

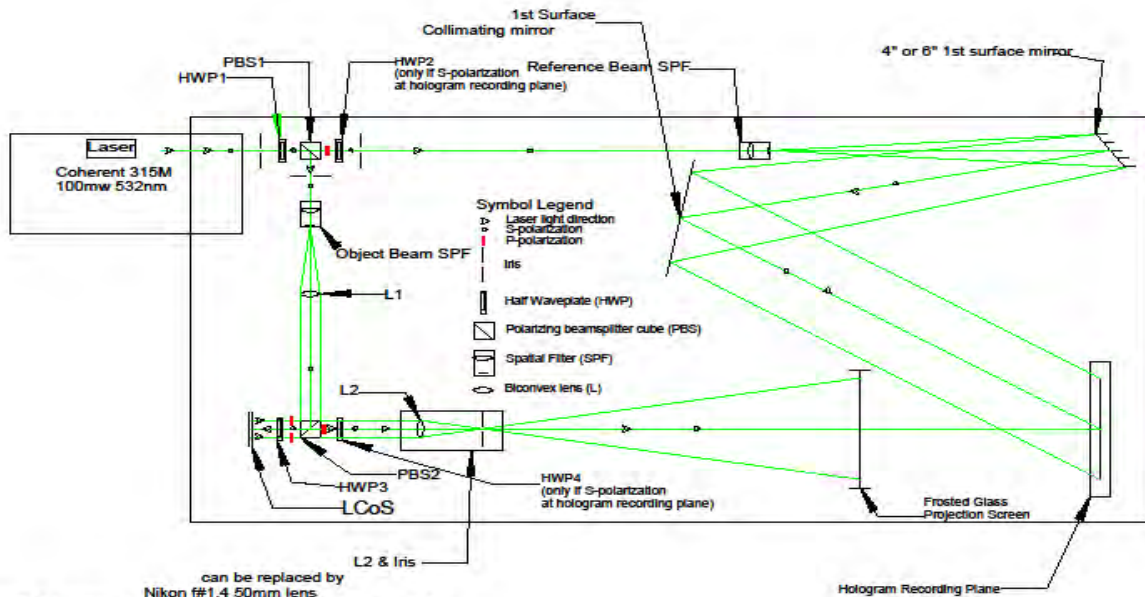
Anatomy of an H1 Hologram Integral LCoS SLM Setup

July 28, 2021

©Joseph Burns

Hologram Research

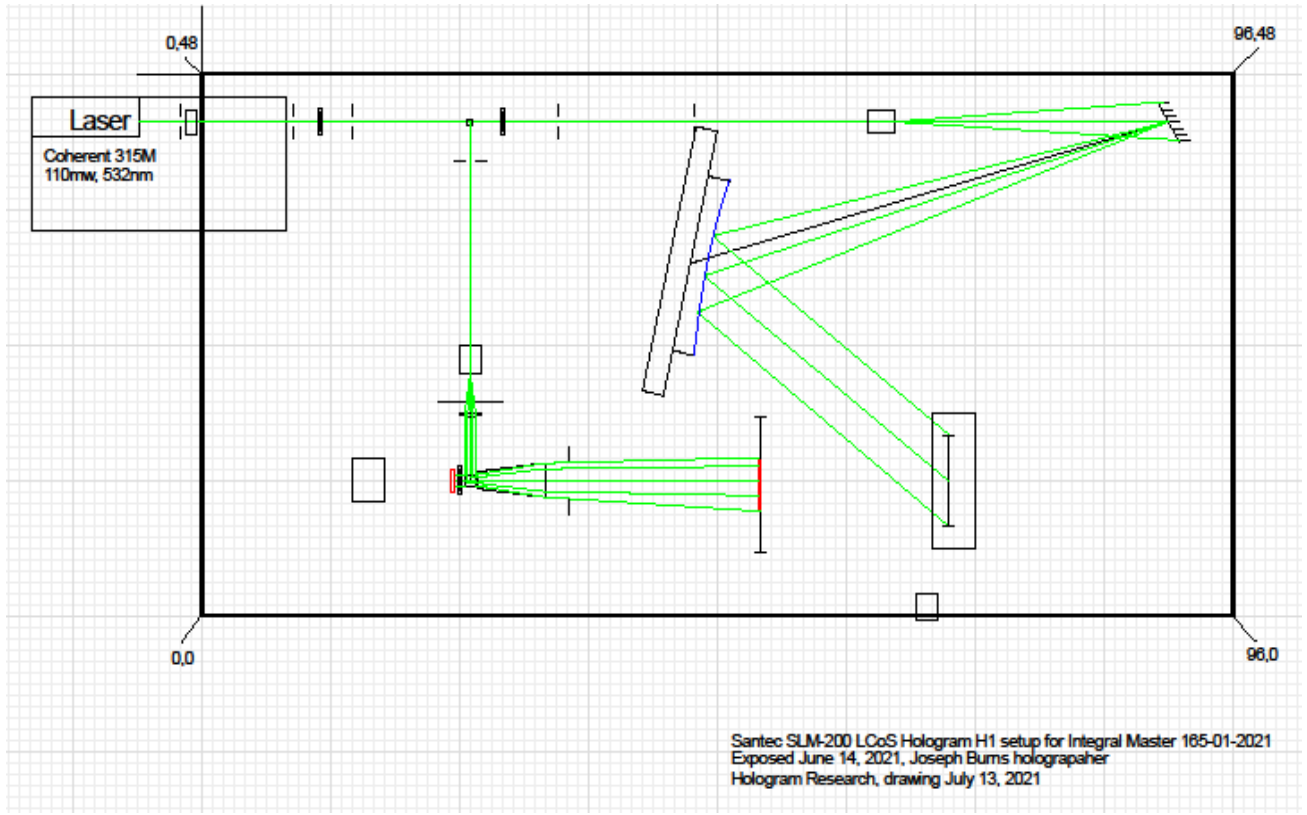
Original Prospective Setup Design, Feb. 2021:

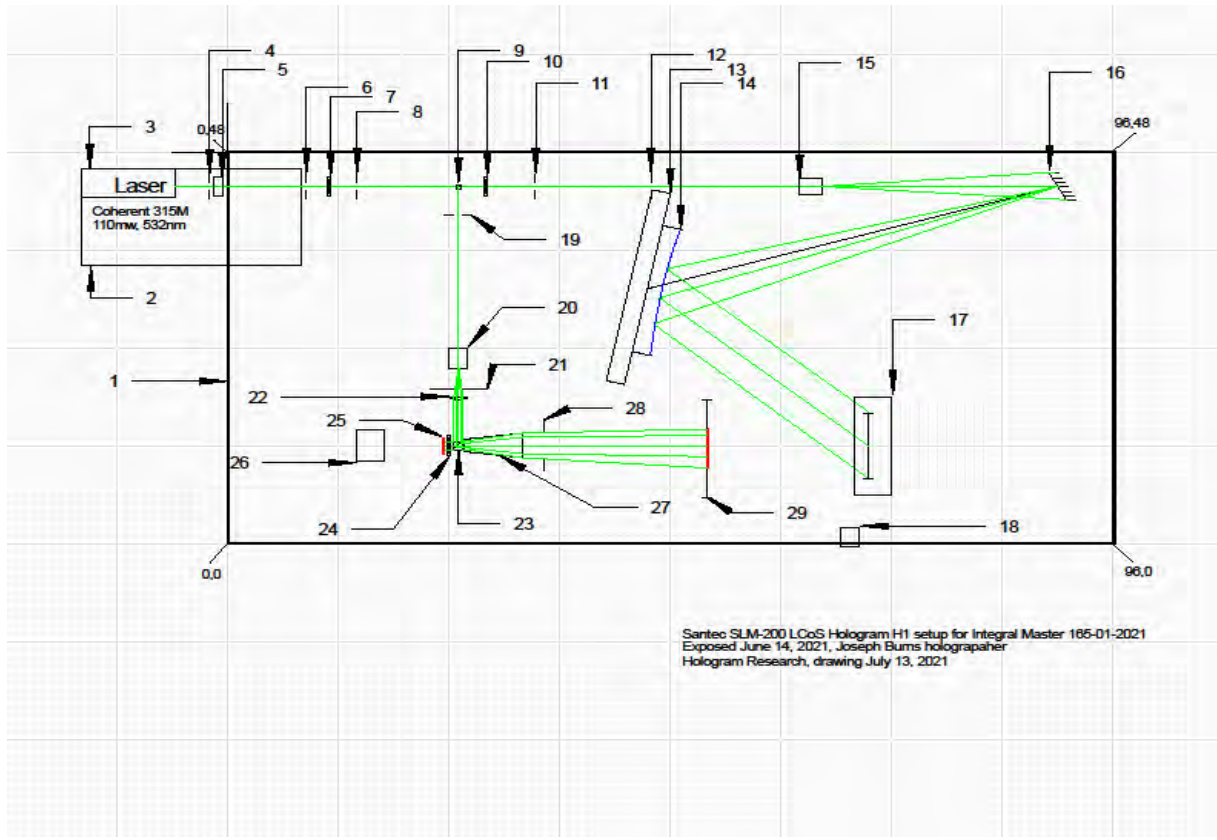


- can be replaced by Nikon #1.4/50mm lens
- HWP1 & HWP2/1"** rotation mounts: 12.7mm, clear aperture 11.5mm
- PBS1:** 12.7mm x 12.7mm x 12.7mm
- HWP3 & HWP4/30mm** rotation mounts: 25.4mm, clear aperture 22.8mm
- PBS2:** 32mm x 32mm x 32mm
- SPF (object beam):** 10-30X microscope objective + pinhole
- L1:** small 1-2" diam. collimating lens, beam to minimize gaussian & fill 1" evenly
- L2:** Nikon #1.4/50mm lens
- SPF (reference beam):** 30-100X microscope objective + pinhole
- 1st surface mirror (reference beam):** 4-6" depending on SPF divergence needed
- 1st surface collimating mirror:** 6-16" depending on H1 longest diagonal
- Hologram plate holder:** depends on size of H1 (from 2x2" to 12x16" plate)
- 3-4 on-table adjustable irises**
- LCoS mounting:** to be determined

