DRIFT CHAMBER

Analysis workshop

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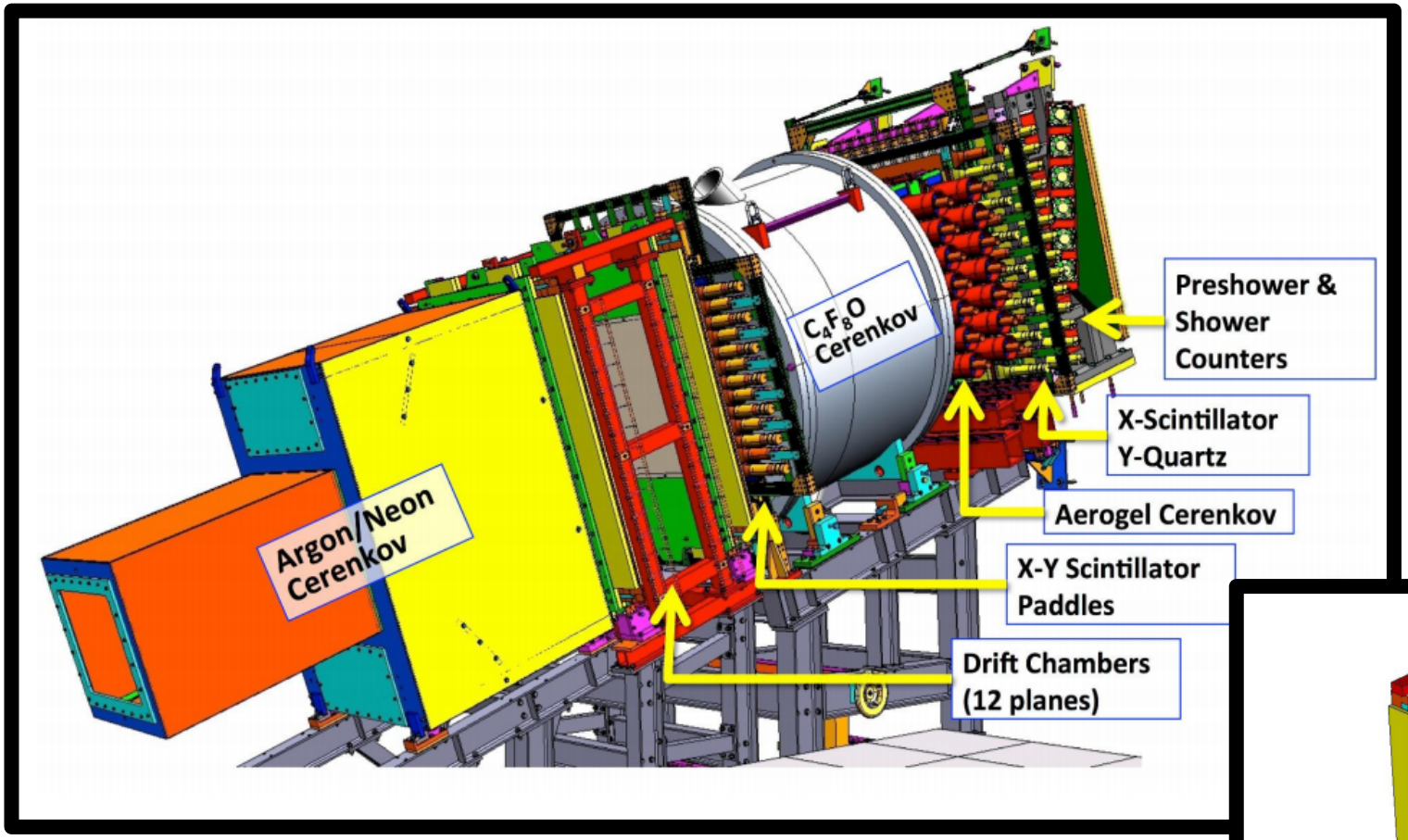
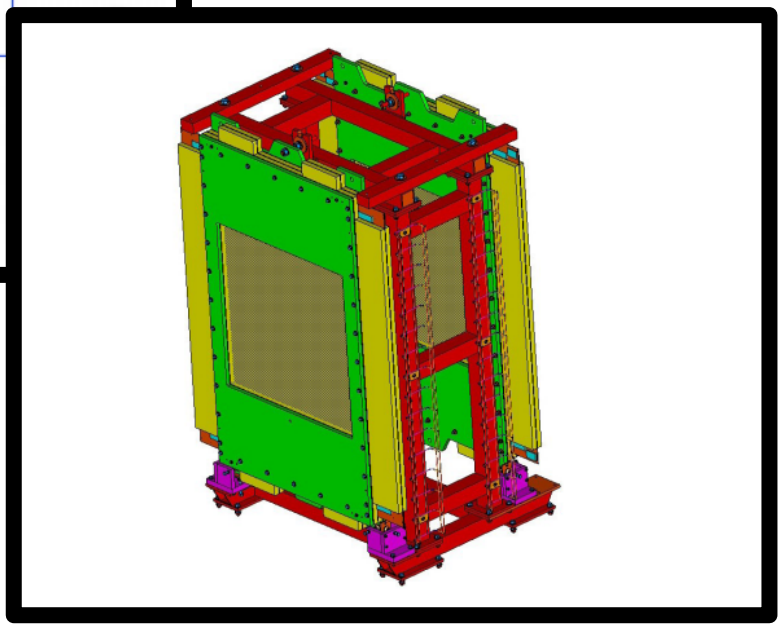
SHMS detector stack



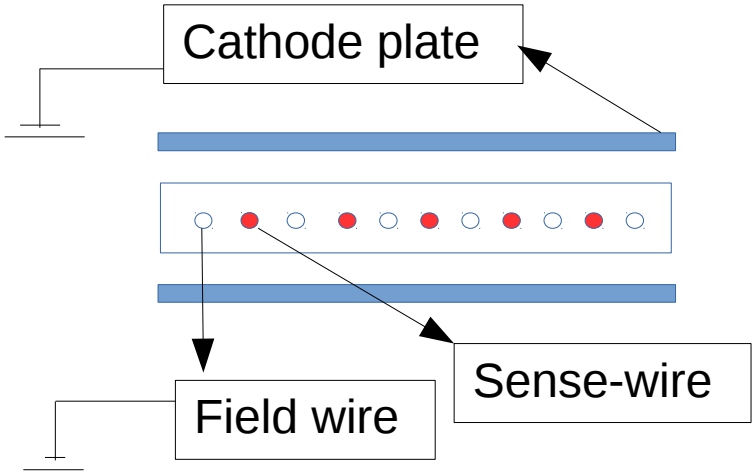


Drift-chamber is a detector used to determine the position of the particle and hence the trajectory.

