Study of the cross section biasing technique using the GEANT4 toolkit for the determination of parasitic neutrons at N.C.S.R "Demokritos"

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A simulation code was developed using the GEANT4[1] toolkit in order to determine the behavior of the neutron production caused by proton induced reactions while applying the cross section biasing technique.[2] As the application of the biasing technique can cause a change in the physical processes occurring during the simulation, the specific implemented technique was tested through control simulations to determine any deviations of the results from the theoretically expected ones. Different materials, geometries and biasing factors were used in order to qualify and qualify the discrepancies between the unbiased and the biased simulations.

One of the main reactions for the production of the neutron beam at the Tandem accelerator laboratory of Tandem van de Graaff 5.5 MV at N.C.S.R. "Demokritos" [3] is the $^{3}H(p,n)^{3}He$ one. In the geometry of the main tritium target, elements such as molybdenum, copper and titanium are included. During the interaction of the proton beam with them, it is possible to produce neutrons that will "contaminate" the main neutron beam. These neutrons are called parasitic and their quantification is necessary in order to avoid obtaining erroneous results for cross section measurements on various targets under study.[4] By constructing the proper geometry and using the GEANT4 code mentioned above, the determination of the parasitic neutrons is achieved with optimal statistical results in short computational times, while the discrepancies between the unbiased and the biased results remain minimal.

References

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