

SUPPLEMENTARY INFORMATION

Implementation of a 4Pi-SMS super-resolution microscope

Jingyu Wang^{1,+}, Edward S. Allgeyer^{2,+}, George Sirinakis², Yongdeng Zhang³, Kevin Hu^{3,4}, Mark D. Lessard³, Yiming Li^{5,6}, Robin Diekmann⁵, Michael A. Phillips⁷, Ian M. Dobbie^{7,*}, Jonas Ries^{5,*}, Martin J. Booth^{1,*}, Joerg Bewersdorf^{3,4,*}

¹ Department of Engineering Science, University of Oxford, OX1 3PJ, UK

² The Gurdon Institute, Tennis Court Road, University of Cambridge, CB2 1QN, UK

³ Department of Cell Biology, Yale University School of Medicine, 333 Cedar St, New Haven, CT 06520, USA

⁴ Department of Biomedical Engineering, Yale University, 17 Hillhouse Avenue, New Haven, CT 06520, USA

⁵ European Molecular Biology Laboratory, Meyerhofstr. 1, 69117 Heidelberg, Germany

⁶ Department of Biomedical Engineering, Southern University of Science and Technology, Shenzhen 518055, China

⁷ Micron Advanced Bioimaging Unit, Department of Biochemistry, University of Oxford, OX1 3QU, UK

+ these authors contributed equally

Supplementary Methods

Sample preparation

Microtubule samples

To label microtubules, COS-7 cells were prepared as previously reported [ref]. After growing on Poly-L-Lysine coated 25 mm round coverslip for 24 hours, cells were rinsed with PBS, warmed to 37 °C, then incubated for 1 minute in 0.05% saponin diluted in cytoskeletal buffer (CBS; 10 mM MES pH 6.1, 138 mM NaCl, 3 mM MgCl₂, 2 mM EGTA, 320 mM sucrose), warmed to 37 °C. Cells were subsequently fixed in 3% paraformaldehyde and 0.1% glutaraldehyde (GA; Electron Microscopy Sciences, Cat# 16019) diluted in CBS, warmed to 37 °C. Cells were permeabilized and blocked with 3% bovine serum albumin (BSA; Jackson ImmunoResearch, Cat# 001-000-162) and 0.2% Triton X-100 (TX-100; Sigma-Aldrich, Cat# T8787) in 1× PBS (diluted from 10× PBS; American Bio, Cat# AB11072-0100) for 30 minutes. The samples were incubated overnight at 4 °C with mouse anti- α -tubulin antibody (Sigma-Aldrich, Cat# T5168) diluted to 1:200 in antibody dilution buffer (1% BSA and 0.2%

TX-100 in 1× PBS). Cells were washed in wash buffer (0.05% TX-100 in 1× PBS) three times for 5 minutes each. For labelling, microtubule samples were incubated with CF660C-conjugated secondary antibody (used at 1:1000) in antibody dilution buffer for 1 hour at room temperature then washed three times for 5 minutes with wash buffer. Lastly, the samples were post-fixed in 3% PFA + 0.1% GA in CBS for 10 min, rinsed with PBS three times, and stored in PBS at 4 °C until imaged.

Nuclear pore complex samples

The nuclear pore complex sample was prepared as previously reported [ref]. U2OS Nup96-SNAP cells were seeded on cleaned high-precision 24 mm round coverslip. The cells were seeded such that they achieved 50-70% confluency on the day of fixation and staining. For fixation, the cells were first prefixed for 30 secs in fixation buffer (2.4% formaldehyde in PBS). They were then incubated for 3 mins in 0.4 % (v/v) Triton X-100 in PBS for permeabilization. After permeabilization, the cells were then incubated in fixation buffer for another 30 mins. The fixation buffer was then quenched using PBS containing 100 mM NH₄Cl. To mitigate unspecific dye binding, the coverslip was incubated in Image-IT FX signal (ThermoFisher Scientific) enhancer for 30 mins. After the blocking step, the cells were stained with SNAP dye buffer (1 μM BG-AF647 (New England Biolabs, no. S9136S), 1 μM dithiothreitol, in 0.5 % (w/v) BSA in PBS) for 2 hours at room temperature. After staining, the coverslip was washed three times for 5 mins.

