LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
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COS Faraday Isolator Pre-alignment Procedure

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1 FARADAY ISOLATOR ASSEMBLY

Assemble the Faraday isolator according to drawing D990536. Note that the output polarizer will be rotated 45 deg with respect to the input polarizer, as shown in the assembly drawing.

2 INPUT POLARIZER ALIGNMENT

Set up the assembled Faraday isolator on an optical table as shown in figure 1.

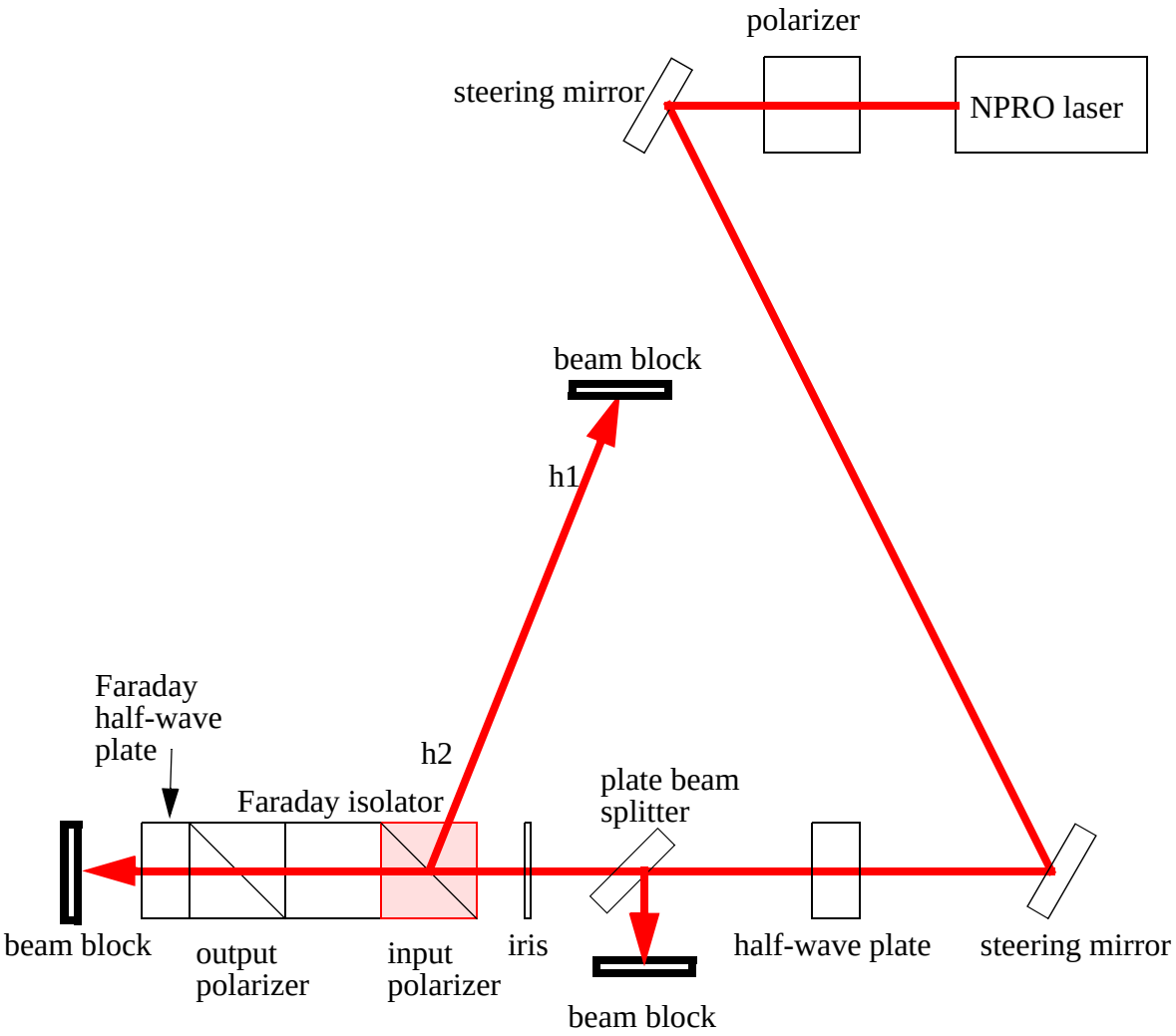


Figure 1: Input polarizer alignment

Turn the NPRO on to minimum power. Place a vertical polarizer in front of the NPRO to increase the extinction ratio. Steer the beam with the two steering mirrors until it passes through the iris and is centered on the input aperture of the Faraday isolator. Move the output end of the Faraday

isolator until the output beam is also centered on the output aperture. Place beam blocks to catch the stray beams; verify with the IR viewer that there are no stray beams exiting the table area.

Rotate the input polarizer so that the reflected beam is parallel to the optical table. This is determined by making the measured beam heights on a target placed at h1 and h2 equal.

3 HORIZONTAL INPUT POLARIZATION

Set the input polarization horizontal by rotating the half-wave plate after the steering mirror until the power transmitted through the Faraday isolator is maximum.

