

# Prototype Sensing Device Design

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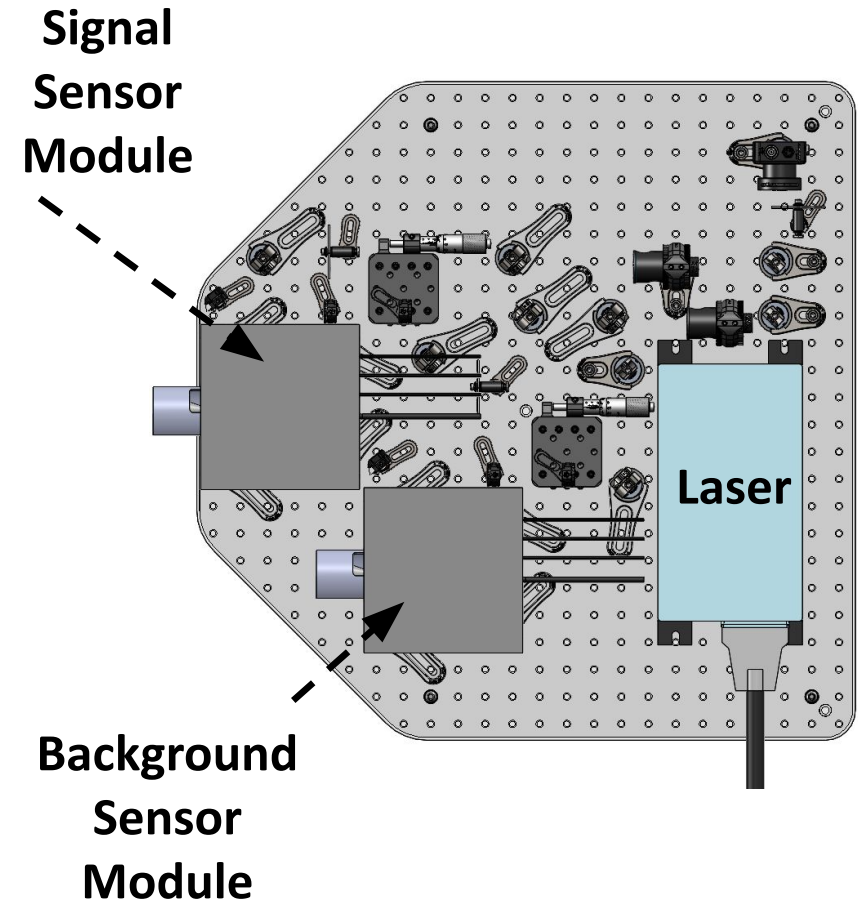
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# Sensor Head Opto-Mechanics

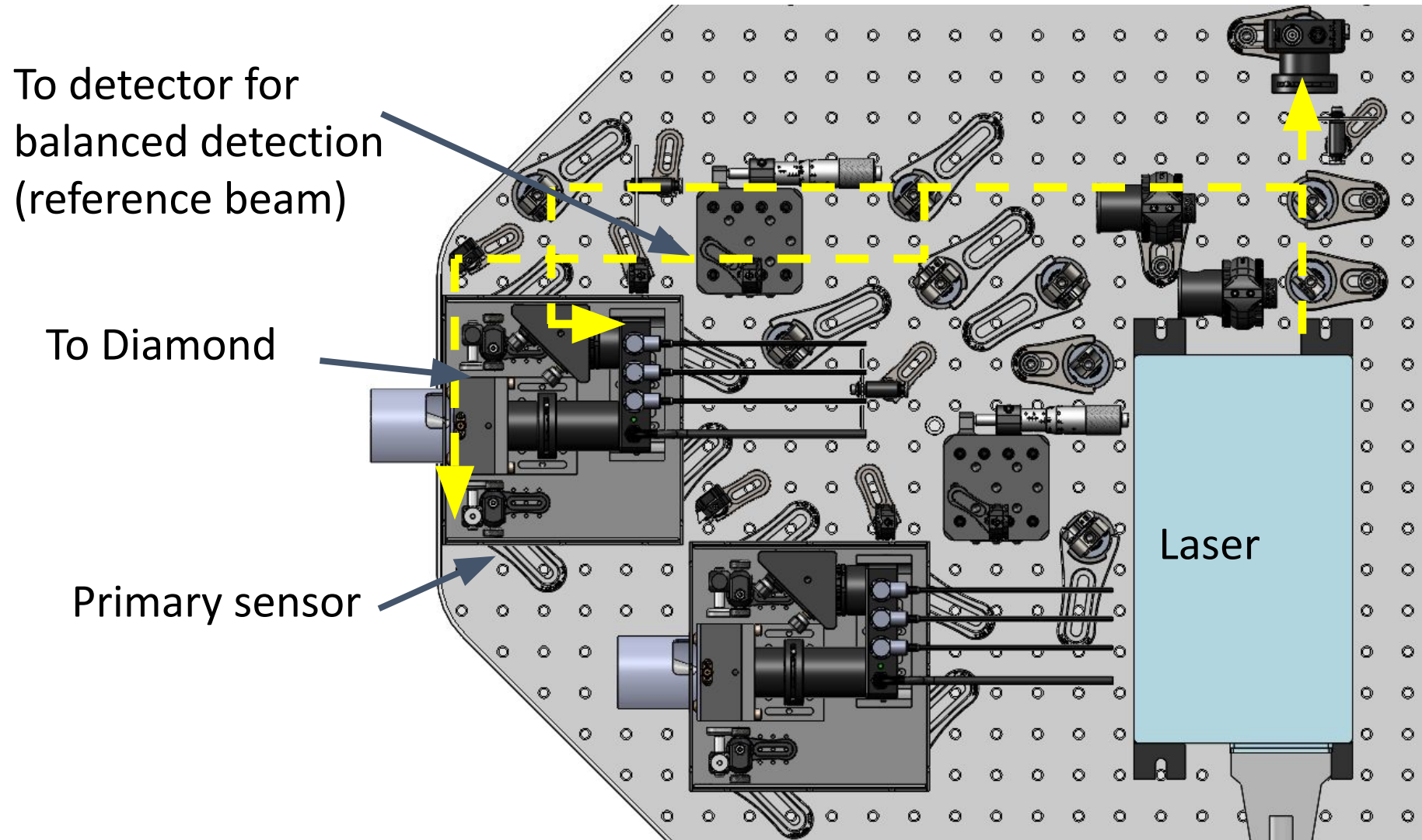
# Sensor head

- Stable mechanical design
- Gradiometry
- Basic design similar to current working configuration
- Improvements in sensors and beam delivery
  - May be checked in advance of full assembly
- Can go back to current design as backup



