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# Novel sensor design for future Nuclear Medicine Scanner based on pixel CdTe detector

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## 12 – 1 PM
## Lecture Hall 143
## *Light lunch will be served*

VIP is the acronym for Voxel Imaging PET Pathfinder project, funded by FP7-ERC Advanced Grant program to develop the future generation of PET scanner. The design uses pixel CdTe detectors connected a dedicated ASIC, the VIP-PIX, by bump-bonding and then are stacked on the top of each other, as shown in fig.1. When the CdTe detectors are cut in a trapezoidal shape it forms a hermit scanner and this increases the detection efficiency. One can use as much needed CdTe detectors to insure the appropriate depth of interaction. In VIP design the edge of the pixel detector is pointing toward the center of the scanner and this gives important features needed for PET application. With CdTe detector thickness of 2mm one can achieve charge collection in short time and thus having a coincidence time window of few nano-seconds.

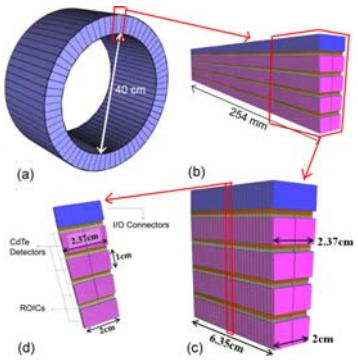


Figure 1-a shows the full VIP scanner. 1-b, is a one sector of the scanner and 60 of these sectors are needed to form the full scanner. In 1-c, one can see section of the sector 1-b. 1-d is the VIP kernel detector module for the VIP scanner and it as 800 channels with 800 voxels, each has a volume of 1x1x2 $mm^3$ of CdTe

A VIP PET scanner with the dimensions shown in fig.1 has a 6.3 millions voxel/channels operating in spectroscopy mode. Thus providing a true 3D sensor detector.
(see also https://www.youtube.com/watch?v=5Zu3ZdEvz8M)
Given that VIP scanner operates in spectroscopy mode, it collects only golden events, thus reduces the scattered events to less than 4% (NEMA NU 1994) compared to 45% for the current PET scanner. This allows the VIP-PET scanner to deliver sharp images with little radiation dose.

This novel sensor design opens the way for new generation of PET, PEM and Compton Camera scanner in nuclear medicine, providing excellent spatial resolution due to the high granularity of the sensor and sharp images due to increase of Signal-To-Noise ration due to the increase of of detection efficiency and the reduction of number of the scattered photons.

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Mokhtar Chmeissani was born in Beirut, Lebanon, in 1960. He did his undergraduate studies at the faculty of Science of the Lebanese University, where he obtained his B.S. in Physics in 1983. He did his Ph.D thesis on particle physics in the analysis of the data collected by the Mark-II detector at Stanford Linear Accelerator Center (SLAC) in Menlo Park, California. His thesis work was focused on the measurement of the strong coupling constant, αs, at a center-of-mass energy of 91.1 GeV. After defending his thesis successfully in early 1991, he went to the European Organization for Nuclear Research (CERN) with a Postdoctoral position with the University of Michigan to work on the L3 Experiment at the Large Electron Positron Collider (LEP) accelerator of CERN. At L3 he focused his research on the data analysis related to Quantum Chromo Dynamics (QCD). After 1.5 years with the University of Michigan he was offered a postdoctoral position at the Institut de Física d'Altes Energies (IFAE) in Barcelona, Spain, to work on both, the ALEPH Experiment at LEP and on particle physics instrumentation R&D, namely on a novel type of detector called Liquid Argon Accordion Calorimeter for the future experiment being prepared for the Large Hadron Collider (LHC) accelerator. Beside his work on data analysis with ALEPH, he also worked on the upgrade of the so called Bhabha Calorimeter, which was used to measure in real-time the Luminosity of LEP. In 1995 he was offered a position at the level of Assistant Professor at IFAE. In 1998, IFAE decided to start an applied physics research line in the field of medical imaging and appointed Mokhtar Chmeissani to take the leadershipIn 2005 he developed a radiation monitor for the LISA Pathfinder, a European Space Mission for detecting gravitational waves. In 2008 he received the Silver Medal at the 36th International Salon of Inventions, Geneva, Switzerland for the concept of a 3D real time breast biopsy system. After the conclusion of the work in the breast biopsy machine, Mokhtar shifted his research towards nuclear medicine. He has found that the current Positron Emission Tomography (PET) Scanners have reached the intrinsic limitation of the technology being used, and because of that he has proposed to construct a new type of PET scanner based on pixel CdTe solid state detectors. This novel detector will yield good quality images with much less radiation dose and open the way to build Compton Gamma Camera. The idea of this novel detector was very well received by the European Research Council (ERC) which awarded him a grant to build a small prototype for evaluation. Beside his work on the novel PET scanner, he is currently leading the development of pixel sensor for use in X-ray scanner for security and quality control. The sensor has 8 thresholds making it possible to detect minute change in material density.

**FOR MORE INFORMATION:**
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