



Shielding Experiments Under JASMIN Collaboration at Fermilab (III) - Measurement of High-Energy Neutrons Penetrating a Thick Iron Shield from the Antiproton Production Target by Au Activation Method

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In an antiproton production ($P\bar{b}$) target station of the Fermi National Accelerator Laboratory (FNAL), the secondary particles produced by bombarding a target with 120-GeV protons are shielded by a thick iron shield. In order to obtain experimental data on high-energy neutron transport at more than 100-GeV-proton accelerator facilities, we indirectly measured more than 100-MeV neutrons at the outside of the iron shield at an angle of 50° in the $P\bar{b}$ target station. The measurement was performed by using the Au activation method coupled with a low-background γ -ray counting system. As an indicator for the neutron flux, we determined the production rates of 8 spallation nuclides (^{196}Au , ^{188}Pt , ^{189}Ir , ^{185}Os , ^{175}Hf , ^{173}Lu , ^{171}Lu , and ^{169}Yb) in the Au activation detector. The measured production rates were compared with the theoretical production rates calculated using PHITS. We proved that the Au activation method can serve as a powerful tool for indirect measurements of more than 100-MeV neutrons that play a vital role in neutron transport. These results will be important for clarifying the problems in theoretical calculations of high-energy neutron transport.

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