

EvtGen Status

John Back

University of Warwick

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Introduction

- EvtGen: software tool to simulate B and D decays
 - Used by range of experiments (LHCb, ATLAS, CMS, Belle2, ...)
 - Created by A. Ryd and D.Lange; now maintained by Warwick team
- Wide range of decay models
 - Amplitudes based on helicity formalism; CP violation (mixing)
 - Takes into account spin/angular correlations; coherent/incoherent production
- Sequential particle decays
 - Specified using text (or xml) decay files
 - Kinematics generally assume resonances are relativistic BW
 - Dalitz plots use isobar model for BWs, not K-matrix
 - Decay probabilities: accept/reject method for each mode in decay chain
- External package features
 - HepMC : for writing events in HepMC format (mandatory)
 - Photos++: FSR photons (optional)
 - Pythia8: generic decays that have no specific EvtGen model (optional)
 - Tauola++: tau decays (optional)

Code Maintenance

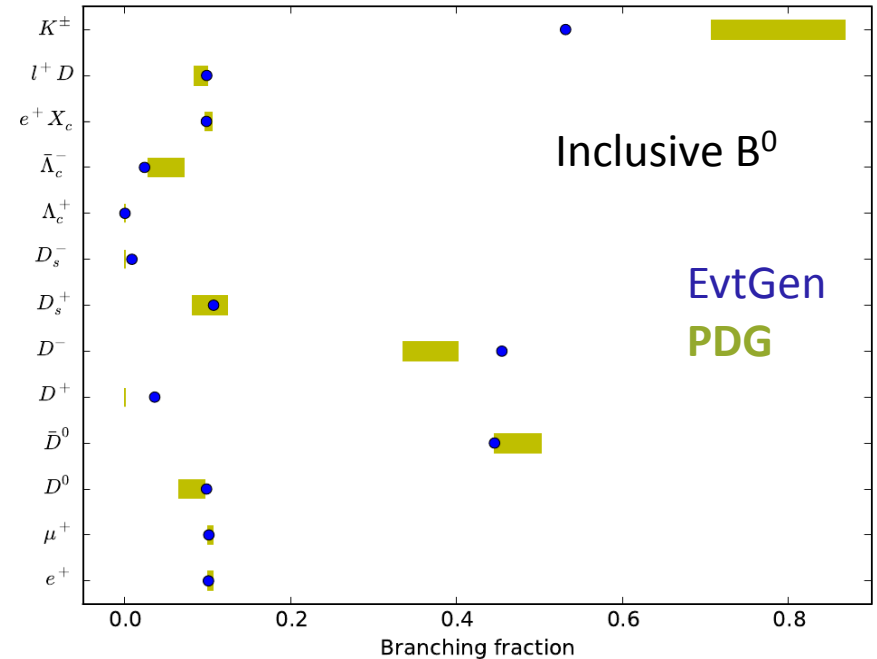
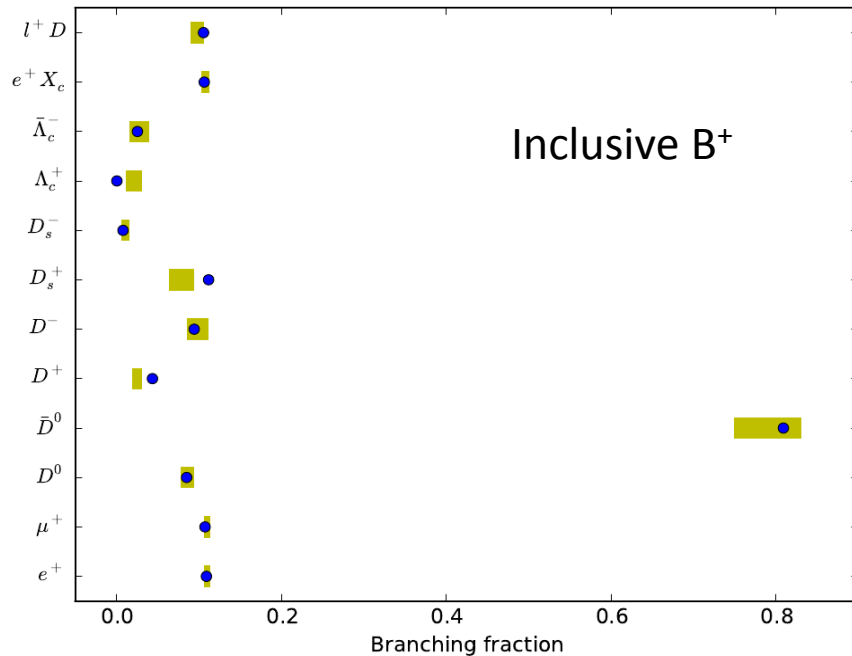
- EvtGen master svn repository hosted at CERN
 - Current tagged version is 1.5.0 (released 21st Oct '15)
 - EvtGen “svn librarian” members have write access
 - Guest read access at <http://svn.cern.ch/guest/evtgen>
 - Example build script, examples and validation code provided
 - Kept up-to-date with changes in external packages (e.g. Photos++)
 - Critical bug fixes/collection of smaller changes \Rightarrow new tag (~1 every few months)
 - New versions announced via announce@evtgen.warwick.ac.uk email list
 - Should contain MC contacts from all known experiments, as far as we know
- Dev team are LHCb collaboration members
 - LHCb uses its own version of EvtGen, manually “synched” with master repository
 - Continually incorporating bug fixes/new models: LHCb \leftrightarrow master
 - There are some (minor) technical differences, but they use the same physics models
- People can ask us questions using email: dev@evtgen.warwick.ac.uk
 - We try to answer as soon as we can
 - Bug fixes/new useful models from users are added to master repository
 - Warwick hosted web-page with news and some doc: <http://evtgen.warwick.ac.uk>

