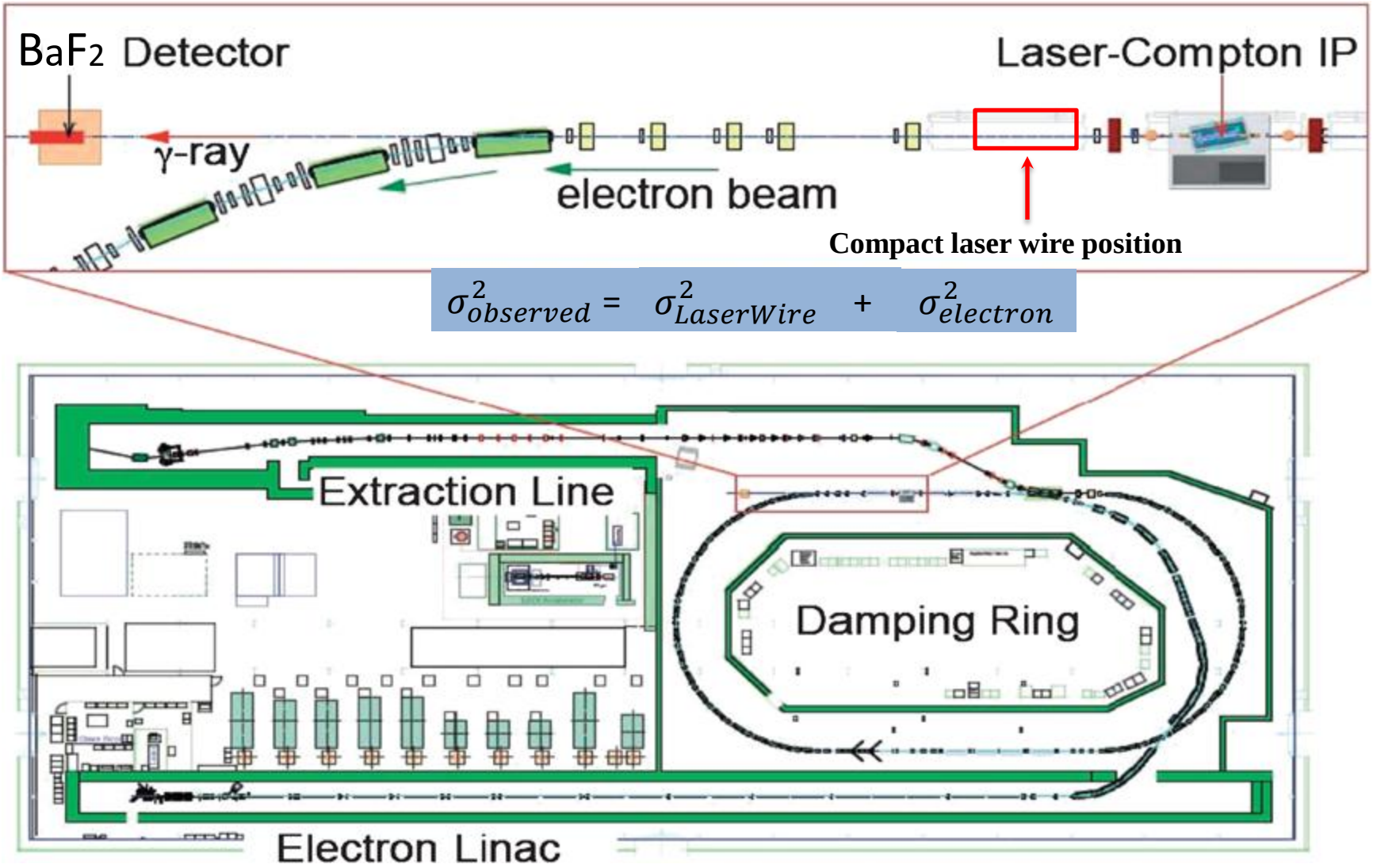
Status of New Damping Ring Laser Wire

Presented by
Arpit Rawankar
Graduate University for Advanced Studies [SOKENDAI], Hayama, Japan

Contents

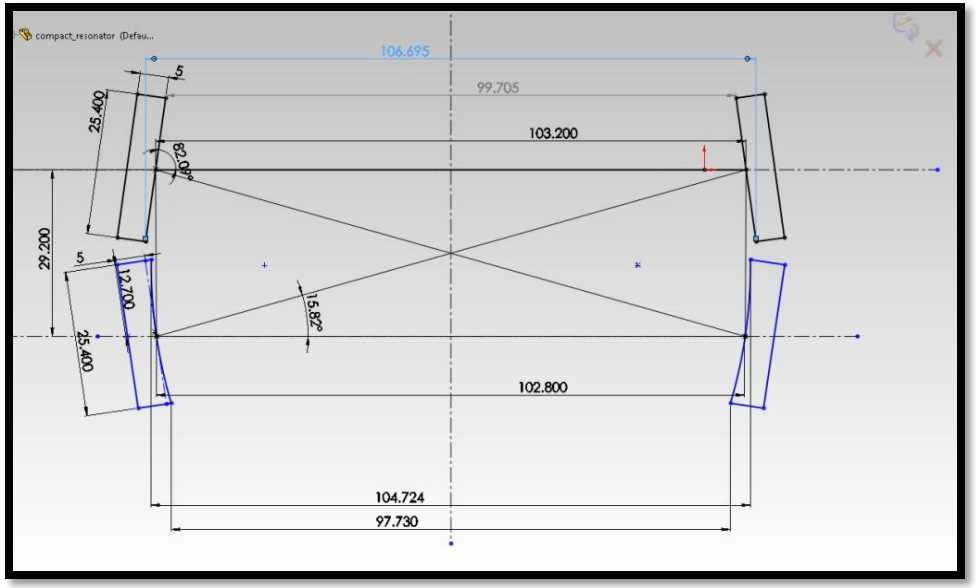
- Introduction
- Design of compact resonator
- Measured parameters of compact resonator
- Preparation of green laser oscillator by second harmonics generation
- Present status

