

# News from the CDC Software group

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Eiichi Nakano on behalf of CDC software group

# Wire-by-wire option

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- Ozaki-san had introduced wire-by-wire option to full simulation
  - small modification to match request from tracking group
- He checks GEANT4 bug (large scattering by thin gas layer)
  - He will confirm using 4.10. If not fixed, he will make contact to GEANT4 expert.
- He will (almost) finalize the full simulation development within this year.
- After finalizing, move to alignment, calibration work.

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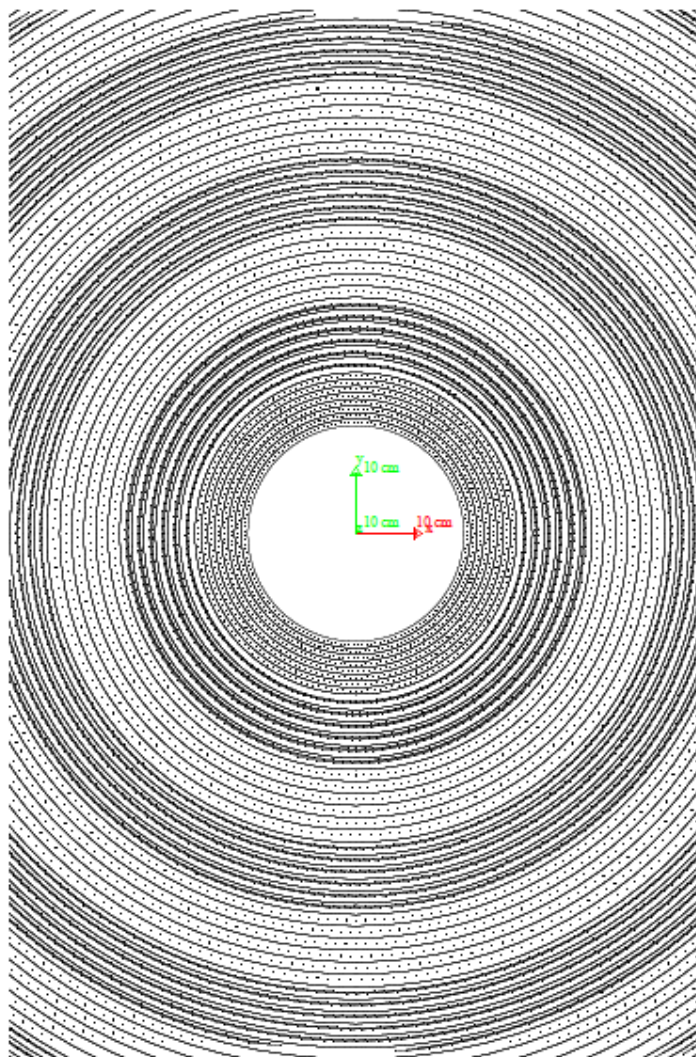
# Wire-by-Wire Mode (1<sup>st</sup> Ver.)

slide ver.#0: original on Jul.09

ver.#1: updated on Jul.20

# Example of View

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*dawncut at  $z=0$*

*only sense wires are  
placed in this plot*

# Wire Hit Rate & PathLength in Wire

*field wire*

*sense wire*

5,000  $\pi^+s$   
 1 GeV/c  
 theta=90deg.