Imaging parameters

The microtubule sample was imaged at 100 fps with a laser intensity of ~7.5 kW/cm² (642 nm). 360,000 frames were recorded in total. The nuclear pore complex sample was imaged at 20 fps with a laser intensity of ~5 kW/cm² (642 nm). 9,000 frames were recorded in total.

Data analysis

The microtubule and nuclear pore complex data were analysed using the analysis software provided following the analysis procedure.

Supplementary Table 1. 4Pi-SMS parts list.

Category	Part Number	Description	Vendor	Quantity	in Drawing
optomech	B90120B	Nexus breadboard, 900x1200	Thorlabs	1	
optomech	PFA52507	800mm active isolation frame 900x1200	Thorlabs	1	
optomech	PTA013	air filter	Thorlabs	1	
optomech	PTA015	compressor	Thorlabs	1	
optomech	PTA1006	compressor oil	Thorlabs	1	
optomech	PBG52503/SPLS4	Optical Breadboard 900 x 300 x 58mm M6/25mm/SPL 6mm top and bottom skin. Full Matrix both sides.	Thorlabs	1	
optomech - cavity	PRM05/M	High Precision Rotation Mount for $\varnothing 1/2"$ (12.5 mm) Optics, Metric	Thorlabs	2	
optomech	SS100-F3H	Suprema Mirror Mount, 1.0 in. Diameter, 3 Locking Hex-Broach, Front Load, 8-32 (M4) CLR	Newport	12	
optomech	ST1XY-A/M	XY Translator with 100 TPI Drives, Metric	Thorlabs	2	
optomech	U100-A-LH-3H	Precision Clear Edge Left Handed Mount, 1.0 in. Diameter, 3 Locking Allen-Keys	Newport	1	
optomech	U100-A3H	Precision Clear Edge Mount, 1.0 in. Diameter, 3 Locking Allen-Key Adjustment	Newport	1	
optomech	LMR1/M	Metric, Lens Mount for $\varnothing 1"$ Optics, Retaining Ring Included	Thorlabs	6	
optomech	9481-M	Pint-Sized Prism Mount, 0.25 to 1.00 in., $\pm 3.5^\circ$, M4	Newfocus	1	
optomech	NT64-566	Optic Mount, 40.0mm Optic Diameter	Edmund Optics	1	
optomech	NT64-560	Optic Mount, 25.0mm Optic Diameter	Edmund Optics	1	
optomech	LP-2A	XYZ $\Theta X \Theta Y$ Lens Positioner, 2.0 in. (50.8 mm) Diameter	Newport	2	Mounts for DM0 and DM1
optomech	KB25/M	Complete 25 mm x 25 mm Kinematic Base	Thorlabs	1	
optomech	RC1	Rail Carrier, 1" x 1", 1/4" (M6) Counterbored Mounting Hole	Thorlabs	1	