ATF Damping Ring

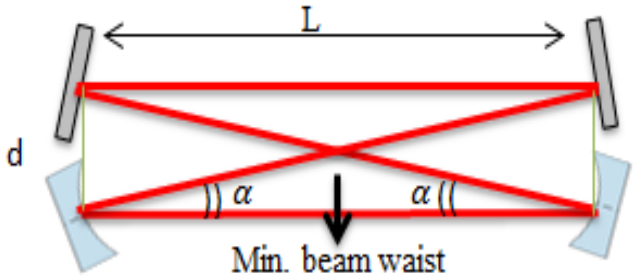


Compact 4 mirror laser wire system

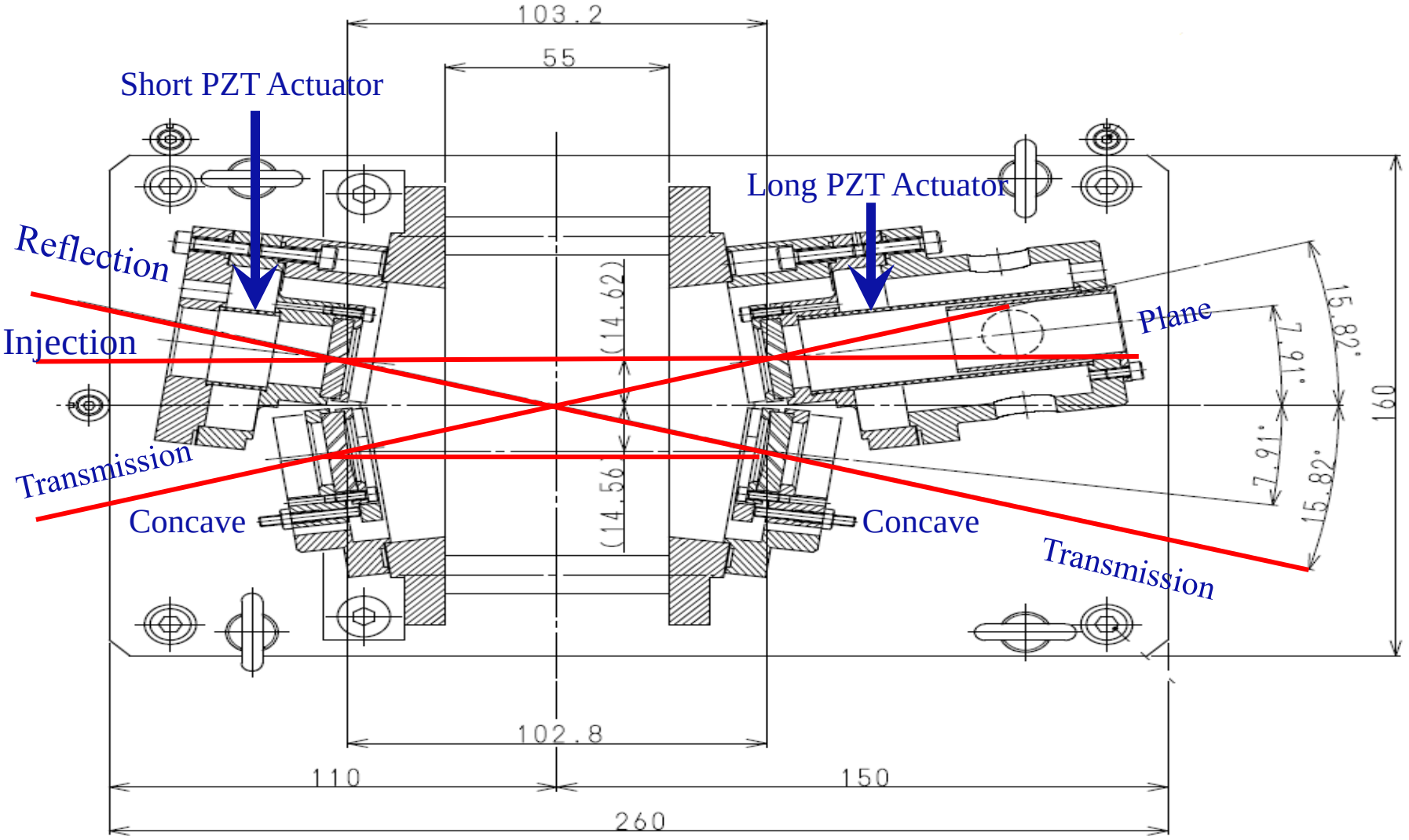
Length of optical cavity = 103 mm
Side by side distance = 29.2 mm
Radius of Curvature = 101.81 $\pm$ 0.2 mm



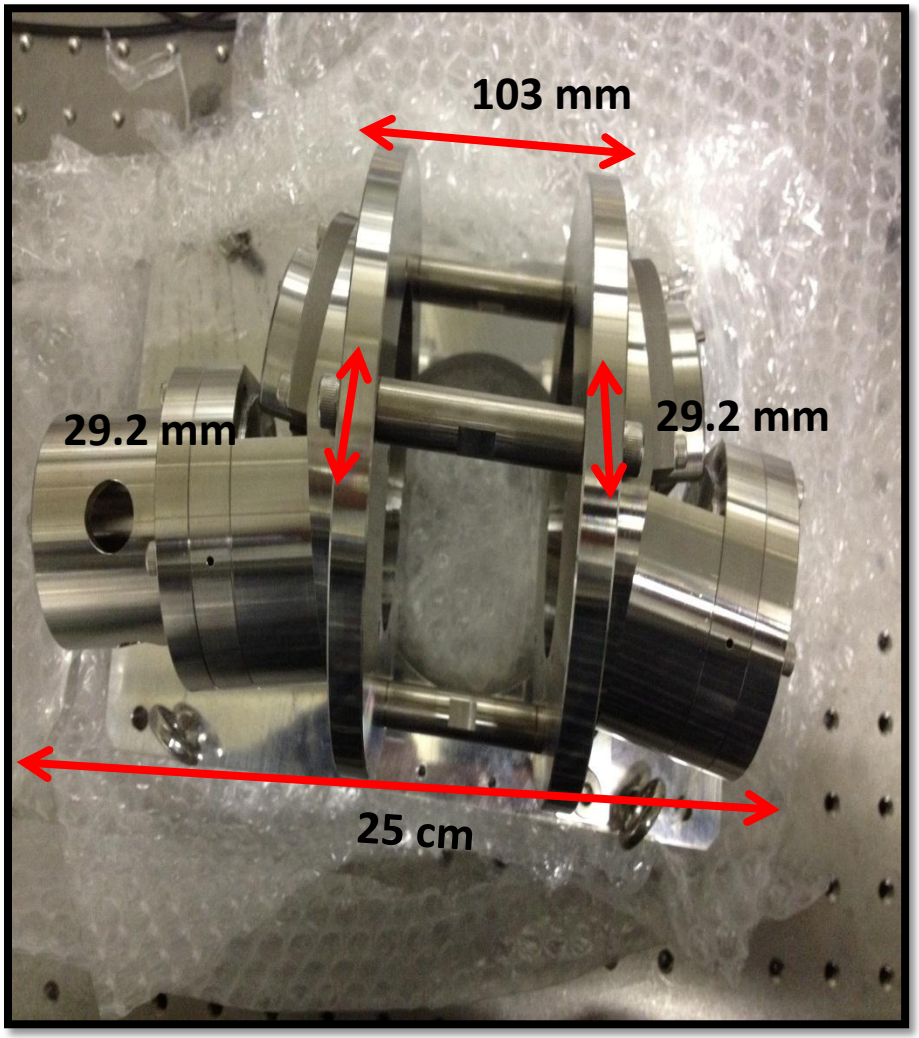
Minimum Beam waist
σ_s= 4 μm, σ_T = 14 μm
Wavelength = 532 nm