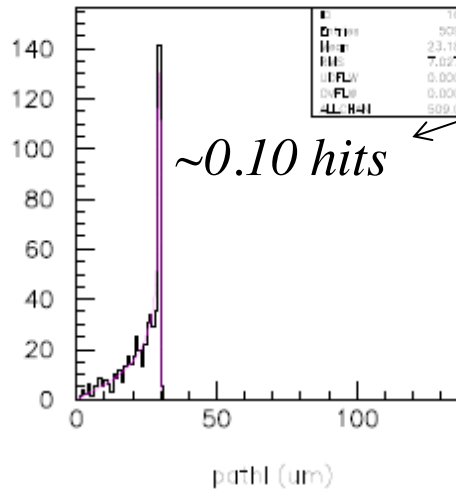
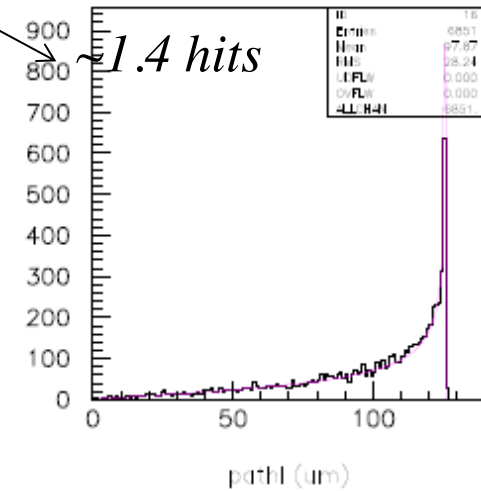
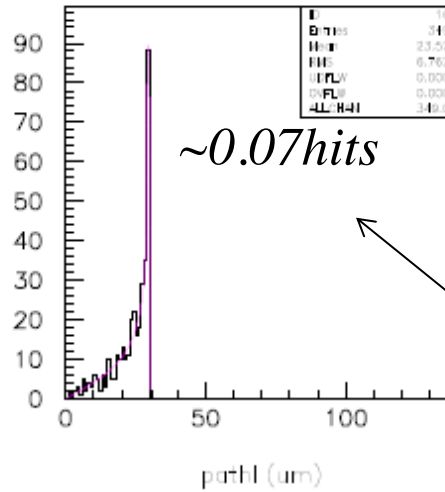
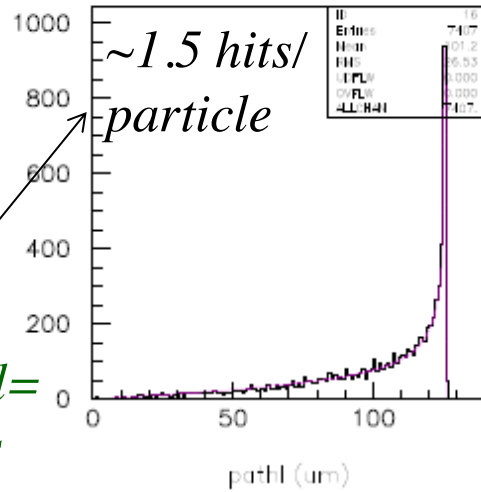
$B=1.5T$

*shapes: ~ as expected*

*expected=*  
*1.56 hits*

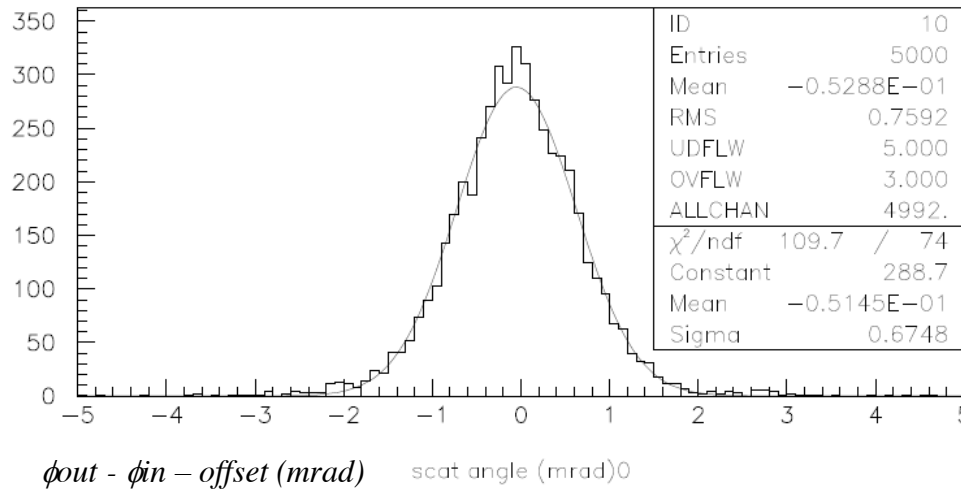
*expected=*  
*0.13 hits*  
*significant fr.*  
*ignored*

