Status of CGEM Simulation

Xudong JU, Linghui WU

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Outline

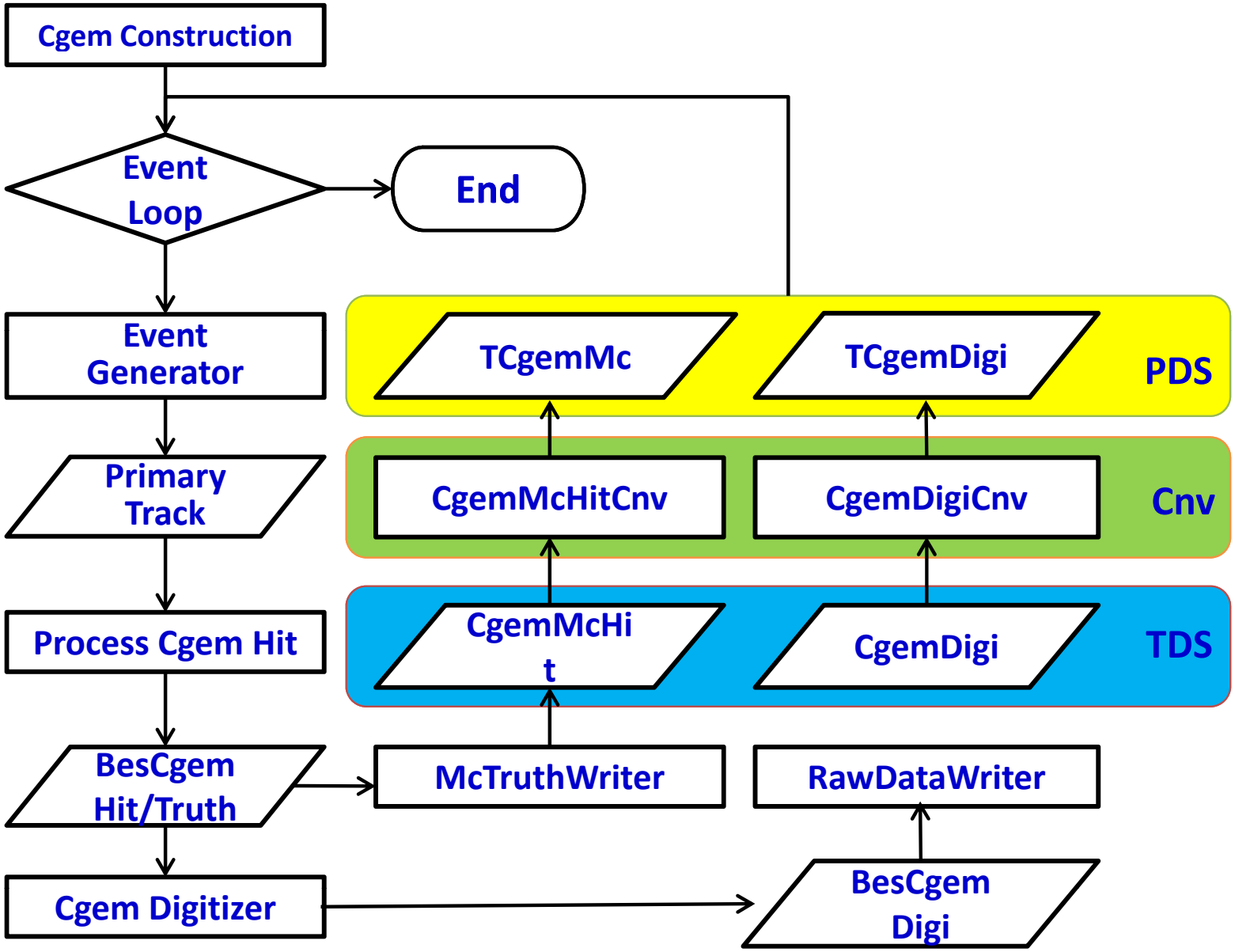
- Development of CGEM simulation
- Update of the framework
- Release of the software
- Summary

