

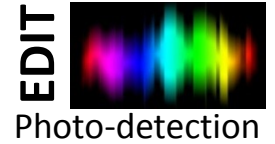
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Single photon counting measurements with a hybrid photon detector

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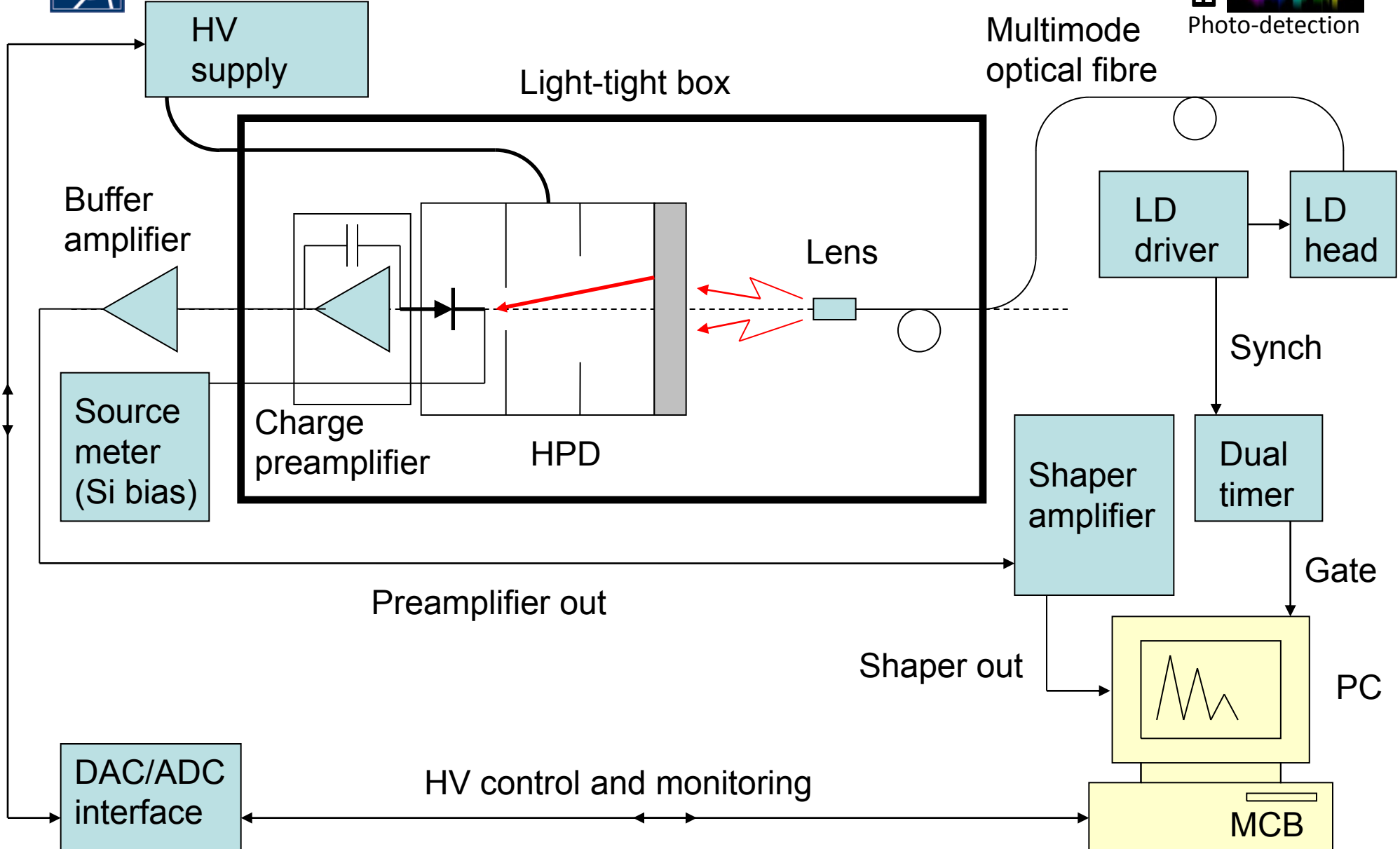
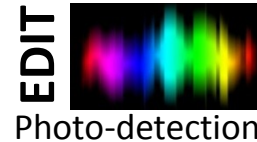
Overview

