A BETHE-HEITLER 5D POLARIZED PHOTON-TO-E+E-PAIR CONVERSION EVENT GENERATOR

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Introduction. The conversion of a high-energy photon to an e+e- pair is described by a 5D differential cross section [1]. Most pair-conversion event generators available in HEP toolkits have been developed with EM shower simulation in mind though [2, 3] and they use products of 1D ersätze. Most often the polar angle of the two tracks are generated independently and therefore energy-momentum is not conserved. The physics model that generates the conversion of linearly polarized photons in Geant4 does so above 100 MeV, while the polarimetry of cosmic sources needs to analyse photon conversion as close as possible to threshold due to the strongly decreasing flux of these sources with energy. Above 100 MeV, the model is incorrect [4]. A huge effort in in progress to extend the good- sensitivity energy range of gamma-ray telescopes to lower energies than for the Fermi/LAT, thanks to a major improvement in single-photon angular resolution, with pure silicon telescopes (no tungsten converter) [5, 6]. In the case of gas detectors such as TPCs, the single-track angular resolution is so good that the polarisation of the incoming radiation can be measured [7], something which has been actually demonstrated experimentally on beam[8].

Materials and methods. I have written a generator that is exact (5D, no high-energy approximation, no small-angle approximation, energy-momentum conservation) and that can generate the conversion of totally or partially linearly polarized photons [7]. The sampling is performed using the VEGAS method, which is not acceptable for a general-use generator as the optimisation and tabulation overhead at a given energy takes several seconds, after which fast event generation can be performed. The code has been validated extensively against published analytical calculations [4, 7, 9, 10].

Results. I have recently modified this code to obtain a VEGAS-free event generation, and I have extended the validation down to threshold and up to a photon energy of 1 PeV.

Conclusion. I am planning to translate the code to C++ over the summer and to make it available to the community, possibly as a Geant4 physics model, would the Collaboration find it agreeable.

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References

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