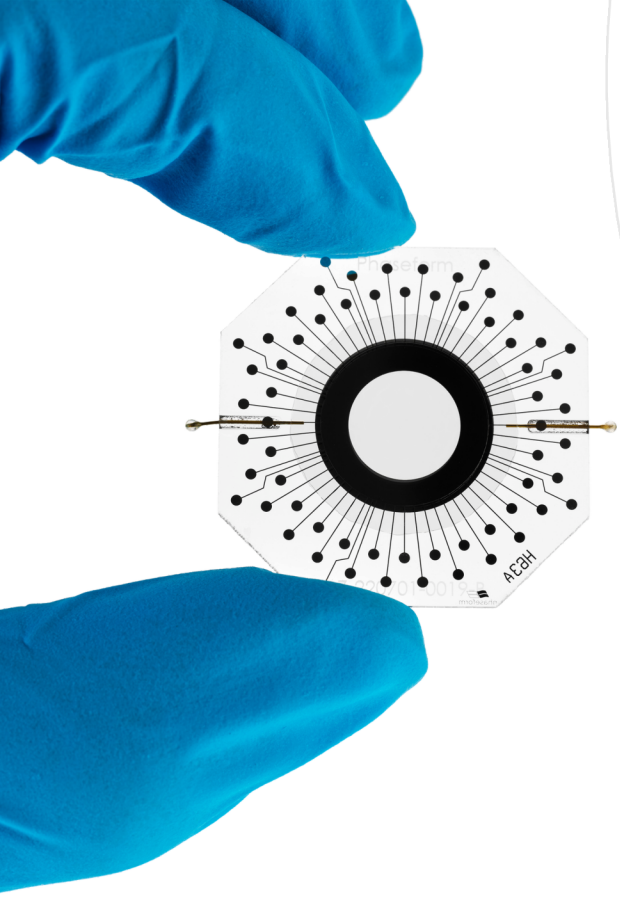


PHI

Plug-and-Play Adaptive Optics Platform for Microscope Camera Ports

Next-generation aberration correction & fast remote focusing, all in one compact unit

WHAT IS IT?

PHI is a compact camera-port adaptive optics platform that enhances microscope imaging performance through aberration correction and motionless remote focusing. The system integrates Phaseform's Deformable Phase Plate (DPP) with a high-speed tunable lens and image-based AO control software, enabling rapid volumetric imaging without modifying the microscope.

KEY FEATURES

- **Plug-and-Play**: Attaches to any standard C-mount camera port - connect power and USB, and you're good to go!
- **Modular**: Easily insert or remove the DPP to switch between standard imaging and adaptive optics.
- **Software Integration**: Compatible with µManager, ScanImage, and upcoming plugins for popular microscope software. Python SDK is available for custom workflows.
- **Future-Proof**: Works with current & upcoming DPPs. Just swap in the DPP that suits your application.

Adaptive Optics for Deeper, Clearer Imaging

- Correct up to the 7th radial order of Zernike modes
- Sensorless AO approach with user-friendly image-based aberration measurement.
- Automatically optimize image quality for thick, scattering tissue samples.

Motionless 3D Focusing

- Integrated Tunable Lens at the conjugate pupil plane with up to 15 diopters focusing range.
- Sub-3 ms response time for fast, z-stack imaging.
- Perform rapid 3D volumetric imaging by refocusing the object plane without physically moving the objective or stage.

phaseform

SPECIFICATIONS

Compatibility

Microscope	Mounts onto any standard C-mount port of upright or inverted microscope frames. Chain multiple C-mount devices: confocal & spinning-disk modules, structured illumination, etc.
Objective lens $D_{\text{pupil}} \simeq 2 \cdot f_{\text{obj}} \cdot NA = 2 \cdot (f_{\text{tube}}/M) \cdot NA$	Covering objectives with pupil diameters from 5 mm to 20 mm. 5 - 11 mm (using Delta 7-10) 11 - 20 mm (using Delta 7-20)