# Sensor head

laser light path to primary sensor for heart signal detection



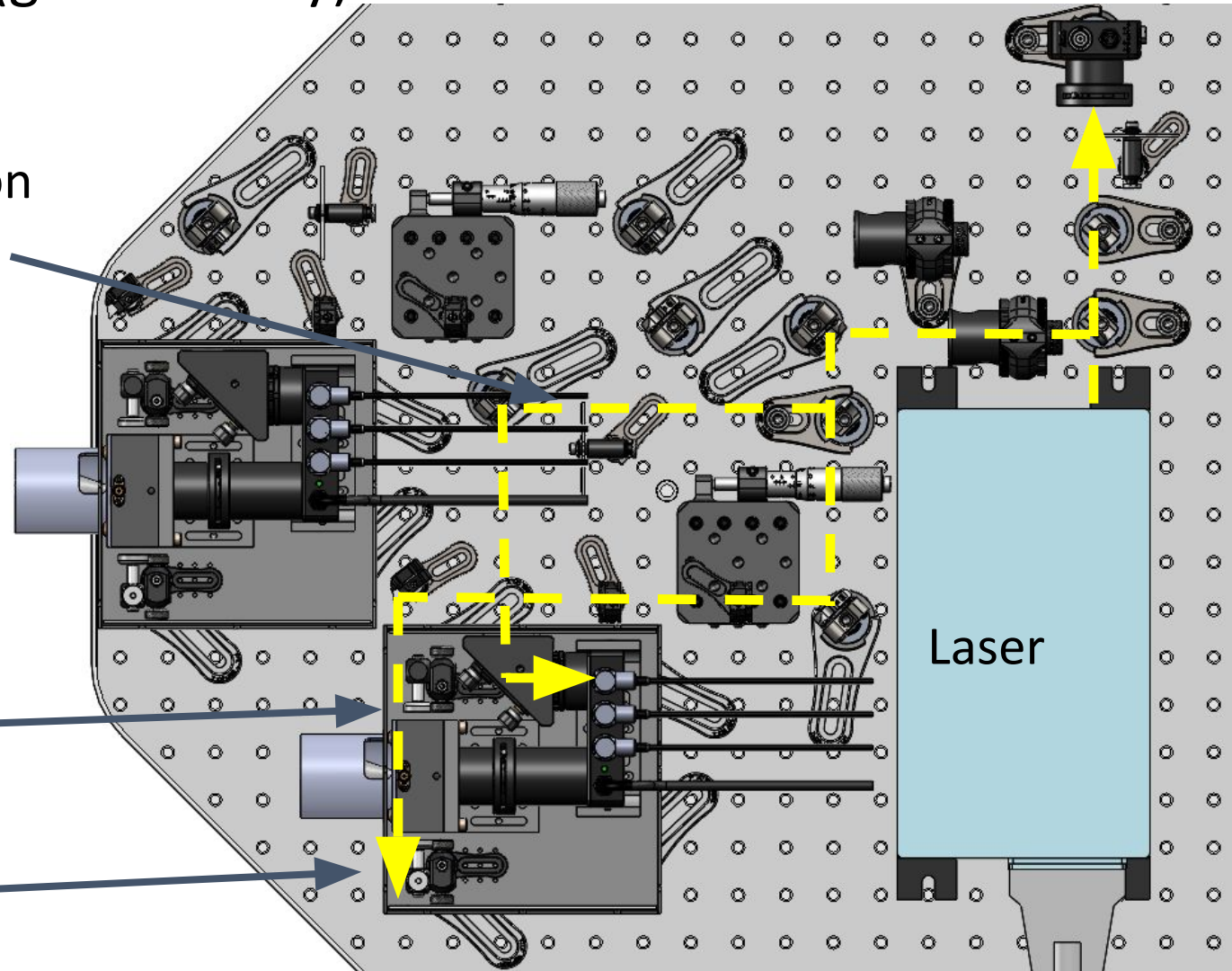
# Sensor head

Laser light path to secondary sensor for ambient noise subtraction (gradiometry)

To detector for  
balanced detection  
(reference beam)

