GeVgamma-Mtg

- Tracking with Test Chamber
- 2025.12.04

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Tracking with TC

Goal: Evaluation of ASAGI 16ch

What I want to do:

- Tracking with two test chambers at the same time:

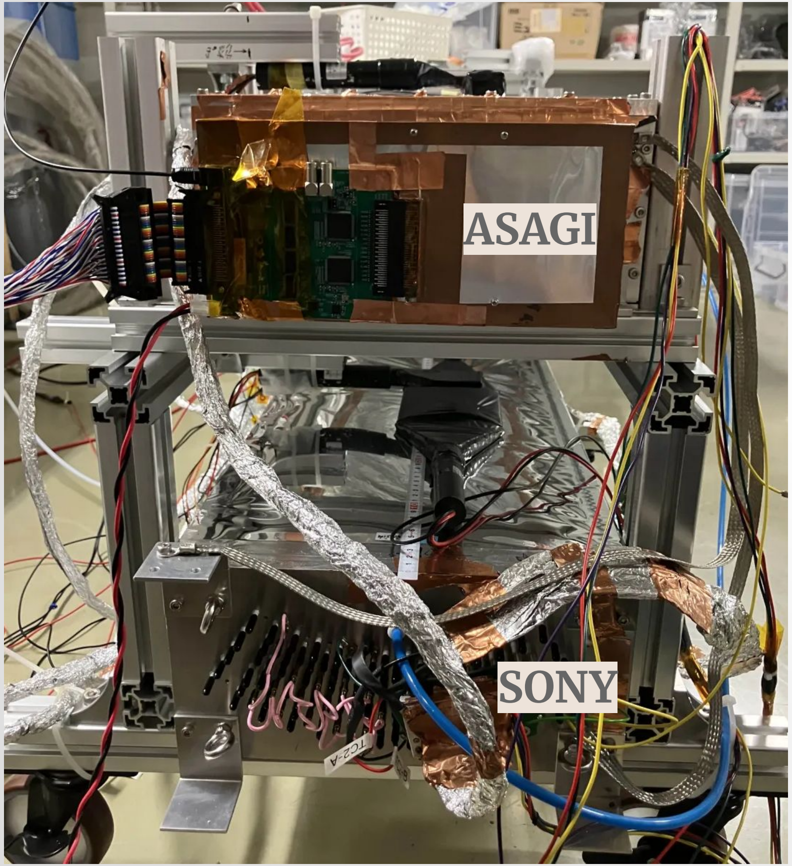
Before last week:

- Controlled the parameters of ASAGI (# of RC and V threshold).
- Got waveforms with some parameter set.
- Got rough efficiency with E15 test chamber (using 90Sr).
    - >99% was obtained (~-2750V).
    - Same level as the SONY-ASD (CXA3183Q):

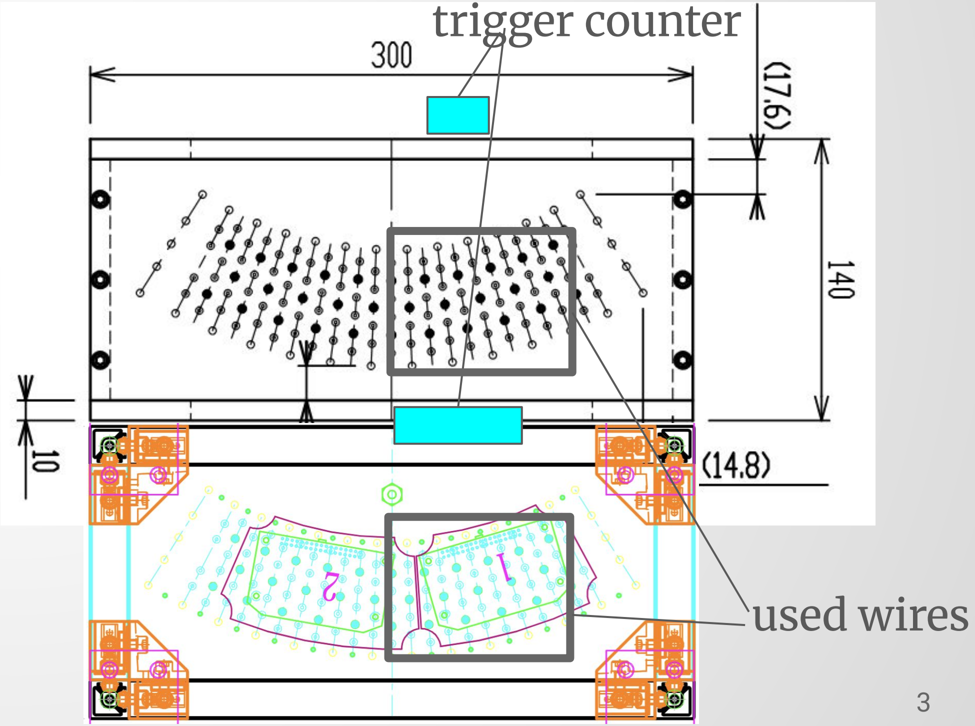
This week:

- Two test chamber
- Cosmic-ray
- Made my codes for tracking with each chamber.
    - But, XT curve correction didn't work...
- Corrected the relative alignment between the tow test chambers.

Tracking with TC: Setup



GasStudy / Run381
(/group/had/knucl/e15/detector_data/test_chmb/data_tc/tdc_2025Jul/)
ASAGI x E15-TC (18:44:11, Vth=-39.6mV)
SONY x E80-TC (Vth=-3V(?))
Ar-C2H6(50:50), -2800V
38,784 events / 10 days



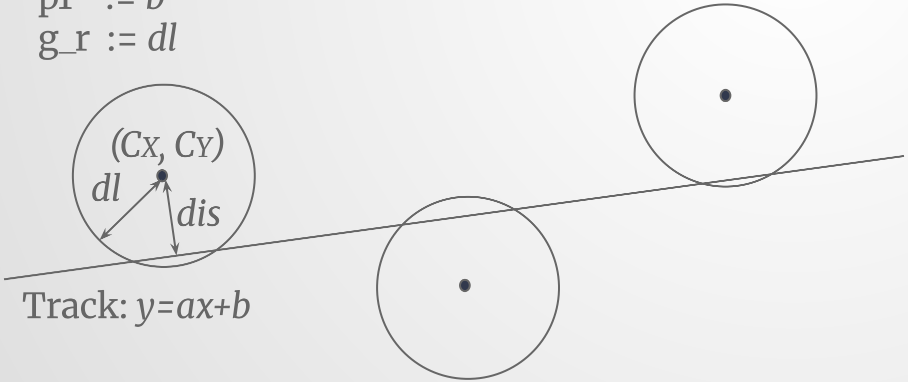
Tracking with TC: Minuit

*The detailed workflow is documented in the backup slides.