Mag	4	10	20	25	40	63	100
Min NA	0.2	0.25	0.4	0.7	0.8	1.2	1.25
Max NA	0.28	0.45	0.75	1.1	1.3	1.45	1.45

Compatible Significantly reduced performance

Software	µManager, ScanImage, ZenBlue or Python SDK (for more get in touch)

Adaptive Optics

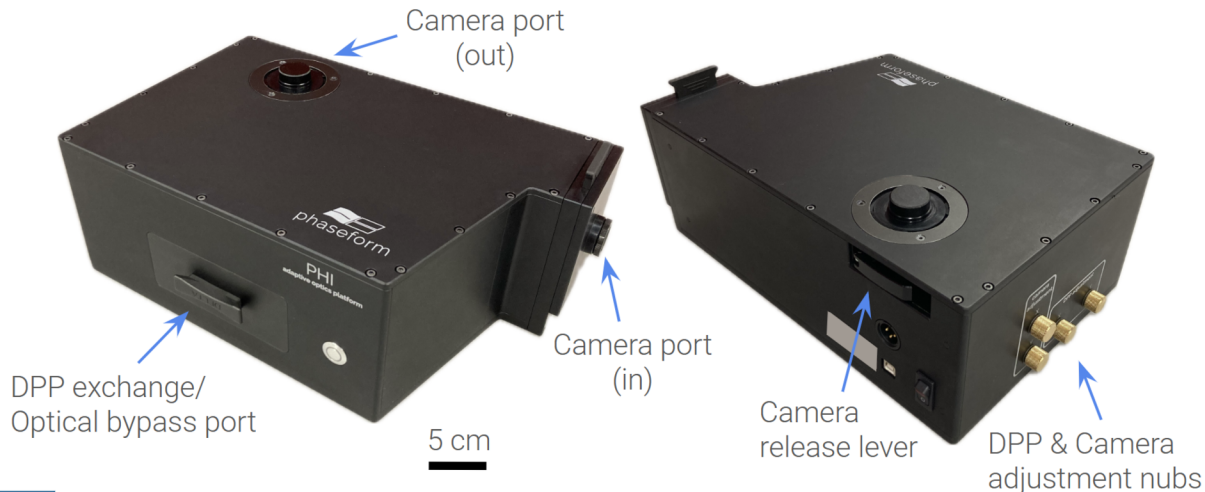
Maximum peak-to-valley of the corrected wavefronts	> 10 µm
Maximum spatial frequency of the correction	7th radial order of Zernike modes
Response time	<40 ms

Remote focusing

Tuning range	up to 15 dpt
Tuning precision Δdiop $\Delta z_{\text{obj}} \simeq \Delta\text{diop} \cdot f_{\text{obj}}^2 = \Delta\text{diop} \cdot (f_{\text{tube}}/M)^2$	0.001 dpt
Response time	3 ms

General

Optical transmission - AO & Remote focusing mode	~ 75% avg (450 nm - 1050 nm)
Optical transmission - bypass mode	> 90% avg (450 nm - 1050 nm)
Power/Connectivity	12V wall power, USB to PC
Weight	8.3 kg
Main applications	Spherical aberration correction, deep tissue imaging, remote focusing, 3D imaging



phaseform

SOFTWARE

PHI comes standard with **Phinden**, Phaseform's turnkey software package that incorporates an intuitive graphical user interface for sensorless, image-based adaptive optics (AO) microscopy. PHINDEN automatically estimates aberrations and applies corrections via the Deformable Phase Plate (DPP) to enhance resolution, signal-to-noise ratio (SNR), and contrast. PHINDEN runs seamlessly in the background alongside native microscope control software, allowing you to preserve your existing workflow.