Prospective LCoS based H1 hologram mastering system
 Joseph Burns
 Hologram Research
 Feb. 2021

Actual June 14, 2021, Setup to Scale:



Actual June 14, 2021, Setup to Scale with Numbered Leaders:

List of Numbered Leaders: [Click a description below for more detail/photos about item # and Glossary.](#)

CAD#	NAME
1	Newport (NRC) 4'x8'x12" table
2	Melles Griot (MG) 23.75"x11.5"x1.75" breadboard
3	Coherent 315M 532nm 110mw laser
4	U/I 2.75" iris
5	NRC 846HP shutter head
6	NRC 1.5" ID iris
7	Union Optic (UO) 12.7mm half waveplate (HWP)
8	NRC 1" ID iris
9	UO 12.7mm polarizing beam splitter cube (PBS)
10	UO 12.7mm HWP
11	NRC 1" ID iris
12	NRC 1" ID iris
13	NRC 2'x2'x 2 11/16" breadboard

- 14 [Hubble Optics 16" f#4.5 collimating mirror](#)
- 15 [NRC 910A reference beam \(RB\) spatial filter \(SPF\)](#)
- 16 [NRC 4" 1st surface mirror](#)
- 17 [Data Optics 5051 plateholder \(PH\)](#)
- 18 [NRC model \(mdl\) 100 magnetic base and slit mechanism](#)
- 19 [NRC 1" ID iris](#)
- 20 [NRC 910A object beam \(OB\) SPF](#)
- 21 [U/I 2.75" iris](#)
- 22 [NRC 2" PAC086 achromatic lens](#)
- 23 [UO 25.4mm PBS2](#)
- 24 [ColorLink 25.4mm TCA-18 trim retarder](#)
- 25 [Santec SLM-200 LCoS spatial Light modulator \(SLM\)](#)
- 26 [Santec SLM-200 controller](#)
- 27 [InFocus \(Hitachi\) SL-502 projection zoom lens](#)
- 28 [U/I 6" iris](#)
- 29 [Stewart Filmscreen 12"x12"x0.25"Aeroglas 100 frosted glass](#)

Components not on table and essential to setup:

- 30 [Lenovo S1 Yoga Laptop computer](#)
- 31 [Custom hardware & LabVIEW software automation controllers](#)
- 32 [Oasis 150 Chiller](#)

Masterlist: Terminology, Equipment manufacturers, Miscellaneous

Detailed List of Components used, by CAD Leader Number:**Component #1:** [Click here to return to item list](#)

Newport (NRC) 4'x8'x12" vibration isolation table

Sub-Components:

Four NRC air piston table isolation legs from 1975 5'x12'x18" table

Comments: Table not isolated for these exposures; table surrounded by enclosed freestanding detached hood.



Component #2: [Click here to return to item list](#)

Melles Griot (MG) 23.75"x11.5"x1.75" breadboard

Sub-components:

Two NRC B-1 slotted plates & two NRC EX-2.5 clamp screws

Comments: Two @ B-1 & EX-2.5 secure breadboard to table, MG extends 15.25" off table & 12.75" outside table detached hood. Purpose is to have laser and shutter outside hood.



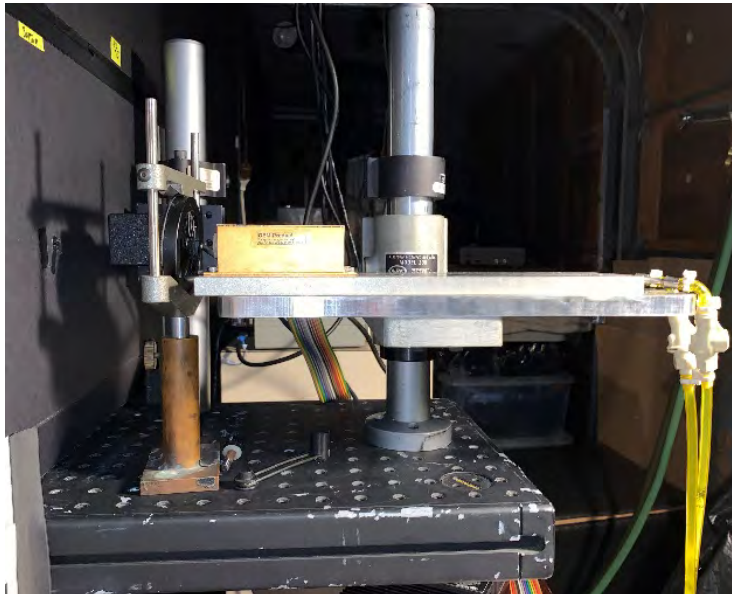
Component #3: [Click here to return to item list](#)

Coherent 315M 532nm 110mw laser

Sub-components:

Sam G. coldplate, connected by PVC tubing with Colder quick release fittings to Oasis 150 solid state chiller, coldplate screwed to BaseLabTools double density 1/4-20 threaded breadboard, NRC mdl 300 rod platform, NRC mdl 32A vertical adjuster, NRC mdl 45 rod, two rod rings under mdl 300, 315M laser controller with dongle, Vicor power supply

Comments: Mdl 45 rod bolted to MG & holds mdl 300. 32A provides fine vertical adjustment of beam height. All items attached to mdl 300, Optical axis 8.5".



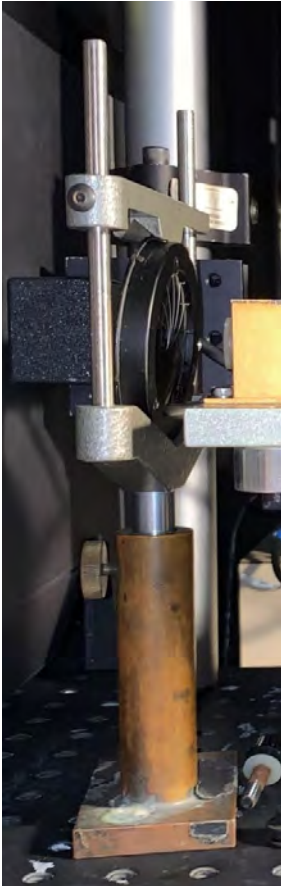
Component #4: [Click here to return to item list](#)

Unidentified (U/I) 2.75" iris

Sub-components:

4" VLH style holder with post (Gaertner or Klinger?) in brass VPH style (Bell Labs?), NRC
BC-2 table clamps.

Comments: VLH & VPH hold iris, base of VPH secured to MG with BC-2 clamp. Purpose is to minimize scatter to and from laser.



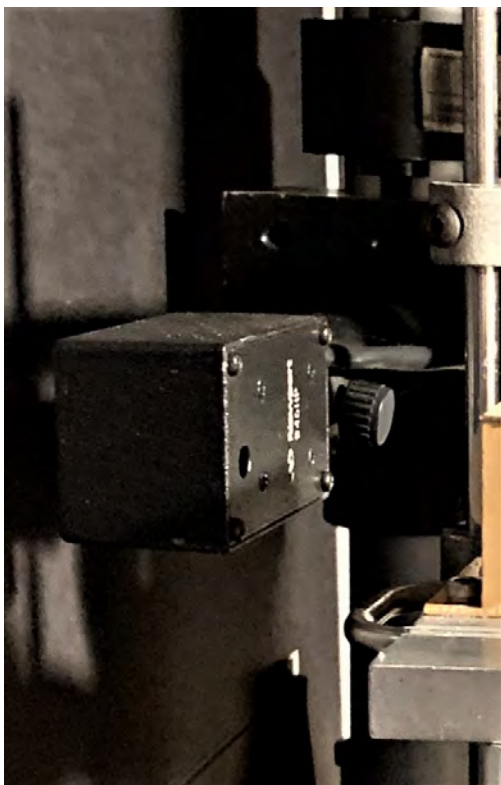
Component #5: [Click here to return to item list](#)

NRC 846HP shutter head

Sub-components:

NRC SP-2 (1/2" diam. threaded steel post), NRC VPH-4, NRC 300-P w/ platform removed, NRC 40 rod, 32A, rod ring, NRC mdl 845 shutter controller w/ custom cable.

Comments: 846HP screwed to SP-2 inserted in VPH-4 screwed to center hole of 300-P attached to mdl 40. 32A adjusts shutter vertically, rod ring under 300-P.



Component #6: [Click here to return to item list](#)

NRC 1.5" ID iris

Sub-components:

NRC SP-2, NRC C-1 post collar, NRC VPH-6, NRC PS-AZ low force magnetic base.

Comments: Iris screwed to SP-2, w/ C-1 on it, inserted into VPH-6 w/ PS-AZ screwed to base.
PS-AZ allows small footprint stability but quick movement on steel table.

Component #7: [Click here to return to item list](#)

Union Optic (UO) 12.7mm half waveplate (HWP)

Sub-components:

NRC RM25A rotating mount for 25.4mm optics, SP-3, C-1, VPH-4, NRC MMB miniature magnetic base.

Comments: UO quartz zero-order cemented HWP in 25.4mm mount (WPZ2312-532-M25.4), inserted in RM25A, screwed to SP-3 w/ C-1, in VPH-4 on MMB. Rotates to control RB/OB beam ratio.

Components #8, 11, 12 & 19: [Click here to return to item list](#)

NRC 1" ID iris

Sub-components:

SP-2, C-1, VPH-6, PS-AZ.

