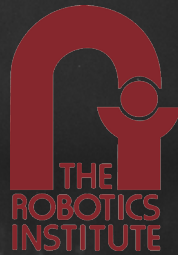


Swept-Angle Synthetic Wavelength Interferometry

Alankar Kotwal¹, Anat Levin², and Ioannis Gkioulekas¹

¹ Carnegie Mellon University

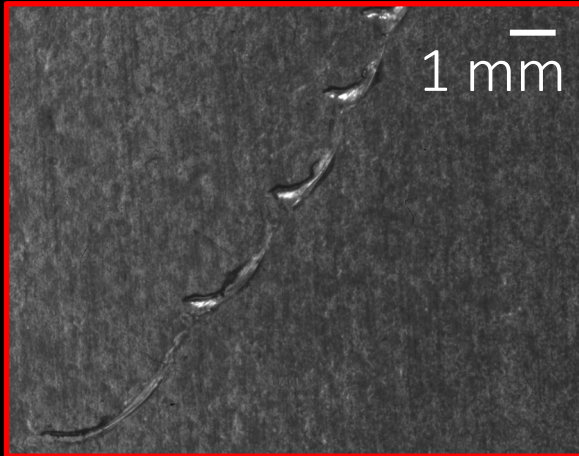
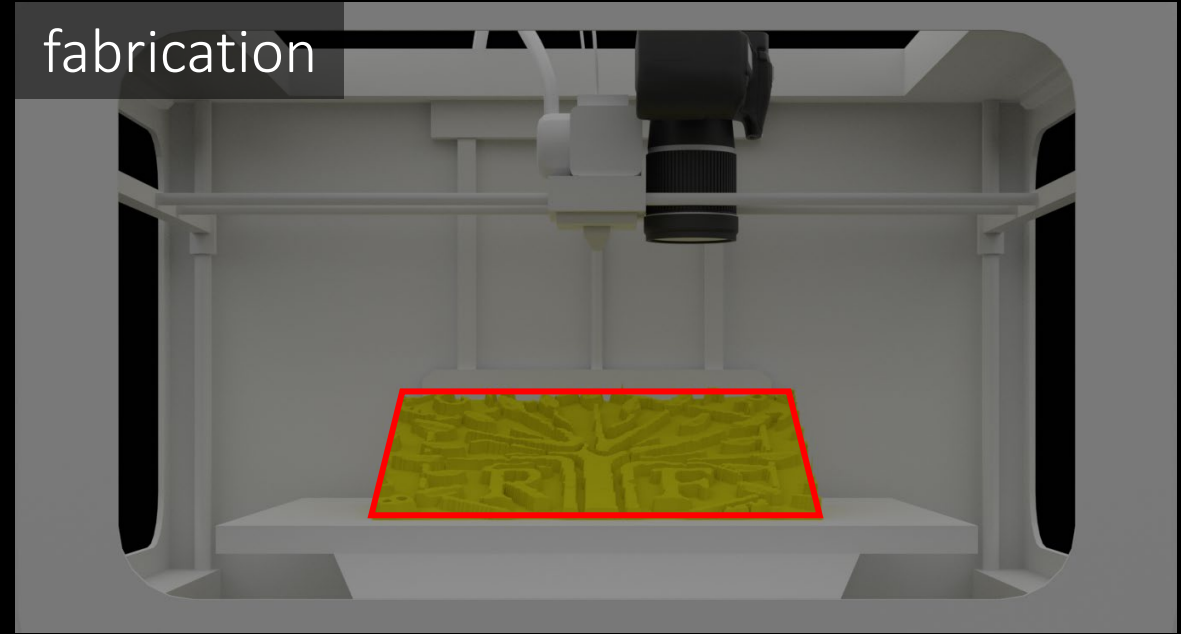


² Technion

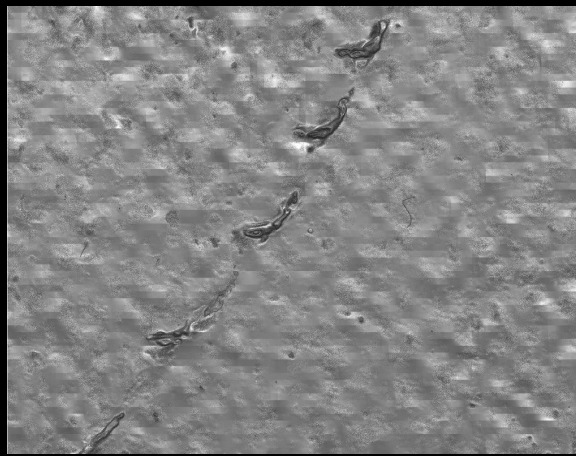


https://imaging.cs.cmu.edu/swept_angle_swi

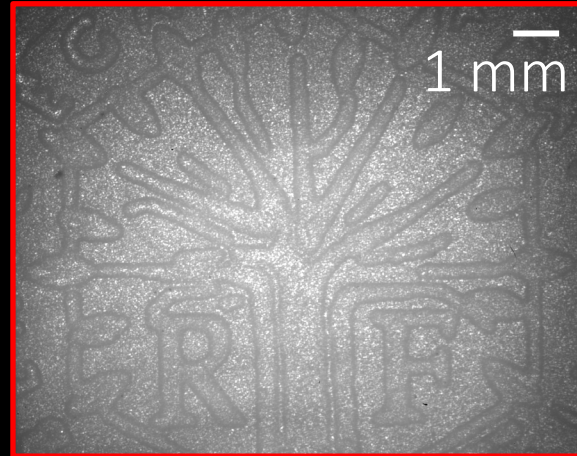
Micron-scale depth sensing: applications