To Diamond

Secondary  
sensor

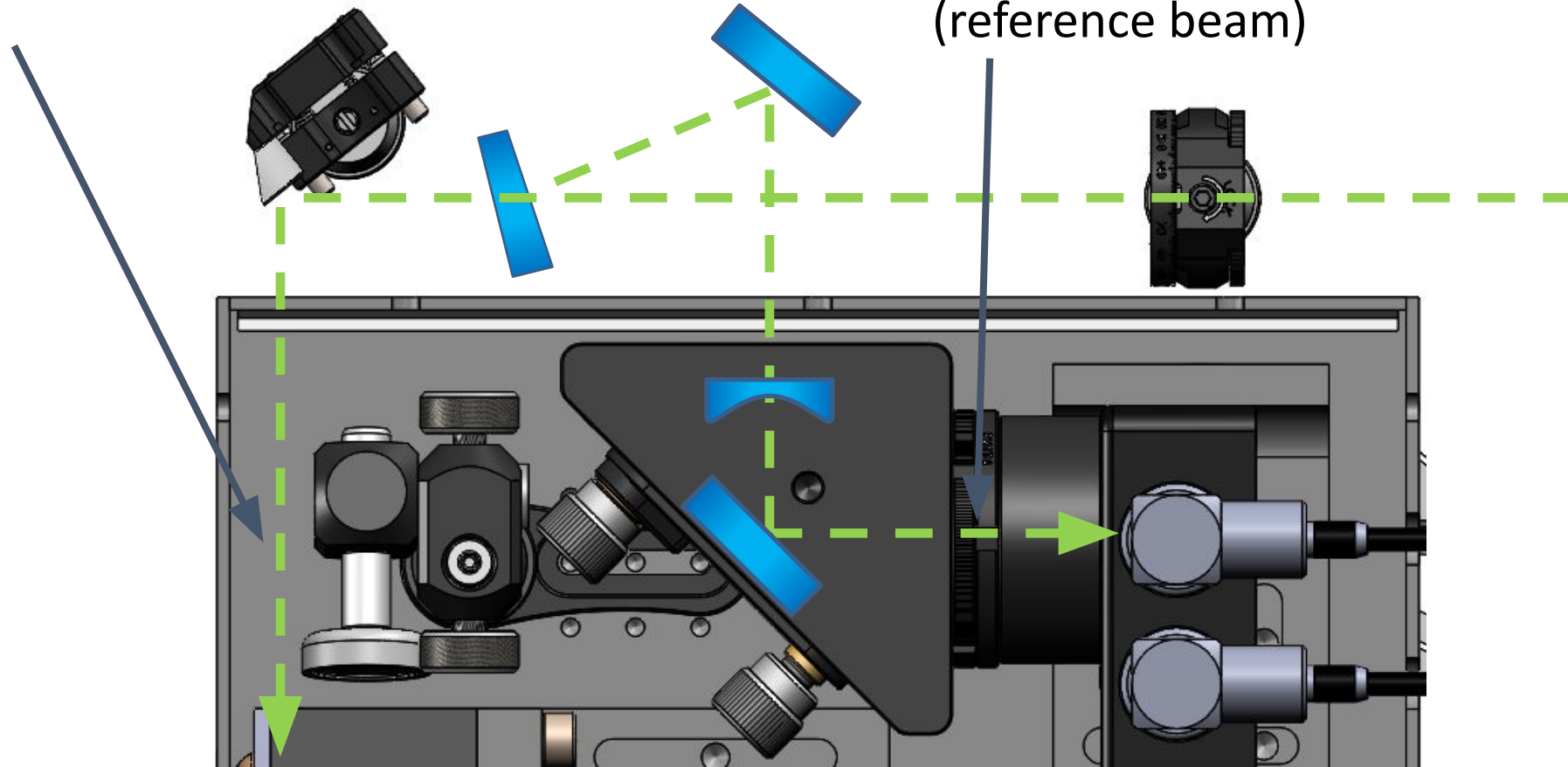


# Alternative Shorter Reference Beam Path

Goal is to keep path lengths short for stability

To Diamond

To detector for  
balanced detection  
(reference beam)



