

Status of Generators in Gauss

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Introduction

- Before DC06, the Gauss interface to external generators was completely modified, but no major changes in external libraries used.
- Before MC09, move to new major versions of the main generators used (Pythia and EvtGen)
- Gauss is now using the most recent versions of Pythia and EvtGen, which will ease the maintainance a lot in the future.
- But transition was painful.

Pythia

- Move from 6.3 with Old Multiple Interaction Model, to 6.4 with New Multiple Interaction Model and new prompt quarkonium production models.
 - Much larger bb (and cc) cross-sections compared to DC06.

	s(bb)#	s(cc)#
DC06	0.698 mb \pm 0.001 mb	3.643 mb \pm 0.003 mb
MC09	1.04 \pm 0.01 mb	8.31 \pm 0.01 mb

- Harder prompt J/ ψ p_T spectrum.

EvtGen

- A bit of history:
 - In 2003, when EvtGen was first introduced in Gauss, modifications were made to allow incoherent B mixing and CP violation, because at that time, they were not available in EvtGen.
 - Between 2003 and 2009, EvtGen was frozen in LHCb, but evolved (slightly) at BaBar.
 - In 2009, CMS complains that the LHCb version of EvtGen is not up-to-date compared to the BaBar one, and it is decided to merge all changes in a single new version.

New EvtGen Version

- The 4 major modifications made by LHCb to use EvtGen were:
 - Incoherent Mixing for B^0 and B^0_s at pp collisions
 - CP violation from incoherent B production (*ie* non zero integrated CP violation)
 - Use Pythia inside EvtGen instead of custom old JetSet version
 - Register dynamically external new models (Will Reece).
- Unfortunately only the last one was kept in the merge, the 3 other were thought to be available in the EvtGen BaBar version.

New EvtGen version

- Incoherent B mixing:
 - Way of passing parameters (Δm and $\Delta\Gamma$) has changed:
 - Δm is passed in the main decay file DECAY.DEC
 - $\Delta\Gamma$ is passed through 2 artificial particles B_H and B_L as the lifetime difference between the 2 states
 - These 2 particles must be defined in the particle table
 - If not, B^0 and B_s^0 are generated with 0 lifetime, but of course as we had defined the particles in our user area, we could not see the effect.
 - Lifetime was not generated correctly (wrong sign in equation)
 - Mixing was not applied correctly to forced B decays.
 - Everything was corrected by Mark Whitehead/Paul Harrison (see Simulation Meeting, 05/06/09)#

New EvtGen version

- CP Violation:
 - Not yet tested, will be done next week by Mark/Paul
 - But used only for a limited number of signal events ($B^0 \rightarrow J/\psi K_s$, $B \rightarrow hh$), and never for minimum bias or inclusive production
 - One specific LHCb model with CP violation ($B_s^0 \rightarrow J/\psi \phi$) was tested and adapted by Greig Cowan and re-introduced in EvtGen. (See Simulation meeting, 12 June 2009)

New EvtGen version

- Interface to Pythia: tested OK (copied what we had in our LHCb version to new EvtGen)#
- Status:
 - CP violation still to test
 - Then send our changes to EvtGen authors to converge to a version containing our modifications
 - Painful transition but we are now synchronized with last EvtGen version.
 - Small issues:
 - Dependency to CLHEP
 - FORTRAN models inside EvtGen

Other Generators

- HIJING:
 - Used in LHCb to generate beam-gas, ...
 - Not supported anymore by authors
 - FORTRAN software, having problems on 64 bit machines (random number generator), OK for 32 bits.
 - We have to update it and maintain it ourselves if we want to continue using it.
- BcVegPy:
 - Used to generate B_c events.
 - Problems observed when changing PDF, not understood yet.
 - Management of data files to improve (phase space sampling files which depend on energy)
- No production with these generators possible for the moment

Conclusions

- A lot of changes in the Gauss generator part.
- CP violation still to test, but main event types can be generated now.
- New event types (decay files) can now be added anytime.
- MC09 generator settings visible here:
- <https://twiki.cern.ch/twiki/bin/view/LHCb/SettingsMc09>
- Next step is to move to Windows and SLC5.