow 1
(0009,17)
Entries 163006
Underflow 0
Overflow 0
(0009,18)
Entries 156009
Underflow 0
Overflow 10
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →


(0010,01)
Entries 162960
Underflow 0
Overflow 2
(0010,02)
Entries 165835
Underflow 0
Overflow 0
(0010,03)
Entries 170351
Underflow 0
Overflow 2
(0010,04)
Entries 165481
Underflow 0
Overflow 868
(0010,05)
Entries 163090
Underflow 0
Overflow 3
(0010,06)
Entries 164791
Underflow 0
Overflow 24
(0010,07)
Entries 160168
Underflow 0
Overflow 0
(0010,08)
Entries 163567
Underflow 0
Overflow 0
(0010,09)
Entries 165331
Underflow 0
Overflow 0
(0010,10)
Entries 165828
Underflow 0
Overflow 3
(0010,11)
Entries 165667
Underflow 0
Overflow 1
(0010,12)
Entries 163871
Underflow 0
Overflow 0
(0010,13)
Entries 168771
Underflow 0
Overflow 0
(0010,14)
Entries 171548
Underflow 0
Overflow 0
(0010,15)
Entries 163313
Underflow 0
Overflow 0
(0010,16)
Entries 162010
Underflow 0
Overflow 1
(0010,17)
Entries 163139
Underflow 0
Overflow 0
(0010,18)
Entries 162711
Underflow 0
Overflow 16
number of events [a.u.]
Δθ [deg]