$B=0T$



# Multiple Scatt. Angle

2014/07/09 18.45

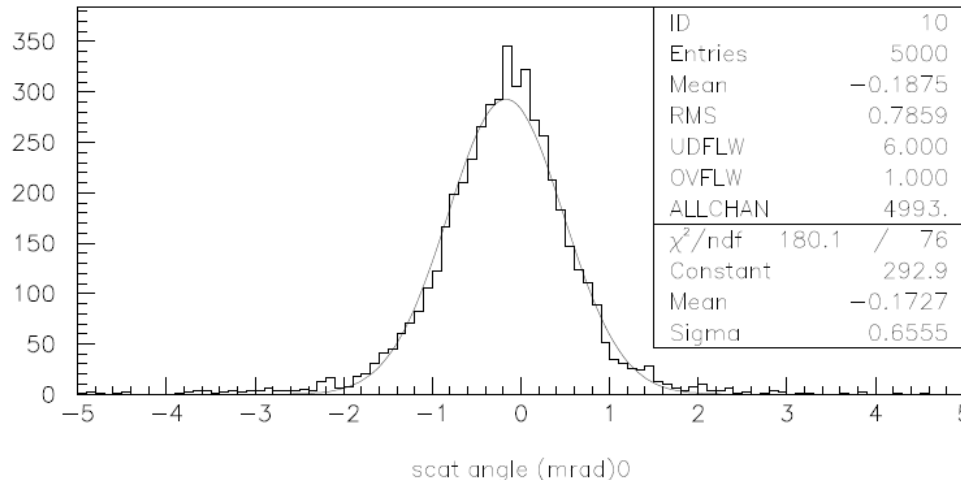


*gas-wire mixture*

*5,000 pi+s  
1 GeV/c  
theta=90deg.  
95cm thick*

*mean = -0.05 mrad*

*sigma=0.67 mrad  
cf. 0.64 from PDG formula*



*wire-by-wire*

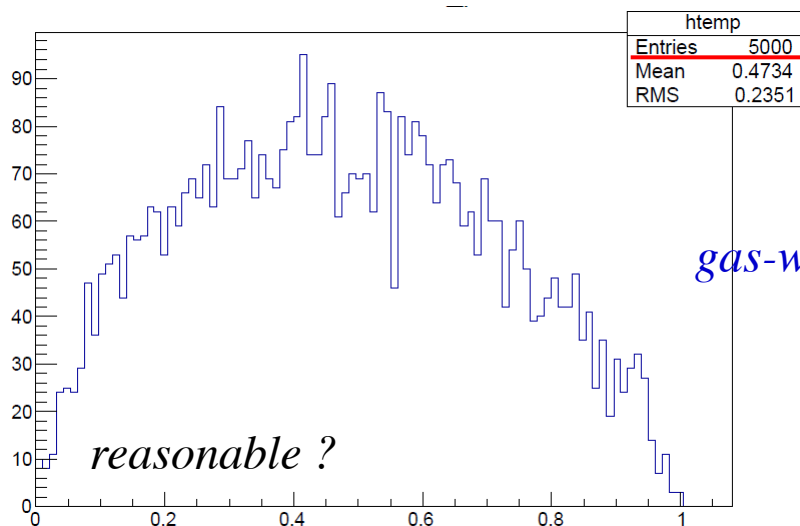
*mean = -0.17 mrad  
← due to G4 bug ?*

*sigma=0.66 mrad  
(n.b. ~half of sense  
wires ignored )*

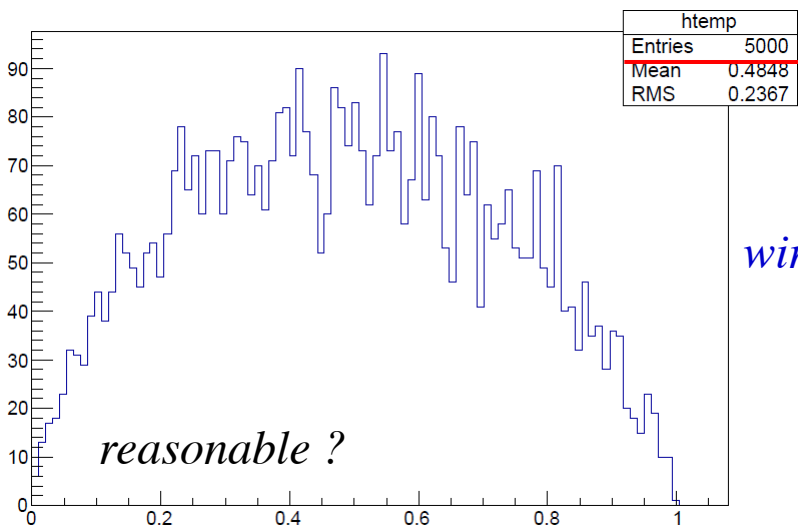
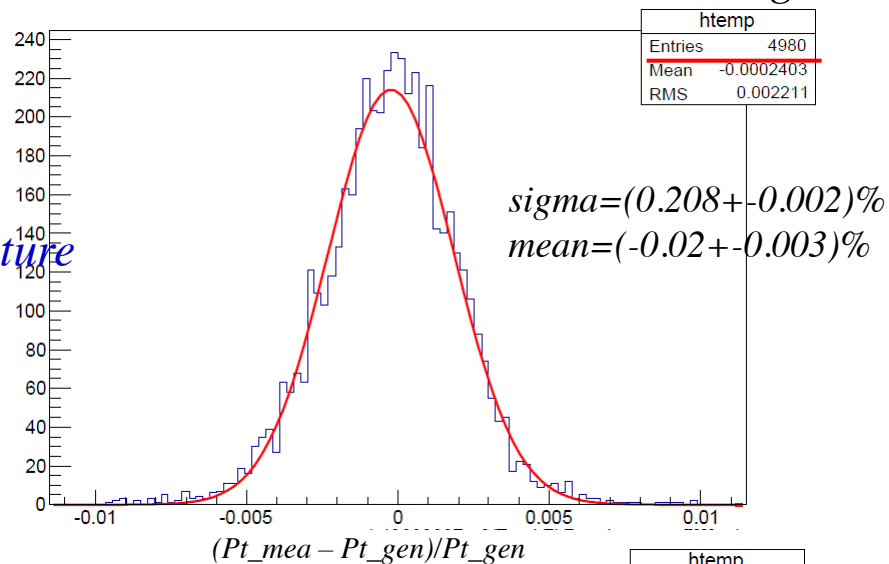
# p-Value & Pt Residual

