Seminar

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Institute for Plasma Research

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Title: Medical radionuclides production using fusion neutrons: Overview and Prospectus

Speaker: Dr. Shrichand Jakhar
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Date: 13th March 2023 (Monday)

Time: 03:30 PM

Venue: Seminar Hall, IPR

Abstract

Radionuclides play an important role in medical applications such as imaging of human organs in diagnosing a specific illness1 and radiotherapy for cancer patients. Their demand is increasing rapidly and supply is limited due to a limited number of production facilities, which are mostly fission research reactors or cyclotrons. The generation of these isotopes using 14 MeV D-T fusion neutrons offers one major advantage – they can induce threshold reactions in specific materials which are not possible with the fission neutrons due to their lower energy. The main threshold reaction is (n, 2n) which has high reaction cross-section at 14 MeV and produces two low energy neutrons which are required for the breeding of radionuclides with high specific activity. At present, ^{99m}Tc is the most extensively used radio-isotope in the nuclear medicine industry covering about 80% of the total volume[2].

This talk will cover present status & future projections for the market of the medical radionuclides, status of conventional production facilities, and some issues in the supply chain. Thereafter, neutronics calculation results will be presented to show the feasibility of their production for two type of 14 MeV DT neutrons sources: Spherical Tokamak based fusion neutron source and accelerator based neutron sources. The results will include realistic irradiation scenario and sensitivity studies with respect to neutron moderator & multiplier materials, enrichment levels of the targets and concentration of the target isotopes in the irradiation material. The challenges involved in this method shall also be discussed. In recent time, medical radionuclide production using fusion neutrons has achieved some major milestones. This progress of the radionuclide production using fusion neutron worldwide will also be presented in the talk.

References

1. Beneficial Uses and Production of Isotopes: OECD Report -787
2. OECD/NEA (2019), The Supply of Medical Isotopes: An Economic Diagnosis and Possible Solutions, OECD Publishing, Paris, https://doi.org/10.1787/9b326195-en