First results on NUV-SiPMs at FBK

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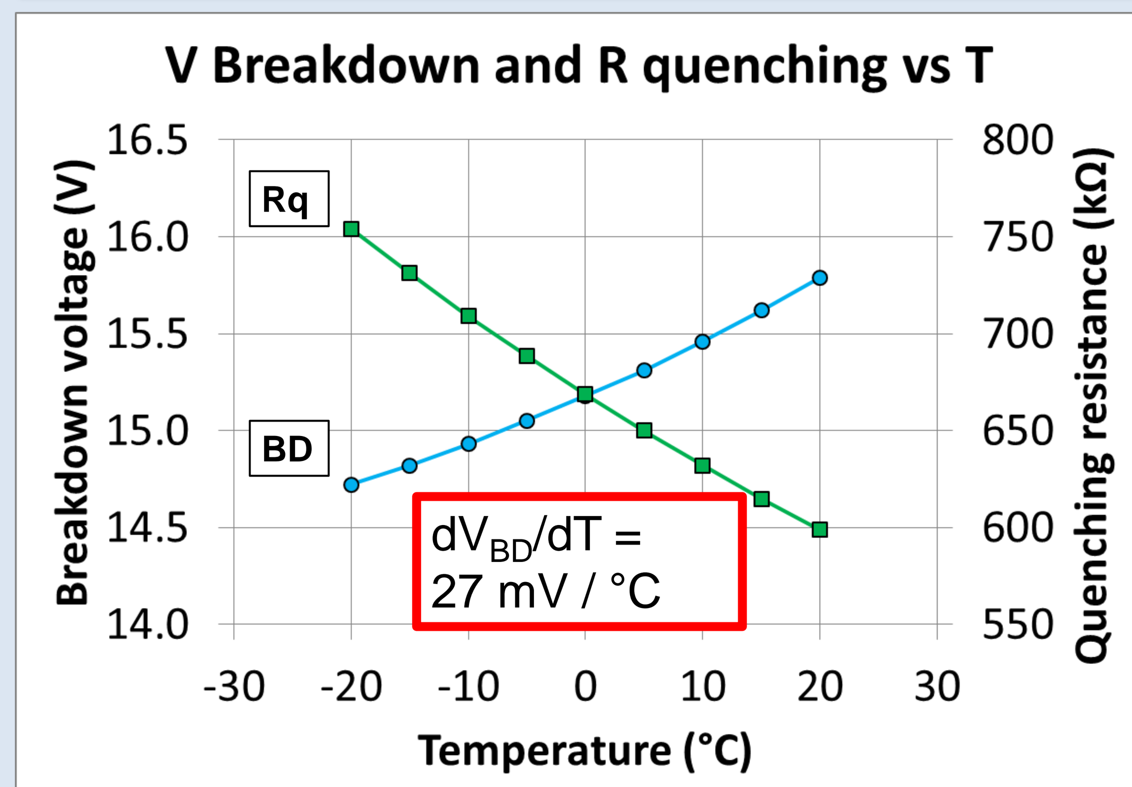
Abstract: in this contribution we show selected results on the first release of Near Ultra Violet SiPM technology (NUV-SiPM) produced at FBK. In particular, we focus our attention on the photo-detection efficiency (PDE) performance. The PDE in the near-UV part of the light spectrum is mainly limited by the quantum efficiency term since the photo-generation takes place in a very shallow region of the silicon. Thus, besides using a p+-on-n junction configuration to have an avalanche triggered by the electrons, we need to implement a very shallow p+ layer. In this context, we will show that our NUV-SiPM technology features a quantum efficiency higher than 80% in the measured range between 360 and 420 nm. This allows to reach a PDE of about 30% at 9 V over-voltage on a SPAD featuring 50 x 50 μm² cell size and 45% fill factor. We will also show other important features of the device such as noise, breakdown voltage temperature dependence and single-cell response uniformity .