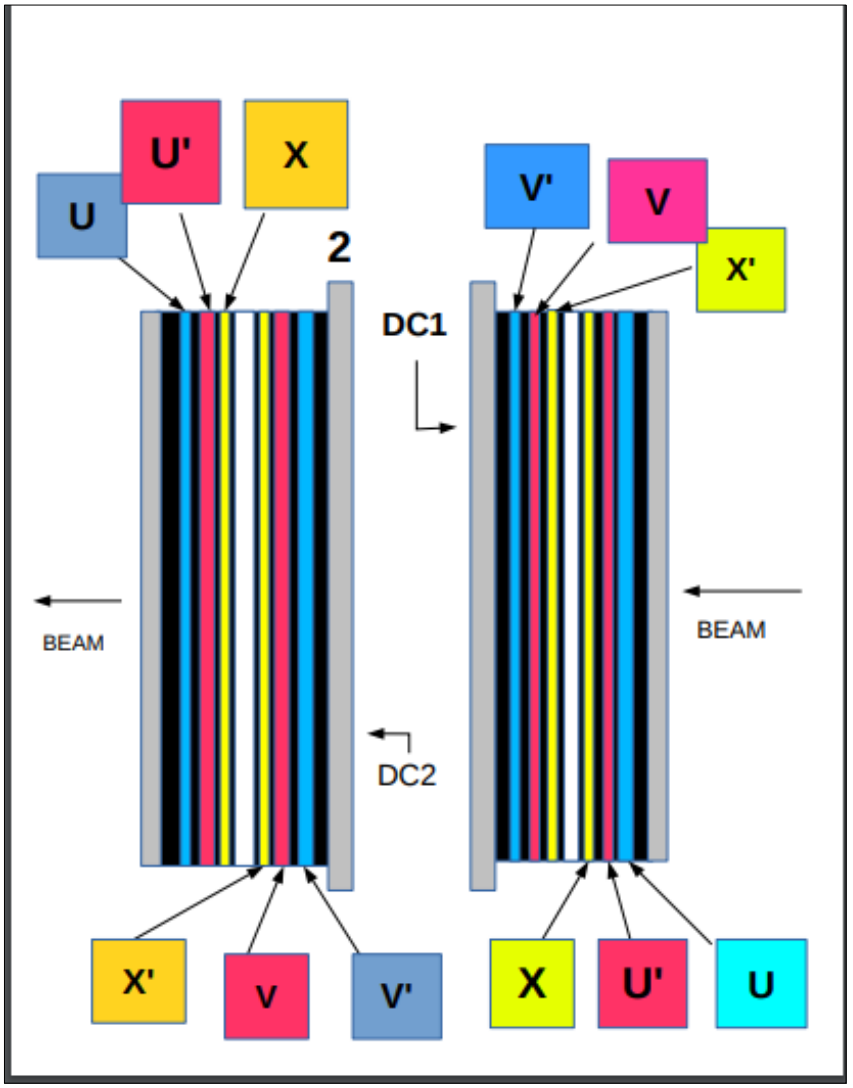
Fig: drift chamber mounted on hut frame

Components of chamber

- 2 chamber in each spectrometer
- Each chamber has 6 wire planes
- Each wire plane is sandwich between 2 cathode plane



Top view of chamber

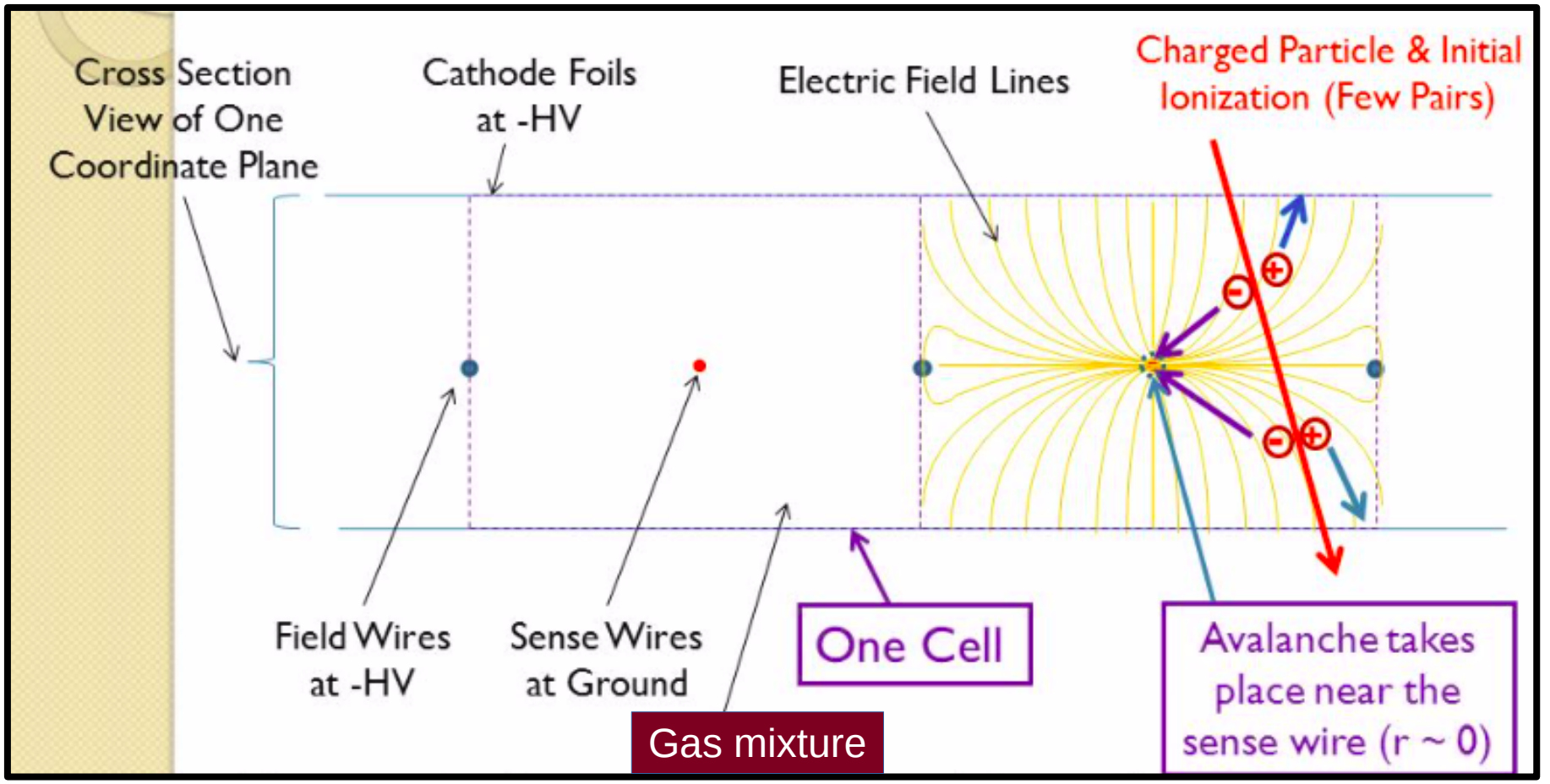


Gas mix
Ethane+Argon
50:50
By volume

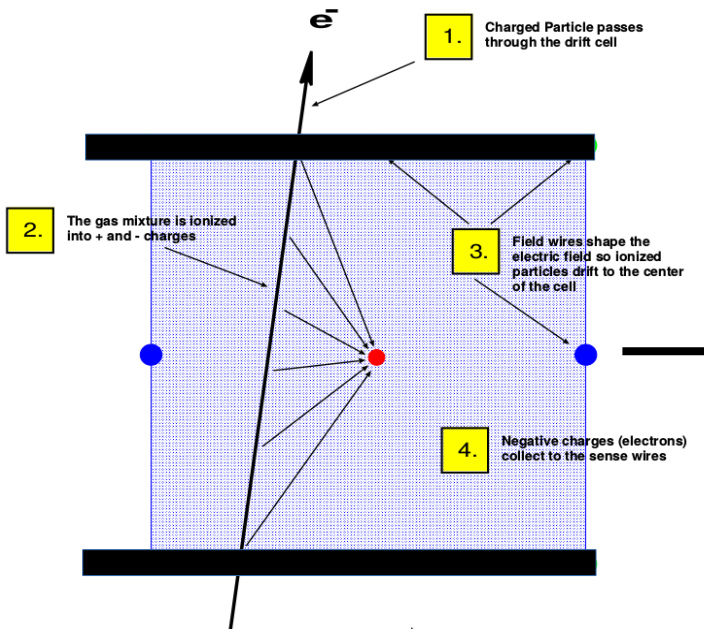
Ar = Ionization
Ethane = Quench

Working Principle of Drift Chamber

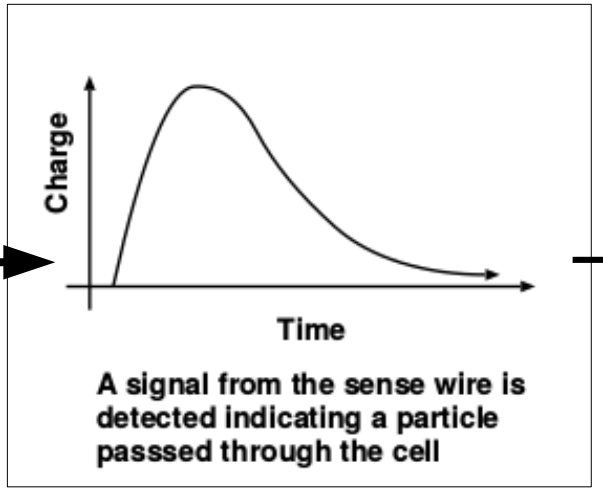
Incoming particles ionize the gas molecules, primary electrons are accelerated by electric field and knocks out the secondary electrons and eventually produces avalanche which induces a current signal on the sense wire.



