Summary of the Photon Detection Efficiency Working Group

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PDE Measurements: Practical Considerations

Recommended procedure should be:

- Robust, reliable
- Work at room and cryogenic temperatures
- Good control of systematics
- Easy to set up

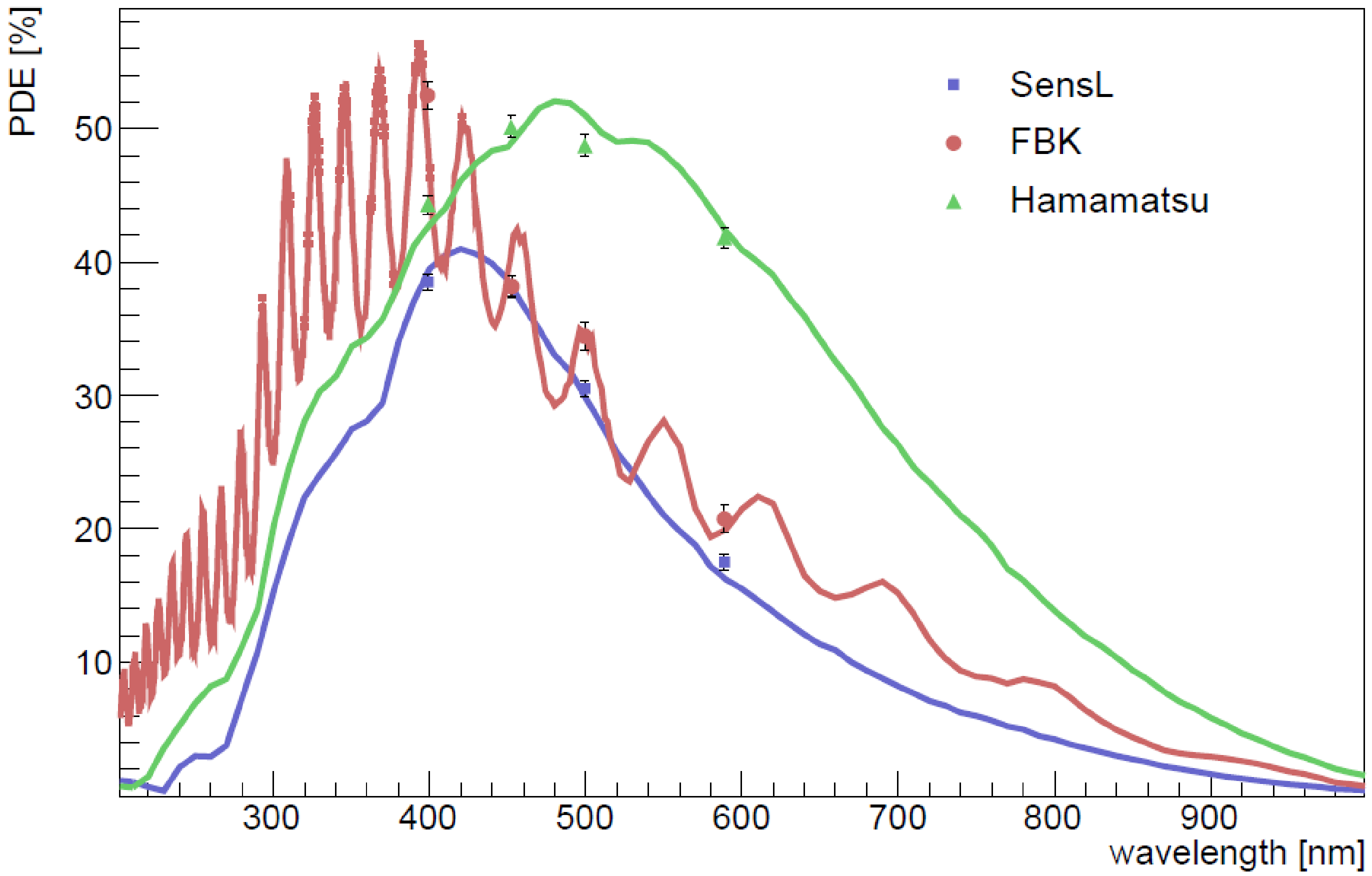
Two Conceptually Different Methods

Continuous Photon Beam vs. Pulsed Photon Beam

Continuous Photon Beam methods are prone to be affected by correlated noise of SiPMs