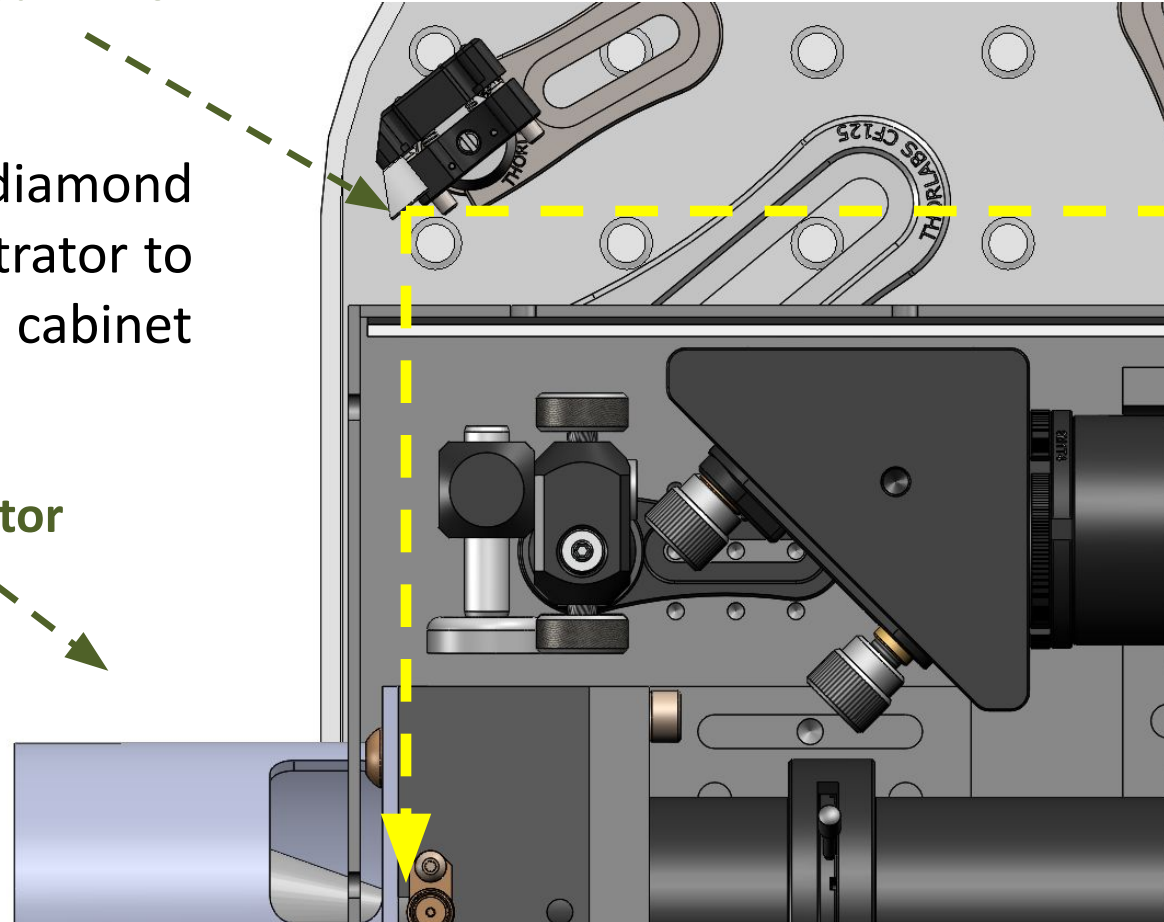


# Design Feature: D-Shaped Final Turn Mirror

**D-shaped mirror**

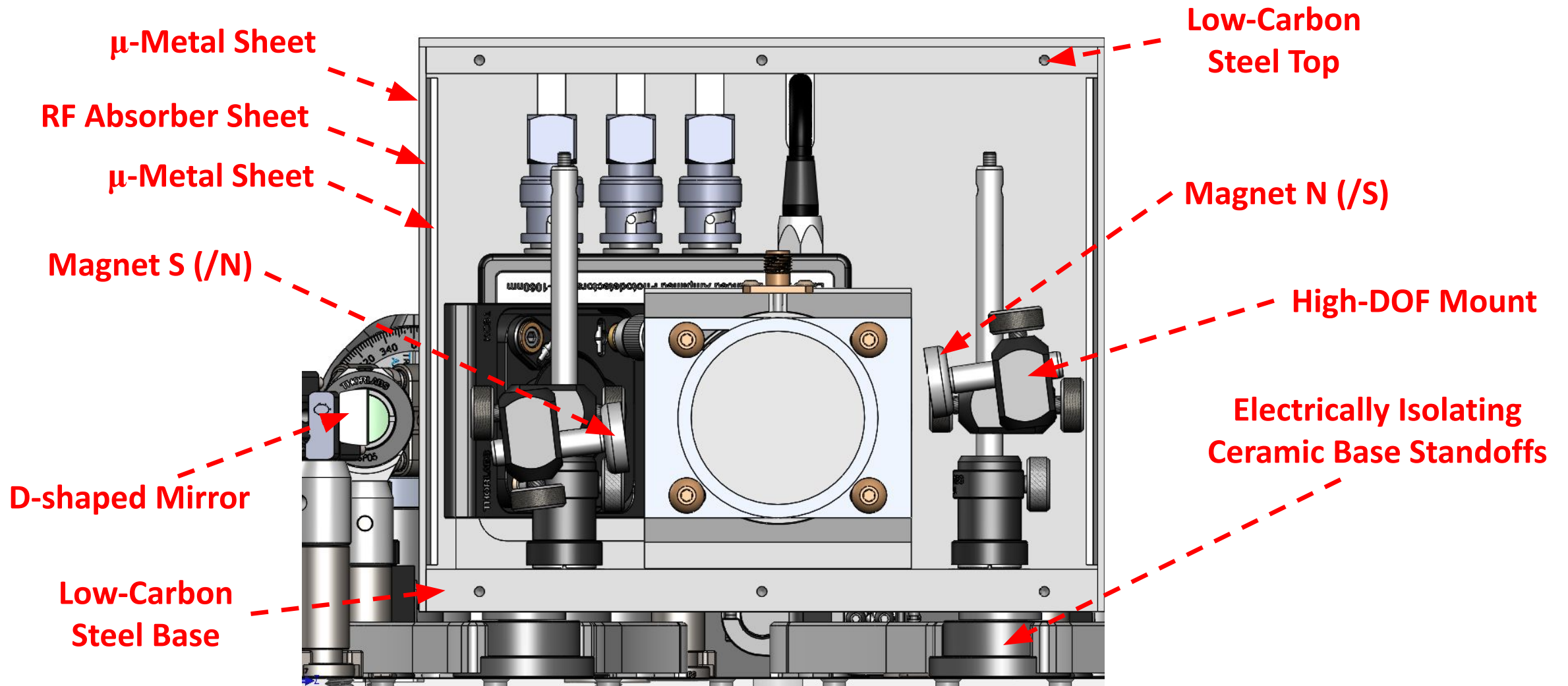
Half-mirror allows for diamond sensor and magnetic concentrator to extend further away from cabinet and closer to patient.

