

MICRO-523: Optical Detectors

Week Thirteen: Single Photon Detection – Exercises

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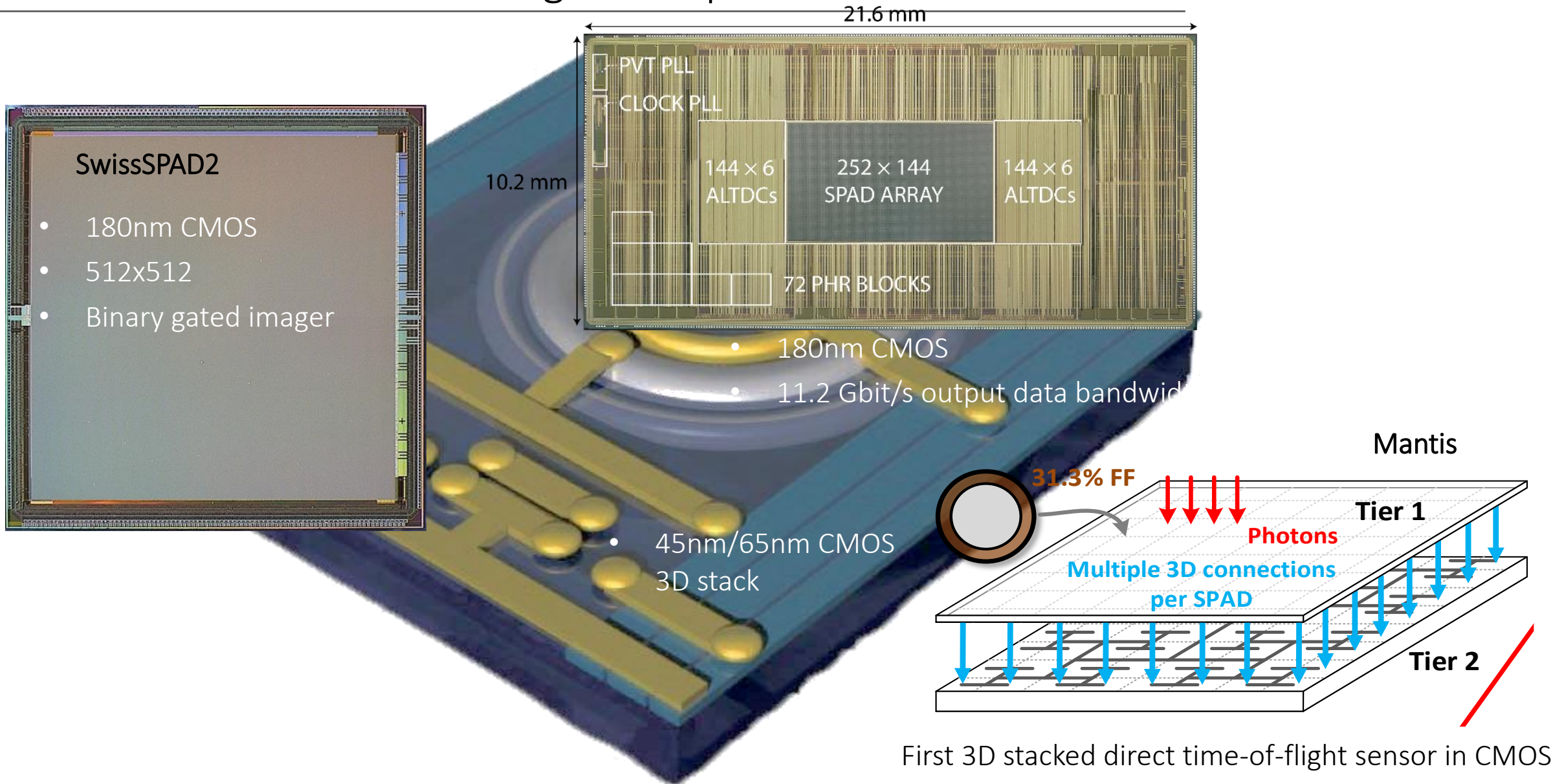
Ecole polytechnique fédérale de Lausanne (EPFL), Neuchâtel, Switzerland

Based on MICRO-523, P.-A. Besse, 2023

TAs: Samuele Bisi, Kodai Kaneyasu

The logo of the École polytechnique fédérale de Lausanne (EPFL), consisting of the letters 'EPFL' in a bold, red, sans-serif font.

