SPAD Test System

Testing the performance of single photon avalanche detectors (SPADs)

Model STS

Modules

- STS-IS (Integrating sphere-based photon flux source)
- STS-GM (Geiger-mode operation module for APDs) – in preparation
- STS-AC (FPGA-based auto-correlation measurement unit) – in preparation

System Variations

- STS-SP (Spectrally tunable detection efficiency measurement in free space)
- STS-SP-F (Spectrally tunable detection efficiency measurement in fiber)

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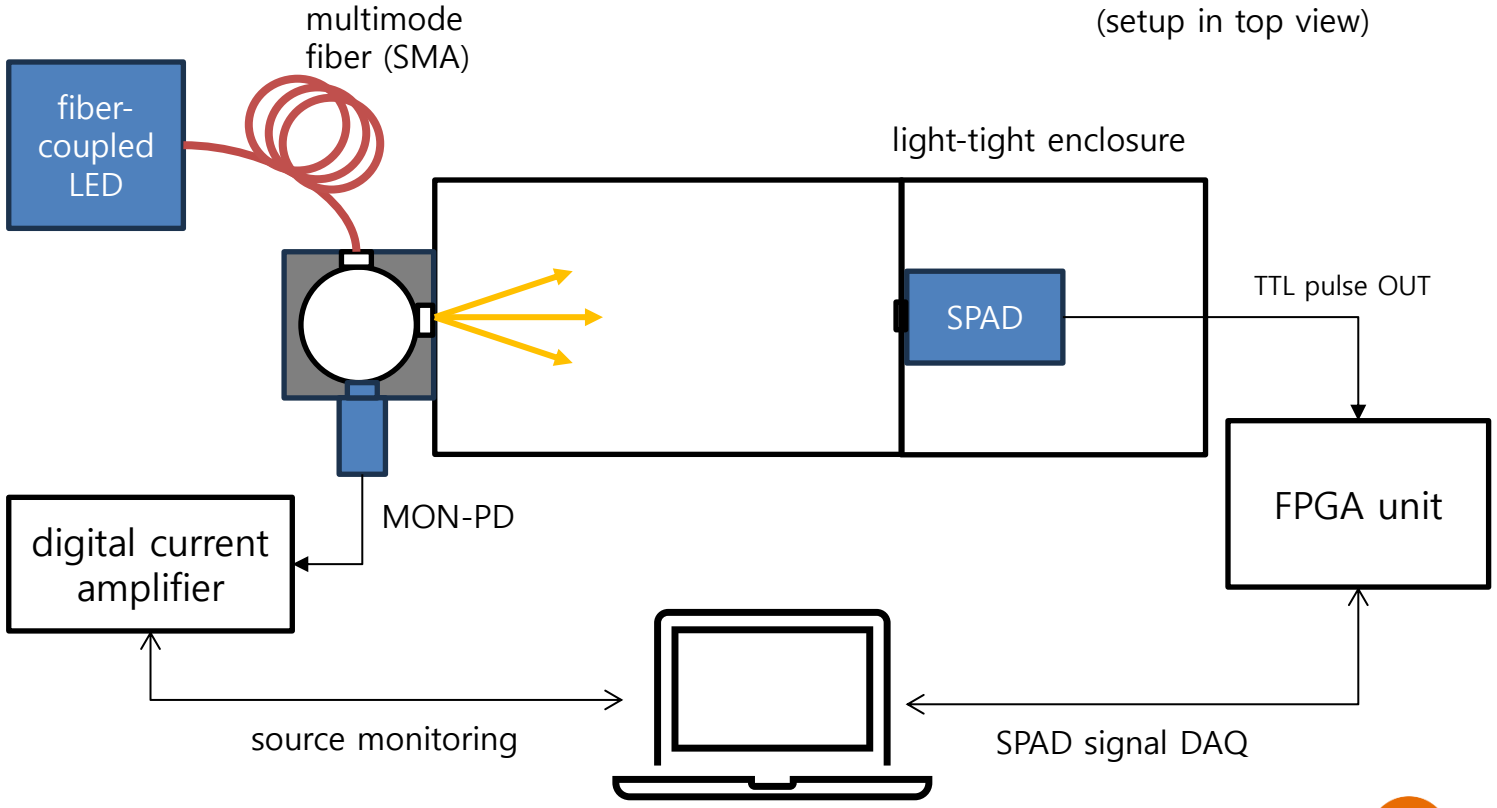
- STS
- STS-IS
- STS-GM
- STS-AC
- STS-SP
- STS-SP-F

The System

- Easy and fast test of key performances of a SPAD at a selected wavelength
  - Dark counts, dead time, after-pulsing probability
  - Detection efficiency (based on photon irradiance calibration)
- Customized instrumentation solution including a software