**Concentrator**



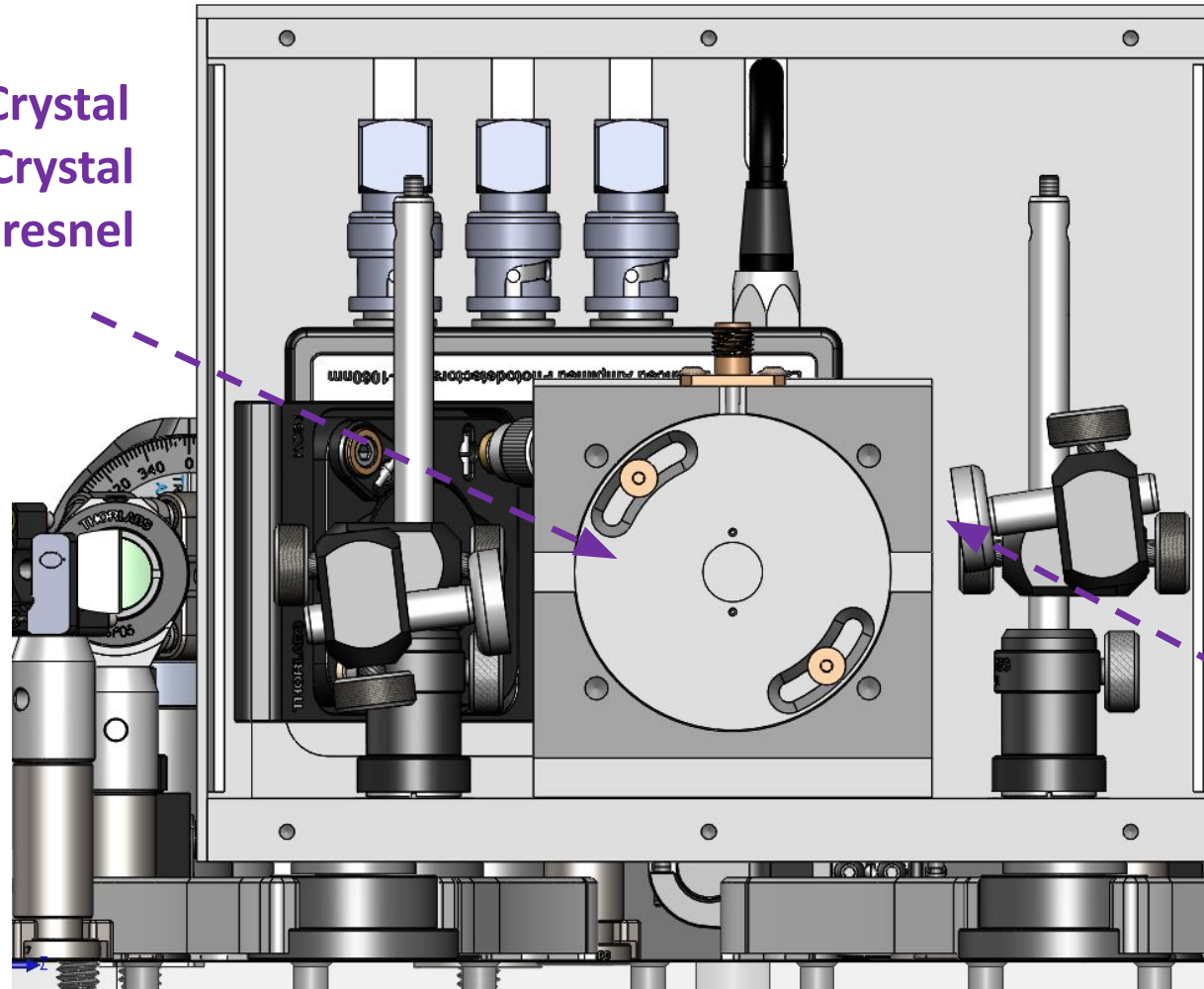


# Sensor Box Detail – Front Panel Removed



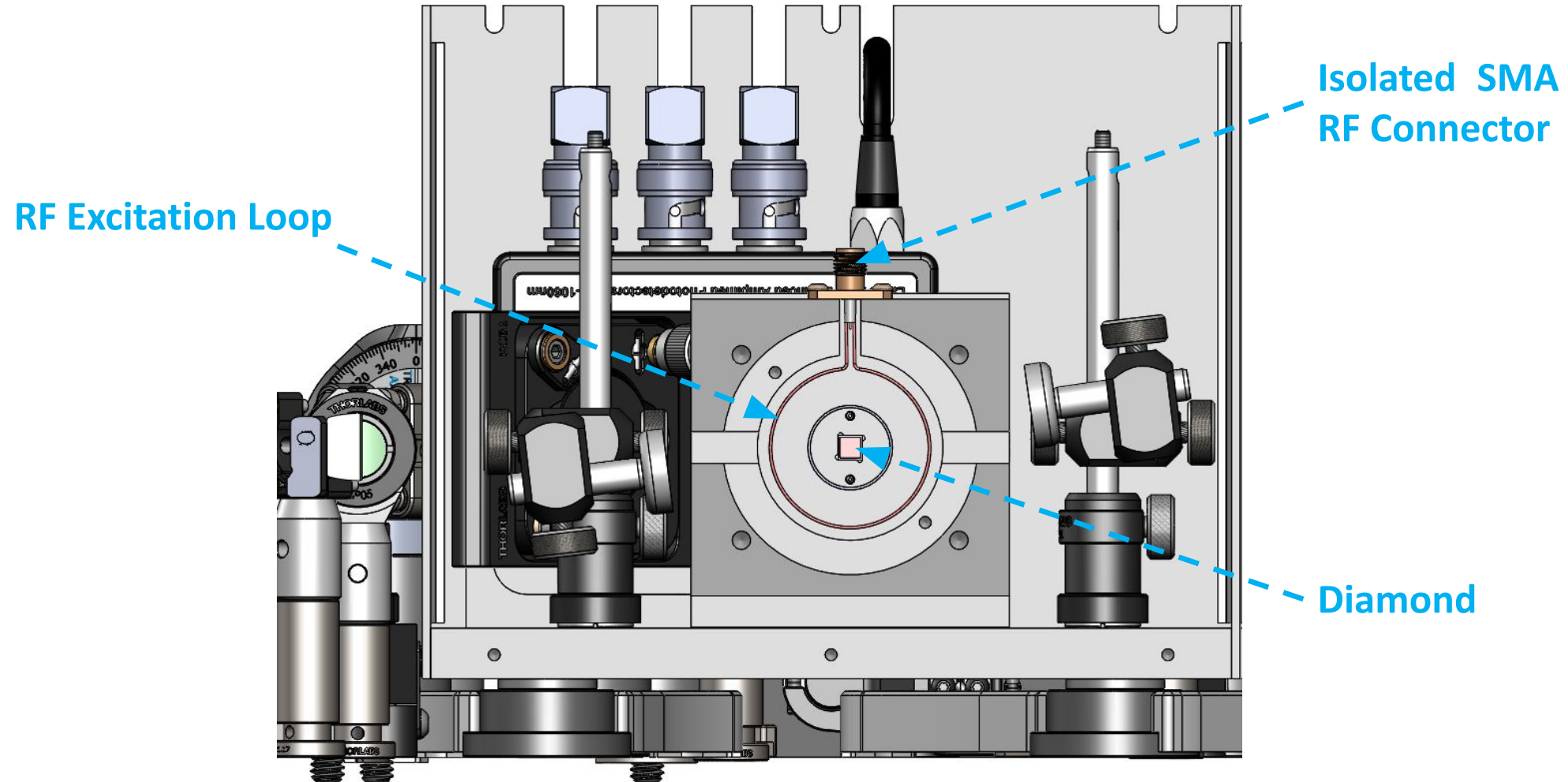
# Sensor Box – Concentrator Removed

Circular, Slotted Crystal Mount Permits Crystal Tilt to Control Fresnel Reflections.

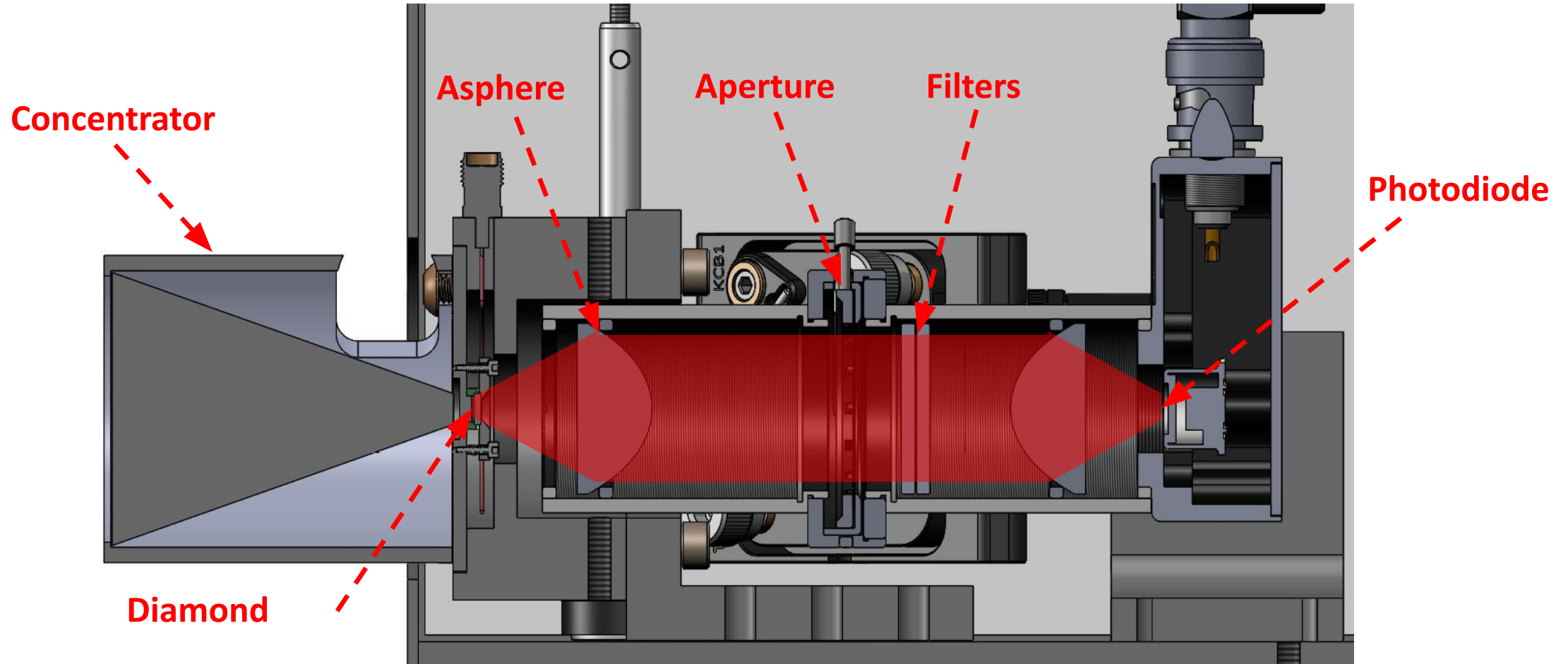


Note that High Strength Nd Magnets can be Attenuated by "Shorting" the Field Lines with Metal Discs.

