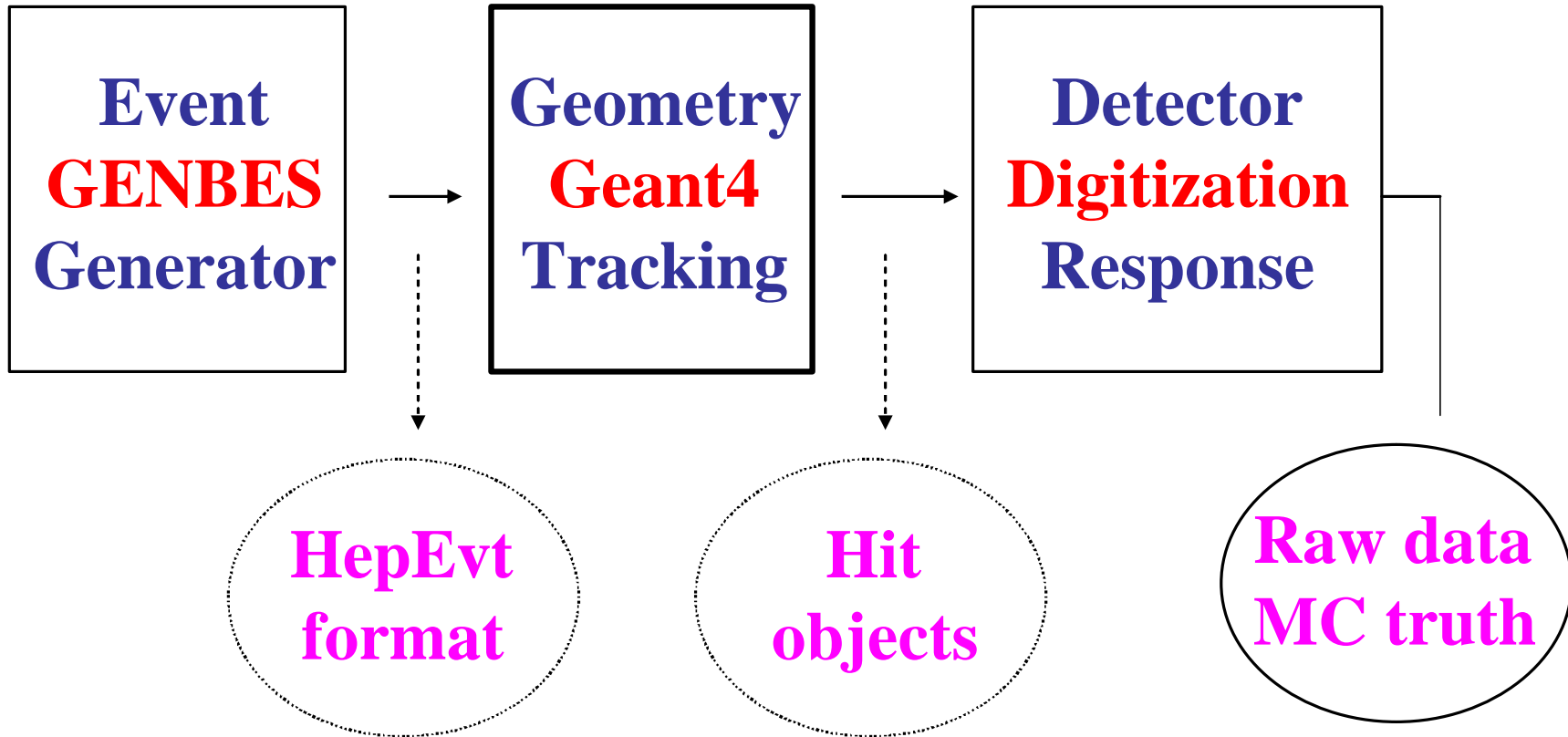


BOOST Introduction

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BOOST Project

(BESIII Object Oriented Simulation Tool)



BOOST Project

(BESIII Object Oriented Simulation Tool)

◆ Components

- Generator
- Particles and physics processes
- Magnetic field
- Material
- MC truth
- Data I/O
- User interface



common parts

- Geometry
- Hits recording
- Digitization



sub-detector parts

BOOST code structure

boost/

{	bes/	common part
	src/	source c++ codes
	include/	header files
{	gen/ ...	event generators
	phy/ ...	physics processes
	tru/ ...	MC truth
	gmk/ ...	common makefiles
	mac/ ...	common card files
	dat/ ...	geometry data files
	exe/ ...	main program for execution
{	doc/ ...	documentations
	mdc/ ...	main drift chamber
	tof/ ...	time of flight
	emc/ ...	electromagnetic calorimeter
	muc/ ...	muon chamber