defects on wing



SWI depth

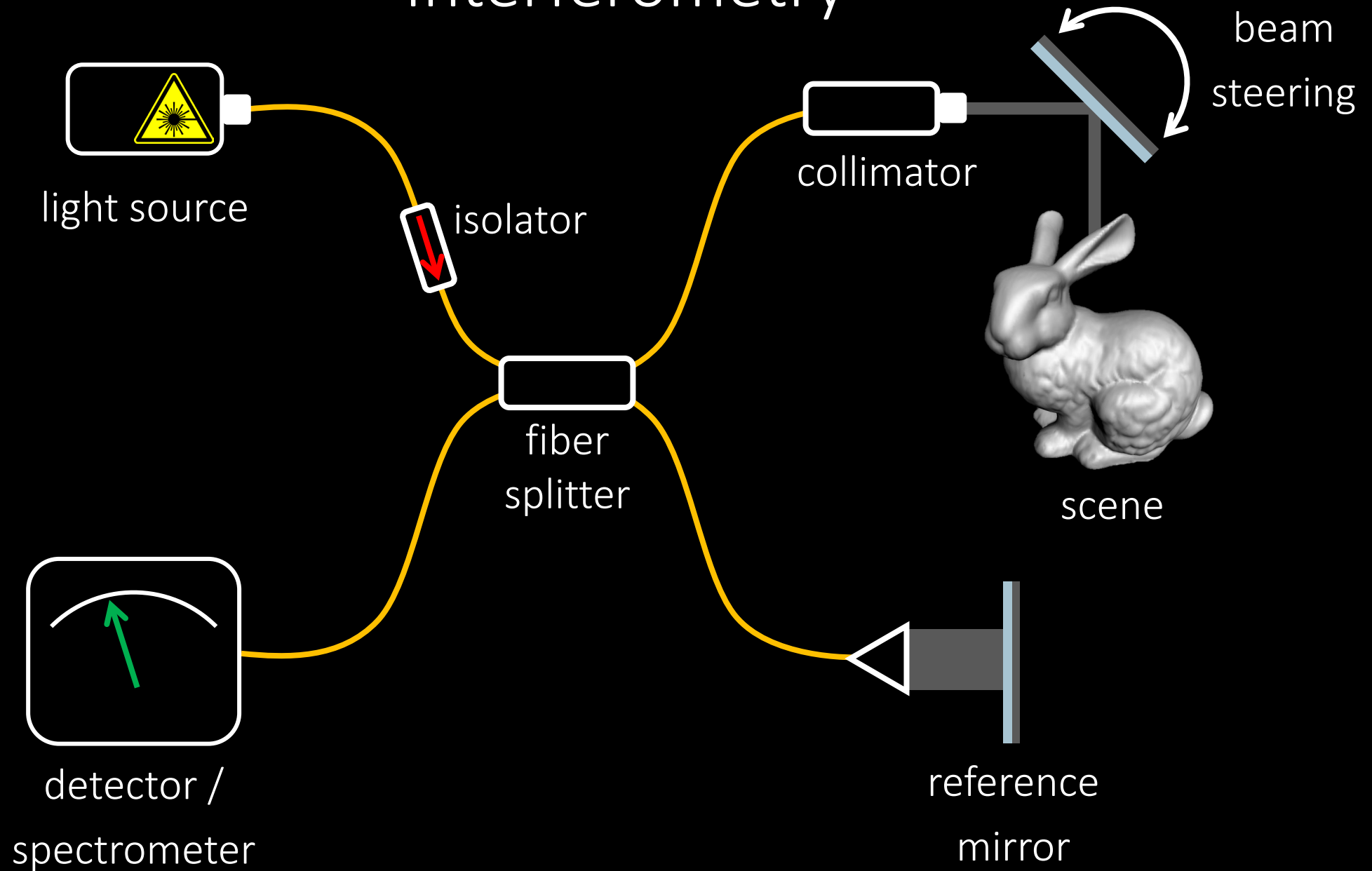


3D-printed coin

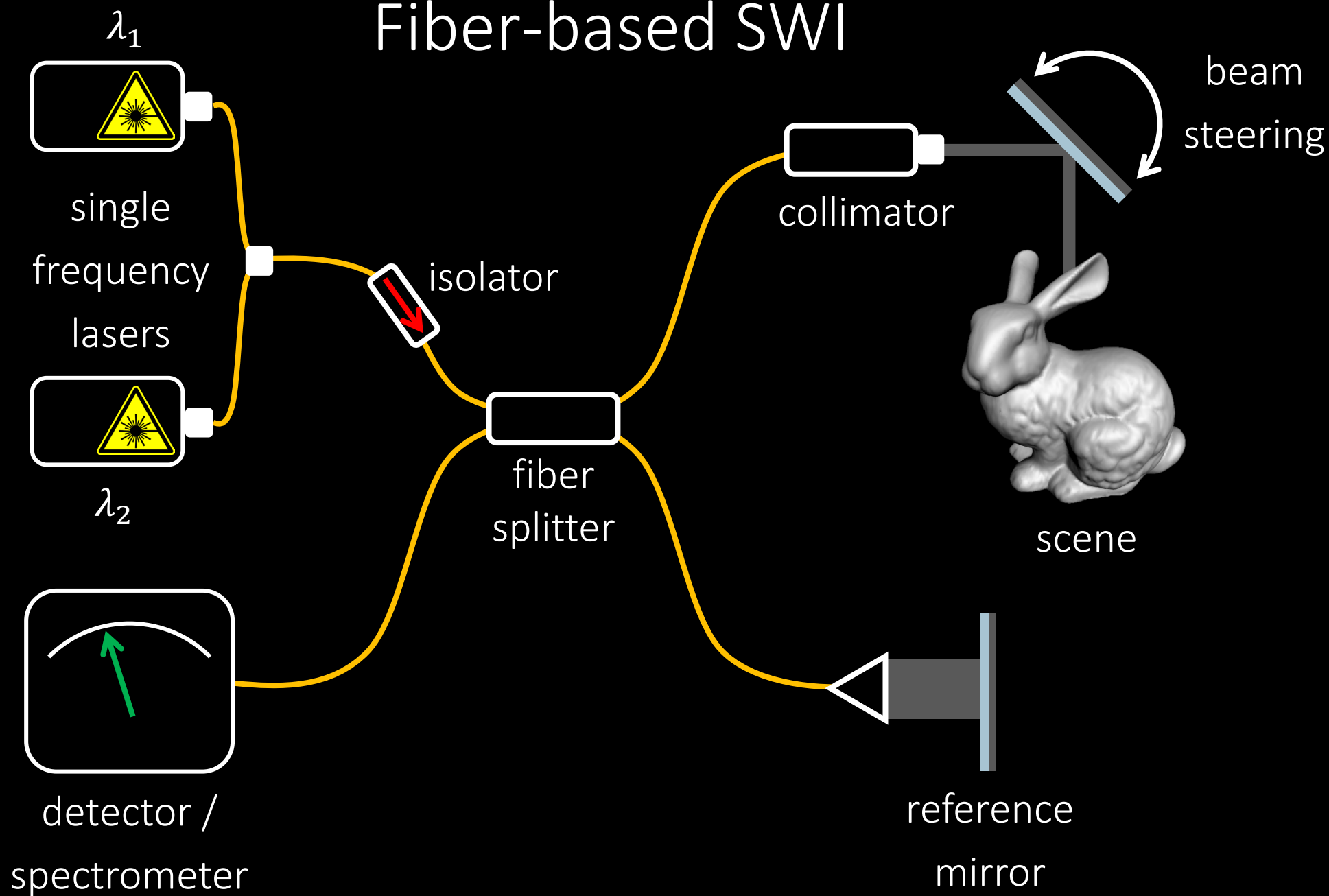


SWI depth

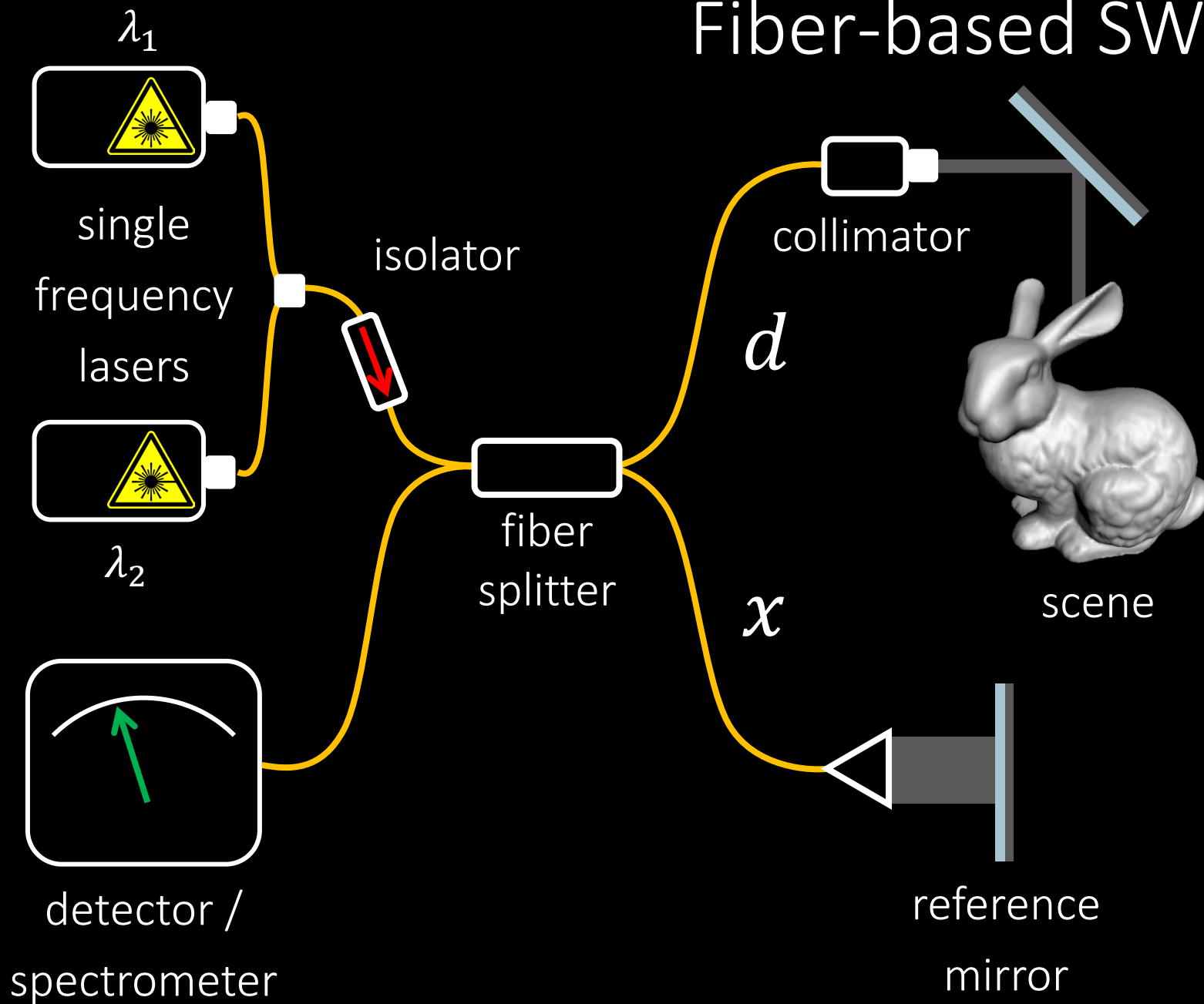
Interferometry



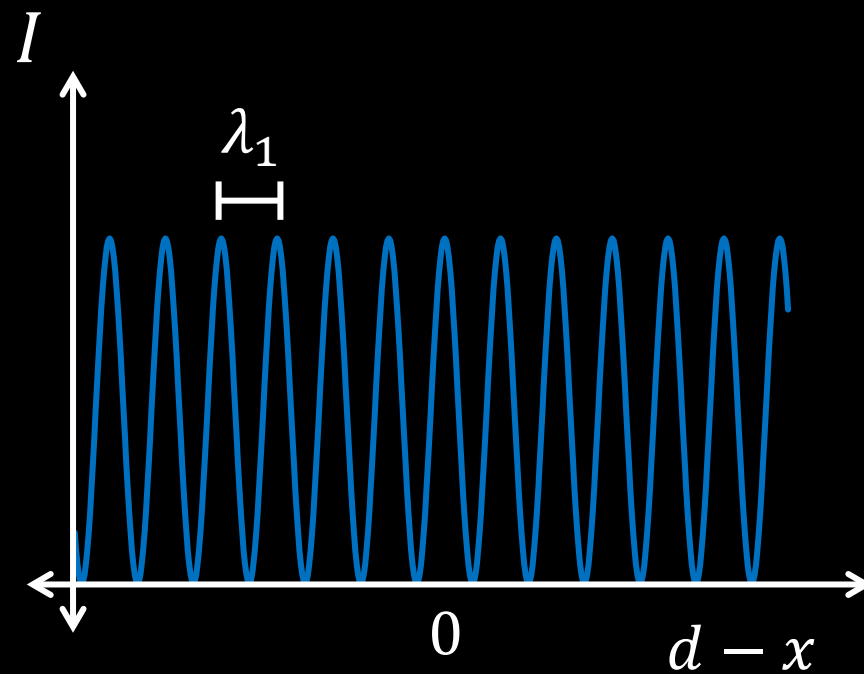
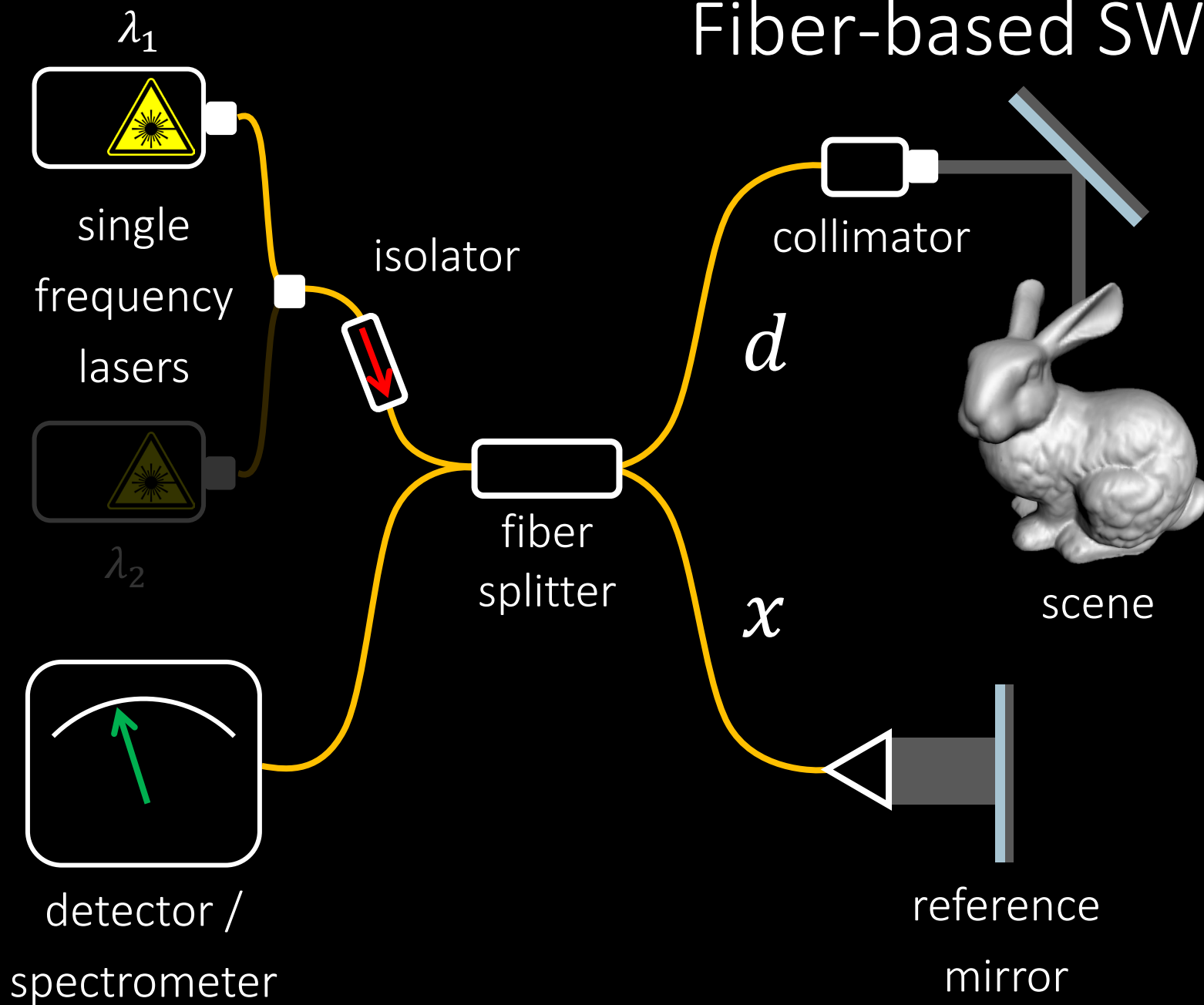
Fiber-based SWI



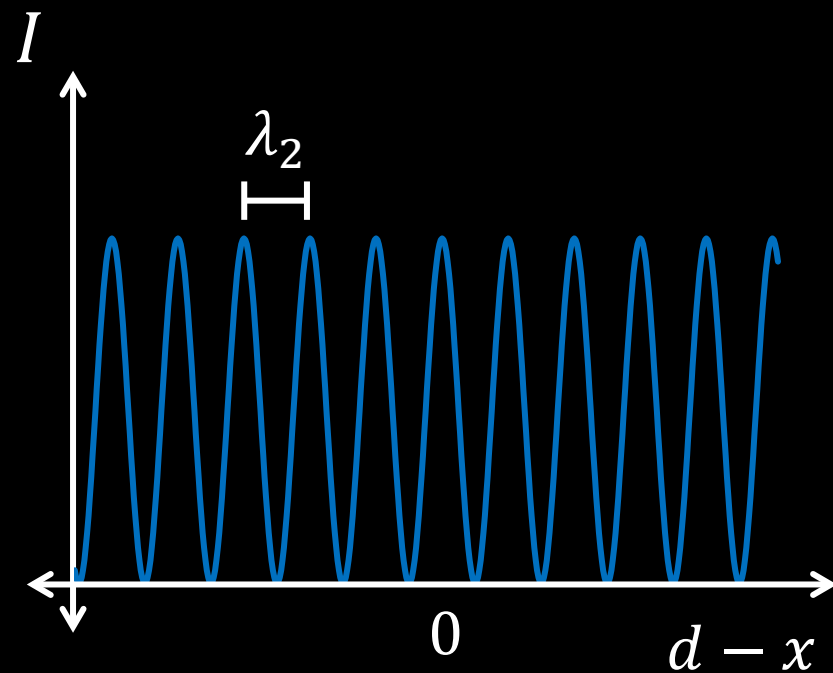
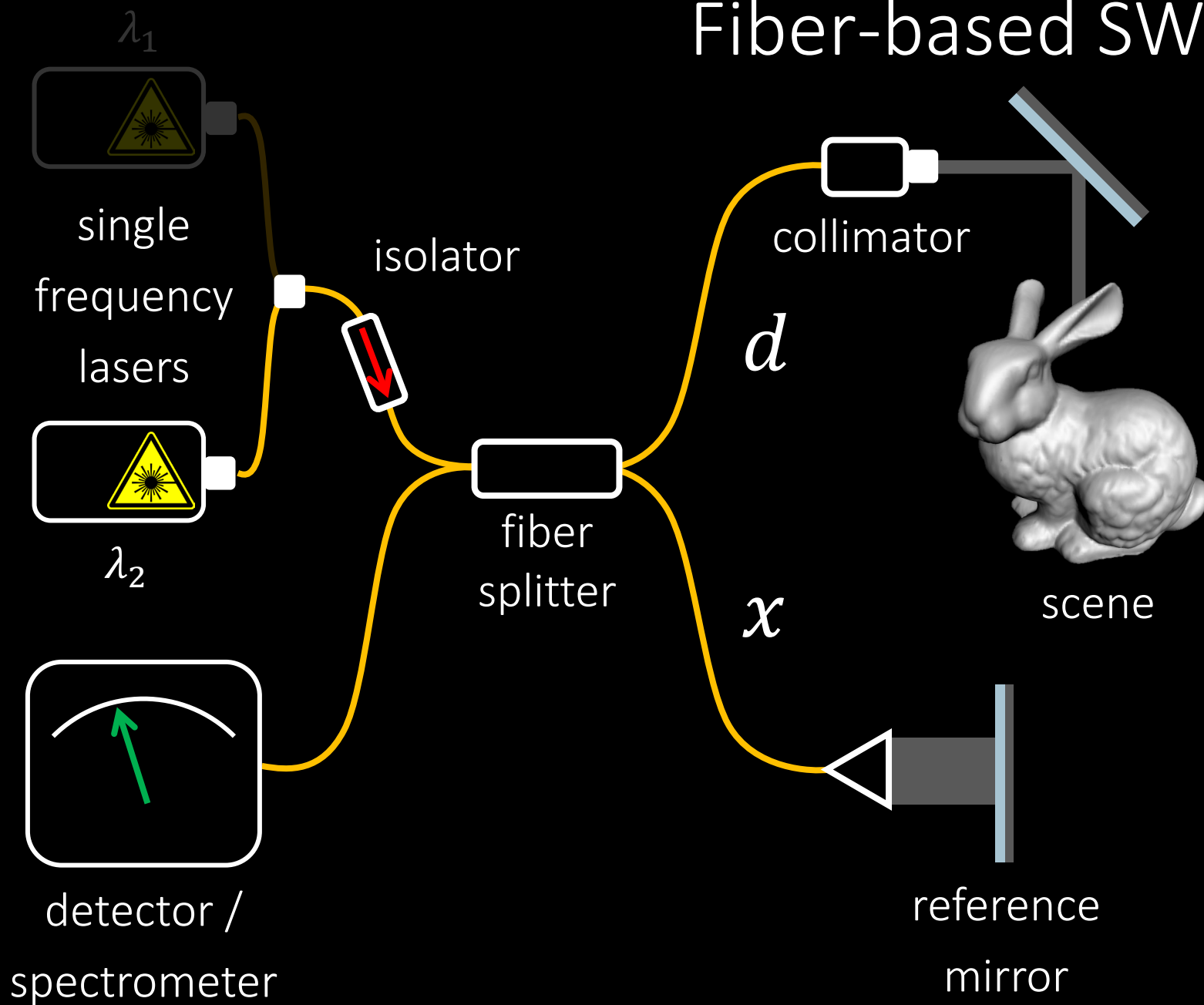
Fiber-based SWI