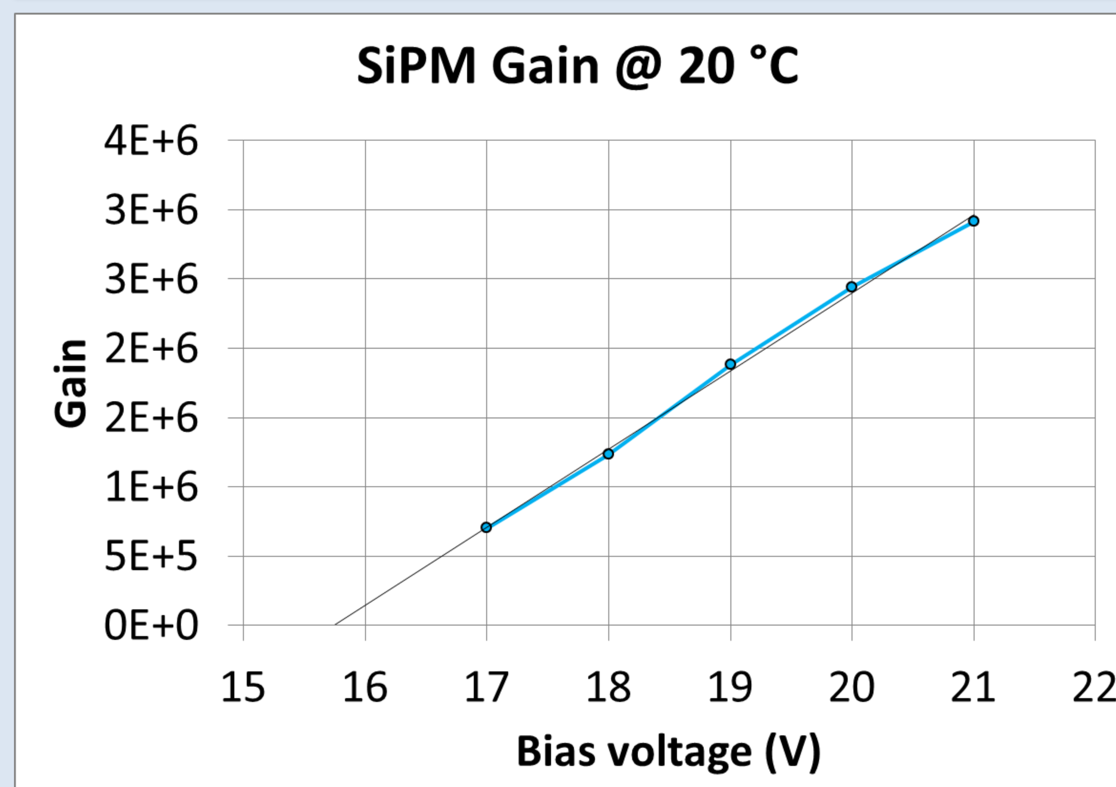
Functional measurements on 1x1 mm² 50 μm cell SiPM