5,000  $pi^+$ s  
1 GeV/c

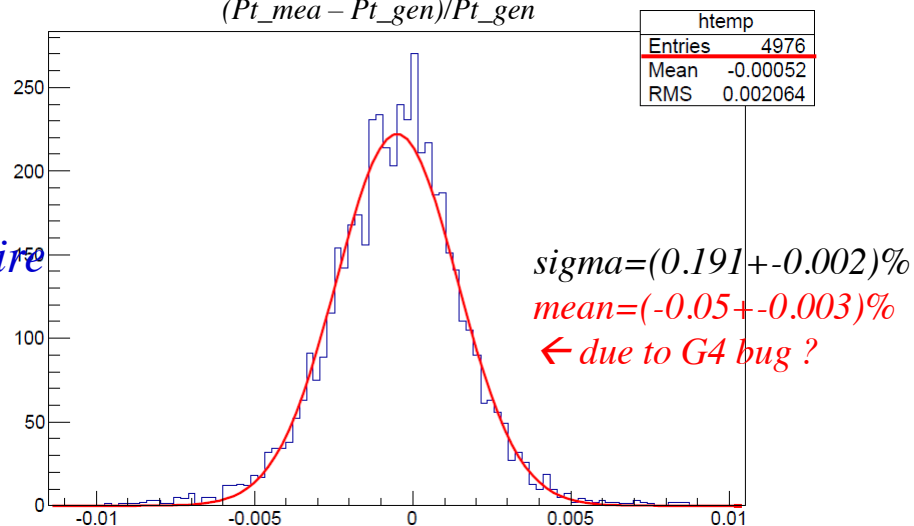
$theta=90deg.$



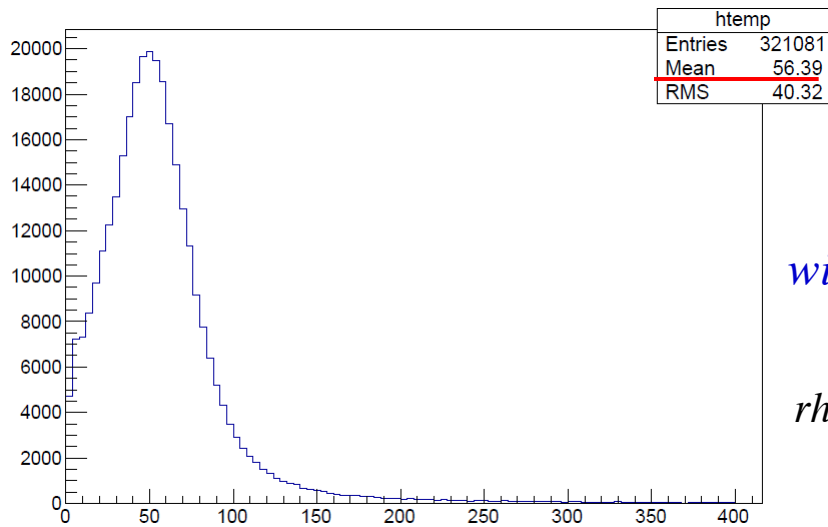
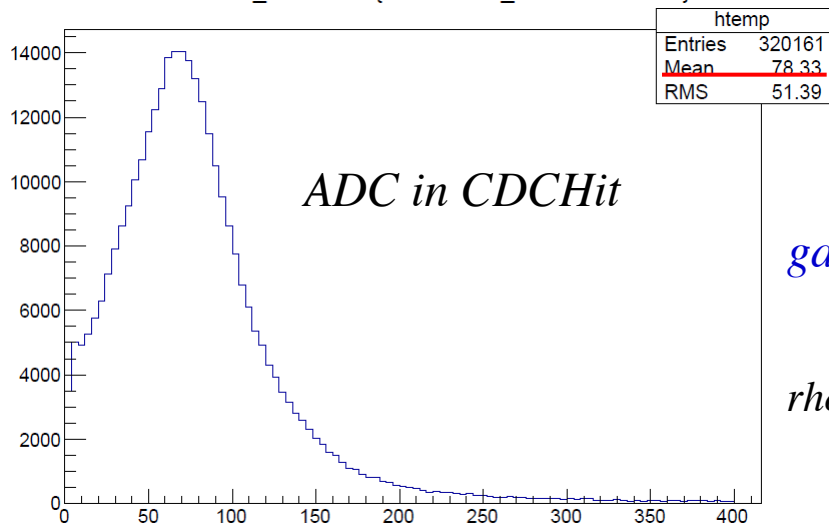
*gas-wire mixture*