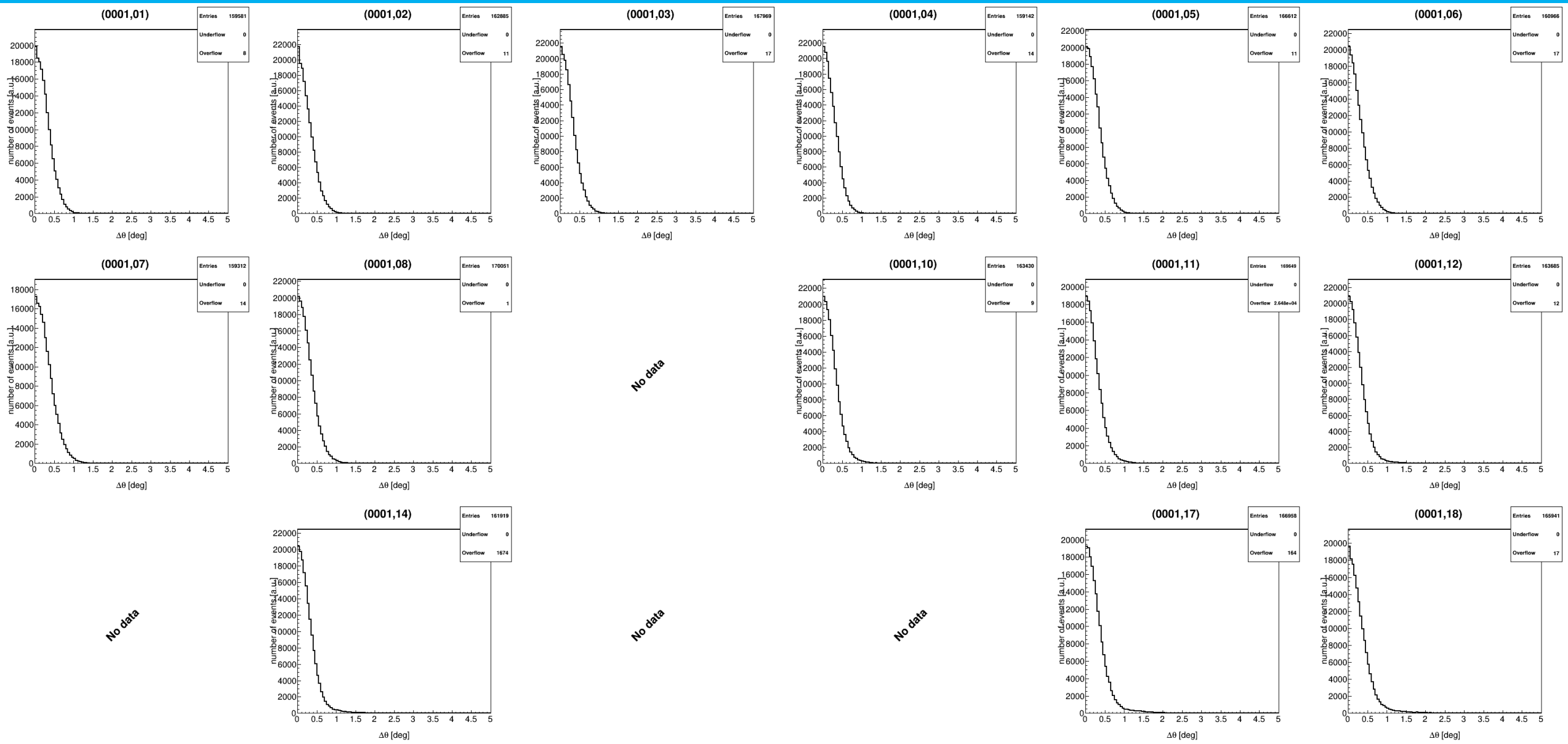
$\Delta\theta$ [°] →


(0011,01)
Entries 170454
Underflow 0
Overflow 2
(0011,02)
Entries 167810
Underflow 0
Overflow 0
(0011,03)
Entries 161986
Underflow 0
Overflow 0
(0011,04)
Entries 164790
Underflow 0
Overflow 0
(0011,05)
Entries 165124
Underflow 0
Overflow 0
(0011,06)
Entries 163517
Underflow 0
Overflow 0
(0011,07)
Entries 164724
Underflow 0
Overflow 0
(0011,08)
Entries 164305
Underflow 0
Overflow 0
(0011,09)
Entries 162833
Underflow 0
Overflow 0
(0011,10)
Entries 165267
Underflow 0
Overflow 0
(0011,11)
Entries 164619
Underflow 0
Overflow 0
(0011,12)
Entries 164552
Underflow 0
Overflow 0
(0011,13)
Entries 164928
Underflow 0
Overflow 0
(0011,14)
Entries 165083
Underflow 0
Overflow 1
(0011,15)
Entries 165079
Underflow 0
Overflow 10
(0011,16)
Entries 170252
Underflow 0
Overflow 1
(0011,17)
Entries 168706
Underflow 0
Overflow 0
(0011,18)
Entries 166060
Underflow 0
Overflow 0
number of events [a.u.]
Δθ [deg]

