

Siemens Competition

Math : Science : Technology

Regional Finalist

Names: Sharon Chen

High School: Henry M. Gunn High School

Mentor: Chen-Ming Chang; Professor Craig Levin

Project Title: *Exploring the Time-of-Flight Capability of BrainPET:
A Radio Frequency Field-Penetrable Positron Emission Tomography Insert
for Simultaneous PET/MR Brain Imaging* (Bioengineering; Electrical
Engineering; Physics)

BrainPET is a radio frequency (RF) field-penetrable positron emission tomography (PET) insert for simultaneous PET/MR brain imaging which provides high-resolution functional and structural imaging. Timing resolution of a PET system is determined by timing jitters and the slope of the leading-edge discriminator of a voltage pulse signal coming from the detectors. Excellent timing resolution in a PET scanner allows it to obtain the time-of-flight information of the annihilation photons, significantly improving the PET image quality and/or reducing the radioactive dose needed to achieve the same image quality. Analyses of coincidence timing resolution are made possible with new and functional specialized 16-pixel readout solid-state photomultiplier boards that emulate BrainPET electronics. Paired with auxiliary equipment, such as an oscilloscope or a Data Acquisition (DAQ) system, they can show which components degrade timing resolution the most. Diagnosing timing degradation sources along the data acquisition pathway of the BrainPET system helps with development of improved time-of-flight PET with reduced statistical noise variance, eminently impacting neurological and oncological studies.