Comments: Iris screwed to SP-2, w/ C-1 on it, inserted into VPH-6 w/ PS-AZ screwed to base.

Component #9: [Click here to return to item list](#)

UO 12.7mm polarizing beam splitter cube (PBS)

Sub-components:

Thorlabs (TL) BS127CAM, New Focus (NF) 9411, NRC PT-1C, SP-4, C-1, VPH-4, MMB.

Comments: UO PBS0112-515-532 cemented, inside BS127CAM, on 9411 prism table, and held on 9411 by PT-1C adjustable arm clamp, all screwed to SP-4 w/ C-1 in VPH-4 on MMB. PBS splits beam into reflected s-pol OB & straight through p-pol RB.

Component #10: [Click here to return to item list](#)

UO 12.7mm HWP

Sub-components:

RM25A, SP-3, C-1, VPH-4, NRC mdl 100.

Comments: UO quartz zero-order cemented in 25.4mm mount (WPZ2312-532-M25.4), inserted in RM25A, screwed to SP-3 w/ C-1, in VPH-4 on mdl 100. Rotates p-pol from PBS back to s-pol (locked).



Components #11 & 12: (see #8)**Component #13: [Click here to return to item list](#)**

NRC 2'x2'x 2 11/16" breadboard

Sub-components:

Mdl 40, mdl 100, two NRC mdl 360-90 right angle mounts.

Comments: Breadboard vertical on 2 11/16" edge on table, left front secured w/ lead shot filled mdl 40 rod w/ epoxied right angle iron, back is secured by two 360-90s pushed flush to back and screwed to table.

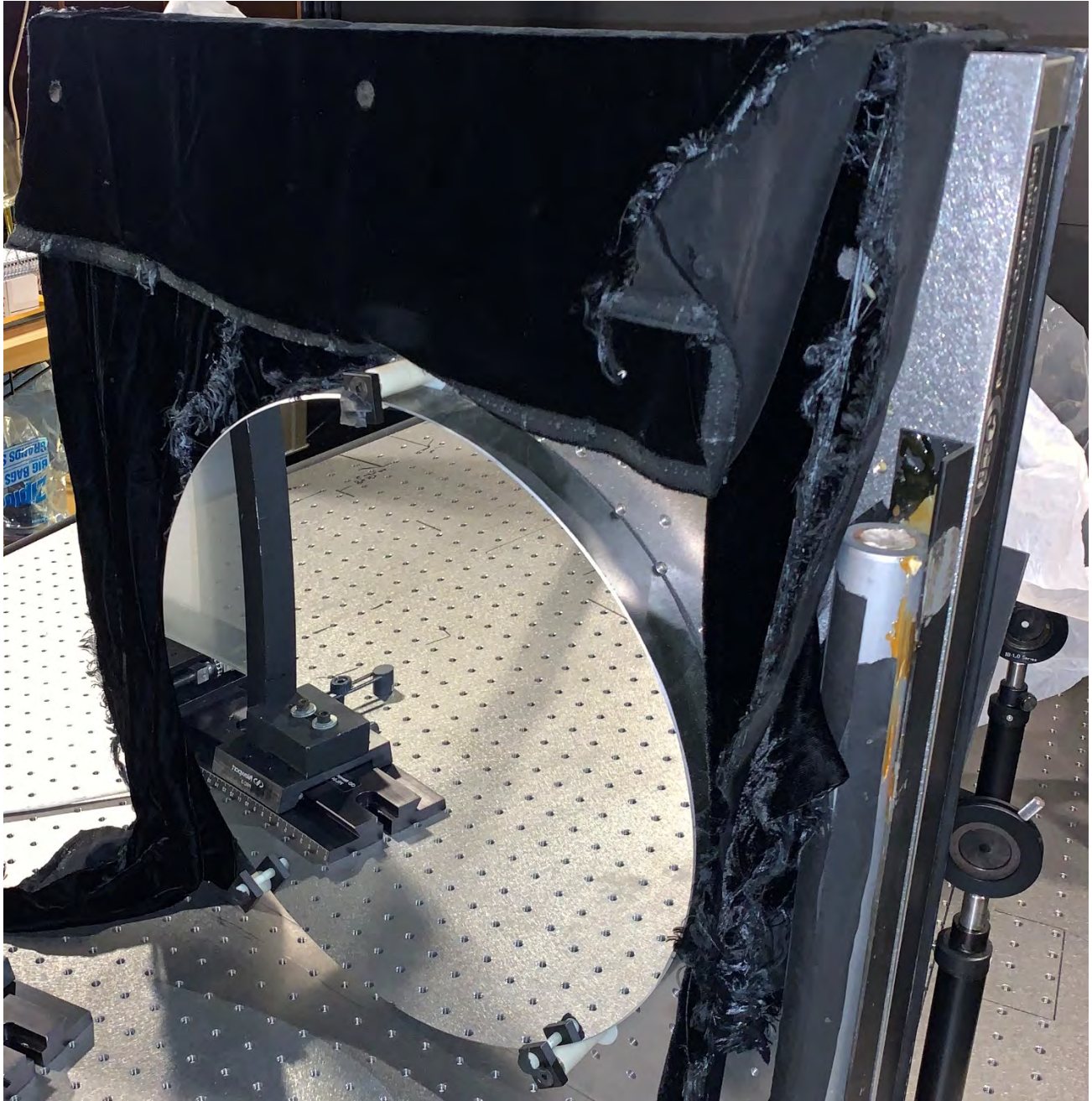
Component #14: [Click here to return to item list](#)

Hubble Optics 16" f#4.5 collimating mirror

Sub-components:

#13 is sub-component and JA Noll custom mirror clamps

Comments: Spherical 1st surface mirror secured & screwed to breadboard by three JA Noll custom mirror clamps.



Component #15: [Click here to return to item list](#)

NRC 910A reference beam (RB) spatial filter

Sub-components:

SP-4, C-1, VPH-3, mdl 100, 10X J.E.A. microscope objective, 25um pinhole.

Comments: 910A screwed to SP-4 w/ C-1, in VPH-3 screwed to mdl 100.

Component #16: [Click here to return to item list](#)

NRC 4" 1st surface mirror

Sub-components:

NRC 625-4 adjustable rod mirror mount, mdl 45, mdl 150 magnetic base, rod ring.

Comments: 4" 1st surf mirror held on mdl 45 rod by 625-4, rod screwed to mdl 150 mag base, rod ring under 625-4 on mdl 45; used to bounce RB SPF laser light to #14, collimating mirror.

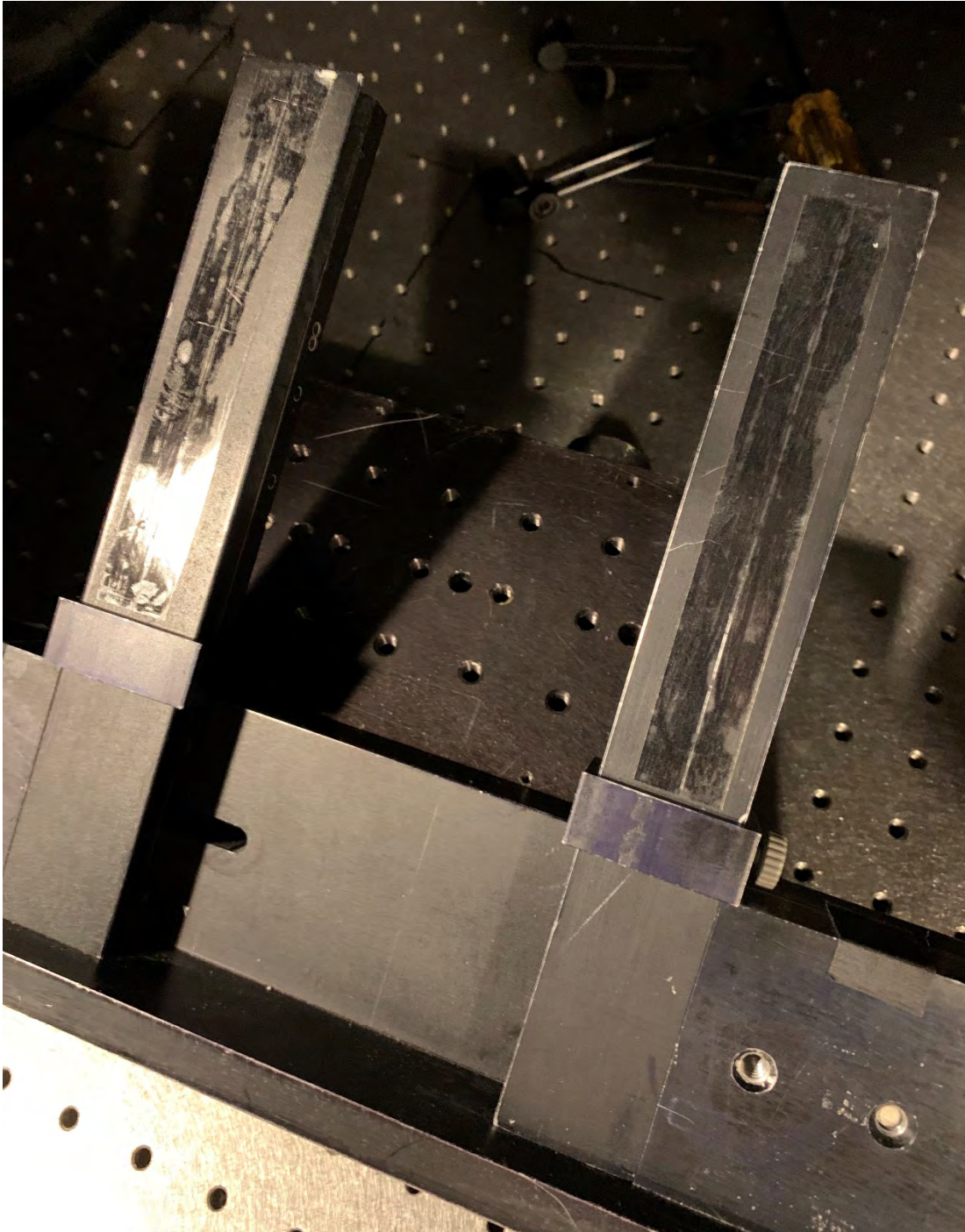
Component #17: [Click here to return to item list](#)

Data Optics 5051 plateholder

Sub-components:

Four BC-2, two adjustable 5051 plate stops.

