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Development of AC-LGADs for near-future Higgs factories and nuclear physics experiments

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Low Gain Avalanche Detectors (LGADs) are characterized by an extremely good time resolution (down to 17ps), a fast rise time (~500ps) and a very high repetition rate (~1ns full charge collection). For the application of this technology to near future experiments such as e+e- Higgs factories, EPIC, or smaller experiments (e.g., the PIONEER experiment), the first issue to be addressed is the intrinsic low granularity of LGADs and the large power consumption of readout chips for precise timing. AC-coupled LGADs, where the readout metal is AC-couple through an insulating oxide layer, could solve both issues at the same time thanks to the 100% fill factor and charge-sharing capabilities. Charge sharing between electrodes allows a hit position resolution well below the pitch/sqrt(12) of standard pixel detectors. At the same time, it relaxes the channel density and power consumption requirement of readout chips. Extensive characterization of AC-LGAD devices will be shown in this contribution, with both laser TCT and probe station (IV/CV). The sensors from a variety of manufacturers had variations of the following parameters: readout dimensions: strip/pad metal contact size (length, width), pitch, sensor production details: N+ layer resistivity, dielectric specs (thickness, value of permittivity), bulk thickness, doping of the gain layer. The initial data suggest that the length of the strip plays a dominant role in determining the distance the pick-up extends. On the other hand, the N+ layer resistivity influences the strength of the picked-up signal. Our study compares the effect of all parameters listed above, including a comparison of different manufacturers.

Early Career

Yes

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