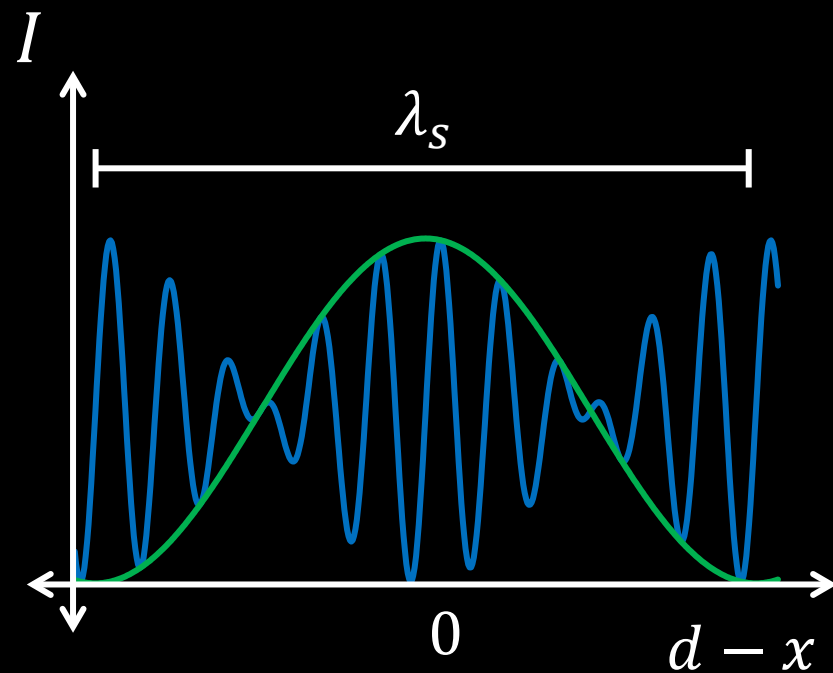
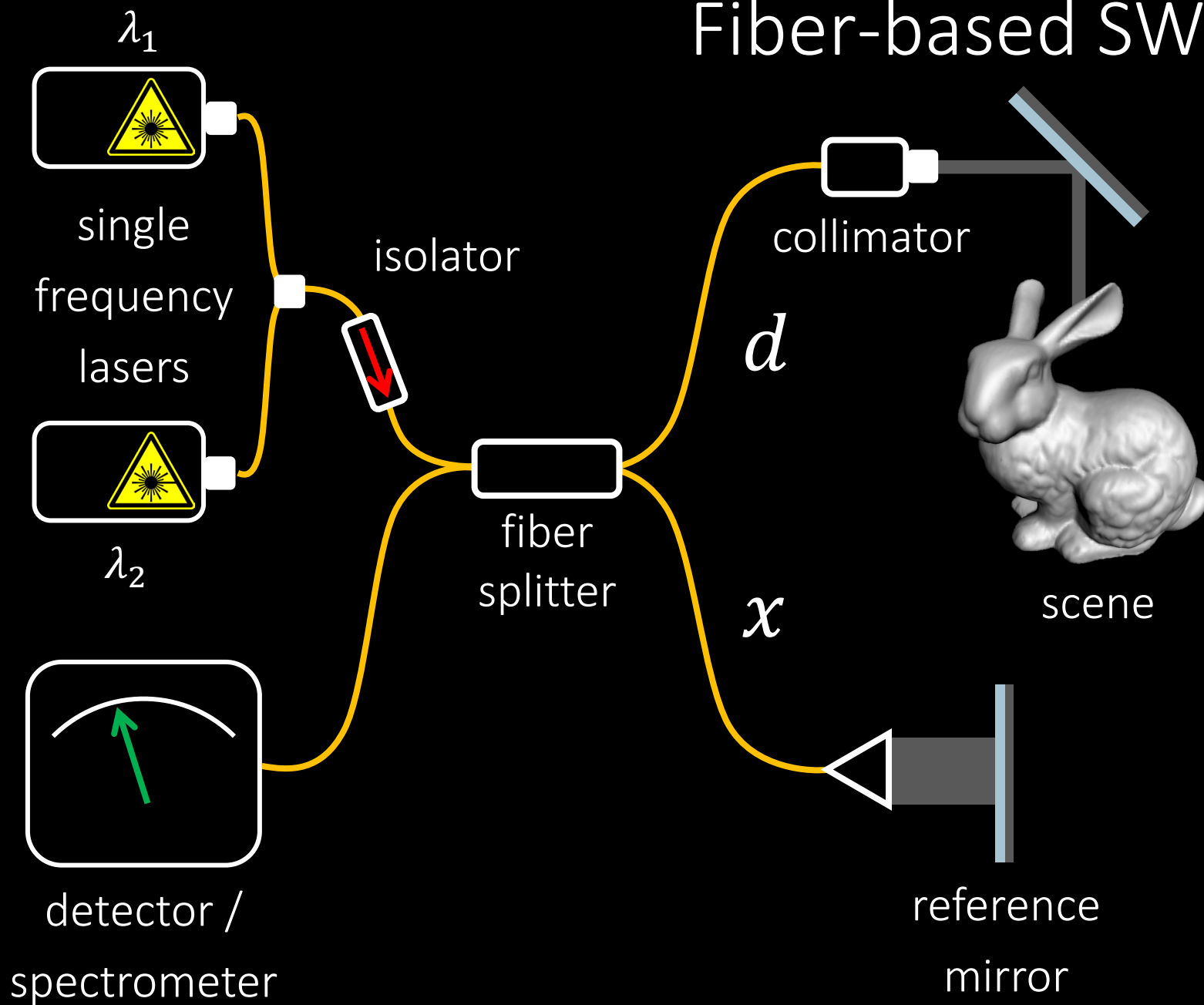
Fiber-based SWI



