[silicon photomultiplier]
(Chapter 8.3.2 in *Elements*)

Silicon Photomultipliers

A recent development is the Silicon Photomultiplier (SiPM). These are thin-film solid-state devices based on p-n junctions reverse-biased at a voltage V_{bias} higher than the breakdown voltage V_B. One or more photons insert charge carriers into the depletion layer of the semiconductor, triggering a charge avalanche. See Figures SiPM-1 and SiPM-2.

The current rises until the ballast load in the quenching circuit lowers the bias voltage lowers the bias field at the diode down to or below V_B, so that the electric field can no longer accelerate carriers to impact-ionize lattice atoms. The device therefore acts in the Geiger mode, producing a standard voltage pulse V_{out} at the output. The device is dead while the quenching circuit recovers (~ millisec).

Significant advantages over standard dynode photomultipliers are low voltage operation (~100v), low power dissipation, compact size (>~ 20 μm), and are very fast, signaling photon arrival in tens of picoseconds. SiPMs are immune to the influence of magnetic fields. They can be assembled into large arrays, several mm in size. The charge gain can be as high as 10^6, similar to a PMT, perhaps joined together in cascade to produce higher gains. SiPMs exhibit temperature-sensitive noise.

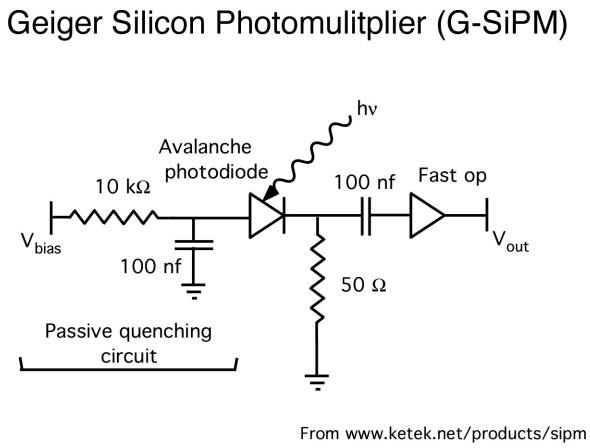

Figure SiPM-1. A silicon photomultiplier circuit.

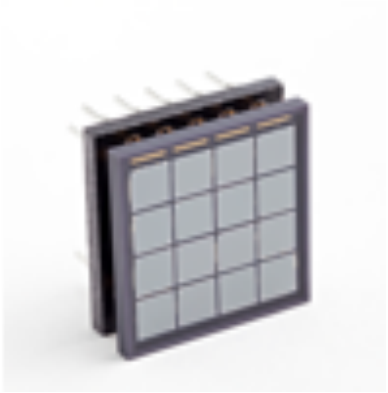

Figure SiPM-2. A 4x4-pixel array of 3-mm SiPM sensors by SensL.

Reference

Website SensL.com.