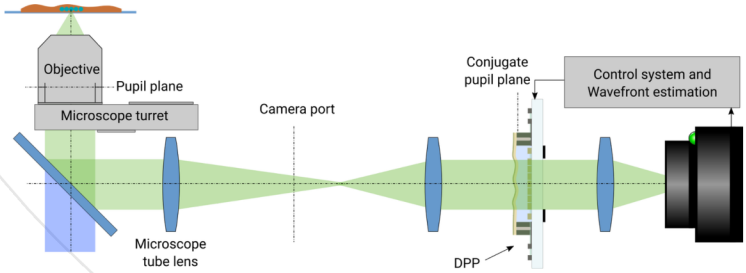
KEY FEATURES

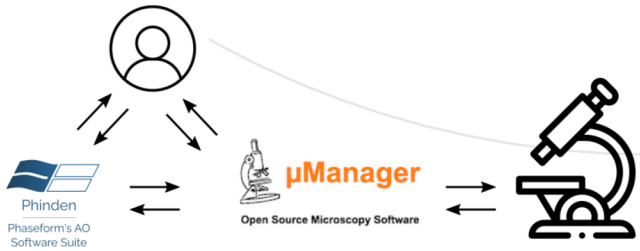
Automates sensorless aberration measurement & correction
Brings the power of image-based adaptive optics to your fingertips — just a few mouse clicks to optimize image quality during live acquisiton.

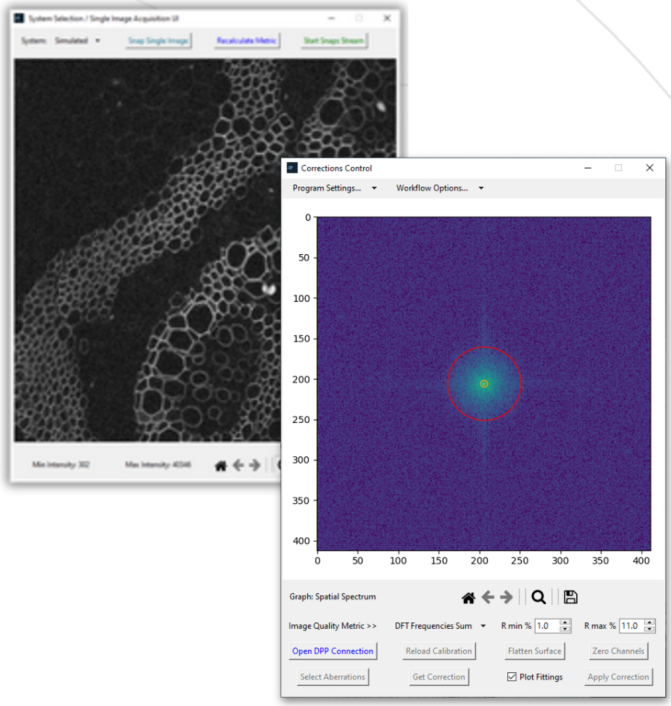
Enables plug-and-play adaptive optics
Provides a streamlined path to full AO integration, combining Phaseform's DPP with minimal hardware and software setup, with minimal disruption to your workflow.

Seamlessly integrates with native control software
Runs in the background alongside platforms like µManager & ScanImage, allowing users to operate their microscopes as usual.

Adapts to diverse modalities, objective lenses, and specimen types
Compatible with a wide range of microscopy techniques and biological samples, using a broad selection of implemented image quality metrics to guide optimal correction.







SYSTEM REQUIREMENTS

Python (SDK available)	Minimum version 3.8, Maximum version 3.12
µManager	Version: µManager 2.0
Zeiss ZenBlue	Tested on: ZEN 3.2
ScanImage	MATLAB: version R2020b and higher ScanImage: version >= 2019aR0 Widows: Supported on Windows 7 SP1, 8.1, 10, 11.
ThorImage	Tested on: special version (2025 latest) provided by Thorlabs

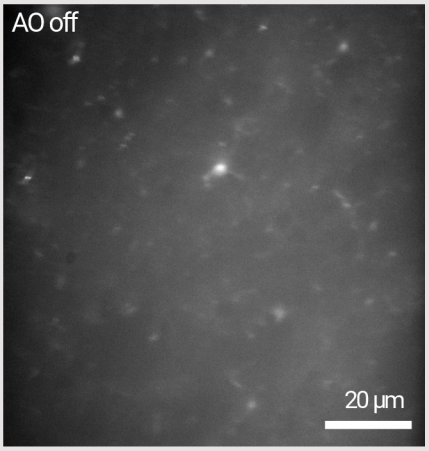
YOUR DESIRED CONTROL SOFTWARE NOT LISTED?