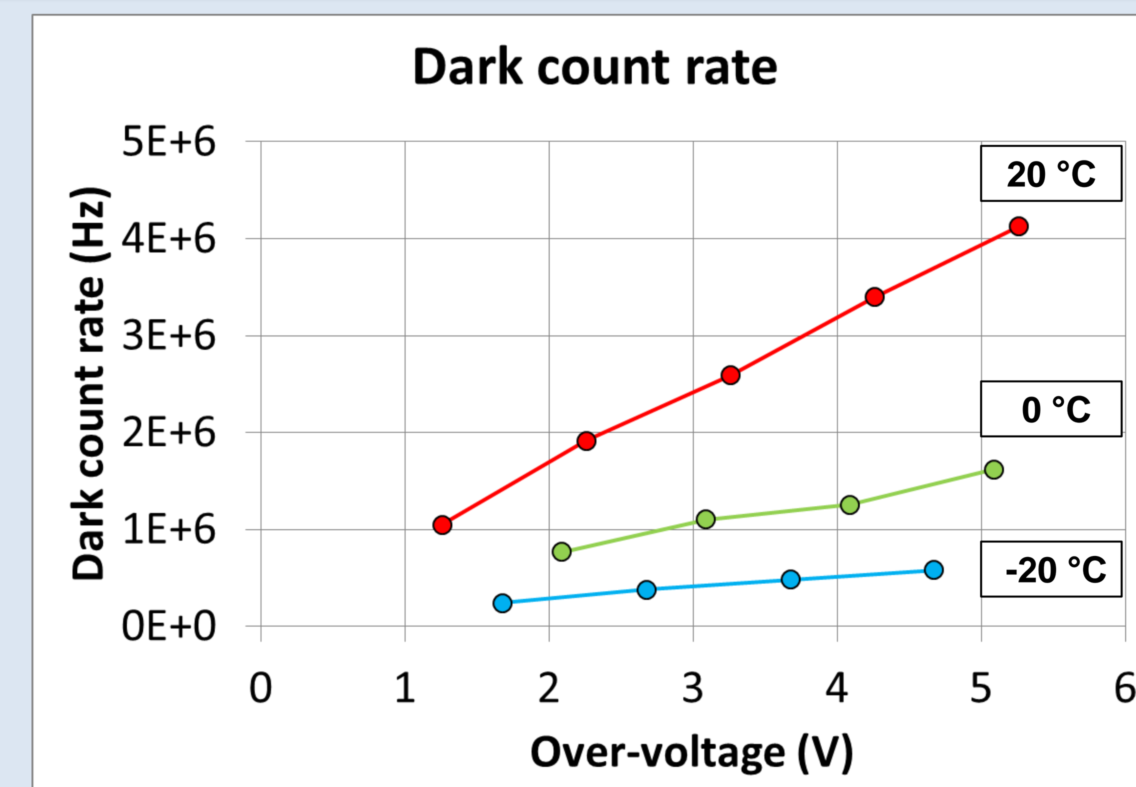
IV measurements



→ Low breakdown voltage T dependence

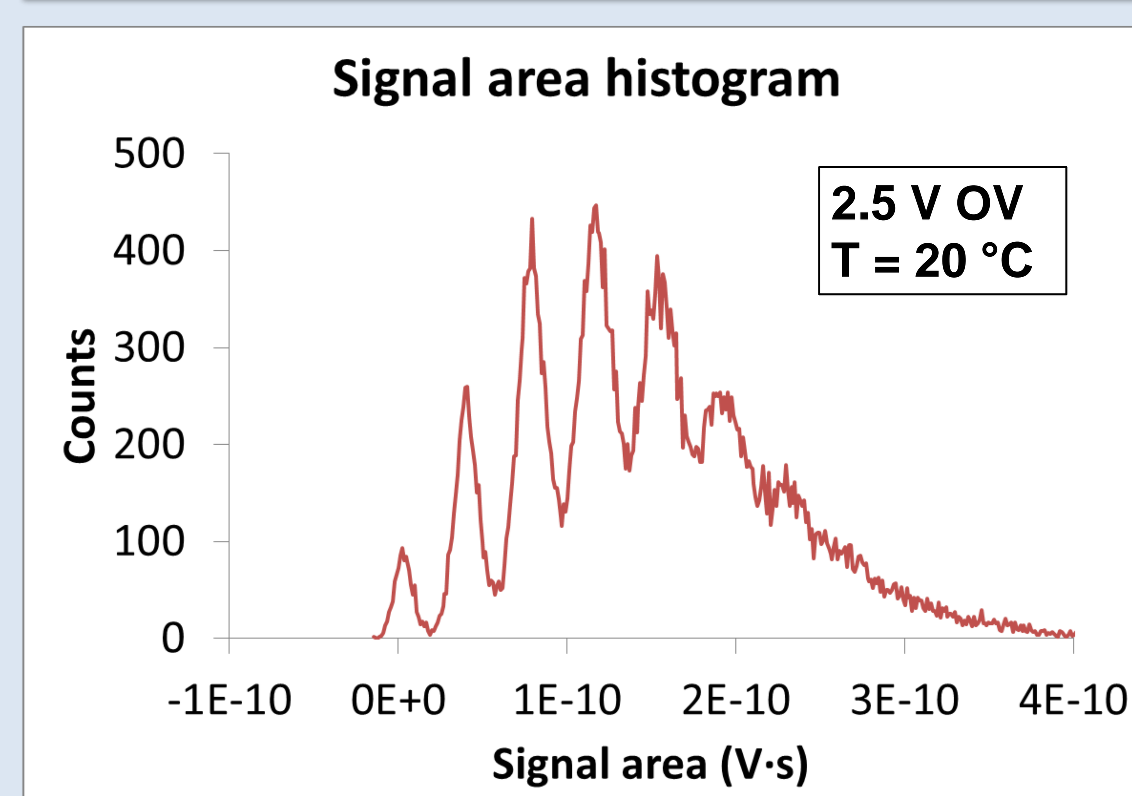
