Progress in Squeezed Light Experiment

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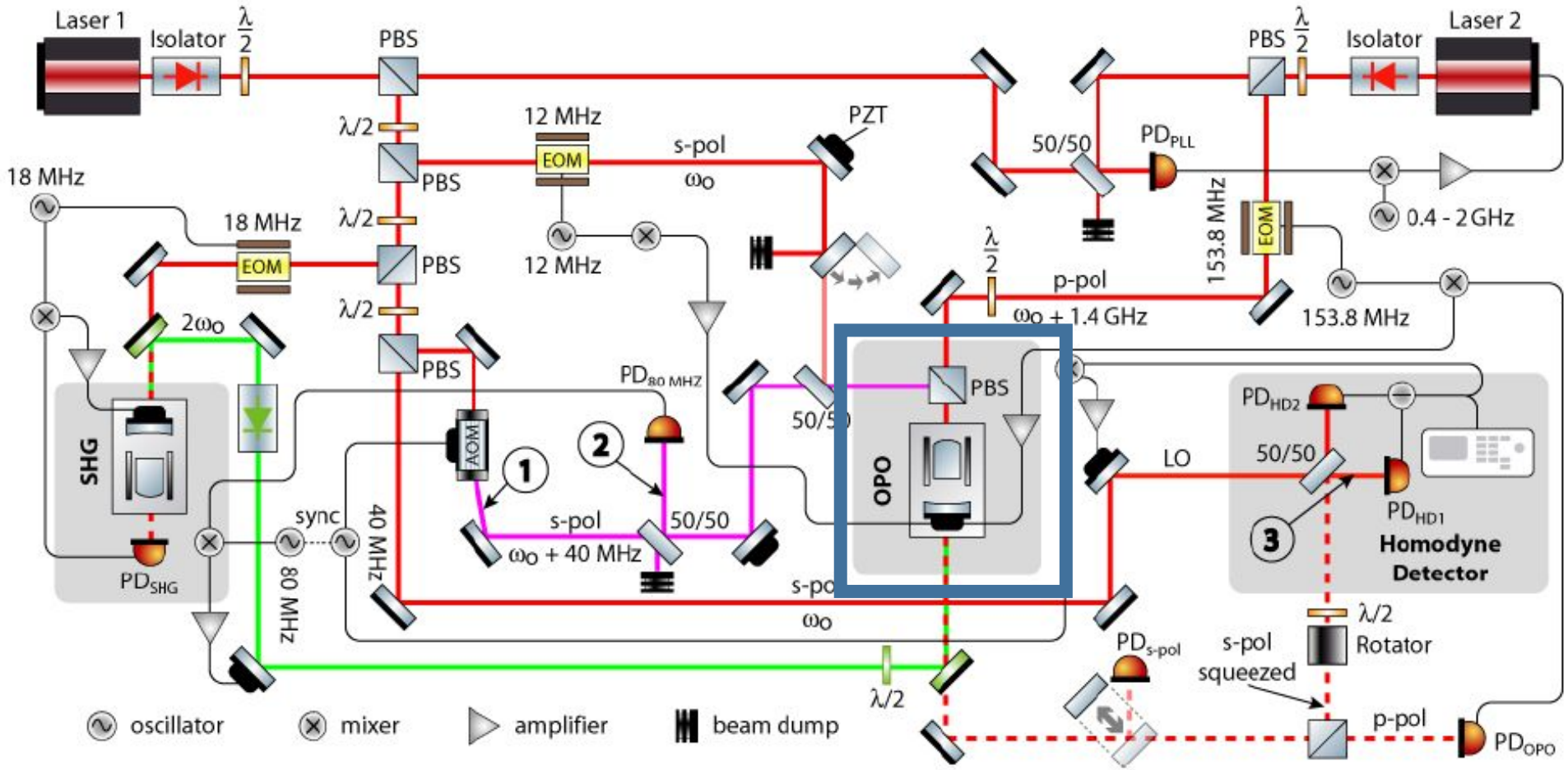
Outline

- Background
- Optical Scheme
- Progress
- Next Step

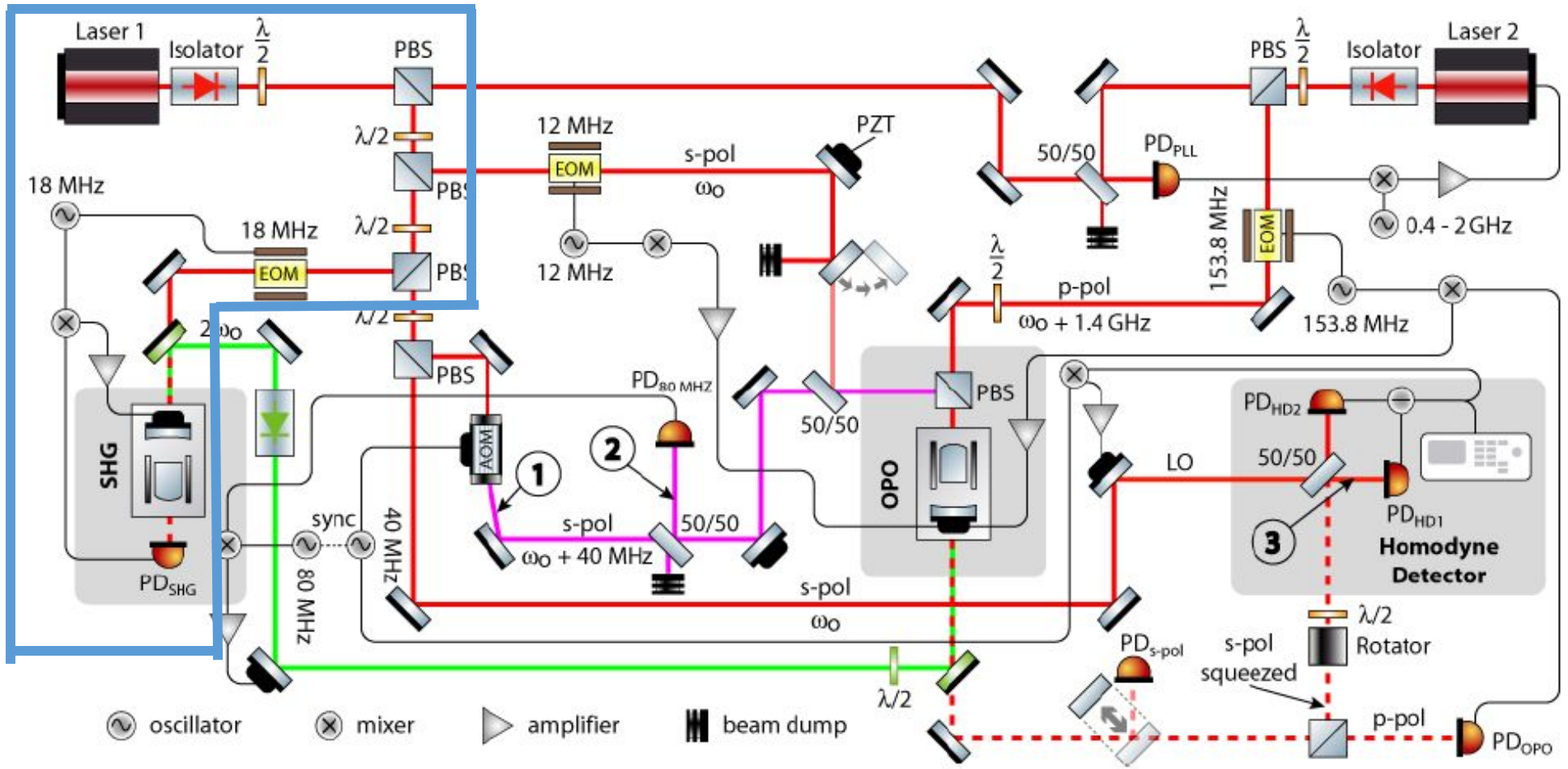
Background

- Quantum noise
  - Shot noise
  - Radiation pressure
- Squeezed state
  - less than zero-point fluctuation
  - greater than zero-point fluctuation
- Reduce the photo counting error