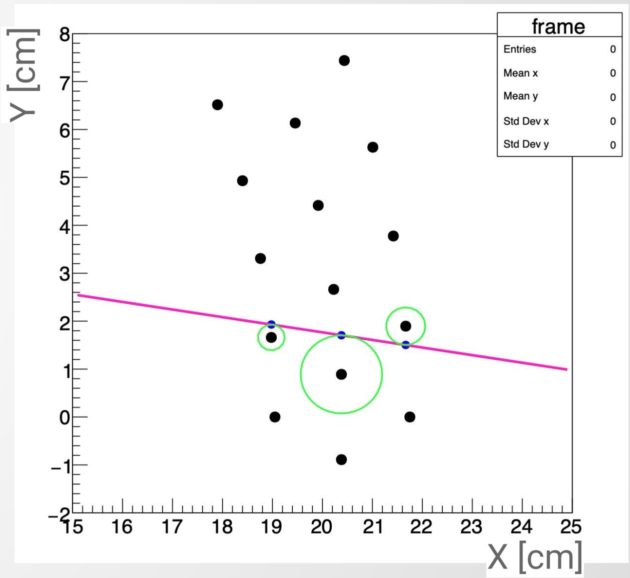
```
const double weight[3] = {2,1,2};

void residual2sum(int &npar, double *gin, double &f, double *par, int iflag) {
  double p0 = par[0];
  double p1 = par[1];
  f = 0.0;
  for (int i = 0; i < g_nhit; ++i) {
    double num = std::abs(p0 * g_cX[i] - g_cY[i] + p1);
    double dis = (num / std::sqrt(p0 * p0 + 1.0)) - g_r[i];
    f += dis * dis / weight[g_lay[i]%3];
  }
}
```

p0 := *a*
p1 := *b*
g_r := *dl*



Example

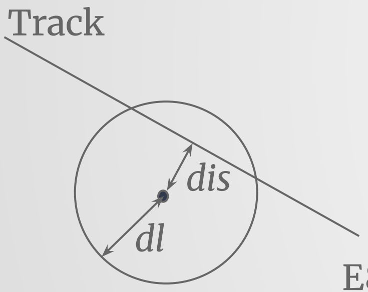


Tracking with TC: DriftTime [ns] vs Residual [um]

Before correction

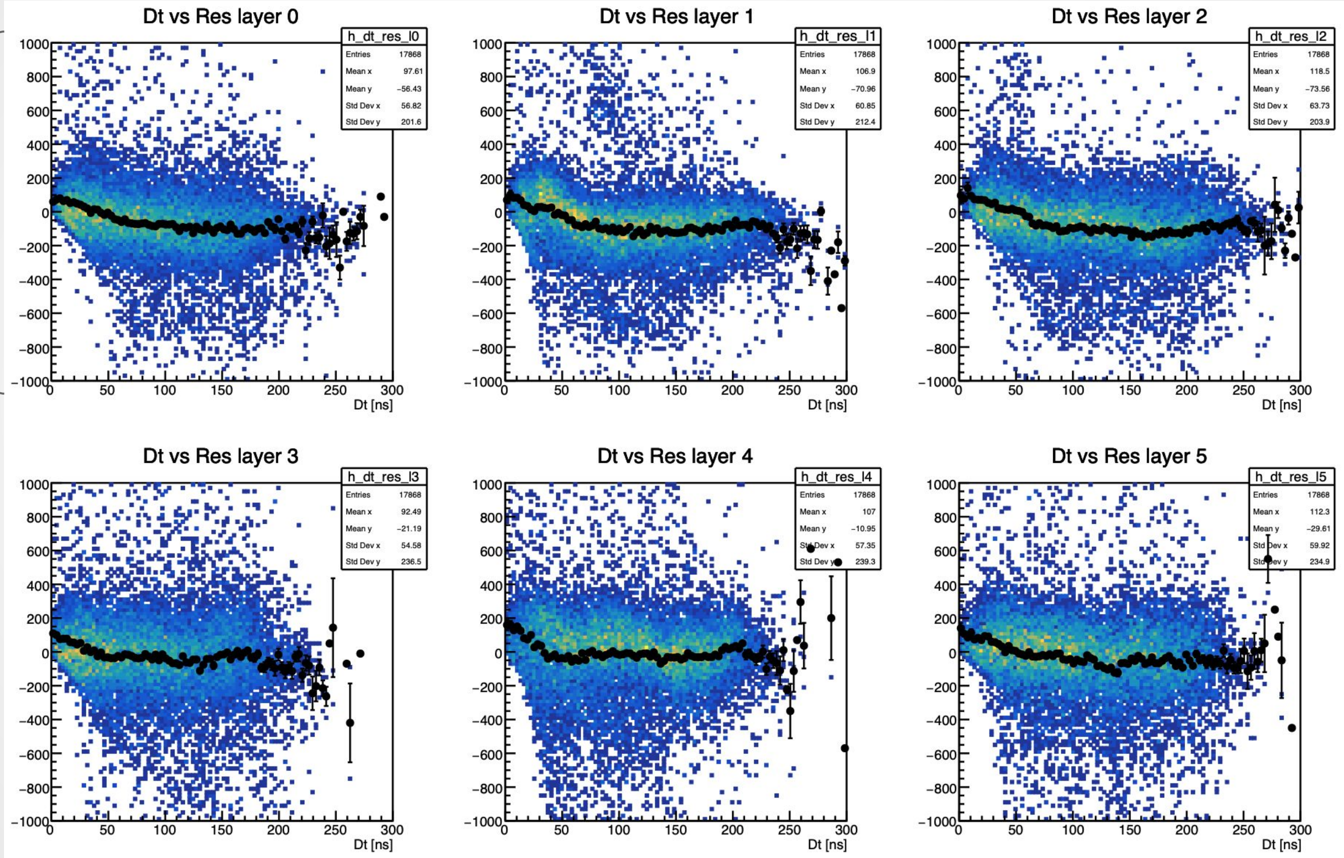
* Black dots are the **average of residuals for each Drift Time.**

Residual := dis - dl



E15-TC
x
ASAGI

E80-TC
x
SONY



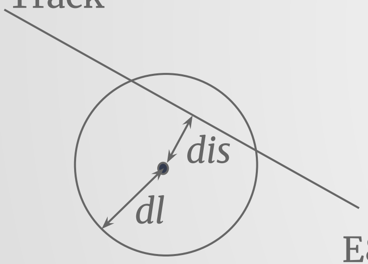
Tracking with TC: DriftTime [ns] vs Residual [um]