Development of CGEM simulation

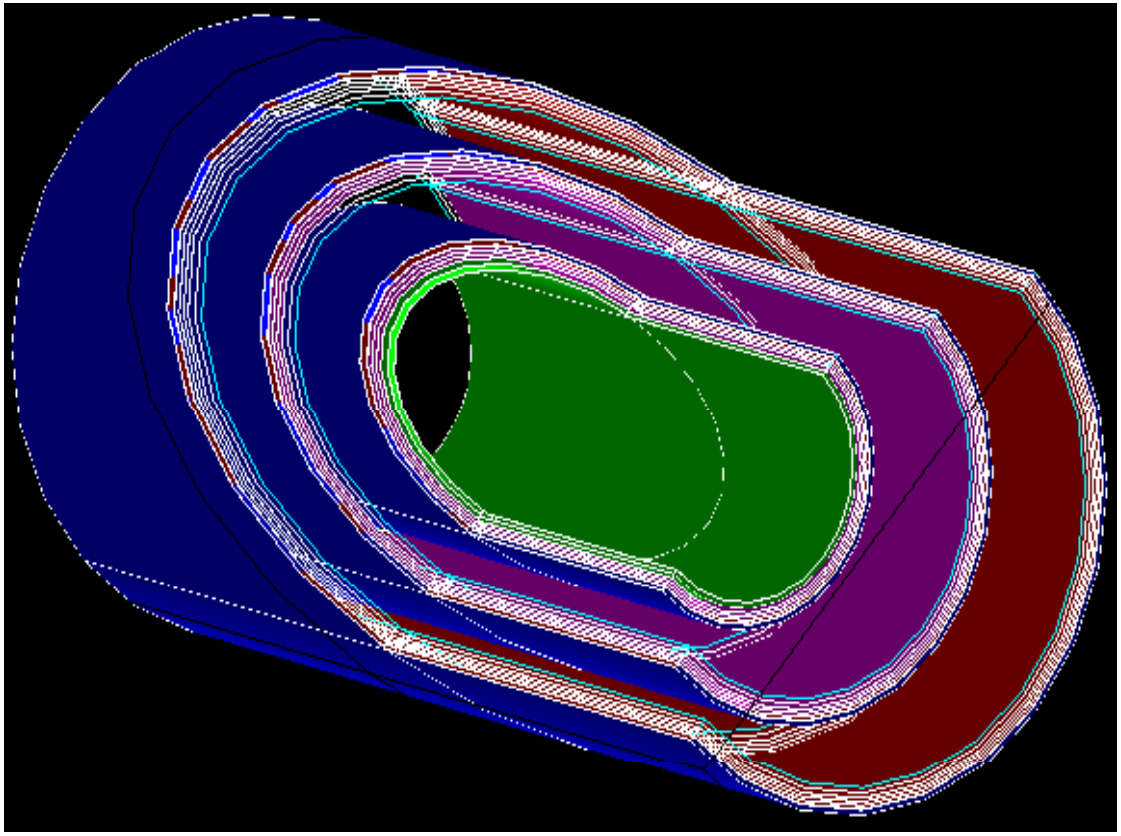
- We have developed a simulation package for CGEM

