Technology development proposal abstracts.

All following abstracts will be presented by their authors on the Academia-Industry Matching Forum on 1st of November in the IEEE NSS/MIC 2016 event.

Abstract # 2071

Title:	Modular High Energy X-Ray Imagers
Author:	Paul Seller
Pres. Type:	Oral

Modular High Energy X-Ray Imagers

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The Detector and Electronics Division at RAL have built many X-ray imaging systems over the last decade. Many of them are very application specific but two in particular have wider application possibilities to industrial, security and medical fields. The HEXITEC detector has demonstrated fully spectroscopic imaging from 2keV to 200keV with sub 1keV (FWHM) energy resolution and count rates of $>10^6$ photons/s per 80x80 pixel module when used with 1mm thick Schottky anode CdTe. The ability to tile the HEXITEC detectors on three sides with a dead space of detectors on three sides with a dead space of <2 pixels and the pixel size of 250μm make it a good candidate to be used as a single module or in tiled arrays. The LASSENA CMOS sensor is our first wafer scale imager. This sensor has 6.7million pixels, each 50μm square giving an active area of 120mm x 140mm which can be readout at 34fps. We have attached scintillator layers to this device to make X-ray sensitive detectors. An STFC funded program called XNEXT tiles these already large modules to create larger area X-ray imager with very small dead regions between individual tiles. Currently we have a 240mm x 250mm active array but the modular nature allows larger arrays if needed. We have demonstrated its use with several different scintillators for different applications but of particular interest is a 1mm thick CsI structured scintillator which allows high spatial resolution, fast readout speed and good efficiency for X-ray tube energies up to 160keV.

Abstract # 2506

Title:	Development of a MR-Compatible DOI-TOF Detector Module for PET Imaging Systems
Author:	Tianpeng Xu
Pres. Type:	Oral

Development of a MR-Compatible DOI-TOF Detector Module for PET Imaging Systems

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PET systems are widely used in clinical and preclinical molecular imaging applications. Various PET systems, including whole-body human and small animal PET, and dedicated systems such as breast and brain PET have been developed. A Standardized PET detector module with good performance will make it much easier and more efficient for different kind of PET scanner instrumentation. In this paper, we developed a compact MR-compatible PET detector with DOI and TOF capability. The detector module has staggered 15×15 +16 ×16 LYSO crystal array with single crystal size of 2×2×7mm3. The detector is coupled to SiPM array (MicroFJ-30035-TSV, SensL). The output signals of SiPMs are multiplexed by 64-channel ASIC chips and then digitized by 80MHz 12-bit ADC chips and TDC implemented inside FPGA to generate energy and timing information. The performance of the detector was preliminarily evaluated. A flood image was acquired and all crystals were clearly identified with an average energy resolution of 12.7% for 15x15 array and 14.2% for 16×16 array. About 300 ps coincidence timing resolution was achieved for a pair of single crystal. More accurate energy resolution and coincidence timing resolution for the detector module will be evaluated in the future. And the MR compatibility evaluation of this module is underway. Large quantities of detector blocks will be made and tested to verify the performance stability and reproducibility. Furthermore, we are developing standardized power and signal interface for better usability.

Abstract # 2674

Title:	easyPET: a Novel Concept for an Affordable Tomographic System
Author:	valentina arosio
Pres. Type:	Oral

View Summary

easyPET: a Novel Concept for an Affordable Tomographic System

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easyPET is a novel PET scanner concept, patented by University of Aveiro, aiming to reduce complexity and cost of conventional preclinical Positron Emission Tomography (PET) scanners. This original principle is based on a pair of detectors and exploits a rotating mechanism with two degrees of freedom to reproduce the functionalities and cover the same field of view of an entire PET ring. A prototype providing two dimensional real-time image reconstruction has been designed, engineered and commissioned. A spatial resolution of 1 ± 0.1 mm and a sensitivity of 0.1 % with an energy threshold of 80 keV have been measured. Thanks to these good performances, combined with the simple design, the affordability and the portability, the easyPET constitutes an asset in high level educational laboratories. A great outcome that has been reached is the commercialization on behalf of CAEN S.p.A. of the easyPET prototype as a didactic PET system.

Abstract # 2691

Title:	MMPDS: First Commercially Available System for Muon Scattering Tomography
Author:	Konstantin Borozdin
Pres. Type:	Oral
Comments:	Oral or poster presentation at the workshop is requested

View Summary

MMPDS: First Commercially Available System for Muon Scattering Tomography

K. N. Borozdin

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On behalf of the Decision Sciences

Decision Sciences' Multi-Mode Passive Detection System (MMPDS) combines technology invented by scientists at Los Alamos National Laboratory with considerable private sector investment, to deliver totally safe, effective and reliable automated detection techniques to speedily detect both shielded and unshielded nuclear and radiological threats. Advanced image reconstruction and data analysis algorithms enable explosives and contraband detection in addition to nuclear threat detection.

