Development and Demonstration of a Low-Cost Strip-PET Scanner Prototype

Mahapatra, Samikshya (School: College Station High School)

Positron Emission Tomography (PET) allows physicians to visualize metabolism in various organs and is widely used in cancer and neurological imaging. The radioactive tracer, usually Fluorodeoxyglucose (18F) accumulates in regions of high metabolism, such as cancer. Fluorodeoxyglucose emits positrons that annihilate with nearby electrons to produce two back-to-back gammas, allowing for the reconstruction of the emission line through surrounding detectors. The intersection of these lines from numerous decays provides a reconstructed source location, indicative of cancer. Traditional PET scanners consist of several rings of highly segmented scintillation detectors lining the outside of an MRI scanner. They are expensive ($>1 million) due to the many (>1000) small detectors coupled with photosensors. An inexpensive ($<50000) strip-PET scanner is being developed using different ideas from experimental particle physics, such as energy and timing, to recreate location. It uses a few long (~2m) scintillators, allowing the setup to be inside the strong MRI magnetic field, without disturbing the photomultiplier tubes (PMT) located outside the field. This design is expected to improve the detection efficiency of the gammas by avoiding Compton scatters in intervening MRI scanner material, a common occurrence in traditional PET scanners. A prototype 4-strip scanner shows promising results with an inch-scale accuracy, compared to the sub-cm accuracy of conventional PET scanners. Future designs with more strips will provide competitive accuracy at a fraction of the cost. The inexpensive strip-PET scanner will allow for life-saving preliminary diagnostics in rural areas and developing countries by providing early cancer detection.