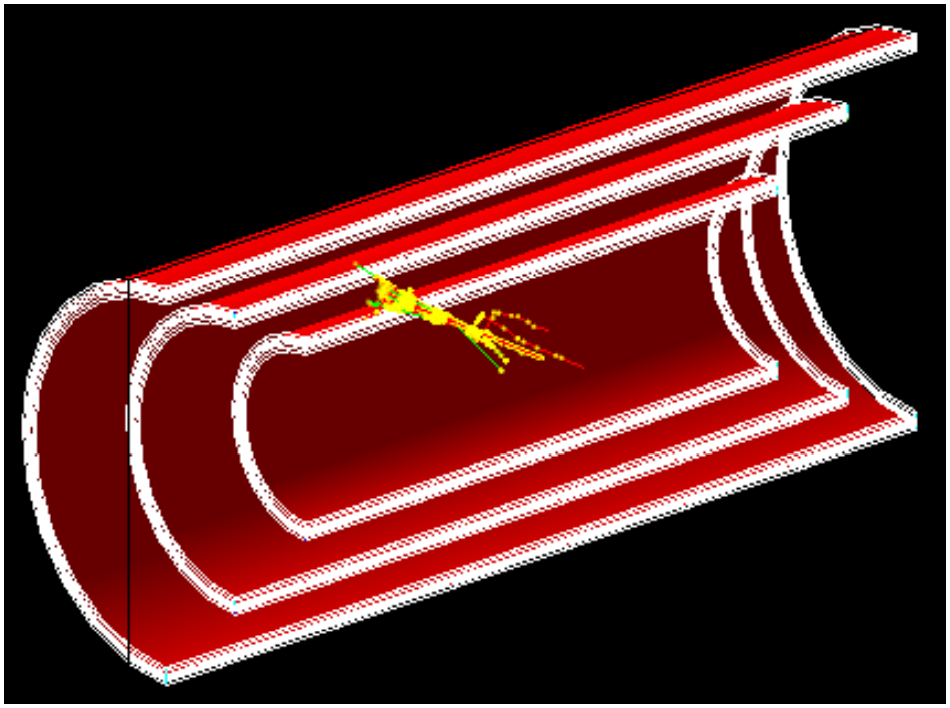
Class	Description
BesCgemGeoParameter	**Input geometry parameters**
BesCgemConstruction	**Construct detector geometry, material, SD**
BesCgemHit	**Define hit**
BesCgemSD	**Process hits and return hits and McTruth**
BesCgemDigi	**Define digi**
BesCgemDigitizer	**Digitize and return digis**

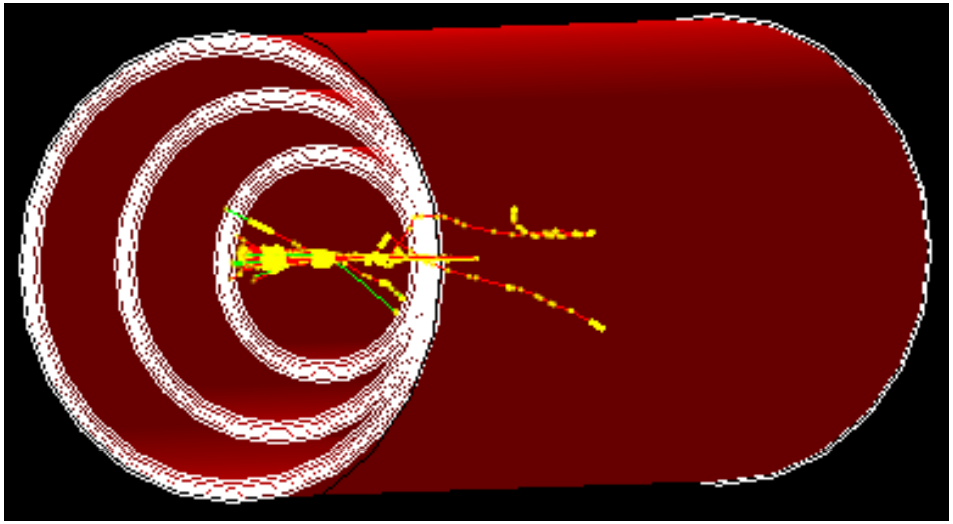
Dataflow of simulation



- The simulation of CGEM： 3 layers
  - for each layer：
    - 1 cathode
    - 3 GEM foils
    - 1 Anode
    - 1 carbon fiber shield







Geometry

Units (mm)	Layer1		Layer2		Layer3	
	R_{in}	Thickness	R_{in}	Thickness	R_{in}	Thickness
Cathode	75.234	3.104	120.5	3.104	163.0	3.104
Gap_D	78.338	3.0	123.604	3.0	166.104	3.0
GEM 1	81.338	0.054	126.604	0.054	169.104	0.054
Gap_T1	81.392	2.0	126.658	2.0	169.158	2.0
GEM 2	83.392	0.054	128.658	0.054	171.158	0.054
Gap_T2	83.446	2.0	128.712	2.0	171.212	2.0
GEM 3	85.446	0.054	130.712	0.054	173.212	0.054
Gap_I	85.5	2.0	130.766	2.0	173.266	2.0
Anode	87.5	0.2512	132.766	0.2512	175.266	0.2512
CF-Shield	87.7512	3.1	133.0172	3.1	175.5172	3.1
Length/ Thickness	532 / 15.6172		690 / 15.6172		847 / 15.6172	