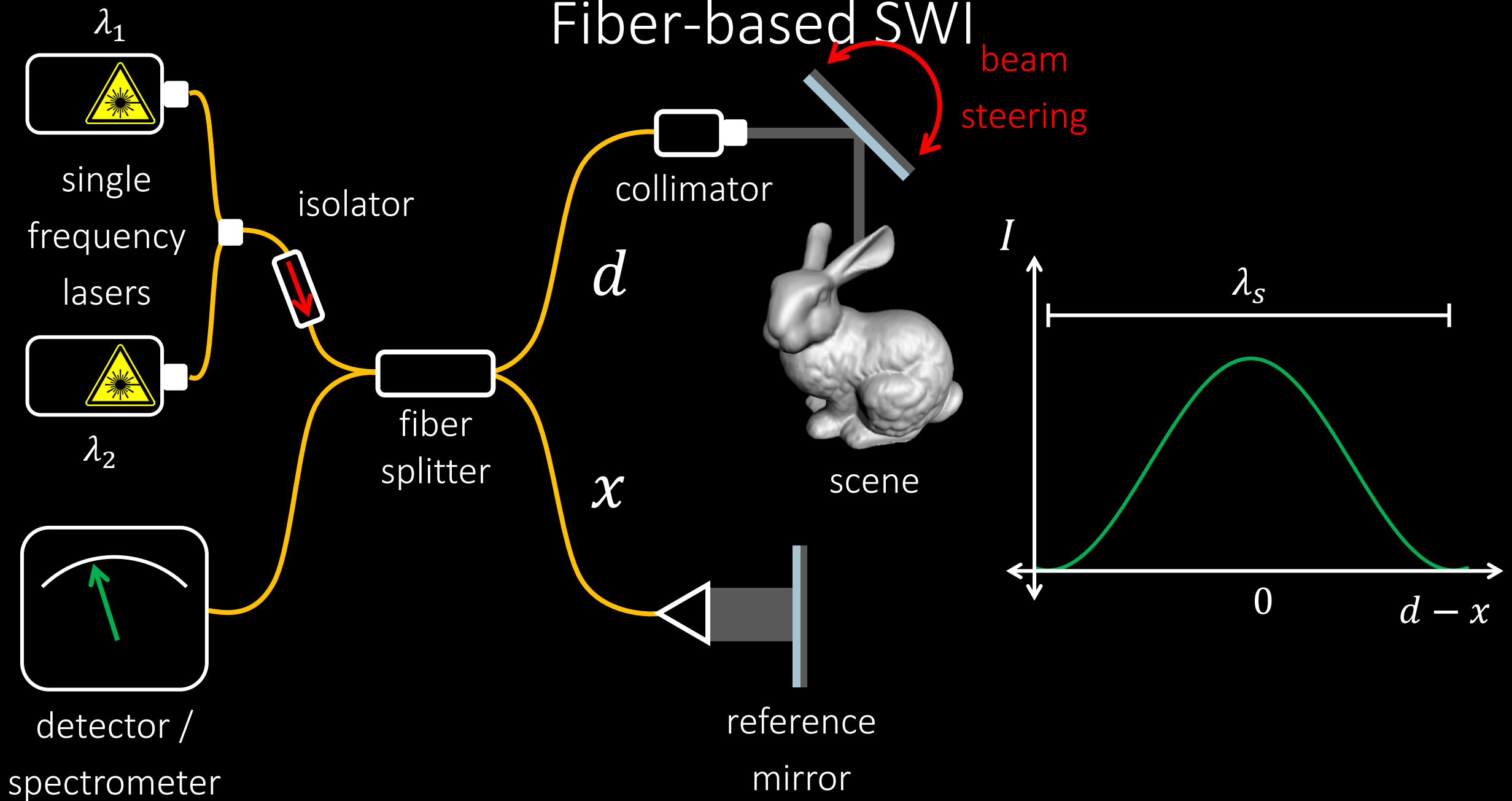
Fiber-based SWI



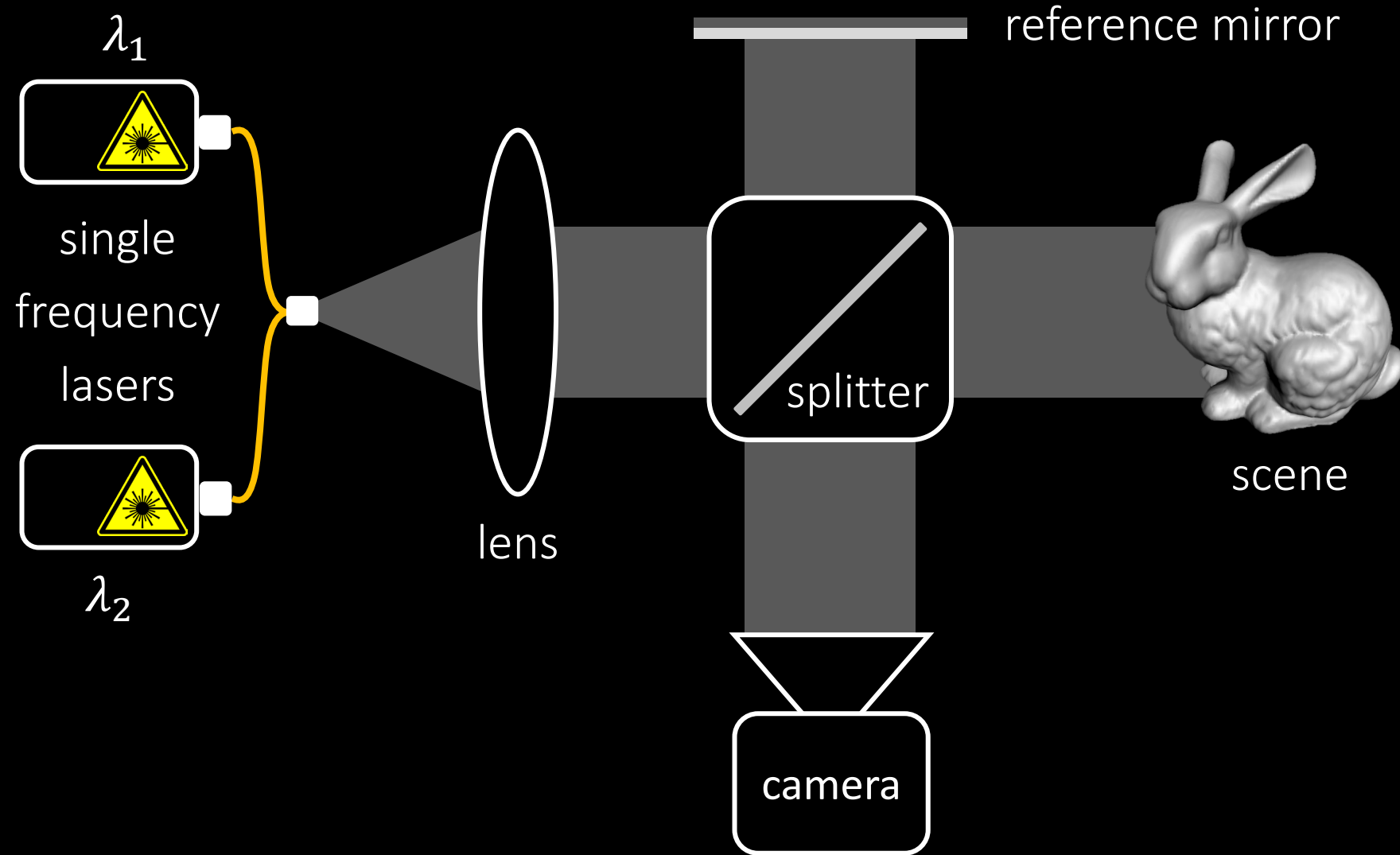
Fiber-based SWI



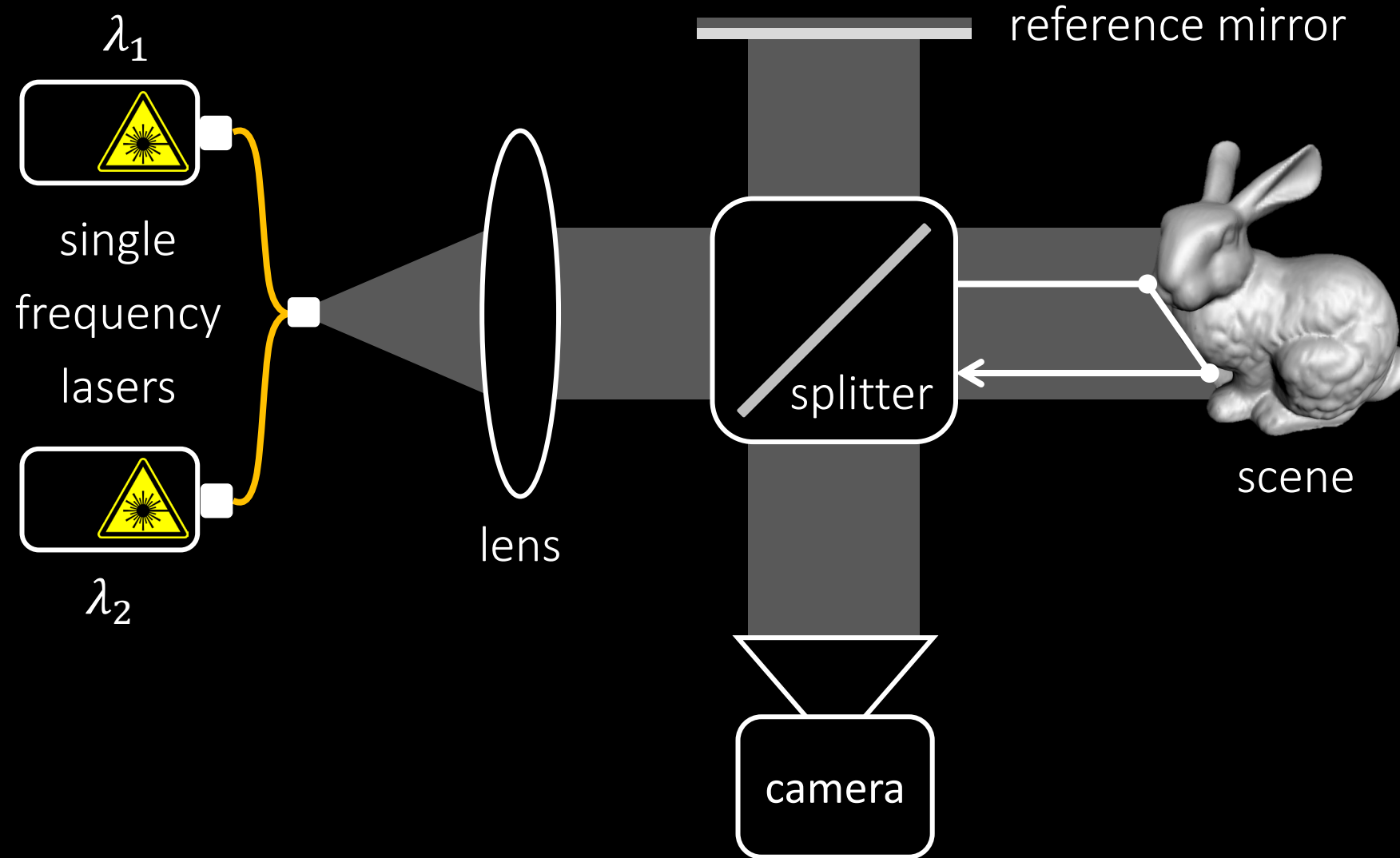
Fiber-based SWI



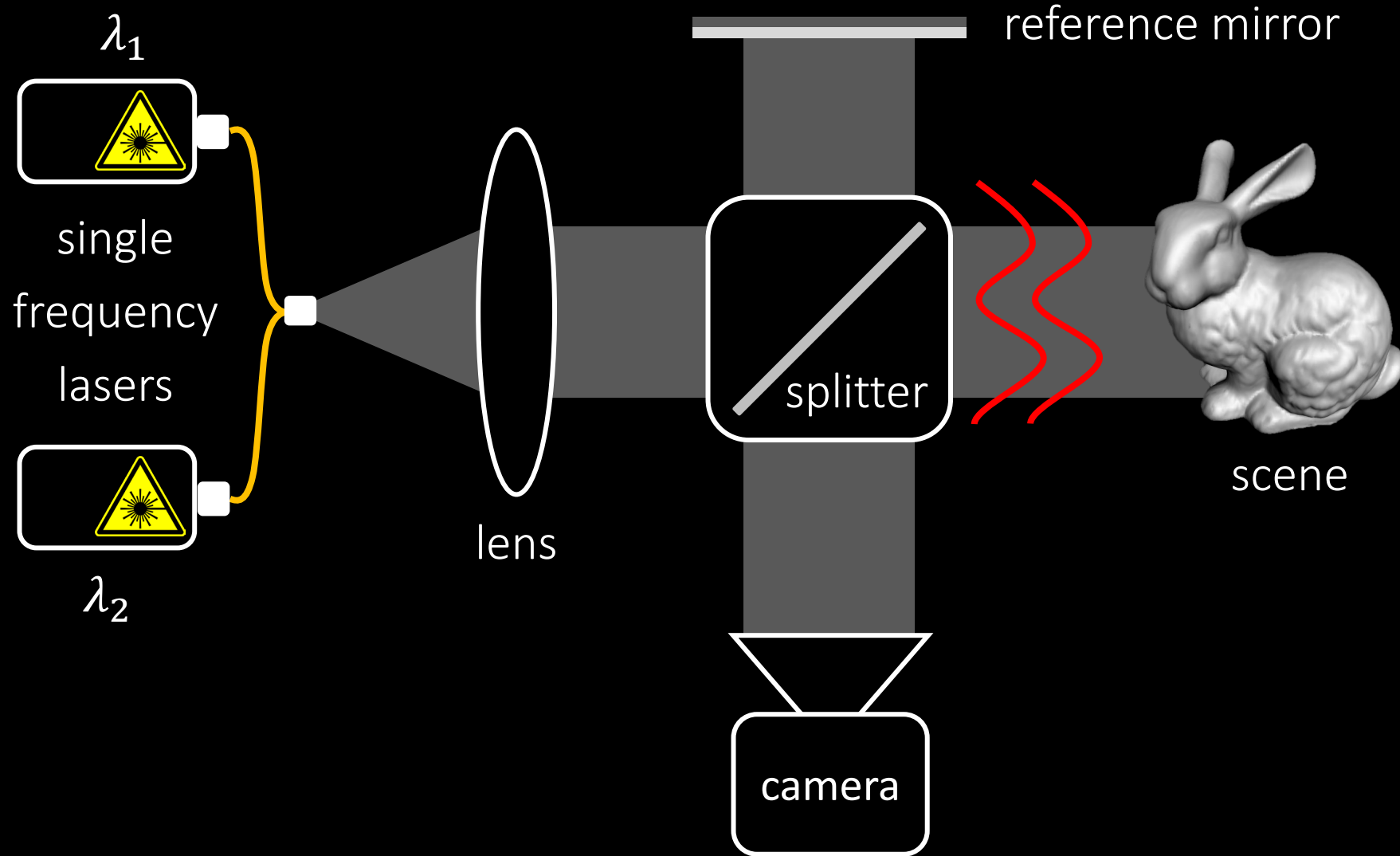
Full-field SWI



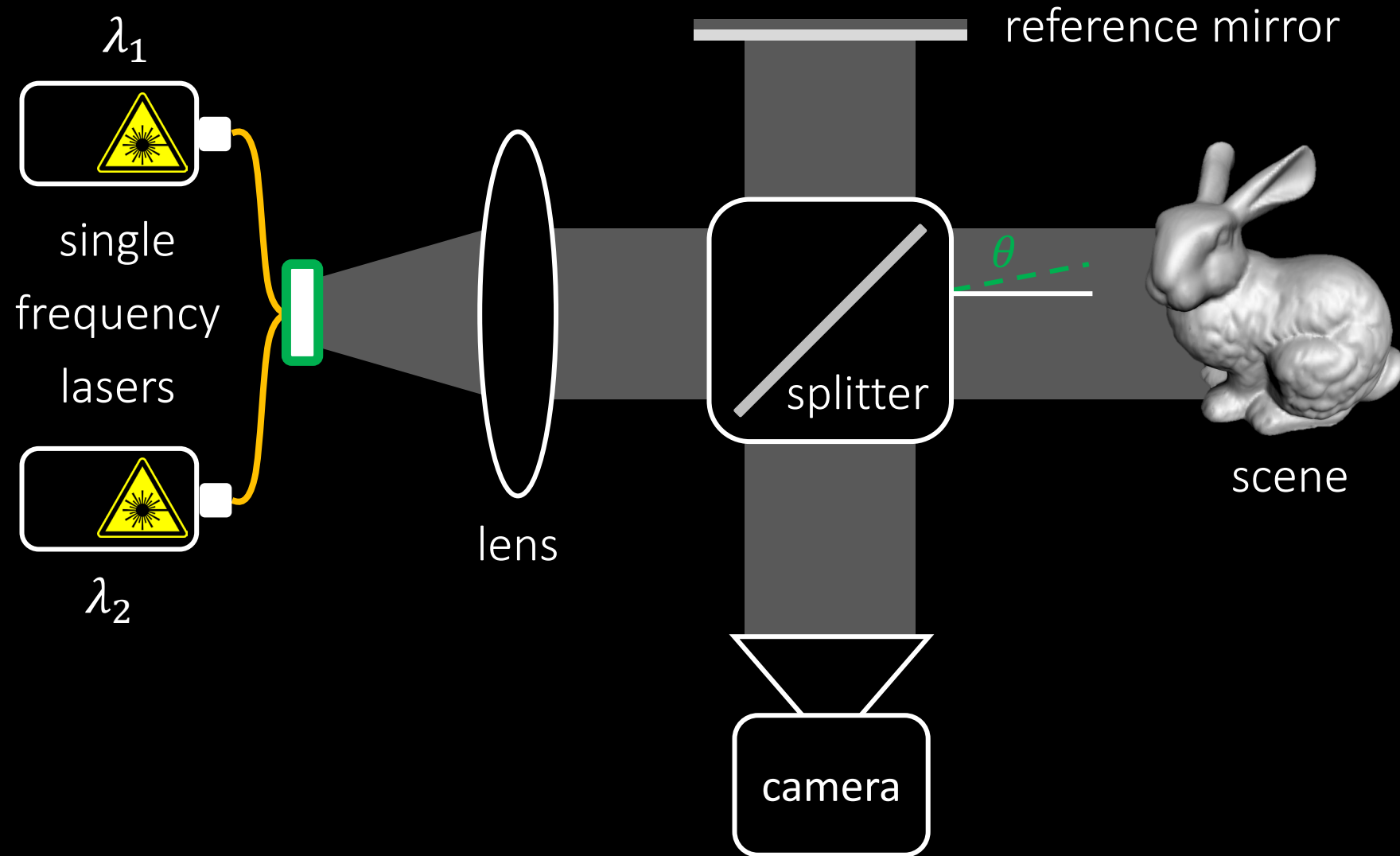
Full-field SWI errors: indirect light



