Prospects for integration of physics event generators

P. Bartalini

OUTLINE

- Event generators
- Event generation in GEANT 4
- Event generator interfaces
- The BPACK project

C++ Event generators

- Pythia 7

  - Pythia is a Monte Carlo package for simulating multi-particle production in collisions between elementary particles (T.Sjöstrand et. al.).

  - C++ version, contact person: Leif Lönnblad (Lund)

  - Work is in progress (almost finished)

- Herwig++

  - HERWIG is a Monte Carlo package for simulating hadron emission reactions with interfering gluons (P.Marchesini et. al.).

  - C++ version, contact persons: M. Seymour (RAL) and B. Webber (Cambridge/CERN)

  - Work is in progress (just started)

- EvtGen 1

  - EvtGen is a Monte Carlo package dedicated to B meson decays that follows the amplitude approach (A.Ryd)

  - C++ version, contact person: A.Ryd (Caltech)

  - The first version is ready (tested on OSF, AIX, SunOS, HPUX, Linux)

  - Not yet amenable for LHC $\rightarrow$ BPACK project

- Event

  list of Collision

  list of ParticleData

- Collision

  list of Step

  initial colliding particles

  initial collision vertex

- Step

  list of Particles

  list of intermediate particles

Pythia 7 overview

- Particle
  - ParticleData
  - pointers to decay products (Particles)
  - color connections
  - pointers to modifications of this particle
  - spin
  - 4-momentum
  - generated mass
  - vertex (space & time)
  - decay (space & time)
  - proper lifetime
  - resolution scale
  - pointer to creation step

- ParticleData
  - PDG number
  - name as character string
  - mass
  - ParticleMass
  - width
  - lifetime
  - charge
  - spin
  - color
  - stable flag
  - anti-particle pointer
  - flag about how to treat anti-particle
  - decay table

Event generation in GEANT 4

contact person Makoto Asai (Hiroshima)

- Actual generation of primary particles is done by concrete classes of G4VPrimaryGenerator derived from G4VuserPrimaryGeneratorAction; for now GEANT 4 provides a couple of G4VPrimaryGenerator concrete classes

  - G4ParticleGun

  - G4HEPEvtInterface → reads an ASCII file produced by an event generator and reproduces G4PrimaryParticle objects associated with a G4PrimaryVertex object

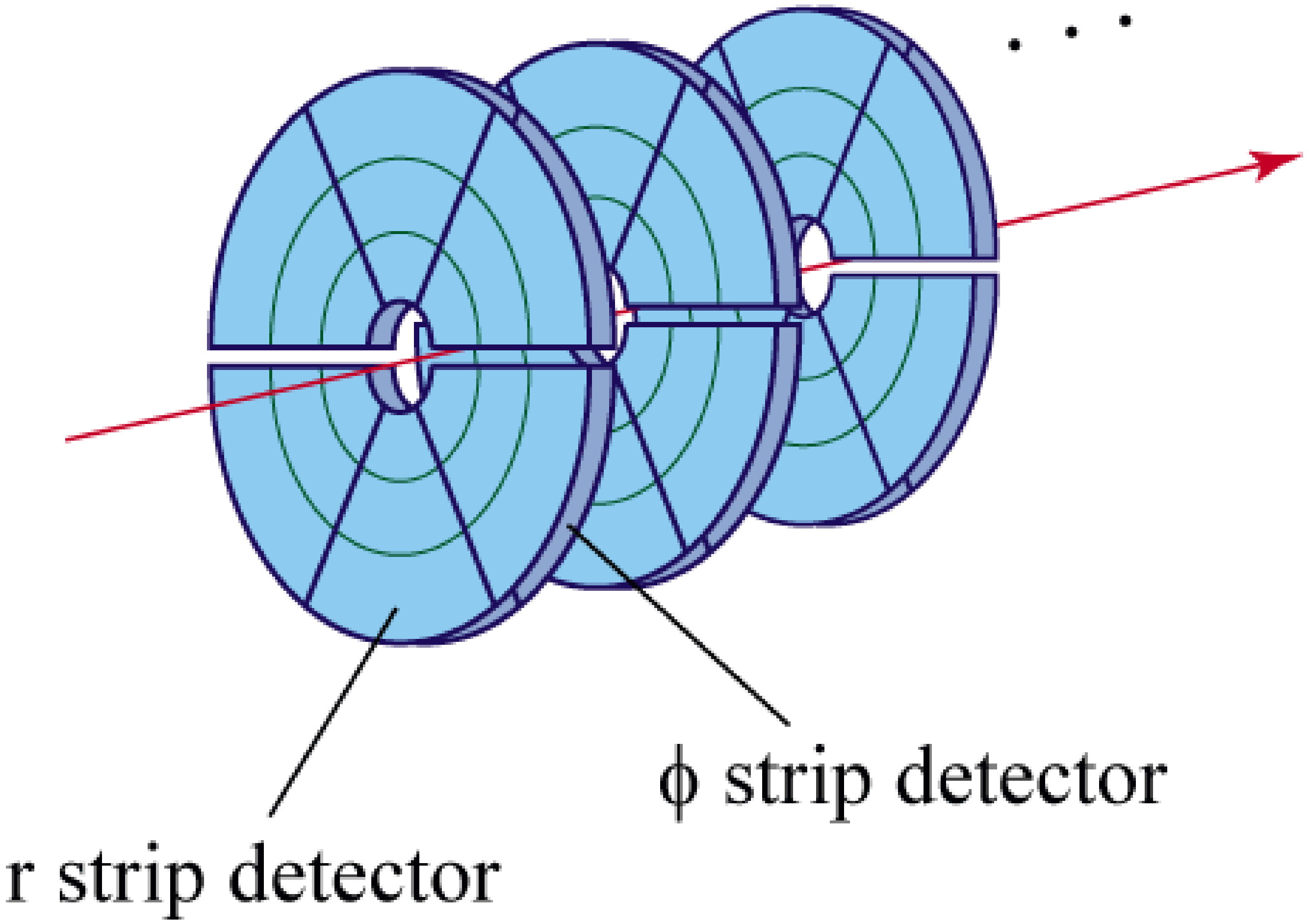
  - once Pythia 7 version is ready GEANT 4 will provide a direct interface

