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The Simulation of Polarized Baryons in the LHC ATLAS using EvtGen.

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We will report on a set of studies we have conducted to assess the feasibility of measuring the polarization of lambda_b hyperons in the CERN ATLAS experiment by making the first successful adaptation of the generation package EvtGen for polarized spin-1/2 particles. The simulations were based on the EvtGen version of ATLAS, a product of ATLAS EvtGen project, reported in other ATLAS abstract to
this conference. The lambda_b simulations have permitted us to develop an efficient method to generate polarized hyperons in the ATLAS detector and to carry out a number of precision tests which replicate the real challenges that will be faced in the actual experiment. We will report on the details of the techniques we used to implement EvtGen for our physics application and on the various test we conducted to validate its performance.

Summary

We have conducted to assess the feasibility of measuring the polarization of lambda_b hyperons in the CERN ATLAS experiment by making the first successful adaptation of the generation package EvtGen for polarized spin-1/2 particles in a large hadron detector. The simulations using EvtGen have permitted us to develop an efficient method to generate polarized hyperons in the ATLAS detector and to carry out a number of precision tests which replicate many of the real challanges that will be faced in the actual experiment. The physics focus of our studies is our plan to acquire over 75,000 inclusively produced lambda_b hyperons in the first three years of ATLAS running, permitting polarization measurements to be made at the level of a few percent. Because of the simplicity of the final state, with only four charged particles, and because of the two displaced vertices involved in the reconstruction, we expect minimal combinatorial backgrounds. Since detector acceptance corrections can dominate the polarization analysis, accurate simulations using polarized particles are required. With the capabilities of EvtGen we have simulated several hundred thousand lambda_b events with fixed polarization and fixed alpha parameter. Using an independent Maximum Likelihood approach we have analyzed the resulting angular distributions from simulated lambda_b decays and extracted the values of polarization and alpha and found them to be in good agreement with the values that were originally given as input. We have been greatly encouraged by our success in developing simple procedures for extracting the polarization and alpha parameter from simulated data. EvtGen allows to specify the complete amplitude information and hence to perform a complete simulation of the angular distributions in a way that properly takes into account the relevant particle spin structure. The lambda_b polarization was introduced exploiting the EvtGen capability to manipulate spinor algebra.
We will report on the details of the techniques we used to implement EVTGen for our physics application and on the various test we conducted to validate its performance

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