After correction

* Black dots are the **average of residuals for each Drift Time.**

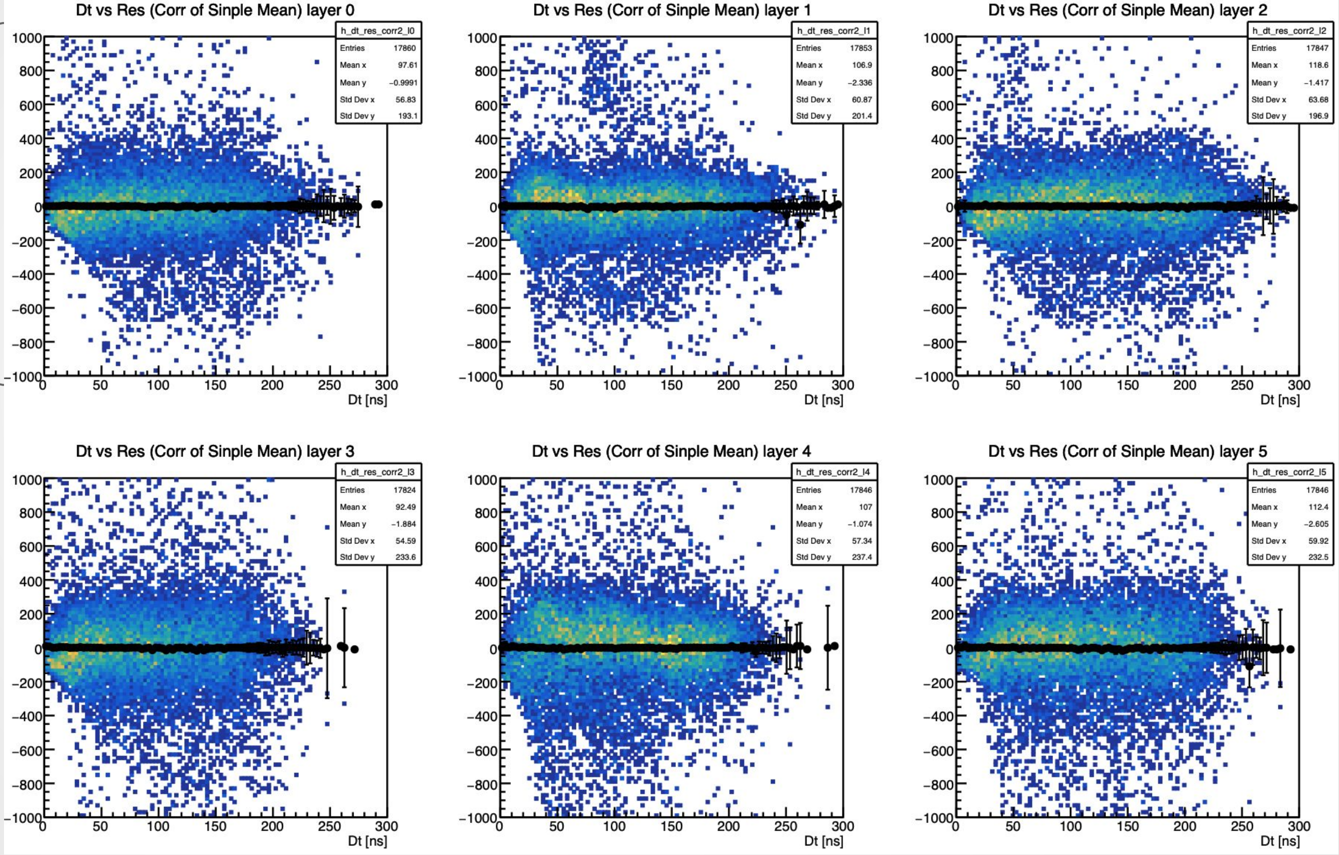
Residual := dis - dl

Track



E15-TC
x
ASAGI

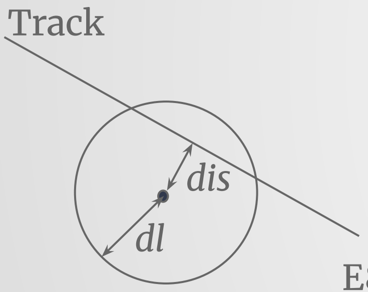
E80-TC
x
SONY



Tracking with TC: Residual [um]

