Are SiPMs going to replace your PMTs?

Paul Lecoq

CERN

Since the description of the photoelectric effect by the quantization of the electromagnetic radiation in 1905 by Einstein the hunting season was open for the detection of single photons. One major driver for the research on single photon detectors has been related to the mysteries of quantum mechanics, such as photon entanglement and more generally quantum information science. More generally low light level detection systems are needed in an increasing number of applications and require photodetectors with high gain, low noise, high detection efficiency, good timing properties and in some cases imaging capability. The invention of the photomultiplier tube in 1935 by Iams and Salzberg of RCA was a major breakthrough in photodetection. Although PMTs may be considered by some to be ancient, and despite various application challenges, they are still the preferred devices in many scientific, medical, and industrial applications.

On the other hand, the complex integration problems of large experiments in particle physics requiring compact detectors, the interest for lower bias voltage in medical devices and embarked systems, and a strong requirement for detectors immune to high magnetic fields have pushed the R&D for the development of SiPMs, multipixel silicon photodiodes with a large number of micropixels working in Geiger mode on a common substrate and connected to a common load.

The relative merits, application domains, and potential for progress of both types of photodetectors will be discussed.

Short Bio

Paul Lecoq received his diploma as Engineer in Physics Instrumentation at the Ecole Polytechnique de Grenoble in 1972, under the leadership of Nobel Laureate Louis Néel. After two years of work at the Nuclear Physics laboratory of the University of Montreal, Canada, he got his PhD in Nuclear Physics in 1974. Since then he has been working at CERN in 5 major international experiments on particle physics, two of them led by Nobel Laureates Samuel Ting and Carlo Rubbia. His action on detector instrumentation, and particularly on heavy inorganic scintillator materials has received a strong support from Georges Charpak. He has been the technical coordinator of the electromagnetic calorimeter of the CMS experiment at CERN, which played an important role in the discovery of the Higgs boson.

Member of a number of advisory committees and of international Societies, since 2002 he is the promoter of the CERIMED.NET initiative (European Center for Research in Medical Imaging) for networking physics and medicine in the field of medical imaging.

He has been awarded an ERC advanced grant in 2013 by the European Research Council.

He has been elected in 2008 member of the European Academy of Sciences and elevated in 2015 to the IEEE fellow grade.

A New Generation of Detectors for Future Neutron Science Instrumentation

Richard Hall-Wilton

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Neutron scattering science - the study of materials using neutrons - is in an exciting period, with new large facilities under construction in China (Chinese Spallation Neutron Source), the US (second target station at the Spallation Neutron Source) and Europe (European Spallation Source). Additionally, large upgrades in the numbers of instruments are planned at major facilities in the US, Japan, Russia and Europe. These upgrades create a much greater demand for detectors in terms of numbers of instruments and their solid angle coverage in the coming decade than in the previous one. Additionally, the requirements of a new generation of instrumentation naturally pushes the boundaries of state-of-the-art in terms of performance. Previous generations of performant neutron detectors used the Helium-3 isotope as the material sensitive to neutrons; however, since 2009, the supply of Helium-3 is increasingly rare and the prices have risen considerably- the so-called "Helium-3 Crisis".

Along with other disciplines reliant upon Helium-3 gas, the neutron scattering community has devoted significant effort into detector development. The aim was to mitigate the usage and demand for Helium-3 by developing replacement technologies, but also to match the challenging performance requirements for the new generation of instruments with creative technical solutions. This talk presents an overview of the status and outlook of these developments, and the performance of this new generation of neutron detectors for large scale facilities, with particular emphasis on the developments for the European Spallation Source.

Short Bio

Since 2011, Richard Hall-Wilton is Detector Group Leader and deputy Division Head of Instrument Technologies at the European Spallation Source (ESS) in Lund, Sweden, with the task of developing and providing the neutron detectors for over 20 instruments at the new green-field facility, as well as finding replacements to the isotope Helium-3 as the detection medium for neutrons. He is also an adjunct professor of electronics at Mid-Sweden University.

Richard Hall-Wilton studied at Cambridge University and received his PhD from Bristol University, UK, in 1999 in experimental particle physics. He has been based primarily at European research institutes - firstly at DESY, working on the ZEUS experiment at the HERA collider, then CERN, working on the CMS experiment at the Large Hadron Collider, and currently at ESS – with additional international experience in York University in Toronto, Canada.

Throughout his career, Richard Hall-Wilton has been involved in the creation process of advanced detector systems, in particular with gaseous detectors and semiconductor detectors. He is an expert in neutron and diamond detector technologies. As well as pioneering the developments of the new generation of neutron detectors across neutron science, he has developed beam monitors as both safety and monitoring systems, advanced triggers for large experiments, including zero- and minimum-bias triggers for the CMS experiment at the LHC, and also track triggers.

X-Ray Free Electron Lasers: Where we are, what has been done and where we might go

J. B. Hastings

LCLS

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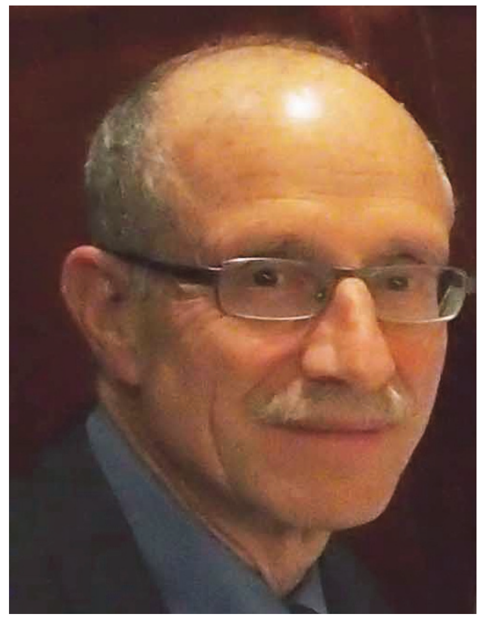

X-ray Free Electron Lasers have been operational for more than 10 years. They are revolutionary light sources whose impact is just beginning to give us a glimpse of their potential to contribute fundamentally to our understanding of the static and dynamic structure of matter at the atomic scale. We will discuss technical challenges, recent experimental results, and the near and longer term directions for sources and science.

Short bio

Jerome Hastings studied Applied Physics at Cornell University and did his PhD under the guidance of B. W. Batterman. After working at the National Synchrotron Light Source for nearly 25 years, in October 2001 he moved to the SLAC National Accelerator Laboratory in Menlo Park, CA, USA. His main interest is in methods and instrumentation for accelerator based light sources. He developed the applications of ultra--high energy resolution methods applied to synchrotron based Mössbauer Spectroscopy and inelastic x--ray scattering. In addition he lead the ultra--short pulse spontaneous radiation facility “Sub--Picosecond Pulse Source” at the SLAC National Accelerator Laboratory from 2001 to 2006. In his tenure at the National Synchrotron Light Source the NSLS R&D effort developed many of the methods and instruments in common use today at 3rd generation synchrotron light sources. He is the science advisor for the LCLS and Professor (research) in the Photon Science Faculty at the SLAC National Accelerator Laboratory. He is a Fellow of the American Physical Society.