Comments: 5051 clamped to table w/ four BC-2, Scotch type 666 tape cut to vertical arm length & adhered to arms above 5051 plate stops,



Component #18: [Click here to return to item list](#)

NRC model (mdl) 100 magnetic base and slit mechanism

Sub-components:

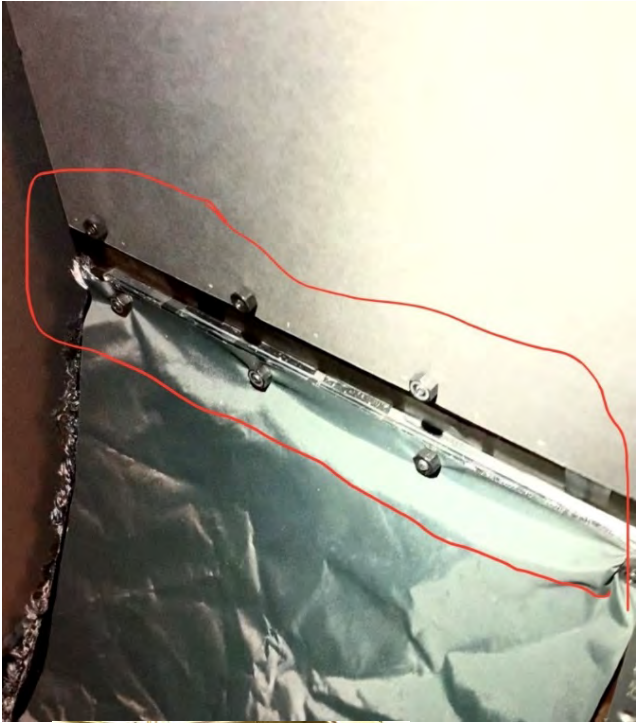
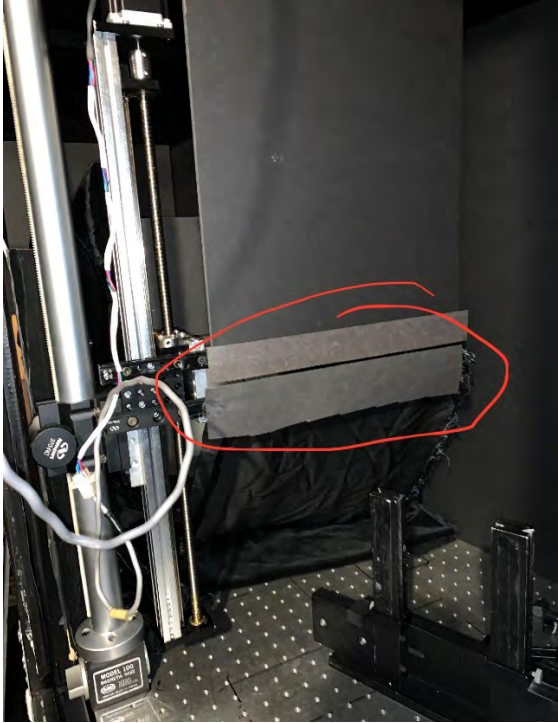
NRC 24" mdl 72 rod w/ rack & pinion gear, NRC mdl 370-RC rack & pinion rod clamp, NRC MRP3-0.25 (3"x3"x1/4") modular riser plate, NRC CR-1, Fuyu 24" stepper translation stage, NRC CB-2, TL C1520 (2.5"x2.5"x1/4") adapter plate, NRC MRL-18, NRC MRL-18M, mdl 100.

Comments: Mdl 72 rod w/ 370-RC rod clamp w/ MRP3-0.25 adapter plate to CR-1 to secure Fuyu stage to mdl 72 rod. CB-2 adapter plate w/ MRL-18 & MRL-18M held by C1520 adapter plate; entire mechanism screwed to mdl 100.

Basics about this slit mechanism: The two MRL-18 rails are attached to the Fuyu stage by the CB-2. The TL C1520 helps keep the MRL rails parallel and travels up and down with the two MRL rails. The CB-2 is screwed to the Fuyu stage carriage. The entire Fuyu stage is attached to the 370-RC by a CR-1.

The gap between the two parallel MRL rails is 1 ¼". Upper MRL has a ¼" thick light-blocking, rigid & flat black foam core card, 13 3/8" wide by 20" high, to protect unexposed/exposed sections of hologram plate from unwanted additional laser light exposure. The card is attached to the MRL-18 by four ¼-20, 3/8" long hex-head screws in countersunk through-holes in the MRL-18 which are secured on the side away from the hologram plate by four ¼-20 black nylon nuts. The lower MRL rail uses a two-layer cloth light-blocking flexible drape of black velvet and Thorlabs light-blocking black fabric of the same size as the foam core card and attached in the same way. The two layers are needed because neither separately completely blocks the laser light but together they do. Depending on the direction of travel of the slit (up or down), the fabric stretches out across the exposed/unexposed portion of the hologram plate or bunches at the bottom. Thanks to John Perry of Holographics North for the method of using flexible cloth for the lower slit guide. For this test series, two pieces of custom-cut flat black construction paper were used to form the 3.2mm (~1/8") wide slit and attached to the MRL-18 rails by Scotch type 666 doublestick tape. Scotch type 235 tape was used for edge light blocking at both ends of the slit. When ready to begin exposing a sequence of eighty 3.2mm slits, the entire mechanism was pushed flush up against the emulsion of the 8"x10" hologram master plate.

Attaching hologram master plate to PH 5051 (#17 above): 5051 PH adjustable plate stops were all the way down and tightened. Use isopropyl alcohol pad to clean two 5051 vertical legs and wipe dry. Cut type 666 tape to length and carefully adhere to each leg. Use orange stick or other non-damaging non-marking tool to rub the white outside tape liner to ensure good adhesion. Just before mounting unexposed hologram plate, remove outside white protective tape liner. In safelight, wearing clean cotton photographer's gloves, remove hologram plate from transfer box. Carefully align and rest only lower edge of hologram plate on top edges of 5051 plate stops and lean plate in against taped 5051 legs and gently rub the plate emulsion at the taped PH legs. Check that hologram plate is flush and firmly attached to taped legs by lightly pulling at edges of plate. At end of exposure series, use a fresh single edge razor blade to help start detaching of plate from tape.



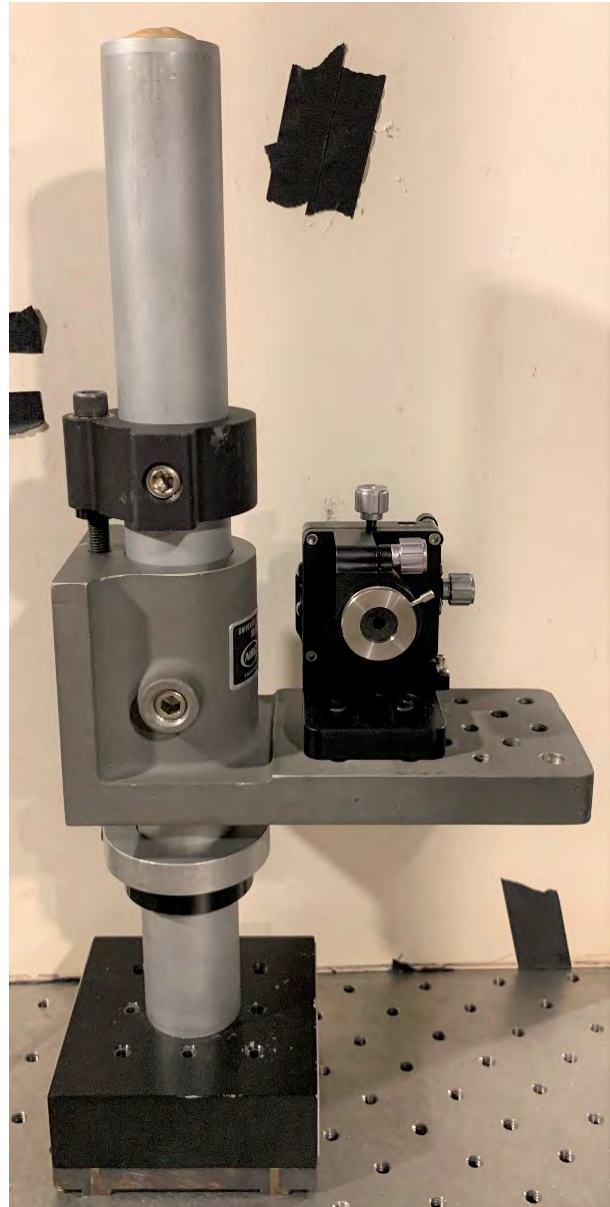
Component #19: (see #8)**Component #20: [Click here to return to item list](#)**

NRC 910A object beam (OB) SPF

Sub-components:

Mdl 300, mdl 40, 32A, NRC mdl 150, two rod rings, 10X J.E.A. microscope objective, 50um pinhole.

Comments: 910A screwed to mdl 300 on mdl 40 rod (lead shot filled), 32A for 910A/300 vertical adjustment on rod, all screwed to mdl 150, two rod rings under mdl 300.