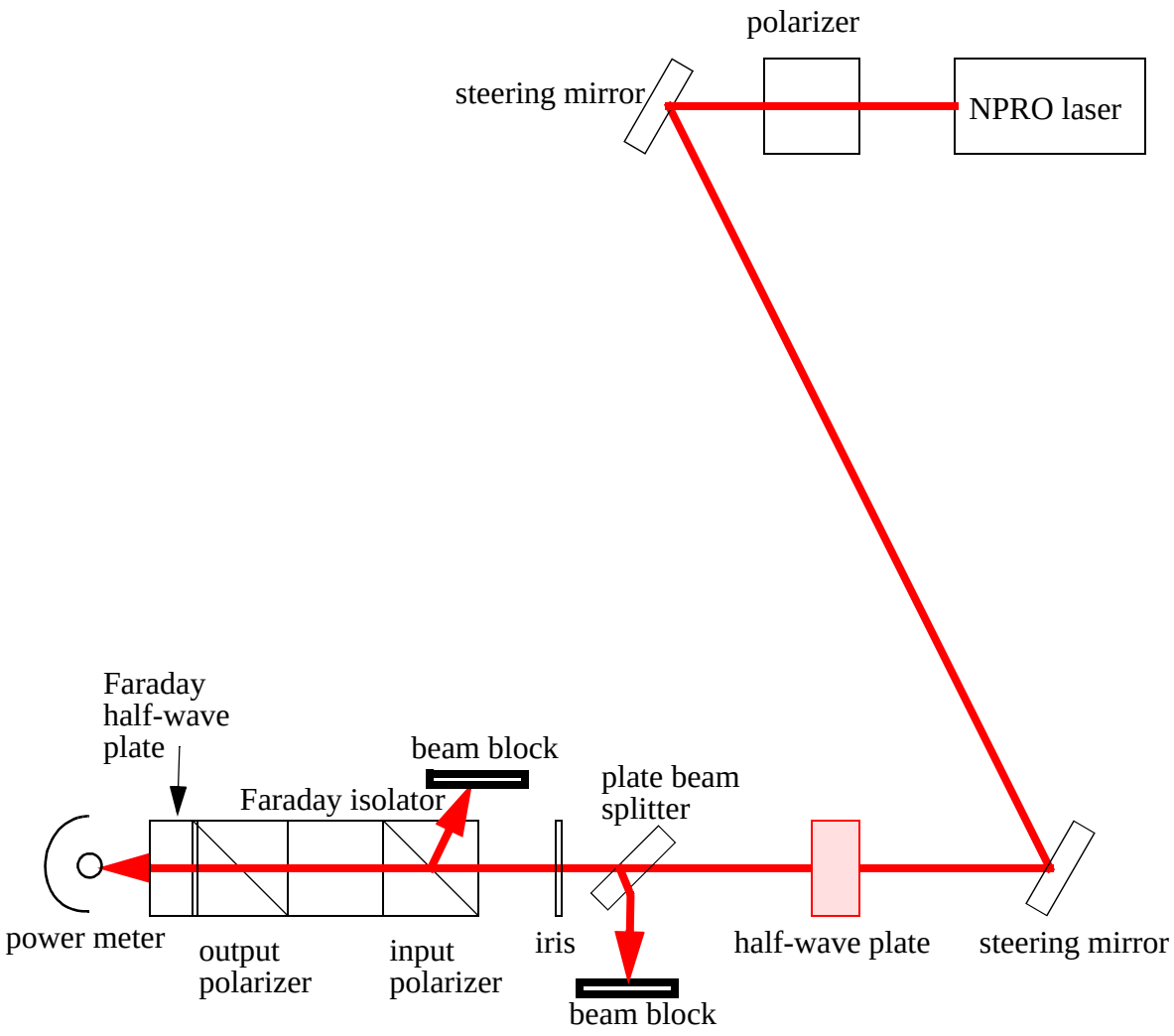


Figure 2: Horizontal input polarization alignment

4 OUTPUT POLARIZER ALIGNMENT

Place a steering mirror at the output of the Faraday isolator and retroreflect the beam back toward the input and through the iris. Measure the power reflected from the beam splitter with a power meter. Rotate the output polarizer to obtain the minimum power at location 3. Note: the room lights will have to be turned off during this procedure to eliminate the effect of ambient light on the power detector.

