Isotope Production at Jefferson Lab’s LERF, A High Power Electron Linear Accelerator

1. Hutton Jefferson Lab (Principal Investigator)

J. Zweit, Virginia Commonwealth University (Co-Investigator)

D. Wells, South Dakota School of Mines and Technology (Co-Investigator)

Abstract:

High power (~100 kW) electron accelerators are well suited for the production of some important isotopes for medical and industrial applications. The Low-energy Electron Recirculator Facility (LERF) is Superconducting Radio Frequency (SRF) electron accelerator where electron energy and current are highly tunable, from 10 MeV to 170 Mev and a few µA to many mA. At LERF, beam powers in excess of 100 kW are easily achievable.

Yields of isotopes depend on the electron beam power. Increasing beam power requires targets that can handle the power. Higher beam energies can create undesired isotopes which have to be removed from the final desired isotope. Additionally, target handling post-irradiation and radiation shielding require attention.

In this proposal, we focus on creating Cu-67 using photo-production method. The reason for this focus is that Cu-67 is a very promising isotope for imaging as well as cancer therapy. The potential market for this isotope is large (numbers, SDSMT?) and there exists no reliably supply. The three major objectives of the proposal are demonstration of i) a target system that can handle 50kW, ii) separation of Cu-67 from the irradiated target and iii) a technique for effective delivery the isotope to a targeted area, such as a tumor. (VCU may want to make this more precise). Three additional objectives are to experimentally establish optimal beam parameters for production, quantify yields and train at least one graduate student in this field. We plan to introduce a new target which has not been explored before, namely Gallium in addition to the more common Zinc target. We will outline the path to take, past this R&D program, to secure a steady supply of Cu-67 isotope at LERF.

In executing this endeavor, we will refine our preliminary simulations of target design and photo-nuclear simulations and verify them against experiments. In order to alleviate radiological concerns (shielding and local activity), we will use LERF’s capability of generating low energy electron beam at high current (10 MeV and 5 mA) to test our target design. We will then vary the beam energy at lower current to produce isotopes in the targets and carry out the objectives listed above.

We fully expect that as a result of this work, there will be a path for reliable production of Cu-67 which will expand the treatments of many types of cancer.