optomech	RLA300/M	Dovetail Optical Rail, 300 mm, Metric	Thorlabs	1	
optomech	RLA600/M	Dovetail Optical Rail, 600 mm, Metric	Thorlabs	1	
shutter	NI USB-6002	Multifunction I/O Device for shutter control	National Instruments	1	
shutter	04 RDI 132	Cavity Bi-Stable Shutter	CVI Melles Griot	2	
optomech	M-GON40-U	Upper Goniometric Stage, 40 x 40 x 20mm, $\pm 5^\circ$ Travel, Metric	Newport	1	
optomech	M-RS65	Aperture Platform Rotation Stage, 65 mm, 10° Fine, Metric	Newport	1	
actuators	TRA12CC	Miniature Motorized Actuator, 12 mm Travel, DC Servo motor	Newport	2	
optomech	SP 60 (27.160.1212)	12 mm Rectangular Aperture	Owis	3	AP1 and AP2
optomech	KSHM 90-LI-MDS (46.095.51KN)	2 Inch Flip Mount	Owis	2	
custom	FAB-OX0001	BS2/lens mount (replaces FAB-P0038)	Custom/Shop	1	
custom	FAB-OX0002	Vertical mount for LMR/1	Custom/Shop	14	
custom	FAB-OX0003	Wedge base plate upper (repl. FAB-P0047)	Custom/Shop	1	
custom	FAB-OX0004	Wedge base plate lower (repl. FAB-P0048)	Custom/Shop	1	
custom	FAB-OX0005	Goniometer spacer (repl. FAB-CAM004)	Custom/Shop	1	
custom	FAB-OX0006	Goniometer cube holder (repl. FAB-CAM003)	Custom/Shop	1	
custom	FAB-OX0007	40mm lens mount lower (FAB-P0044 variant)	Custom/Shop	1	
custom	FAB-OX0008	Wedge support (mirror of FAB-P0051)	Custom/Shop	1	
custom	FAB-OX0009	Overview mirror flip mount (repl. FAB-CAM002)	Custom/Shop	1	
custom	FAB-OX0010	Alignment tool	Custom/Shop	6	
custom	FAB-OX0011	Module 1 plate	Custom/Shop	1	
custom	FAB-OX0012	Module 2 plate	Custom/Shop	1	
custom	FAB-OX0013	Module 3 plate	Custom/Shop	1	
custom	FAB-OX0014	Module 4 plate	Custom/Shop	1	
custom	FAB-OX0015	15mm lens holder with glue holes	Custom/Shop	2	
custom	FAB-OX0016	Filter cube support - mirror of P0029	Custom/Shop	1	

custom	FAB-OX0017	Upper objective holder	Custom/Shop	2	
custom	FAB-OX0018	Upper z-carriage bracket	Custom/Shop	2	
custom	FAB-OX0019	Upper objective shim	Custom/Shop	10	
custom	FAB-OX0020	Piezo pusher base component	Custom/Shop	1	
custom	FAB-OX0021	Piezo pusher plate with cutout	Custom/Shop	1	
custom	FAB-OX0022	Pizeo pusher actuator	Custom/Shop	2	
custom	FAB-OX0023	Pizeo pusher plate	Custom/Shop	3	
custom	FAB-OX0024	Pizeo pusher base with cutout	Custom/Shop	1	
custom	FAB-OX0025	Upper objective pusher bar	Custom/Shop	1	
custom	FAB-OX0026	Camera bracket crossbrace	Custom/Shop	4	
	FAB-OX0027	Upper Z carriage bracket block	Custom/Shop	1	
custom	FAB-P0001	Tower Leg Foot	Custom/Shop	2	
custom	FAB-P0002	Tower Leg	Custom/Shop	2	
custom	FAB-P0003	ASI to Stage Bracket	Custom/Shop	2	
custom	FAB-P0004	Lower Tower Plate	Custom/Shop	1	
custom	FAB-P0005	Upper Tower Plate	Custom/Shop	1	
custom	FAB-P0008	M-227 Clamp	Custom/Shop	3	
custom	FAB-P0009	Sample Holder	Custom/Shop	1	
custom	FAB-P0010	Lower Float Plate	Custom/Shop	1	
custom	FAB-P0015	Lower OBJ Holder	Custom/Shop	1	
custom	FAB-P0018	Mirror Mount, U100	Custom/Shop	2	
custom	FAB-P0019	Mirror Mount, SS100	Custom/Shop	6	
custom	FAB-P0025	Vertical Support Foot	Custom/Shop	2	
custom	FAB-P0026	Vertical Support Leg	Custom/Shop	1	
custom	FAB-P0027	Mirror Mount 45DEG SS100	Custom/Shop	2	
custom	FAB-P0028	Lens Mount, LMR1/M	Custom/Shop	2	
custom	FAB-P0029	Filter Cube/Lens Support Upper	Custom/Shop	1	
custom	FAB-P0031	Bridge Brace	Custom/Shop	2	

