Development of a small, cost-efficient scintillation detector for use in automated synthesis of PET radiopharmaceuticals

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INTRODUCTION

- Multistep positron emission tomography (PET) radiopharmaceutical production is conducted within an automated synthesis module for enhanced safety and efficiency
- The key to the automation is radiation detectors to monitor the transfer of radioactivity between compartments
- Current detectors in use come at a high cost ($2,000-10,000), thus motivating the development of a low-cost alternative

METHODS

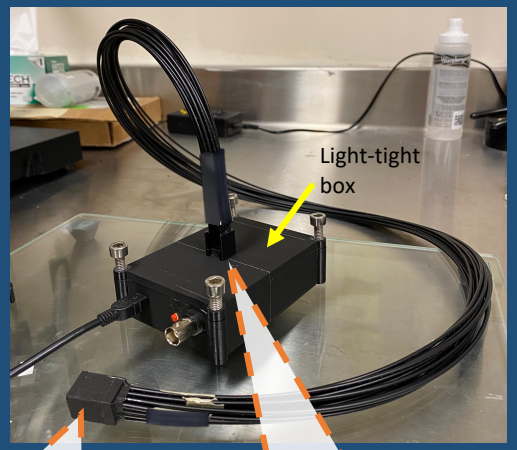
- Geant4 Monte Carlo simulations were performed to design and optimize the detector geometry
- Plastic scintillating fibers, silicon photomultipliers, and low-cost electronics were used to construct the detectors
- ^{18}F radiotracer ($t_{1/2}$=109.7 min) was used to calibrate and assess the detector performance

RESULTS	16-fiber	Spiral
Cost (US $)	172	184
Measured $t_{1/2}$ (minutes)	167.7	105.88
Uncertainties (± mCi)	45	4

Two low-cost detectors were developed using **plastic scintillating fibers** and **silicon photomultipliers**

These detectors can be used to **facilitate troubleshooting** of faulty reactions during automated PET radiopharmaceutical synthesis

16-fiber Detector



Spiral Detector

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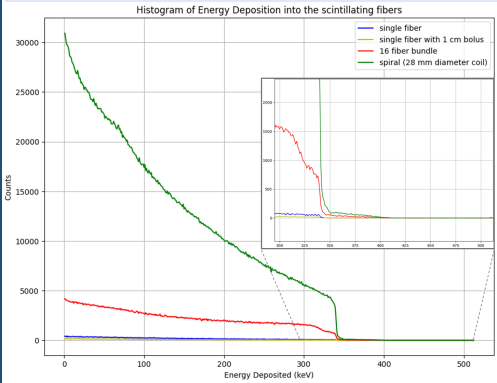
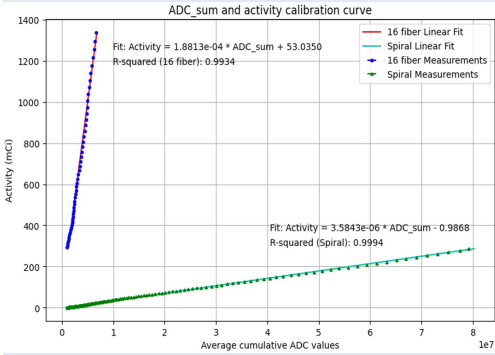
Geant4 simulation energy histogram



Detector calibration curves



^{18}F decay curves