Optical scheme

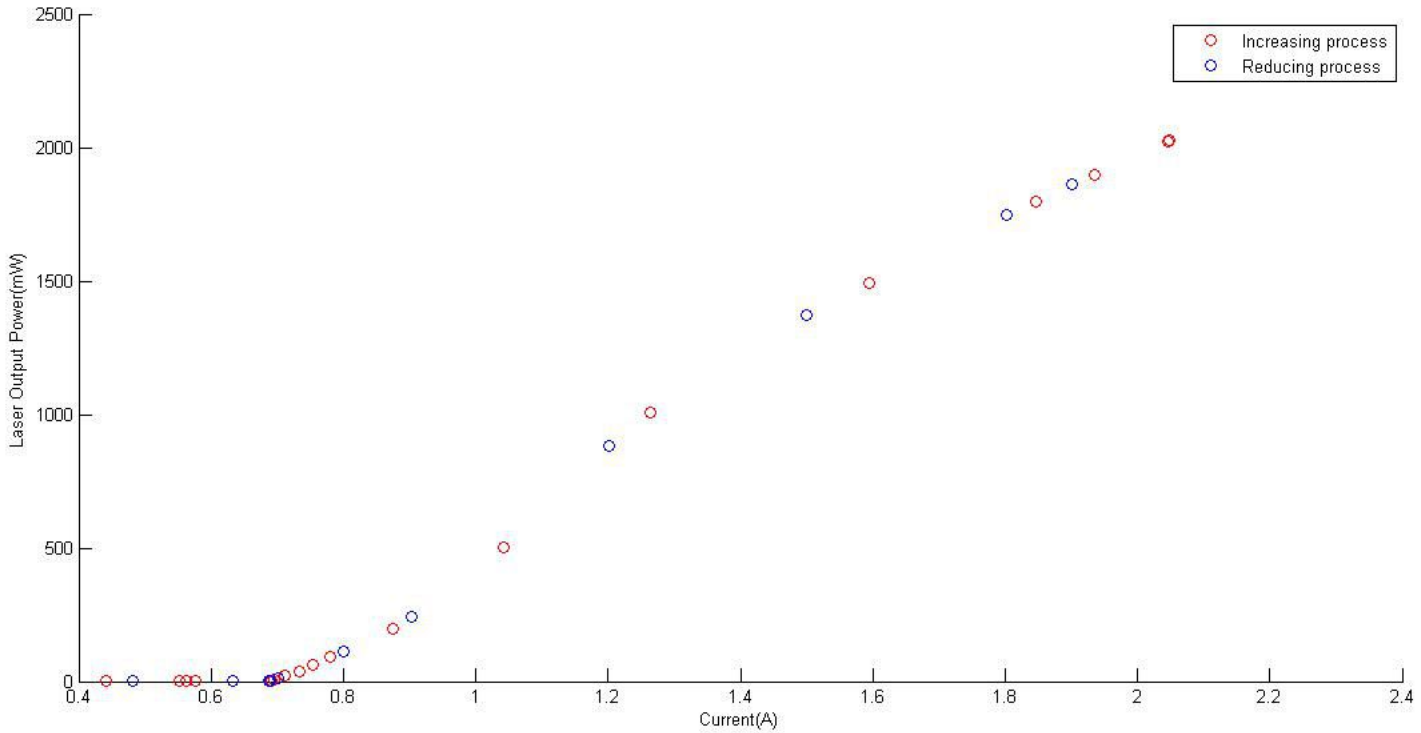


Optical scheme



Output power vs. current of diode

- Laser Safety
- 2W @1064nm
- Align
- Data collection



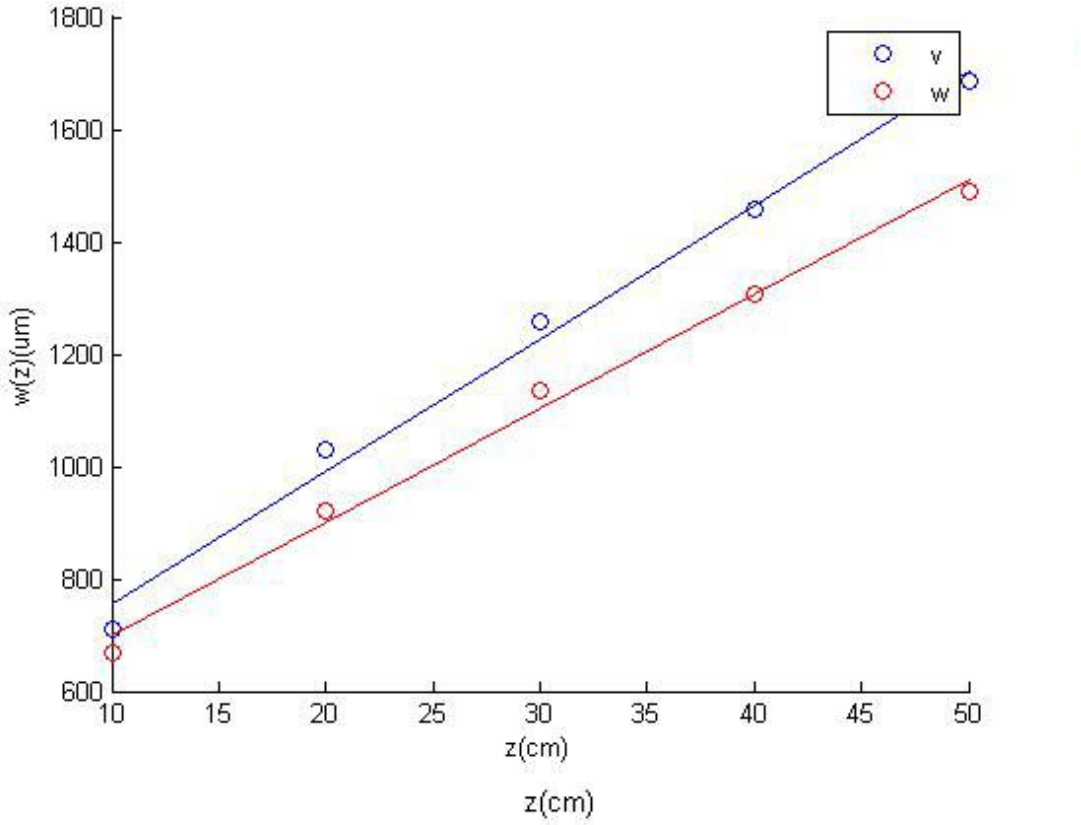
Position of Beam waist

- First test

$$\omega(z)=\omega_0\sqrt{1+\left(\frac{(z-z_0)}{z_R}\right)^2} \qquad \text{(Eq1)}$$