*wire-by-wire*



# ADC (Energy Deposit)





# Speed

Name	Calls	Memory(MB)	Time(s)	Time(ms)/Call
EventInfoSetter	5001	0	0.10	0.02 +- 0.00
EventInfoPrinter	5000	0	0.38	0.08 +- 0.52
Gearbox	5000	0	0.07	0.01 +- 0.00
Geometry	5000	0	0.07	0.01 +- 0.00
ParticleGun	5000	0	0.28	0.06 +- 0.08
FullSim	5000	0	68.24	13.65 +- 12.62
CDCDigitizer	5000	0	8.83	1.77 +- 1.03
TrackFinderMCTruth	5000	0	3.21	0.64 +- 0.11
GenFitter	5000	0	195.83	39.17 +- 5.04
RootOutput	5000	83	37.63	7.53 +- 47.44
Total	5001	83	316.04	63.19 +- 49.55

*gas-wire mixture*

Name	Calls	Memory(MB)	Time(s)	Time(ms)/Call
EventInfoSetter	5001	0	0.10	0.02 +- 0.00
EventInfoPrinter	5000	0	0.41	0.08 +- 0.38
Gearbox	5000	0	0.07	0.01 +- 0.00
Geometry	5000	0	0.07	0.01 +- 0.00
ParticleGun	5000	0	0.32	0.06 +- 0.07
FullSim	5000	0	64.08	12.82 +- 8.89
CDCDigitizer	5000	0	8.49	1.70 +- 1.25
TrackFinderMCTruth	5000	0	3.23	0.65 +- 0.33
GenFitter	5000	1	251.07	50.21 +- 6.48
RootOutput	5000	91	35.80	7.16 +- 43.72
Total	5001	93	365.06	73.00 +- 45.13

*wire-by-wire*

*Not reflected in the table but FullSim initialization takes much longer time in w-by-w mode*

# How to Switch On

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- Just set MaterialDefinitionMode=2 in CDC.xml.  
Default=0, which means the mixture of gases & wires.
- Then confirm that a corresponding message of “CDCGeometryPar: ...” appears in your log.

# Alignment

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# Modification/Update for (Mis)alignment

r12659 in svn

# Modification/Update

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- CDCGeometryPar class
  - Now this contains the following 3 sets of sense wire positions:
    - base positions for use in FullSim;
    - misaligned positions for use in Digitizer;
    - aligned positions for use in reconstruction.
  - The getters are updated:  
wireForwardPosition(...) → wireForwardPosition(..., set).
    - wireForwardPosition(..., CDCGeometryPar::c\_Misaligned) returns a misaligned wire position.
    - wireForwardPosition(..., CDCGeometryPar::c\_Aligned) returns an aligned wire position.
    - wireForwardPosition(...) returns a base wire position, i.e. same as before.
  - wireForwardPosition(..., z, set) is overloaded.  
This returns a virtual wire position at the forward z-end. Here, the virtual position is an intersection of a tangent to the wire at the input z-position and the forward z-end plane.  
You can get wire sag effect using this.
  - Likewise for wireBackwardPosition function.

# ...Modification/Update

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- FullSim and Digitizer

- Base wire positions are used in FullSim, i.e. same as before.
- Digitizer is modified to use misaligned wire positions, i.e. drift-time is computed using misaligned wire positions.
- Correction of drift-time for wire sag is now done in Digitizer, not in FullSim.

- Translator

- A new geometry translator, RealisticCDCGeometryTranslator, is introduced.
  - `getWireForwardPosition(...)` returns an aligned wire position.
  - `getWireForwardPosition(..., z)` returns a virtual aligned wire position (similar to mentioned above).
- Likewise for `getWireBackwardPosition` function.

- Input (mis)alignment.xml files

These files are not ready yet. Instead tentatively non-xml files are prepared on `cdc/data` directory: (mis)alignment.dat files.