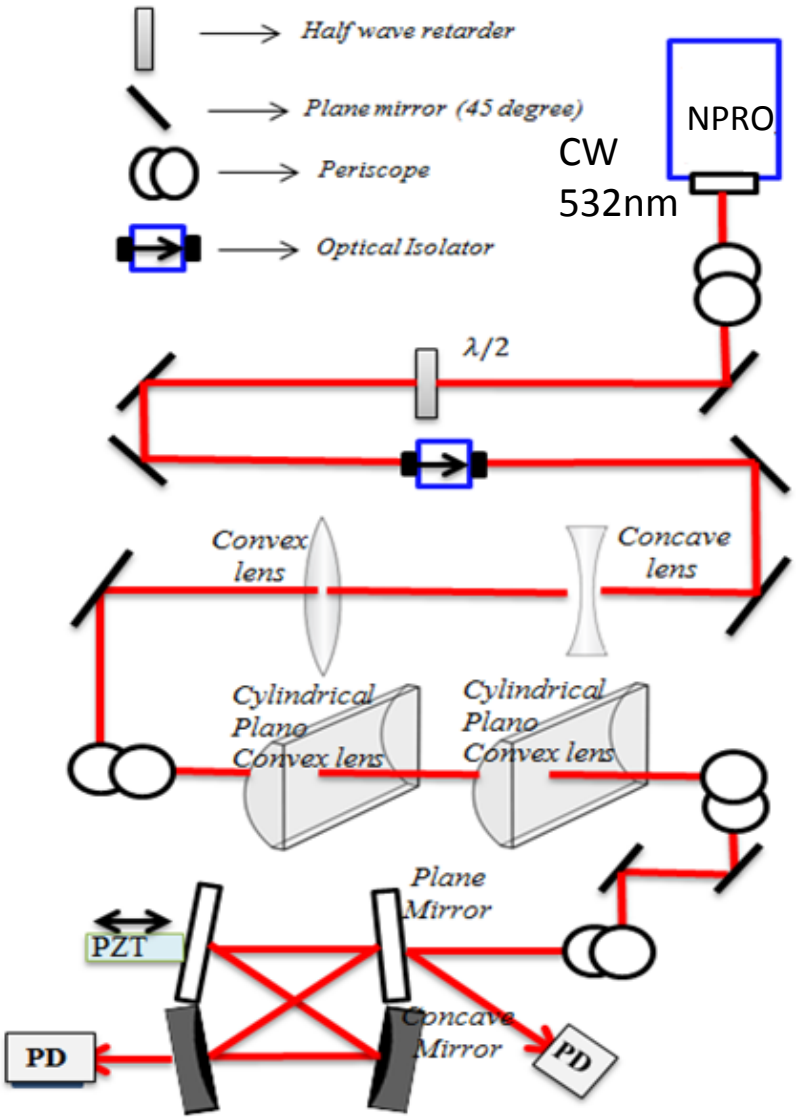
Design Of Mirror holders & Mirror Alignment scheme