Component #21: [Click here to return to item list](#)

U/I 2.75" iris

Sub-components:

U/I Iris in 4" plate w/ permanent post, old U/I Bell Labs (S&H?) VPH style gravity base stand.

Comments: Iris w/ plate (Klinger?) is blocking stray light to next component (#22), 2" achromatic lens.

Component #22: [Click here to return to item list](#)

NRC 2" PAC086 achromatic lens

Sub-components:

NRC PERFORMA-i, SP-2, C-1, VPH-4, mdl 100.

Comments: PAC086 is collimating beam from OB 910A SPF, in PERFORMA-i (P200-AI28) optic mount screwed to SP-2 in VPH-4 screwed to mdl 100.

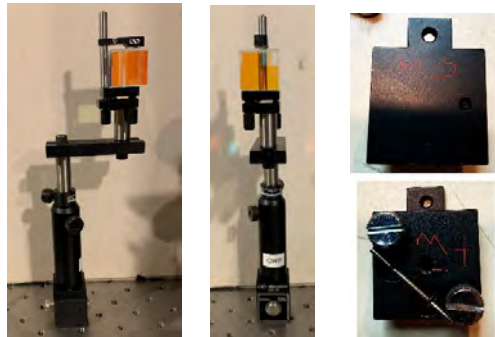
Component #23: [Click here to return to item list](#)

UO 25.4mm PBS2

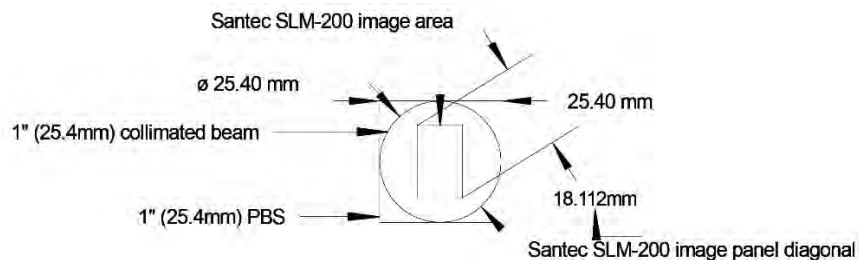
Sub-components:

Old u/i possible NRC 1" adjustable mount, NRC OC1-GR-2 rod, NRC adjustable small prism clamp, SP-1, B-1, SP-3, C-1, VPH-3, MMB.

Comments: UO PBS 0125-515-532 (cemented, 532nm AR), cantilevered on old 1" mount w/ u/i NRC prism clamp, 1" mount screwed to SP-1 (acts as riser from B-1) to B-1.



Cantilevered 1" PBS mount details, etc.: The several non-custom projection lenses (PL), that I tried, have a relatively short focal length less than 2" (50.8mm). For example, the SL-502 PL used in this setup has a zoom focal length between 23-31mm. The PBS2 alone is 25.4mm plus a minimized mount table, VPH diameter and MMB. Add the compensation plate (CP – could be a HWP, QWP or trim retarder) and mount and SLM mount, and it can be difficult to stay within the required PL focal length. After trial and error, this cantilevered PBS2 mount was constructed so that the CP mount and rear lens of PL could both be almost touching the front and back PBS2 faces. The PBS2 mounting table was similar to an NRC MM-1 in size and kinematic function except that it has a separate convenient piece off the square 1" area convenient for placing a PBS post clamp. It has metric mounting holes and needs thread adapters for convenient mounting of the PBS clamp and SP VPH post. The Santec LCoS imaging panel is 15.36 x 9.6mm with a diagonal of 18.112mm. The retaining ring for a 25.4mm CP needs to have a clear aperture of at least the diagonal of the SLM imaging panel and the overall thickness of the CP mount needs to be thinner than existing non-custom mounts allow (at least for this existing optical system) if the full range of possible magnification by the PL, of the SLM image panel, is to be achieved. Although PBS2 is optically the same in terms of polarization output as any other PBS, I think of PBS2 as the "imaging" PBS vs. the PBS beam splitter used to split the beam into RB/OB.

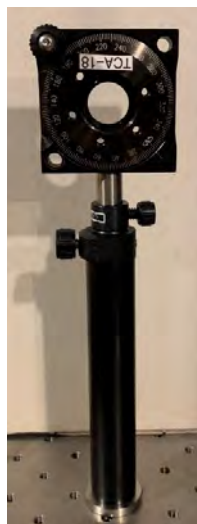
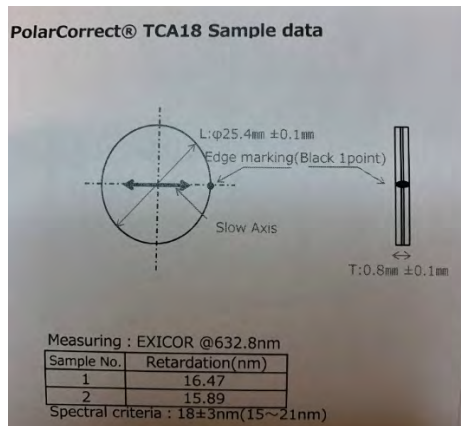


Component #24: [Click here to return to item list](#)

ColorLink 25.4mm TCA-18 trim retarder

Sub-components:

NRC RSP-1 rotator mount w/ threaded NRC A-1.25-1RR optic retaining ring, SP-4, C-1, VPH-6, PS-AZ.

Comments: TCA-18 held in RSA-1, to SP-4 w/ C-1 in VPH-6 w/ PS-AZ.

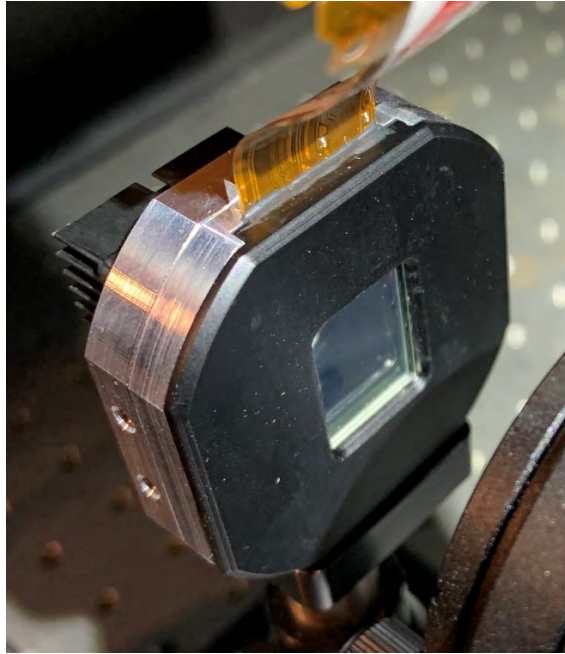
Trim retarder short discussion: The trim retarder can replace a HWP and/or QWP between the PBS2 and LCoS SLM. The final test $8 \times 10''$ hologram was made using this trim retarder after both HWP and QWPs were tested. In technical literature, this general class of optics placed between the SLM and PBS, is sometimes referred to as a "compensation plate" (CP), a term adopted here and in the accompanying report. Jeffrey Weil, without whose insight, this Santec SLM demo might not have been as successful, introduced me to the idea of using a trim retarder. More detail and discussion is provided about this in the accompanying report. This demo also might not have had a successful outcome if Bob Hess hadn't introduced me to the concept that CP's, in general, serve the purpose of controlling LCoS SLM image contrast. As Jeff Weil said, it's all about improving the SLM image contrast.

Component #25: [Click here to return to item list](#)

Santec SLM-200 LCoS spatial Light modulator

Sub-components:

Siskiyou IXM200.C2 adjustable mount, SP-4, C-1, VPH-4, MMB.

Comments: SLM held by IXM200.C2 screwed to SP-4 w/ C-1 in VPH-4 on MMB.



Introduction

1. Introduction

1.1 Description
 The santec spatial light modulator (SLM) is based on reflective liquid crystal on silicon (LCoS) microdisplay technology. The SLM has an active matrix display with 1920 x 1200 resolution (WUXGA) and a 0.63 diagonal which enables the SLM to modulate optical phases freely and generate arbitrary 2D phase patterns (gratings, phase mask, holograms, etc.) on a LCoS pixel-by-pixel basis. The phase response of SLM is adjusted even for different wavelengths (450 to 1600 nm) automatically using proprietary GUI software with built-in adjustable gamma control. The signal is addressed via a standard DVI (Digital Visual Interface) signal e.g. by a PC's graphics.

The SLMs are characterized by ultra-low phase fluctuation from high drive frequency over 1kHz and 10bit high resolution addressing. These abilities are suitable for various applications including laser material processing, optical switching devices, wavefront correction and pulse shaping.

1.2 Features

- Stable operation with no mechanical motion
- All-in one compact design
- Pure, linear and precise phase control: Addressing bit depth 10 Bit
- Telecom qualified high reliability: Telcordia GR-1221 Core
- Ultra-low phase fluctuation: Typ. <math>< 0.001\pi</math> rad.
- Wide wavelength range (450 to 1600 nm) by adjustable gamma control

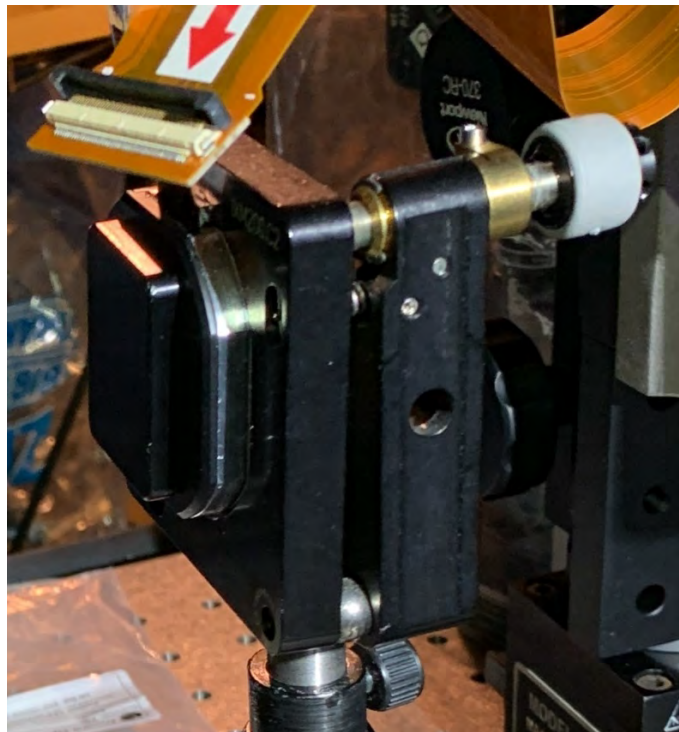


(a) All-in-one model



(b) Separate model

Figure 1: SLM body.