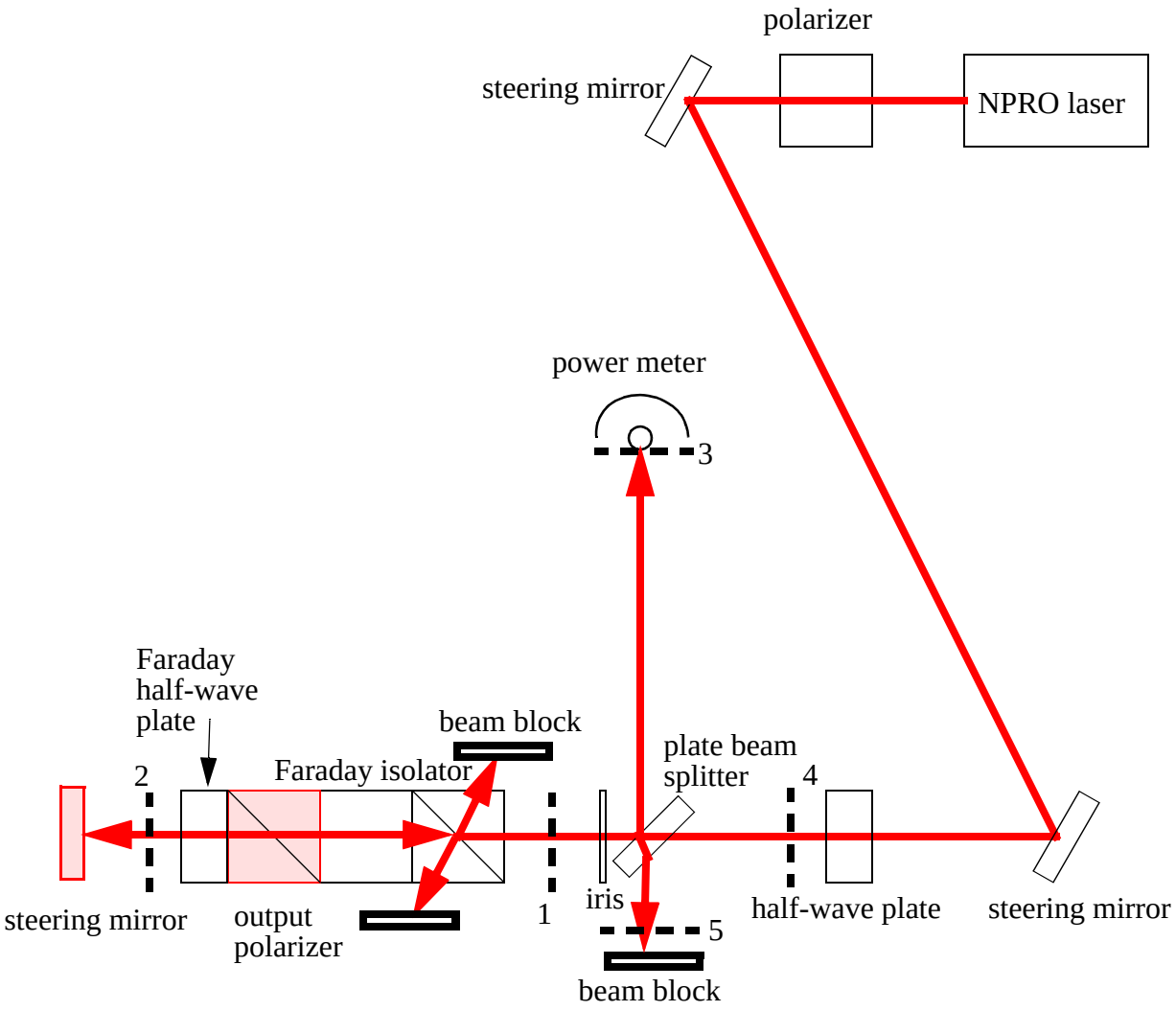


Figure 3: Output polarizer alignment

5 FARADAY ISOLATOR PERFORMANCE

Measure the power at locations 4 and 5, as shown in figure 3, and calculate the reflectivity of the beam splitter.

$$R = P5/P4$$

Measure the power at locations 1, 2, and 3 and calculate the transmissivity and extinction ratio of the Faraday isolator.

$$\text{transmissivity} = P2/P1$$

$$\text{extinction ratio} = (P3/R)/P2$$

6 HORIZONTAL OUTPUT POLARIZATION

Orient a polarization analyzer horizontal by aligning it with the horizontally polarized input beam at location 1. Place the analyzer at the output of the Faraday isolator, as shown in figure 4. Rotate the Faraday half-wave plate until the power through the horizontal polarization analyzer is maximum.

This completes the pre-alignment of the Faraday isolator.