Reminder: AQUA – SPAD Design Examples



Exercise 13.1: analysis of a paper

SwissSPAD2/3: a family of natively digital, time gated SPAD cameras with continuous streaming at up to 100 kpfs and picosecond system-level synchronization for quantum imaging applications

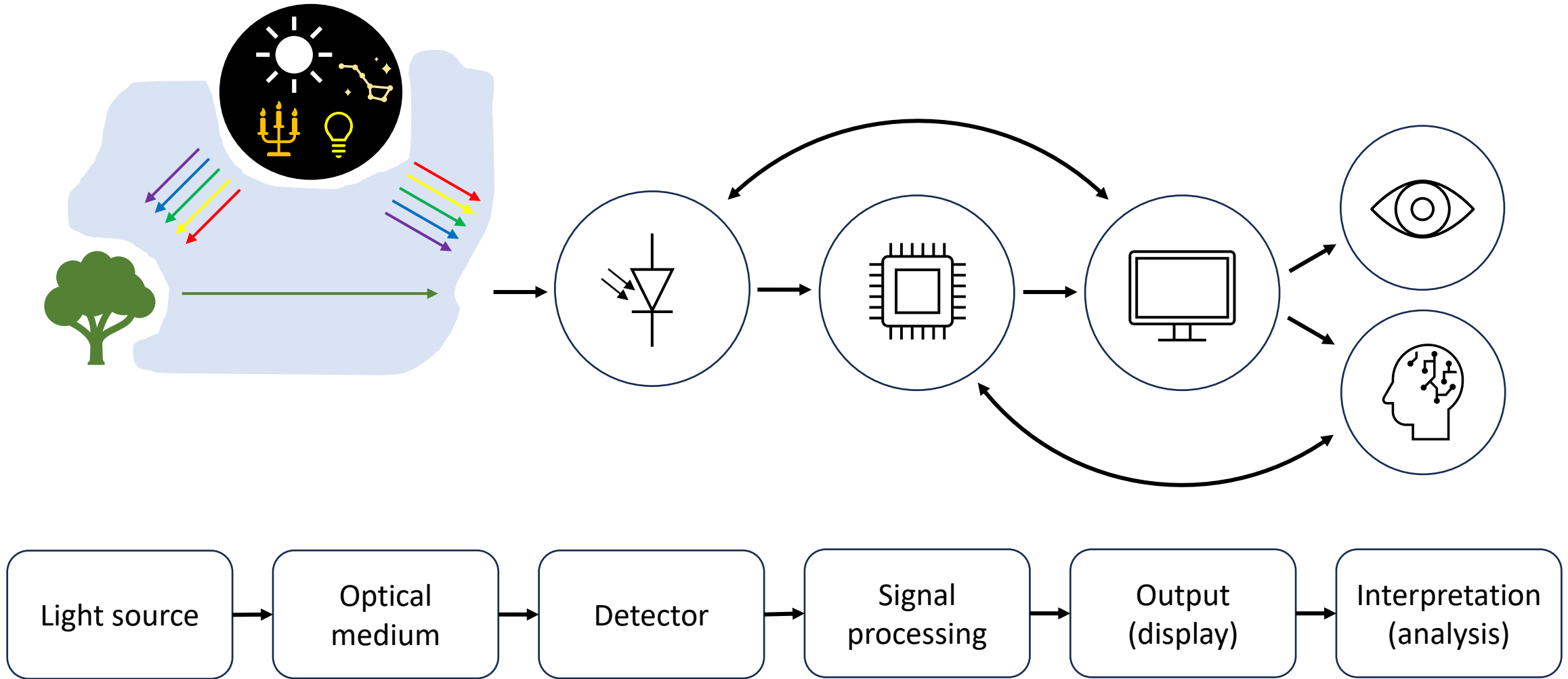
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Working in groups:

- 1) Read and understand the paper
- 2) Choose one section of the paper (1-2, 3, 4, 5) and resume it in a few slides (1-3 slides)
- 3) Present to the class the key points of the selected part

Exercise 1.1: Components of an optical system



Exercise 1.1: Components of an optical system

Select 1-2 key blocks in the previous slide:

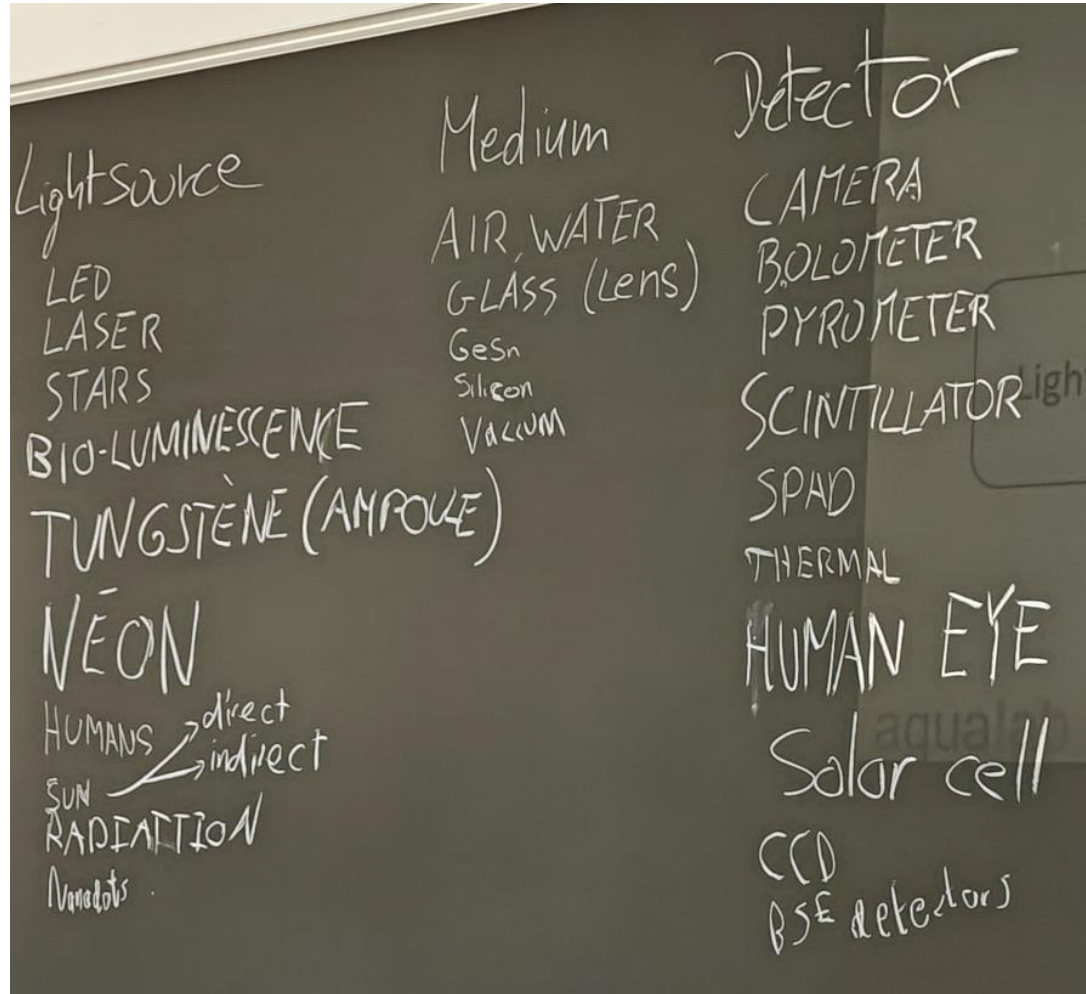
- What are their main parameters?
- Can you think of examples?

Ideas:

- **Light source:** laser vs thermal light, CW vs pulsed operation, wavelength, ...
- **Optical medium:** air, tissue, ..., close by, far, ...
- **Detectors:** single-point vs 2D camera, all-solid-state vs photomultiplier tube, size, number of pixels, ...
- **Signal processing:** one single image vs a movie, averaging (mean value) vs peak finding, ...
- **Output (display):** human eye vs screen, colour palette, bit depth, ...
- **Interpretation:** simple intensity, time of arrival = distance, multispectral -> fruit ripening, ...

Exercise 1.1': Components of an optical system – *results & update*

Current year



Exercise 1.1': Components of an optical system – *results & update*

Light source

- LED → W3
- Laser → Ex 2.4
- Stars
- Bio-luminescence
- Tungstène
- Néon
- Humans
- Sun → W1
 - Direct/Indirect
- Radiation
- Nanodots

Optical medium

- Air
- Water
- GeSn
- Silicon
- Vacuum

Detector

- Camera
- Bolometer
- Pyrometer
- Scintillator
- SPAD → W11,12
- Human Eye
- Solar cell
- CCD → W6,7
- BSE detectors

Reflection point:

- Sometimes no need for an output
- Knowing the detector limits can improve the interpretation
- Manipulation of light sources
- Calibration

What can you add??