

Short Course on “Photodetectors” for PhD students

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Program of the short course:

- Detection Regimes and Figures of Merit

The Bandwidth-Noise Tradeoff; Quantum and Thermal Regimes; Figures of Merit of Detectors (NEP and Detectivity, Background Limit or BLIP, NEP and D for Single Photon Detection)*

- Invariants of Radiometry

The Law of Photography; The Invariants in Free Propagation; Acceptance and Degrees of Freedom; Applying Invariance to Problem Solving; Extension of Invariants

- Avalanche Photodiode, SPAD and SiPM

Avalanche Photodiode (Gain of the APDs, Frequency Response and Noise Experimental Evidence and Deviations, APD Structures, Bandgap Engineered APD, APD Biasing and Requisites); Single Photon Avalanche Detectors or SPAD (The APD in Geiger Mode, SPAD Structures, SPAD Quenching, SPAD Performances and Parameters); Silicon Photomultipliers; SPAD Arrays (Microlenses for SPAD Arrays)

- Coherent Detection

Direct and Coherent Detection (Introduction, Coherence Factor, Signal to Noise Ratio, Conditions for Coherent Detection, S/N and BER, Number of Photons per Bit); Coherent Techniques (The Balanced Detector, The Balanced Scheme in Phase Measurements, Examples of Coherent Schemes, Photomixing)

- Advanced Photodetection Techniques

Detection with Optical Preamplification; Injection Detection (Injection Gain, Bandwidth and Noise of Injection Detection, Detection of Terahertz Waves); Non-Demolitive Detection; Detection of Squeezed States, Ultrafast (ps and fs) Pulse Detection (Autocorrelation Measurements, FROG); Detection for Quantum Communications; Detection for LIDAR.

Reference: Photodetectors, 2nd ed., Wiley and IEEE Press, 2020, available in the library of the University, or ask the teacher.

Lectures: 12 h – 2,4 credits + 1 credit for students who intend to take a final exam (optional)

Timetable: **Dec. 17** time 11-13, **Jan. 8** time 11-13, **Jan. 15** time 11-13, **Jan. 22** time 11-13, **Jan. 29** time 11-13, **Feb. 2**, time 11-13.

Venue: Magenta Lecture Room, floor B

Presentation: oral for resident PhDs, streaming for PhD students abroad or attending from another Universities

Link: <https://unipv-it.zoom.us/j/91605421264?pwd=kJEZomTPdgdeURY72qgbfFYZHzW6T.1>

A copy of lecture notes will be provided in advance of lessons