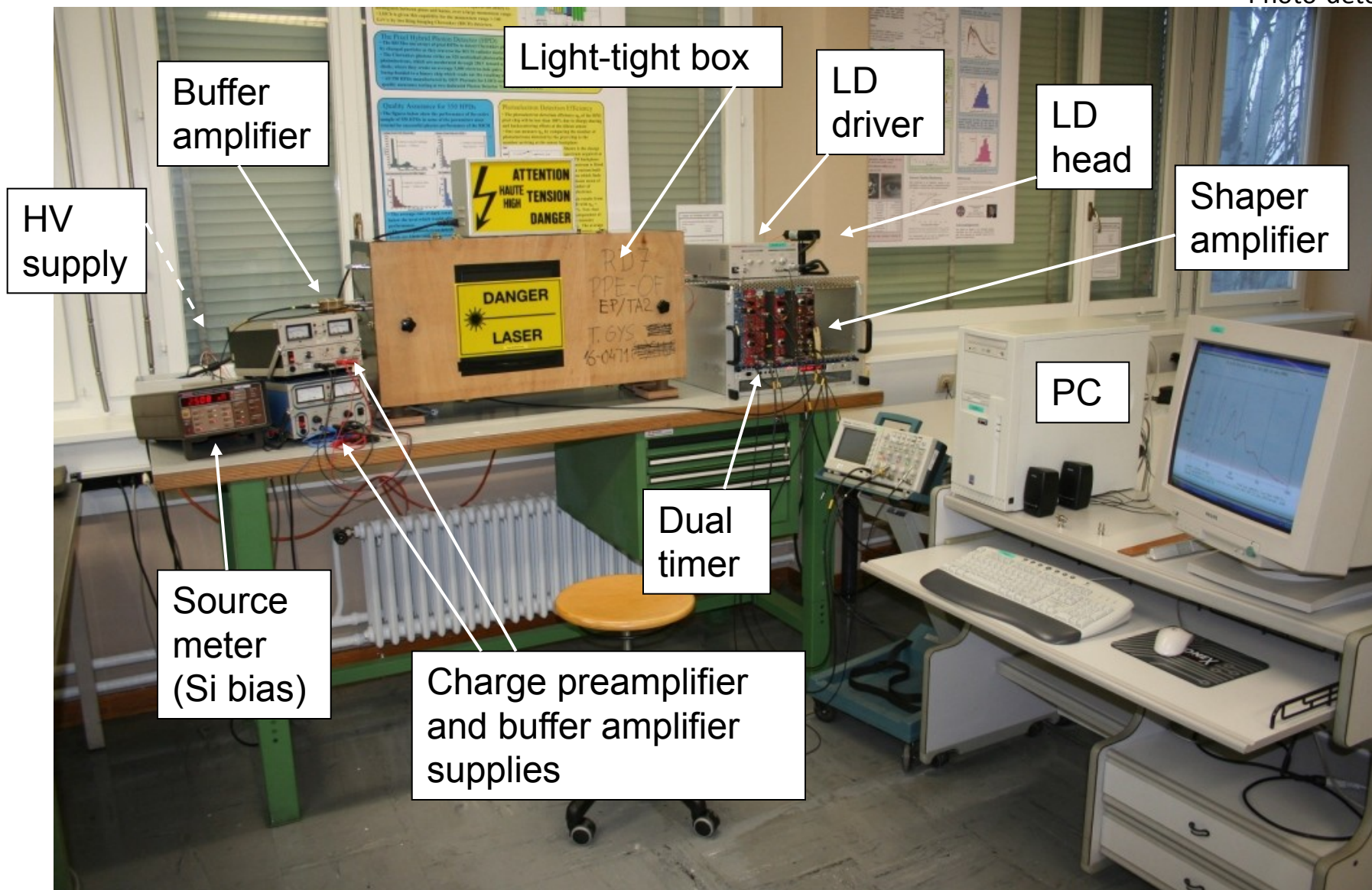


- Measurement, analysis and discussion of single photoelectron spectra recorded with a hybrid photon detector illuminated by a picosecond pulsed laser diode source