Full-field SWI errors: aberrations



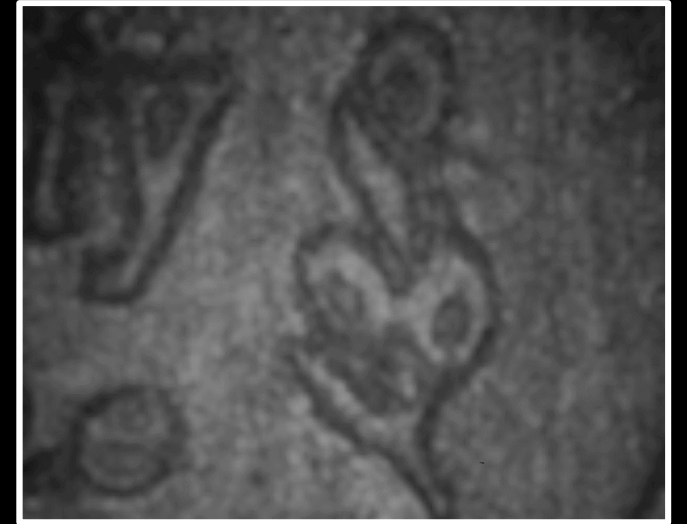
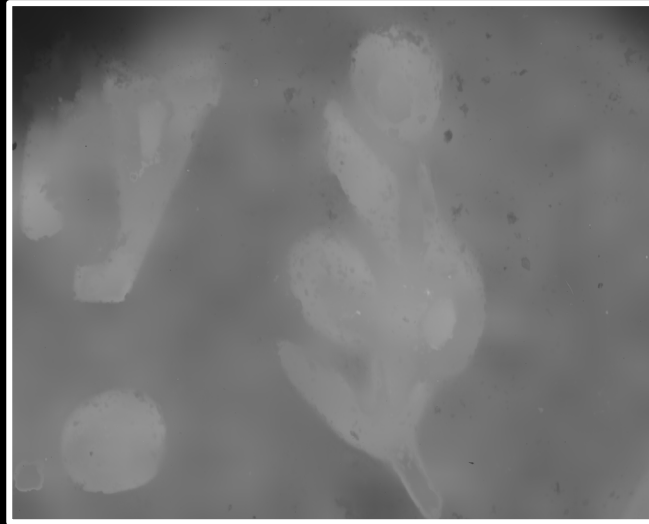
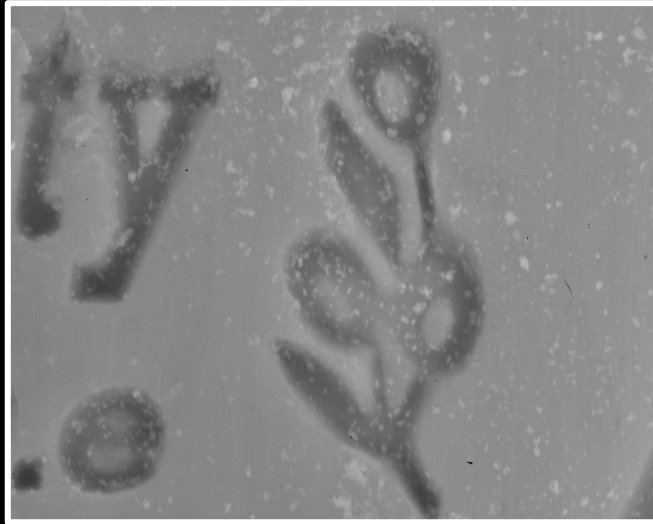
Swept-angle SWI



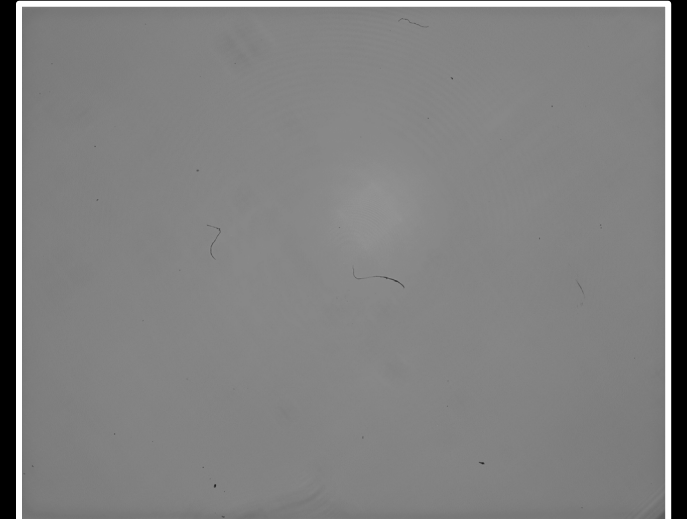
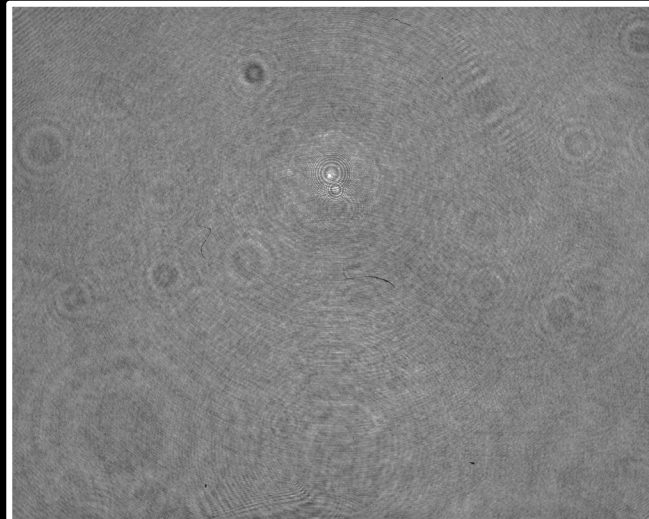
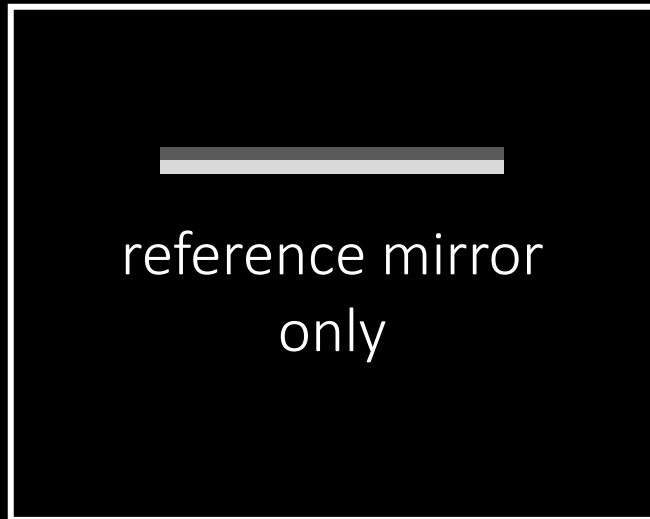
Constructing swept-angle source