$$z_R=\frac{1}{2}k_0\omega_0^2 \qquad \text{(Eq2)}$$

Direction	ω_0 (μm)	z_0(cm)
w	141.6	-20.97
v	164.7	-23.05



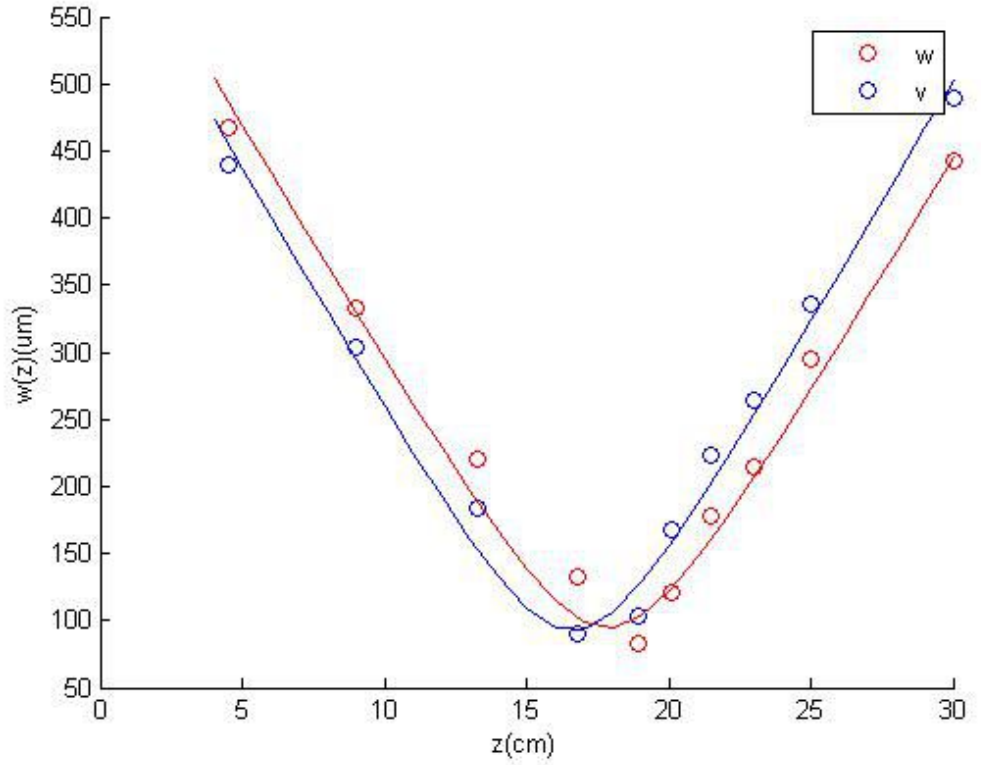
Position of beam waist

- Add lens (practical)
- f=100 mm

$$\omega(z)=\omega_0\sqrt{1+\left(\frac{(z-z_0)}{z_R}\right)^2} \qquad \text{(Eq1)}$$

$$z_R=\frac{1}{2}k_0\omega_0^2 \qquad \text{(Eq2)}$$

Direction	ω_0 (μm)	z_0(cm)
w	94.77	17.83
v	91.87	16.58



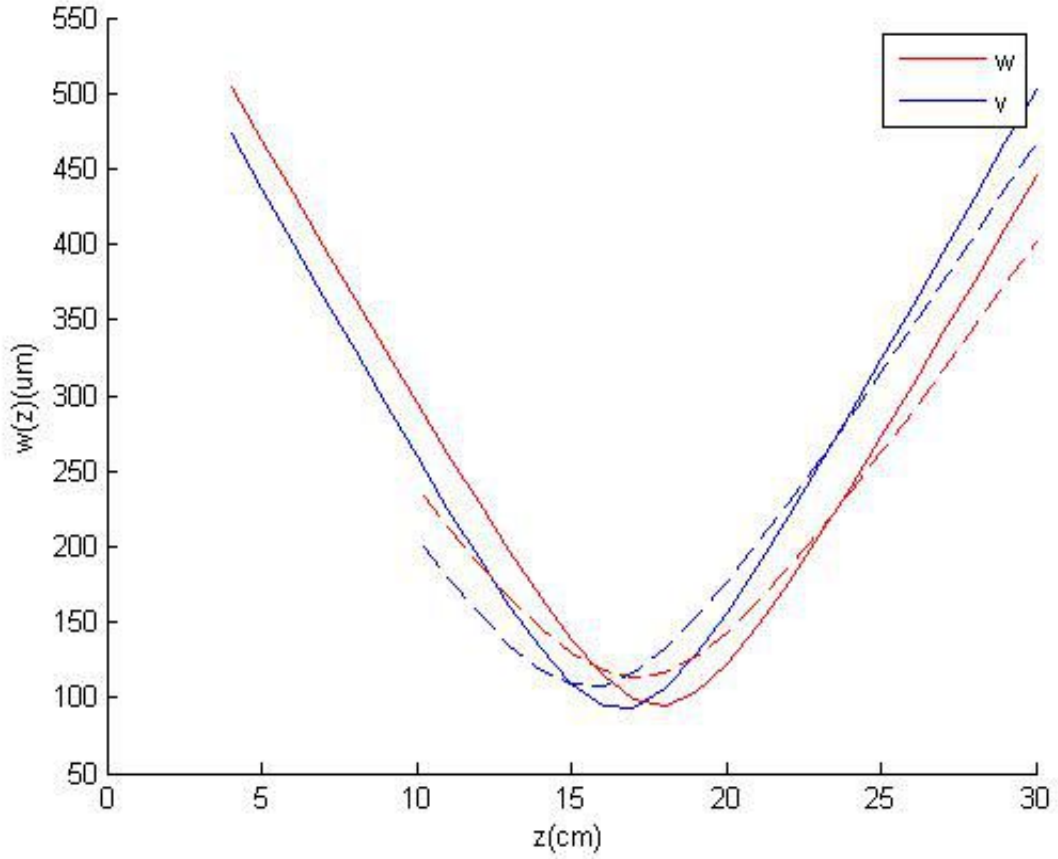
Position of beam waist

- Add lens(theoretical)
- f= 100 mm

$$d_2 = \frac{z_{R1}^{\ 2} - d_1(f - d_1)}{z_{R1}^{\ 2} + (f - d_1)^2} f \qquad (Eq3)$$

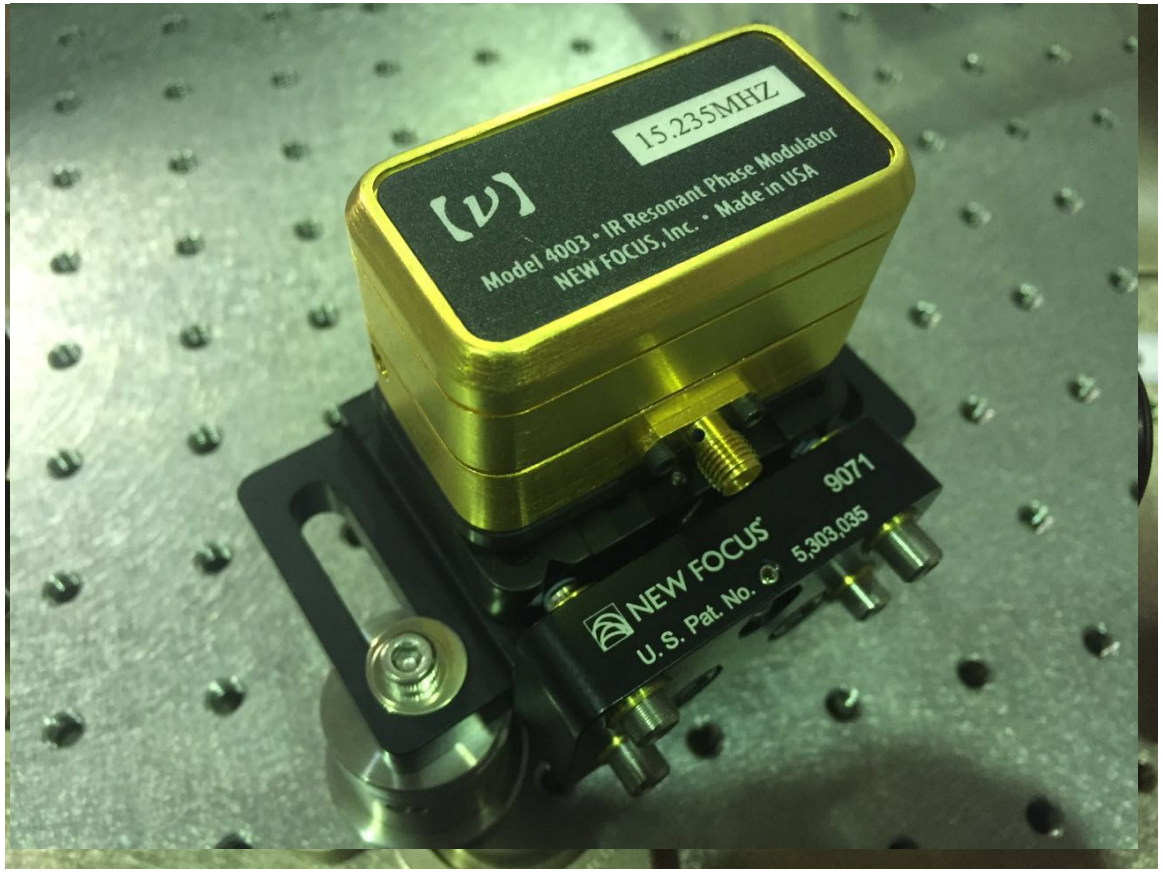
$$z_{R2} = \frac{z_{R1} f^2}{z_{R1}^{\ 2} + (f - d_1)^2} \qquad (Eq4)$$