custom	FAB-P0032	Filter Cube - Excitation	Custom/Shop	2	
custom	FAB-P0033	Filter Cube - Emission	Custom/Shop	2	
custom	FAB-P0035	Sample Holder for 2 Cover Glass	Custom/Shop	10	
custom	FAB-P0039	Prism Glue-on Mount	Custom/Shop	1	
custom	FAB-P0044	BS Lens Mount	Custom/Shop	1	
custom	FAB-P0048	Wedge Only Mount UPPER	Custom/Shop	1	
custom	FAB-P0050	Wedge Only Mount LOWER	Custom/Shop	1	
custom	FAB-P0051	Wedge Support Large	Custom/Shop	1	
custom	FAB-P0052	C-Mount Bolt for iXon	Custom/Shop	1	
custom	FAB-P0043	Mount for widefield mirror	Custom/Shop	1	
custom	FAB-P0042 - w/sCMOS	Triangle iXon camera bracket	Custom/Shop	2	
custom	FAB-P0041	sCMOS Mount Plate	Custom/Shop	1	
custom	FAB-CAM001	Filter Wheel Mounting Bracket	Custom/Shop	1	
custom	FAB-CAM005	Cavity Shutter Mount	Custom/Shop	2	
custom	FAB-CAM013	Vertical Support with Cutout	Custom/Shop	1	
custom	ASF-10002	Mirror Mount Jogged	Custom/Shop	2	
custom	ASF-10003	Aperture Mount W/SLOT	Custom/Shop	2	
objectives	UPLSAPO 100XS	UPLSAPO 100XS; U PLAN S-APO 100X Silicone OIL OBJ,NA 1.35, WD 0.2	Olympus	2	OBJ0 & OBJ1
adaptiveoptics	Multi-5.5	Multi-DM MEMS Deformable Mirros	BMC	2	DM0 & DM1
optics - ImgSep	MRAK25-P01	Right-Angle Prism Dielectric Mirror, 400 - 750 nm, L = 25.0 mm	Thorlabs	1	M17
optics	DBL14017/100	90.0MM EFL X 25.0MM Dia. ACHROMAT SINGLE-LAYER MgF2 VISIBLE	JML Optics	2	L3 and L4
optics	NT47-640	Achromatic Lens 25mm Dia. x 85mm FL, VIS 0 Coating	Edmund Optics	2	L1 and L2
optics	NT49-280	Achromatic Lens 40mm Dia. x 300mm FL, VIS 0 Coating	Edmund Optics	3	L0 and L5
optics	NT47-641	Achromatic Lens 25mm Dia. x 100mm FL, VIS 0 Coating	Edmund Optics	1	
optics	W-4PISMSN	BK7 and quartz wedges	UVisIR	1	W0 and W1
optics	LAO-350.0-25.0	Standard 400-700-nm Cemented Achromats, f 350 mm, diameter 25 mm	CVI Melles Griot	2	L6 and L7
optics	DLB-15-100PM	Achromatic doublets, 15 mm Dia. x 100 mm FL, 400-700 nm	OptoSigma	2	L8 and L9