Error mitigation with swept-angle scanning

indirect
light



free-space
optics
aberrations

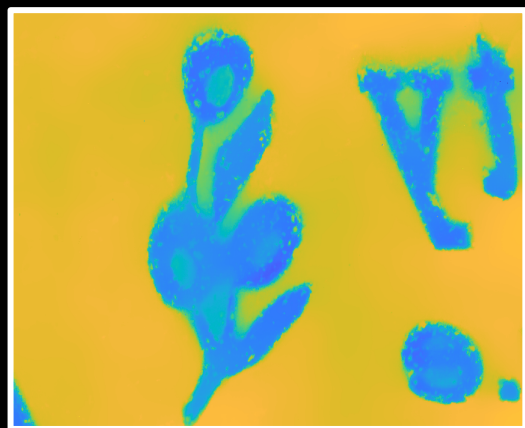


target

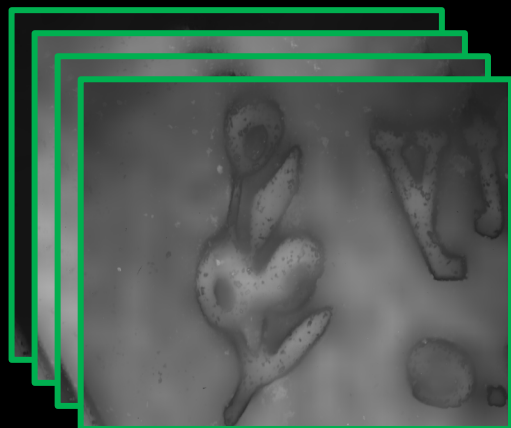
without swept-angle

with swept-angle

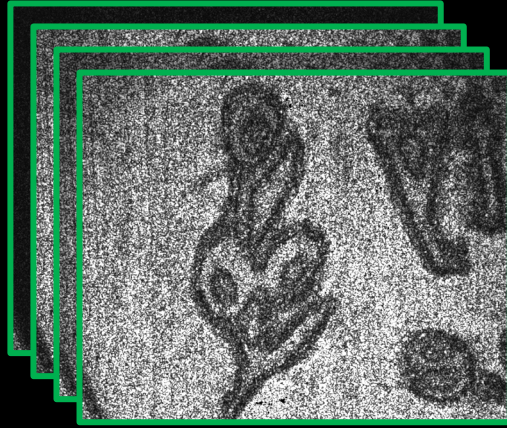
Signal processing pipeline



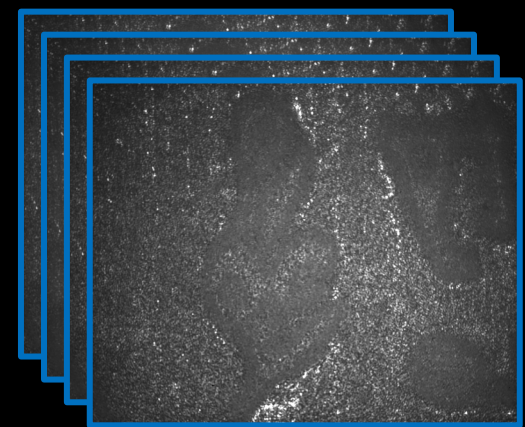
depth



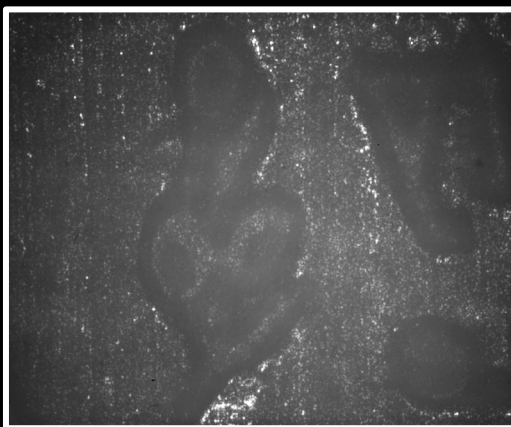
denoised envelope



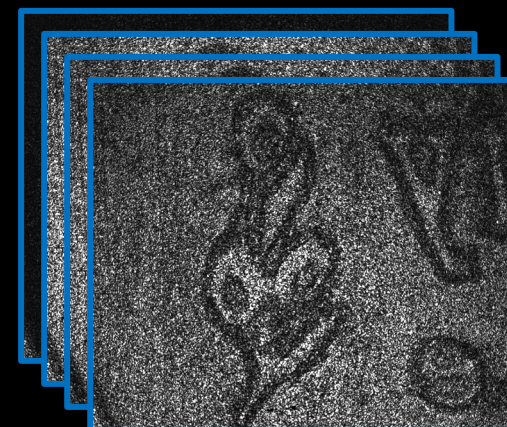
envelope



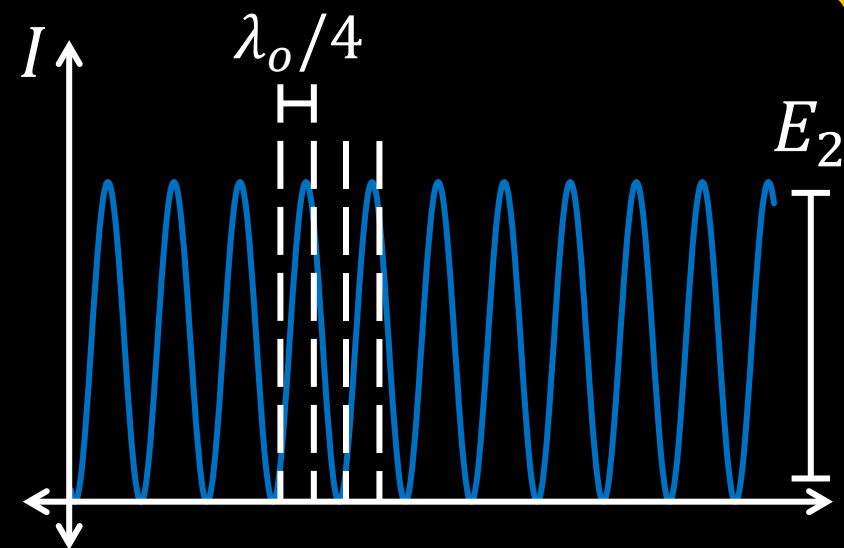
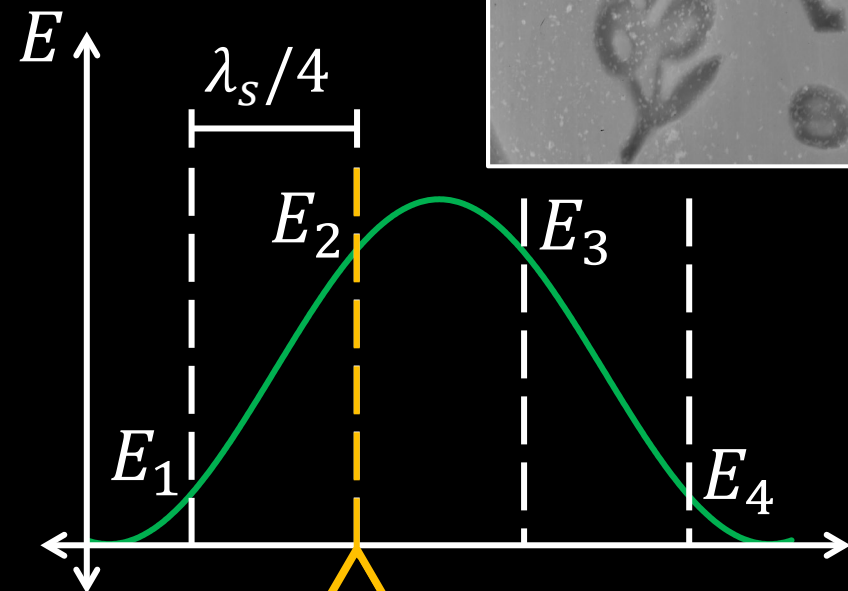
raw frames



interference-free



interference-only



Comparison with other interferometric methods

	axial resolution	lateral resolution	acquisition time	indirect light robustness
scanning FD-OCT	high	low	slow	yes
full-field TD-OCT	high	high	slow	no
scanning SWI	high	low	slow	yes
full-field SWI	high	high	fast	no
swept-angle SWI	high	high	fast	yes

