The gain vs. voltage dependence for avalanche photodiodes (APDs) is usually described by Miller’s formula [1]:

\[
M(V) = \frac{1}{\frac{1}{M_0} + \frac{dM}{dV} V}
\]  

(1)

This formula works well at very high gains (when bias is close to APD’s breakdown voltage \(V_B\)). However, agreement between (1) gain vs. voltage dependence is rather poor for APDs operating at moderate gains \((100 \text{ to } 2000)\). In this presentation we propose a new empirical formula describing gain vs. voltage dependence of APDs in wide range of gains \((20 \text{ to } 300)\):

\[
\frac{1}{M*} = \frac{1}{M_0} + \frac{dM}{dV} V
\]

(2)

Measuring gain vs voltage dependences of different APDs and SiPMs (before breakdown), we observed that relative change of APD gain can be approximated by linear function in wide range of gains:

\[
\frac{1}{M*} = \frac{1}{M_0} + \frac{dM}{dV} V
\]

(3)

where \(V_B\) is APD’s breakdown voltage, \(a\) and \(b\) are parameters depending on the APD structure. When \(V\) is close to \(V_B\) eq. (3) coincides with the formula (1) for \(n=1\):

\[
M(V) = \frac{1}{\frac{1}{M_0} + \frac{dM}{dV} V}
\]

(4)

In this presentation we compare the results of APDs gain measurements with the calculations using formula (3). APD gain was measured using blue LED continuous light illumination:

\[
M(V) = \frac{\text{Total}(V) - \text{dark}(V)}{\text{Total}(100V) - \text{dark}(100V)}
\]

(5)


**Introduction**

**Method**

We propose new empirical formula describing gain vs. voltage dependence of APD. Good agreement between this formula and real gain vs voltage dependence was found for several APDs/SiPMs used in HEP and medical applications.

**Summary**