optics	NT47-009	Non-Polarizing Cube Beam splitter 25mm VIS	Edmund Optics	1	BS0
optics	10FC16PB.3	Broadband Polarizing Cube Beam splitter, 25.4 x 25.4 x 25.4 mm, 420-680 nm	Newport	1	
optics	NT49-002	Polarizing Cube Beam splitter 25mm VIS	Edmund Optics	1	PBS0
optics	AQWP05M-600-UM-SP	Achromatic 1/4 wave plate 400800nm, unmounted (Custom)	Thorlabs	2	QWP1 and QWP1
optics	FSR-KG1	Colored Glass Filter, 25.4 mm Diameter, Heat Absorbing, KG.1	Newport	1	
optics	10Z40ER.2	Broadband Metallic Mirror, Zerodur, 25.4 mm Diameter, $\lambda/20$, 480-20,000 nm	Newport	14	M3-M16
optics	FF01-446/523/600/677-25	446/523/600/677 nm BrightLine quad-band bandpass filter - 25 mm x 3.5 mm	Semrock	2	
optics	Di01-R405/488/561/635-17.5x24	405/488/561/635 BrightLine Laser Dichroic Beam splitter, 17.5 x 24.0 mm	Semrock	2	DI0 and DI1
optics-filters	ET700/75m	Emission filter in filter wheel Sputter/Hard Coated 700nm/75nm	Chroma	1	
EM filters	FF01-600/52-25	600/52 nm BrightLine® single-band bandpass filter	Semrock	1	
Optics-excitation	FF01-390/482/563/640-25	390/482/563/640 nm BrightLine® quad-band bandpass filter	Semrock	1	CF
Optomech	CXY1	CXY1 - 30 mm Cage System, XY Translating Lens Mount for \varnothing 1" Optics	Thorlabs	2	
Optomech	LM2XY_M	LM2XY/M - Translating Lens Mount for \varnothing 2" Optics, 1 Retaining Ring Included, Metric	Thorlabs	1	
Optomech	RC1	Dovetail Rail Carrier, 1/4" (M6) Counterbore	Thorlabs	5	
Optomech	RLA450_M	RLA450/M - Dovetail Optical Rail, 450 mm, Metric	Thorlabs	1	
Optomech	KM200	Kinematic Mirror Mount for \varnothing 2" Optics	Thorlabs	1	
Optomech	RC3	Rail Carrier, Perpendicular Dovetail	Thorlabs	2	
Optomech	SM1SMA	SMA Fiber Adapter Plate with External SM1 (1.035"-40) Threads	Thorlabs	1	

Optomech	KCB1_M	KCB1/M - Right-Angle Kinematic Mirror Mount with Tapped Cage Rod Holes, 30 mm Cage System and SM1 Compatible, M4 and M6 Mounting Holes	Thorlabs	1	
Optomech	ER2	Cage Assembly Rod, 2" Long, \varnothing 6 mm	Thorlabs	4	
Optomech	ER4	Cage Assembly Rod, 4" Long, \varnothing 6 mm	Thorlabs	4	
Optomech	SM1Z	Z-Axis Translation Mount, 30 mm Cage Compatible	Thorlabs	1	
Optomech	CP08_M	SM1-Threaded 30 mm Cage Plate with Flexure Clamping, 1 Retaining Ring, M4 Tap	Thorlabs	2	
Optomech	LS-P642H0588A00_M	\varnothing 1" (\varnothing 25 mm) Posts for Polaris® Mirror Mounts	Thorlabs	1	
Optomech	PLS-P642H0300A00_M	\varnothing 1" (\varnothing 25 mm) Posts for Polaris® Mirror Mounts	Thorlabs	1	
Optomech	TR30-M	\varnothing 12.7 mm Optical Post, SS, M4 Setscrew, M6 Tap, L = 30 mm	Thorlabs	1	
Optomech	PLS-P642H0457A00_M	\varnothing 1" (\varnothing 25 mm) Posts for Polaris® Mirror Mounts	Thorlabs	1	
Optomech	PLS-P642H0394A00_M	\varnothing 1" (\varnothing 25 mm) Posts for Polaris® Mirror Mounts	Thorlabs	1	
Optomech	CP02B	30 mm Cage Mounting Bracket	Thorlabs	1	
Optomech	PH50_M	\varnothing 12.7 mm Post Holder, Spring-Loaded Hex-Locking Thumbscrew, L=50 mm	Thorlabs	1	
Optomech	C4W	30 mm Cage Cube	Thorlabs	1	
Optomech	SM1D12	SM1 Lever-Actuated Iris Diaphragm (\varnothing 0.8 - \varnothing 12 mm)	Thorlabs	10	
Optomech	B4C/M	kinematic Cage Cube Platform for C4W/C6W, Metric	Thorlabs	1	
Optomech	FFM1	30-mm-Cage-Compatible Rectangular Filter Mount	Thorlabs	1	