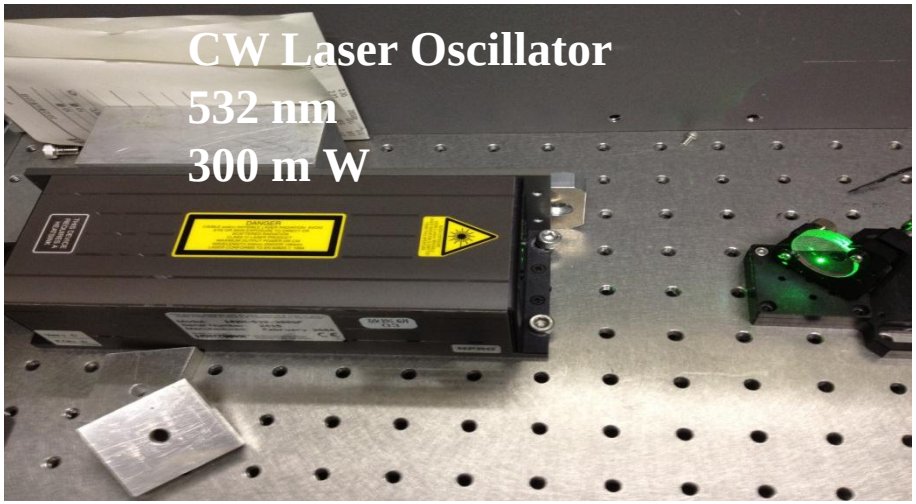


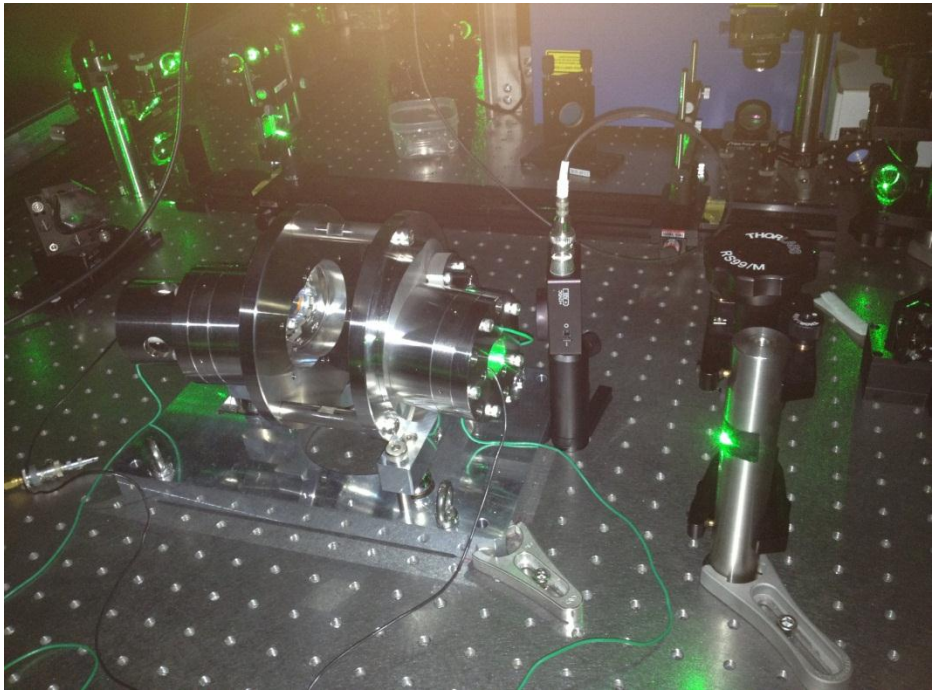
Compact optical cavity design



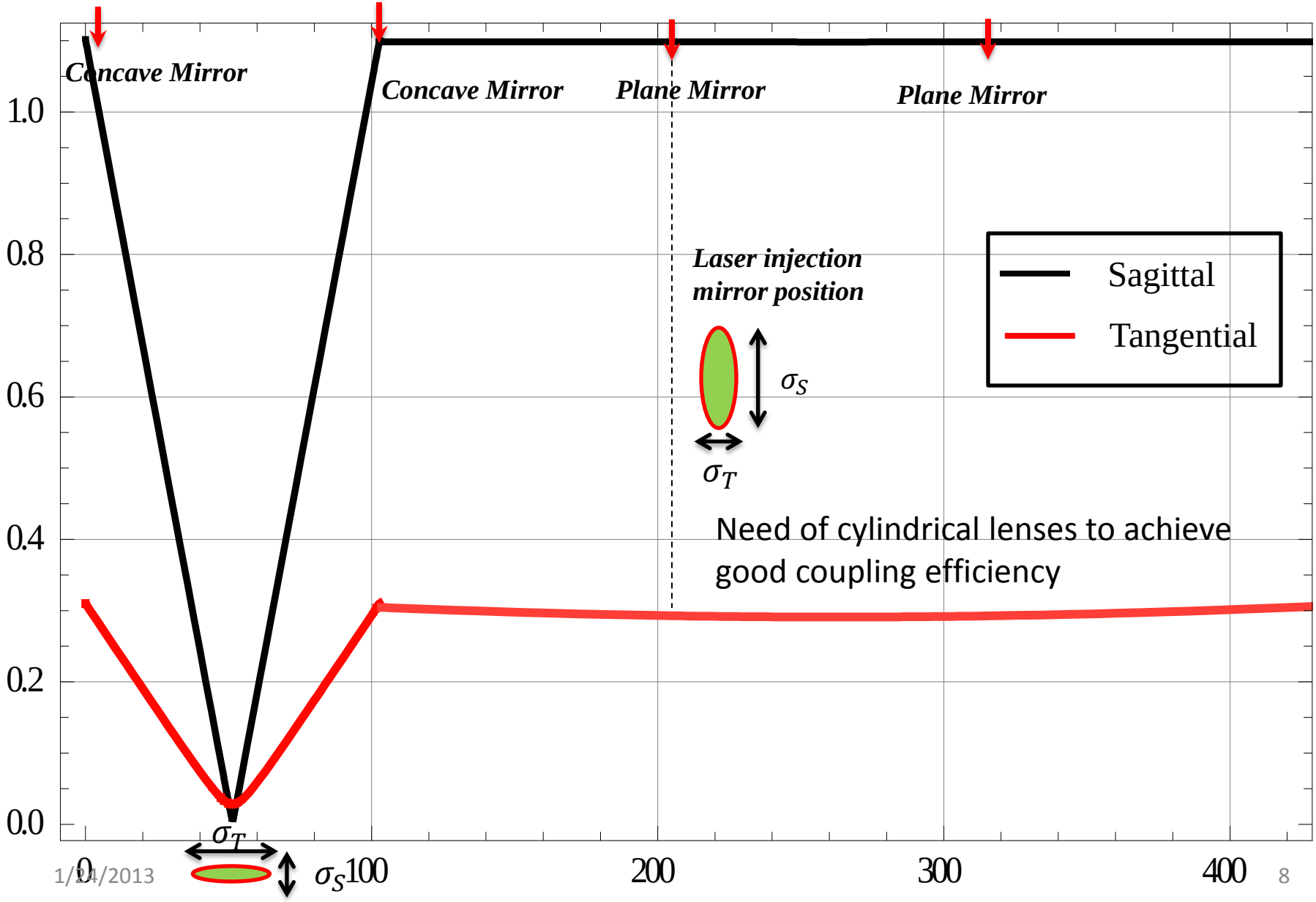
System setup



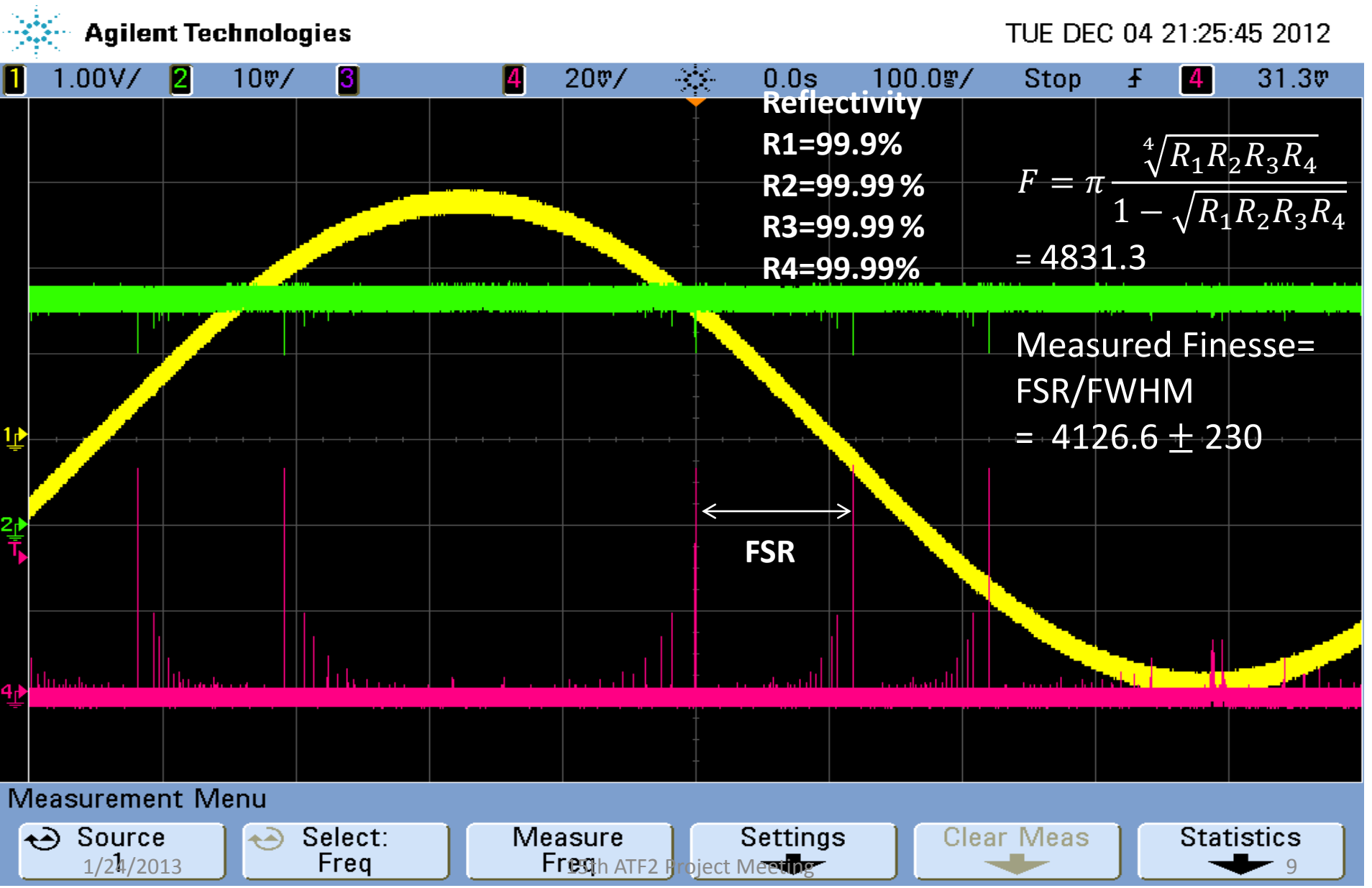




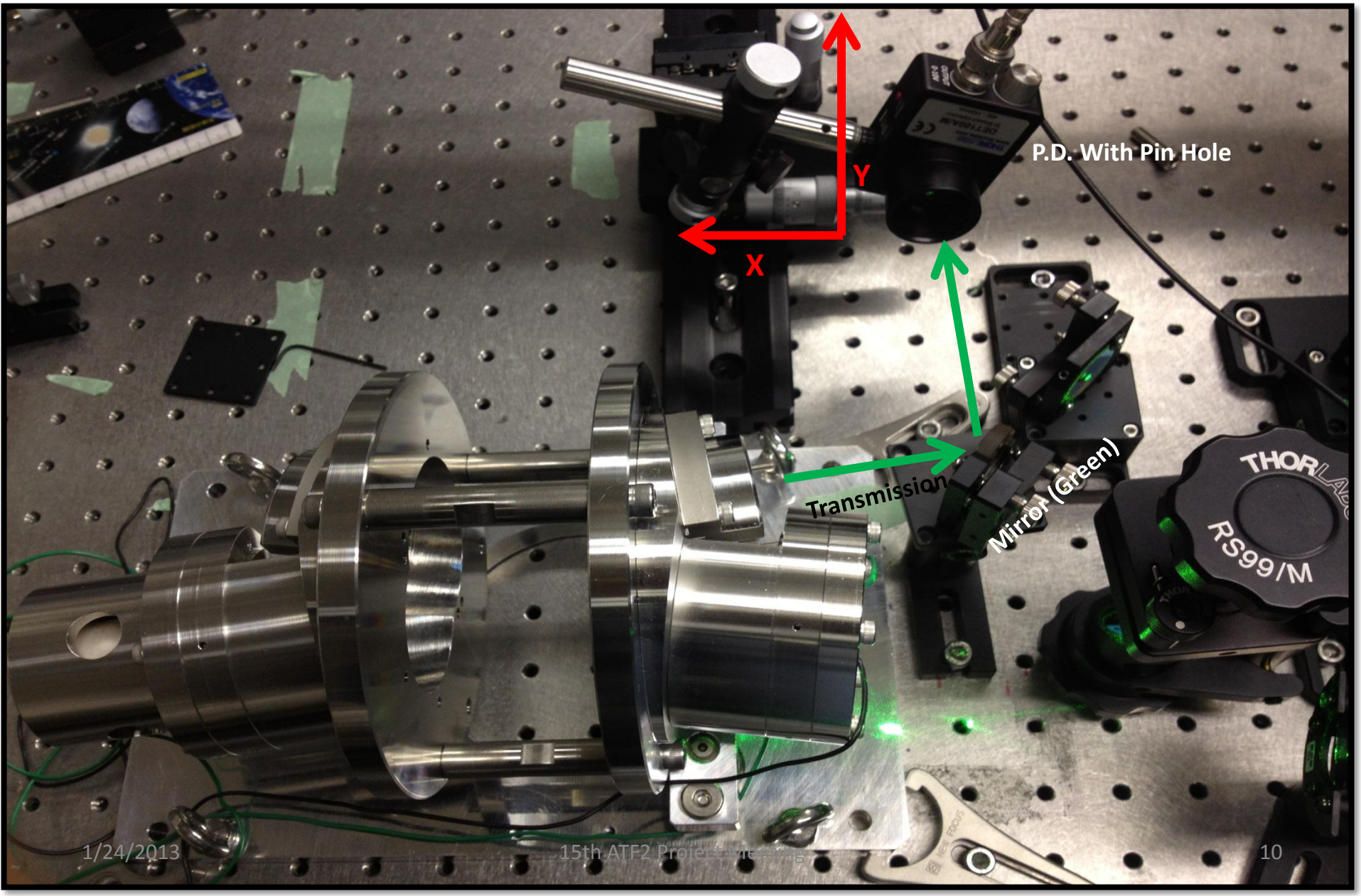
Beam evolution inside compact resonator



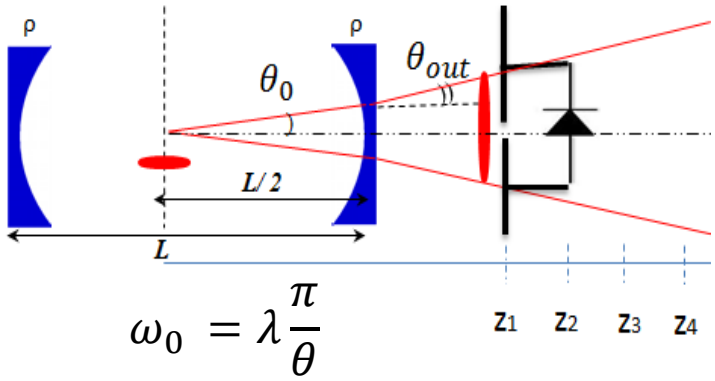
Finesse


Agilent Technologies
TUE DEC 04 21:25:45 2012
1 1.00V/ 2 10mV/ 3 4 20mV/ 0.0s 100.0ms/ Stop 4 31.3mV
Reflectivity
R1=99.9%
R2=99.99 %
R3=99.99 %
R4=99.99%
$F = \pi \frac{\sqrt[4]{R_1 R_2 R_3 R_4}}{1 - \sqrt{R_1 R_2 R_3 R_4}}$
= 4831.3
Measured Finesse=
FSR/FWHM
= 4126.6 ± 230
FSR
Measurement Menu
Source 1
Select: Freq
Measure Freq
Settings
Clear Meas
Statistics