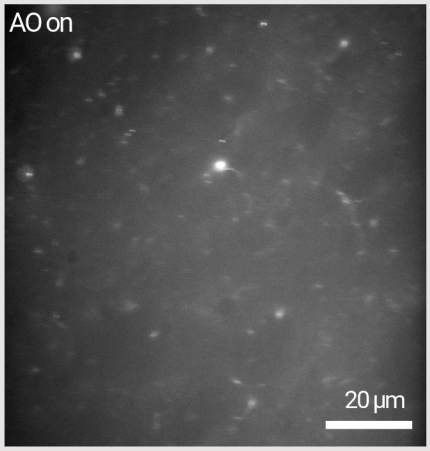
Contact us to explore possibilities for integrating PHINDEN with your specific system. We'll make it happen!

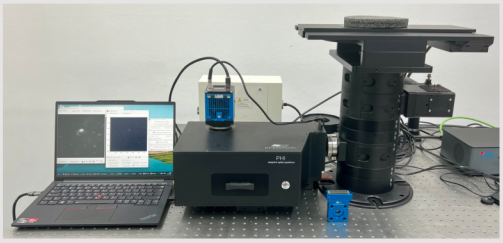
phaseform

CASE STUDIES

Deep tissue imaging



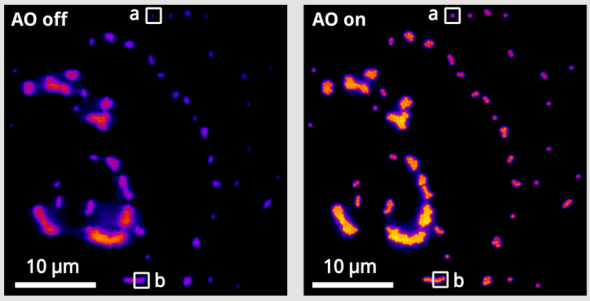


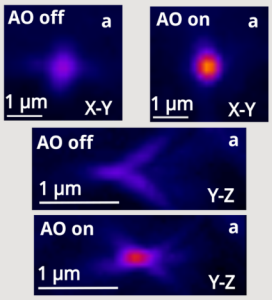


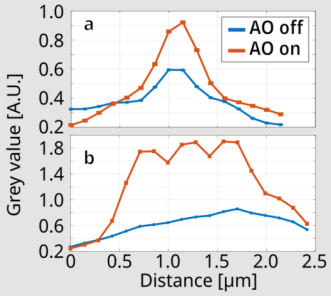
Fixed mouse brain slice, GFP, Nikon 60x 1.40 oil objective, 0.21 WD

OpenFrame Microscope, UltimEyes GmbH
Courtesy of Dr. Jan Felix Evers &
Dr. Joseph Gompertz

