

APD-photosensor serial characterization laboratory for FAIR experiments established

A. Wilms¹, the FAIR@GSI division RBDL^{1,#}

¹GSI, Darmstadt, Germany.

For the readout of the electromagnetic calorimeters of PANDA [1] and R3B [2] Avalanche Photodiodes (APDs) will be used. To this end the individual sensors need to be characterized before installation in the final detector systems. Therefore a screening laboratory has been established October 2014.

The new APD screening facility at GSI

The main part of the newly established APD laboratory inside the Heck hall is the mass screening room in which 100 devices can be characterized simultaneously inside five climate cabinets. Each cabinet is humidity and temperature controlled and allows the temperature dependent full characterization of the sensors in nearly completely automatized procedures (see Figure 1).



Figure 1: Installation of 5 climate cabinets inside one room of the APD laboratory.

To reach the envisaged screening capacity of 2000 APDs per month, the APD laboratory of the RBDL division is operated in shift mode. For the PANDA EMC, all APDs need to be characterized twice, once before and once after gamma irradiation.

APD screening & results

In addition to the optical parameters measured at given wavelengths, the temperature dependence of the gain-bias characteristics may be measured. Further, the quantum efficiency at different temperatures, the electrical properties like capacitance and excess noise may be measured at the facility in the future, as soon as the ongoing validation of the respective apparatuses is done.

Approx. 4600 APDs have been characterized so far for the PANDA EMC with respect to their parameters at 20°C and at their nominal manufacturer-given gain of $M = 100$. The distributions for the voltage values to be applied to reach a gain of $M = 100$ as well as the breakdown voltages of approx. 3800 APDs are shown in Figure 2 and Figure 3 respectively.

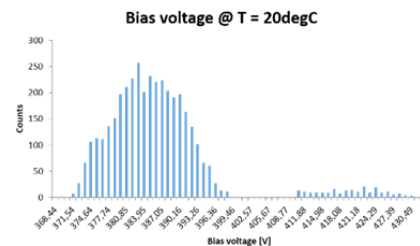


Figure 2: Bias voltage distribution for validated APDs at 20°C for $M = 100$.

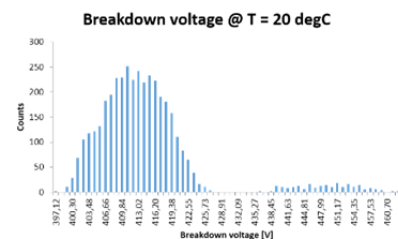


Figure 3: Distribution of breakdown voltage for the same APDs: Two groups of devices can clearly be identified. Both groups are still found within specifications.

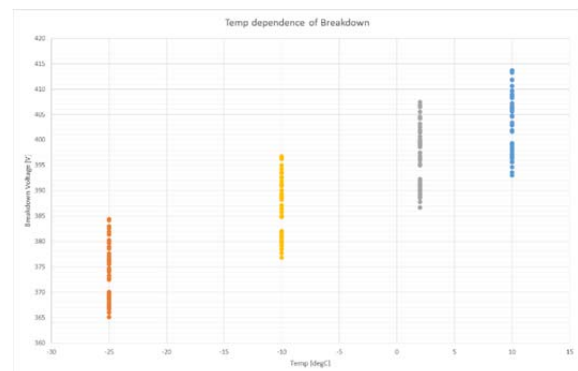


Figure 4 First preliminary data of a sample of 60 APDs showing the temperature dependence of the breakdown voltage. Each device shows a strictly linear behaviour.

Up to now only around 1% of the devices did not match the required technical specifications defined by the collaboration.

References

- [1]: Technical Design Report for PANDA Electromagnetic calorimeter (2008) arXiv:0810.1216
- [2]: Technical Report for the Design, Construction and Commissioning of the CALIFA Barrel (November 2011)