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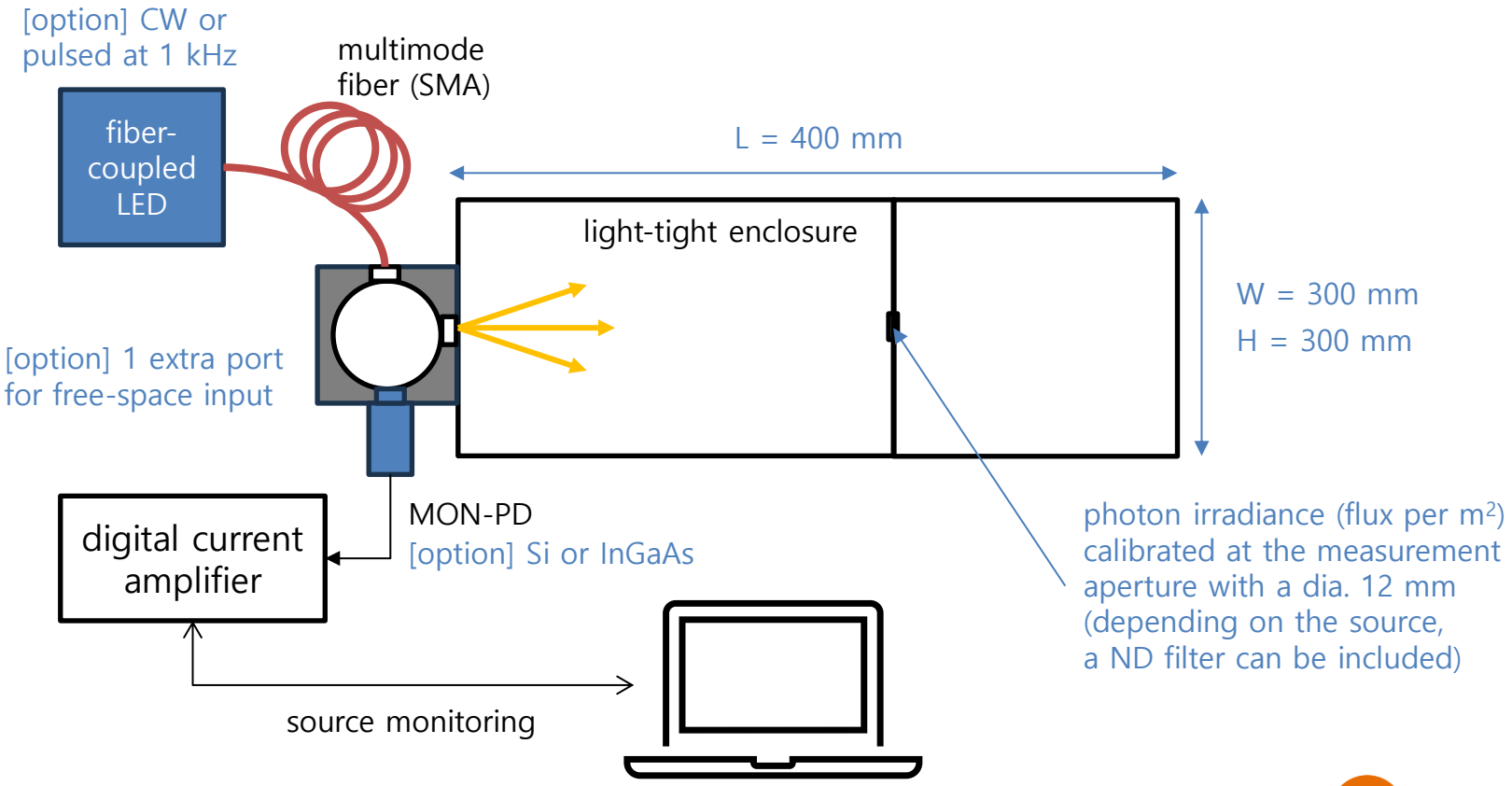
Integrating Sphere-based Photon Flux Source

- Integrating sphere with a diameter of 50 mm
- Monochromatic LED source coupled via a multimode fiber
  - Wavelength selectable from 280 nm to 1450 nm (see Thorlabs "fiber-coupled LEDs")
- Photon irradiance calibrated at the measurement aperture (for DE measurement)



