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Comparison of FNTD and OSLD Detectors' Responses to Light Ion Beams Using Monte Carlo Simulations and Exprimental Data

Authors : M. R. Akbari, H. Yousefnia, A. Ghasemi

Abstract : Al2O3:C,Mg fluorescent nuclear track detector (FNTD) and Al2O3:C optically stimulated luminescence detector (OSLD) are becoming two of the applied detectors in ion dosimetry. Therefore, the response of these detectors to hadron beams is highly of interest in radiation therapy (RT) using ion beams. In this study, these detectors' responses to proton and Helium-4 ion beams were compared using Monte Carlo simulations. The calculated data for proton beams were compared with Markus ionization chamber (IC) measurement (in water phantom) from M.D. Anderson proton therapy center. Monte Carlo simulations were performed via the FLUKA code (version 2011.2-17). The detectors were modeled in cylindrical shape at various depths of the water phantom without shading each other for obtaining relative depth dose in the phantom. Mono-energetic parallel ion beams in different incident energies (100 MeV/n to 250 MeV/n) were collided perpendicularly on the phantom surface. For proton beams, the results showed that the simulated detectors have over response relative to IC measurements in water phantom. In all cases, there were good agreements between simulated ion ranges in the water with calculated and experimental results reported by the literature. For proton, maximum peak to entrance dose ratio in the simulated water phantom was 4.3 compared with about 3 obtained from IC measurements. For He-4 ion beams, maximum peak to entrance ratio calculated by both detectors was less than 3.6 in all energies. Generally, it can be said that FLUKA is a good tool to calculate Al2O3:C,Mg FNTD and Al2O3:C OSLD detectors responses to therapeutic proton and He-4 ion beams. It can also calculate proton and He-4 ion ranges with a reasonable accuracy.

Keywords : comparison, FNTD and OSLD detectors response, light ion beams, Monte Carlo simulations
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