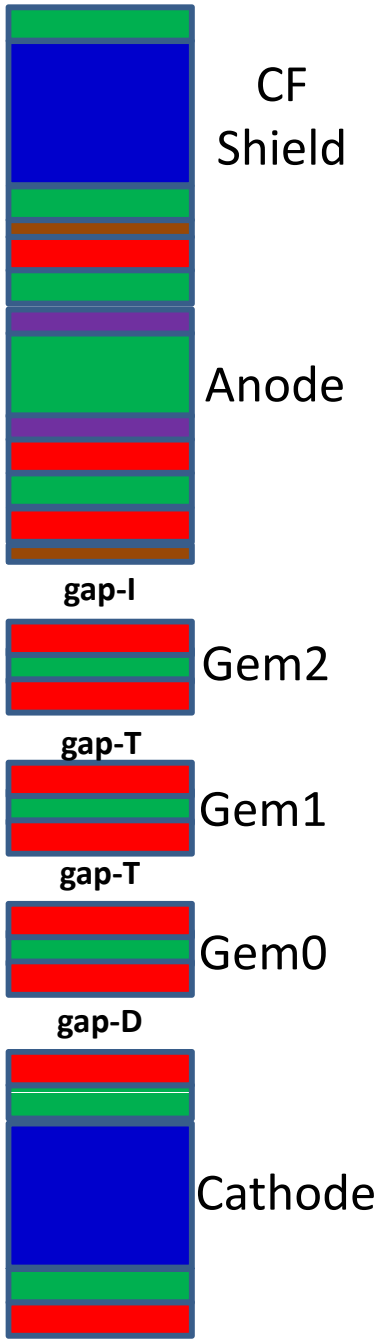
Material Budget

Foil	Material	Thickness (X/μm)	X/X_0 (10^{-4})
GEM	Cu	2× 0.8	1.12
	Kapton	50× 0.8	1.40
	Cu	2× 0.8	1.12
Cathode	Cu	2	1.40
	Kapton	50	1.75
	Honey comb	3000	2.4
	Kapton	50	1.75
	Cu	2	1.40
CF Shield	Kapton	50	1.75
	Honey comb	3000	2.4
	Kapton	50	1.75

1 CGEM layer

Foil	Material	Thickness (X/μm)	X/X_0 (10^{-4})
Anode	Au	0.1	0.303
	Cu	2.5	1.75
	Kapton	50	1.75
	Cu	1.5	1.05
	Epoxy	10	0.30
	Kapton	125	4.37
	Epoxy	10	0.30
	Kapton	50	1.75
	Cu	2	1.40
	Au	0.1	0.303

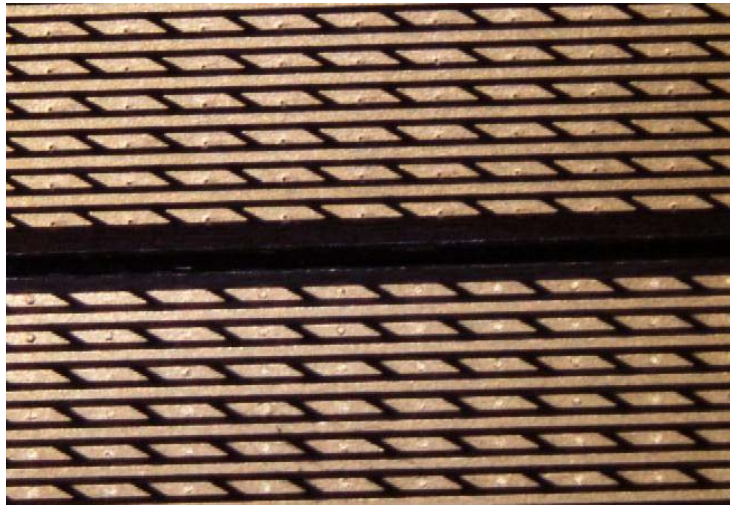
The total material budget of 3 CGEM layers is : 1.164%



Readout Strip

	Layer1	Layer2	Layer3
Sheets number	1	2	2
Anode radius(mm)	87.50	132.766	175.266
Layer width(mm)	549.78	834.2	1101.22
Sheet width(mm)	549.78	417.10	550.61
Z length(mm)	532.00	690.00	847.00
Stereo angle(rad)	0.8018	0.5428	0.5758
Pitch(mm)	0.65	0.65	0.65
X channel N	846	1284	1696
V channel N	1177	2198	2844
Total channel N	2023	3482	4540