Optics-diagnosis	DMSP805L	DMSP805L - Ø2" Shortpass Dichroic Mirror, 805 nm Cutoff	Thorlabs		
Optomech	CXY2	60 mm Cage System Translating Lens Mount for Ø2" Optics	Thorlabs	1	
Optomech	Owis - 46.090.51KN	flip mirror holders with DC geared motor, with mechanical limit switches, for optics with ø 50 mm / 50.8 mm (2"), deflection to the right	Owis	1	
Optomech	KCB2_M	Right-Angle Kinematic Mirror Mount with Tapped Cage Rod Holes, 60 mm Cage System and SM2 Compatible, M4 and M6 Mounting Holes	Thorlabs	1	
Optomech	LC6W	60 mm Cage Cube	Thorlabs	1	
Optomech	LB4C_M	Kinematic Prism Platform for 60 mm Cage Cube, Metric Taps	Thorlabs	1	
Optomech	LB5C1	Ø2" Optic Mount for 60 mm Cage Cube with Setscrew Optic Retention	Thorlabs	1	
Optomech	46.045.26KN	flip mirror holders with DC geared motor, with mechanical limit switches, for optics with ø 25 mm / 25.4 mm (1"), deflection to the left	Owis	1	
Optomech	RC12FC-P01	Protected Silver Reflective Collimator, 450 nm - 20 µm, Ø12 mm Beam, FC/P	Thorlabs	1	
Optomech	K5X1	5-Axis Locking Kinematic Mount for Ø1" Optics	Thorlabs	1	
Optomech	RC2_M	Dovetail Rail Carrier, 50.8 mm x 25.4 mm, M6 Counterbore, M4 Taps	Thorlabs	1	
Optomech	PLS-P642H0293A00_M	Custom POLARIS Mounting Post, Height: 2.93 in	Thorlabs	2	
Optomech	PLS-P642H0335A00_M	Custom POLARIS Mounting Post, Height: 3.35 in	Thorlabs	1	
Optomech	PLS-P642H0537A00_M	Custom POLARIS Mounting Post, Height: 5.37 in	Thorlabs	1	

Optomech	PLS-P642H0446A00_M	Custom POLARIS Mounting Post, Height: 4.46 in	Thorlabs	1	
Optomech	PLS-P642H0495A00_M	Custom POLARIS Mounting Post, Height: 4.95 in	Thorlabs	1	
Optomech	LCPMA1	Snap-On 60 mm Cage Mounting Bracket, #8 (M4) Slot	Thorlabs	1	
Optomech	TR100_M	Ø12.7 mm Optical Post, SS, M4 Setscrew, M6 Tap, L = 100 mm	Thorlabs	1	
Optomech	RA90_M	Right-Angle Clamp for Ø1/2" Posts, 5 mm Hex	Thorlabs	1	
Optomech	TR50_M	Ø12.7 mm Optical Post, SS, M4 Setscrew, M6 Tap, L = 50 mm £4.01	Thorlabs	1	
Optomech	ER05	Cage Assembly Rod, 1/2" Long, Ø6 mm	Thorlabs	4	
Optomech	LCP4S	30 mm to 60 mm Cage Plate Adapter, 4 mm Thick	Thorlabs	1	
Optomech	SM1CPL10	SM1 Lens Tube Flexure Sleeve Coupler, 1.0" Long	Thorlabs	1	
Optomech	SM1L05	SM1 Lens Tube, 0.50" Thread Depth, One Retaining Ring Included	Thorlabs	1	
Optomech	DCC1545M	USB 2.0 CMOS Camera, 1280 x 1024, Monochrome Sensor	Thorlabs	1	
Optomech	CML15	C-Mount Extension Tube, 15 mm Long	Thorlabs	1	
Optomech	4-40 x 3/16	Stainless Steel Screws	Thorlabs	4	
Optics	f = 500.0 mm	f = 500.0 mm, Ø1", N-BK7 Mounted Plano-Convex Round Cyl Lens, ARC: 650 - 1050 nm	Thorlabs	1	CY0
actuators	M-227.10	High-Resolution DC-Mike Linear Actuator, 10 mm	PI	3	
actuators	C-863.11	Mercury DC-Motor Controller, 1 Channel, with Wide-Range Power Supply	PI	3	
actuators	M-219.10	M227 ball tip ends	PI	3	
actuators	LS-50	ASI translation stage for tower	ASI	2	
actuators	LE-ZF	Micro-E linear encoder for LS-50 stages	ASI	2	
actuators	MS2	MS2 LS 50 controller	ASI	1	
actuators	P-541.ZCD	Low-Profile Z-Nanopositioning Stage, 100µm, Cap. Sensors, Sub-D Connector	PI	1	