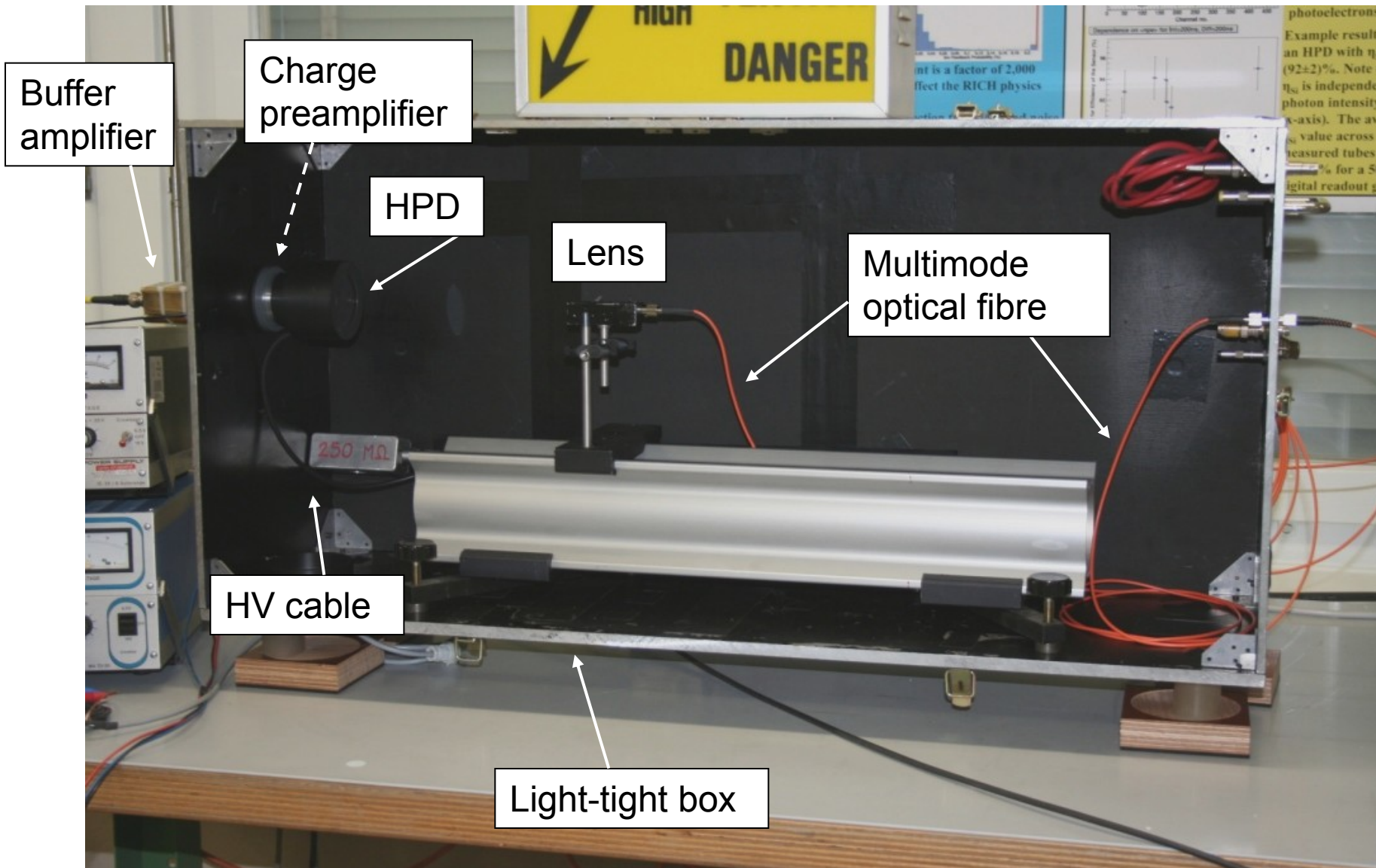
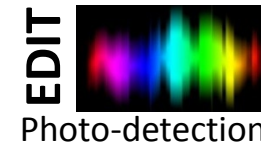
Experimental setup: sketch

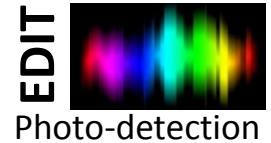






Experimental setup: photograph 2

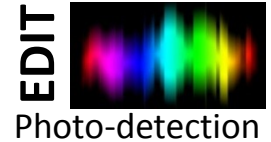




- Introduction
 - Discussion of measurement protocol and key parameters (Poisson average, electronics noise, dark counts, etc.)
 - HPD and setup description and operation – safety aspects
- Switching on
 - Signal generation and processing
 - Photo-electron energy dissipation – HPD gain
 - Pre-amplification - electronics noise
 - Amplification and shaping – digitization
 - Diode reverse bias
 - leakage current – depletion - full depletion – electronics noise – capacitive load
 - over-depletion – photoelectron stopping range – charge carrier collection efficiency
 - High voltage ramp-up
 - diode ohmic contact – photoelectron stopping range – dead layer – HPD gain
 - nominal operating point



Analysis and discussion



- Measurements statistics
- Estimate Poisson average μ from $P_{\mu}(0)$, correlate with spectrum average
- Discuss contribution of photo-electron energy dissipation in Silicon – dead layer – Fano factor – small intrinsic gain fluctuations
- Discuss contribution of photo-electron back-scattering (irreducible continuum – combinatorics - spectrum fit models)
- Discuss contributions of electronics noise (leakage current/ capacitive load) - link to solid-state detectors and readout electronics



- **Technical references**
 - HPD data sheets
 - Charge preamplifier/buffer amplifier/shaper data sheets and manual
 - MCB data sheets and manual
- **Pre-requisite literature**
 - Pioneering work on photon counting with HPDs
 - Vacuum photon detectors (image intensifiers) and solid-state detectors
 - Back-scattering effects
 - Theoretical and experimental work
 - Proposed models of photoelectron spectra