Beam waist measurement using divergence method

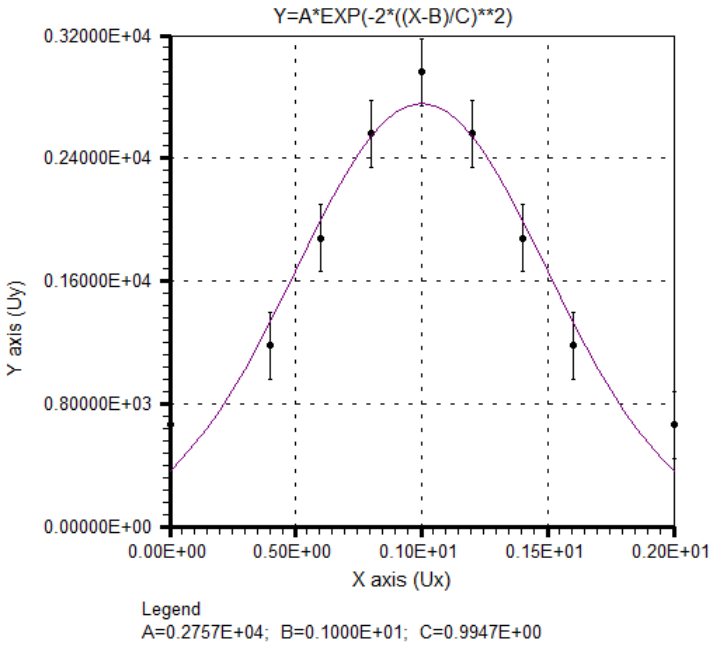


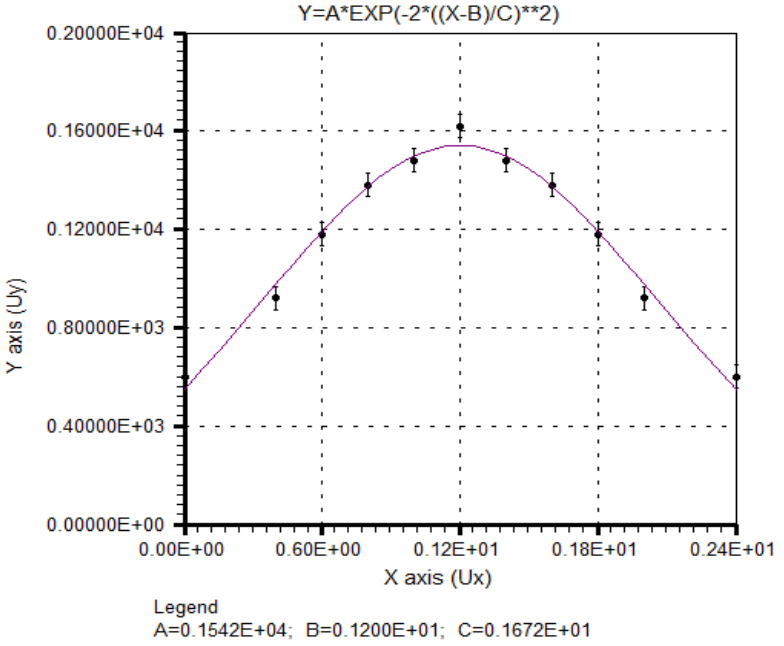
Beam waist Measurement



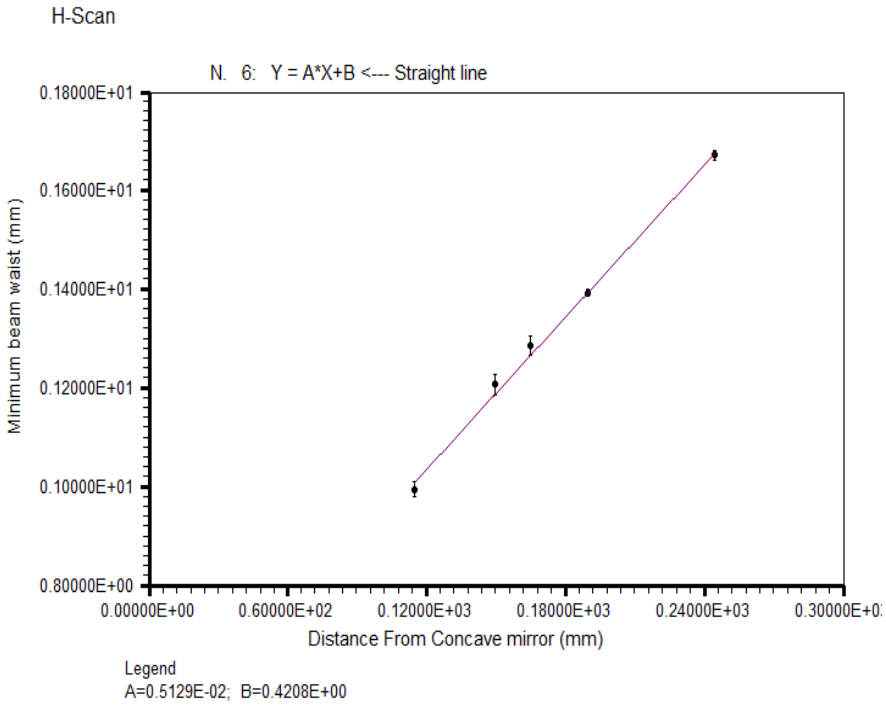
$$\omega_0 = \lambda \frac{\pi}{\theta}$$

$$\omega_0 = \frac{\lambda}{2\pi} \frac{[(n-1)L+2\rho]}{\rho\theta_{out}}$$

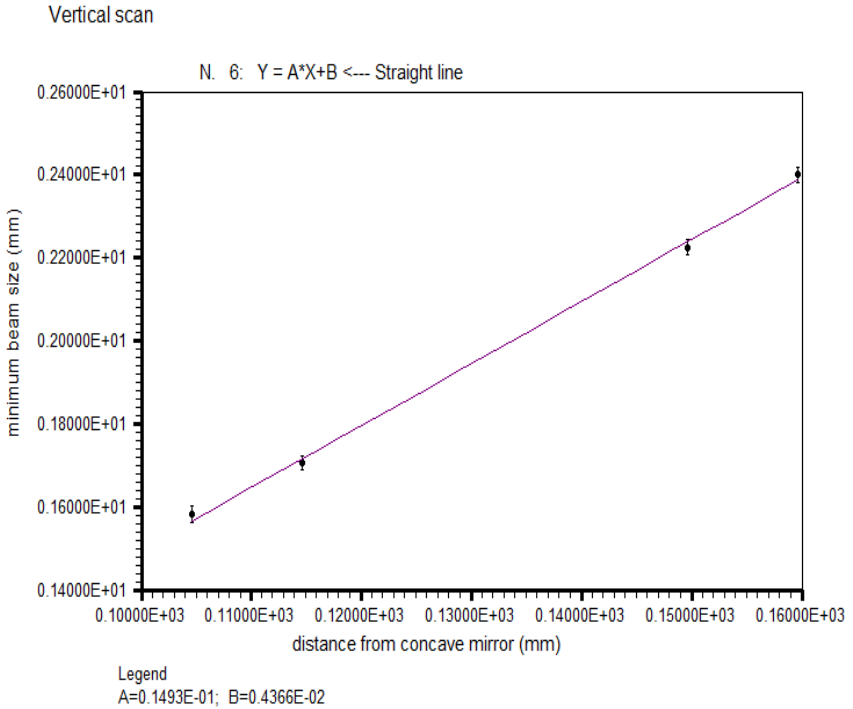




Beam waist as function of divergence angle



σ_T =20.14 ± 0.7 um



σ_s = 6.9 ± 0.3 um

Errors in divergence angle and radius of curvature is considered for calculations

