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ELECTRON ACCELERATOR FOR NEUTRON THERAPY AND RADIOISOTOPES PRODUCTION

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The paper vows to the studying the possibility of high-power electron accelerators for neutron therapy and radioisotopes production. Computations are performed for both applications, and the results are normalized to the characteristics of the modern-day MEVEX accelerator (average electron current 4 mA at a monoenergetic electron beam 35 MeV).
The unifying problem for applications is the task of cooling the target: at a beam energy ˜ 140 kW, almost half or more of this energy is released directly into the target. Therefore, a liquid heavy metal was chosen as a target to combine high quality thermohydraulics with maximum production of both bremsstrahlung radiation and photoneutrons. The target was optimized using precise codes for the tasks of radiation transport and thermal hydraulics. Optimization was carried out for the installation as a whole: 1) the target configuration; 2) the composition of the material and the configuration of the photoneutron removal unit for neutron capture therapy (NCT) and 2) the scheme of generating bremsstrahlung for radioisotopes production. The photoneutron block provides an acceptable beam quality for NCT with a large neutron flux density at the output: ˜ 2·1010 cm-2s-1, which is an order of magnitude higher than the values at the output of existing and projected reactor beams. Such intensity at the beam output will allow to abandon the fractionated irradiation in many cases. As for radioisotopes production, using optimal reaction channel (γ, n) 43 radioisotopes in 5 groups were received. For example, by the 100Mo(γ, n)99Mo reaction the precursor 99Mo of main diagnostic nuclide 99mTc with specific activity ˜ 6 Ci/g and total activity of the target 1.8 kCi could be produced after 1 day irradiation exposure. The proposed schemes of generation and extraction of photoneutrons and bremsstrahlung have a number of advantages over traditional methods: a) the use of electron accelerators for the production of neutrons is much safer and cheaper than the use of reactor beams; b) the accelerator with the target and the beam output unit with the necessary equipment and tooling can be easily placed on the territory of the clinic; c) the propose liquid gallium target for NCT, which also serves as a coolant, is an “environmentally friendly” material: its activation is relatively small and quickly (four days) decreases to the background level.

1. Yu.A. Kurachenko, H.A. Onischuk et al. DOI 10.26583/npe.2019.4.12
2. Yu.A. Kurachenko, H.A. Onischuk et al. DOI: 10.12737/1024-6177-2019-64-5-48-53

The speaker is a student or young scientist

No

Section

1. Design and development of charged particle accelerators and ionizing radiation sources

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