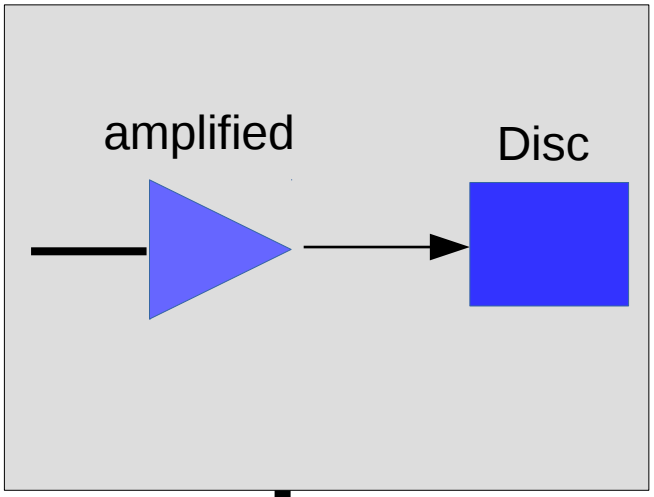
Working Principle of Drift Chamber

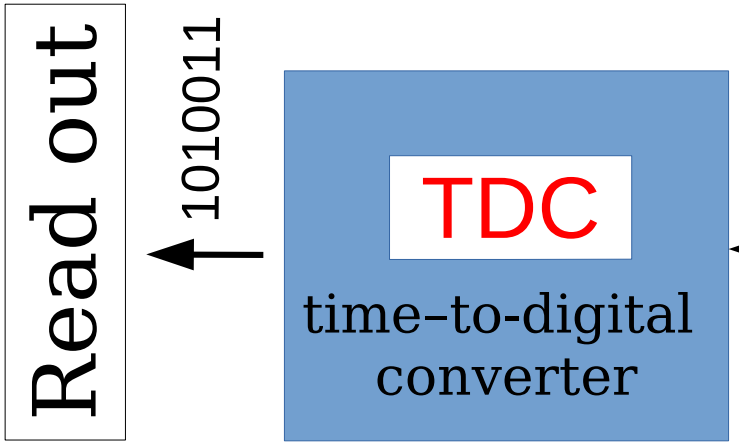


Single drift cell

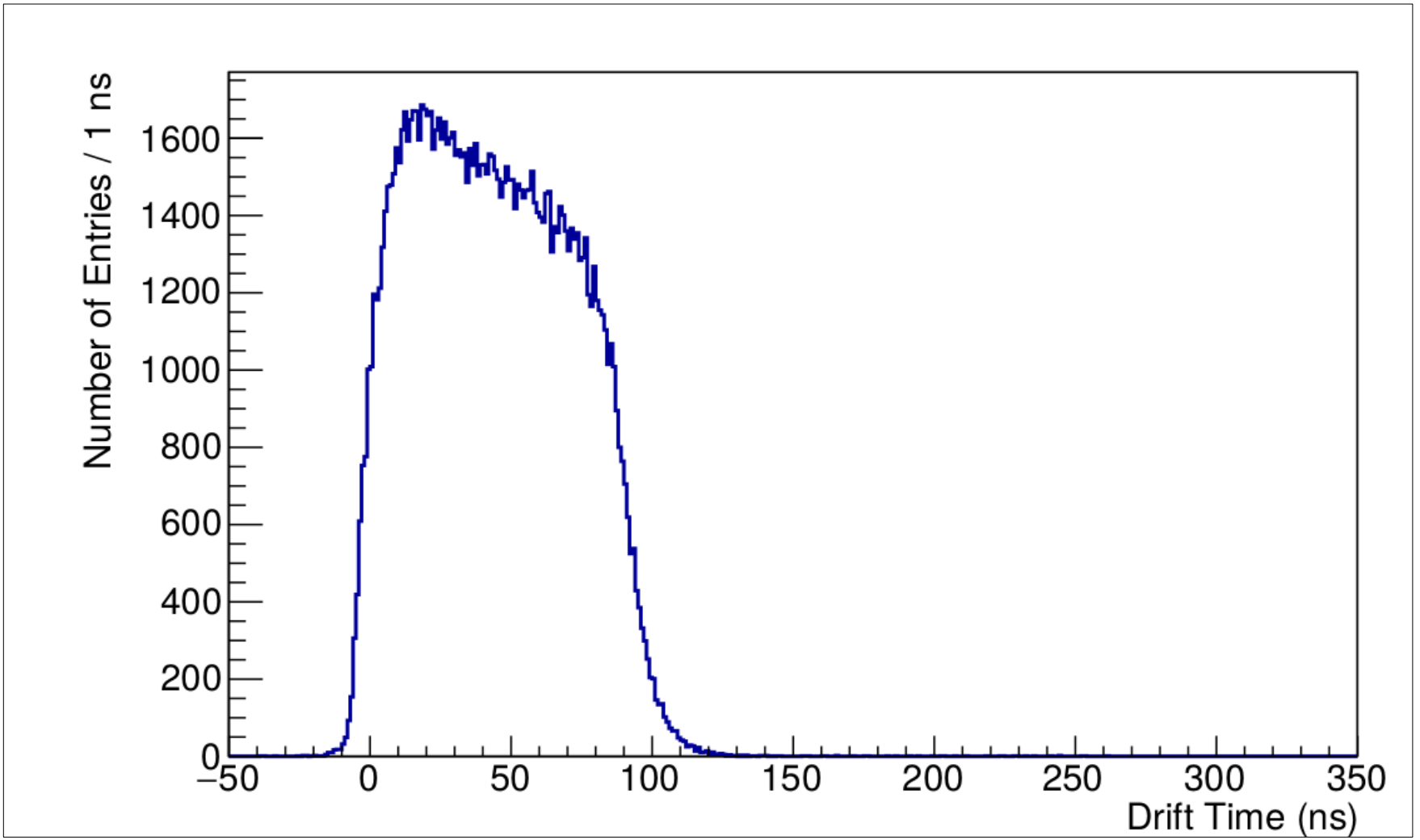


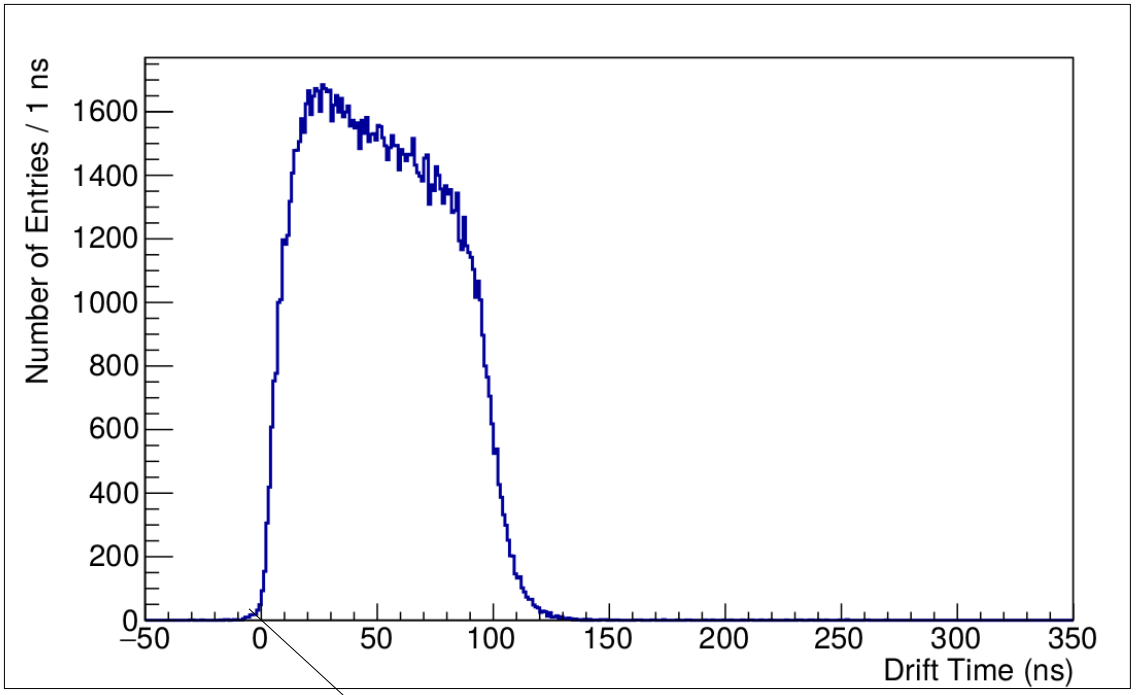
card attached directly to DC



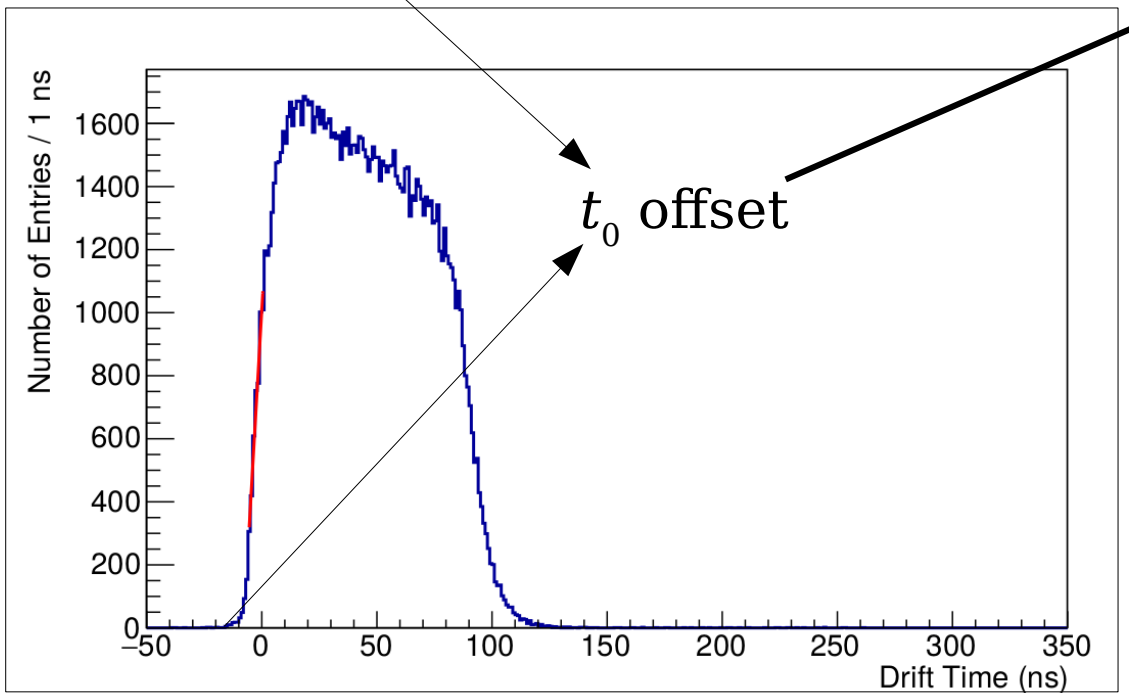


- TDC values from all of the wire in a given plane for a large number of events is taken to obtain a drift time distribution which is then averaged over all the wire of a plane to form a drift time distribution per plane.





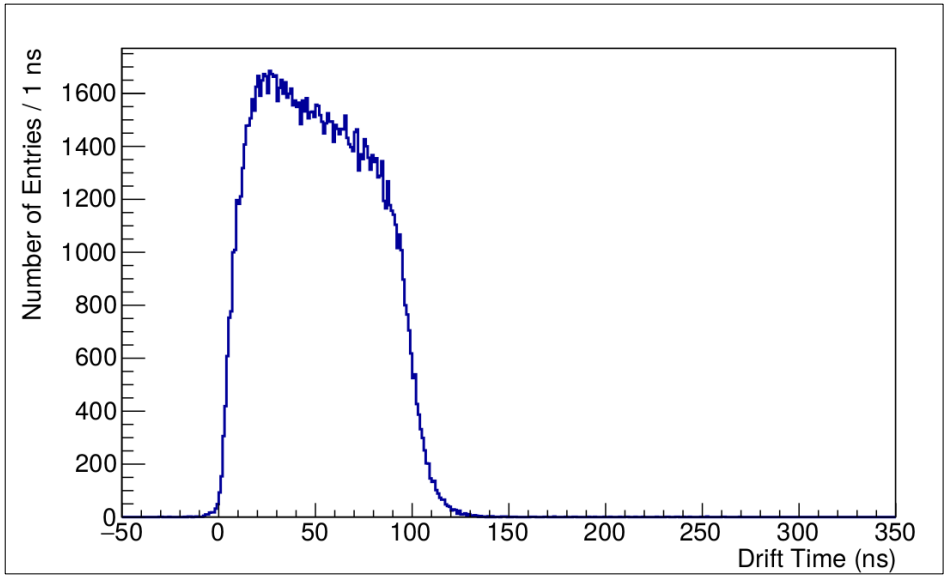
Ideal drift time should look like



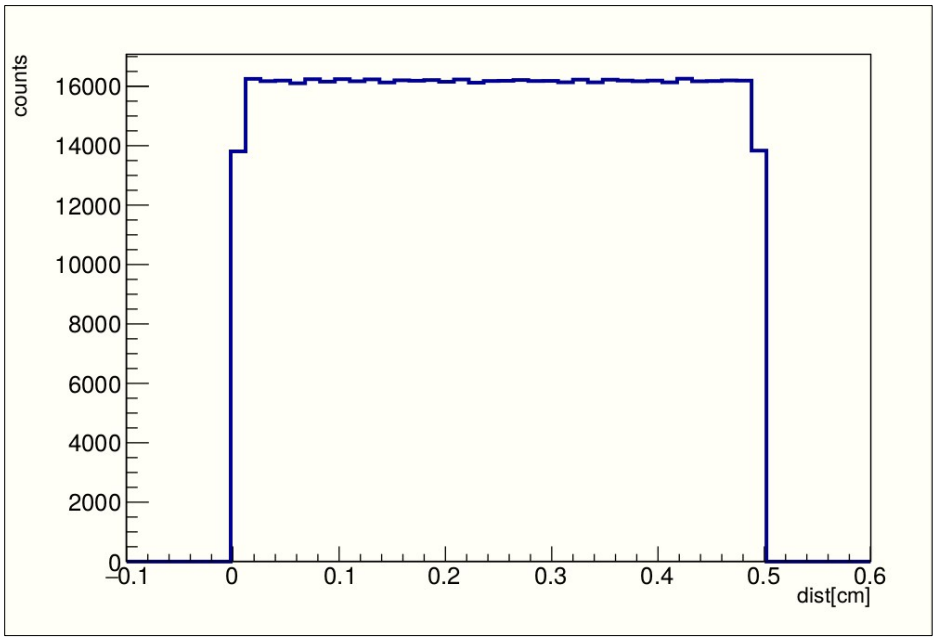
- It is difference between this two time

A part of calibration is to find the t_0 offset of each plane

After correcting t_0 offset



➔ Calibration procedure makes a lookup table to convert drift times to drift distances



Calibration procedure

Skinny rootfile

- To speed up the calibration we can trim the rootfiles
  - cd DEF-files/{spec}/DC/PRODUCTION/BLOCK
  - Change the **pblock_vars.def**

```
#********************
# Block Definitions *
#********************

block T.shms.*
block P.ngcer.*
block P.dc.*
block P.hod.*
block P.hgcer.*
block P.aero.*
block P.cal.*
block P.tr.*
block P.gtr.*
block P.kin.*
block P.rb.*
block P.react.*
```

```
#********************
# Block Definitions *
#********************