Dark measurements





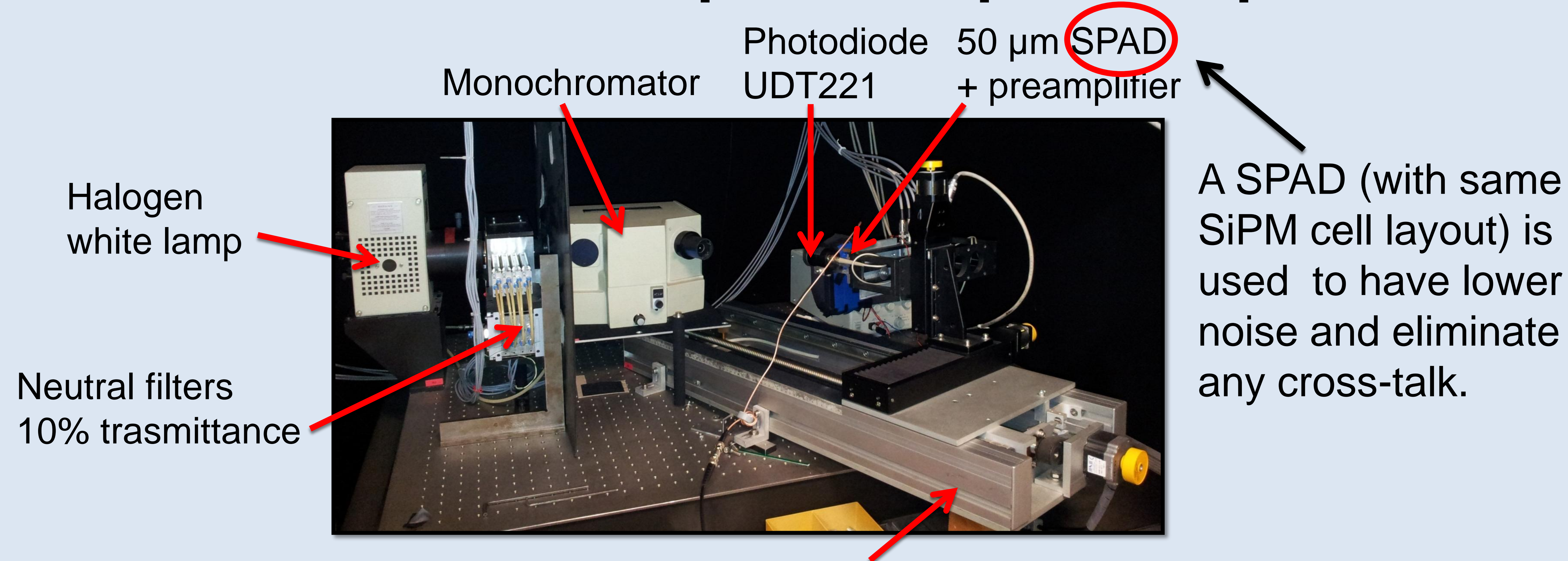
→ still relatively high primary dark count