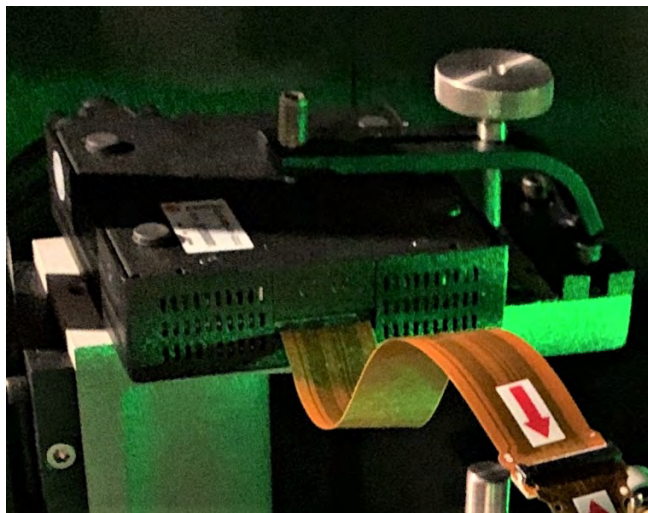


Component #26: [Click here to return to item list](#)

Santec SLM-200 controller

Sub-components:

Mdl 300, NRC CL-4 clamp, B-1, two 370-RC rod clamps, NRC mdl 70 rod, mdl 100.

Comments: SLM controller held to upside down mdl 300 w/ CL-4 clamp, B-1 screwed to end of mdl 300 to support curved end of CL-4, mdl 300 screwed to top of one of two 370-RC rod clamps, mdl 300 on mdl 70 rod on mdl 100.

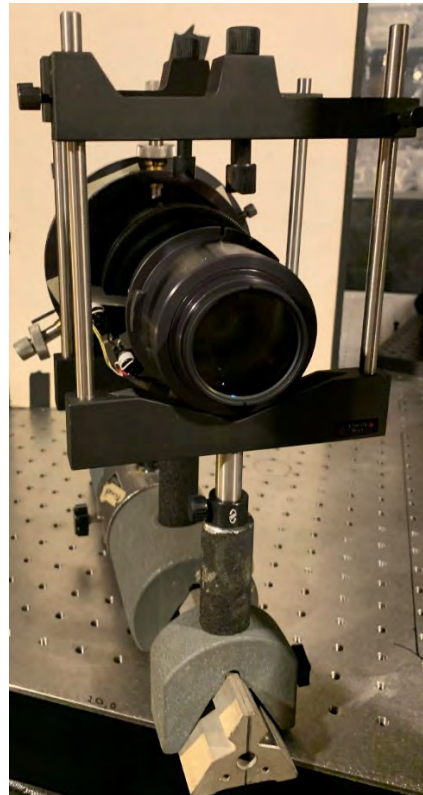
Component #27: [Click here to return to item list](#)

InFocus (Hitachi) SL-502 projection zoom lens

Sub-components:

Two Creative Stars (CS) VLH style 5" adjustable mounts, two SP-3, two C-1, Spindler & Hoyer (S&H) 1.25"w VPH rail mount, S&H 3.5"w VPH rail mount, 50cm steel triangular optical rail.

Comments: SL-502 supported by two CS VLH style mounts screwed to SP-3s w/ C-1s in two different S&H style VPHs made for riding triangular rail.

**Manufacturer Specs**

Model: SL-502 Specifications

Code	SL-502
Lens Type	Short throw zoom
Focal Length	23 to 31 mm
f/Stop	f/2.2 to 2.8
Screen Size	40 to 500" (101.6 to 1270 cm)
Projection Distance	2.83 to 51.17' (0.86 to 15.60 m)

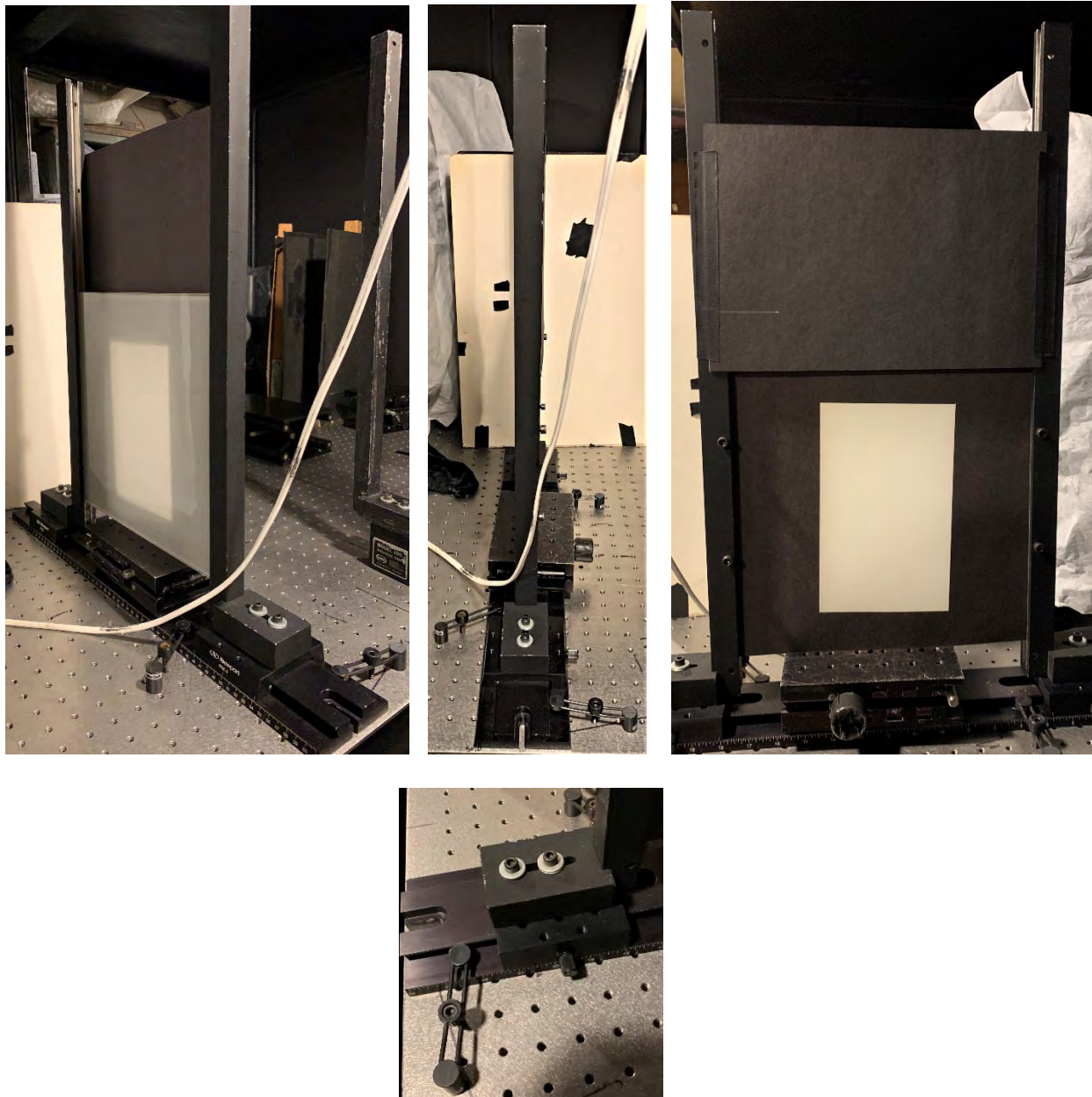
Component #29: [Click here to return to item list](#)