BOOST Project

(BESIII Object Oriented Simulation Tool)

◆ Developers

- Liu Huaimin: common parts
- Yuan Ye: MDC
- Deng Ziyan: TOF & common parts
- Fu Chengdong/He Miao: EMC
- Peking University: MUC & xml geometry

BOOST Project

(BESI I I Object Oriented Simulation Tool)

- ✓ Phase 1: Framework prototype, simple geometry with hit
 - ✓ Finished, BOOST prototype realized in May, 2003
- ✓ Phase 2: Detailed detector with simple digitization
 - ✓ Finished, now digits and MC truth output can be used for reconstruction
- Phase 3: Detailed digitization, data/MC comparisons
 - In progress, need information from beam test and data. A long-term work!

Geant4 and BOOST releases

◆ Geant4

- Release 6.1 March, 2004
- Release 6.2 June, 2004
- Release 7.0 December, 2004
- Patch of 7.0 February, 2005

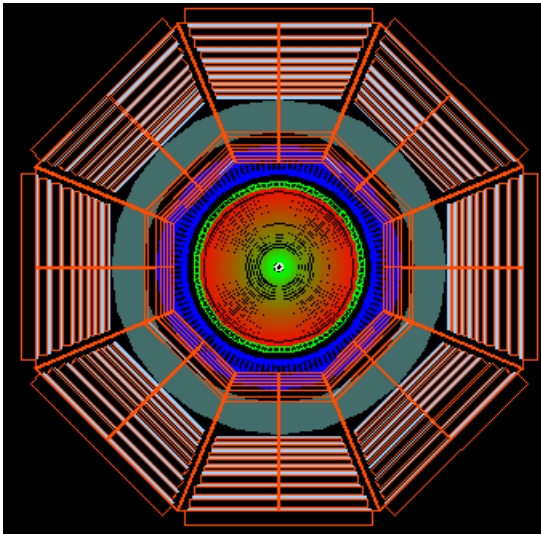
◆ BOOST (mantained by cvs)

- 'boost-1-0' (March, 2004) -----Geant4.6.1
- 'boost-1-1' (June, 2004) -----Geant4.6.2
-
- 'boost-2-0' (February, 2005) ----Geant4.7.0
- 'boost-2-1' (May, 2005) ----- Geant4.7.0+p01

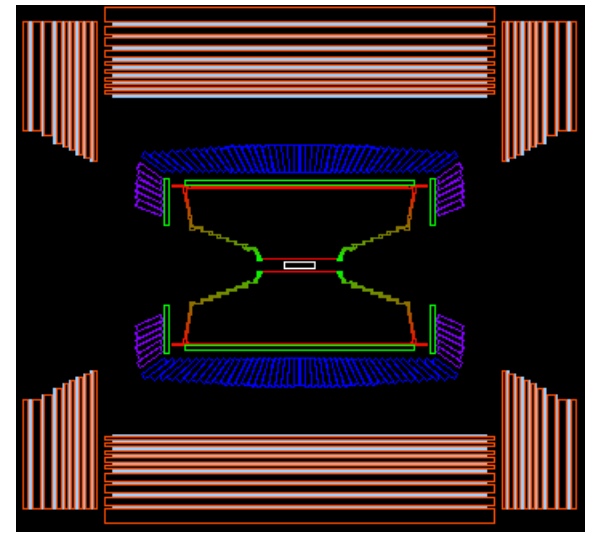
BOOST Current Status

geometry

From boost-2-1



barrel: **MDC**, **TOF**, **EMC**, **SCM**, **MUC**



end-cap: **TOF**, **EMC**, **MUC**

BOOST Current Status

generator

◆ genbes: (BESII generator system)