Direction	ω_0 (μm)	z_0(cm)
w	113.5933	17.0597
v	107.5640	15.5662

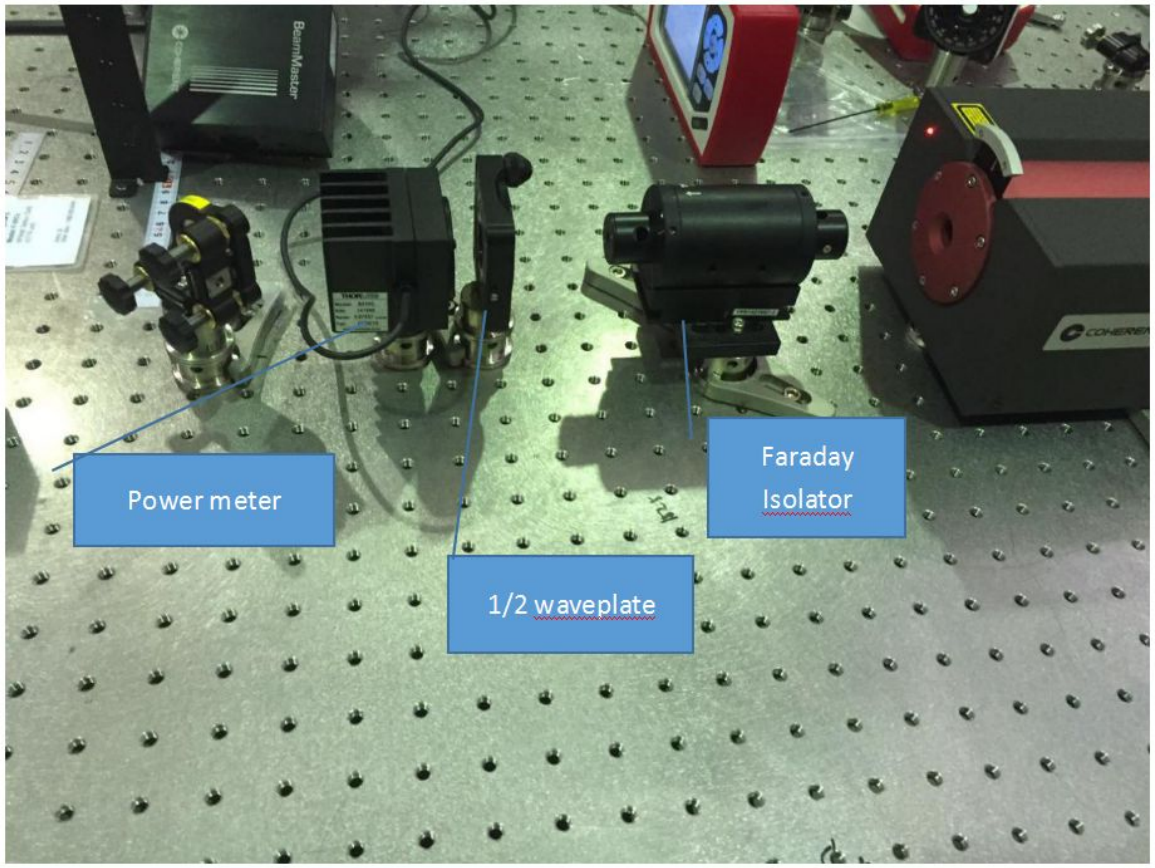


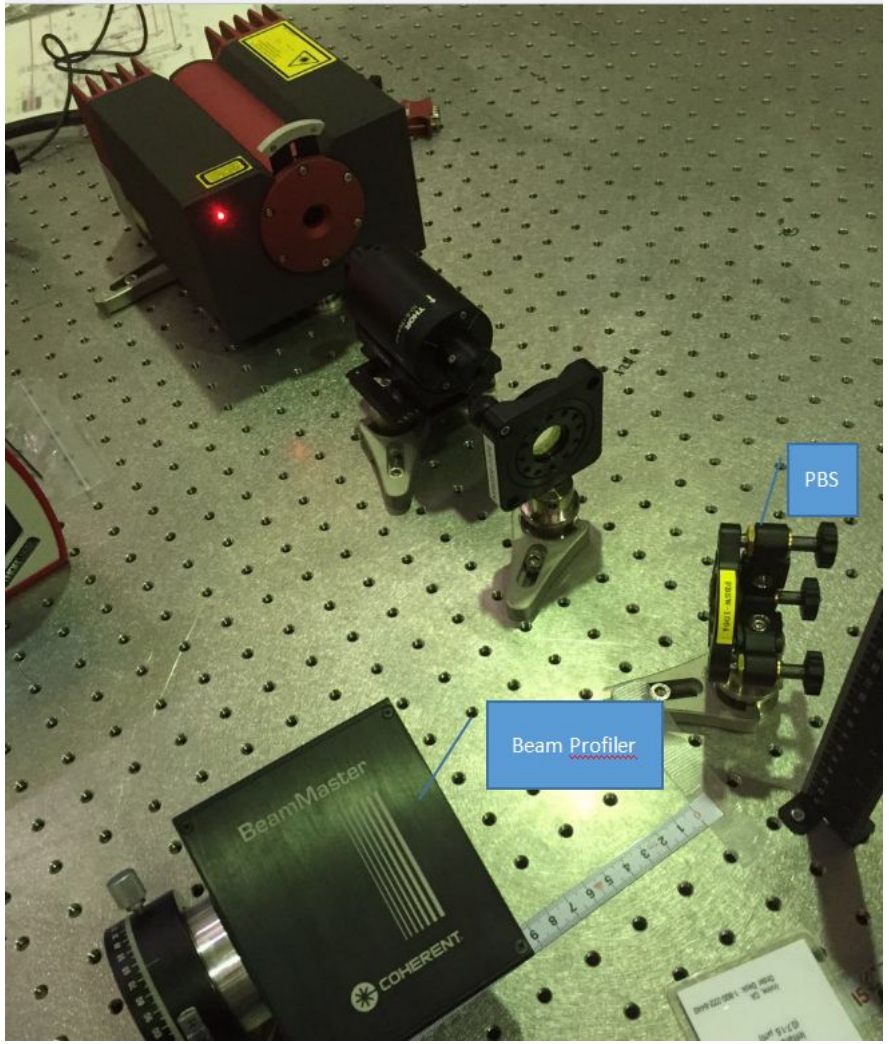
Transmission rate

- Faraday Isolator
- Phase Modulator