Setup

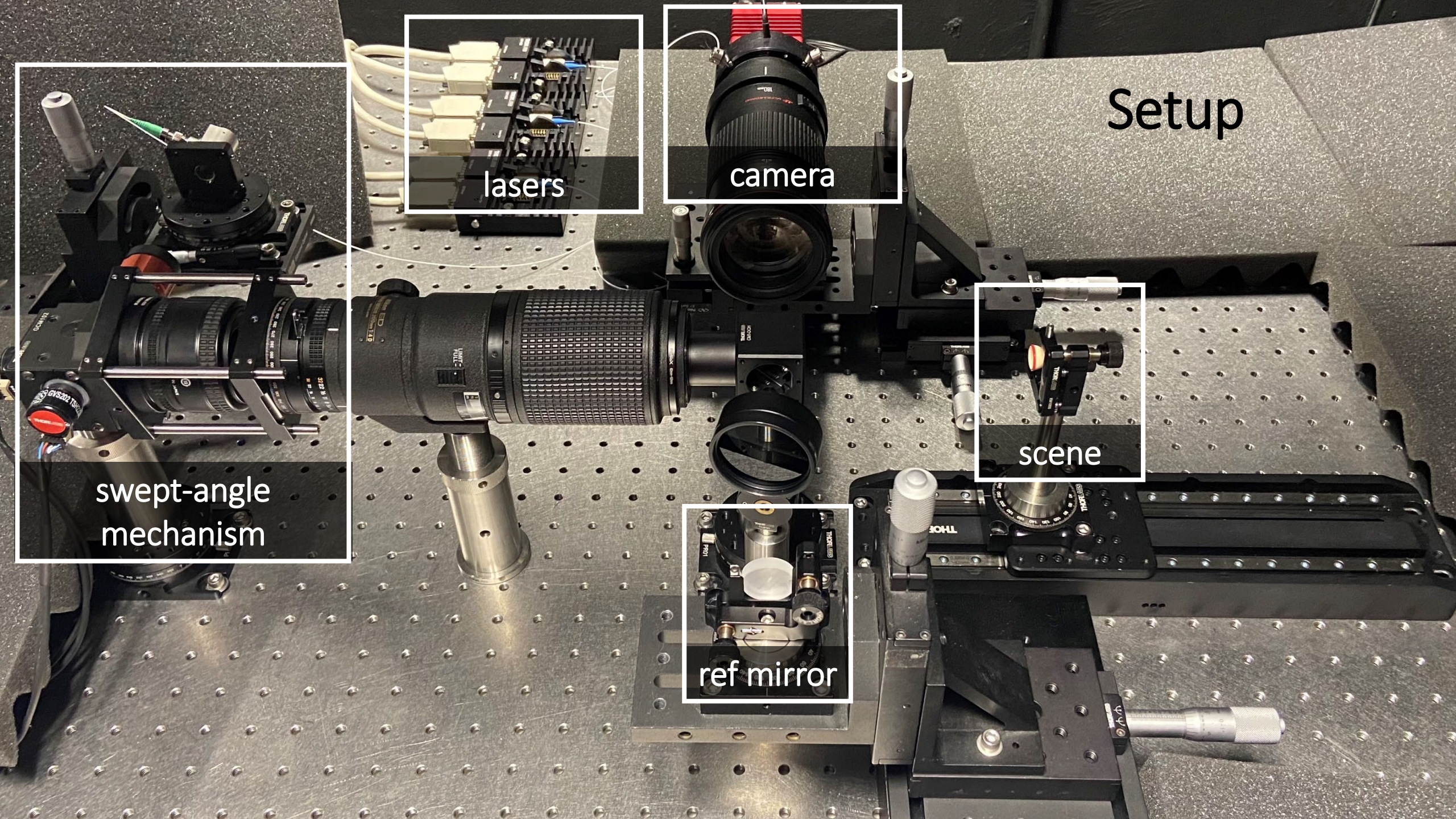
lasers

camera

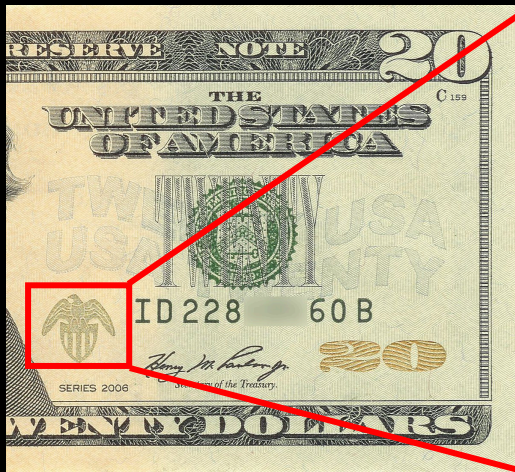
swept-angle
mechanism

scene

ref mirror



Results: \$20 bill eagle



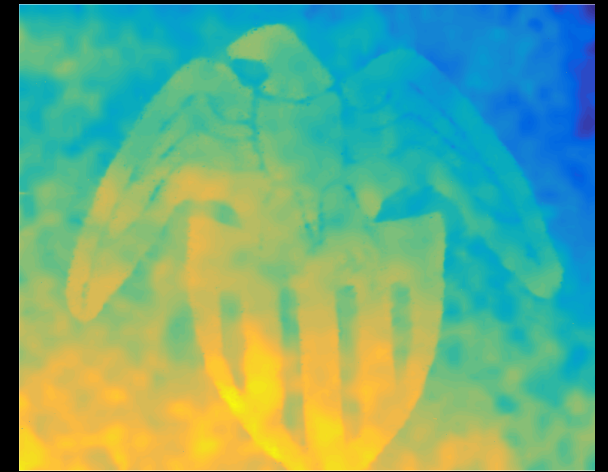
dollar bill



scene

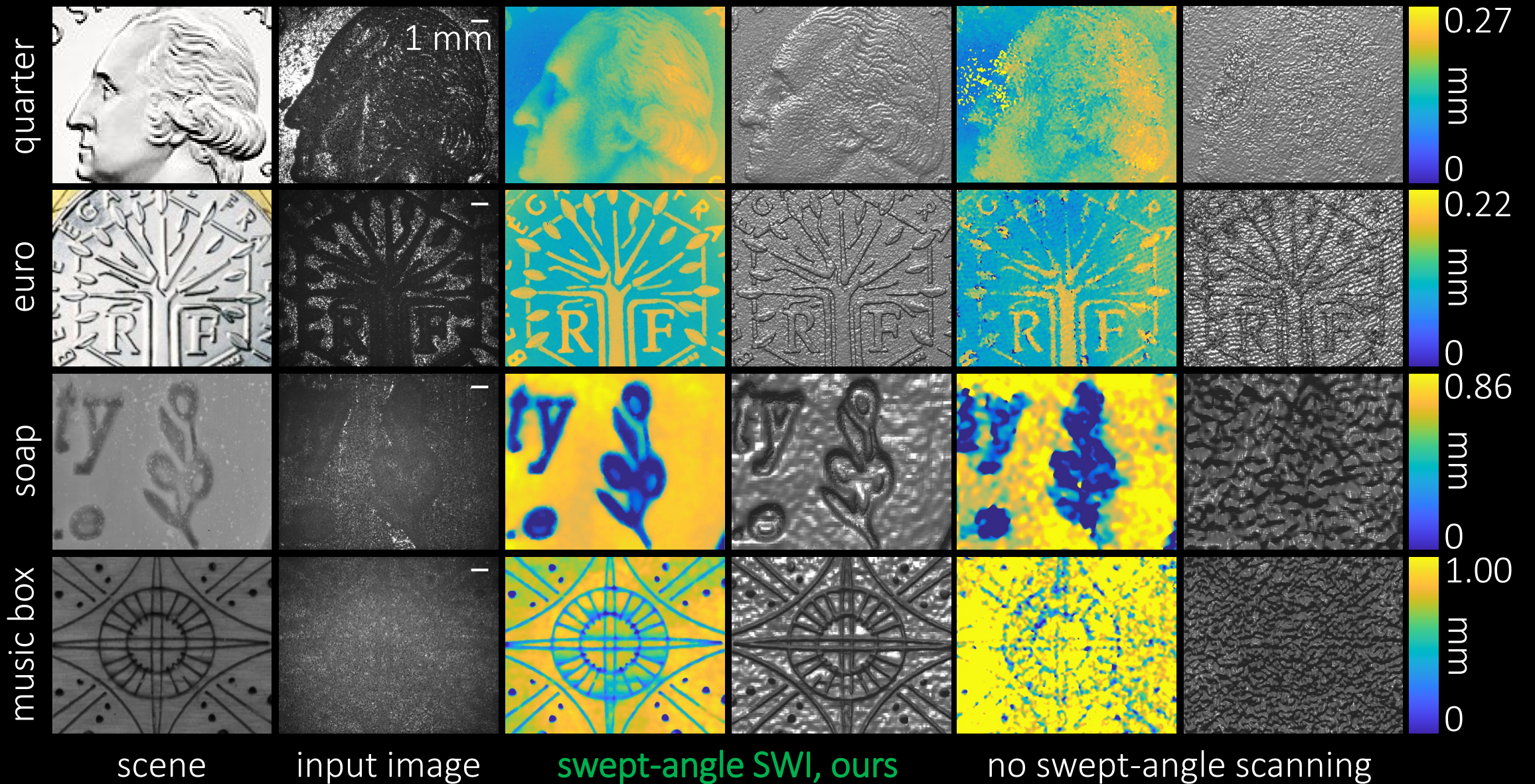


recovered depth surface

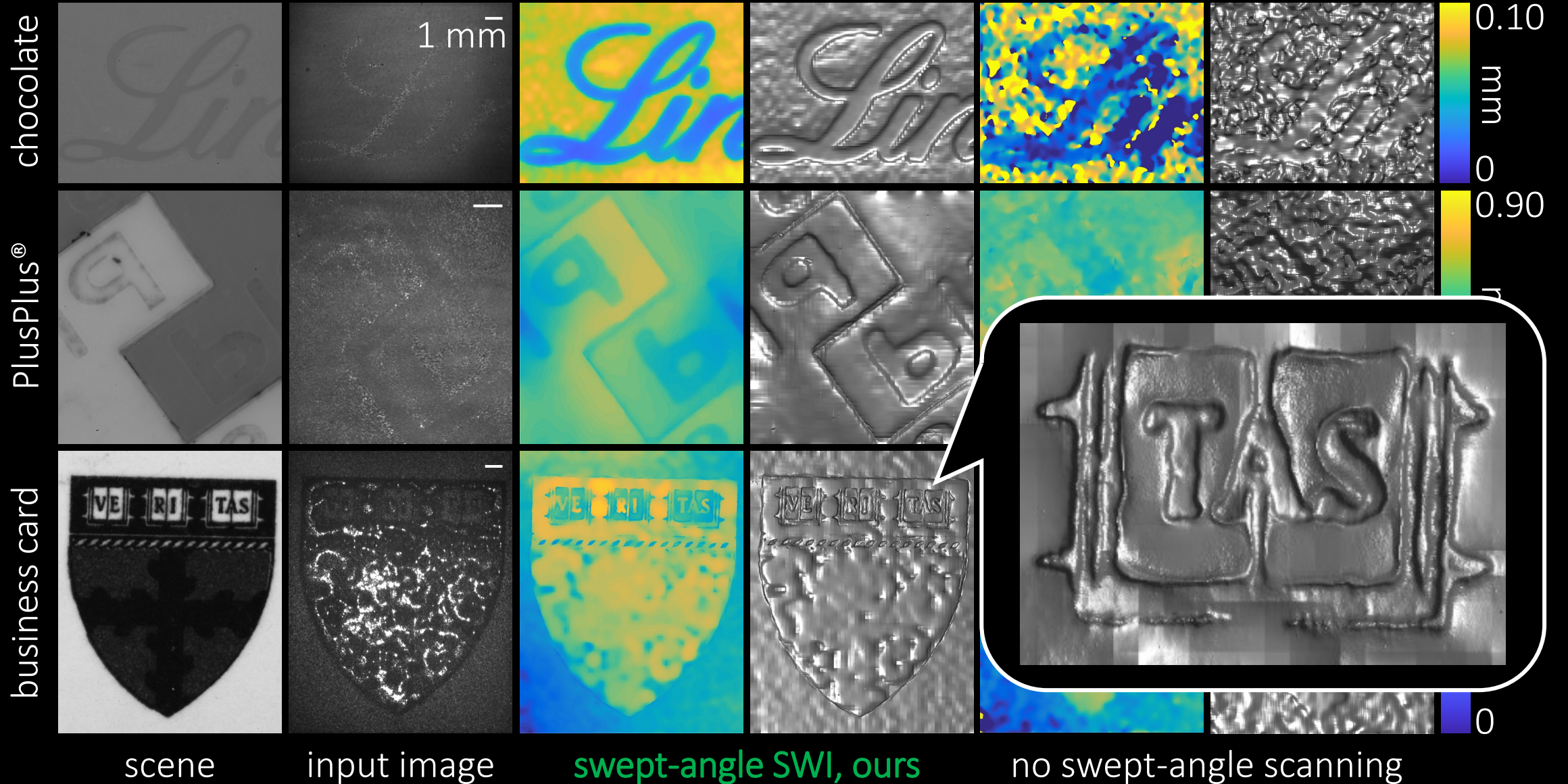


recovered depth map

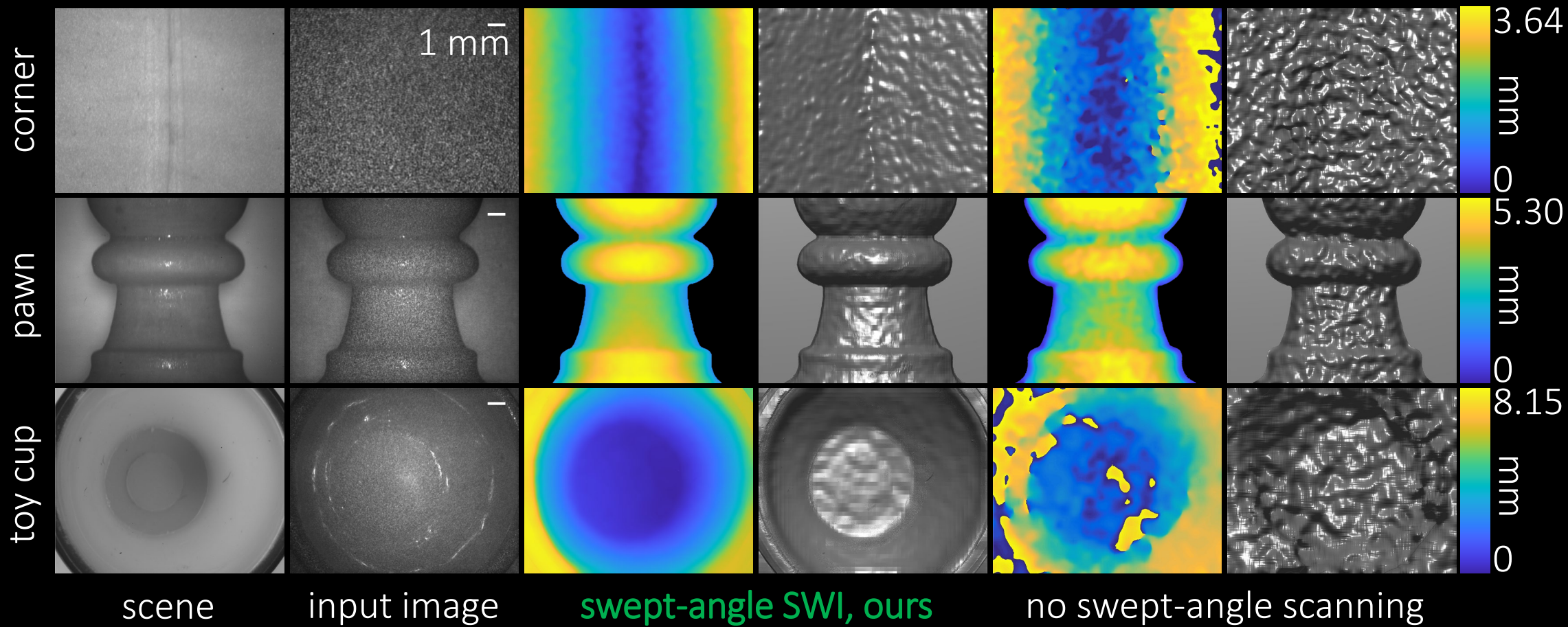
Results: 1 mm depth range



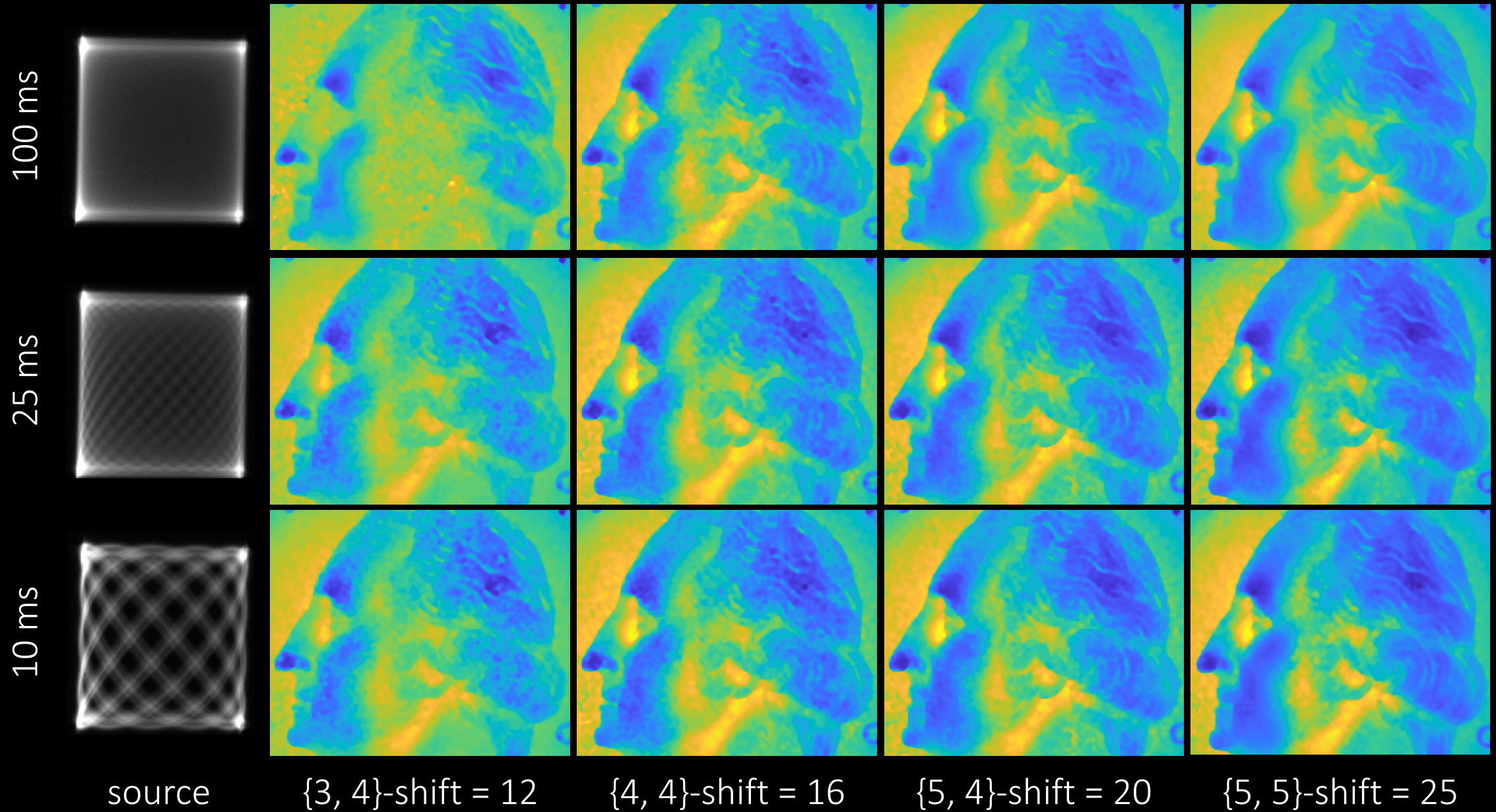
Results: microscopic scenes



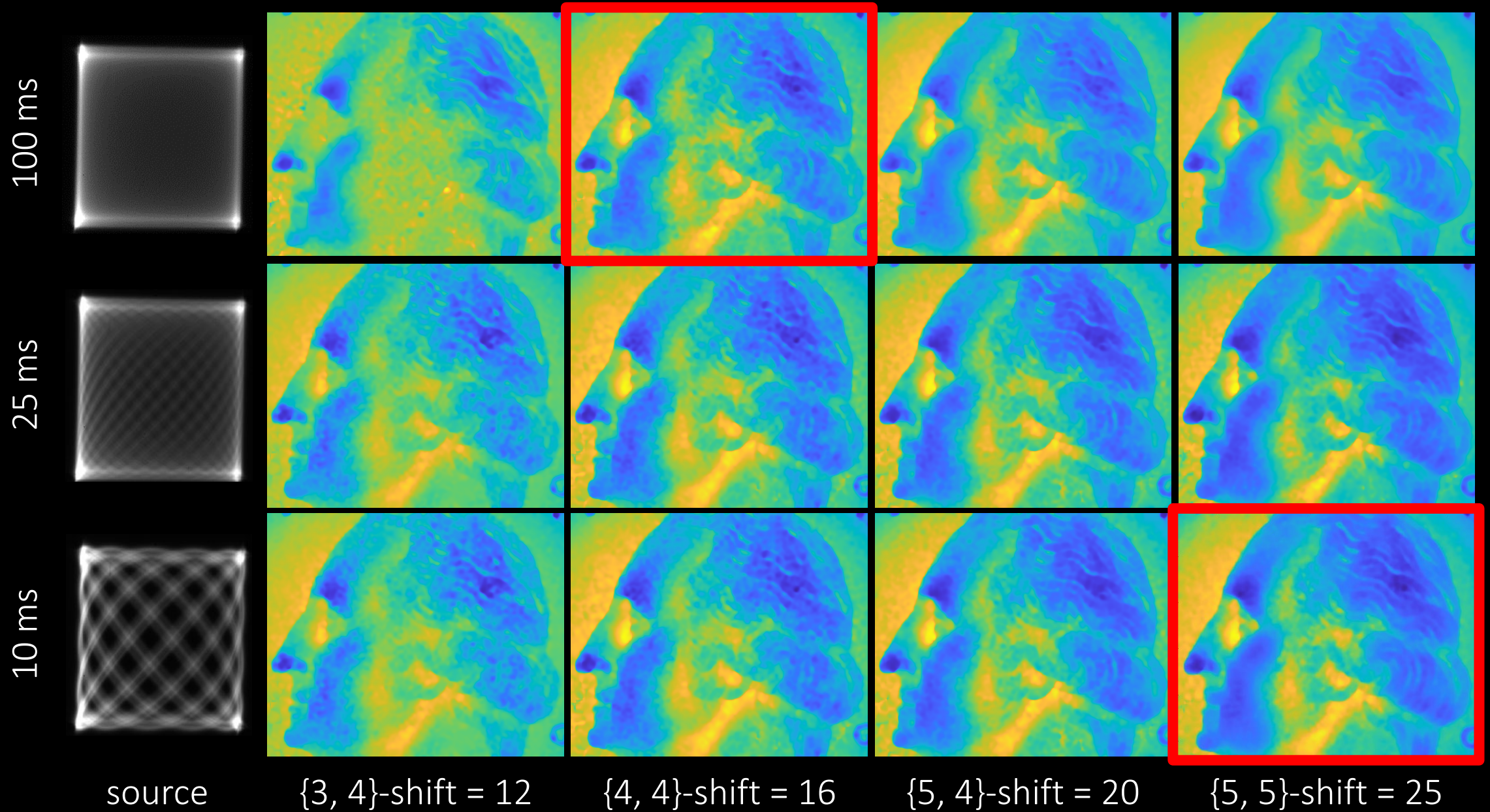
Results: macroscopic scenes



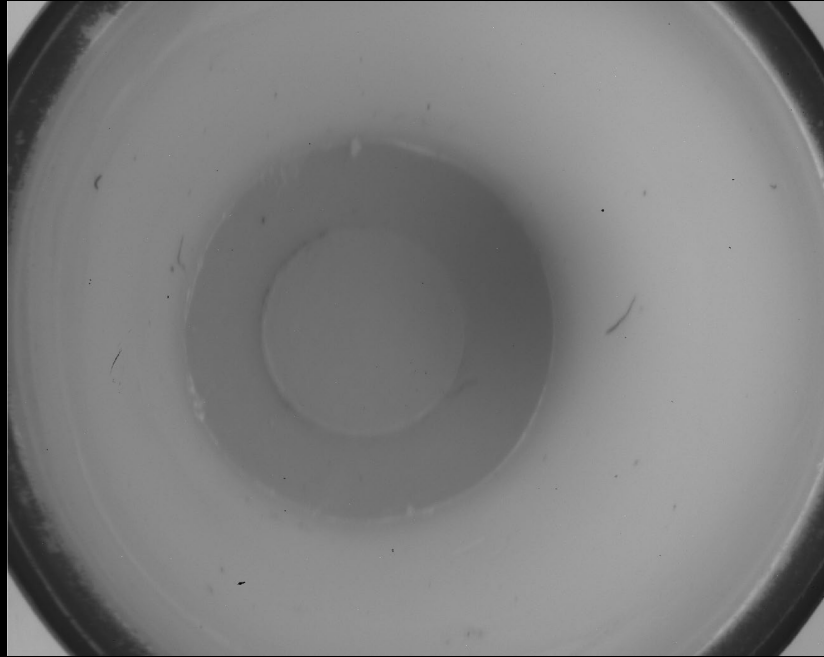
Acquisition time v/s quality



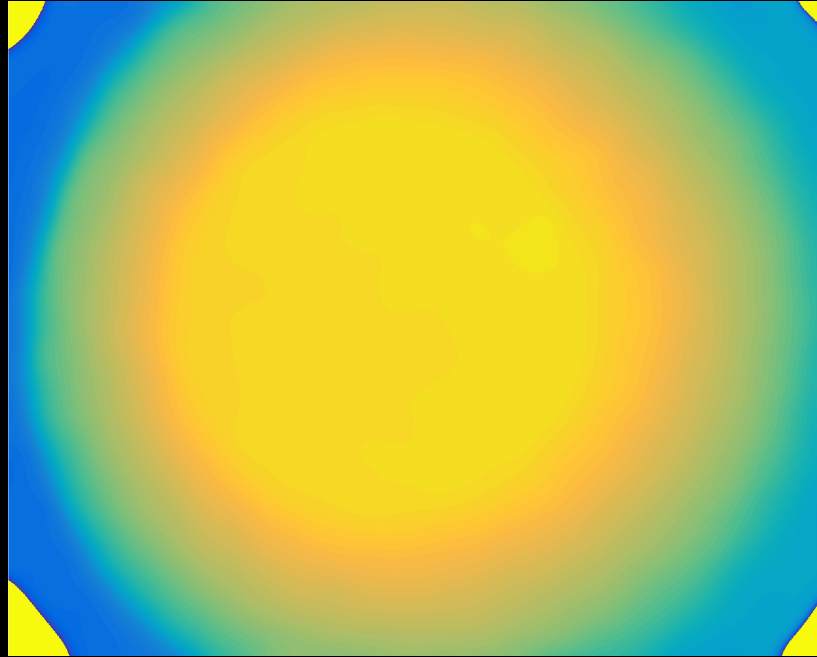