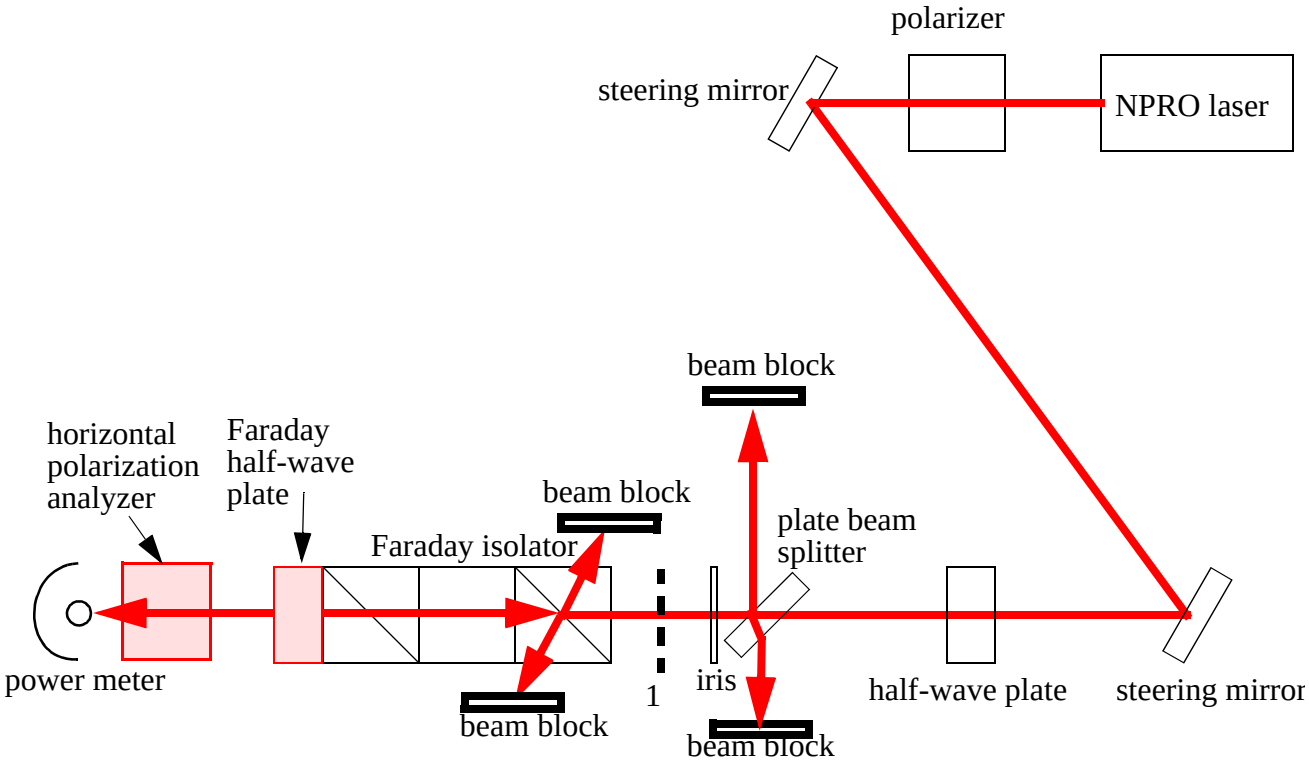