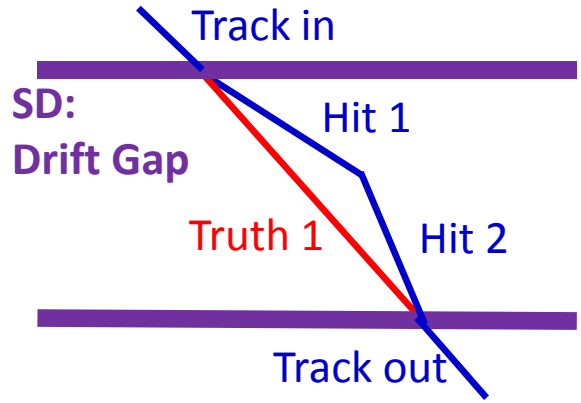
- Not constructed in the detector geometry.
- Just used in the digitization.
- Not consider the Dead zone.
- Should be determined by the real electronics.



total channel N = 10045

Hit and McTruth

Item		Description
G4int	m_ID_track	ID of current track
G4int	m_ID_layer	ID of CgemLayer
G4int	m_pdg_code	PDG code of the particle
G4double	m_global_time	Time since the current event began
G4double	m_E_deposit	Total energy deposited during the step
G4double	m_L_step	Step length
G4ThreeVector	m_XYZ_pre	Position of Pre Point
G4ThreeVector	m_XYZ_post	Position of Post Point
G4ThreeVector	m_P_pre	Momentum of Pre Point
G4ThreeVector	m_P_post	Momentum of post point



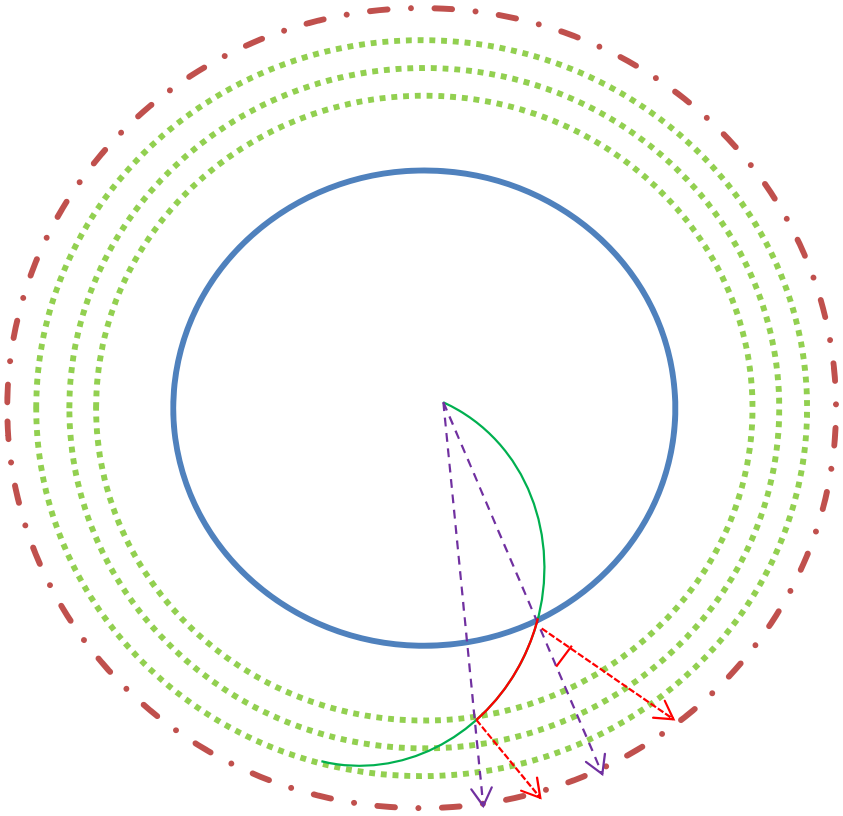
- McTruth is the sum of all steps in a segment of the track.
- McTruth will be saved and used by reconstruction.