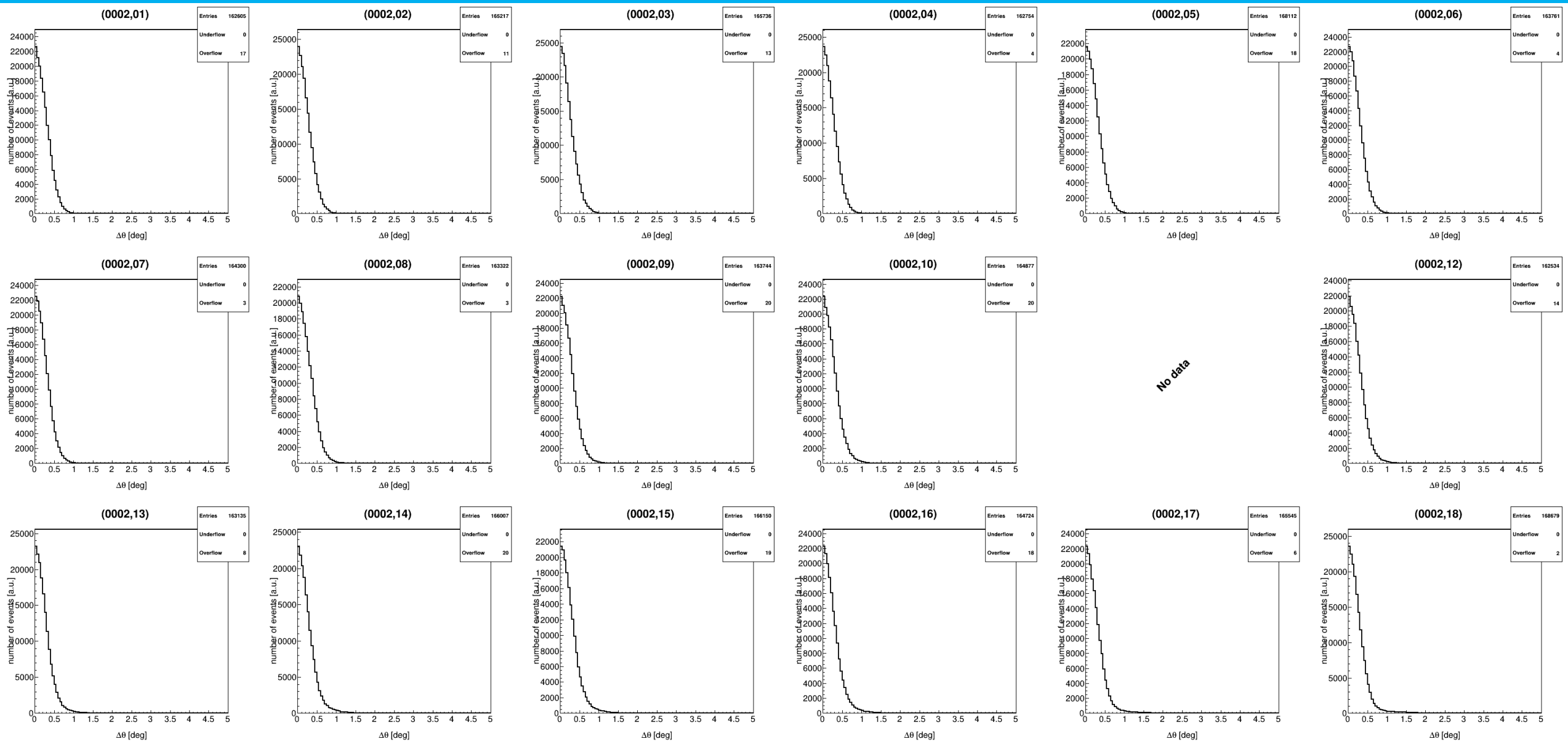
$\Delta\theta$ [°] →