Response to pulsed LED (λ = 380 nm)



→good single cell response uniformity (peak resolution mainly limited by electronic noise)

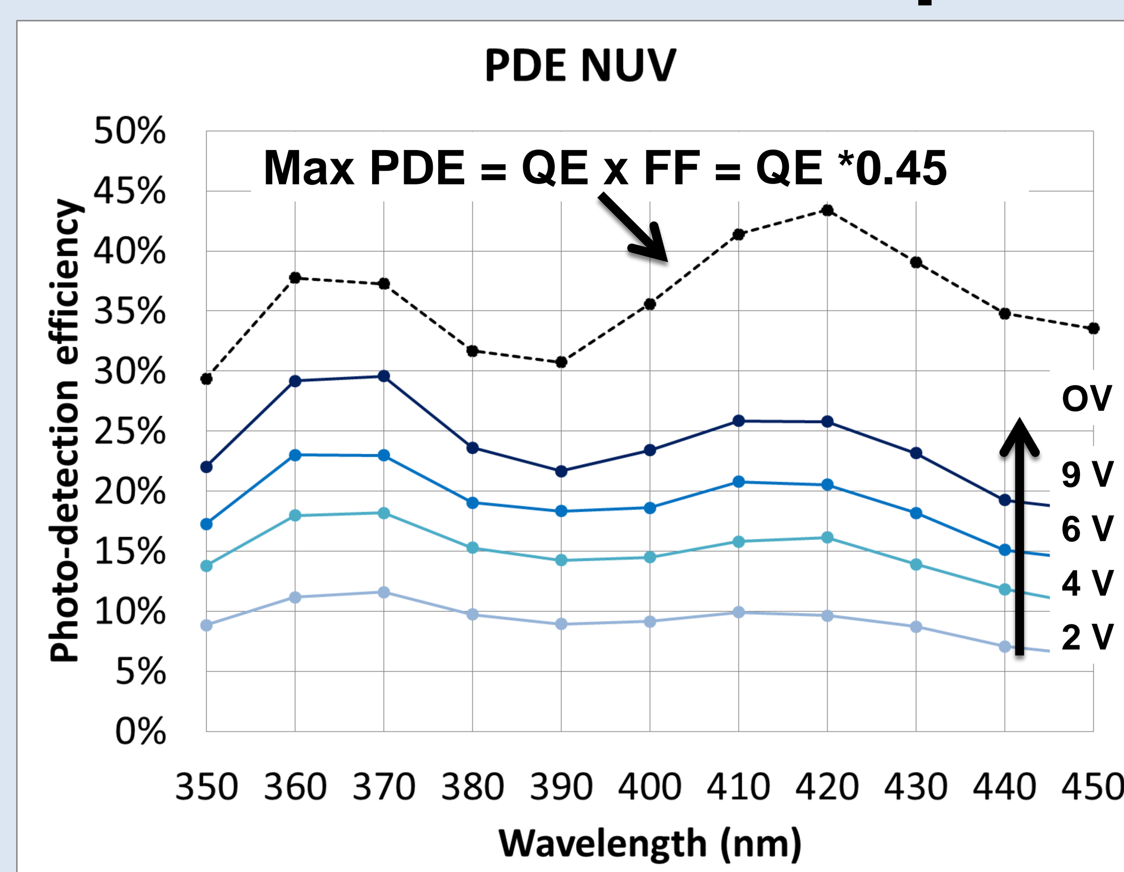
PDE measurement setup and acquisition procedure