- format  
[layerNo] [cellNo] [backward dx,dy,dz (cm)] [forward dx,dy,dz (cm)] [wire tension (gW)].  
Here, (dx,dy,dz) is the (mis)aligned wire position w.r.t. the base wire position (i.e. difference).
- All (dx,dy,dz) are set to 0, i.e. no misaligned wires are assumed. Likewise, no aligned wires.
- All wire tensions are set to 50 gW (design value).

# ...Modification/Update

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- How to switch on misalignment in Digitizer
  - Prepare misalignment.dat on cdc/data directory, in which (dx,dy,dz) must be non-0.
  - Specify this file in CDC.xml as an input file.
- How to switch on alignment in reconstruction
  - Prepare alignment.dat on cdc/data directory, in which (dx,dy,dz) must be non-0.
  - Specify this file in CDC.xml as an input file.
- How to switch on wire sag in Digitizer
  - Set wire tensions in the misalignment.dat file to non-0.
  - Set the sag option of Digitizer to true (false by default).
- How to switch on wire sag in reconstruction
  - Set wire tensions in the alignment.dat file to non-0.
  - And when using the realistic geometry translator, you need to switch it on via a flag to the translator (off by default).
- CDCRecoHit class

This hasn't been updated. Since this is strongly coupled to GenFit, it's better for its expert(s) to do it, I think.

# Beam test analysis

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- Uchida-san and Tang-san analyzing beam test data
  - beam test target : data transfer and electronics check
  - Other items : x-t relation, resolution
  - Compare x-t relation of data and Garfield simulation