Acquisition time v/s quality



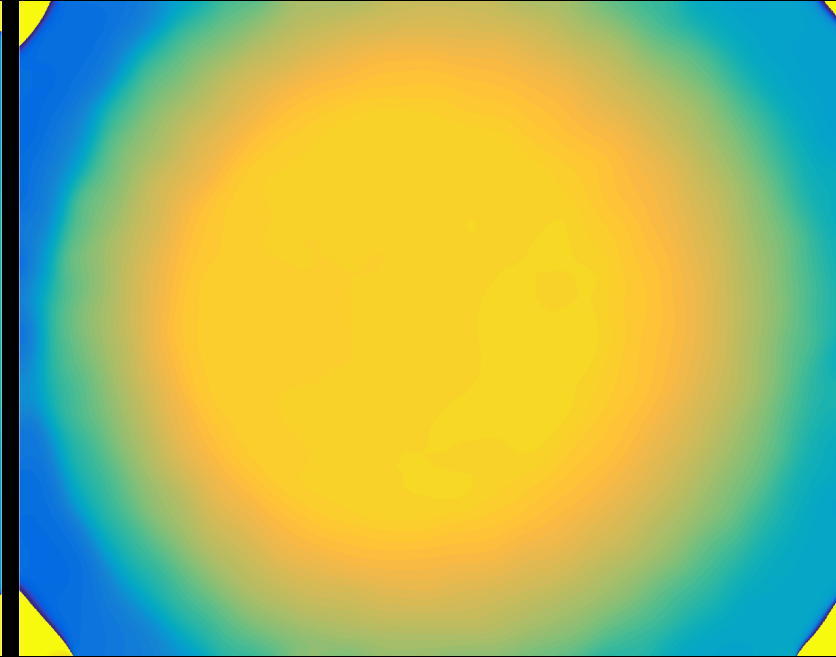
Robustness to environmental conditions



scene

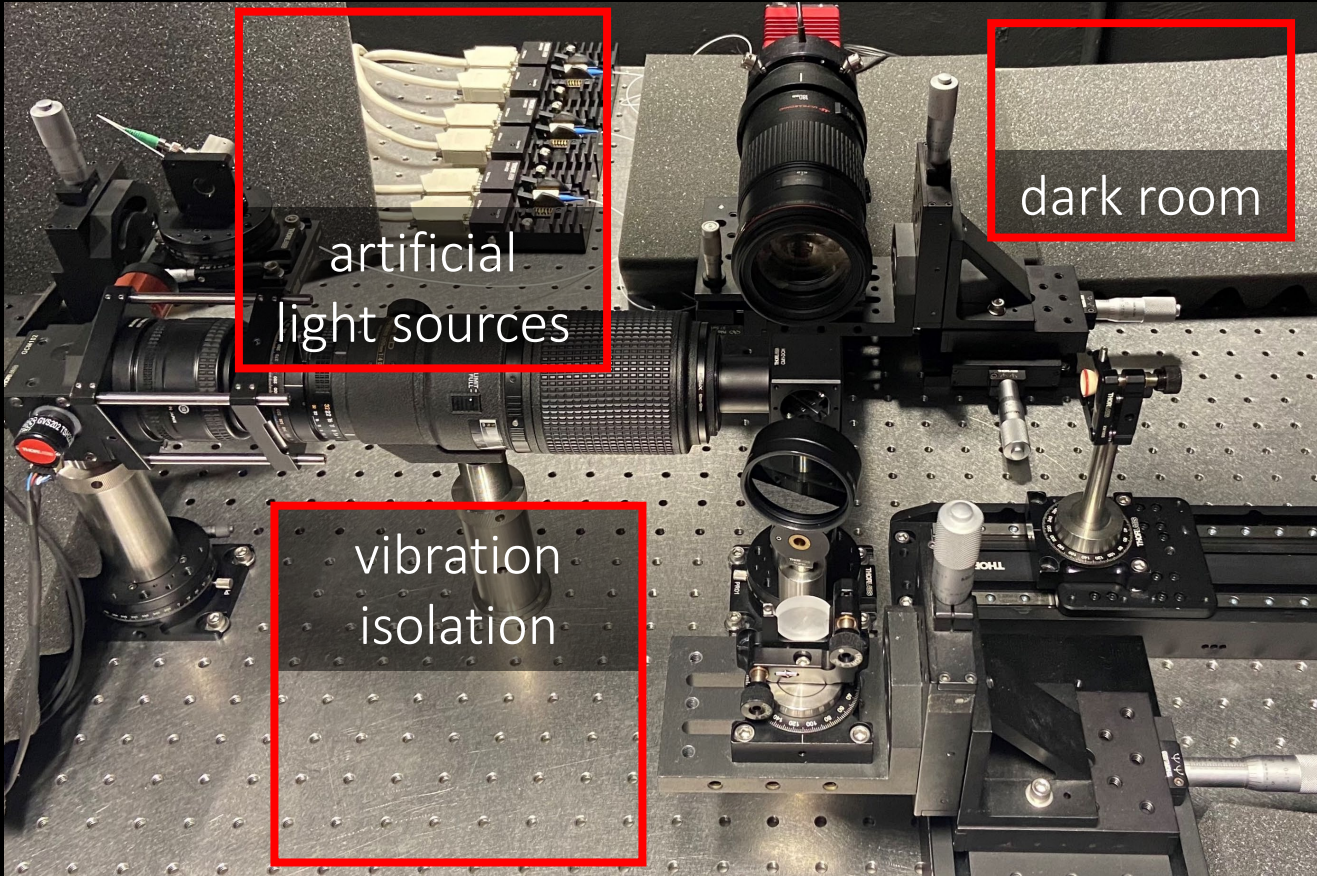


ours, no ambient light

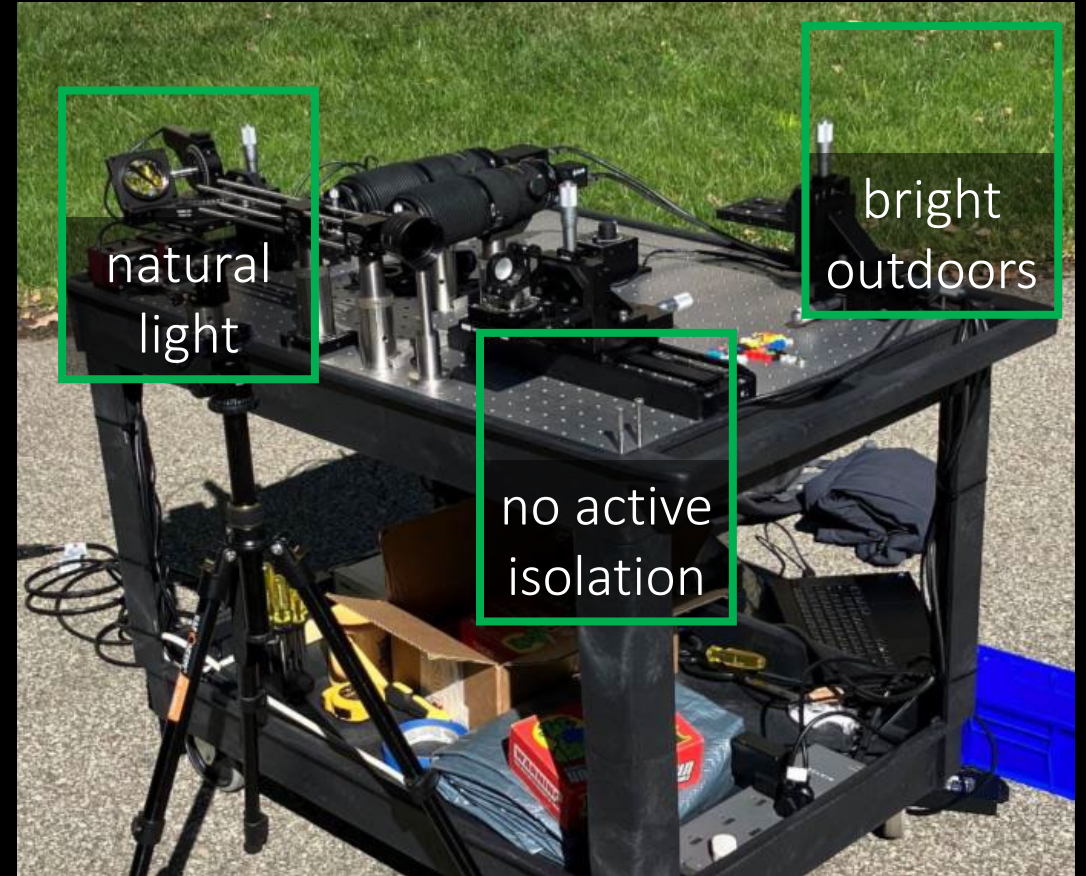


ours, 10% laser to
ambient light ratio

Passive interferometry



swept-angle SWI



passive interferometry

Swept-Angle Synthetic Wavelength Interferometry

more details:



[https://imaging.cs.cmu.edu/
swept_angle_swi](https://imaging.cs.cmu.edu/swept_angle_swi)

visit our posters!

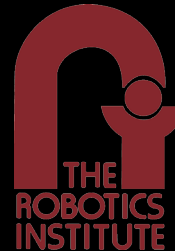
Wed, 21 Jun, 10:30-12:00

Tue, 20 Jun, 16:30-18:00

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