#block T.shms.*
#block P.ngcer.*
block P.dc.*
#block P.hod.*
#block P.hgcer.*
#block P.aero.*
#block P.cal.*
#block P.tr.*
#block P.gtr.*
#block P.kin.*
#block P.rb.*
#block P.react.*
```

Turning on only the dc block

```
-:---  pblock_vars.def    All L16    Git:test  (Fundamental)
Wrote /home/abishek/HallC/hallc_replay/DEF-files/SHMS/PRODUCTION/BLOCK/pblock_vars.def
```

Getting uncorrected rootfile

✔set the parameter '**p_using_tzero_per_wire = 0**' in the parameter file located at:

hallc_replay/PARAM/{spec}/DC/**pdc_cut.param**

```
; Utilize per wire tzero offsets, 1 means true
p_using_tzero_per_wire = 1

; TEST-STAND PARAMETERS
; Custom parameter file which should be loaded when aiming to analyze HMS DC
; data with no tracking.
psel_using_scin = 0

; TDC window limits for each plane.
pdc_tdc_min_win = -13000, -13000, -13000, -13000, -13000, -13000
                  -13000, -13000, -13000, -13000, -13000, -13000
pdc_tdc_max_win = -10000, -10000, -10000, -10000, -10000, -10000
                  -10000, -10000, -10000, -10000, -10000, -10000

pdc_fix_lr = 1
pdc_fix_propcorr = 1

; Zero time correction for each plane in ns that is added to TDC time.
pdc_plane_time_zero = 1290.00, 1290.00, 1290.00, 1290.00, 1290.00, 1290.00
                      1290.00, 1290.00, 1290.00, 1290.00, 1290.00, 1290.00
```

