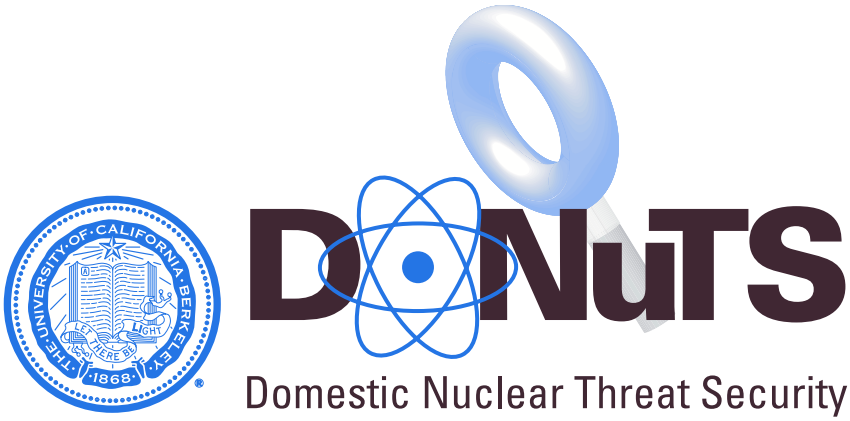

DoNuTS Technical Meeting

Time: **1600 Wednesday, 31 March 2010**

Place: **NE Conference Room, 1106 Etcheverry**

Speaker: **Paul Barton, University of Michigan**

Subject: **Fabrication of Silicon Photomultipliers for the Readout of Scintillation Radiation Detectors**

Radiation detecting scintillation crystals have traditionally been read out using vacuum tube technology relying on multiple secondary electron emission dynodes to amplify an electron from a photoelectric event at the cathode entrance window. The recently developed solid state alternative to these photomultiplier tubes, the silicon photomultiplier, has generated interest for its compact size and comparable photon detection efficiency in the UV to visible range of wavelengths of many scintillators. While several commercial devices exist, we attempt to explore the fundamental limitations of these devices through simulation and fabrication at the Lurie Nanofabrication Facility at the University of Michigan.

We have designed and are testing arrays of silicon Geiger-mode avalanche photodiodes. When the signals from multiple diodes are summed, the device is termed a silicon photomultiplier. Several diode doping techniques are examined as well as some potential impurity gettering methods. Industry standard process and device simulators are used to inform the design of an appropriate electric field distribution for uniform avalanche characteristics. The integrated avalanche quench resistor on each diode has classically been fabricated in CMOS-standard doped polysilicon on top of the diode, which is opaque, and therefore can reduce the photon detection efficiency. Methods for the integration of transparent high-resistivity indium tin oxide resistors are presented. We also examine the underlying statistics of the inherent noise processes which ultimately increase the uncertainty in the estimate of the energy, position, and timing of incident radiation quanta.