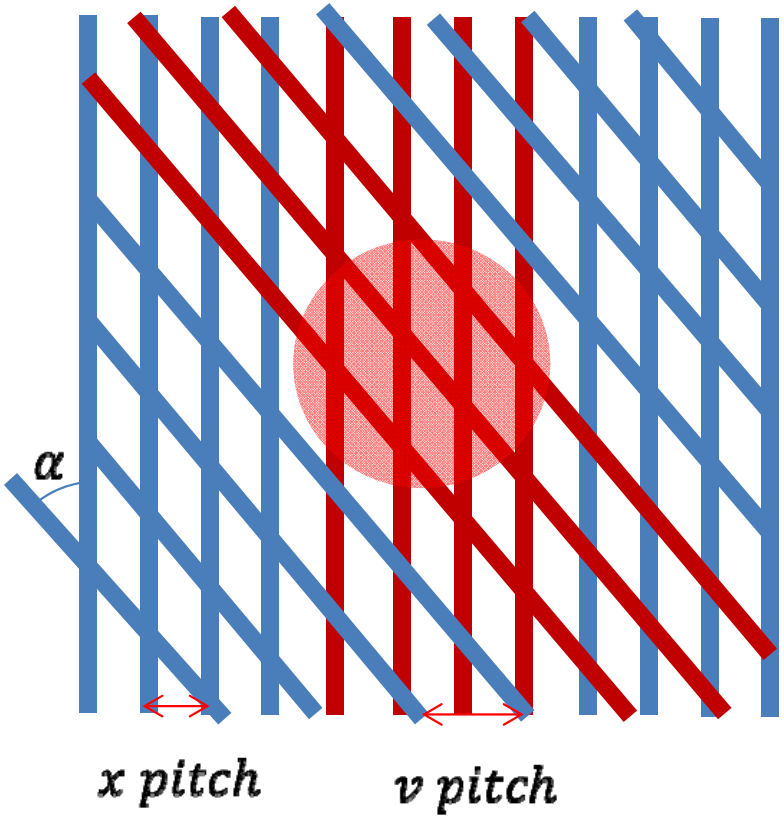
Digi

Item		Description
G4int	m_ID_track	ID of hit track
G4int	m_ID_layer	ID of CgemLayer
G4int	m_ID_sheet	ID of Readout sheet
G4int	m_F_XV	Flag of Strip: 0-X; 1-V
G4int	m_ID_strip	ID of Readout strip
G4double	m_E_deposit	Deposit energy (Q)
G4double	m_global_time	Time since the event was created

- Digi is obtained from the digitization of hits.
- Digi is output in the same format as data.

Digitization



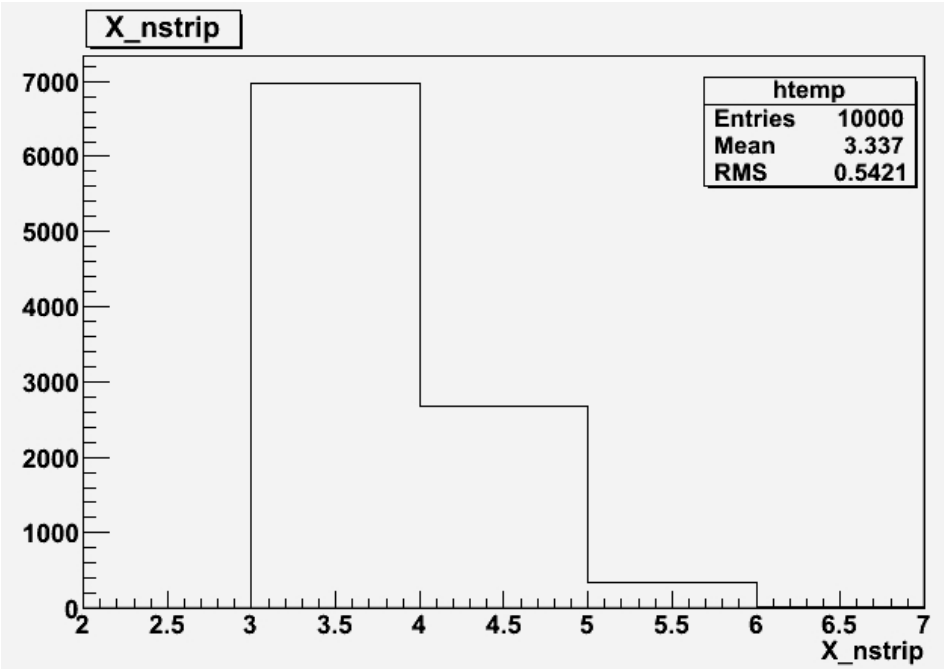


- Simple digitization model :
  - Lorentz angle = 0
  - Threshold = 0
  - no diffusion
  - no noise