Replay the Run

- From hallc_replay

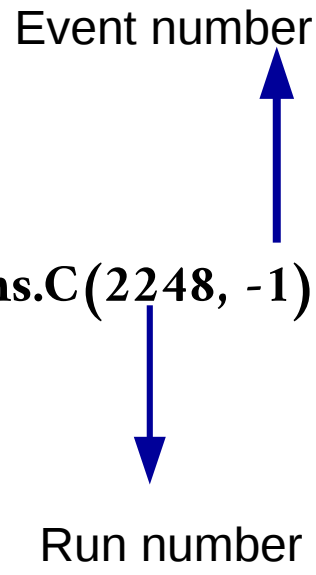
  Execute

  ./hcana

  .x SCRIPTS/{spec}/PRODUCTION/{spec}_replay_production_all_{spec}.C

  With run Number and the event number as argument

  (take higher event number for better result)



Example :

./hcana SCRIPTS/SHMS/PRODUCTION/shms_replay_production_all_shms.C(2248, -1)

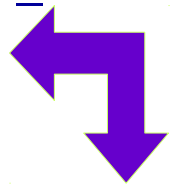
Main Calibration code

- Run the calibration script with the newly produced root file as input

Code reside at :

hallc_replay/CALIBRATION/dc_calib/script

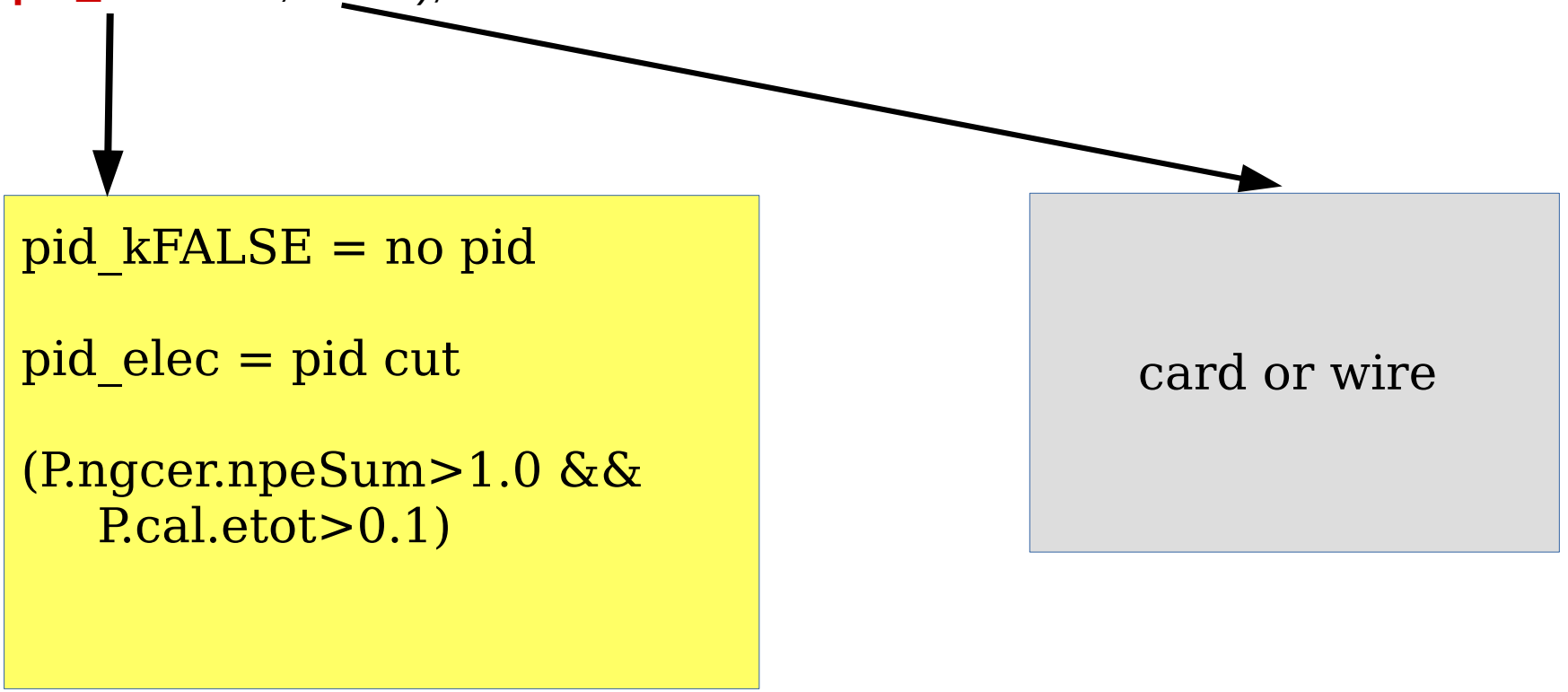
Open file **main_calib.C**



```
using namespace std;

int main_calib()
{

  //prevent root from displaying graphs while executing
  gROOT->SetBatch(1);


  //measure execution time
  clock_t cl;
  cl = clock();

                                                                          //pid_elec, pid_kFALSE (no PID cuts)
                                                                          // |
                                                                          // v
  //  DC_calib obj("HMS", "../../../ROOTfiles/hms_replay_production_all_1856_hodtrefcut1000_-1.root", 1856,-1, "pid_elec", "card");

    DC_calib obj("SHMS", "../../../ROOTfiles/shms_replay_production_all_1791_-1.root", 1791, -1, "pid_kFALSE", "card");

  // DC_calib obj("HMS", "../../../ROOTfiles/hms_coin_replay_production_1866_1000000.root", 1866, 1000, "pid_kFALSE");

  obj.setup_Directory();
```

DC_calib obj("**SHMS**", "../../../ROOTfiles/**shms_replay_production_all_2248_-1.root**", **2248**, **-1**,

"**pid_kFALSE**", "card");



- Run the script by :

root -l main_calib.C

Produce folder → SHMS_DC_cardlog_run#

This folder contains

pdc_calib_2248.param
pdc_tzero_per_wire_2248.param
SHMS_DC_driftimes.root
t_zeroCARD_values_1u1.dat
t_zeroCARD_values_1u2.dat
t_zeroCARD_values_1v1.dat
t_zeroCARD_values_1v2.dat
t_zeroCARD_values_1x1.dat
t_zeroCARD_values_1x2.dat
t_zeroCARD_values_2u1.dat
t_zeroCARD_values_2u2.dat
t_zeroCARD_values_2v1.dat
t_zeroCARD_values_2v2.dat
t_zeroCARD_values_2x1.dat
t_zeroCARD_values_2x2.dat

pdc_calib_2248.param
pdc_tzero_per_wire_2248.param
SHMS_DC_drifttimes.root
t_zeroCARD_values_1u1.dat
t_zeroCARD_values_1u2.dat
t_zeroCARD_values_1v1.dat
t_zeroCARD_values_1v2.dat
t_zeroCARD_values_1x1.dat

- **Copy this two file**

  pdc_calib_2248.param

  pdc_tzero_per_wire_2248.param

- **To this location:**

  hallc_replay/PARAM/SHMS/DC/

In the DC folder:

~cp pdc_calib_run#.param pdc_calib.param

~cp pdc_tzero_per_wire_run#.param pdc_tzero_per_wire.param

(hallc_replay/{spec}/DC)

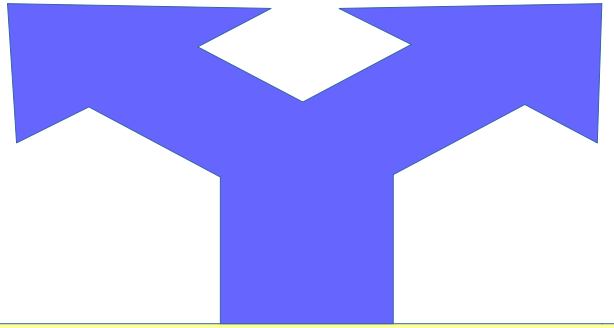
~Turn on the flag

p_using_tzero_per_wire = 1

From the hallc_replay directory replay the script again:

Look for this two variables in rootfile to validate the calibration

→ P.dc.{plane}.dist & P.dc.residual[i]

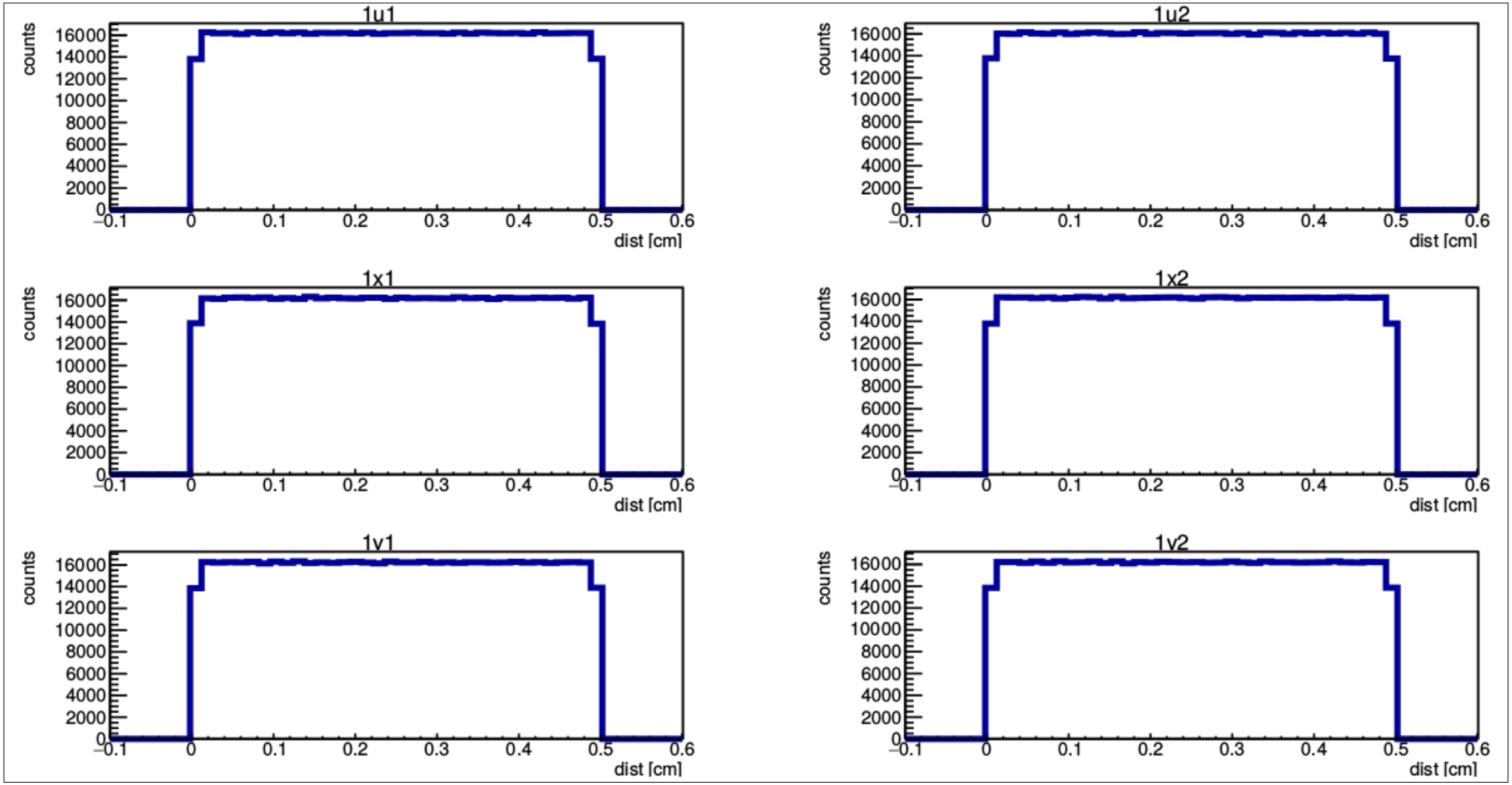


(biased by other plane)

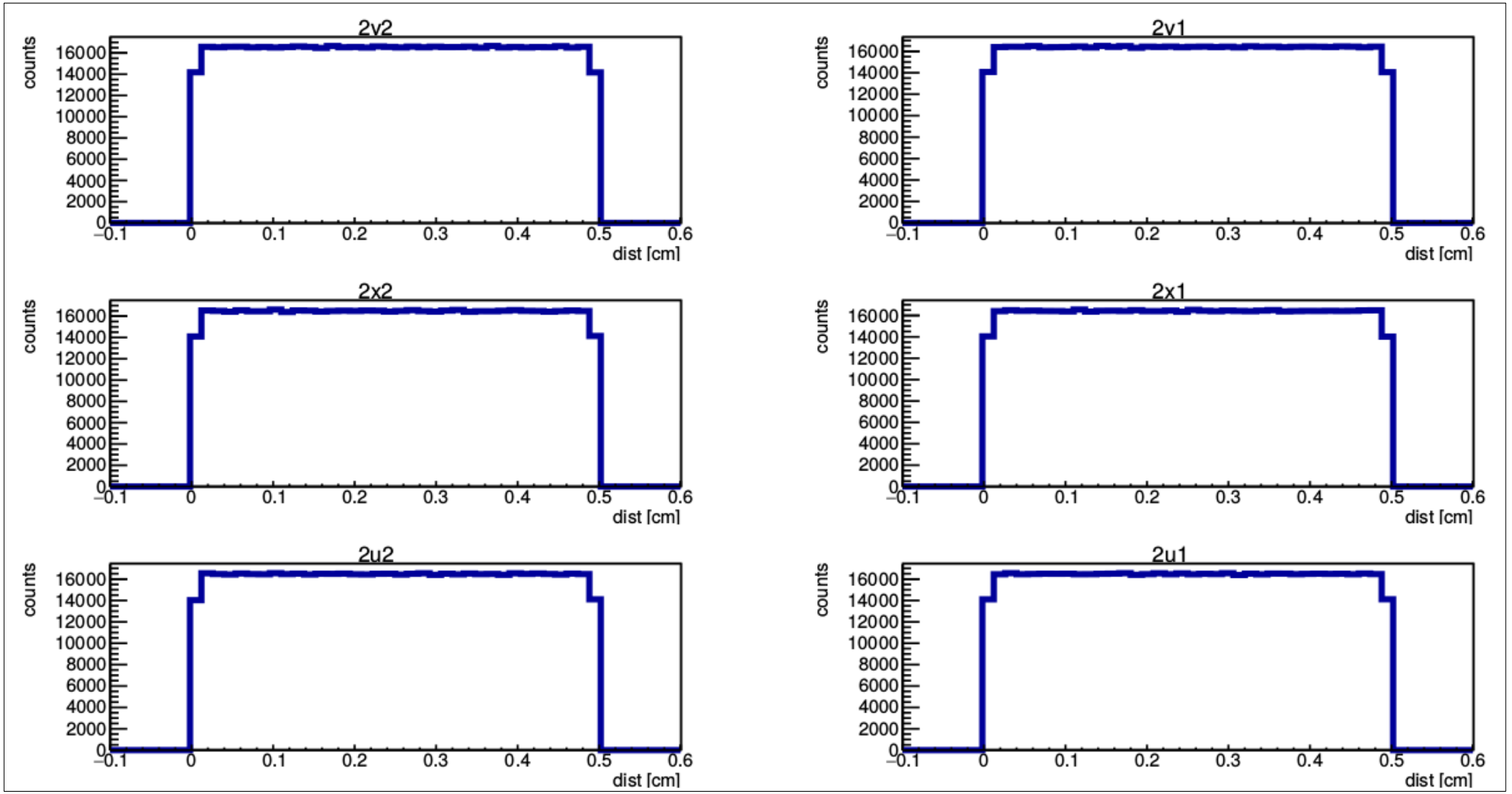
Planes = "1u1" = residual [0]
Planes = "1u2" = residual [1]
Planes = "1x1" = residual [2]
Planes = "1x2" = residual [3]
Planes = “1v1" = residual [4]
Planes = "1v2" = residual [5]
Planes = "2v2" = residual [6]
Planes = "2v1" = residual [7]
Planes = "2x2" = residual [8]
Planes = "2x1" = residual [9]
Planes = "2u2" = residual [10]
Planes = "2u1" = residual [11]