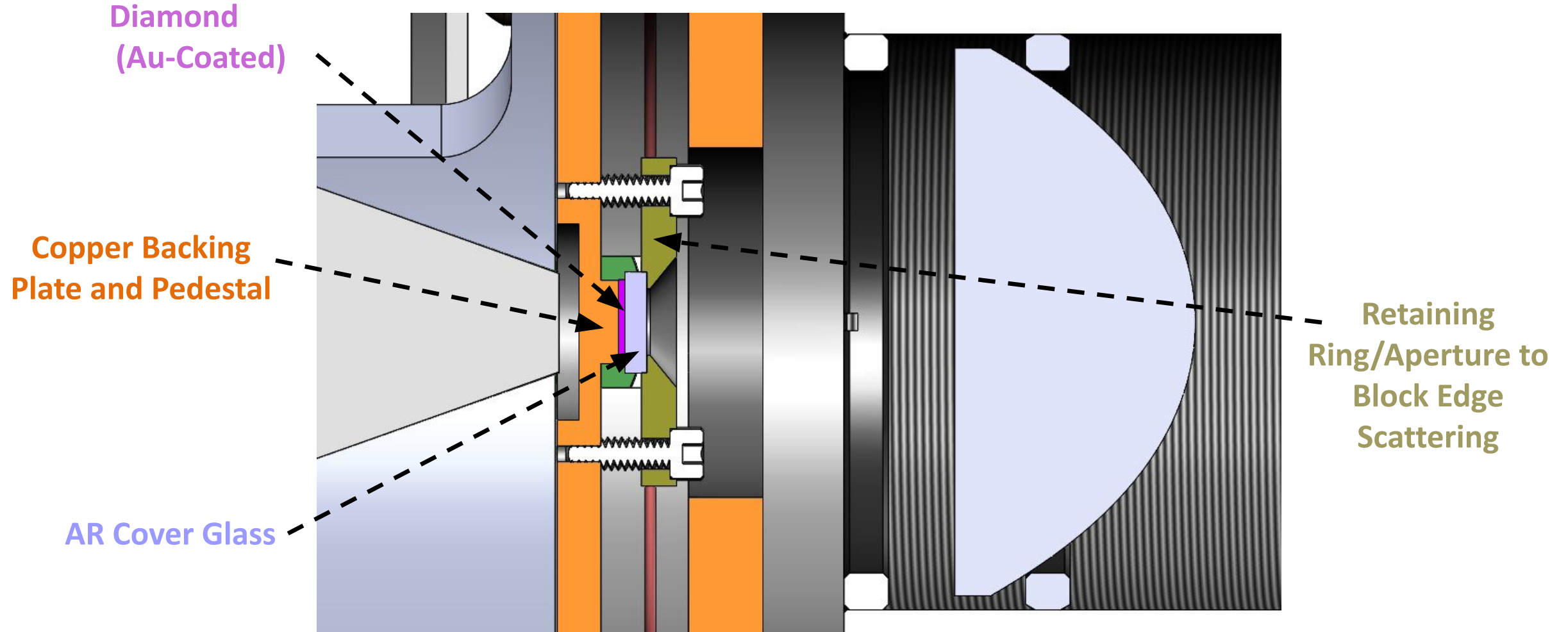
# Sensor Box – Backing Plate Removed



# Sensor Fluorescence Collection Side X-Section

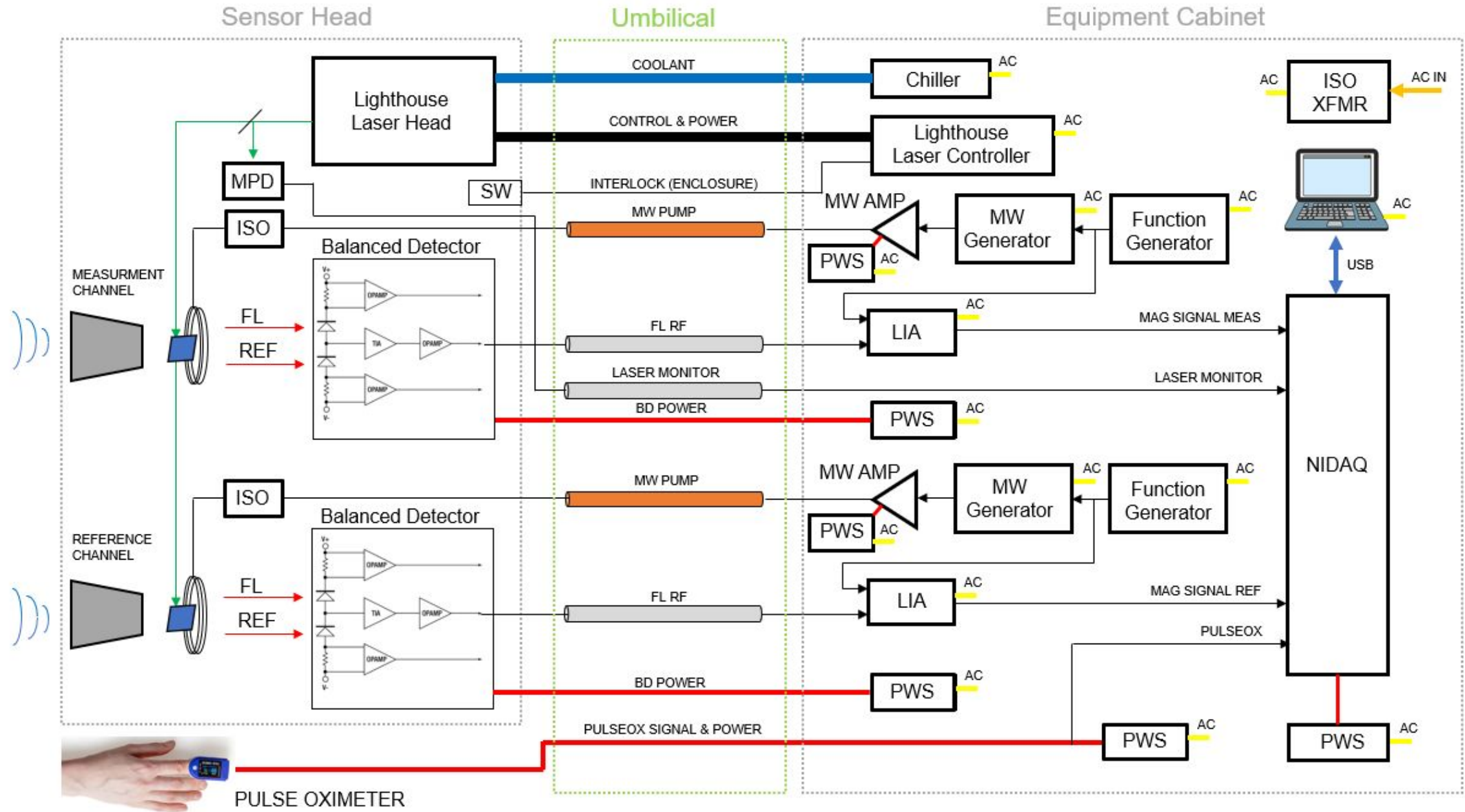


# NV Diamond Closeup X-Section



# Electronics

# Interconnection Diagram (V1.0)





# Optical Head Parts List

	Vendor	Description	Part Number	Qty	Unit
1	Thorlabs	Aluminum Breadboard, 24" x 24" x 3/4", 1/4"-20 Taps	MBH24	1	ea
2	Thorlabs	Self-Contained 25 mm Translation Stage, 1/4"-20 Taps	LX10	2	ea
3	Thorlabs	Clamping Fork for 1/4"-20 (M6) Cap Screw	MSC2	8	ea
4	Thorlabs	Rotation Mount for Ø1/2" (Ø12.7 mm) Optics, 8-32 Tap	RSP05	4	ea
5	Thorlabs	Ø1" Post, 1/4"-20 Tap, L = 0.31"	RS031	4	ea
6	Thorlabs	Right-Angle Kinematic Mirror Mount with Tapped Cage Rod Holes, 30 mm Cage System and SM1 Compatible, 8-32 and 1/4"-20 Mounting Holes	KCB1	2	ea
7	Thorlabs	Mini-Series Kinematic Mount for 1/2" Tall Rectangular Optics, Right Handed, 4-40 Taps	MK05S	4	ea
8	Thorlabs	Ø1" Pedestal Pillar Post, 1/4"-20 Taps, L = 1"	RS1P	2	ea
9	Thorlabs	Ø1" Ceramic Pedestal Pillar Post, Length = 1/2"	RS05PC	9	ea
10	Thorlabs	0.050" (1.3 mm) Hex Key Thumbscrew, 4 Pack	HKTS-050	1	ea
11	Thorlabs	Locking Collar for M2.5 x 0.20 Adjusters, 5 Pack	F10SC1-5	2	pkg
12	Thorlabs	Spanner Wrench for F2ESC1-5 M2 x 0.20 and F10SC1-5 M2.5 x 0.20 Locking Collars	SPW403	1	ea
13	Thorlabs	Ø0.47" Pedestal Pillar Post, 8-32 Setscrew, 1/4"-20 Tap, L = 1.168"	TRP1.17	2	ea
14	Thorlabs	Dual Rotation Mount for Ø1" Optics, Two Interchangeable Rotating Carriages, 8-32 Tap	DLM1	2	ea
15	Thorlabs	Mounted Glan-Laser Polarizer, Ø10 mm CA, AR Coating: 350 - 700 nm	GL10-A	2	ea
16	Thorlabs	Ø1/2" Zero-Order Half-Wave Plate, SM05-Threaded Mount, 532 nm	WPHSM05-532	2	ea