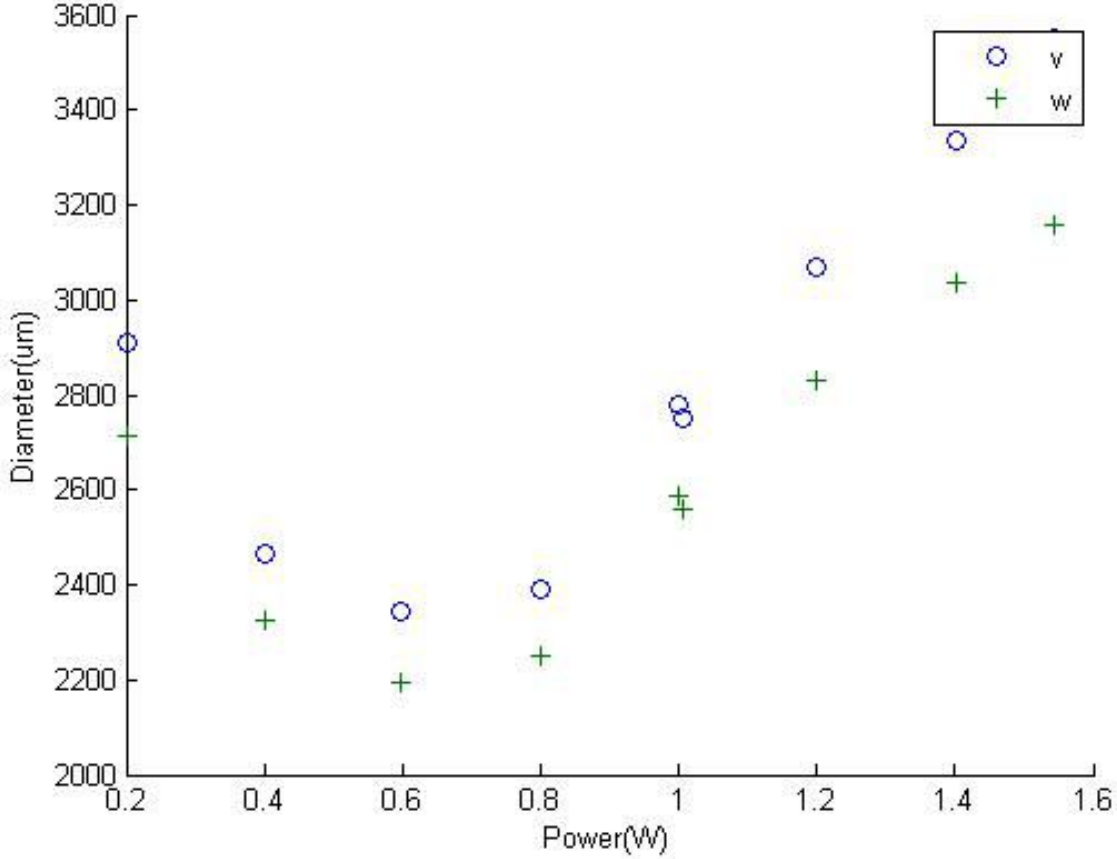


Beam size vs. Output power

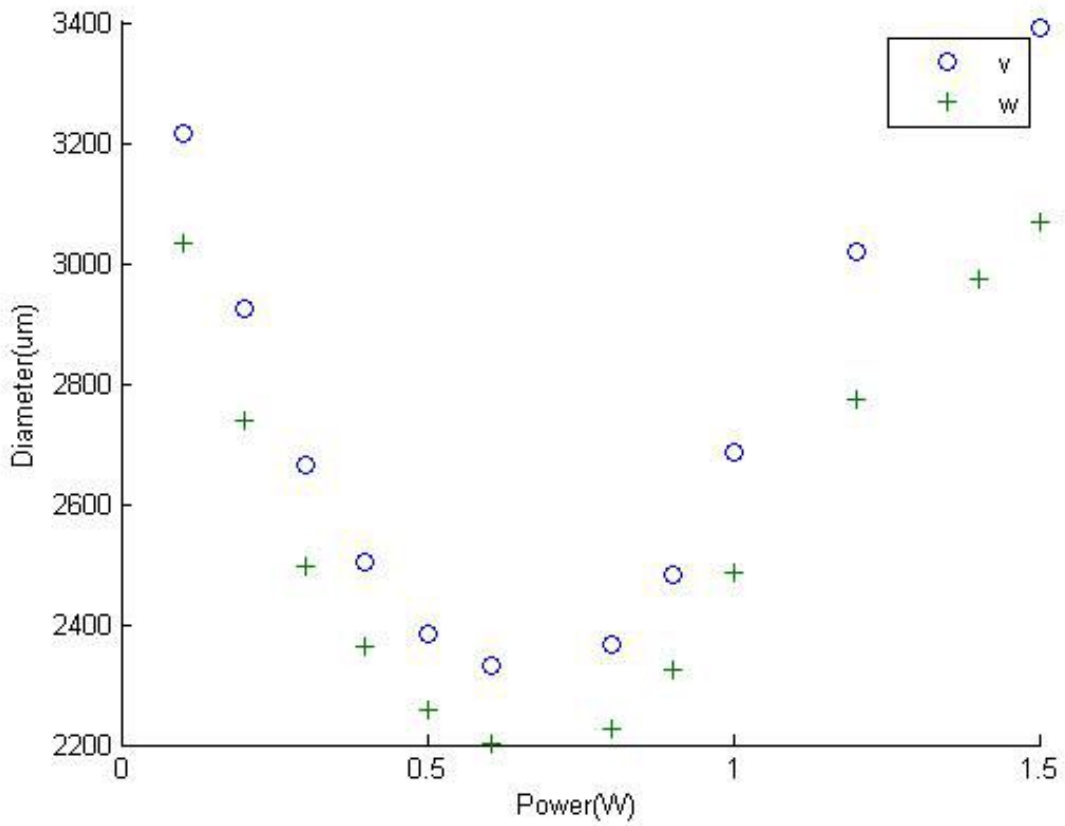




Beam size vs. Output power

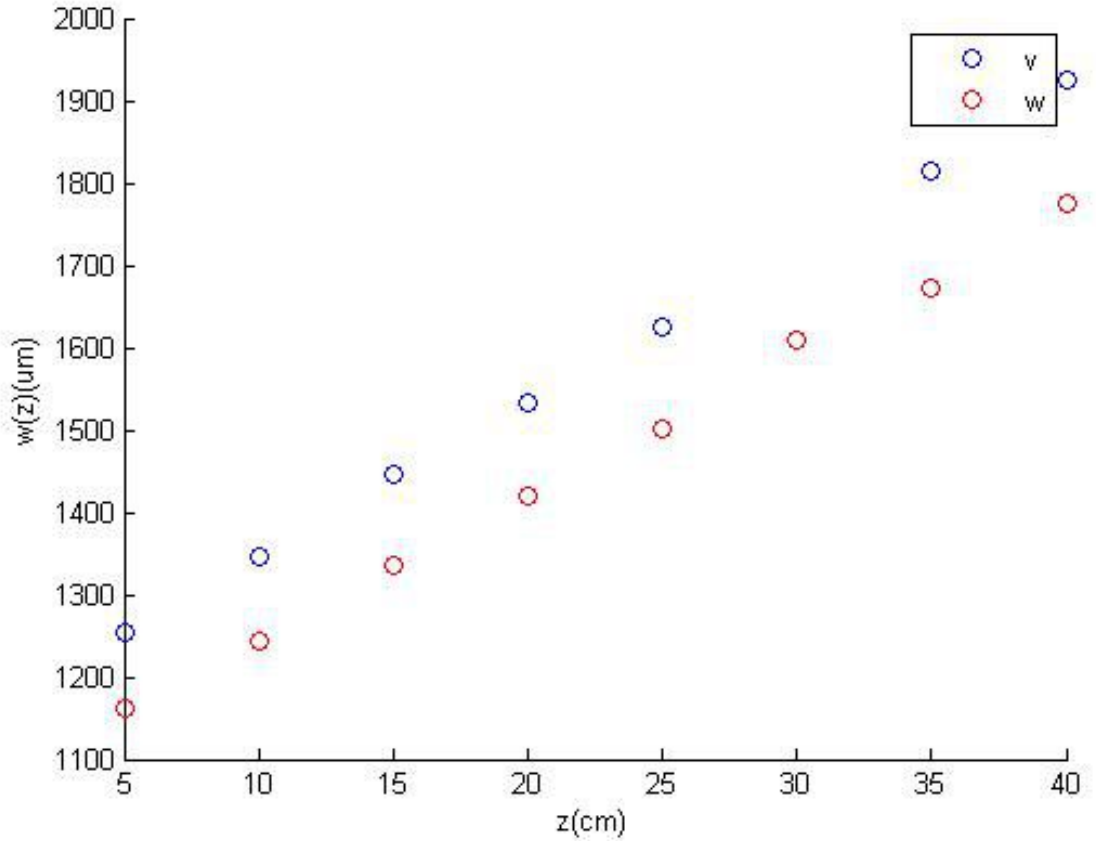


