2.5 Event Generators at Belle II

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The next generation B–factory Belle II at the upgraded KEKB accelerator, SuperKEKB, is aiming to start data taking in 2017. The broad physics program covers e.g. physics with B and D mesons, μ and τ leptons as well as measurements using the method of radiative returns and direct searches for new physics. The expected dataset will exceed the one collected by the predecessor Belle by a factor of 50 and imposes high precision requirements on the used event generators and requires a flexible and powerful software framework. The bulk of the data will be collected at the $\Upsilon(4S)$ resonance, but it is planned to collect sizable data sets also off–resonance and at energies around the narrow resonances $\Upsilon(1S)$, $\Upsilon(2S)$ and $\Upsilon(3S)$.

Belle II uses a single software framework, basf2 [1, 2], for all data processing tasks which runs on standard Linux systems. It is based on a user–defined chain of individual modules where each subsequent module can read data from the preceding modules from a so-called data store. Event generators usually serve as specialized modules that provide four vectors to be fed into the subsequent GEANT4 based detector simulation as well as precision cross section calculations used for normalization. If available from the generator, all mother-daughter relations of both unstable particles and radiative photons are stored and used in Monte Carlo truth matching during analysis. FORTRAN–based generators are interfaced using extern "C" functions where the user inputs and generator outputs are provided as FORTRAN common blocks and global C/C++ extern structs of the same name. All generators use a random generator provided by the basf2 framework. The original input interfaces are replaced by Python steering scripts that provide access to the generator options in a uniform and user–friendly way.

The available physics generators include BABAYAGA.NLO [3], BHWIDE [4], KKMC4.19 [5, 6], PHOKHARA9.1b [7], KORALW1.51 [8], AAFH [9], BBREM[1] and EvtGen [11].
TAUOLA [12] and PHOTOS [13] are used by EvtGen and KKMC to handle τ decays and radiative corrections in decays. MadEvent [14] is used to simulate New Physics processes. Light quark continuum is modeled using KKMC (hard interaction), PYTHIA8 (fragmentation) [15] and EvtGen (decays). Standardized HepEvt or Les Houches event (LHE) format can be read by dedicated input modules. The data from the data store can be obtained at any stage of the module–chain in ROOT or HepEvt file format.

In conclusion, all basic event generators are available in basf2 and ready for physics and trigger studies. Future projects will focus on the precision validation and improvements needed to match the demanding precision requirements for luminosity measurements and

[1] C++ implementation based on the original FORTRAN code [10].

low multiplicity physics especially at the narrow resonances. A semi–automatic framework to check EvtGen models is under development. Work has started to use the Belle datasets taken off–resonance and at the $\Upsilon(1S)$ to tune PYTHIA8 within the basf2 framework.

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