→ P.dc.{plane}.residualsExclPlane[i]

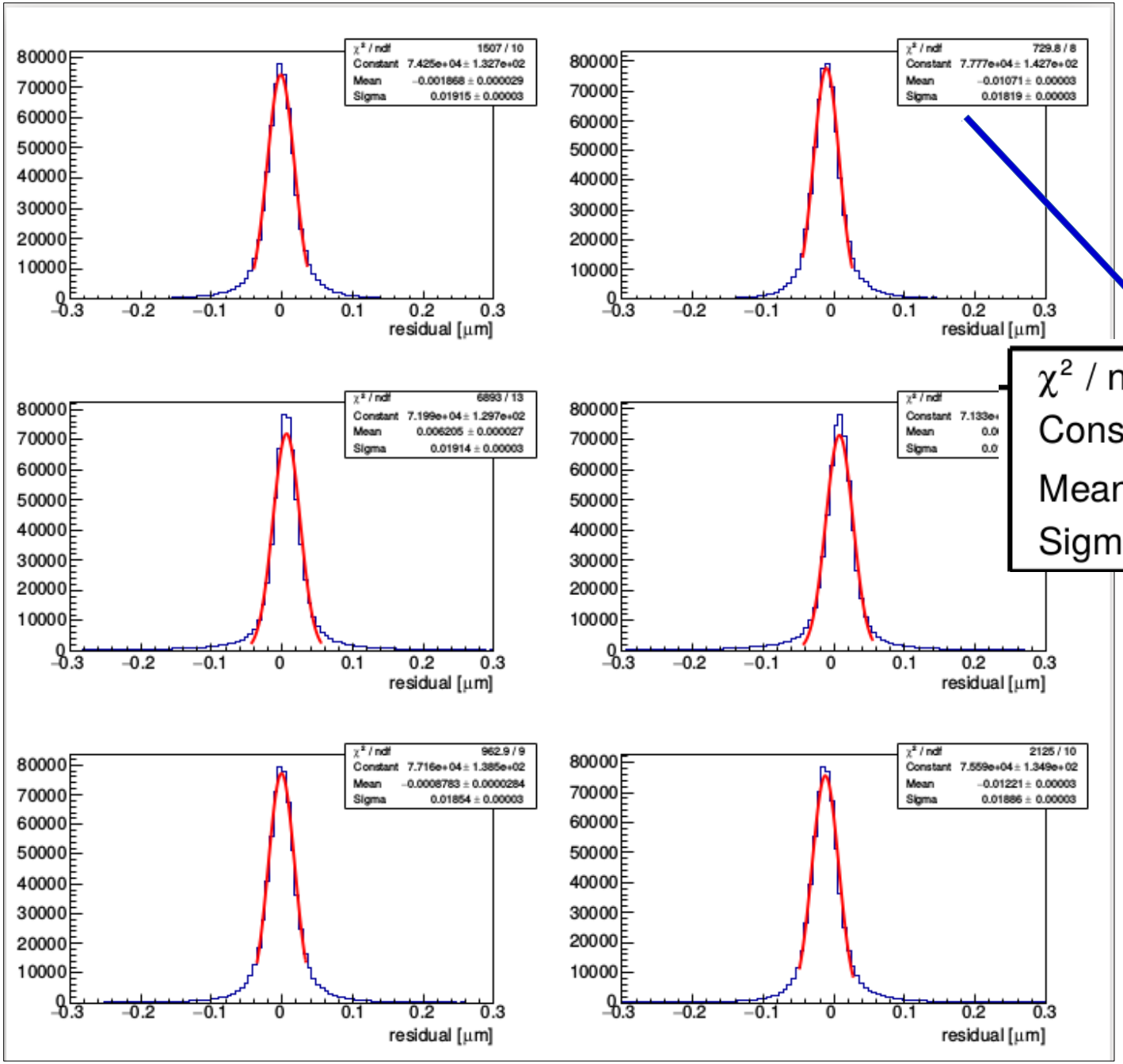
Drift-distance from chamber 1



Drift-distance from chamber 2



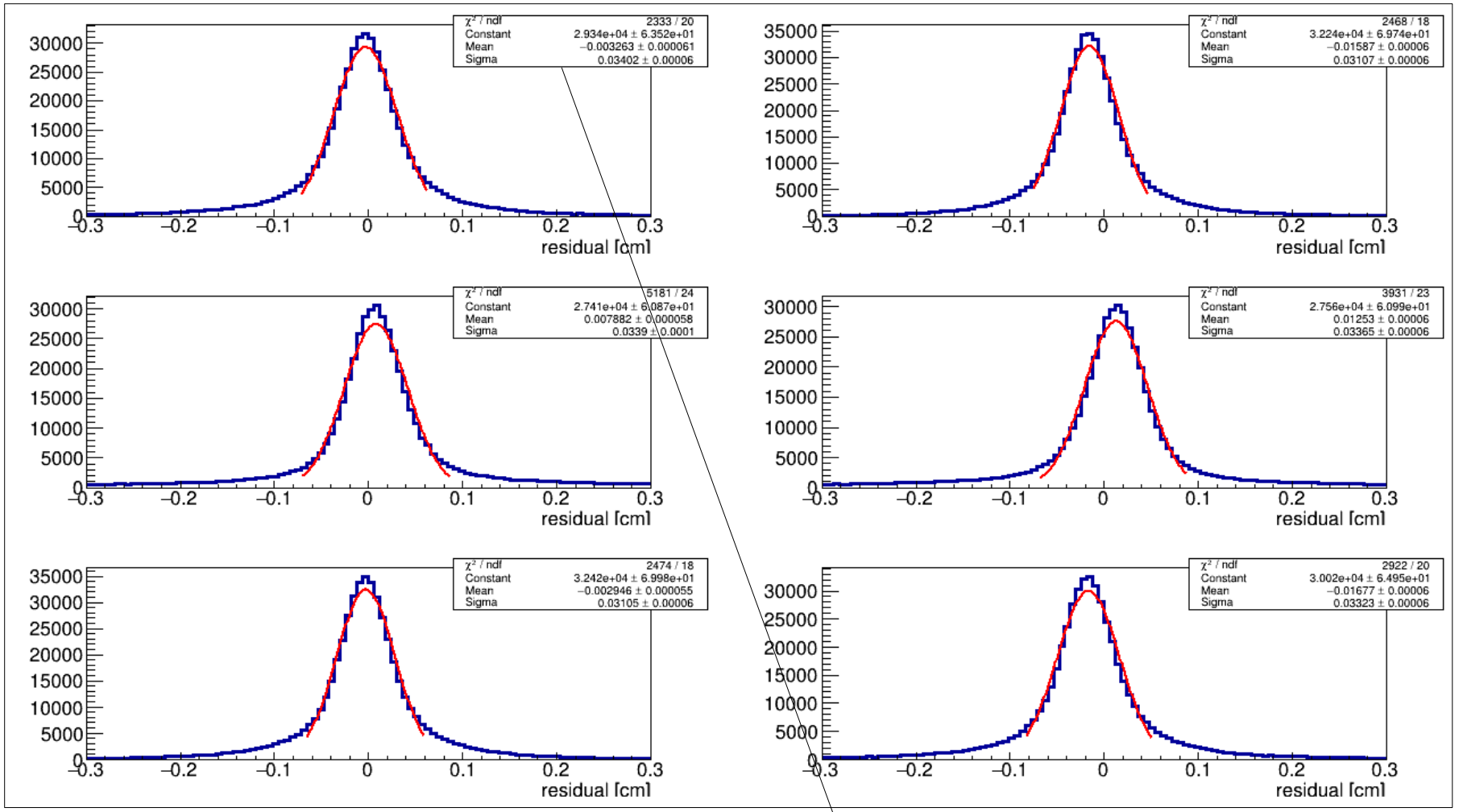
Residual of all the corresponding planes

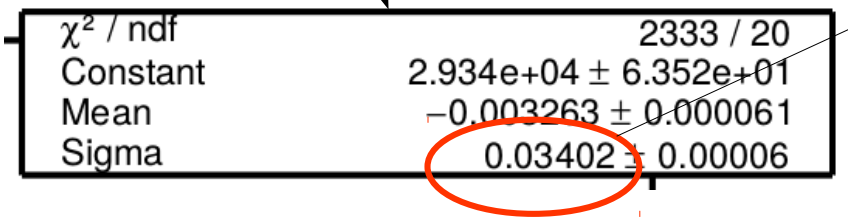


χ^2 / ndf	2336 / 11
Constant	7.562e+04 ± 1.318e+02
Mean	−0.0138 ± 0.0000
Sigma	0.01941 ± 0.00003