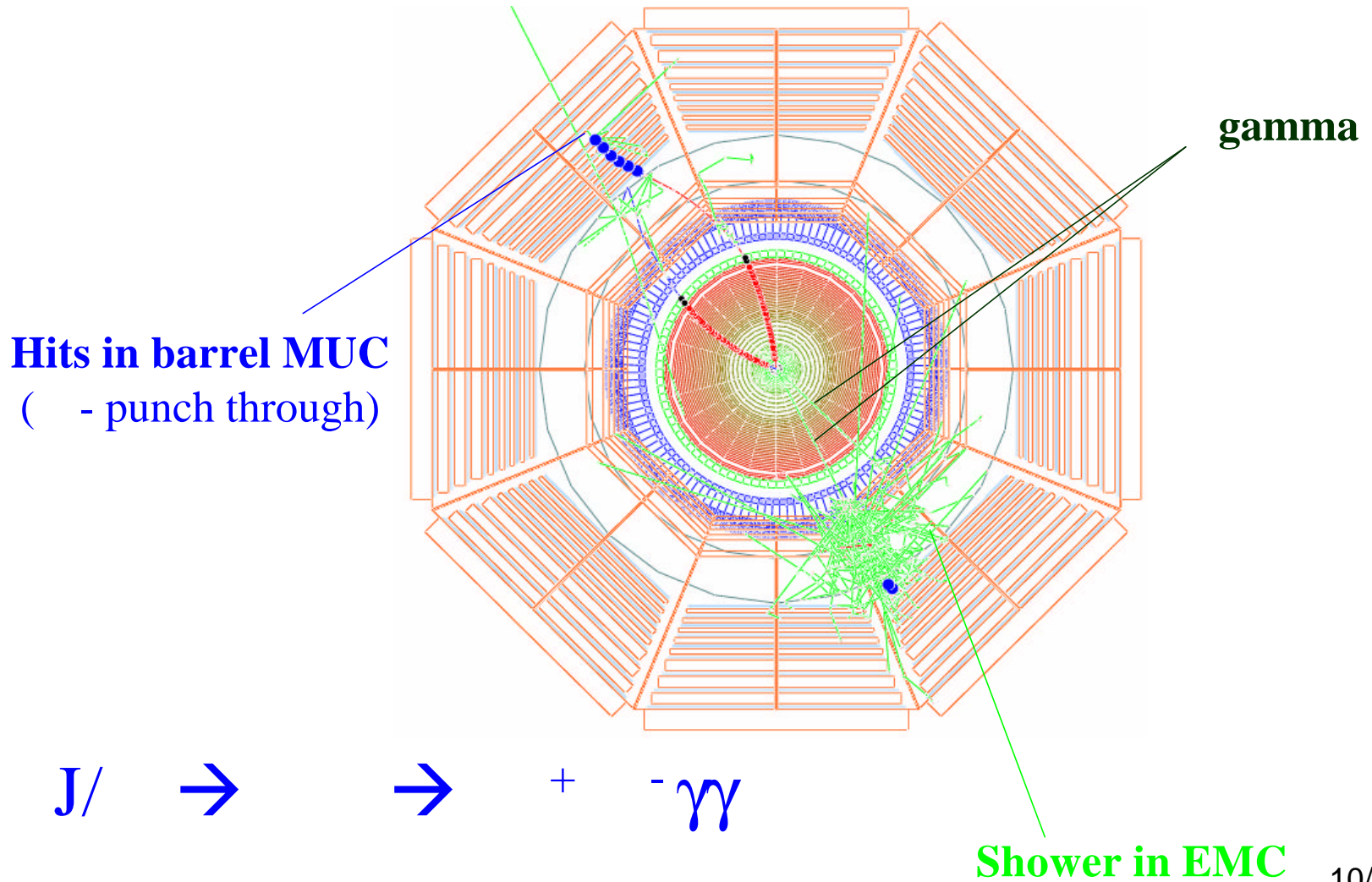
- Generate events in an ASCII file which supports HEPEVT interface with Geant4
- The same user interface as BESII
 - genbes.cards , genbes.user
- All BESII generators can be used in BOOST

◆ tester: (single-particle generator for debugging)

- Shoot particles of given type
- to a given direction
- with given kinetic energy
- Users can randomize above quantities

BOOST Current Status

generator: rhopi



BOOST Current Status

processes & magnetic field & material

◆ Physics processes

- BesPhysicsList constructed with Geant4 classes
- Many hadronic models installed, LHEP, LHEP-GN, QGSP-GN,
- More research on them needed to choose suitable ones for BESIII physics