Spherical Aberration Correction

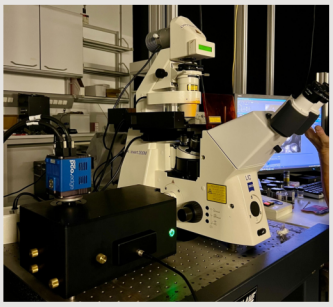




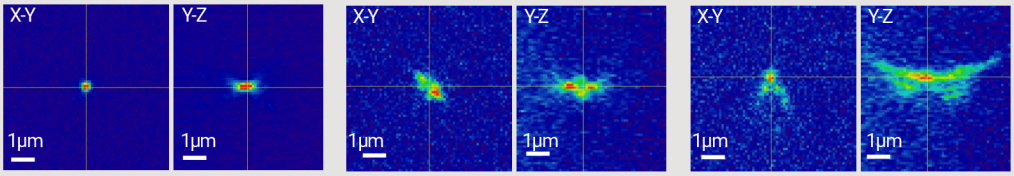


Fluoresbrite® YG microspheres (0.50 µm) imaged with a Zeiss 40×/1.3 NA oil objective under mismatched immersion (n = 1.566 vs. 1.518). Delta 7^{10} corrects spherical aberration and higher-order modes up to 4th-order Zernike.

Zeiss Axiovert 200M, Life Imaging Center, University of Freiburg.
Courtesy of Dr. Roland Nitschke.



PSF Shaping



Flat wavefront

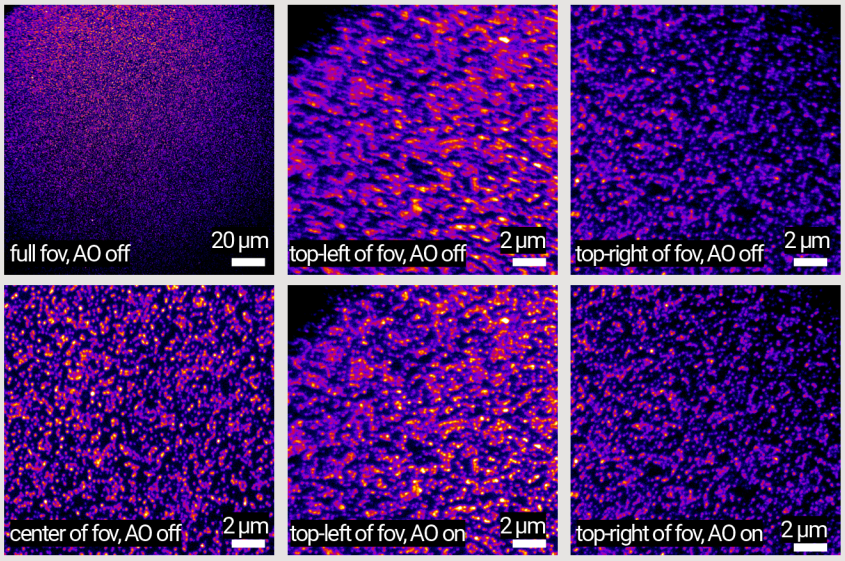
Astigmatism

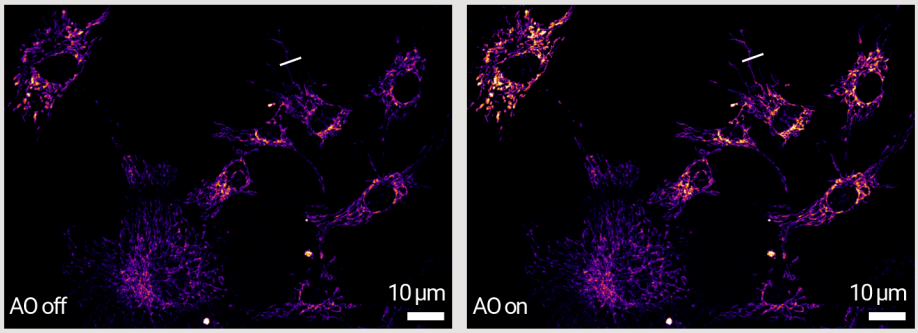
Coma

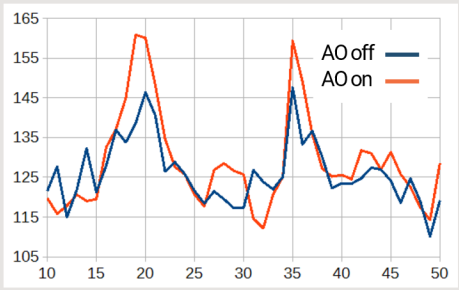
200 nm beads, 63x/1.4 Oil DIC Plan-Apochromat
System aberrations corrected