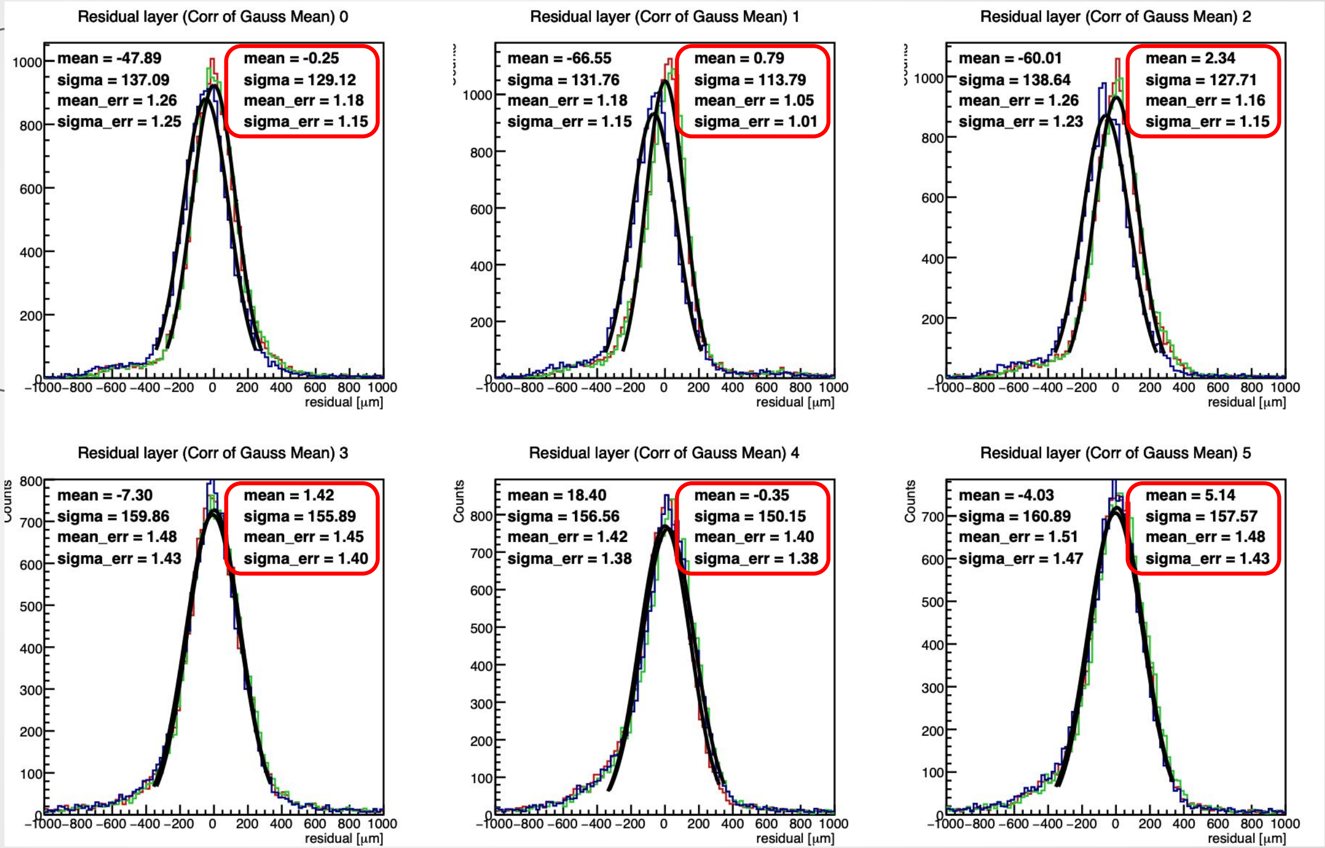
Before and **After** correction

Residual := dis - dl



E15-TC
x
ASAGI

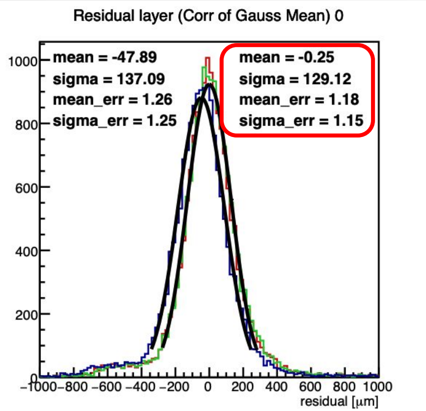
E80-TC
x
SONY



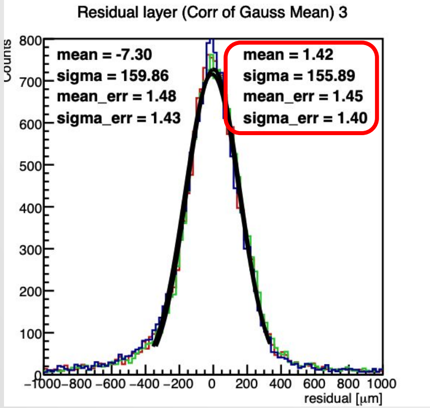
Tracking with TC: Residual comparison w/ E15-CDC

Before and After correction

E15-TC
x
ASAGI



E80-TC
x
SONY



From my m-thesis (E15-CDC)

4.4.6 位置分解能

ここでは位置分解能を残差分布を正規分布と考えた時のその標準偏差 σ と定義した。位置分解能の印加電圧依存性を全 Layer について図 4.45 に示す。

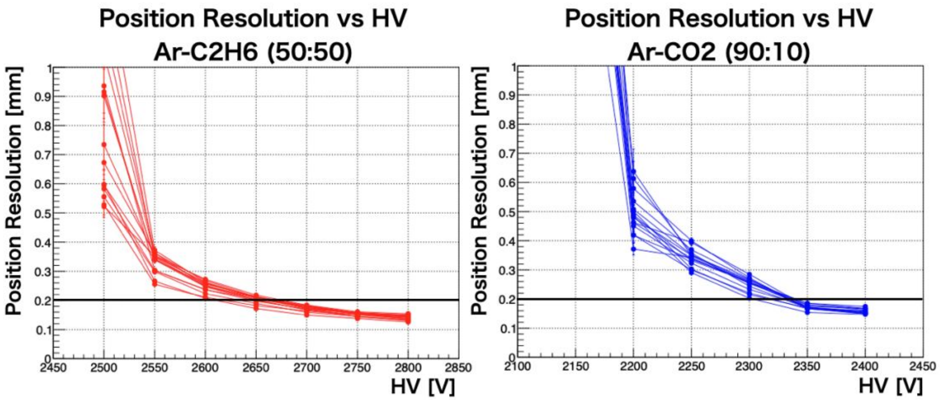


図 4.45: 位置分解能の印加電圧依存性

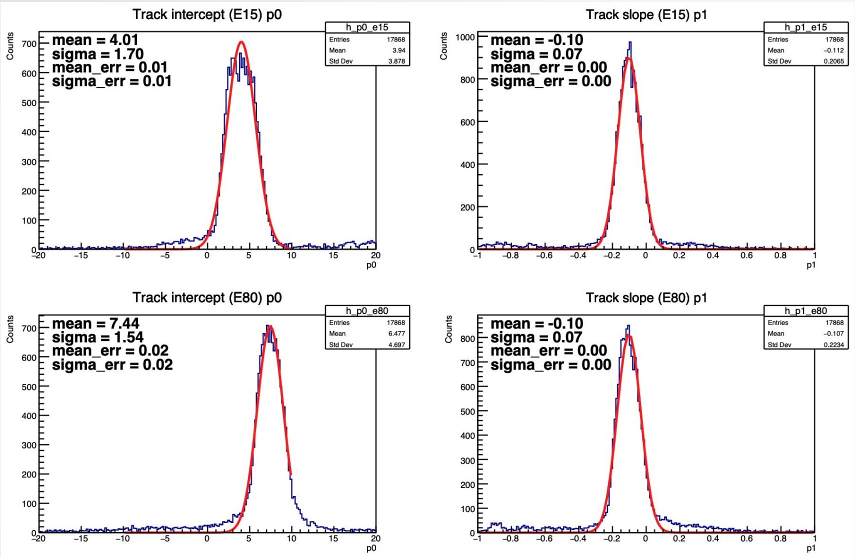
Even w/o XT correction, the values look reasonable. However, because only a few layers are used, this comparison should be only as a reference.

Tracking with TC: Parameter of the obtained tracks

Track: *y=ax+b*

E15-TC x ASAGI

E80-TC x SONY



b *a*

Current relative alignment

```
const std::pair<float,float> center_list[3][5] = { // [cm]
  {
    {19.05, 0}, {18.977509, 1.660316899}, {18.76058769, 3.307997785},
    {18.40088699, 4.930502809}, {17.90114443, 6.51548373}
  },
  {
    {20.38058372, -0.889835502}, {20.38058372, 0.889835502},
    {20.22547517, 2.662734321}, {19.91643855, 4.415368124},
    {19.4558258, 6.13439831}
  },
  {
    {21.75, 0}, {21.66723468, 1.895637405}, {21.41956863, 3.776847864},
    {21.00888672, 5.629314231}, {20.4383145, 7.438938117}
  }
};
```

```
// ===================================================================
//  E80 (layer 3,4,5) 用 center_list (E15 から x+20, y+1 シフト)
// ===================================================================
const std::pair<float,float> center_list_e80[3][5] = { // [cm]
  { // layer 3
    {39.05,       1.0},
    {38.977509,   2.660316899},
    {38.76058769, 4.307997785},
    {38.40088699, 5.930502809},
    {37.90114443, 7.51548373}
  },
  { // layer 4
    {40.38058372,  0.110164498},
    {40.38058372,  1.889835502},
    {40.22547517,  3.662734321},
    {39.91643855,  5.415368124},
    {39.4558258,   7.13439831}
  },
  { // layer 5
    {41.75,        1.0},
    {41.66723468,  2.895637405},
    {41.41956863,  4.776847864},
    {41.00888672,  6.629314231},
    {40.4383145,   8.438938117}
  }
};
```

The slope “a” is fully consistent, which is expected.

