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MCNP calculations of the high-power LIEBE molten target at CERN for the production of radioisotopes

Higher beam powers are sought to enhance production of short-lived isotopes, therefore targets able to accommodate such powers are required. With this in mind, a liquid metal target prototype was designed and assembled at CERN, named LIEBE (LIquid Eutectic lead Bismuth for Eurisol). Flux and dose rate maps obtained from Monte Carlo simulations of a 1 mm radii monoenergetic 70 MeV –100 μA flux proton beam falling on the LIEBE target are presented. By a series of proton transport calculations the simulations were performed using the MCNP Monte Carlo code. The latest MCNP input was created with accuracy to the LIEBE target geometry and FENDL-3.1 cross-section data library was used. Performed simulations showed that at the edge of the diffusion chamber, where the proton beam interacts with the target, gamma and neutron dose rates reach almost 2 MSv/h each and around the target dose rates are much lower, roughly 361 Sv/h for gamma rays and 214 Sv/h for neutrons. The proton beam penetrates the liquid eutectic lead bismuth roughly 7 mm deep. Based on the distribution of the flux and dose rate around the target further required changes to the LIEBE target can be evaluated.

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