

## **Silicon Photomultipliers & Beyond:**

### **New sensors for the fast, spatially resolved detection of few optical photons**

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The efficient detection of very low light intensities, i.e. few optical photons, is commonly required in a wide range of experiments. In the last years, the traditional vacuum photo multiplier tubes (PMTs) have been replaced more and more by silicon based devices which are today superior in several figures of merit. The most successful type are 'silicon photomultipliers' (SiPMs) which consist of many small avalanche photo diodes basically operated in parallel. Purely passive SiPMs require additional external electronics (often specialized ASICs), which are tailor-made to specific applications. Another type of 'digital' SiPMs combines the photo sensors and active electronics on a single silicon chip, offering many new, interesting possibilities. The main focus of the developments and optimizations has been on time resolution, which is now well below 100 ps. Spatial resolution was achieved mostly by using multiple devices. Recently however, several types of intrinsically position-sensitive few-photon-devices have been developed. In particular, we are successfully operating a single photon sensitive 2D camera chip with the potential to operate at several 100.000 frames per second at room temperature.

After a description of the operation and of the key properties of SiPMs, the new structures will be presented. As one demanding sample application, PET imaging will be briefly discussed.