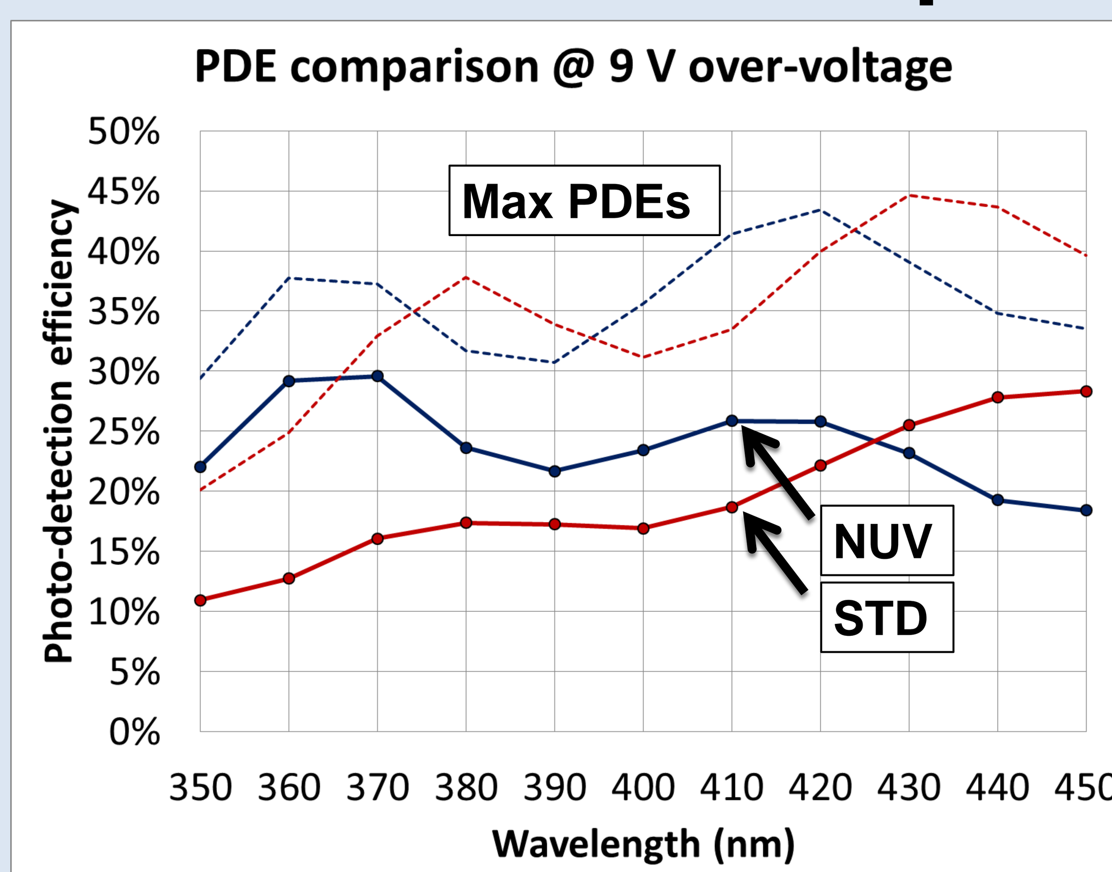
A SPAD (with same SiPM cell layout) is used to have lower noise and eliminate any cross-talk.

Pulse rate is extracted from the histogram of the **time difference between consecutive pulses**. Only events falling on Poisson statistic are counted to eliminate after-pulse contribution!!