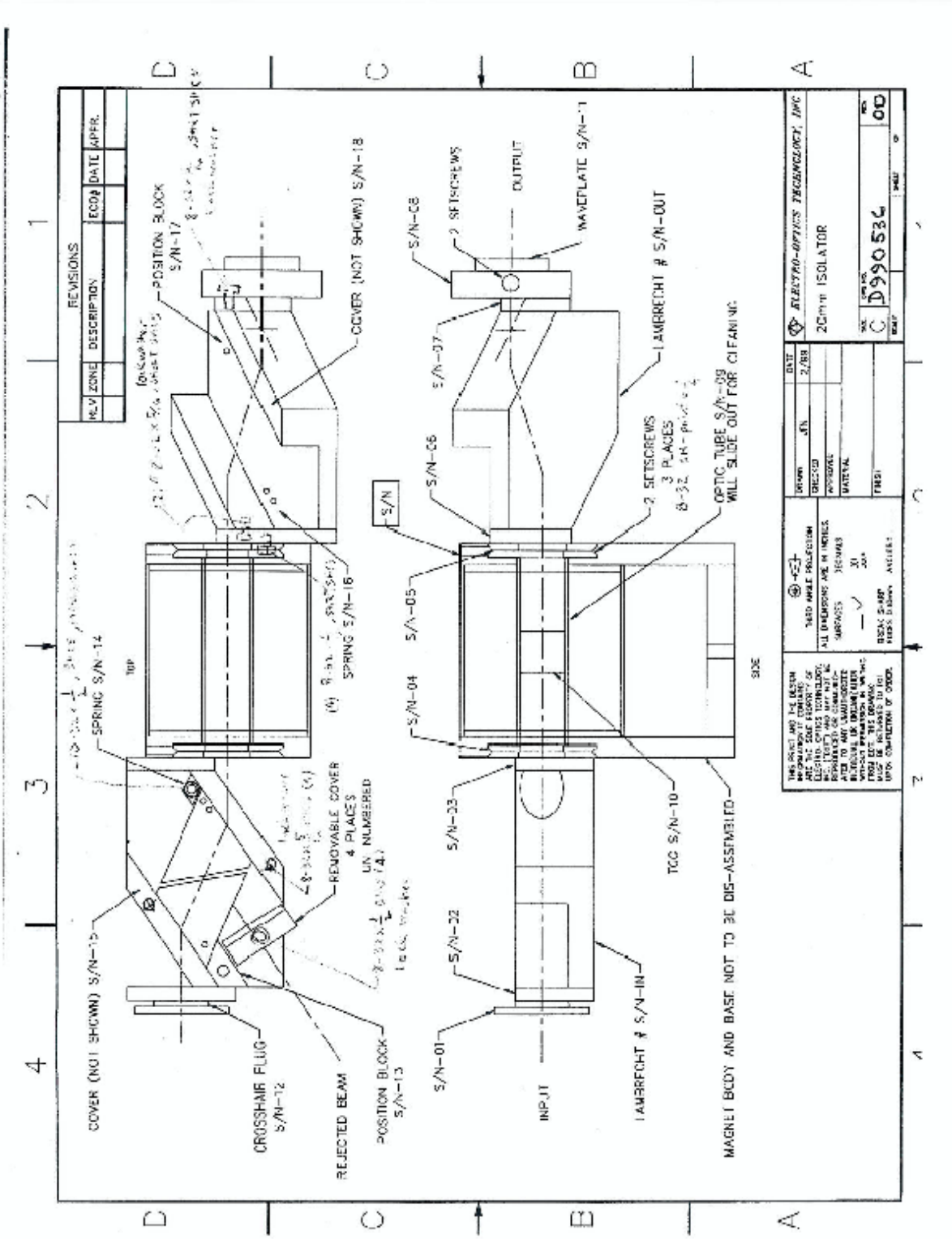