First test



Second test

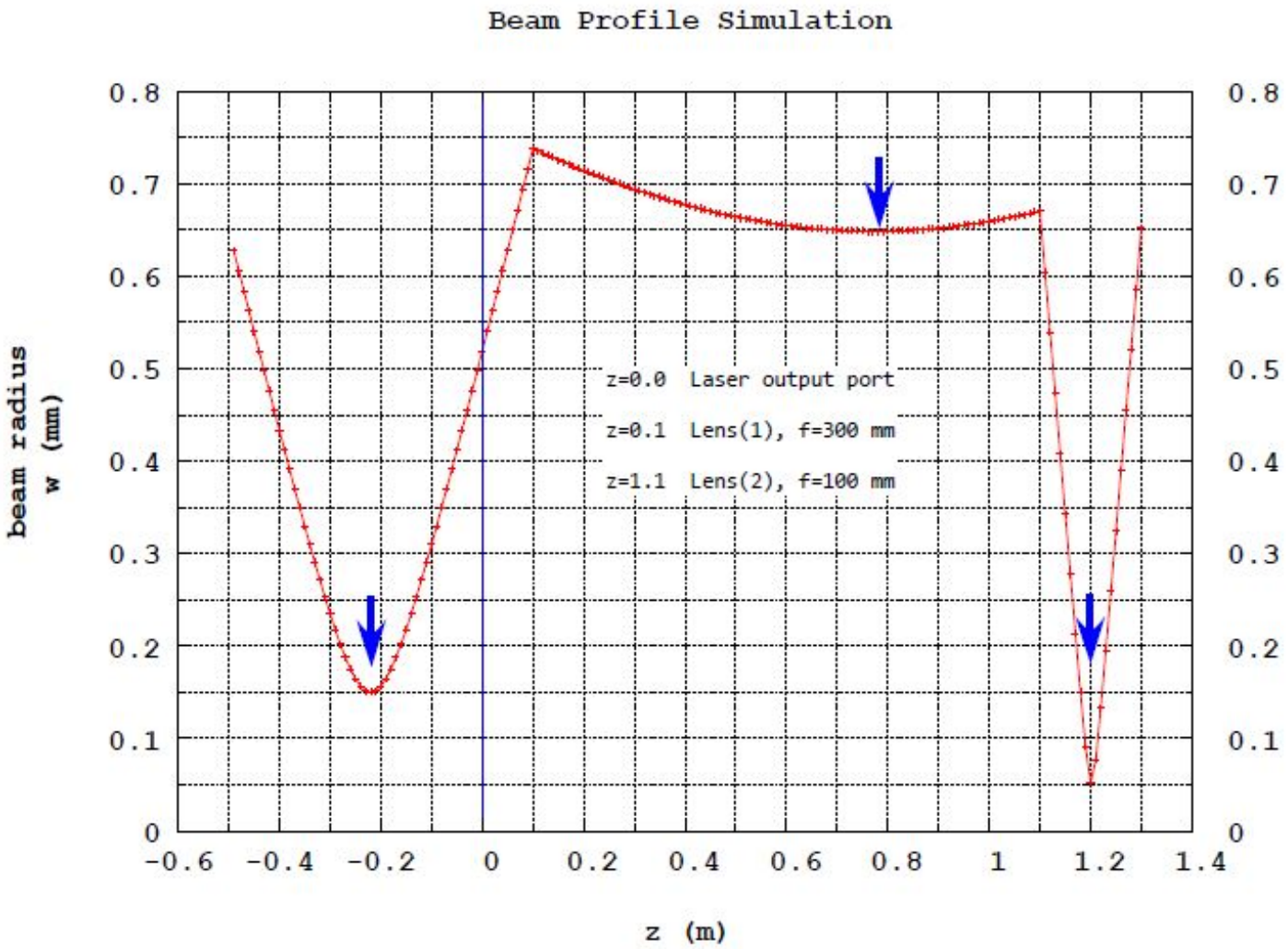
Beam profile



Conditions:

- Beam radius should be about 40μm arriving at SHG
- Distance between lens and SHG should be about 30cm