R= 101.81 ± 0.2 mm

Theoretical design values for waist in tangential plane

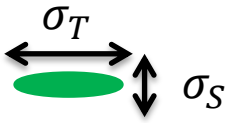
σ_T = 14.1 um

Theoretical design values for waist in sagittal plane

σ_s = 3.95 um

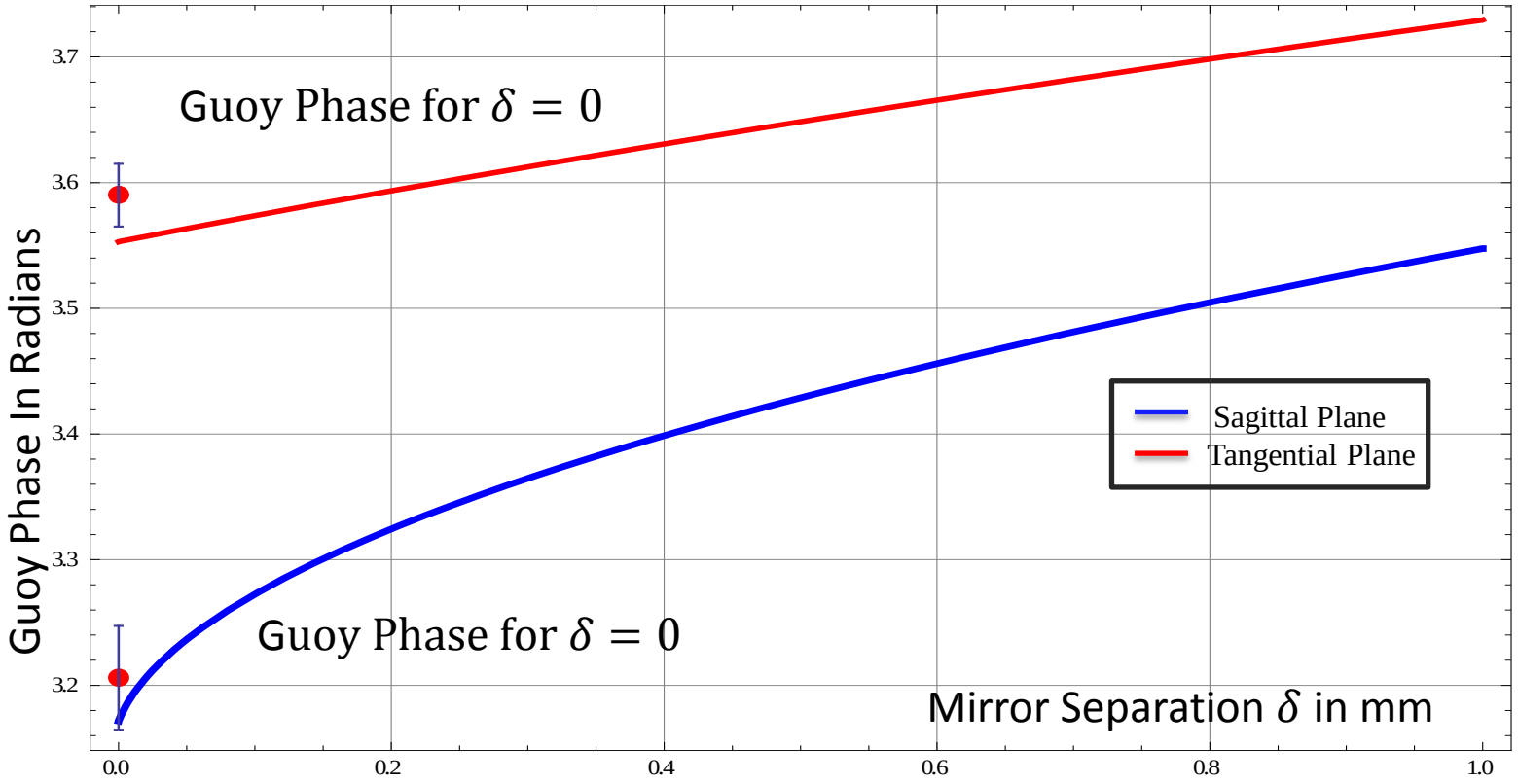
Ratio = $\sigma_T/\sigma_S \approx 3.5$

Measured Ratio = $\sigma_T/\sigma_S \approx 3$



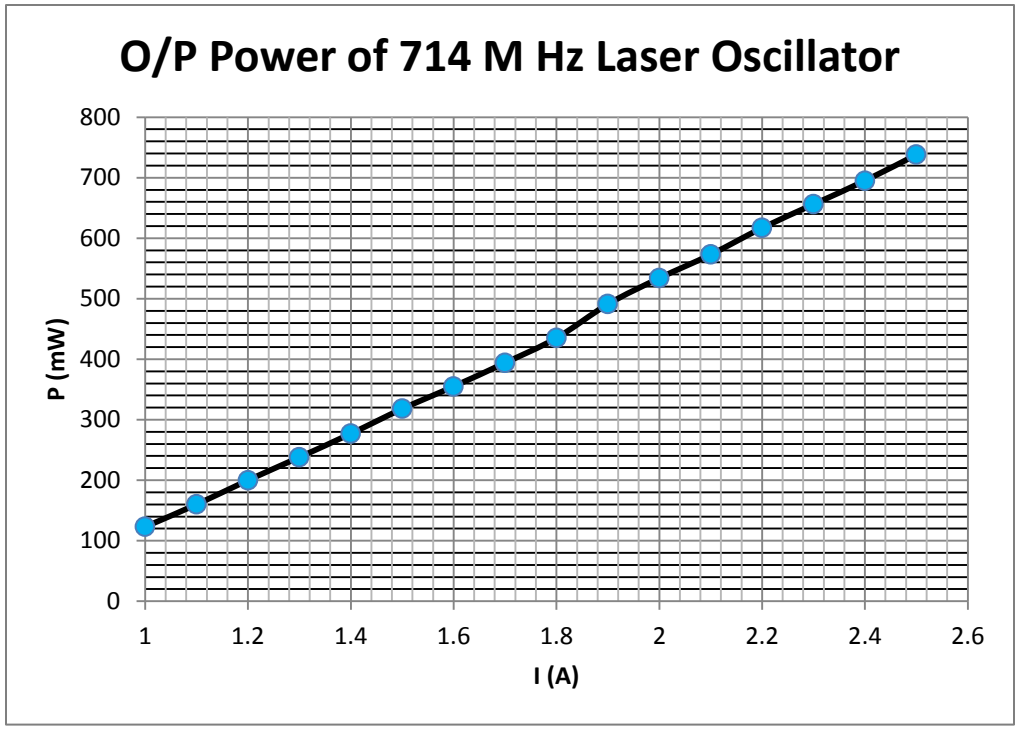
Guoy Phase Measurement

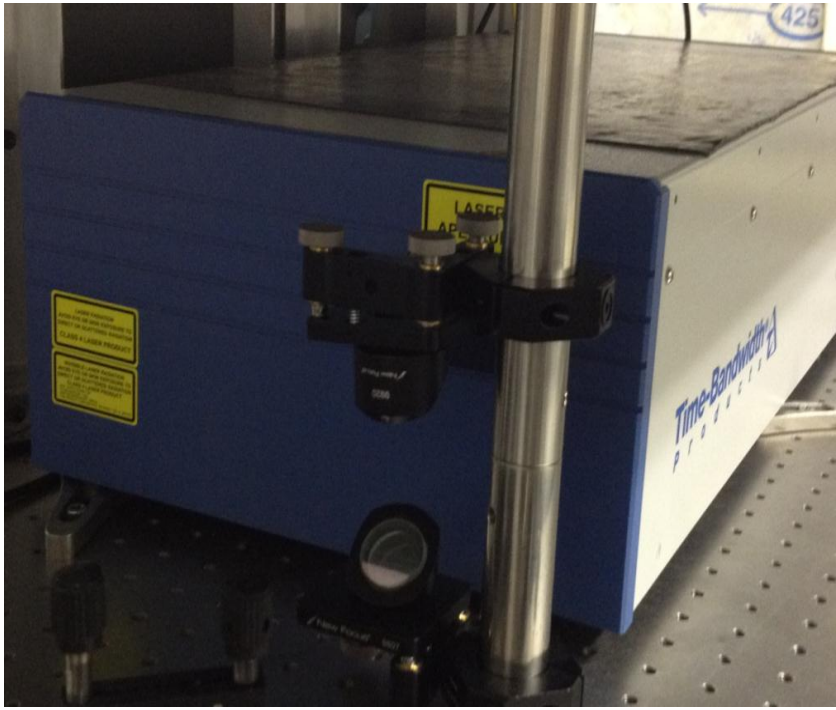
