Contribution ID: **26** Type: **not specified**

Benchmarking secondary neutron production with 113-MeV to 800-MeV proton beams using MCNPX 2.7.0, PHITS 2.52 and FLUKA2012 Monte Carlo codes

Wednesday, 30 April 2014 11:20 (25 minutes)

The capability to accurately model the production of secondary neutrons from protons interacting with matter is of tremendous importance in Proton Therapy. These neutrons are the major source of secondary doses delivered to a patient during treatment. They also represent the most important contribution to the ambient doses remaining outside the biological shielding. They also constitute an important background for the prompt gamma cameras used in the online monitoring of proton beam range. The IBA Company, world leader in the market of commercial proton therapy system is very active in these different fields and pursues several research projects on these topics.
To validate the Monte Carlo codes used for these studies, we make use of differential neutron production cross sections measured at Los Alamos National Laboratory for 113-MeV to 800-MeV protons impinging on thin and thick targets made of different materials from Beryllium up to Uranium-238. These data are compared to predictions obtained with recent versions of the well-known MC codes MCNPX 2.7.0, PHITS 2.52 and FLUKA 2012.
Comparisons of the total production yields, doubly differential cross sections and angular distributions between measured data and MC expectations will be presented for the different target types, beam energies and nuclear models.

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Session Classification: Session 6. Code Benchmarking and Intercomparison, Convener: Robert Grove