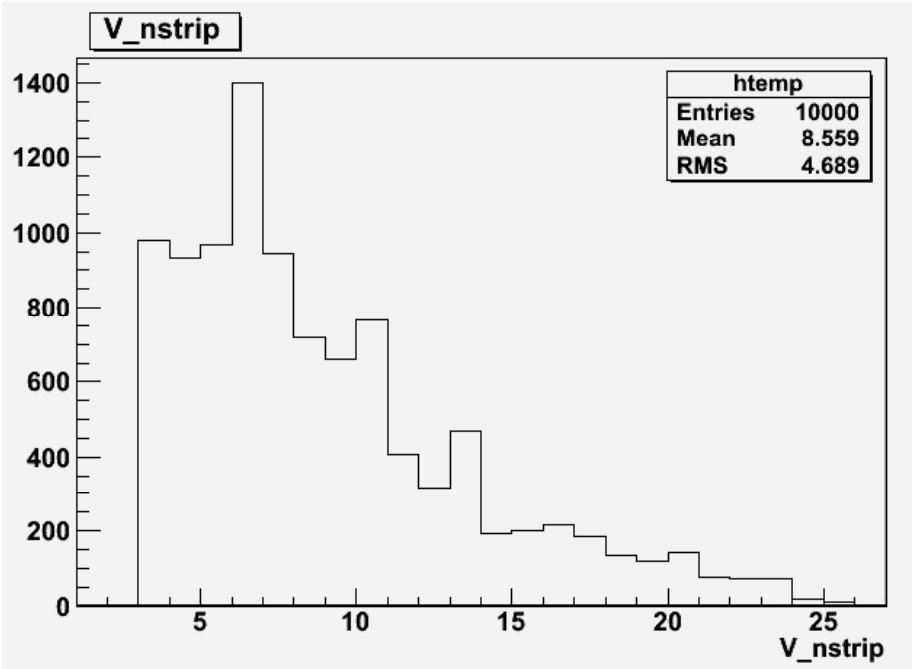
Distribution of number of fired strips

(Single particle)