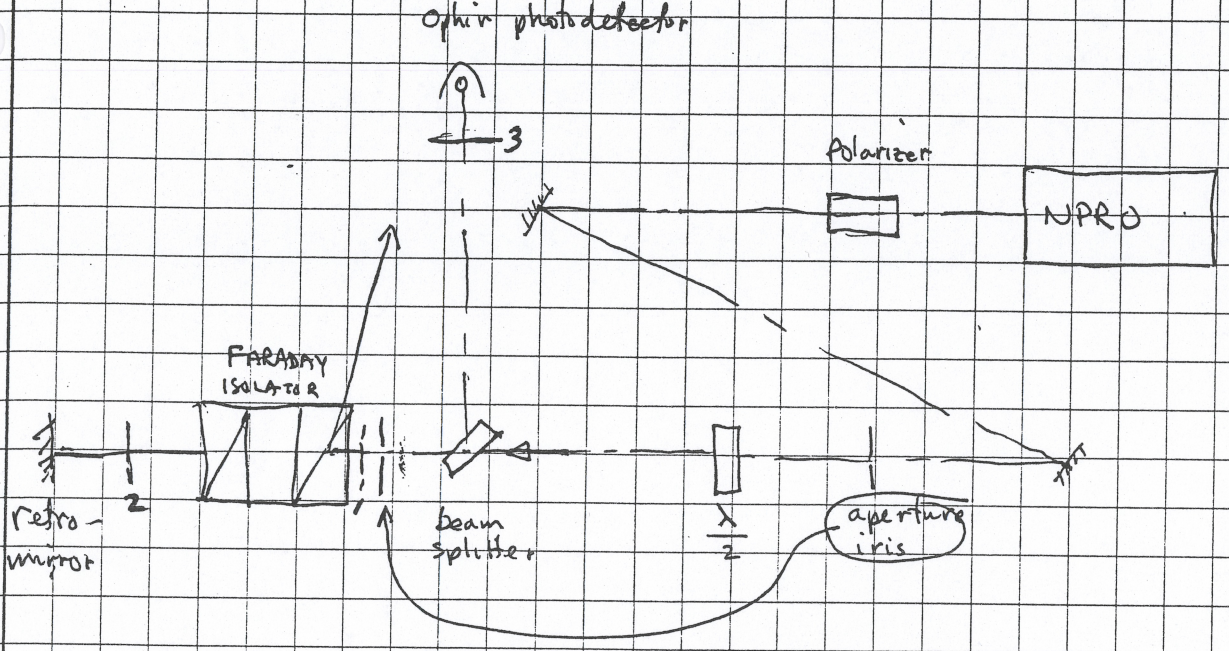