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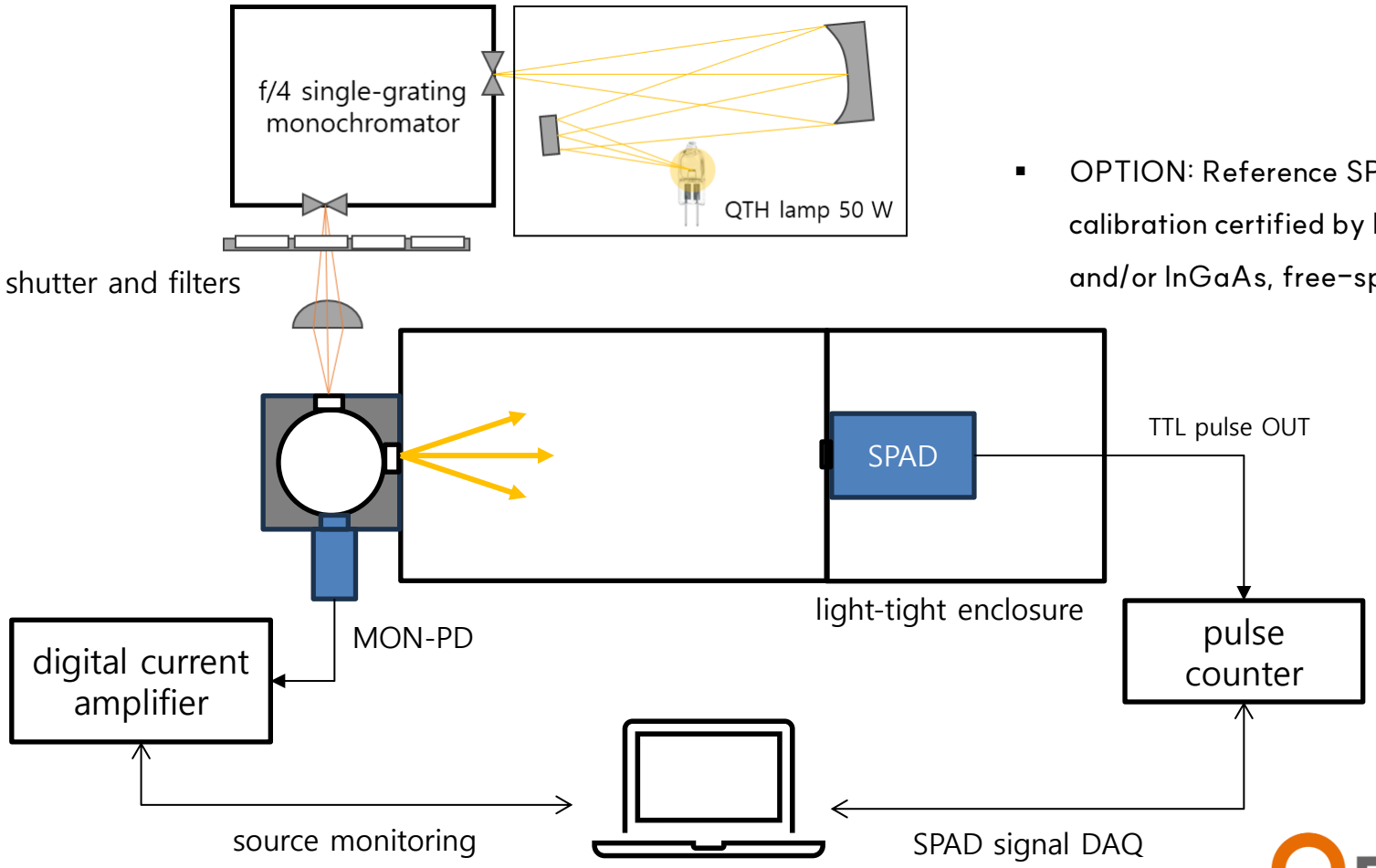
Spectrally Tunable DE Measurement in Free Space

- STS-IS combined with a spectrally tunable monochromatic light source
  - DE measured as a function of wavelength from 300 nm to 1600 nm
- Fully automated measurement of DE with traceability to KRISS



- OPTION: Reference SPAD for calibration certified by KRISS (Si and/or InGaAs, free-space)