Twist

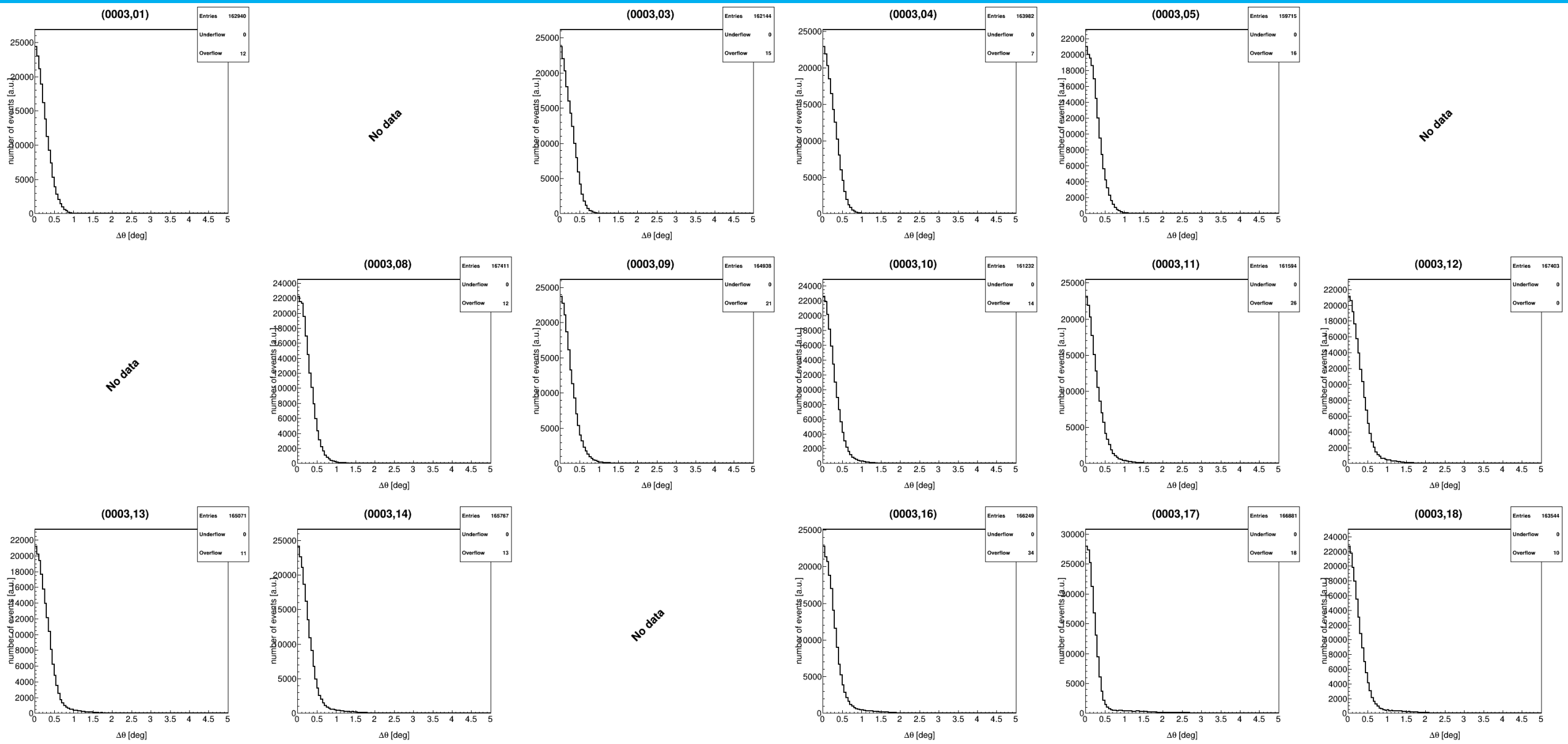
(after calibration)


