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# Gain and Noise in GaAs/AlGaAs Avalanche Photodiodes with Thin Multiplication Regions

*Wednesday, 27 June 2018 16:00 (1 hour)*

In this presentation avalanche photo diodes based on GaAs/AlGaAs and separated absorption and multiplication regions (SAM –APD) will be discussed. The structures have been fabricated by molecular beam epitaxy utilizing a δ p-doped layer of carbon to separate the multiplication region and the absorption region. The layer thickness of the latter defines the quantum efficiency and subsequently the time resolution of the structure, which in turn allows tailoring the device for specific scientific applications. Within the multiplication region a periodic modulation of the band gap is obtained by growing alternating nanometric layers of AlGaAs and GaAs with increasing Al content, which enables to tune the band gap and subsequently provides a well-defined charge multiplication. The use of such staircase hetero-junctions enhances electron multiplication and conversely reduces –at least in principle - the impact of the noise associated to the hole amplification, which should result in a decreased overall noise, when compared to p-i-n diodes. Since the doping density of the δ layer controls the punch-through of photo induced primary charges from the absorption to the multiplication layer, several devices with different carbon concentrations have been fabricated and have been characterized. In this presentation gain and noise measurements, which have been carried out on these devices utilizing photons from visible light to hard X-ray, will be discussed and will be compared to the results of a nonlocal history-dependent model specifically developed for this kind of staircase APDs.

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