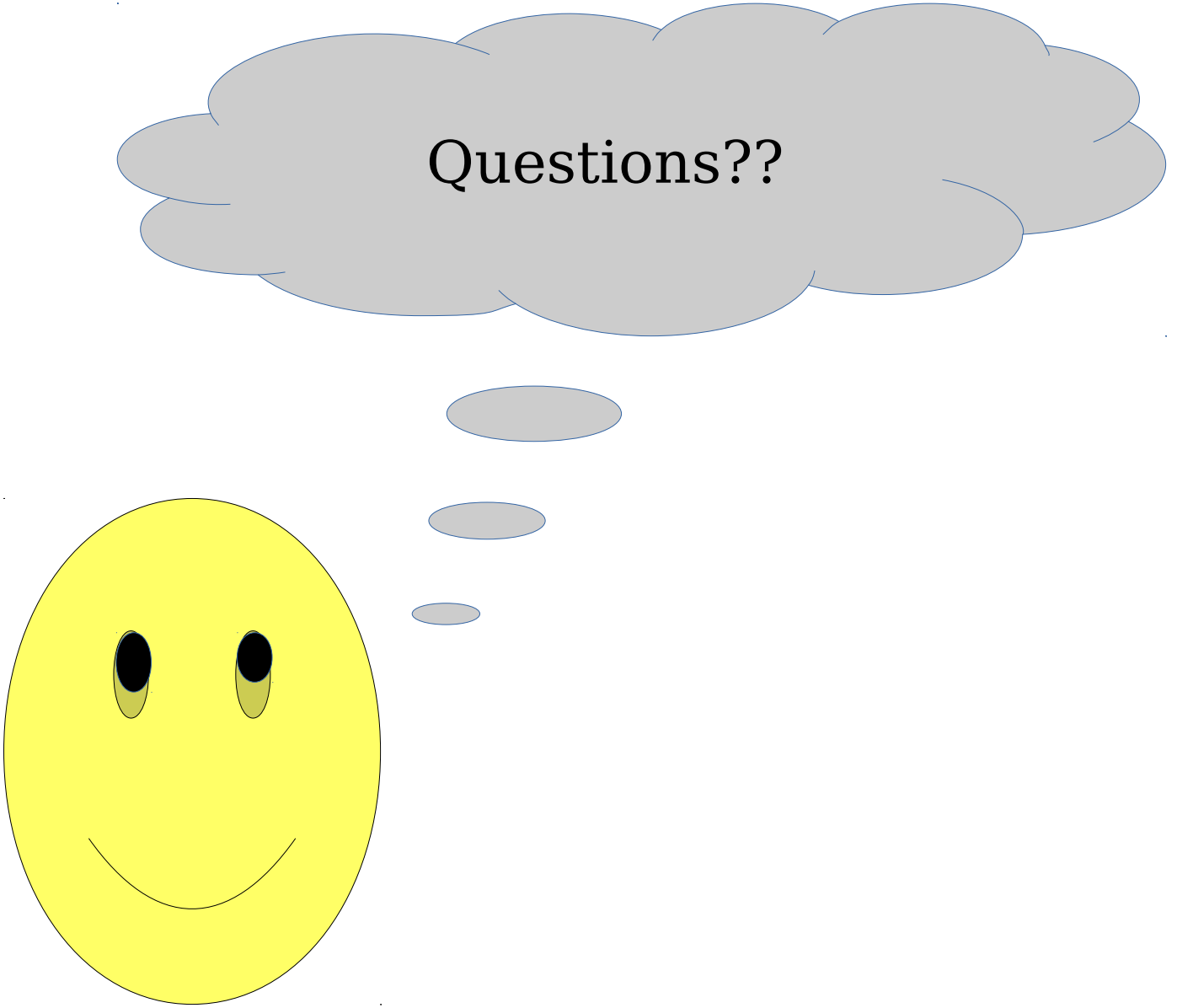
residual

P.dc.{plane}.residualsExclPlane[i]





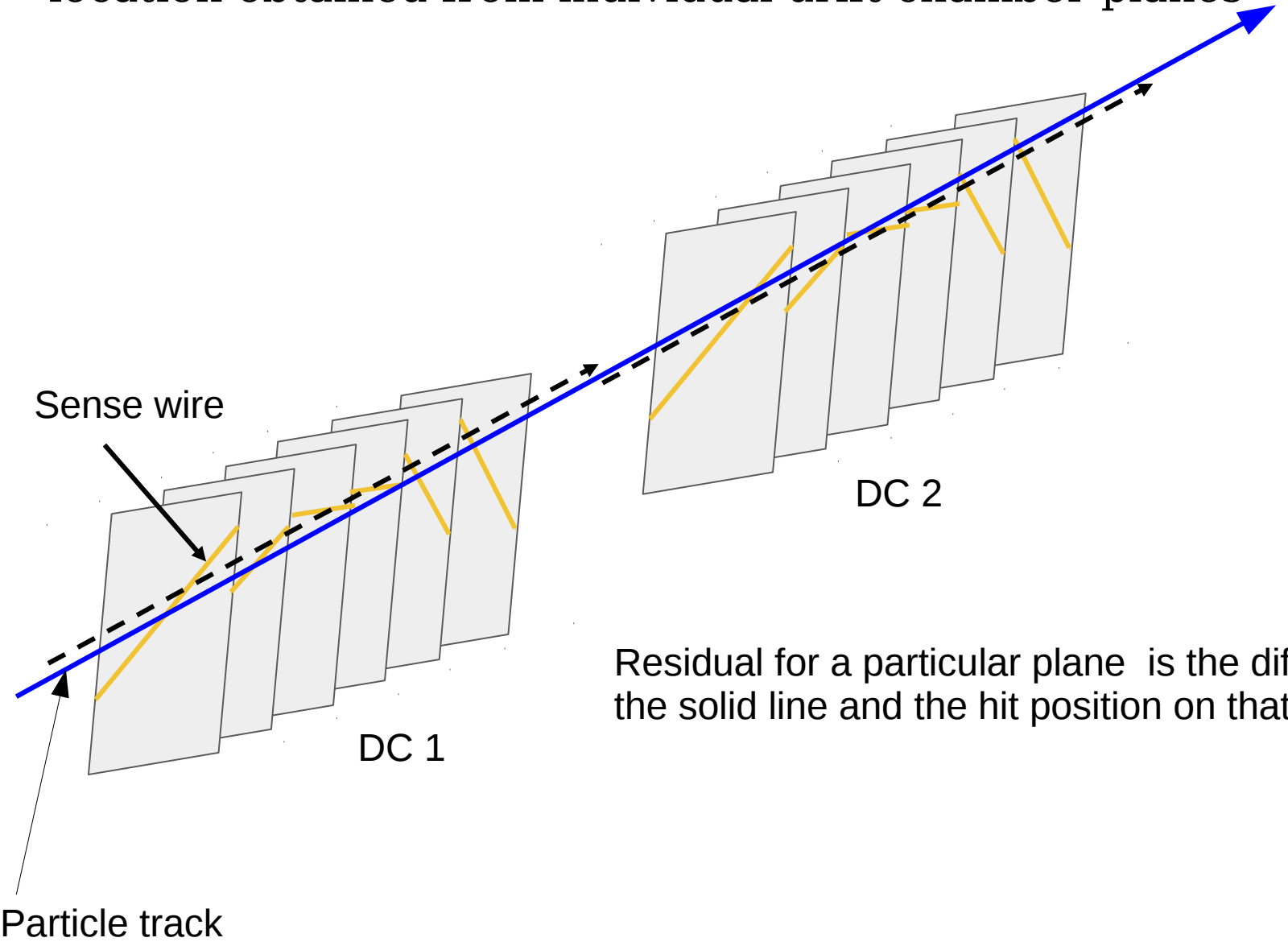
Unbiased residual



Thank you

Back up slide

Residual is the difference between the final track position and the hit location obtained from individual drift chamber planes



Residual for a particular plane is the difference between the solid line and the hit position on that plane.