17	Thorlabs	SM1 Lens Tube Mount for 8 mm and 10 mm Mounted Polarizing Prisms	SM1PM10	2	ea

18	Thorlabs	Releasable Cable Ties, 7.6 mm (0.3") Wide (Qty. 100)	CMS011	1	pkg
19	Thorlabs	Cable Tie Bases for 7.6 mm (0.3") Wide Ties (Qty. 250)	CMS010	1	pkg
20	Thorlabs	Screw-On Cable Straps (Qty. 15)	CS1	1	pkg
21	Thorlabs	Slit Harness Wrap, 5 m (16.5 ft), Insertion Tool Included	CMS015	1	ea
22	Thorlabs	Ø1/2" Aluminum Post, 8-32 Setscrew, 1/4"-20 Tap, L = 1"	TRA1	8	ea
23	Thorlabs	Ø1/2" Aluminum Post, 8-32 Setscrew, 1/4"-20 Tap, L = 4"	TRA4	4	ea
24	Thorlabs	Ø1/2" Aluminum Post, 8-32 Setscrew, 1/4"-20 Tap, L = 6"	TRA6	4	ea
25	Thorlabs	SM1 Lens Tube Without External Threads, 1/2" Long, Two Retaining Rings Included	SM1M05	4	ea
26	Thorlabs	SM1 Lever-Actuated Iris Diaphragm (Ø1 - Ø25 mm)	SM1D25	3	ea
27	Thorlabs	SM1 (1.035"-40) Coupler, External Threads, Fixed Shoulder and Locking Ring	SM1T4	4	ea
28	Thorlabs	Si Switchable Gain Detector, 320 - 1100 nm, 11 MHz BW, 75.4 mm2, Universal 8-32 / M4 Taps	PDA100A2	1	ea
29	Thorlabs	Adapter with External SM1 Threads and Internal SM05 Threads, 0.15" Long	SM1A6	2	ea
30	Thorlabs	Polaris® Ø1/2" Mirror Mount, 3 Low-Profile Hex Adjusters	POLARIS-K05	8	ea
31	Thorlabs	Ø1" Pedestal Pillar Post, 1/4"-20 Taps, L = 1.5"	RS1.5P	10	ea
32	Thorlabs	Ø1" Post, 1/4"-20 Tap, L = 0.28"	RS028	8	ea
33	Thorlabs	Adapter with Internal 8-32 Threads and External 1/4"-20 Threads, 0.38" Length	AE8E25E	20	ea
34	Thorlabs	Ø1" Pillar Post, 1/4"-20 Taps, L = 0.5"	RS05	2	ea
35	Thorlabs	Ø1" Post, 1/4"-20 Tap, L = 0.39"	RS039	2	ea
36	Thorlabs	Clamping Fork, 1.24" Counterbored Slot, Universal, 5 Pack	CF125-P5	3	pkg
37	Thorlabs	Clamping Fork, 0.38" Counterbored Slot, Universal, 5 Pack	CF038-P5	2	pkg