The intercept “b” differs by about 3.4 cm.

However, this is not enough to determine the relative alignment...

What should I do? Or maybe is that not necessary?

To do

- To make summary of gain of CDC and test chamber:

- To make codes to iterate correction of a XT parameter:
- Tracking with the two test chambers at the same time:
    - Tracking with 5 layers, then evaluating the other layer:

- Proceedings of HYP2025 (~ Jan. 31 2026?)
    - CDS
- RIKEN Accelerator Progress Report (~ Jan. 31 2026?)
    - ASAGI?

- To make a manual of ASAGI with Hanai-san and Shirotori-san:

Schedule

~2025.12.14 RIKEN : Test chamber analysis, Restoration of test chamber
~2025.12.23 Sendai : Intensive lectures
~2025.12.25 RIKEN :
~Holiday~
2026.1.5~ : Unknown

Backup

Tracking with TC: Workflow 1

1. **makeTree.C(381)**
   - Calculation of ToT
   - ch -> (Layer#, Wire#)

2. **makeXt.C(381)**
   - DriftTime -> DriftLength (pol 11)
     - Only first hits in ToT range is used.
     - To determine XT curve for each layer:

3. **makeHits.C(381, 0)**
   // The second argument is how many times the correction has been applied.
   - Re-make a tree to use for tracking later:

Tracking with TC: Workflow 2

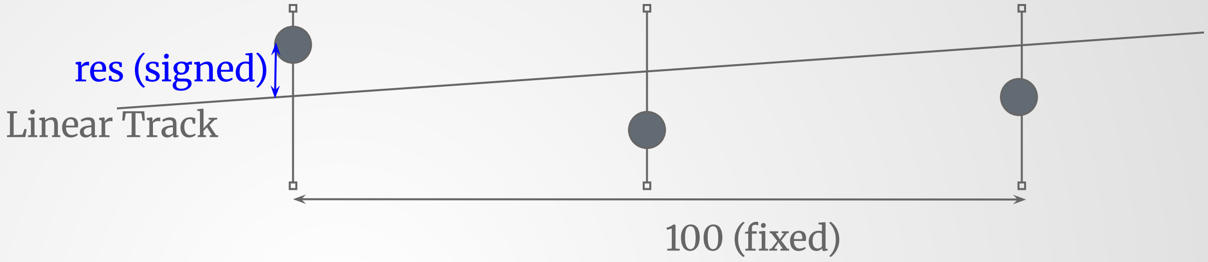
1. **runTracking.C(381, 0)**
    - Make clusters (all layers hits required).
        - # of clusters is typically 1~6.
    - Rough tracking to determine the best cluster:
    - Refine the track of the best cluster by “minuit”
        - Least-squares of difference between distance and drift length

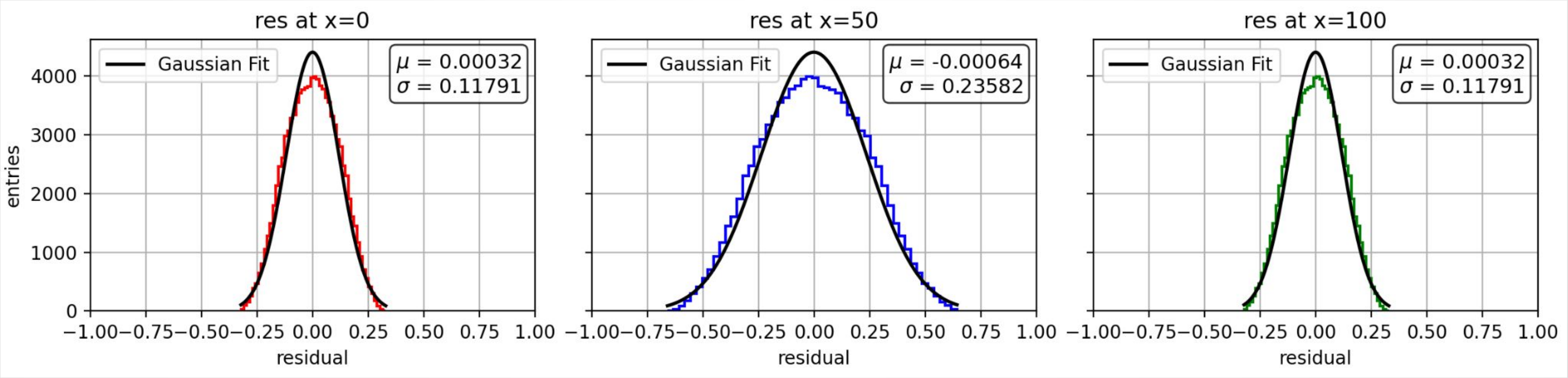
2. **checkTracks.C(381, 0)**
    - Forcible correction of Residual vs DriftTime (Not XT correction):
      -> Sigma of residual distribution as a rough resolution:
    - Determine “a” and “b” of the obtained tracks (y=ax+b)
    - Comparison “a” and “b” between E15-TC and E80-TC
    - Determine relative position of E80-TC with respect to the E15-TC

Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 1

Uniform distribution
(0 <= y <= 1)
-> sigma = 1/sqrt(12)

