Training on quantum detection, single-photon imaging, SiPMs, SPADs

Contribution ID: 5

Type: not specified

Modeling of SPADs and SiPMs

Thursday 23 May 2013 10:45 (1h 30m)

Single Photon Avalanche Diodes (SPADs) and Silicon PhotoMultipliers (SiPMs) have since long ceased to be a scientific curiosity and have become a valuable tool for many applications both in research and industrial fields. Such a transition, on one hand, has been favored by the remarkable improvement in SPADs and SiPMs performance obtained in the last years; on the other hand, the widespread use of these devices in many cutting edge applications push the research community for a continuous improvement in their performance and complexity.

A detector development based on a "trial and error" approach is in most cases ineffective and impractical both because of the remarkable time and costs needed for each iteration of the fabrication process and because of the difficulties in identifying the suitable modifications to the device structure. Actually, an effective detector' s development requires a detailed understanding of the physical phenomena that regulate its behavior and the availability of physical models that allows the device designer to evaluate the effect of the main parameters (doping and electric field profiles, defects type and distribution, etc.) on detector performance.

In this lecture we will discuss the physical modeling of SPADs and SiPMs as a whole. In fact, although the latters are significant different from the formers in terms of applications, architectures and sometimes even in terms of the corresponding electronics circuits, the core of the detectors is the same and therefore a unified treatment is possible. In this optics we will present the main figures of merit common to both the detectors (Breakdown Voltage, Photon Detection Efficiency, Dark Count Rate, Afterpulsing Probability, Optical CrossTalk and Timing Jitter) and for each of them we will analyze the physical phenomena that influence its behavior. Then we will discuss the modeling of such phenomena highlighting both relevant parameters and possible limitations.

Brief biography of the speaker

Angelo Gulinatti was born in Codogno, Italy, in 1977. He received the Laurea degree in electronics engineering and the Ph.D. degree in information technology (both summa cum laude) from Politecnico di Milano, Italy, in 2003 and 2007 respectively.

Since 2008 he is Assistant Professor at Politecnico di Milano where he carries out his research activity in the development and modeling of silicon Single Photon Avalanche Diodes (SPAD). In particular he contributed to the development of several generations of large area, high detection efficiency and low noise SPADs including the ones now commercialized by Micro Photon Devices. Currently, he works at the development of arrays of detectors with low Timing Jitter and improved Photon Detection Efficiency.

Presenter: Mr GULINATTI, Angelo (POLIMI)

Session Classification: SiPM Materials and Modelling (3rd Module)