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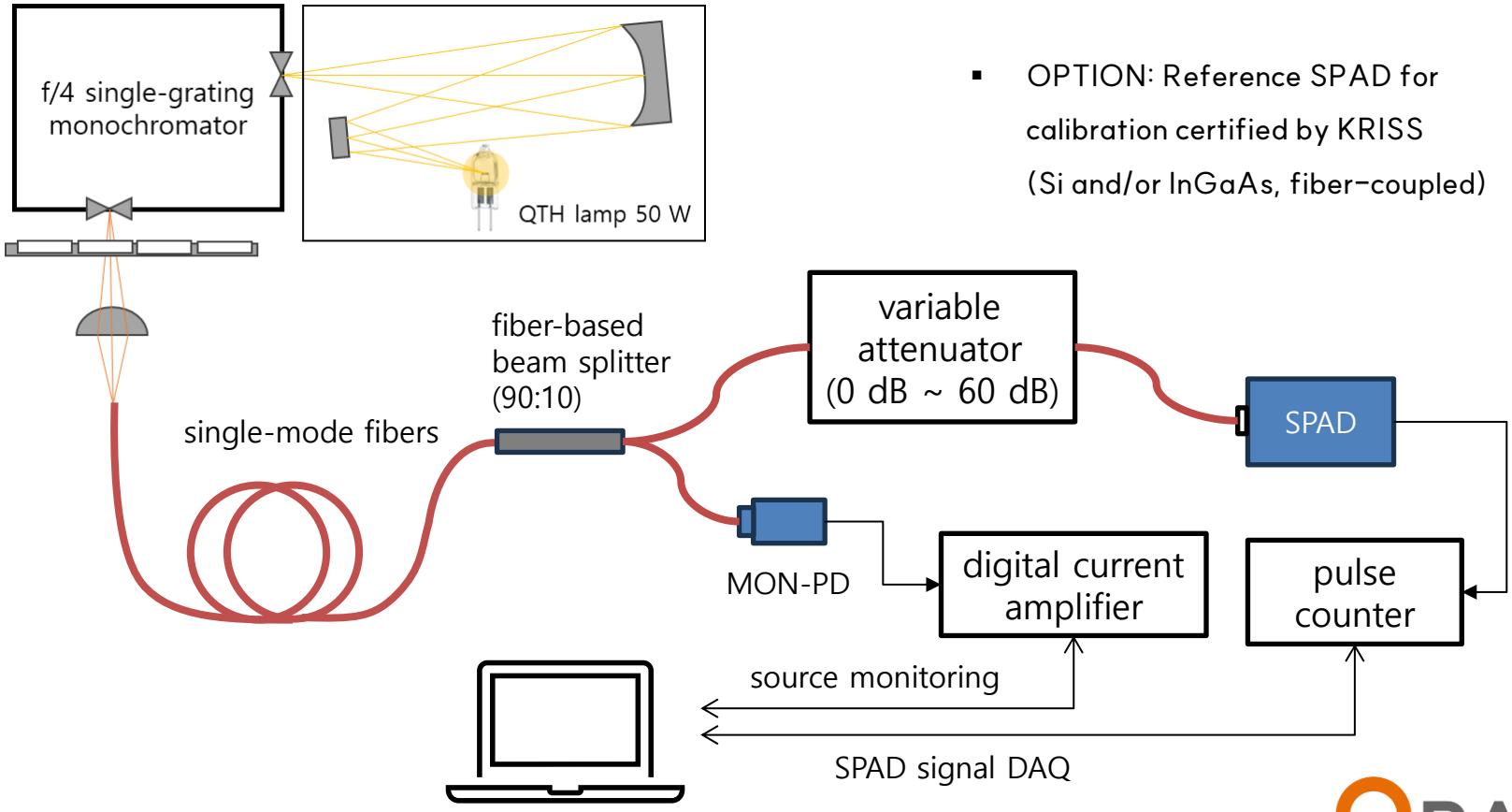
Spectrally Tunable DE Measurement in Fiber

- DE comparison with a fiber-coupled spectrally tunable monochromatic light source
  - DE measured as a function of wavelength from 800 nm to 1600 nm
  - Extension to 300 nm – 800 nm possible by changing the fiber components
- Fully automated measurement of DE with traceability to KRISS



- OPTION: Reference SPAD for calibration certified by KRISS (Si and/or InGaAs, fiber-coupled)

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Specifications for Spectrally Tunable DE Measurement

	STS-SP (free-space)	STS-SP-F (fiber)
Spectral light source	QTH lamp with a single-grating monochromator	
Wavelength range	300 nm – 1600 nm[1)]	
Spectral bandwidth	< 5 nm	
Wavelength accuracy	< 0.2 nm	
Spectral stray	< 10^{-4} above 350 nm, < 10^{-3} below 350 nm	
Radiant power stability	< ±0.02%	
Beam incidence on SPAD under test	Overfilled with a uniform flux in free space	Coupled from a single-mode fiber (FC/PC connector)
Calibrated quantity	Irradiance (W/m^2) or photon irradiance (counts/s/m^2)	Radiant flux (W) or photon flux (counts/s)
Spatial uniformity of flux at DUT	< 0.1% in a diameter of 12 mm	N.A.
DE measurement uncertainty[2)]	< 2% (k = 2)	

1) For STS-SP-F, different fiber components are required for the range 300 nm – 800 nm and the range 800 nm – 1600 nm.

2) For the optimal accuracy, the corrections related with dark counts and after-pulsing probability of the SPAD under test should be properly applied.

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