A key technology behind the success of Decision Sciences' MMPDS is a scattering muon tomography. Muons are naturally occurring cosmic ray-induced particles that continuously rain down from the Earth's upper atmosphere, harmlessly penetrating everything in their path. Decision Sciences' MMPDS tracks these muons, detecting and recording their deflection in different materials to provide signatures for material density and atomic number, uniquely sensitive to high-Z, high-density materials. The system produces no ionizing radiation, meaning it is completely safe for people, animals, plants and food. Harnessing natural flux of cosmic-ray muons and high-energy electrons produced in the atmosphere, MMPDS detectors track these charged particles through even heavily shielded SNM materials. Based on these tracks the system computes a color-coded 3-D image of scanned objects. Combining automatic detection and 3-D imaging with its gamma radiation detection capabilities, MMPDS provides efficient and safe scanning while facilitating the flow of commerce. Depending on customer requirements and configurable threat levels, a typical 40-foot shipping container can be cleared fast when no threat is detected, at the same time automatically alerting the operator to more complicated scenes requiring extended scan time up to several minutes for reliable threat detection. MMPDS modular construction enables the system to be scaled up or down to scan any type of vehicle, rail cars and cargo containers.

Based on marketing materials of Decision Sciences International Corporation http://decisionsciencescorp.com/

Abstract # 2707

Title:	A Modulated X-Ray Generator for Possible Industrial Applications
Author:	Toru Tamagawa
Pres. Type:	Oral

View Summary

A Modulated X-Ray Generator for Possible Industrial Applications

T. Tamagawa

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On behalf of the CCNS-MXS collaboration

We invented a modulated X-ray generator (CCNS-MXS) by using gas electron multiplier (GEM) foils combining with the coniferous carbon nano structure (CCNS). The CCNS-MXS is a compact but high-power X-ray generator, controlled by a low voltage (~100V) applied to the GEM foil.
The GEM foil, originally invented at CERN by F. Sauli, is a typical micro pattern gaseous detector, but we use it in vacuum as a metal-mesh extraction-electrode of electrons from CCNS. The extracted electrons are accelerated by a high voltage and bombard on a metal target generating high flux X-rays.
We employed CCNS as the field emission device, in which carbon nanotube (CNT) roots to a substrate with some bulky structures of carbon, forming tight connection between CNT and substrate. We just put the GEM foil onto the CCNS substrate and applied the gate voltage to the GEM electrodes. Thanks to the thinness (50-100um) of the GEM foil, the CCNS+GEM device becomes an efficient electron emitter working with a low (< 100V) gate voltage.
We can turn on and off the generator quickly (<1 us) by switching the gate voltage; it is not necessary to switch the high voltage applied to the target metal.
The CCNS-MXS can issue trigger timing, i.e. can emit X-rays with synchronous to the data acquisition timing of an imaging system. This character implies that the generator becomes a good device for which the industrial imaging for fast-rotating devices such as engines, turbo fans, etc.
We will present the design and performance of the X-ray generator at the conference.

Abstract # 2709

Title:	RHIP, a Radio-Controlled High-Voltage Insulated Picoammeter
Author:	Silvia Dalla Torre
Pres. Type:	Oral

View Summary

RHIP, a Radio-Controlled High-Voltage Insulated Picoammeter

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A picoammiter system has been developed by prototyping and engineering. It consists in a current-voltage converter, based on an operational amplifier with very low input current, a high precision ADC, a radio controlled data acquisition unit and the computer-based control, visualization and storage. The picoammiter is characterized by a precision of the order of a tenth of picoamperes and it can measure currents between points laying at potentials of the order of a ten of kilovolts. The current-voltage converter and the radio transmitter are battery powered and a number of strategies have been implemented to limit the power consumption. The system is designed for multichannel application and up to 256 parallel channels can be controlled. The overall implementation is cost-effective to make the availability of multichannel setups easily affordable.
The design, implementation and performance of the picoammiter system are described in detail.

Abstract # 2716

Title:	Technology Frontier for Fast Advanced Scintillator Timing
Author:	Karl Ziemons
Pres. Type:	Oral

View Summary

Technology Frontier for Fast Advanced Scintillator Timing

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On behalf of the COST Action FAST Collaboration

Scintillator based detectors have been very successful in high energy physics (HEP) calorimetry, nuclear physics, medical imaging, and many other applications. Technologies for single photon detection are rapidly evolving, with silicon photomultipliers (SiPMs) replacing vacuum photomultiplier tubes in many applications. In particular, the potential of such detectors to achieve precise timing information better than 10ps is of increasing importance for those applications. The implications of such a radical improvement in time resolution come with huge benefits in many domains. HEP will profit from a significant increase in detection efficiency and the health sector from an unprecedented improvement in imaging quality and image reconstruction time. Such a 'paradigm' change, however, must go hand-in-hand with a similar break in the interdisciplinary domain of photon detection. Therefore, new expertise must be gained in the fields of scintillators, photo detectors, as well as electronics read out systems to develop ultrafast timing scintillator-based detectors. The Fast Advanced Scintillation Timing (FAST) at the European Trans Domain COST Action TD1401 is more than a technology shift. It represents a technical revolution with profound impact on feasible applications in particle physics, accelerator physics, medical & biological imaging, non-destructive industrial processing and electronic design issues. An important objective that this action also embarks on is training early stage researchers in a very innovative approach. We need change agents from every facet of industry, government, academia and healthcare to harness the full potential of FAST and to define what is possible. Responsible transformation will be ushered through an alliance of industry and academia.

European Trans Domain COST Action TD1401 COST is supported by the EU Framework Programme Horizon 2020