EvtGen in ATLAS

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ATLAS EvtGen users: General requirements

- **ATLAS does all B-decays at Event Generator level (Pythia, Herwig, EvtGen, etc), no need to do it at detector simulation level (Geant). Dominant part of B and Charm hadrons decay inside beam pipe radius=2.4cm – fraction beyond this point is negligible.**
- **Only decays K0s, Lambda are done in Geant.**
- **In case of K0s and Lambda from exclusive B-decays we first decay in Event Generator a full decay chain for instance B->J/$\psi(\mu\mu)$ $K^0_s(p\pi)$ and apply acceptance cuts. Events are written into output files, which acan be used as input into fast (detector) simulations – Atlfast or full detector simulations (Geant).**
- **In case of Geant K0s or Lambda decay is removed from event chain and K0s and Lambda is given a chance to interact with detector. If not then the weak decay of K0s or Lambda is generated in Geant again.**

→ No need to call EvtGen from Geant in ATLAS

→ For K0, Lambda special treatment (to preserve correct angular information given by EvtGen at a new decay point).

ATLAS EvtGen B-physics group requirements

Exclusive decays:

- **Strong B-decays: Σb, etc – production polarization must be defined in spin operator (by hand – no model for b-production yet) and correctly treated to get polarization of secondary B-baryons – otherwise all baryon weak decays angular distributions incorrect.**
- **Elmg B-decays – EvtPhotos, ok.**
- **Weak decays EvtGen provides:**
  - ✓ **Default decay models for all decays – are they all consistent?**
  - ✓ **Tools for user to accommodate own model:**
    - ✓ **Complex amplitudes – interference effects – strong and weak phases differences, CP violation, interference between resonances in final states.**
  - ✓ **General algorithm for angular distribution in cascade decays – using spin-density matrix – ok, can be used also for strong/elmg decays.**

→ Need to complete baryons, polarizations and strong decays however tools in EvtGen exist – ok

→ EvtGen OK for individual exclusive channels, however a problem is with inclusive samples generator – see next.

ATLAS EvtGen B-physics group requirements

Semi-Inclusive samples:

- **Semi-leptonic decays: EvtGen has several models for semi-leptonic decays however problem with multiplicities of the rest. Pythia has a model simular to fragmentation.**
- **bb->J/ψX very bad condition in Pythia (EvtGen) – experimental data missing on multiplicities, need some model on fragmentation**

→ For all types of inclusive decays: EvGen should provide decays of all species even if it calls Pythia(Jetset) for higher-multiplicity decays.
→ bb->J/ψX data on X-multiplicities and other X properties are needed: can CDF and D0 supply??

ATLAS EvtGen other groups requirements

- **QCD b-production based on combining exclusive B-decays with semi-leptonic , bb->J/ψX and b-jets.**
- **Top, SUSY, Higgs – use b-jets and semi-leptonic samples**
- **What is needed of b-jets: multiplicities, pT distributions,**
- **correct number of K0, Lambda0 contained in b-jet.**
- **These properties are treated in PYTHIA – with more or less success. There is no need that EvtGen duplicates this.**
- **Curently part of decays are in EvtGen – rest in Pythia(Jetset) – must check if b-jets and semi-leptonic general properties are OK this way.**

EvtGen in ATHENA

- **EvtGen has been implemented in ATHENA – similar as in Gaudi (LHCb)**
- **Events are first converted from HEPEVT to HepMc then communicated ot EvtGen and back to HepMC.**
- **More details in J.Catmore presentation Friday.**
- **ATLAS plan to keep close with LHCb – however will not follow LHCb in B-decays from Geant.**
- **In correspondence with previous B-generation ATLAS provides user a possibility of generation of only one exclusive channel per one run.**
- **ATLAS use a concept of repeated hadroniztion (for timing reasons). This is preserved also in case of using EvtGen.**
- **We will keep both possibilities Pythia or EvtGen user can choose.**

Conclusions:

- **Technically we can provide EvtGen as a default B-decay tool for all ATLAS groups however all of them (except for B-group) are interested in inclusive samples and need more general properties.**

- **These properties are treated in PYTHIA – with more or less success. There is no need that EvtGen duplicates this.**
- **EvtGen –makes part of decays in Pythia(Jetset) – must check if b-jets and semi-leptonic general properties are OK this way.**

- **We will keep both Pythia and EvtGen modes opened and recommend Pythia for inclusive samples generation untill b-jet general properties are checked for EvtGen.**

- **ATLAS plan to go close with LHCb – however do not follow LHCb in B-decays from Geant.**
- **Different types of data are expected from BaBar, Belle about exclusive decays, however we need CDF, D0 to describe inclusive samples.**