38	Thorlabs	Polaris Ø1/2" Glue-In Fixed Mount, Optimized for Beamsplitters	POLARIS-B05G	6	ea
39	Thorlabs	Ø0.47" Pedestal Pillar Post, 8-32 Setscrew, 1/4"-20 Tap, L = 0.75"	TRP075	2	ea
40	Thorlabs	Ø0.47" Pedestal Pillar Post, 8-32 Setscrew, 1/4"-20 Tap, L = 1.0"	TRP1		ea
41	Thorlabs	Ø1/2" Optical Post, SS, 8-32 Setscrew, 1/4"-20 Tap, L = 0.75"	TR075-P5	1	pkg
42	Thorlabs	Adapter with External 8-32 Threads and External 4-40 Threads	AP8E4E	10	ea
43	Thorlabs	Mini-Series Kinematic Mirror Mount for Ø1/2" Optics, 4-40 Taps	MK05	2	ea
44	Thorlabs	External SM05 Thread to Ø1/2" Optic Mount Adapter	SM05P05	2	ea
45	Thorlabs	Adapter with External SM1 Threads and Internal SM05 Threads, 0.15" Long	SM1A6	2	ea
46	Thorlabs	SM1 (1.035"-40) Locking Ring, 1.25" Outer Diameter, Slots for Spanner Wrench	SM1NT1	2	ea
47	Thorlabs	Extra-Thick SM1 (1.035"-40) Threaded Retaining Ring	SM1RRC	4	ea
48	Thorlabs	SM1 (1.035"-40) Stress-Free Retaining Ring	SM1LTRR	2	ea
49	Thorlabs	MIL-A-3920 Optical Adhesive with Resiliency, 1 oz.	NOA61	1	ea
50	Thorlabs	SM1 Retaining Ring for Ø1" Lens Tubes and Mounts, 10 Pack	SM1RR-P10	1	pkg
51	Thorlabs	Mini-Series Optical Post, Ø6 mm, L = 3"	MS3R	4	ea
52	Thorlabs	Mini-Series Optical Post, Ø6 mm, L = 1"	MS1R	4	ea
53	Thorlabs	Mini-Post Swivel Post Clamp, 360° Continuously Adjustable	MSWC	4	ea
54	Thorlabs	Mini-Series Optical Post, Ø6 mm, L = 0.5"	MS05R	4	ea
55	Thorlabs	Tapped Mini-Series Construction Cube, 4-40 Taps	MSCB1	4	ea
56	Thorlabs	Swivel-Base Mini-Series Post Holder, 3/4" (19 mm) Tall, #4 (M3) Slot	MSH075	4	ea

57	Thorlabs	SM1 Lens Tube, 1.50" Thread Depth, One Retaining Ring Included	SM1L15	4	ea
58	Thorlabs	Ø1/2" Broadband Dielectric Mirror, 400 - 750 nm, 10 Pack	BB05-E02-10	1	pkg
59	Thorlabs	Ø1" Broadband Dielectric Mirror, 400 - 750 nm	BB1-E02	2	ea
60	Thorlabs	Ø1/2" UVFS Beam Sampler for Beam Pick-Off, ARC: 350-700 nm, 3 mm Thick	BSF05-A	2	ea
61	Thorlabs	Ø1/2" 50:50 Laser Line Plate Beamsplitter, Coating: 532 nm, t = 3.0 mm	BSW40-532	1	ea
62	Thorlabs	Ø1/2" 90:10 (R:T) UVFS Plate Beamsplitter, Coating: 400-700 nm, t = 3 mm	BSX04	2	ea
63	Thorlabs	Ø1/2" 10:90 (R:T) UVFS Plate Beamsplitter, Coating: 400-700 nm, t = 3 mm	BSN04	2	ea
64	Thorlabs	Ø1/2" 70:30 (R:T) UVFS Plate Beamsplitter, Coating: 400 - 700 nm, t = 3 mm	BST04	1	ea
65	Thorlabs	Ø25 mm Neutral Density Filter, AR Coated: 350-700 nm, OD: 0.3	NE03B-A	2	ea
66	Thorlabs	Ø25 mm Neutral Density Filter, AR Coated: 350-700 nm, OD: 0.5	NE05B-A	2	ea
67	Thorlabs	Ø25 mm Neutral Density Filter, AR Coated: 350-700 nm, OD: 1.0	NE10B-A	2	ea
68	Thorlabs	Unmounted Ø25 mm Absorptive ND Filter, Optical Density: 2.0	NE20B	4	ea
1	Edmund Optics	25mm Dia., 0.83 Numerical Aperture NIR Coated, Aspheric Lens	67-259	4	ea
2	Edmund Optics	12.7mm x -25mm FL, VIS 0° Imaging Grade PCV Cylinder Lens	34-659	4	ea
3	Edmund Optics	12.7mm Dia x 100mm FL, VIS 0° Imaging Grade PCX Cylinder Lens	34-650	2	ea
4	Edmund Optics	12.7mm x -50mm FL, VIS 0° Imaging Grade PCV Cylinder Lens	34-660	2	ea

1	K&J Magnetics	Diameter = 5/8" (0.625") Height = 3/16" (0.188") Threaded Male Stud = #4-40 UNC 2A NdFeB, Grade N42 Plating Nickel Magnetization Direction: Axial (Poles on Flat Ends) Weight: 0.244 oz. (6.931 g) Pull Force: 15.63 lbs	MMS-C-A	6	ea
2	K&J Magnetics	1/2" dia. x 1/8" thick NdFeB, Grade N42SH Plating Nickel Magnetization Direction: Axial (Poles on Flat Ends) Weight: 0.106 oz. (3.02 g) Pull Force 6.44 lbs Surface Field: 2952 Gauss	D82SH	4	ea
3	K&J Magnetics	NdFeB, Grade N52, 1/2" dia. x 1/8" thick, Plating Black Nickel Magnetization Direction: Axial (Poles on Flat Ends) Weight: 0.106 oz. (3.02 g) Pull Force, 7.97 lbs Surface Field: 3309 Gauss	D82B-N52	4	ea
4	K&J Magnetics	1/2" dia. x 1/8" thick NdFeB, Grade N42 Plating Ni-Cu-Ni (Nickel) Magnetization Direction: Diametrical Weight: 0.106 oz. (3.02 g) Pull Force 2.79 lbs Surface Field: 7157 Gauss	D82DIA	2	ea
5	K&J Magnetics	1/2" dia. x 1/4" thick NdFeB, Grade N52 Plating Black Nickel Magnetization Direction: Axial (Poles on Flat Ends) Weight: 0.213 oz. (6.03 g) Pull Force 13.47 lbs Surface Field: 5233 Gauss	D84B-N52	4	ea