(0001,01)
Entries 159581
Underflow 0
Overflow 8
(0001,02)
Entries 162885
Underflow 0
Overflow 11
(0001,03)
Entries 167969
Underflow 0
Overflow 17
(0001,04)
Entries 159142
Underflow 0
Overflow 14
(0001,05)
Entries 166612
Underflow 0
Overflow 11
(0001,06)
Entries 160966
Underflow 0
Overflow 17
(0001,07)
Entries 159312
Underflow 0
Overflow 14
(0001,08)
Entries 170051
Underflow 0
Overflow 1
No data
(0001,10)
Entries 163430
Underflow 0
Overflow 9
(0001,11)
Entries 169649
Underflow 0
Overflow 2.648e+04
(0001,12)
Entries 163685
Underflow 0
Overflow 12
No data
(0001,14)
Entries 161919
Underflow 0
Overflow 1674
No data
No data
(0001,17)
Entries 166958
Underflow 0
Overflow 164
(0001,18)
Entries 165941
Underflow 0
Overflow 17
number of events [a.u.]
Δθ [deg]

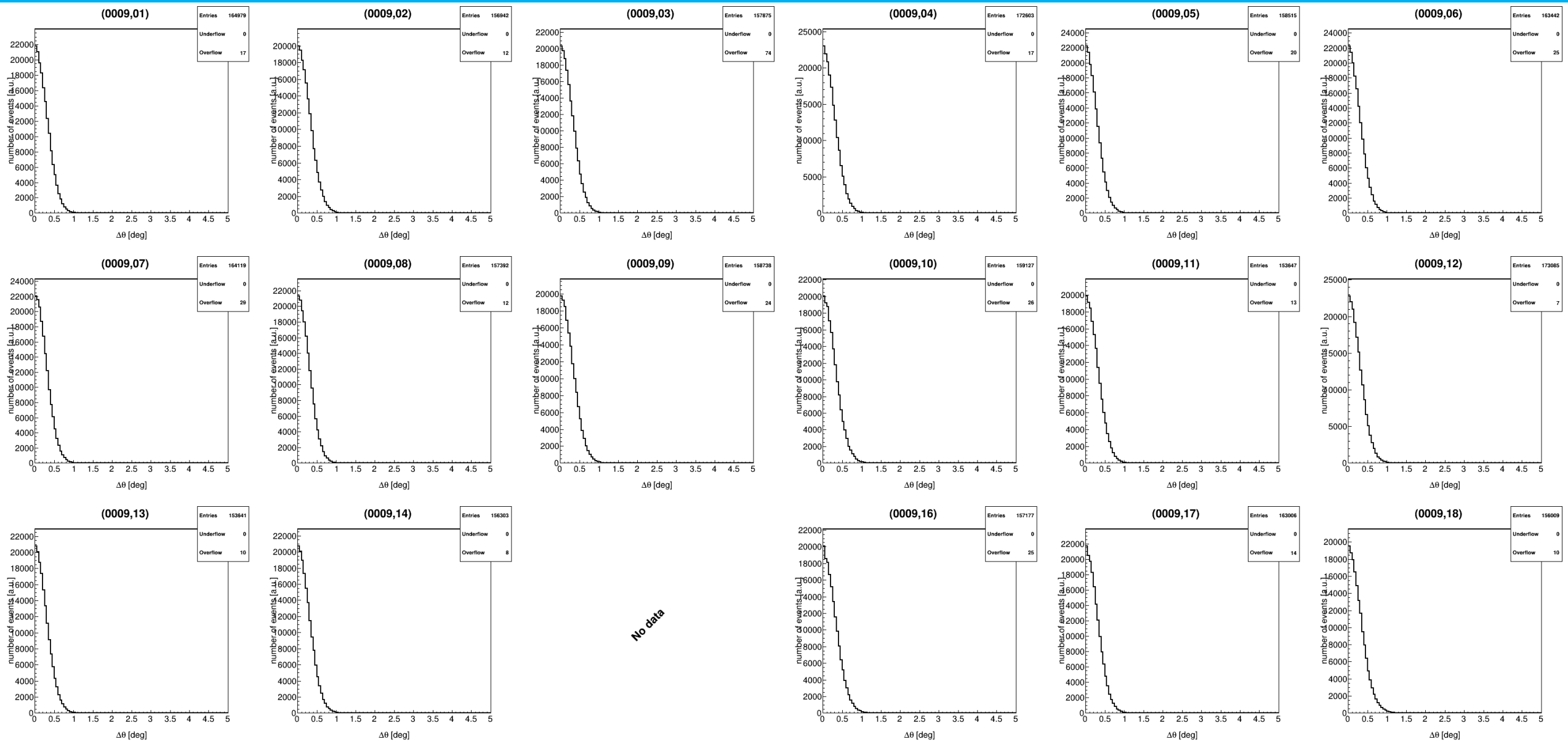
$\Delta\theta$ [°] →


(0002,01)
Entries 162605
Underflow 0
Overflow 17
(0002,02)
Entries 165217
Underflow 0
Overflow 11
(0002,03)
Entries 165736
Underflow 0
Overflow 13
(0002,04)
Entries 162754
Underflow 0
Overflow 4
(0002,05)
Entries 168112
Underflow 0
Overflow 18
(0002,06)
Entries 163761
Underflow 0
Overflow 4
(0002,07)
Entries 164300
Underflow 0
Overflow 3
(0002,08)
Entries 163322
Underflow 0
Overflow 3
(0002,09)
Entries 163744
Underflow 0
Overflow 20
(0002,10)
Entries 164877
Underflow 0
Overflow 20
No data
(0002,12)
Entries 162534
Underflow 0
Overflow 14
(0002,13)
Entries 163135
Underflow 0
Overflow 8
(0002,14)
Entries 166007
Underflow 0
Overflow 20
(0002,15)
Entries 166150
Underflow 0
Overflow 19
(0002,16)
Entries 164724
Underflow 0
Overflow 18
(0002,17)
Entries 165545
Underflow 0
Overflow 6
(0002,18)
Entries 168679
Underflow 0
Overflow 2
number of events [a.u.]
Δθ [deg]