Zeiss Axiovert 200M
Life Imaging Center
University of Freiburg
Courtesy of Dr. Roland Nitschke

Combining with other microscope camera port accessories





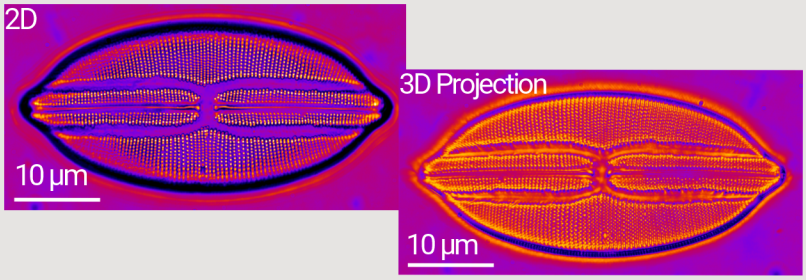


PHI integrated between the camera port and a spinning disk confocal unit. Top: 100 nm fluorescent beads, showing improved image quality toward the edges of the field of view (correction applied over the entire FoV). Bottom: cells with fluorescently labeled mitochondrial networks, demonstrating enhanced contrast and improved resolution of fine structures. 60x Oil objective, camera pixel size 6.5 µm.
Nikon Eclipse Ti with CrestOptics CICERO at the Light Imaging Facility, EMBL Rome. Courtesy of Dr. Alvaro Hernan Crevenna Escobar

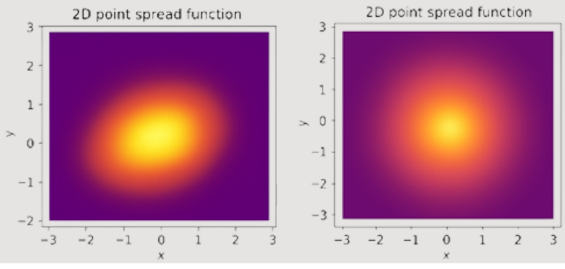
3D imaging - remote focusing

Navicula Lyra imaged with a 100× oil objective: left shows a single focal plane, while right is a 3D projection from a high-resolution z-stack acquired using PHI's tunable lens, enabling ~14 nm axial steps over ~3.4 µm depth.

Zeiss Axiovert 200M, Life Imaging Center, University of Freiburg, Courtesy of Dr. Roland Nitschke



