Abstract Submitted
for the APR21 Meeting of
The American Physical Society

Xenon-Doped Liquid Argon Scintillation for Positron Emission Tomography ALEJANDRO RAMIREZ, University of Houston, XINRAN LI, Princeton University, ANDREW RENSHAW, University of Houston, 3DPI COLLABORATION — Positron Emission Tomography (PET) is used to observe metabolic processes within patients. It works by reconstructing the annihilation origin of incident gamma rays produced by a positron emitting tracer. However, inefficiencies of current PET technology, such photomultiplier tubes, can result in poor imaging. We propose 3D: a full body, Time of Flight (TOF) PET scanner using Silicon Photomultipliers (SiPM) coupled with a xenon-doped Liquid Argon (Lar+Xe) scintillator. We simulated this design using Geant4 while following the National Electrical Manufacturers Associations evaluation tests for performance assessment. We will present results that highlight a 200-fold increase in sensitivity, spatial resolutions comparable to commercial PET scanners and produce PET images from 15-30 second scans faster than traditional 30-35-minute scans. Further studies will involve optimizing the layer thickness of Lar+Xe. Moreover, scintillation induced ionization electrons can produce Cherenkov radiation along with the Lar+Xe scintillation light. We will discuss strategies to characterize this other signal in Geant4 to improve the timing resolution of our scanner. With the Lar+Xe scintillator and SiPMs of 3D, we can use the precise TOF info of gamma rays to improve the localization of individual positron annihilations and provide low-dose PET scans for patients who may be at high risk for exposure to radiation.

Alejandro Ramirez
University of Houston

Date submitted: 05 Apr 2021 Electronic form version 1.4