A Novel Method for PET Radioisotope Photoproduction

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This project is focused on developing a novel method for the production of 18F radioisotopes used in PET scans for diagnostic purposes. Positron Emission Tomography (PET) is a diagnostic technique which creates an image of metabolic activity inside the body. A positron-emitting isotope (18F) is attached to a glucose molecule and ingested by a patient. Positron-electron annihilation results in two gamma rays that are detected and create an image of high-glucose uptake regions, which correspond to active cells such as cancer cells.

Currently, the mainstream 18F production method is with proton-beams on heavy water, with proton cyclotrons. The method is expensive - $1.5k per dose - and inefficient, with fewer than 10% of UK patients in need able to access a PET scan. Reasons for this include, high cost of proton cyclotrones, the low natural abundance of 18O, and the difficulty of Fluorine extraction from water.

This project promises a solution: by using a photon beam on a fluorine-containing target, we are expecting to bring the cost down to $200-$500 per dose. The method can be implemented in existing electron accelerators within hospitals, currently used for radiation therapy, allowing for widescale improvements in the cost and accessibility of this life-saving technology.

In my talk I will discuss the results of target simulations investigating the optimal parameters such as electron beam energy, radiator thickness, fluorine-containing medium, density, target dimensions, magnetic field, and more.