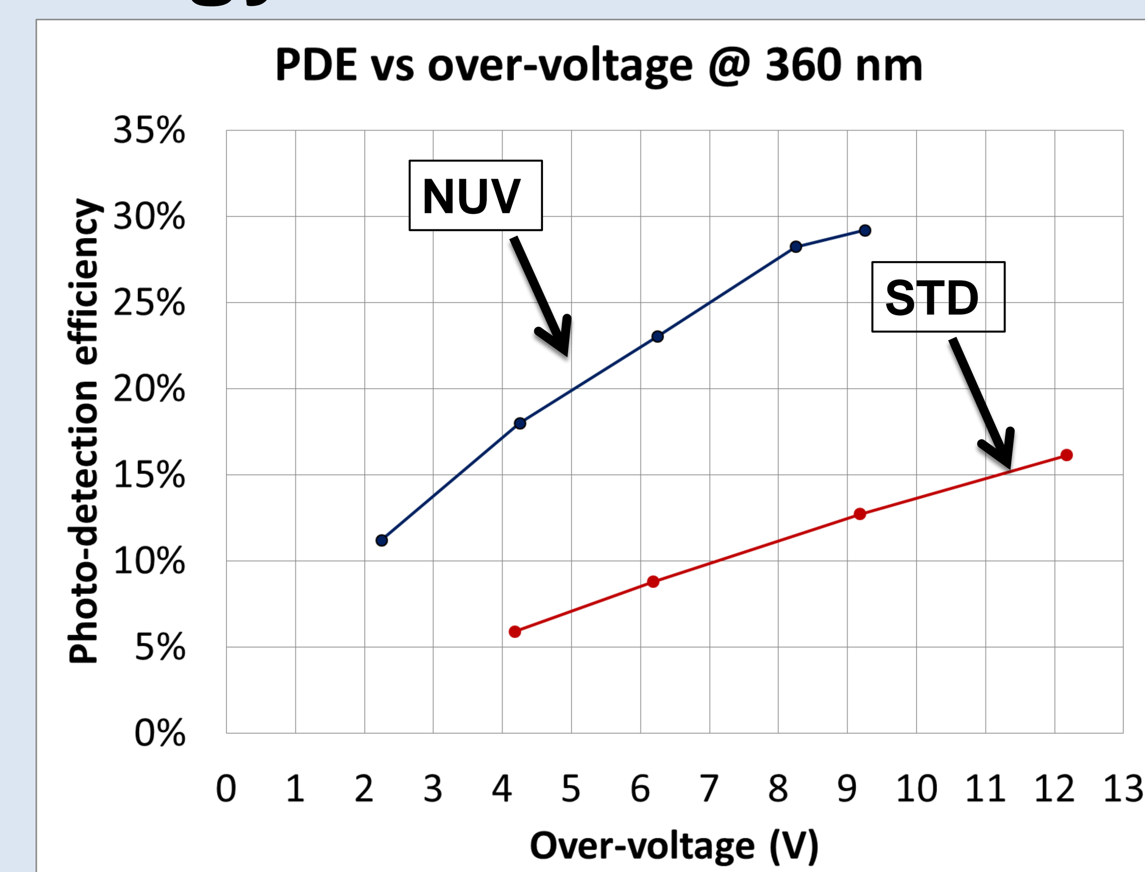
PDE results and comparison with Standard n-on-p technology



QE measured on test photo-diode allows us to evaluate max PDE (higher plot). **PDE=30% is measured at 360 nm, 9 V OV.**



At the same 9 V over-voltage the **NUV PDE is a factor ~ 2.5 greater** than standard n-on-p technology.



In NUV SiPM PDE **increases faster** with OV w.r.t STD since the avalanche is triggered by electrons instead of holes.

Conclusions: We presented the first results of the Near Ultra Violet SiPM technology (NUV-SiPM) produced at FBK. The functional measurements on a 1x1mm² 50x50um² SiPM show that the device is working properly. The optical characterization of a SPAD with the same cell structure of the SiPM evidences a PDE as high as 30% at 360nm and 9 V over-voltage which is a rather good value considering a FF=45%. For the same over-voltage and wavelength, PDE in NUV-SiPM is a factor ~ 2.5 greater than in standard technology. We are currently working to improve the noise and after-pulse performance of this new technology.

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