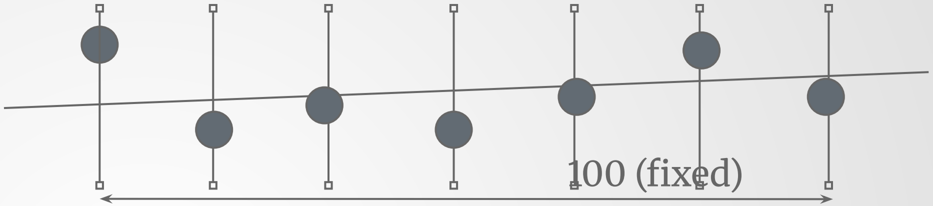


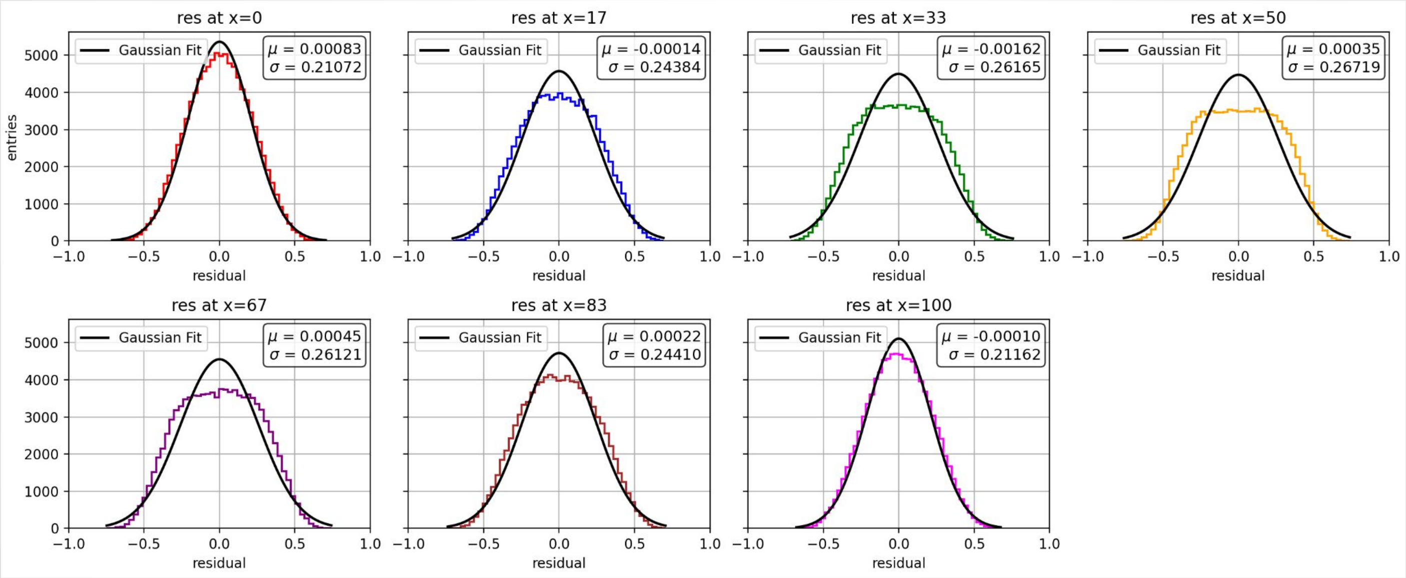


Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 5

Uniform distribution
(0 <= y <= 1) -> sigma = 1/sqrt(12)

