Ph.D. Thesis Abstract for Miguel A. Avila-Rodriguez

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Low Energy Cyclotron Production of Multivalent Transition Metals for PET Imaging and Therapy

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Recent advances in high-resolution tomographs for small animals require the production of nonconventional long-lived positron emitters to label novel radiopharmaceuticals for PET-based molecular imaging. Radioisotopes with an appropriate half life to match the kinetics of slow biological processes will allow to researchers to study the phamacokinetics of PET ligands over several hours, or even days, on the same animal, with the injection of a single dose. In addition, radionuclides with a suitable half life can potentially be distributed from a central production site making them available in PET facilities that lack an in-house cyclotron.

In the last few years there has been a growing interest in the use of PET ligands labeled with radiometals, particularly isotopes of copper, yttrium and zirconium. Future clinical applications of these tracers will require them to be produced reliably and efficiently. This thesis work deals with implementing and optimizing the production of the multivalent transition metals ^{61,64}Cu, ^{86}Y and ^{89}Zr for molecular PET imaging and therapy. Our findings in the production of these radionuclides at high specific activity on an 11 MeV proton-only cyclotron are presented. Local applications of these tracers, including Cu-ATSM for *in vivo* quantification of hypoxia, synthesis of targeted radiopharmaceuticals using activated esters of DOTA, and a novel development of positron emitting resin microspheres, are also be discussed. As a result of this thesis work, metallic radionuclides are now efficiently produced on a weekly basis in sufficient quality and quantity for collaborating scientists at UW-Madison and external users in other Universities across the country.

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