actuators	E-621.CR	Piezo Amplifier / Servo-Controller Module, 1 Channel, -30 to 130 V, Capacitive Sensor, USB, RS-232	PI	1	
actuators	P-612.2SL	XY Nanopositioning System with 20 x 20 mm Aperture, 100 x 100 μ m, Strain Gauge Sensors	PI	1	
actuators	E-621.SR	Piezo Amplifier / Servo-Controller Module, 1 Channel, -30 to 130 V, SGS-Sensor, USB, RS-232	PI	2	
actuators	E-501.621	9.5-Chassis for up to four E-621 Modules, Power Supply	PI	1	
actuators	N-565.260	high precision linear stage, replaces discontinued N664. 52mm travel	PI	1	
actuators	E-861.1A1	NEXACT Controller, 1 Channel, Linear Encoder	PI	1	
actuators	U-751.24	U-751 XY Stage with Piezomotors	PI	1	
actuators	C-867.2U2	C-867.2U2 PILine [®] Motion Controller	PI	1	
actuators	MT1/M-Z8	Motorized 12 mm Translation Stage, Metric	Thorlabs	2	
actuators	TDC001	T-Cube DC Servo Motor Controller	Thorlabs	2	
actuators	TPS001	15 V Power Supply Unit for a Single T-Cube	Thorlabs	2	
lightsources	CPS532-C2	Collimated Laser-Diode-Pumped DPSS Laser Module, 532 nm, 0.9 mW, Round Beam, \varnothing 11 mm Housing	Thorlabs	1	
lightsources	LP940-SF30	LP940-SF30 - 940 nm, 30 mW, A Pin Code, SM Fiber-Pigtailed Laser Diode, FC/PC	Thorlabs	1	
optomech	RC12FC-P01	RC12FC-P01 - Protected Silver Reflective Collimator, 450 nm - 20 μ m, \varnothing 12 mm Beam, FC/PC	Thorlabs	1	
optomech	SM15RR	SM15 Retaining Ring for \varnothing 15 mm Lens Mounts	Thorlabs	2	
detectors	ORCA FLASH C11440-22CU	SMS CAMERA	Hamamatsu	1	
detectors	CAMERALINK EXTENSION KIT	Frame Grabber CameraLink	Hamamatsu	1	
optomech	84889	USB Motorized Filter Wheel	Edmund Optics	1	
optomech	Stock #59-770	8-position Holder for 1" (25mm) Diameter Filters	Edmund Optics	1	