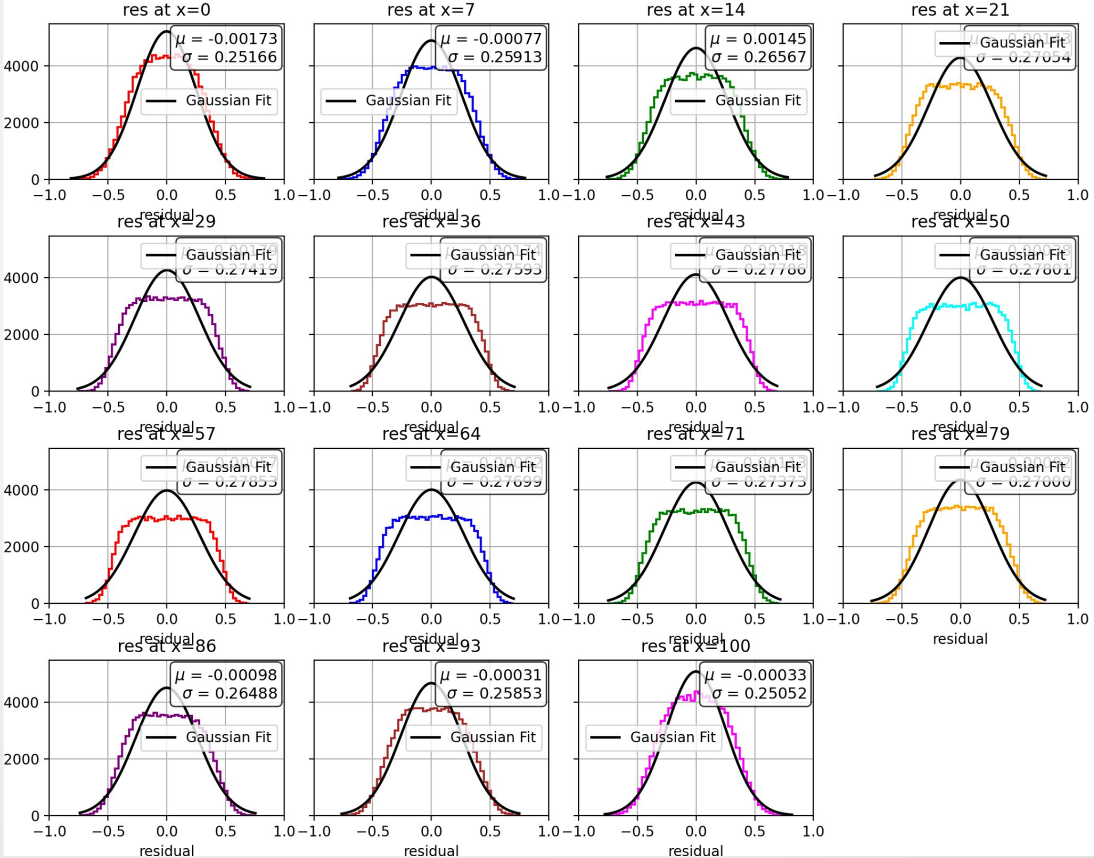




Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 13

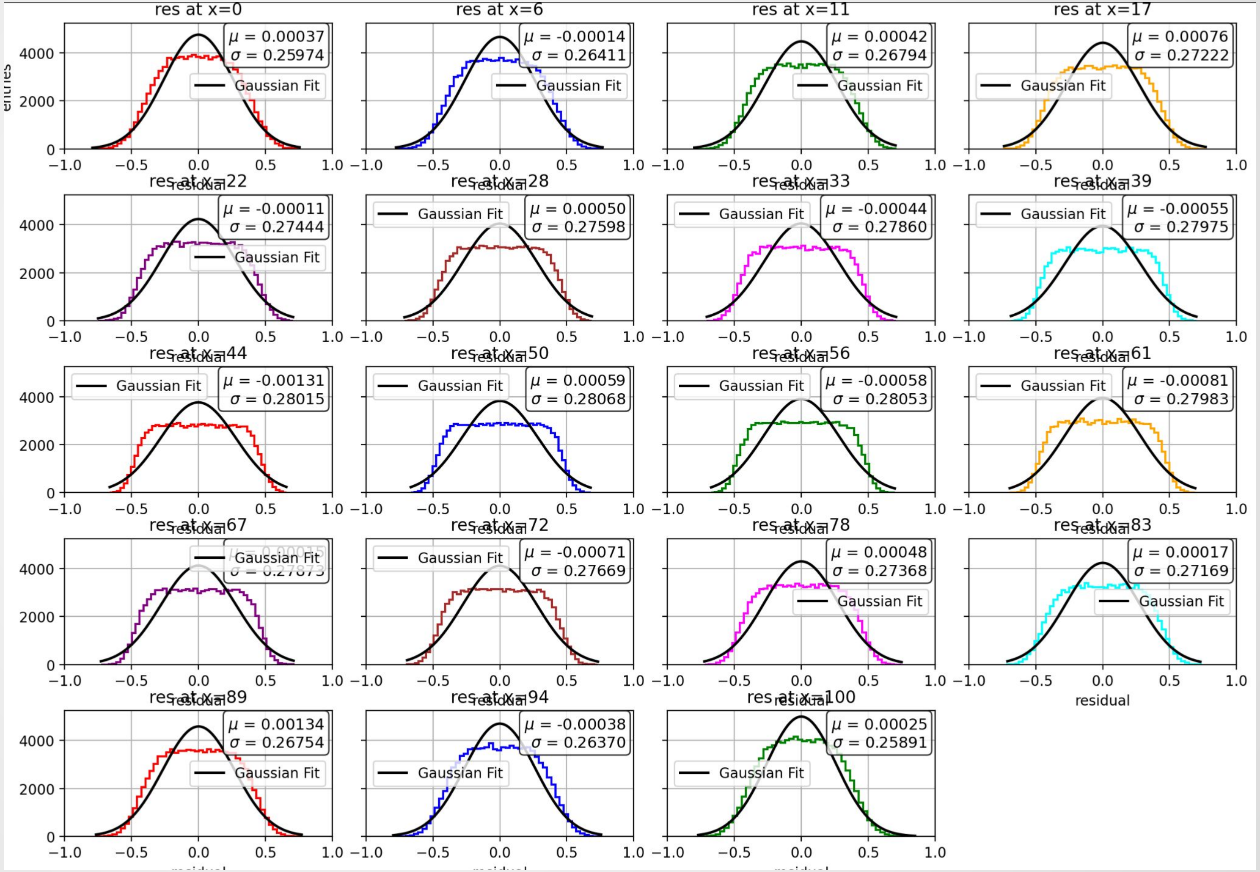
Uniform distribution
(0 <= y <= 1)
-> sigma = 1/sqrt(12)



Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 17

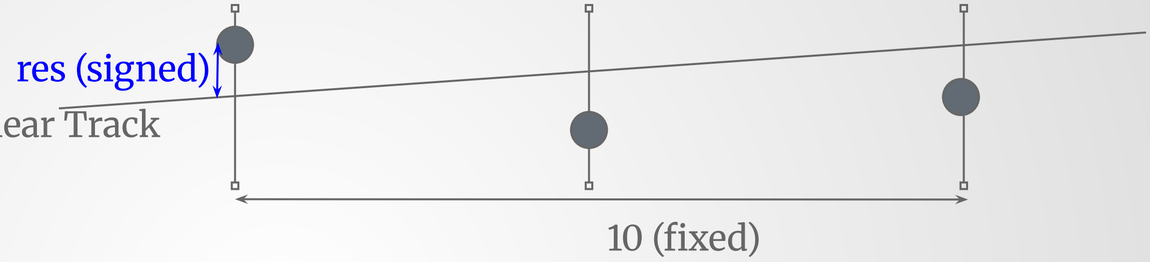
Uniform distribution
(0 <= y <= 1)
-> sigma = 1/sqrt(12)

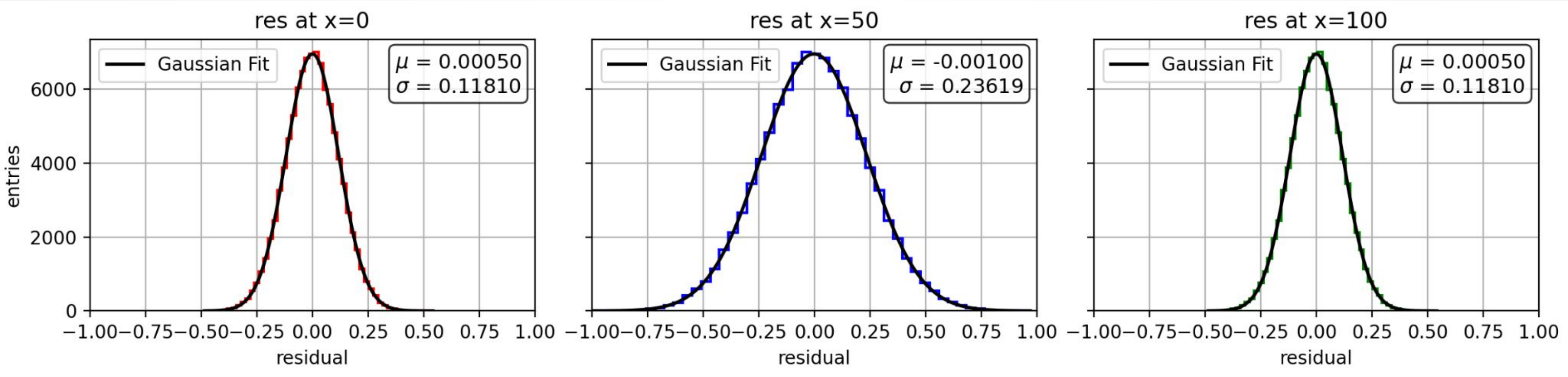


Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 1

Normal distribution
(sigma = 1/sqrt(12))