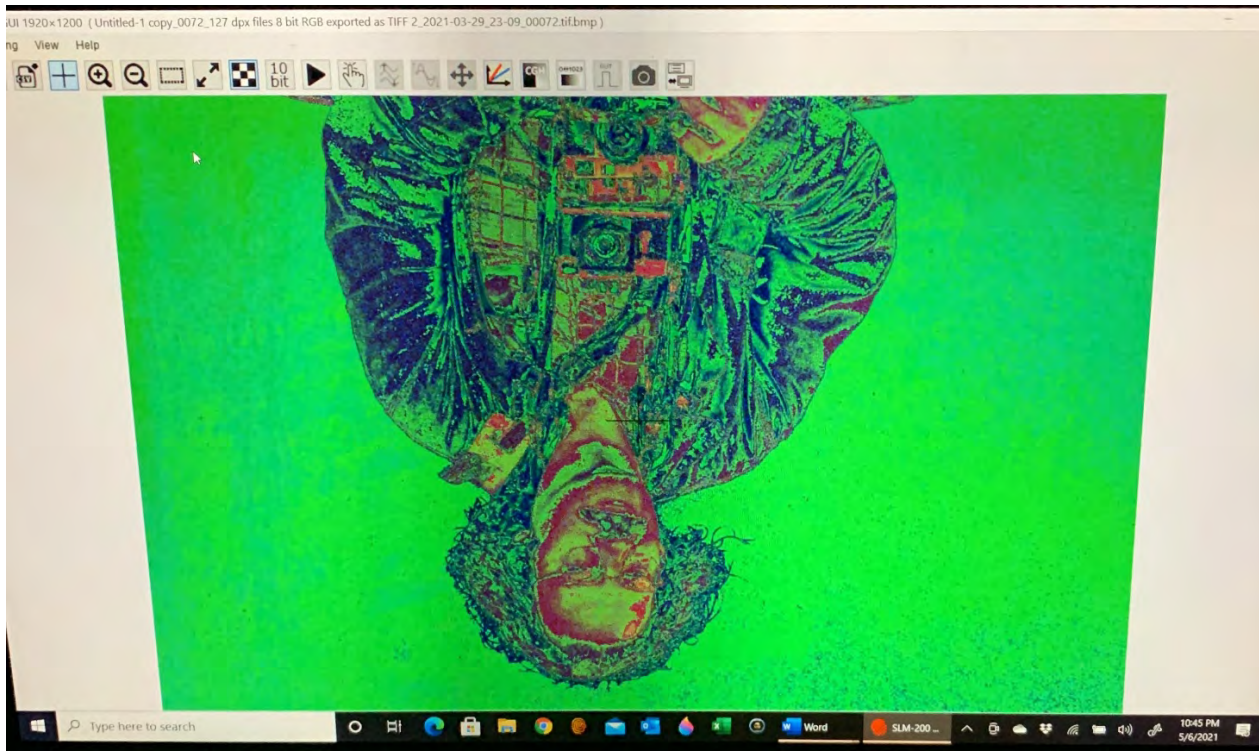
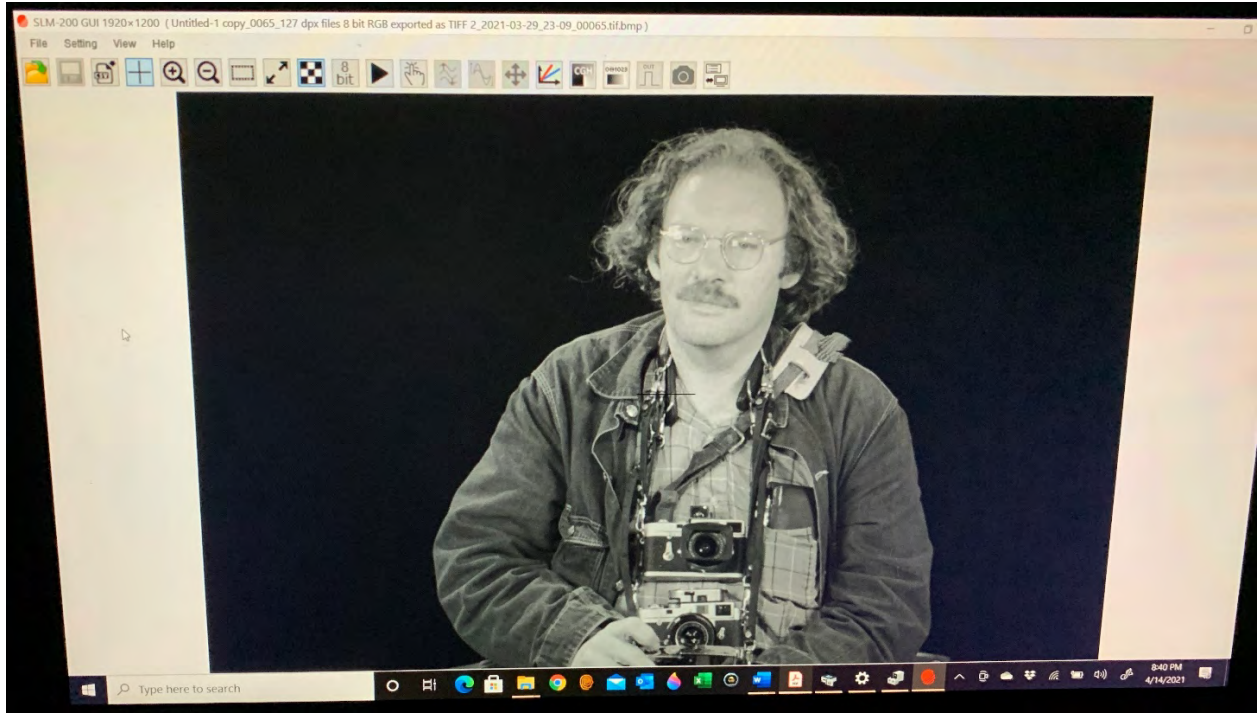
Stewart Filmscreen 12"x12"x0.25"Aeroglas 100 frosted glass

Sub-components:

NRC mdl 270 lab jack, two custom 24" vertically slotted threaded right-angle legs, four 1.25" 1/4-20 hex screws, NRC PRL-24 low profile rail, two NRC PRC-3 rail sliders, three BC-2, custom cut black construction paper frame.

Comments: 12"x12" Aeroglas 100 frosted glass screen (clear side to laser beam) w/ custom cut black construction paper 5"wX8.125"h cutout aperture supported by mdl 270 adjustable lab jack, between vertical slots of two 24" right angle legs screwed to PRC-3s on PRL-24 rail secured to table by three BC-2s.



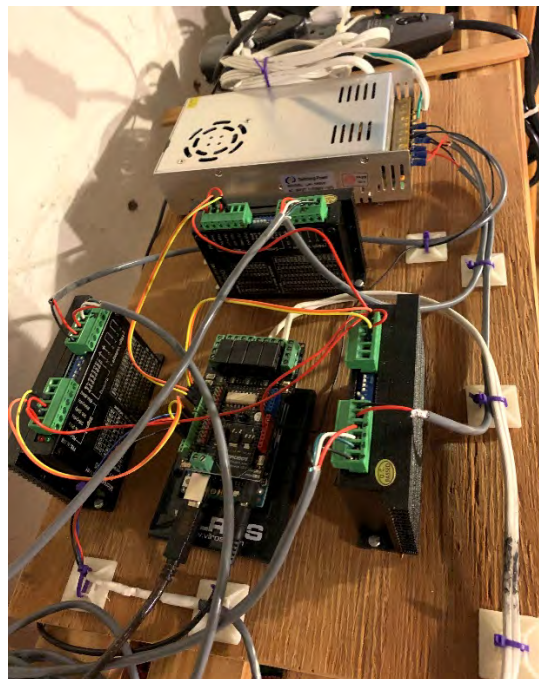
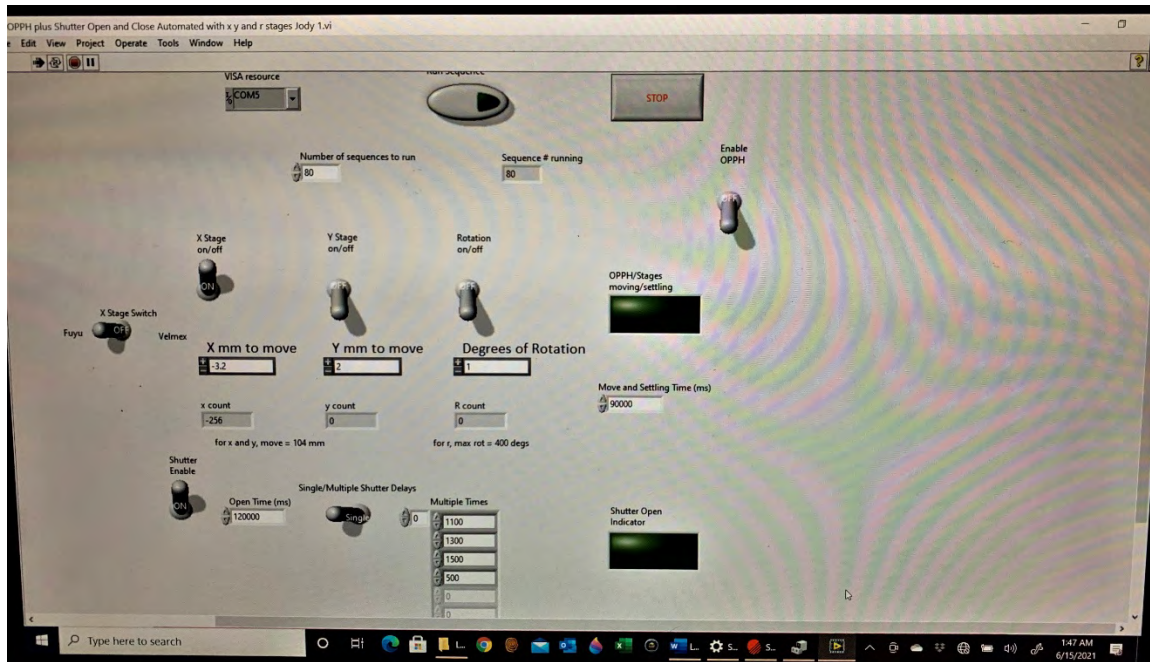


Component #31: [Click here to return to item list](#)

Custom hardware & LabVIEW software automation controllers

Sub-components: see comments below

Comments: Custom LabVIEW software controller for automated eighty exposure sequencing of 846HD shutter (Component #5) and slit mechanism (Component #18). Very special thanks to artist Joe Pentland for software and hardware design and implementation. Required special 40 foot "active" USB 2 cable to connect to custom automation controller.