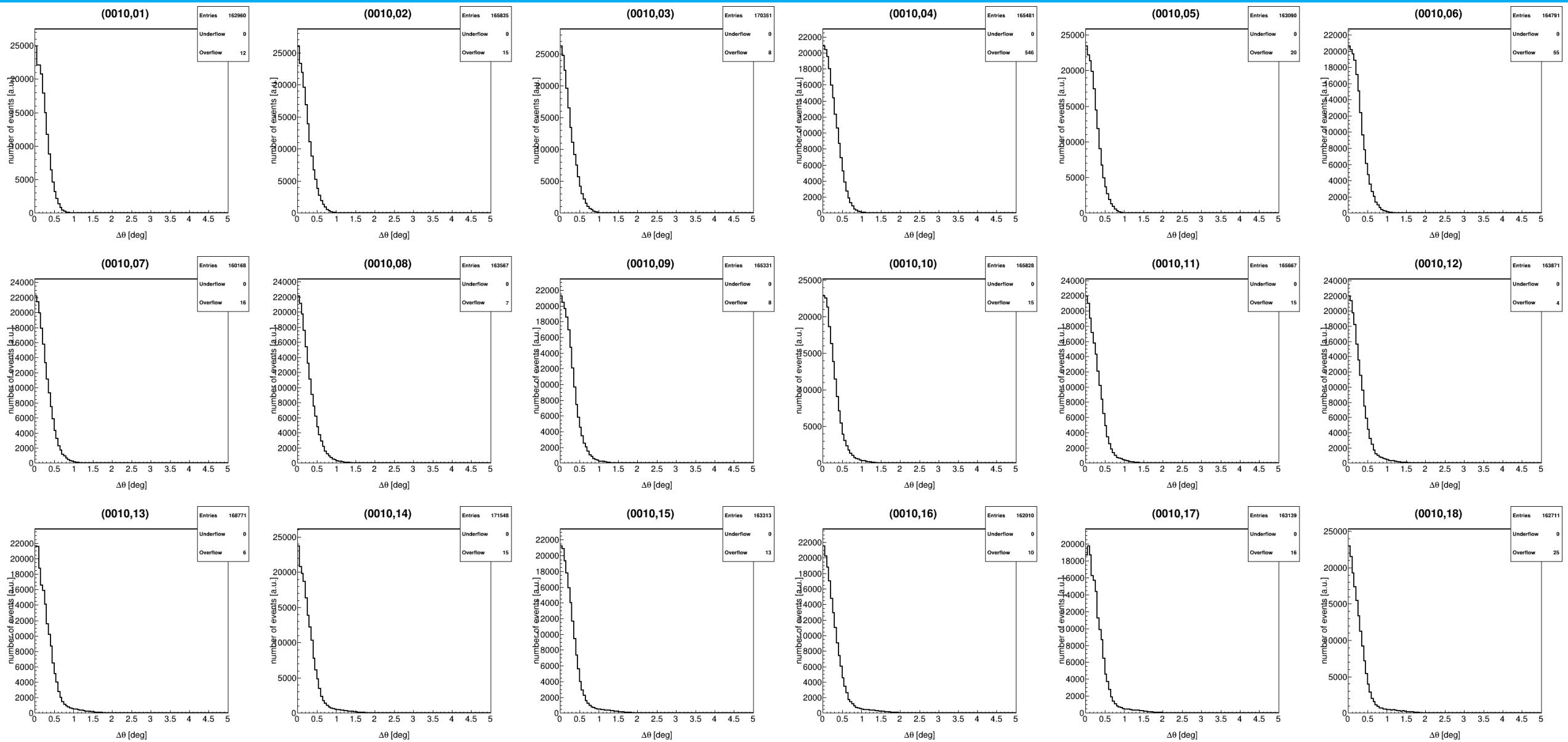
$\Delta\theta$ [°] →


(0003,01)
Entries 162940
Underflow 0
Overflow 12
No data
(0003,03)
Entries 162144
Underflow 0
Overflow 15
(0003,04)
Entries 163982
Underflow 0
Overflow 7
(0003,05)
Entries 159715
Underflow 0
Overflow 16
No data
No data
(0003,08)
Entries 167411
Underflow 0
Overflow 12
(0003,09)
Entries 164938
Underflow 0
Overflow 21
(0003,10)
Entries 161232
Underflow 0
Overflow 14
(0003,11)
Entries 161594
Underflow 0
Overflow 26
(0003,12)
Entries 167403
Underflow 0
Overflow 0
(0003,13)
Entries 165071
Underflow 0
Overflow 11
(0003,14)
Entries 165767
Underflow 0
Overflow 13
No data
(0003,16)
Entries 166249
Underflow 0
Overflow 34
(0003,17)
Entries 166881
Underflow 0
Overflow 18
(0003,18)
Entries 163544
Underflow 0
Overflow 10
number of events [a.u.]
Δθ [deg]