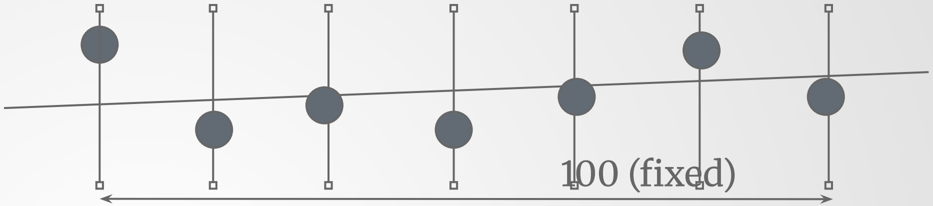


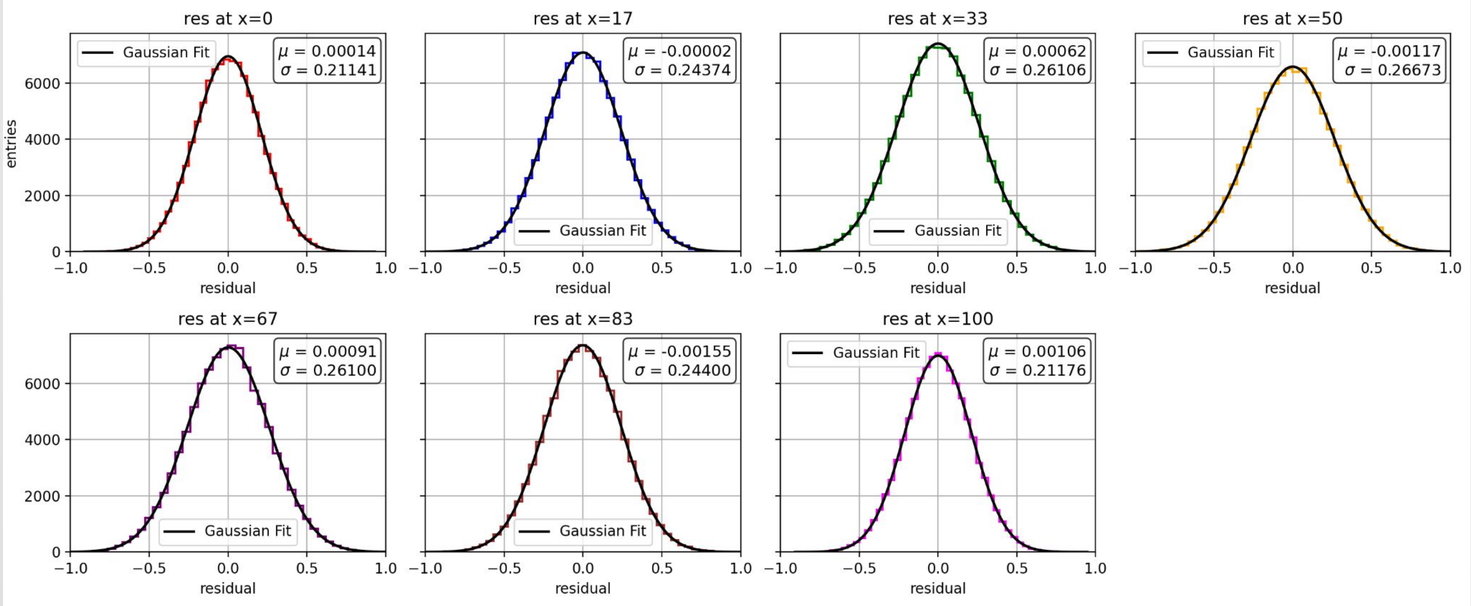


Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 5

Normal distribution
(sigma = 1/sqrt(12))

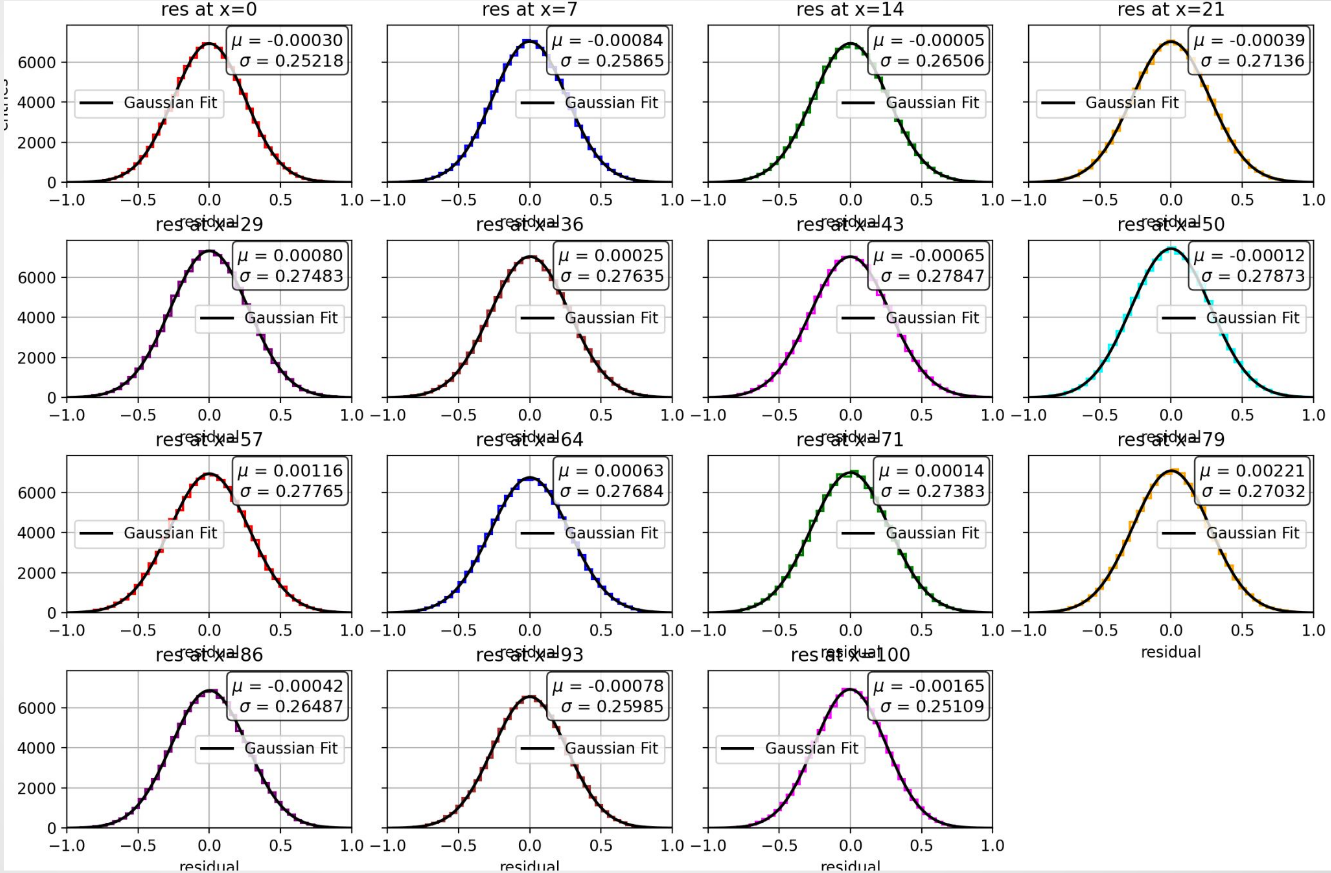




Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 13

Normal distribution
(sigma = 1/sqrt(12))



Simple simulation:
- How is residual distribution changed by NDF? -

NDF = 13

Normal distribution
(sigma = 1/sqrt(12))