→ More than one photoelectron per detected photon
→ Tricky to correct for

WG recommends "pulsed" method as standard PDE measurement method



Measurements only at distinct wavelengths
→ need to fit spectral response measurement to PDE measurements

Effect of Non-Poissonian pulsed Light Sources

Necessary Condition: Light source needs to be “Poissonian”

Average number of detected photons measured by counting how often no signal is detected

$$\overline{N}_{\mathrm{Ph}} = \ln\left(\frac{N_0^{\mathrm{DC}}}{N_0}\right)$$

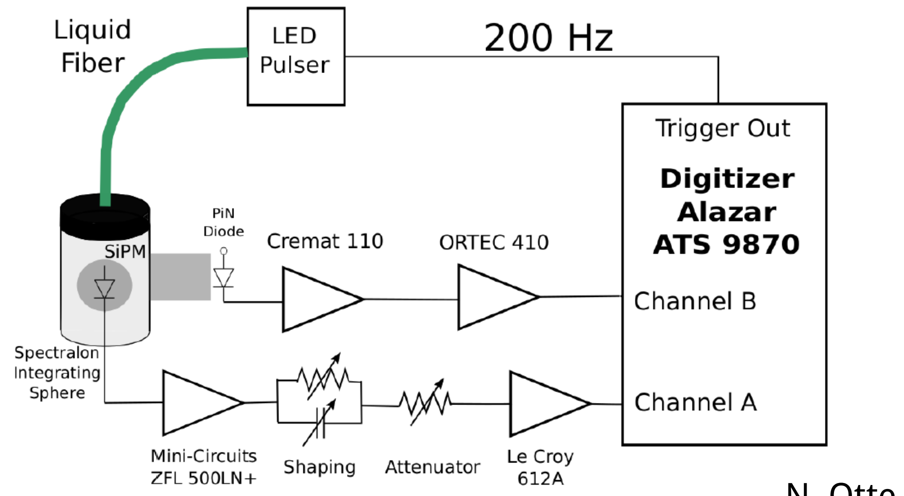
Assumes Poisson statistics

Not always the case: For example mode mixing in lasers, some LEDs

→ photons can be correlated

Need a list of “approved” light sources (LEDs and lasers)

Swapping Sensors vs. Optical Splitter



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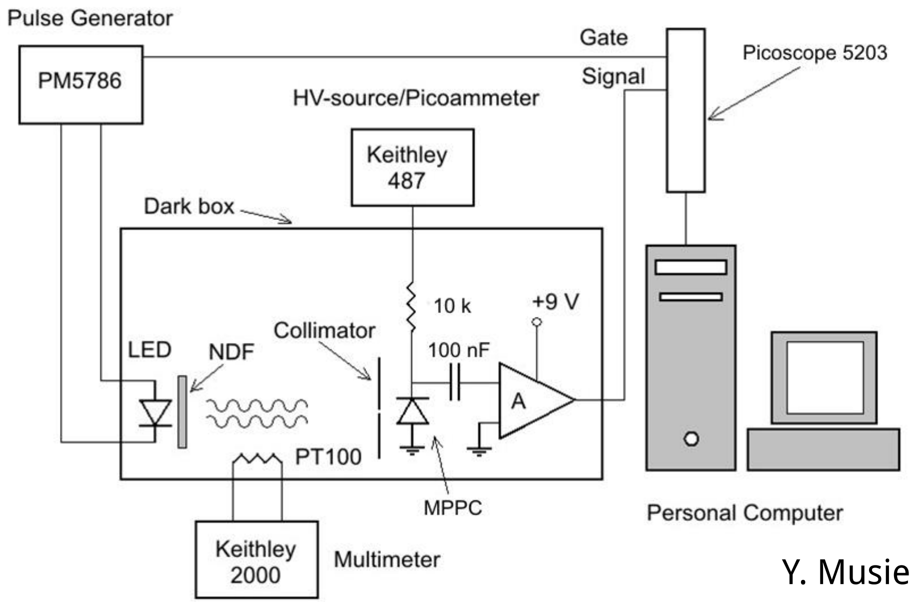