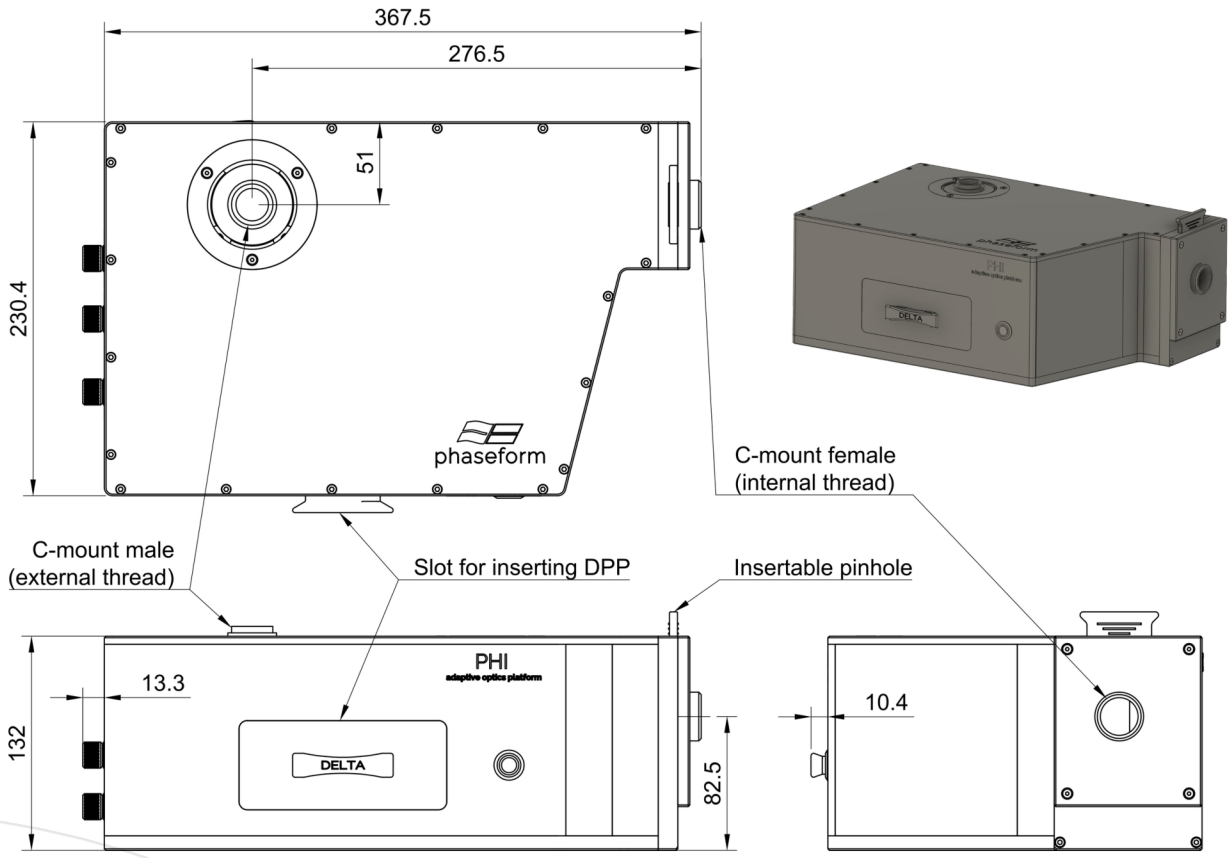
Aberration-free imaging



Single-Molecule Localization Microscopy (SMLM) of mobile ATTO488-DOPE in a supported lipid bilayer using TIRF illumination (Zeiss Plan-Apochromat 100×/1.46). AO correction symmetrizes the PSF and improves localization accuracy and effective resolution.

TU Wien, Institute of Applied Physics, Biophysics Research Unit, Courtesy of Dr. Mario Brameshuber.

MECHANICAL DRAWINGS



DISCLAIMER

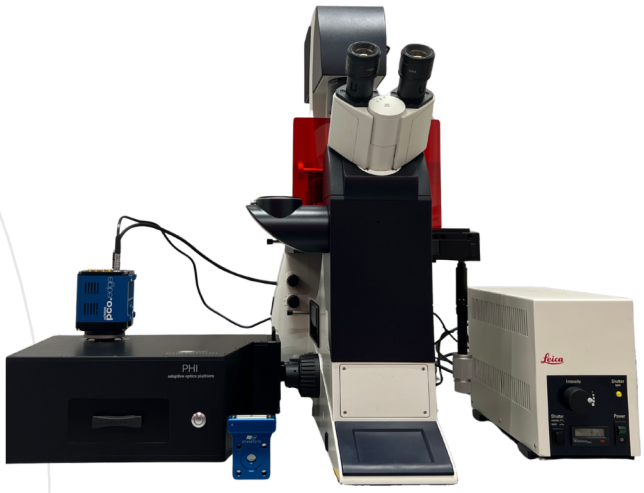
All specifications are preliminary and subject to change without notice. No representation or warranty, either expressed or implied, is made as to the reliability, completeness, or accuracy of this specification sheet.

CONTACT US

Get in touch with us today for a live demo!

Phaseform GmbH
Georges-Köhler-Allee 302
79110 Freiburg i.B.
Germany

www.phaseform.com
info@phaseform.com
+49 761 216 0800 0



Phaseform is supported by

European Innovation Council

phaseform