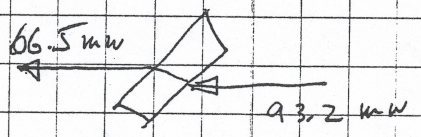
Figure 4: Horizontal output polarization


REVISIONS
REV
ZONE
DESCRIPTION
ECO#
DATE
APPR.
POSITION BLOCK S/N-17
COVER (NOT SHOWN) S/N-18
SPRING S/N-16
SPRING S/N-14
COVER (NOT SHOWN) S/N-15
CROSSHAIR PLUG S/N-12
REMOVABLE COVER 4 PLACES UN NUMBERED
REJECTED BEAM
POSITION BLOCK S/N-13
TOP
S/N
S/N-08
2 SETSCREWS
OUTPUT
WAVEPLATE S/N-11
S/N-07
S/N-06
S/N-05
S/N-04
S/N-33
S/N-22
S/N-01
INPUT
LAMBRECHT # S/N-IN
2 SETSCREWS 3 PLACES 8-32
OPTIC TUBE S/N-09 WILL SLIDE OUT FOR CLEANING
LAMBRECHT # S/N-OUT
TCC S/N-10
MAGNET BODY AND BASE NOT TO BE DIS-ASSEMBLED
SIDE
ELECTRO-OPTICS TECHNOLOGY, INC.
20mm ISOLATOR
D990536
C
00

Faraday Isolator Alignment



Beam splitter



power @ 1	58.5 mW	34 mW
power @ 2	57.3 mW	
power @ 3	< 0.5 μW	0.4 μW

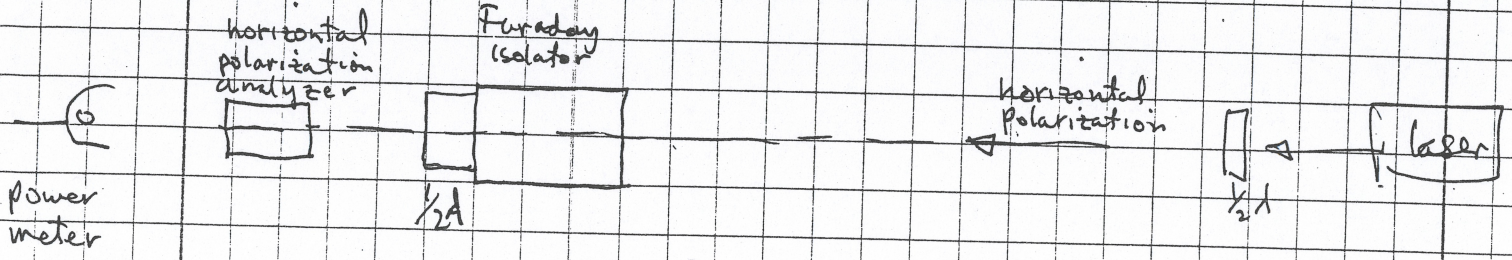
Transmissivity $T = \frac{57.3}{58.5} = 98\%$

extinction ratio $\varepsilon = \frac{0.5\,\mu W}{57.3\,mW} = 9 \times 10^{-6}$

Reflectivity of BS $\frac{93.2 - 66.5}{93.2} = 29\%$

$$\varepsilon = \frac{0.4\,\mu W}{34\,mW \times 0.29} = 4 \times 10^{-5}$$

2. Alignment of output $\lambda/2$ plate.



1. The polarization of the input laser was set horizontal by maximizing the power through the Faraday isolator (by rotating the laser polarization with a $\lambda/2$ plate)

2. a Brewster angle polarizer (analyzer was set horizontal by maximizing the horizontal laser power through the analyzer (by rotating the analyzer)

3. The horizontal analyzer was placed at the output of the Faraday isolator. & the output $\lambda/2$ plate was rotated to maximize the power through the horizontal analyzer