Recent Developments

- New physics models (from LHCb):
 - Generic Dalitz plot model (resonance parameters via xml file)
 - Rare $\Lambda_b \rightarrow \Lambda^* \ell \ell$
 - $B_c \rightarrow \text{scalar } \ell \nu$, $B_c \rightarrow \text{tensor } \ell \nu$
 - $B \rightarrow 4 \text{ leptons}$, e.g. $B^- \rightarrow \mu^+ \mu^- \text{ anti-}\nu_\mu \mu^-$
 - EvtSVPHelCPMix: complete mixing phenomenology of $B_s \rightarrow \text{vector } \gamma$
- Added Mersenne-Twister random number generator
 - Enabled if configure script detects c++11-feature compiler (e.g. gcc 4.7)
- Various issues resolved:
 - Bug fixes, mainly from LHCb “JIRA” web bug-tracking reports
 - Photos++ changes in v3.60 caused problems with EvtGen.
Fixed in v3.61 after working closely with Photos developers (~2 weeks)
- Fortran Wilson coefficient code replaced with C++ (“Spence function”)

Particle Tuning

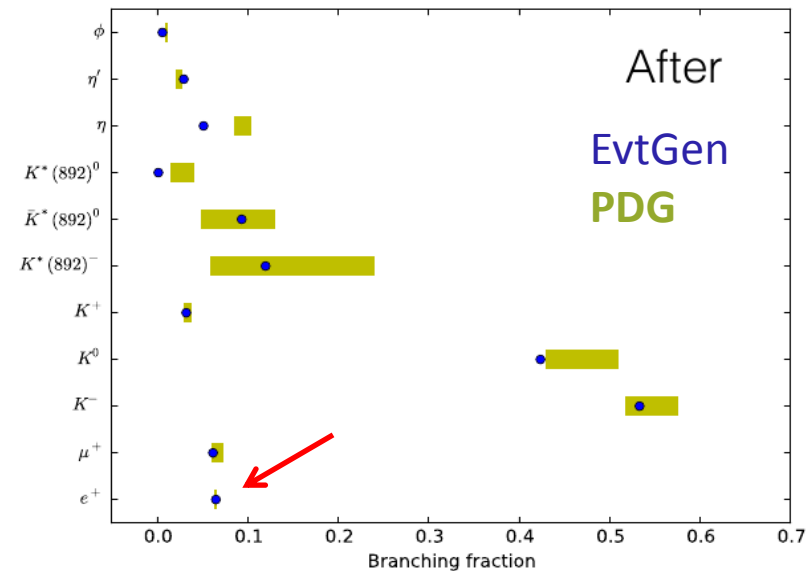
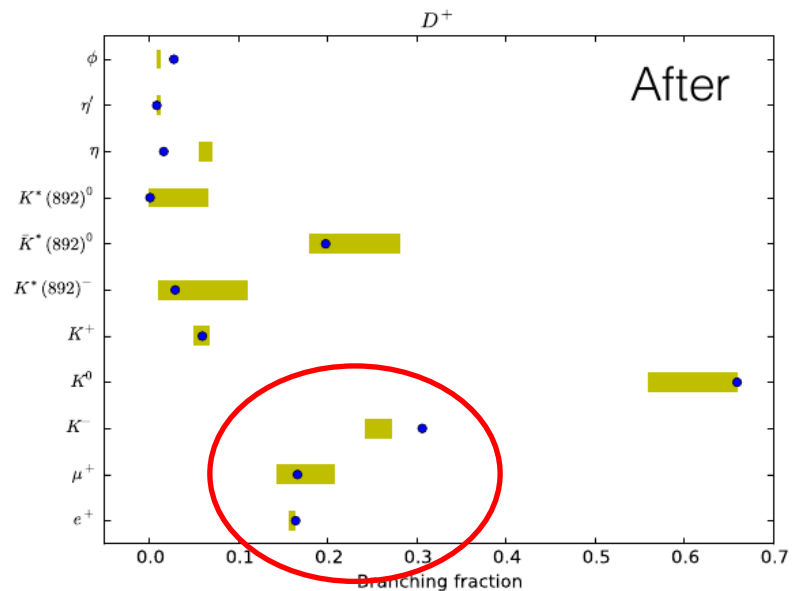
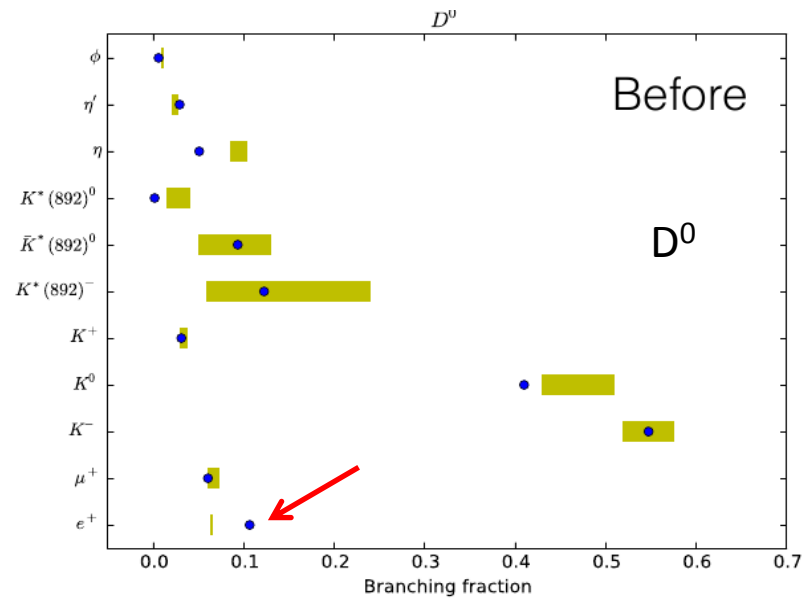
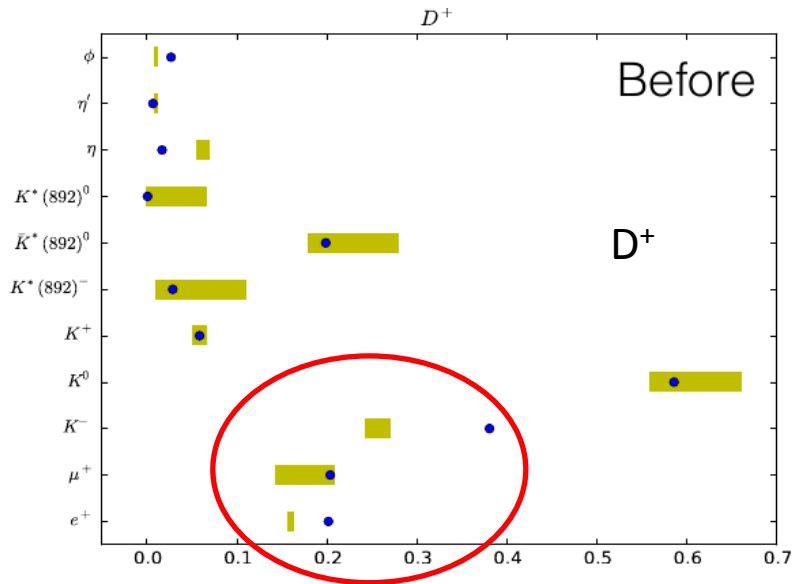
- DECAY.DEC updates in progress:
 - Full generic particle decay file using PDG BFs
 - Non-trivial issues using “automatic” tools
 - PDG sub-mode table indents inconsistent \Rightarrow double counting
 - Requires careful manual checking (reading original papers)
 - Σ Exclusive = Inclusive not always the case (e.g. semileptonic decays)



- Particle properties in evt.pdl
 - Updated within LHCb version, will add to svn master

Inclusive charm BF tuning