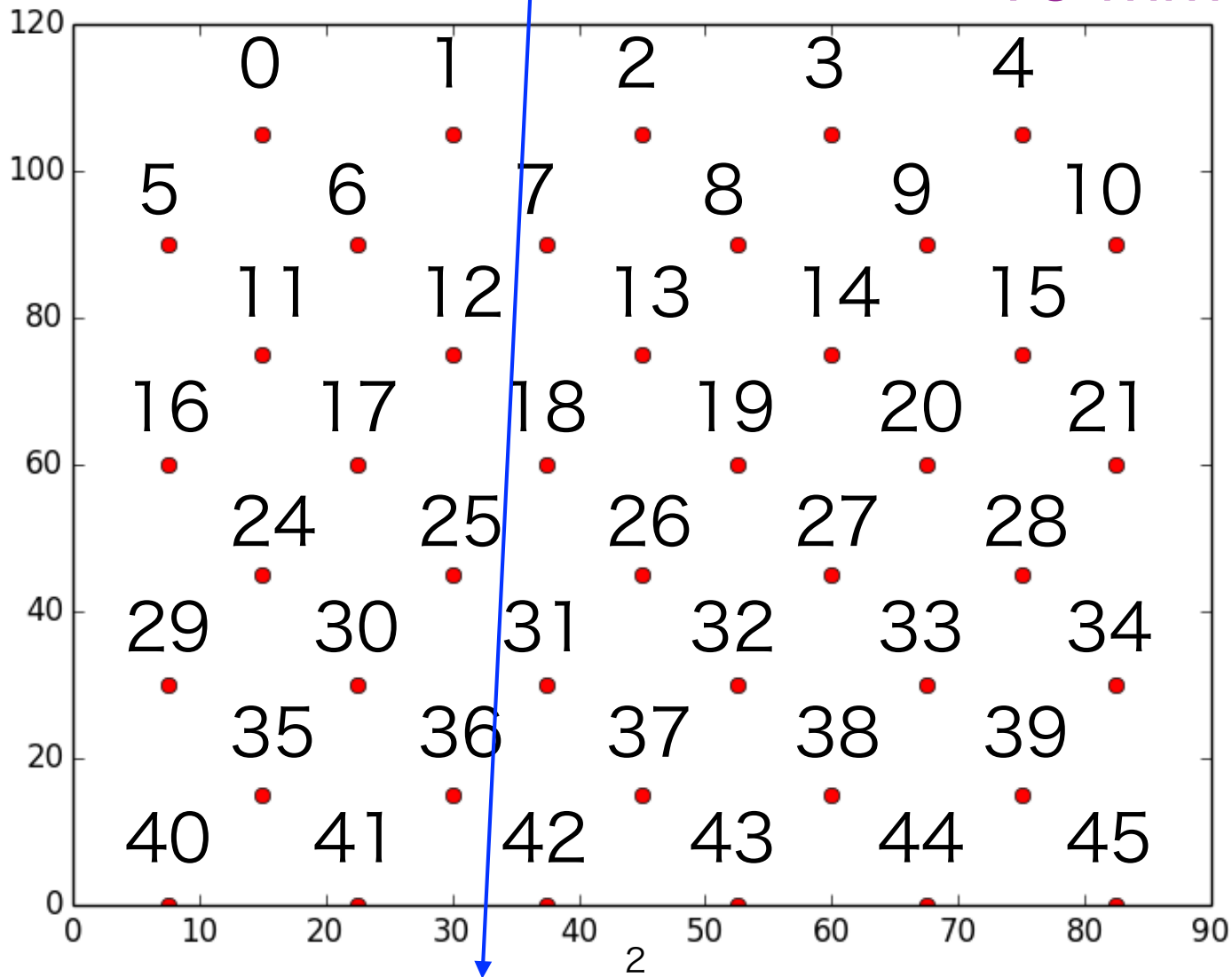


# Wire config (2013)

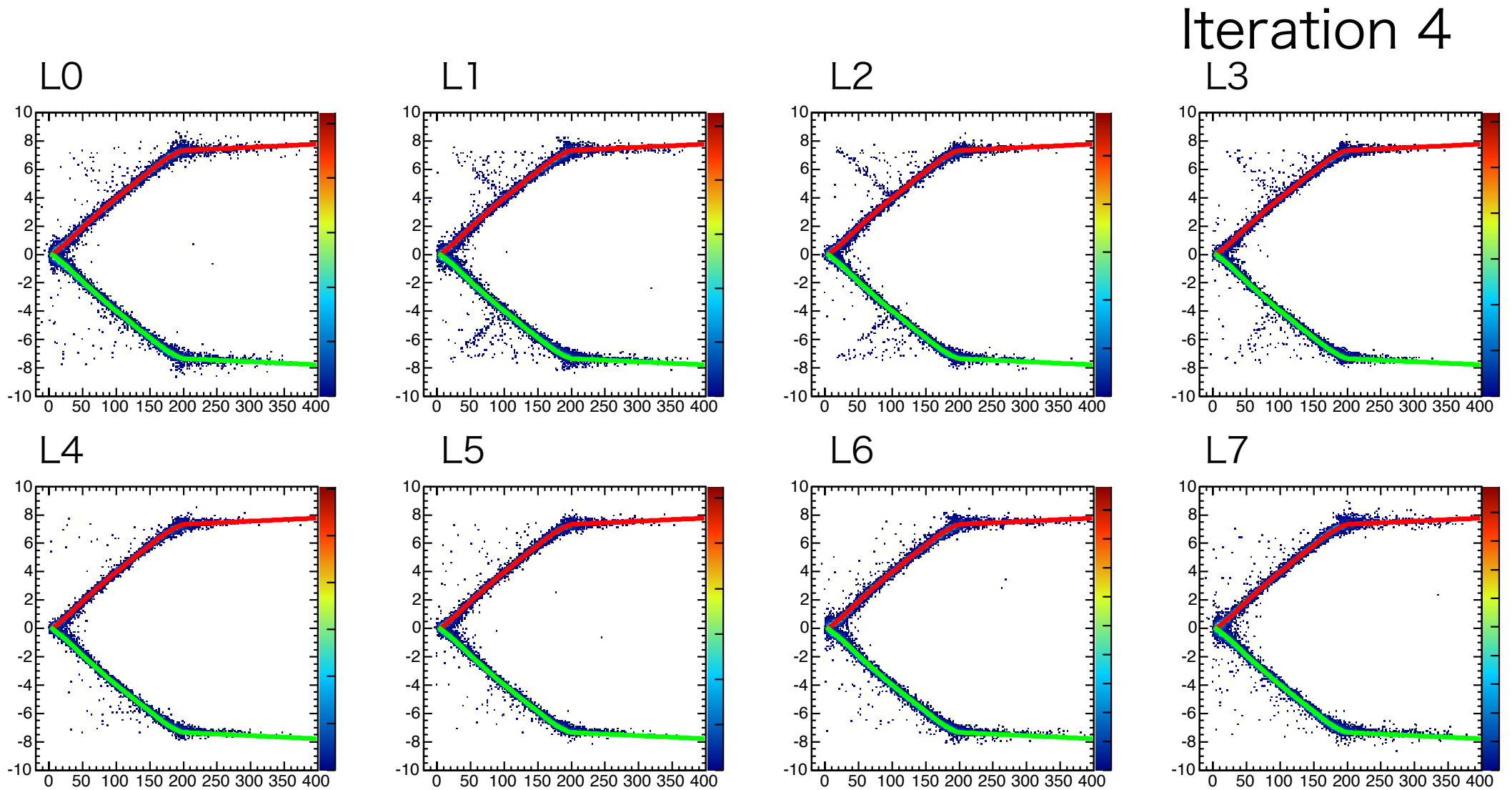
e<sup>-</sup> track

square cell

15 mm x 15 mm



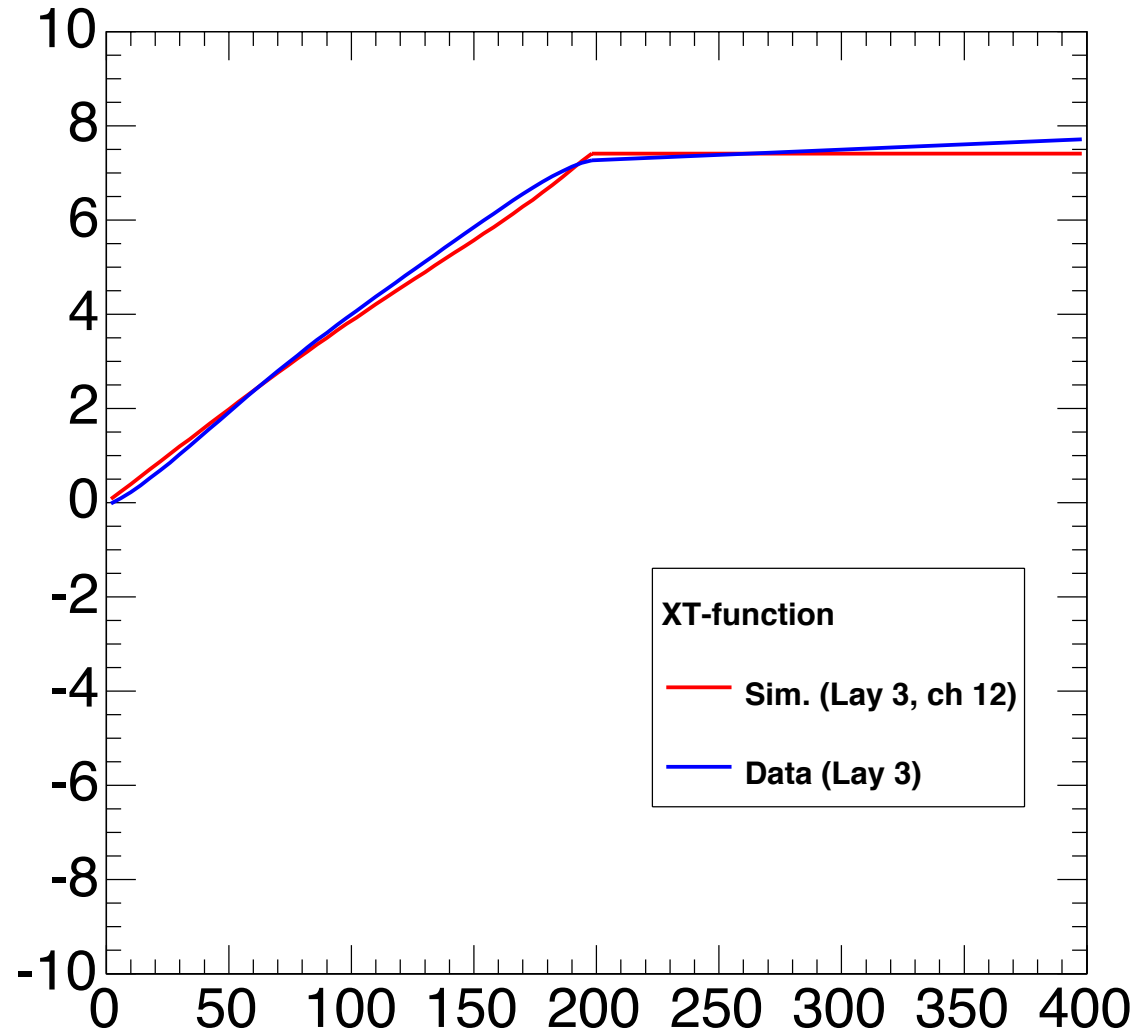
# XT-plot and XT-function



→ Drift time (nsec)

# Comparison between Simulation and data

Sim. (Garfield) by Nakano-san  
cell by cell  
Left/Right difference  
Data ana. by Uchida  
layer by layer  
No Left/Right difference



# Plans for near future

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- Nakano
  - simulation more realistic x-t relation using Heed in Garfield (target : before next B2GM)
  - and try to switch to Garfield++
    - merit : 3D configuration using free software
- Uchida-san
  - develop unpacker/packer in this winter
  - continue analyzing beam test data : theta dependence

# Request for tracking group

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- tracking software for no magnetic field
  - it is very helpful for cosmic ray test
  - It is also used for checking CDC trigger.

# Plan of satellite meeting at November B2GM

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- We like to have CDC/tracking joint meeting at Nov.1 evening (Sat.)
- Discuss with CDC hardware/software and tracking group
- Can you join this meeting?