◆ Magnetic field

- 1 Tesla uniform magnetic field defined inside SCM

◆ Material

- All materials needed in BOOST defined in XML

BOOST Current Status

hits and digitization

◆ Hits recording

- Finished last year

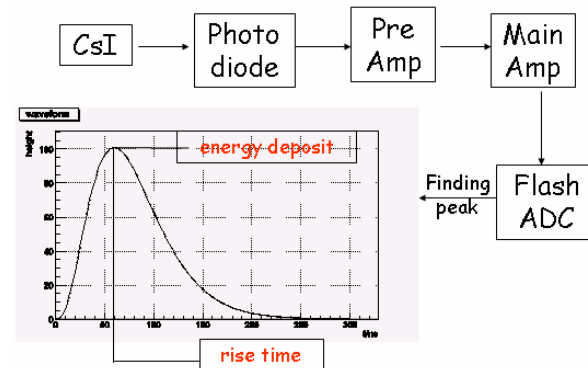
◆ digitization

➤ MDC

- Drift distance → drift time
- dE/dx
- Wire resolution added
- Simple background added

➤ TOF

- Detailed digitization
- Light emission & light propagation
- PMT response & threshold discrimination



➤ EMC

- waveform added
- Simulate main amplifier output
- Provide risetime to eliminate noise
- No noise, so not used now

➤ MUC

- Digit information added

BOOST Current Status

MC truth

◆ Purpose

- To provide truth information for reconstruction debugging
- Similar to MCMADE in BES I I

◆ What to save

- True state of the particles and their association with detector response
 - Particle
 - particles from generator
 - uninterrupted decayed daughters
 - Detector response
 - hits in sub-detectors associated with particles

BOOST Current Status

MC truth

◆ Track and vertex (associated with particle)

- Track
 - PDGcode
 - charge
 - original vertex
 - terminal vertex
 - four-momentum
 - decayed daughters
- Vertex
 - parent track
 - position
 - time

◆ truth hits (associated with track)

- Considering demand of each reconstruction developer
- MDC
 - Hit history
- TOF
 - First-hit
- EMC
 - Total energy loss
- MUC
 - Hit history

BOOST Current Status

Data I/O

◆ Ascii data I/O

- It's temporary, but useful in software (SIM + REC) development
- Ascii data format fixed for the moment
- MC truth (TRUTH) & Raw data (DIGI) included in one file
 - EVHEAD
 - TRACKTRUTH, VERTEXTRUTH
 - MDCTRUTH, MDCDIGI
 - TOFTRUTH, TOFDIGI
 - EMCTRUTH, EMCDIGI
 - MUCTRUTH, MUCDIGI
- Users can turn on/off TRUTH and DIGI part of each sub-detector in run cards

BOOST Current Status

User interface

- ◆ Friendly to both users and developers
 - source ~dengzy/.boostenv
 - cvs co boost
 - edit boost.cards & boost.user
 - more controls in run cards
- ◆ Run background/terminal/interactive/PBS job freely
 - boost -b/-t/-i/-q
 - use 'boost -h' for detail

BOOST Performance

Speed

◆ From LHC experience

- G4 direct comparison with G3
- G4 is slower (1.5~2) than G3
- G4 tracking particle to 0 energy

◆ Compared with SIMBES

- SIMBES (G3/BESII), BOOST (G4/BESIII)

◆ How to compare

- Similar cuts
 - CUTE CUTM (10KeV), range cuts (1mm)
- Same platform (Besfarm7)
- Physics events used (dimuon, rho pi, bhabha)

BOOST Performance

Speed

CPU time (s) for one event Besfarm7 (PIII/933)		
Event	SIMBES	BOOST
ee -> uu	0.122	0.189
J/ ->	0.471	0.763
ee -> ee	0.736	1.224

- ◆ BOOST **1.5 times** slower than SIMBES
- ◆ More to do about speed improvement
 - Threshold cut in digitization
 - Speed of hadronic models to be compared
- ◆ Stable (no crash for 100,000 events)

BOOST Integration to BOSS framework

◆ Different developing environment

➤ BOOST

- On besfarm
- Configured with gmake
- Based on GEANT4

➤ BOSS

- On koala
- Configured with CMT
- Based on GAUDI

◆ Integration Status

- BOOSTAlg algorithm/packages created in BOSS
- Key functions of BOOST realized in BOSS
- Interface of saving data to TDS is ok
- Codes imported into cvs