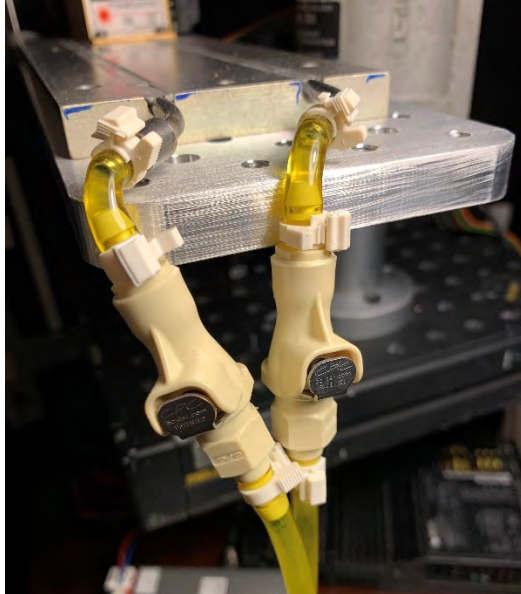


Component #32: [Click here to return to item list](#)

Oasis 150 chiller

Sub-components: Koolance LIQ-702CL-B cooling fluid, CPC quick release fittings, PVC tubing, Sam G coldplate, Coherent Compass 315M laser

Comments: Stable operation of the 315M laser requires a large heatsink or chiller. I opted for a chiller. The box is a custom-built sound dampened box top and bottom, inside and out. Colder quick release fittings are “no drip”. It’s important that the tubing which runs to the coldplate on which the laser is screwed, isn’t too long in order not to stress the small chiller pump.



Masterlist: Terminology, Equipment manufacturers, Miscellaneous:

[Click here to return to item list](#)

Terminology:

HWP: Half waveplate

QWP: Quarter waveplate

PBS: Polarizing beam splitter cube

OB: Object beam

RB: Reference beam

s-pol: s-polarization, aka vertical linear polarization

p-pol: p-polarization, aka horizontal linear polarization

SPF: Spatial filter

PL: projection lens

CP: compensation plate (HWP, QWP, trim retarder)

Mdl: model

PVC: polyvinyl chloride

u/i: unidentified

Rod ring: Tightenable metal retaining ring to prevent rod mount from going lower

µm: Micron

nm: Nanometer

mm: Millimeter

mw: Milliwatt

Companies:

Santec: <https://www.santec.com/en/>

NRC: Newport: <https://www.newport.com/>

NF: New Focus: <https://www.newport.com/b/new-focus>

TL: Thorlabs: <https://www.thorlabs.com/>

MG: Melles Griot: Thorlabs bought MG UK mfg. in 2004, CVI bought MG optics

BaseLabTools: <https://www.baselabtools.com/>

Coherent: <https://www.coherent.com/>

Vicor: <http://www.vicorpower.com/all-products/>

Solid State Cooling: <https://www.sscooling.com/>

CPC: Colder Products Company: <https://www.cpcworldwide.com/>

Koolance: <https://koolance.com/>

Data Optics: <https://www.dataoptics.com/index.html>

S&H: Spindler & Hoyer: <http://www.hasi.gr/node/1656>,

<https://www.laserfocusworld.com/optics/article/16548715/optics-industry-report>

https://americanhistory.si.edu/collections/search/object/SILNMAHTL_21664

Siskiyou: <https://www.siskiyou.com/>

CS: Creative Stars: <https://www.indiabizclub.com/company/creative-stars-electro-optics-inc-0teoeonp7g0t04aki>

JA Noll: <http://janoll.com/>

UO: Union Optic: <https://www.u-optic.com/index/siteid/2.html>

Hubble Optics: <https://www.hubbleoptics.com/>

Stewart Filmscreen: <https://www.stewartfilmscreen.com/en>

Fuyu: <https://www.fuyumotion.com/>

inFocus: <https://infocus.com/product-category/projector/>

Hitachi: <https://picclick.com/HITACHI-SL-502-Infocus-Lens-023-short-throw-projector-lens-291707698721.html>

<https://www.bhphotovideo.com/c/product/322407->

[REG/Hitachi SL 502 Short Throw Zoom Projection.html/specs](REG/Hitachi_SL_502_Short_Throw_Zoom_Projection.html/specs)

ColorLink: <https://www.colorlink.co.jp/global/>

Lenovo: <https://www.lenovo.com/us/en/pc>

LabVIEW:

https://www.vipm.io/package/national_instruments_lib_labview_interface_for_arduino/

Sam's LaserFAQ: <https://www.repairfaq.org/sam/lasersam.htm>

Newport equipment:

RS2000-48-12: 4'x8'x12" optical vibration table

Four vintage 1975 vibration isolation legs originally for 5'x12'x18" table

2'x2'x 2 11/16" steel ¼-20 threaded breadboard

B-1: 1"x3" slotted baseplate

BC-2: 3.5" table base clamp

EX-2.5: extra-long clamp screw

CL-4: table clamp

VPH: vertical post holder

SP: 1/2" diam steel post, number is length in inches, each end female threaded, ¼- 20 & 8-32

C-1: ½" ID adjustable post collar

Mdl 40: 14" x 1.5" stable heavy duty optical support rod

Mdl 45: 14" x 1.5" damped stable heavy duty optical support rod

Mdl 72: 24" x 1.5" stable heavy duty optical support rod, nylon gear rack

370-RC: Geared rod post clamp

MRP3-0.25: modular riser construction plate, 3"x3" x.25"

Mdl 300: single piece rod mounted stable platform

Mdl 300-P: Rod mounted stable platform, can be separated into two pieces

Mdl 32A: Rod mounted vertical fine positioner for adjusting 300 series

625-4: Rod mounted adjustable 4" mirror mount

4" diameter round mirror, unknown mdl number

PERFORMA-I P2300-A128: 2" lens and mirror precision adjustable mount

Mdl 100: strong force magnetic base

Mdl 150: strong force large magnetic base

MMB: strong force miniature magnetic base

PS-AZ: VPH screw-on low force magnetic base

RM25A: 1" (25.4mm) optic rotator

RSA-1: 1" (25.4mm) narrow profile optic rotator

RSP-1: 1" (25.4mm) narrow profile optic rotator

A-1.25-1RR: threaded insert ring for holding 1" (25.4mm) optics in rotation mounts
9411: adjustable prism table for PBS
PT-1C: adjustable clamping arm for PBS on prism table
OC1-GR-2: 2" narrow cage rod used for holding PBS clamp
846HP: electronic laser shutter head (high power capable)
845: electronic laser shutter controller
PAC086: 2" achromatic lens
Mdl 360-90: versatile right-angle mount
910A: 5-axis optical spatial filter
PRL-24: low profile 24" precision dove tail rail
PRC-3: low profile adjustable rail mount for PRL series
CR-1: construction rail, 1"x5"
CB-2: construction plate, 2.5" x 3.5"
MRL-18: single piece miniature dovetail optical rail, $\frac{3}{4}$ " x 18"
MRL-18M: two-piece miniature dovetail optical rail, $\frac{3}{4}$ " x 6" & $\frac{3}{4}$ " x 12" connected
ALM-4: variable size precision adjustable optic mount (up to 4")
Mdl 270: adjustable precision lab jack

Thorlabs equipment:

BS127CAM: 12.7mm cube protective cage
C1520: 2.5"x2.5" x $\frac{1}{4}$ " construction adapter plate

Data Optics equipment:

5051: adjustable plate holder

Colorlink equipment:

TCA-18: trim retarder (replaces HWP/QWP)

Siskiyou equipment:

IXM200-C2: 2" adjustable (kinematic) optic mount

Stewart Filmscreen equipment:

Aeroglas 100: 12"x12"x $\frac{1}{4}$ " frosted glass projection screen

InFocus (Hitachi) equipment:

SL-502: short throw projection zoom lens

Creative Stars equipment:

VLH: variable lens holder

JA Noll:

Three custom mirror clamps

Spindler & Hoyer (Klinger) equipment:

50cm steel triangular optical rail
1 ¼" wide VPH rail mount
2 ½" wide VPH rail mount
3 ½" wide VPH rail mount

FUYU equipment:

24" stepper motor translation stage for moving slit incrementally across hologram plate

Coherent, Inc. equipment:

Compass 315M 110mw 532nm via Dave Battin
Compass 315M controller with dongle via Dave Battin

Vicor equipment:

Power supply FlatPAC, 24VDC, mdl VI-MU3-06, via Dave Battin

Solid State Cooling Systems equipment:

Oasis 150 chiller: solid state chiller for keeping laser at constant temperature

CPC (Colder Products Company) equipment:

Colder quick release fittings for chiller ports, tubing and coldplate

Koolance supplies:

Cooling fluid (LIQ-702CL-B) for laser chiller/coldplate

Lenovo equipment:

S1 Yoga laptop with Windows 10 pro 64bit, LabVIEW for Arduino, Santec SLM GUI

Miscellaneous:

- Custom detached freestanding enclosed table hood, 52 ½" W X 77" L X 74.5" H, for light and air current blocking, wood, metal brackets, flat black ¼" thick foam core detachable access panels.
- Custom 24" slotted & ¼-20 threaded right angle legs, matte flat black
- Coldplate for laser cooling, custom from Sam Goldwasser (Sam's LaserFAQ)
- Vicor power supply for 315M laser via Dave Battin
- PVC tubing for connecting Oasis chiller to coldplate
- 1960's vintage 4" VLH style lens mount (Klinger, S&H?) & two VPH style post holders, all from Don White of Bell Labs as surplus (including S&H equipment above).
- Scotch type 666 doublestick tape: used for holding unexposed hologram plate to 5051 plateholder legs
- Scotch type 235 black photographer's tape: all-purpose hologram table tape for holding air current blocking and light blocking cards, etc.
- J.E.A microscope objectives, Jodon Engineering Associates (gone)
- Pinholes, unknown combination of NRC & National Aperture