optomech	AJS100-0.5H-NL	High Precision Hex Adjustment Screw, 12.7 mm Travel, 100 TPI, Hex, No Lock	Newport	2	
hardware	NOA61	MIL-A-3920 Optical Adhesive with Resiliency, 1 oz.	Thorlabs	1	
hardware	91545A270	Nylatron Flat Washer 3/8" Screw Size, .51" OD, .02"-.04" Thick, Pack of 5	McMaster Carr	1	
hardware	9657K258	Steel Compression Spring Zinc-Pltd Music Wire,.250" L,.180" OD,.018" Wire, Pack of 12	McMaster Carr	1	
hardware	9001T15	Music Wire Ultra-Precision Compression Spring .500" Length, .18" OD, .018" Wire Diameter, Pack of 3	McMaster Carr	1	
hardware	9434K25	Music Wire Precision Compression Spring Zinc-Plated, .500" Length, .18" OD, .018" Wire, Pack of 5	McMaster Carr	1	
hardware	9657K46	Steel Compression Spring Music Wire, 1.0" L,.187" OD, .014" Wire Diameter, Pack of 12	McMaster Carr	1	
hardware	1986K53	Type 302 Stainless Steel Compression Spring 1.00" Length, .188" OD, .020" Wire Diameter, Pack of 6	McMaster Carr	1	
hardware	9434K32	Music Wire Precision Compression Spring Zinc-Plated, .875" Length, .18" OD, .026" Wire, Pack of 5	McMaster Carr	1	
Consumables	CSHP-No1.5-25	High Precision Glass Cover Slip, box of 100, 25mm diameter, No. 1.5.	Bioscience Tools C B Consulting	2	
hardware	1000T11	Ultraviolet Light with Stand, 2 Tubes, 365 NM Wavelength	McMaster Carr	1	
hardware	93285A210	Metric Nylon Tip 18-8 SS Socket Set Screw M4 Size, 4mm Length, 0.7mm Pitch, Pack of 5	McMaster Carr	1	
hardware	16399-10	Brass screws, M2 x 3, Pack of 10	Ted Pella, Inc.	1	
hardware	16399	SEM Clips 1/2" Length, Pack of 10	Ted Pella, Inc.	1	
hardware	4629T67	Compartmented Plastic Box Translucent, 4-24 Adj Compartments, 14" O'all Length	McMaster Carr	4	
tools	8647A42	Mitutoyo Standard Electronic Caliper 500-196-20, 0-6" (0-150mm) Range	McMaster Carr	1	
optics	PF20-03-P01	Protected silver mirror, 2"	Thorlabs	3	FM0, M21 and M22

optics	PF10-03-P01	Protected silver mirror, 1"	Thorlabs	2	
optomech	KM100	1" kinematic mirror mount	Thorlabs	1	
optomech	KM200	2" kinematic mirror mount	Thorlabs	1	
optics	AC508-300-A	300mm achromat	Thorlabs	1	L12
optomech	LMR2_M	2" fixed lens holder	Thorlabs	1	
hardware	MSVC4-20	M4x20 high precision dowel pin, EN1.4125 steel	Misumi, Euro	20	
hardware	MSVC4-15	M4x15 high precision dowel pin, EN 1.4125 steel	Misumi, Euro	120	
hardware	MSVC3-25	M3x25 high precision dowel pin, EN 1.4125 steel	Misumi, Euro	0	
hardware	MSVC-15	M3x15 high precision dowel pin, EN 1.4125 steel	Misumi, Euro	20	
hardware	MSVC3-10	M3x10 high precision dowel pin, EN 1.4125 steel	Misumi, Euro	0	
hardware	MSVC3-8	M3x8 high precision dowel pin, EN 1.4125 steel	Misumi, Euro	0	
hardware	TR-M4M6	M6M-M4Fx10 thread adapter, pack of 10	Newport	12 pcs	
hardware	SXSNS4-L0-P4-B8-H6.5-T1-E0.5	M4 to 4h6 dowel adapter	Misumi, Euro	20	
Sample	CG15XH	Precision Cover Glasses, #1.5H Thickness, Ø25 mm, Pack of 1000	Thorlabs	100 x 10	
hardware	16399	PELCO SEMClip™ Clips, pkg/10	Ted Pella	1	
hardware	16399-10	PELCO SEMClip™ Screws, Brass, M2 x 3mm length, pkg/10	Ted Pella	1	