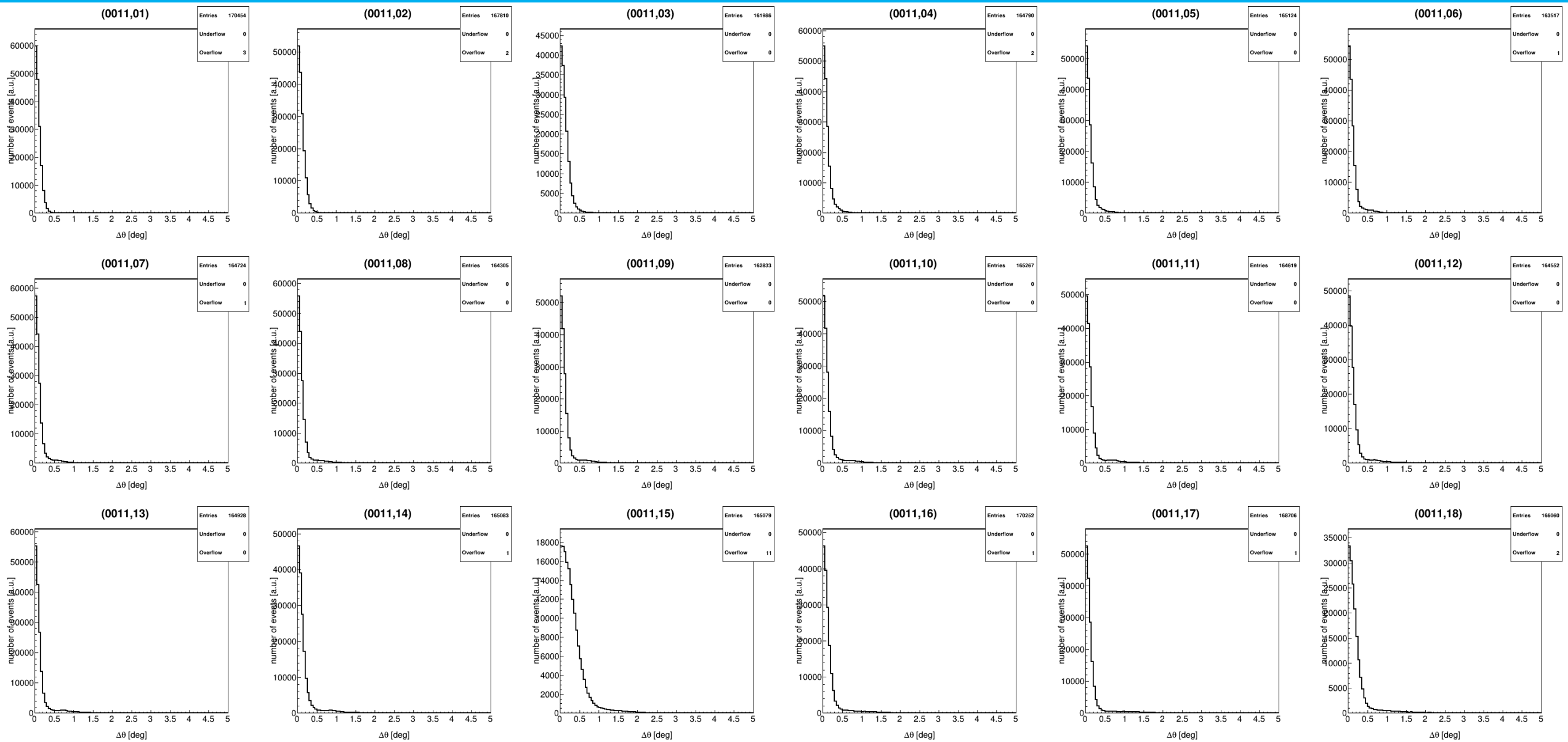
$\Delta\theta$ [°] →


(0009,01)
Entries 164979
Underflow 0
Overflow 17
(0009,02)
Entries 156942
Underflow 0
Overflow 12
(0009,03)
Entries 157875
Underflow 0
Overflow 74
(0009,04)
Entries 172603
Underflow 0
Overflow 17
(0009,05)
Entries 158515
Underflow 0
Overflow 20
(0009,06)
Entries 163442
Underflow 0
Overflow 25
(0009,07)
Entries 164119
Underflow 0
Overflow 29
(0009,08)
Entries 157392
Underflow 0
Overflow 12
(0009,09)
Entries 158738
Underflow 0
Overflow 24
(0009,10)
Entries 159127
Underflow 0
Overflow 26
(0009,11)
Entries 153647
Underflow 0
Overflow 13
(0009,12)
Entries 173085
Underflow 0
Overflow 7
(0009,13)
Entries 153641
Underflow 0
Overflow 10
(0009,14)
Entries 156303
Underflow 0
Overflow 8
No data
(0009,16)
Entries 157177
Underflow 0
Overflow 25
(0009,17)
Entries 163006
Underflow 0
Overflow 14
(0009,18)
Entries 156009
Underflow 0
Overflow 10
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →


(0010,01)
Entries 162960
Underflow 0
Overflow 12
(0010,02)
Entries 165835
Underflow 0
Overflow 15
(0010,03)
Entries 170351
Underflow 0
Overflow 8
(0010,04)
Entries 165481
Underflow 0
Overflow 546
(0010,05)
Entries 163090
Underflow 0
Overflow 20
(0010,06)
Entries 164791
Underflow 0
Overflow 55
(0010,07)
Entries 160168
Underflow 0
Overflow 16
(0010,08)
Entries 163567
Underflow 0
Overflow 7
(0010,09)
Entries 165331
Underflow 0
Overflow 8
(0010,10)
Entries 165828
Underflow 0
Overflow 15
(0010,11)
Entries 165667
Underflow 0
Overflow 15
(0010,12)
Entries 163871
Underflow 0