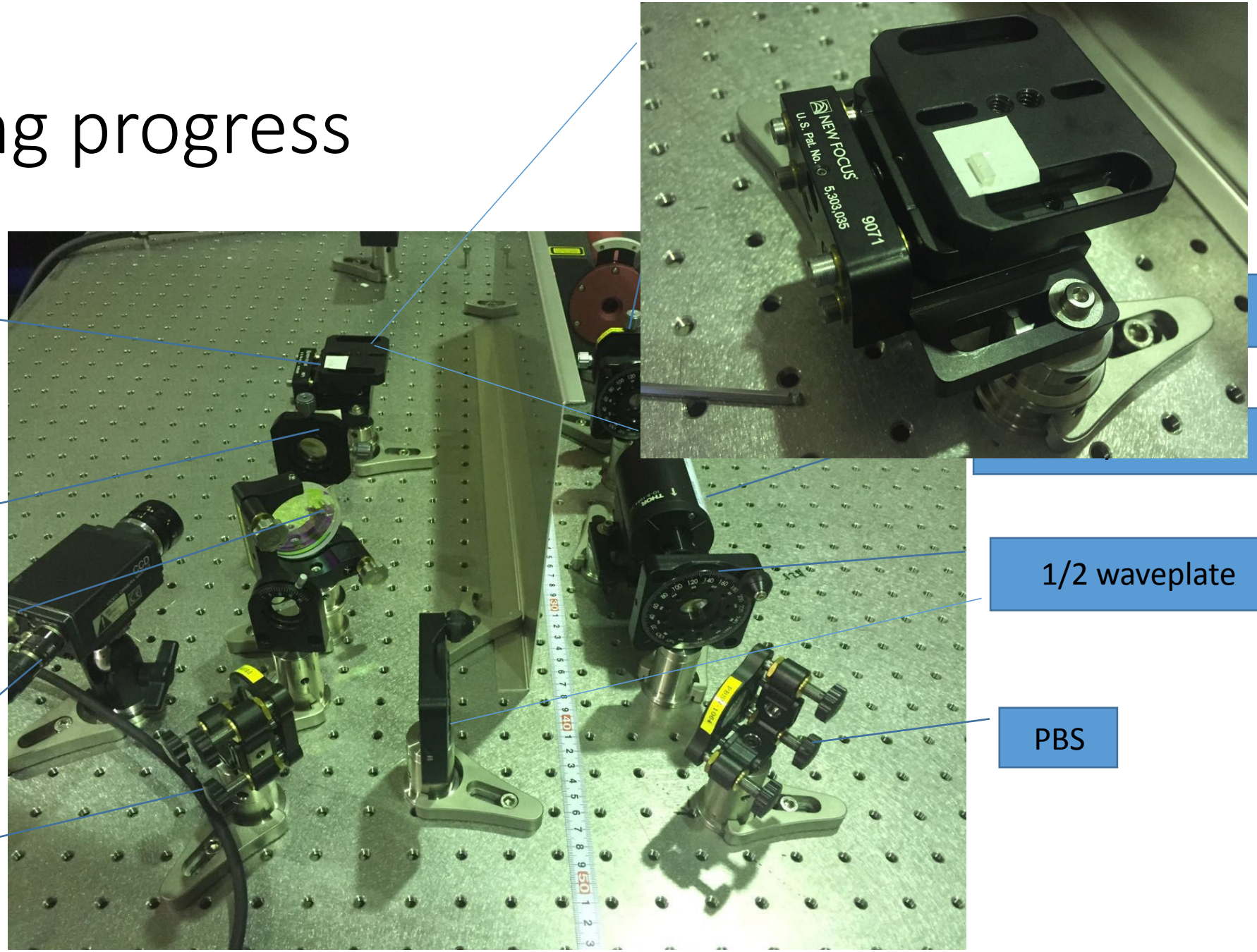
Redesign and Re-calculation



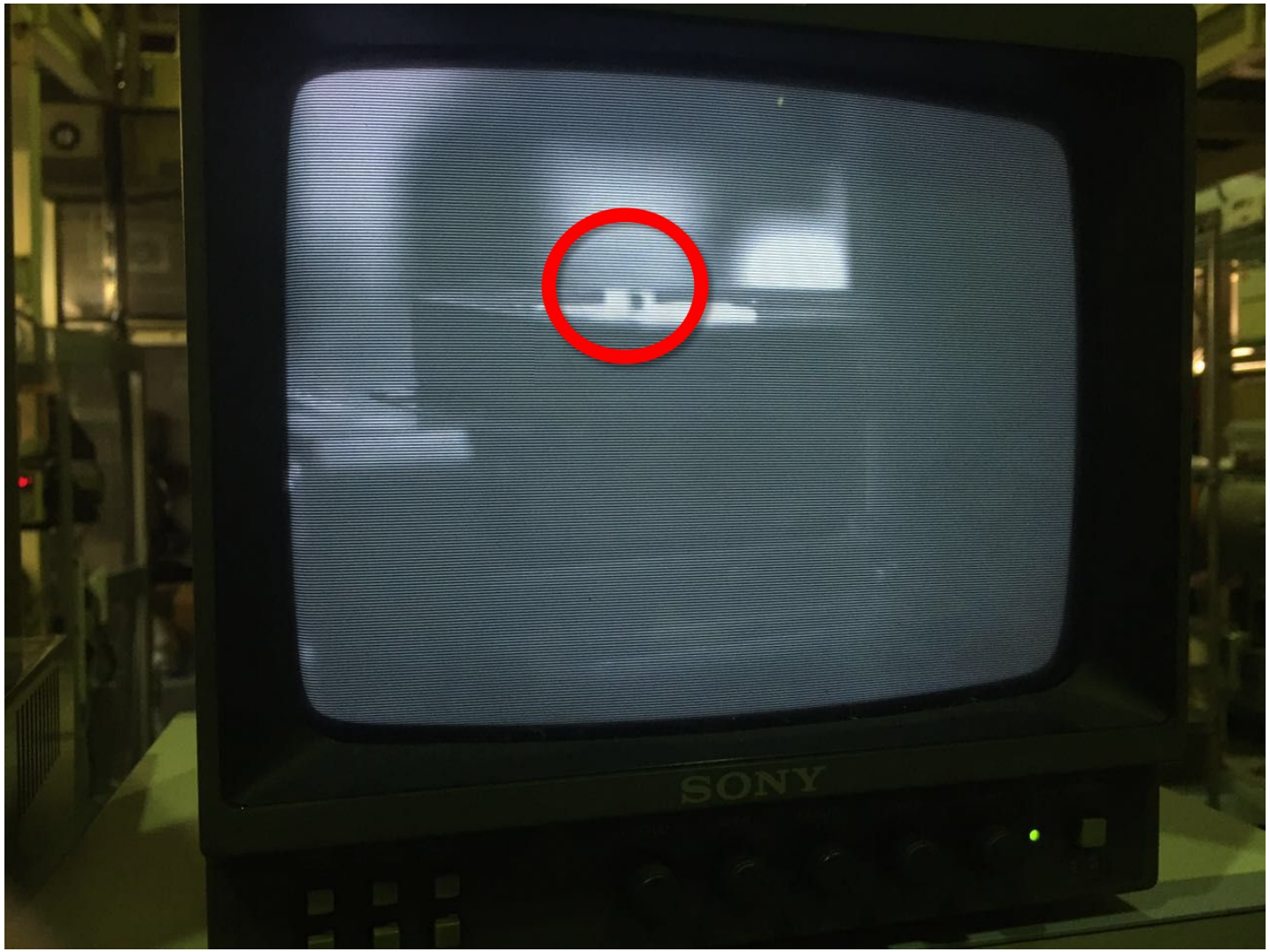
z_0=-22cm

w_0=150μm

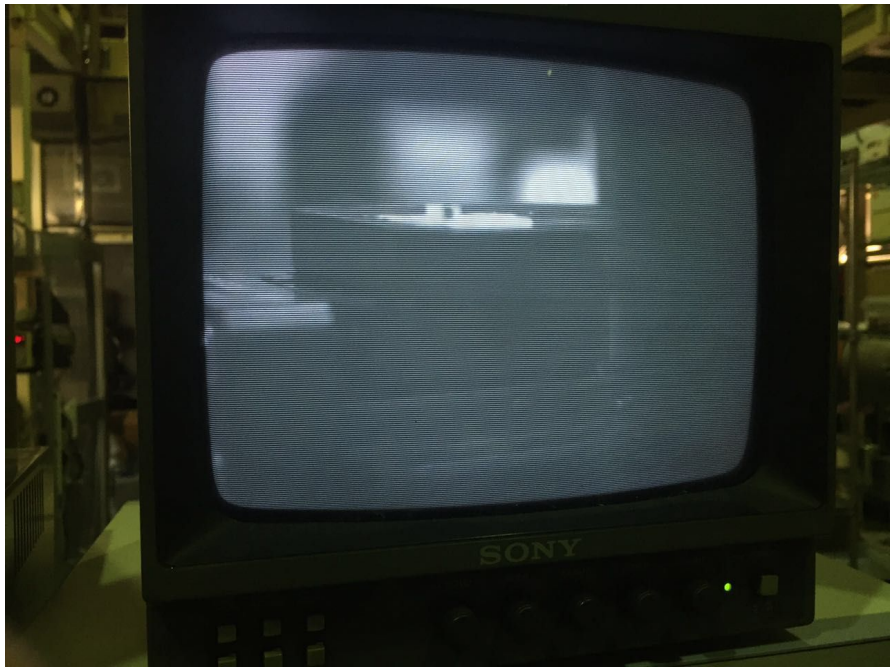
Mounting progress

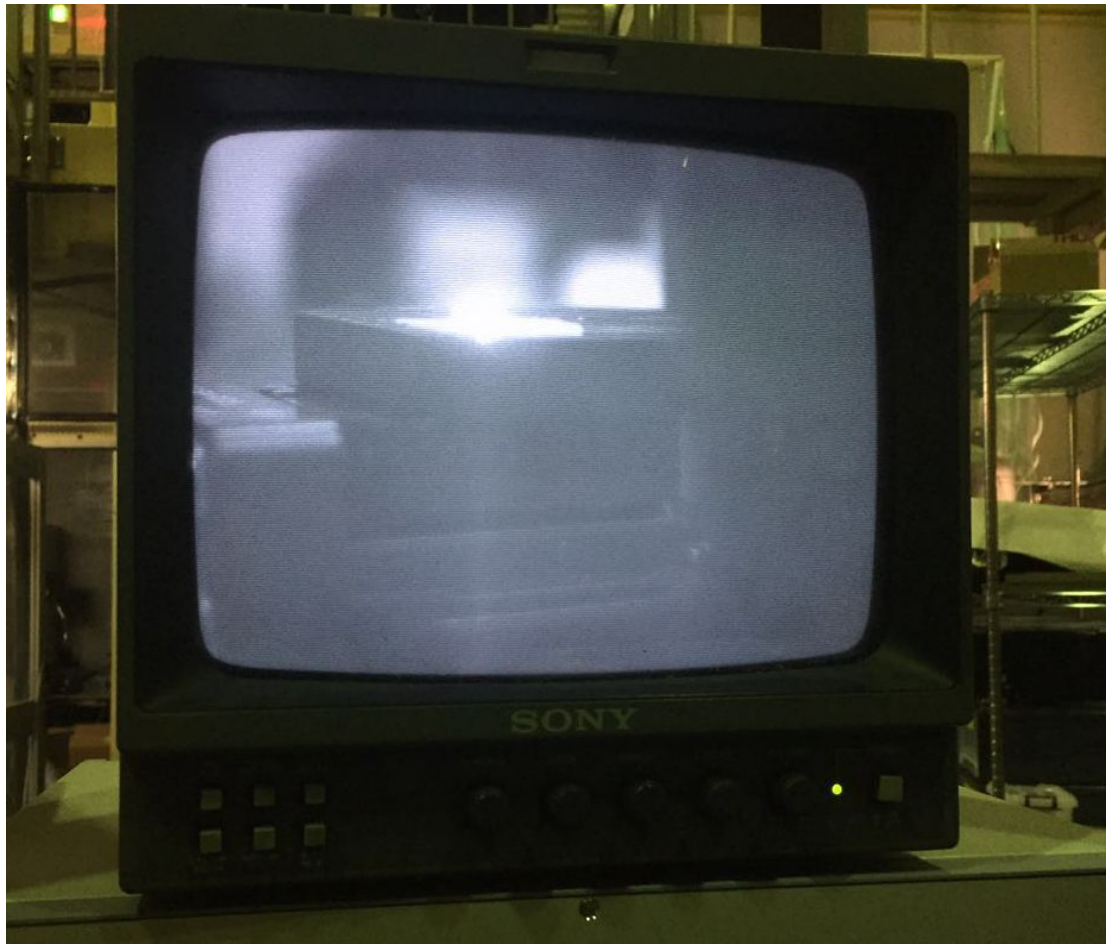


Mounting progress

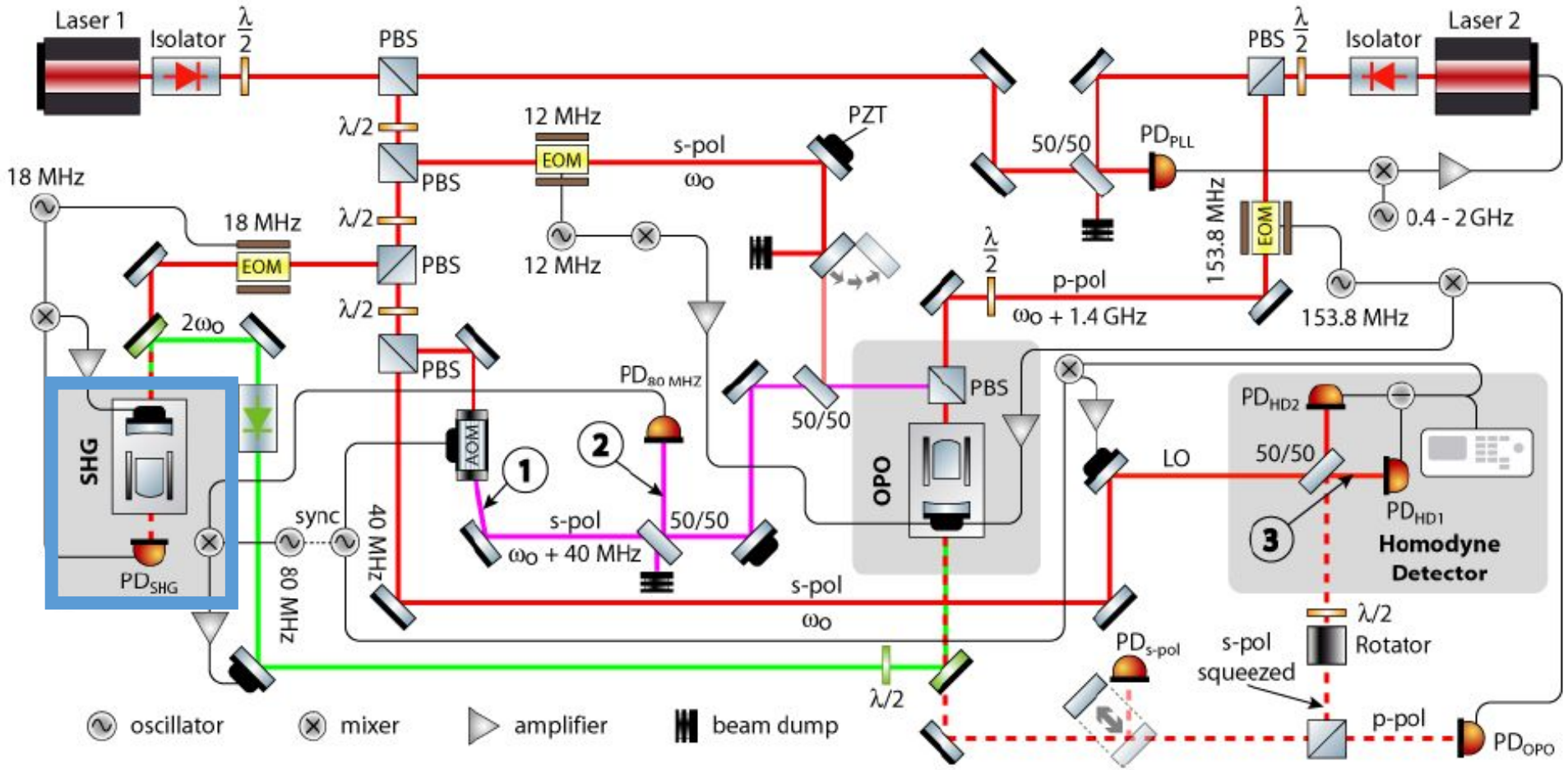


Mounting progress





Next Step


Laser 1
Isolator
λ/2
PBS
λ/2
PBS
λ/2
PBS
λ/2
PBS
12 MHz
EOM
12 MHz
s-pol
ωo
PZT
18 MHz
18 MHz
EOM
2ωo
SHG
PDSHG
PDSO MHZ
AOM
1
2
sync
80 MHz
40 MHz
s-pol
ωo + 40 MHz
50/50
50/50
PBS
OPO
s-pol
ωo
λ/2
50/50
PDPLL
PBS
λ/2
Isolator
Laser 2
0.4 - 2GHz
153.8 MHz
EOM
153.8 MHz
λ/2
p-pol
ωo + 1.4 GHz
LO
PDHD2
50/50
PDHD1
Homodyne
Detector
3
λ/2
Rotator
PDs-pol
s-pol
squeezed
p-pol
PDOPO
oscillator
mixer
amplifier
beam dump

Thank you for your attention!