X-strip



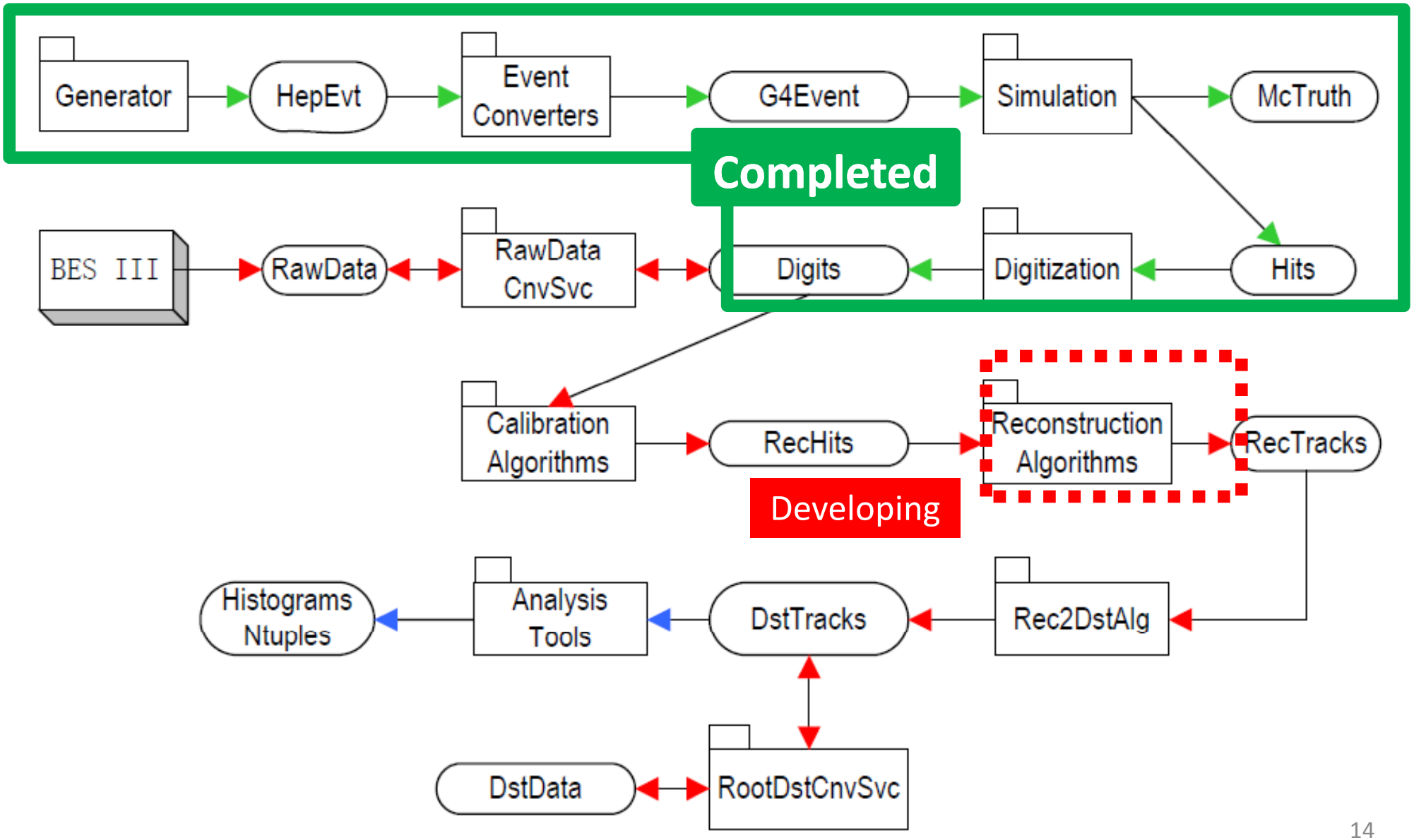
V-strip



Update of framework

- Update the framework of BOSS
  - Add new Cgem packages
    - Simulation/BOOST/CgemSim
    - Cgem/CgemRawEvent
    - Cgem/CgemRecEvent
    - Cgem/CgemGeomSvc
    - ……
  - Update related packages
    - Simulation/BOOST/BesSim
    - Simulation/BOOST/MdcSim
    - Simulation/BOOST/SimUtil
    - Simulation/G4Svc
    - DetectorDescription/Identifier
  - Modify related packages
    - Event/EventModel
    - Event/McTruth
    - Event/RawEvent
    - Event/RootCnvSvc
    - Event/RootEventData
    - Event/DstEvent
    - Event/EvtRecEvent
    - Event/RootIO
    - Event/AsciiDmp
    - Event/HltEvent
    - ……

Dataflow


Generator
HepEvt
Event Converters
G4Event
Simulation
McTruth
Completed
BES III
RawData
RawData CnvSvc
Digits
Digitization
Hits
Calibration Algorithms
RecHits
Reconstruction Algorithms
RecTracks
Developing
Histograms Ntuples
Analysis Tools
DstTracks
Rec2DstAlg
DstData
RootDstCnvSvc

Software release (1)

- CgemBoss-0.0.1
  - CGEM simulation with old geometry
- CgemBoss-0.0.2
  - Update CGEM simulation
  - Update framework
- CgemBoss-0.0.3
  - Fix some bugs in simulation
  - Add CGEM hit cluster reconstruction

Software release (2)

- CVS:
  - http://koala.ihep.ac.cn/cgi-bin/viewcvs.cgi/CgemBossCvs/
- Distribution area:
  - /afs/.ihep.ac.cn/bes3/offline/Boss/mdcu/CgemBoss

Summary

- A preliminary CGEM simulation package is developed
- Boss framework is updated for CGEM
- An algorithm of CGEM hit cluster reconstruction is developed
- CgemBoss0.0.3 will be released soon

Thanks!