Dynamics of Anti-Proton – Protons and Anti-Proton – Nucleus Reactions

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A detailed simulation of processes induced by antiprotons is needed for search of antiprotons in cosmic rays and study of antiproton-proton and antiproton-nucleus interactions in future experiments. Various processes take place in the antiproton-proton interactions which are caused by creation and fragmentation of quark-gluon strings. We used the main assumptions of the Quark Gluon String Model (QGSM) or Dual Parton Model (DPM) for estimation of the cross sections of these processes. We also performed an analysis of a wide set of experimental data to determine these cross sections more correctly. We implemented the developed approach in the FTF model of the Geant4 toolkit for the Monte Carlo simulation of the antiproton-proton interactions. The approach allows the main features of the antiproton-proton interactions to be described in a wide energy region, from rest energy up to thousand GeV.

We extended this approach for the simulation of antiproton-nucleus reactions. The asymptotic Abramovsky-Gribov-Kancheli (AGK) cutting rules have been applied for determination of the multiplicity of produced strings. We proposed finite energy corrections to the AGK rules to extend the model to low energies. For calculation of total and inelastic cross sections of antiproton interactions with nuclei we used Glauber approximation. Good results [1] were obtained for the majority of experimental cross sections. All of these were introduced in the extended FTF model of Geant4. Recently, many experimental data on neutron production have been analyzed to improve spectra of the neutrons produced in the antiproton-nucleus interactions.

The FTF model reproduces correctly the general properties of antiproton-proton and antiproton-nucleus interactions [2]. The simulation results of the FTF model and comparison with experimental data will be presented in the report. The FTF model can be accessed using the FTFP_BERT PhysicsList in the Geant4 toolkit.

References

[1] V. Uzhinsky, J. Apostolakis, A. Galoyan et al., *Phys. Lett. B* **705** (2011) 235.

[2] A. Galoyan, V. Uzhinsky, *Hyperfine Interactions*, **215** (2013) 69; arXiv:1208.3614 [nucl-th].