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Evaluation of Secondary Neutron Characteristics in FLASH Proton Therapy

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Background and Aim

FLASH proton therapy

- Using transmission technique with high energy proton beams (> 200 MeV)

In this study, to address challenges in human safety and facility management,

1.Evaluating neutron characteristics under FLASH conditions

2. Comparing beam stopper and shielding materials to assess shielding effectiveness

Subject and Methods

Experimental setup

- Beam information
  - 228 MeV of single Bragg peak beam
  - 200 nA of cyclotron current
  - → ~ 67Gy/s @Advanced Markus chamber
- Measurement setup
  - Solid water phantom with Advanced Markus
  - Beam stoppers: water, brass, concrete
  - Sheilding materials: HDPE, BPE
  - Detector: AT117M (ATOMEX, Belarus)
    - 0.024 eV – 14 MeV
- Simulation setup
  - Tool for Particle Simulation (TOPAS) v 3.9
  - 10^8 of primary particles
  - Physics: default setting for proton therapy

Fig1. Beam profile of FLASH proton beam

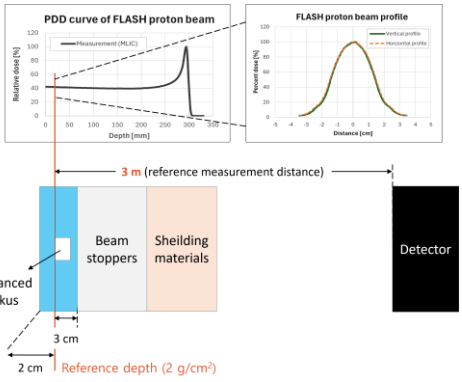


Fig2. Measurement setup scheme

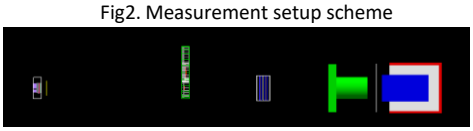


Fig3. Simulation setup for FLASH proton beamline

Results

Angular dependency of secondary neutrons

Brass: Higher neutron yield at 0.01 -10 MeV

→ resulting in **a higher H*(10) than water**

HDPE/BPE: effectively attenuated neutron

→ showing **similar shielding performance**

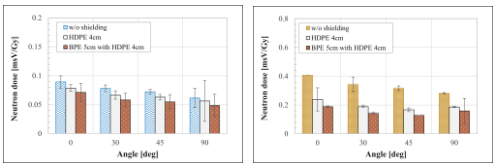
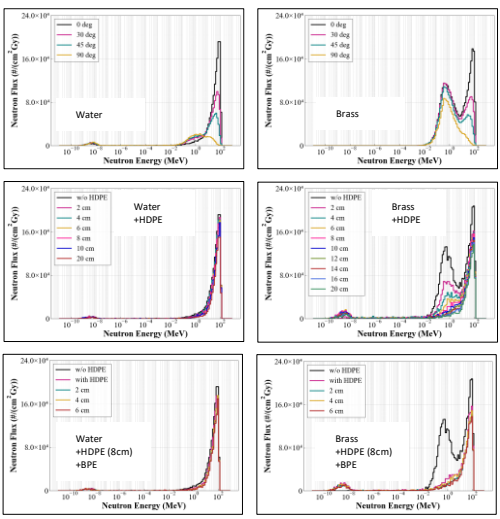


Fig4. Measurement results for neutron spectrum

Fig5. Simulation results for neutron spectrum →



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