Y. Musienko

Pro:
- Measure reference and DUT simultaneously

Contra:
- Possible wavelength dependent splitting ratio
- Photons can trickle out over long time from integrating sphere

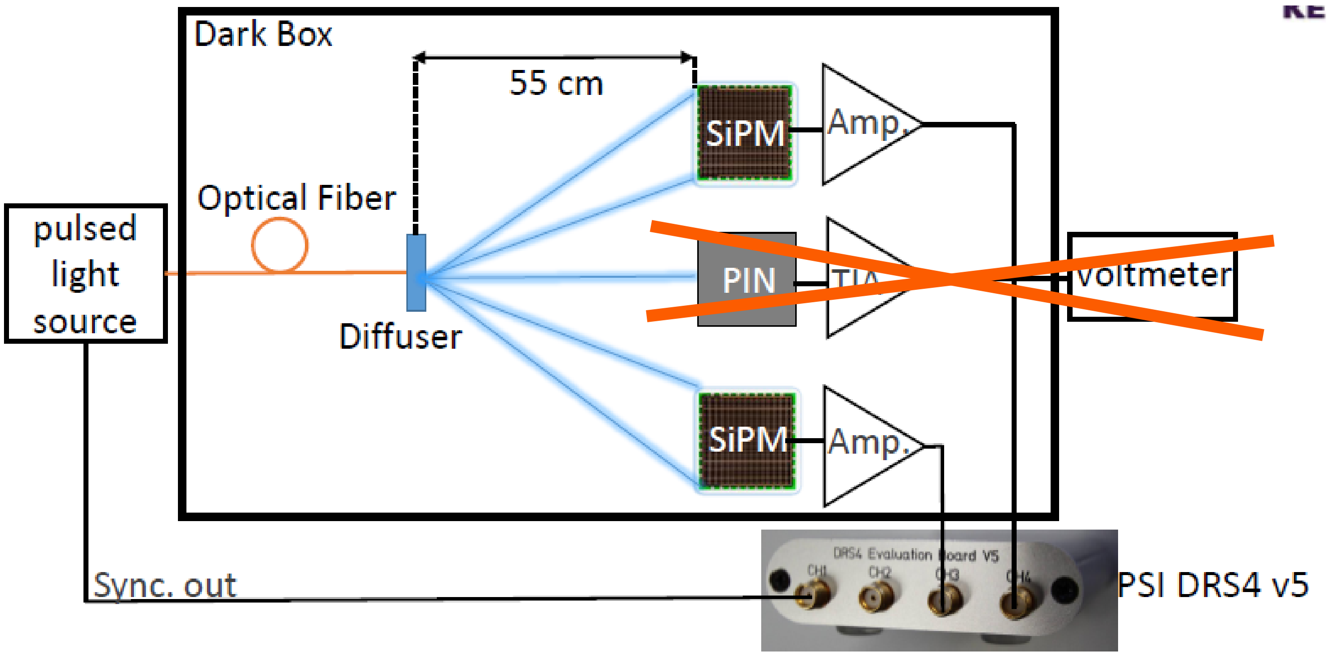
Pro:
- no beam splitter

Contra:
- reference and DUT need to be measured in sequence
→ need a monitoring device

Solution: Combine the two methods

Proposed Standard Setup

- Use calibrated SiPM as reference (i.e. no PiN diode) → splitting ratio of ~ 1
- Standard “PDE Box“



s. E. Engelmann