Contribution ID: **410** Type: **Oral**

Tech transfer or give-and-take? On the history and future of silicon photomultipliers in medical imaging and other domains.

Tuesday, 3 June 2014 17:10 (20 minutes)

The silicon photomultiplier (SiPM) is a photosensor that can be fabricated in cost-effective CMOS technology while offering high internal gain, fast response, and insensitivity to magnetic fields. The first prototype devices were developed in the late 1990s. Commercial products, including arrays of SiPMs with a total sensitive area of several square cm, became available in the mid-2000's. The potential of the SiPM as an alternative for the vacuum photomultiplier tube (PMT) in scintillation detectors for nuclear physics, particle physics, medical imaging, and other domains, was quickly recognized by a number of academic and industrial groups worldwide. The high utilization potential of SiPMs, combined with a healthy degree of competition between SiPM developers, has resulted in rapid improvement of their performance, robustness, and availability. Further innovations, such as fully digital implementations of the silicon photomultiplier (dSiPM), have been introduced in the meantime. Today, large-scale application is imminent in the domain of medical imaging, where two of the largest manufacturers of positron emission tomography (PET) devices have just released SiPM-based PET/CT and PET/MRI scanners for clinical use. With a coincidence resolving time (CRT) of ˜350 ps FWHM, these systems redefine the state-of-the-art in clinical time-of-flight (TOF) PET imaging. This talk discusses the introduction of SiPMs in PET detector technology as a process of give-and-take with particle physics and other domains, highlights research activities that are expected to further improve PET image quality, and indicates how some of the ongoing developments in TOF-PET(/MRI) instrumentation may be of use to other domains as well.

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Session Classification: V.b Health & Bio

Track Classification: Technology transfer: 5b) Health and healthcare