- Present scenario → disentangle generation and simulation

- Future scenario → just Pythia ? More sophisticated generator interfaces (StdHepC++) ?

B decay in GEANT ?

B interaction in the VELO detector and material can happen!



- A concrete class of G4VPrimaryGenerator, the G4PrimaryParticle object is constructed with either a pointer to G4ParticleDefinition or an integer number which represents P.D.G. particle code.
- GEANT 4 will simulate only the particles which are defined as G4ParticleDefinition class objects. Other primary particles will be simply ignored by G4EventManager. But it may still be useful to construct such "intermediate" particles for recording the origin of the primary event
- The G4PrimaryParticle class object can have a list of its daughter particles. If the parent particle is an "intermediate" particle, which Geant4 does not have a corresponding G4ParticleDefinition, this parent particle is ignored and daughters are assumed to start from the vertex with which their parent is associated
- GEANT 4 is able to perform decay in flight of particle that have a corresponding G4ParticleDefinition, however the priority is given to the physics generator

StdHep

- The SICb simulation currently uses the public version of *StdHep*, the generator and analysis framework built by the Fermilab simulation group; also maintained at CERN
- PDG compliant particle data base
- Translation routines

  - Generator commons → /HEPEVT/

  - /HEPEVT/ → generator commons, Geant 3 (KINE and VERT).
- Utility routines:

  - QQ related (decay particles and update /HEPEVT/)

  - Quark contents; mother/daughter operations
- Tools (not used in SICb):

  - Machine independent I/O streams

  - Generator event display

StdHepC++

contact person: Lyn Garren (Fermilab)

- The first version (StdHep 4.07) is available and it is tested on the Fermilab supported platforms
- It is consistent with the Pythia 7 strategies
- For backward compatibility it provides interfaces to the existing fortran /HEPEVT/ common block
- It will implement all functions currently in the fortran StdHep implementation
- It will iterface EvtGen !
- XDR, LHC++ and root I/O will be supported
- It is identified as being pursued for inclusion in CLHEP or enchancements of a CLHEP package; contact person: Andreas Pfeiffer (CERN)
- The spinoff on GEANT 4 have to be discussed; CLHEP–GEANT 4 contact person: Gabriele Cosmo (CERN)

The BPACK project

- Joint effort for a common development od a B decay package (collaborators from ATLAS, CMS, LHCb, BaBar, CDF, Theory)
- first meeting of CMS, LHCb and ATLAS Friday November 12 at 9:00-12:30 in room 40-4d-08
- first video conference meeting of BaBar, CDF, CMS, LHCb and ATLAS; Wednesday November 17 at 17:00-19:30 in room 40-4-C01
- second meeting of CMS, LHCb and ATLAS Friday December 3 at 14:00-18:00 in room 32-S-C22
- http://home.cern.ch/ msmizans/production/Bpack

- physics requirements $\longrightarrow$ EvtGen
- software requirements $\longrightarrow$ StdHepC++, Decay data base
- organisation requrements $\longrightarrow$ officialisation, LoI

  - Olivier Schneider presentation at the LHCb week

  - END OF THE YEAR LHCb GENERATOR MINI–WORKSHOP IN CLERMONT FERRAND