THE USE OF PSI'S HIGH INTENSITY PROTON ACCELERATOR (HIPA) COMPLEX TOWARDS MEDICAL-RADIONUCLIDE DEVELOPMENT

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Paul Scherrer Institute (PSI) runs a High Intensity Proton Accelerator (HIPA) facility, with three accelerators run in tandem to increase proton beam energy. Initially, a Cockroft-Walton accelerator accelerates protons at 870 keV that are fed into a separated-sector cyclotron, known as Injector II. There, the protons are accelerated to 72 MeV, at a beam intensity of up to 2.5 mA, en route to a larger cyclotron, referred to as the 'Ring' cyclotron. The Ring cyclotron accelerates the protons further to 590 MeV, which is then sent down the beamline to various experimental vaults for physics research. The remainder of the beam is collected in a Pb target, which serves as a neutron spallation source for the Swiss Neutron Source (SINQ). The proton beam is split not far from the exit of Injector II, where a maximum of 100 μA protons is gleaned from high intensity 72 MeV protons into the IP2 target station. These protons irradiate various targets towards the production of exotic radionuclides intended for medical purposes [1].

Many radiometals in use today, as radiopharmaceuticals, are for the diagnosis and treatment of disease, with the most popular means of detection being Positron Emission Tomography. These positron emitters are easily produced at low-proton energies using medical cyclotrons, however, developments at these facilities are lacking, as many such cyclotrons situated at clinics do not perform research and development with them. The fixed 72 MeV proton beam from Injector II is degraded at IP2 to provide the desired energy to irradiate targets to produce the likes of ^{44}Sc, ^{43}Sc, ^{64}Cu and ^{68}Ga as a proof of principle, which are of interest to the nuclear medicine community. Other radionuclides developed at this facility include ^{165}Er and ^{155}Tb, for use in Single Photon Emission Tomography and potential Auger therapy. The results from this development work in the form of target preparation and design, chemical separation systems and methods can then be implemented at facilities containing medical cyclotrons [2].

The use of SINQ towards neutron irradiation of enriched Gd targets led to the development of ^{161}Tb, a therapeutic radionuclide which can possibly be the paradigm shift in radionuclide therapy. The production of the nuclide has since been scaled up to the use of research reactors with higher neutron fluxes, with therapeutic activities envisaged for the near future [1].

The HIPA facility at PSI provides the means to produce radionuclide developmental research, as a proof of concept. Once perfected, the conceptual design can be transferred to collaborative partners. It is aimed to develop the nuclides in question such that they can be part of the radiopharmaceutical manufacturing process under Good Manufacturing Practice (GMP), such that they can be administered to patients.

REFERENCES

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