Implemented in LHCb DECAY.DEC (Michal Kreps); will add to svn master



Future

- Updates in progress
 - DECA.DEC: list of generic decays; consistency between inclusive/exclusive modes
 - evt.pdl: particle property file
 - Adding new physics models (some more expected from LHCb soon)
- Will migrate repository to HepForge
 - Well maintained infrastructure
 - Integrated svn repository with web-tools, doxygen documentation
 - Tracking of bugs and new/requested features
 - Idea is that all experiments will use this version
 - Could use git, but will probably stick to svn (for HepForge web-tools)
- Would like to remove remaining EvtGen Fortran code
 - Old CPV models involving $B \rightarrow 3$ pseudoscalars (e.g. 3π with CKM α)
 - Do we still need them? EvtGenericDalitz is now available...
 - If so, we'll convert them to C++
 - Fortran compiler is still required if you need Tauola++
- Lots of hardcoded physics parameters (Dalitz models, form factors...)
 - Would be good to unify these, allow configuration via parameter files
 - Long term project, depends on interest from potential users

Summary

- We try to stay active with EvtGen maintenance
 - Most development driven by physics interests
- Aim: don't want experiments to diverge code
 - If you add anything, let us include it in svn master
- Planned updates and changes:
 - DECAY.DEC, evt.pdl, new physics models
 - Move repository to HepForge
- If you identify bugs/develop new features
 - Let us know so that it can benefit others.