Overflow 4
(0010,13)
Entries 168771
Underflow 0
Overflow 6
(0010,14)
Entries 171548
Underflow 0
Overflow 15
(0010,15)
Entries 163313
Underflow 0
Overflow 13
(0010,16)
Entries 162010
Underflow 0
Overflow 10
(0010,17)
Entries 163139
Underflow 0
Overflow 16
(0010,18)
Entries 162711
Underflow 0
Overflow 25
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →


(0011,01)
Entries 170454
Underflow 0
Overflow 3
(0011,02)
Entries 167810
Underflow 0
Overflow 2
(0011,03)
Entries 161986
Underflow 0
Overflow 0
(0011,04)
Entries 164790
Underflow 0
Overflow 2
(0011,05)
Entries 165124
Underflow 0
Overflow 0
(0011,06)
Entries 163517
Underflow 0
Overflow 1
(0011,07)
Entries 164724
Underflow 0
Overflow 1
(0011,08)
Entries 164305
Underflow 0
Overflow 0
(0011,09)
Entries 162833
Underflow 0
Overflow 0
(0011,10)
Entries 165267
Underflow 0
Overflow 0
(0011,11)
Entries 164619
Underflow 0
Overflow 0
(0011,12)
Entries 164552
Underflow 0
Overflow 0
(0011,13)
Entries 164928
Underflow 0
Overflow 0
(0011,14)
Entries 165083
Underflow 0
Overflow 1
(0011,15)
Entries 165079
Underflow 0
Overflow 11
(0011,16)
Entries 170252
Underflow 0
Overflow 1
(0011,17)
Entries 168706
Underflow 0
Overflow 1
(0011,18)
Entries 166060
Underflow 0
Overflow 2
number of events [a.u.]
Δθ [deg]

$\Delta\theta$ [°] →

Conclusions & Outlook

- Fitting of AHRS data using quaternions works
  - allows for calibration of “offsets”
  - allows for determination of resolutions
- Definitions of signs of (yaw, pitch, roll) to be checked
- Selection of data to be defined and implemented