Radius of curvature =101.81 $\pm$ 0.2 mm

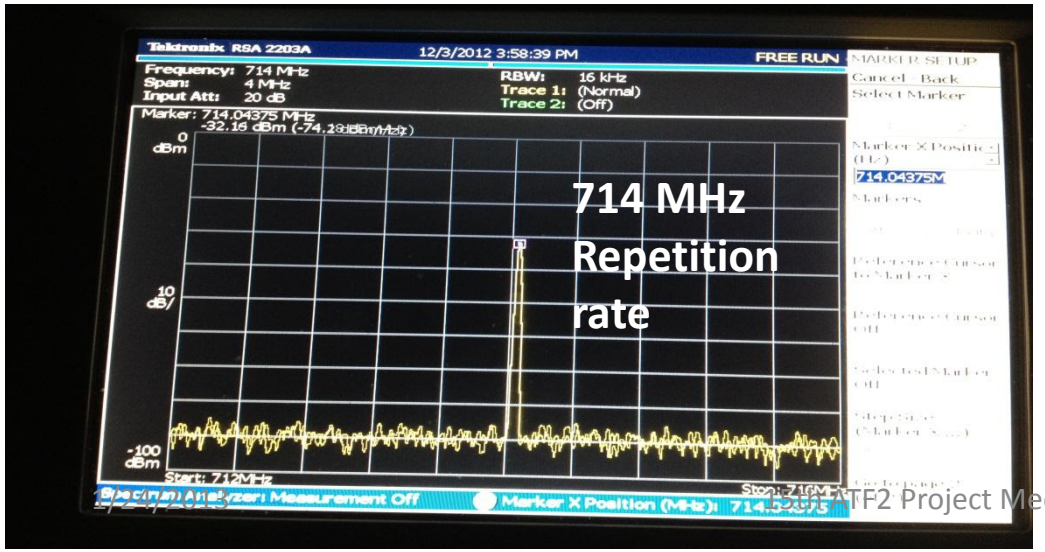


	Minimum beam waist
Sagittal Plane beam size (σ *value*)	5.79 $\pm$ 1.535 um
Tangential Plane beam size (σ *value*)	16.02 $\pm$ 2.5 um

Mode-Locked Pulsed Laser Oscillator

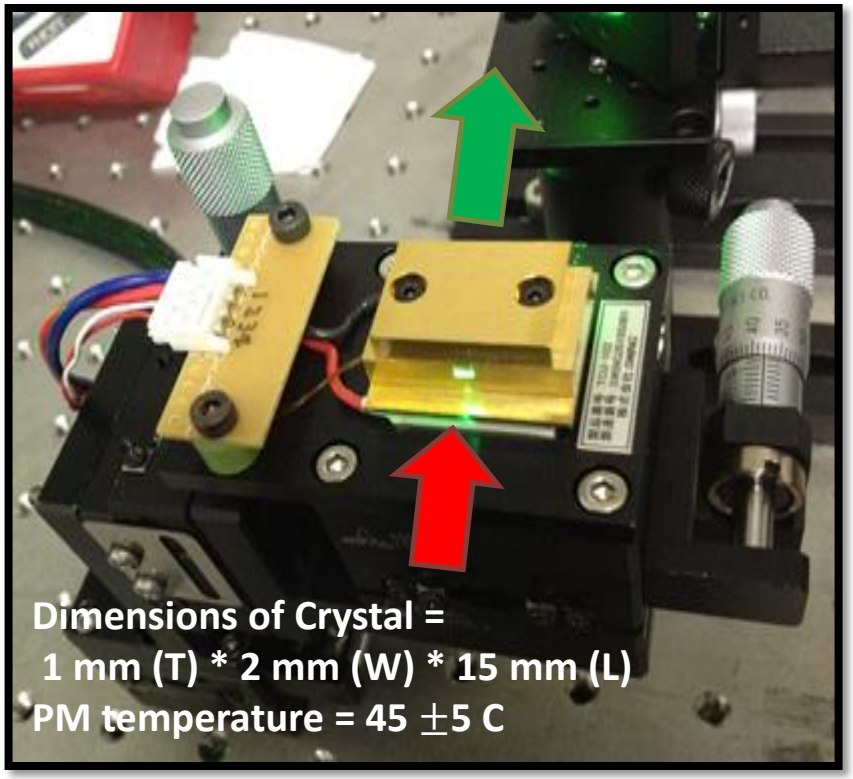






Repetition rate = 714 M Hz
O/P Power = 650 m W
Pulse width = 7.5 ps
Crystal = Nd: VAN
Wavelength = 1064 nm (IR)

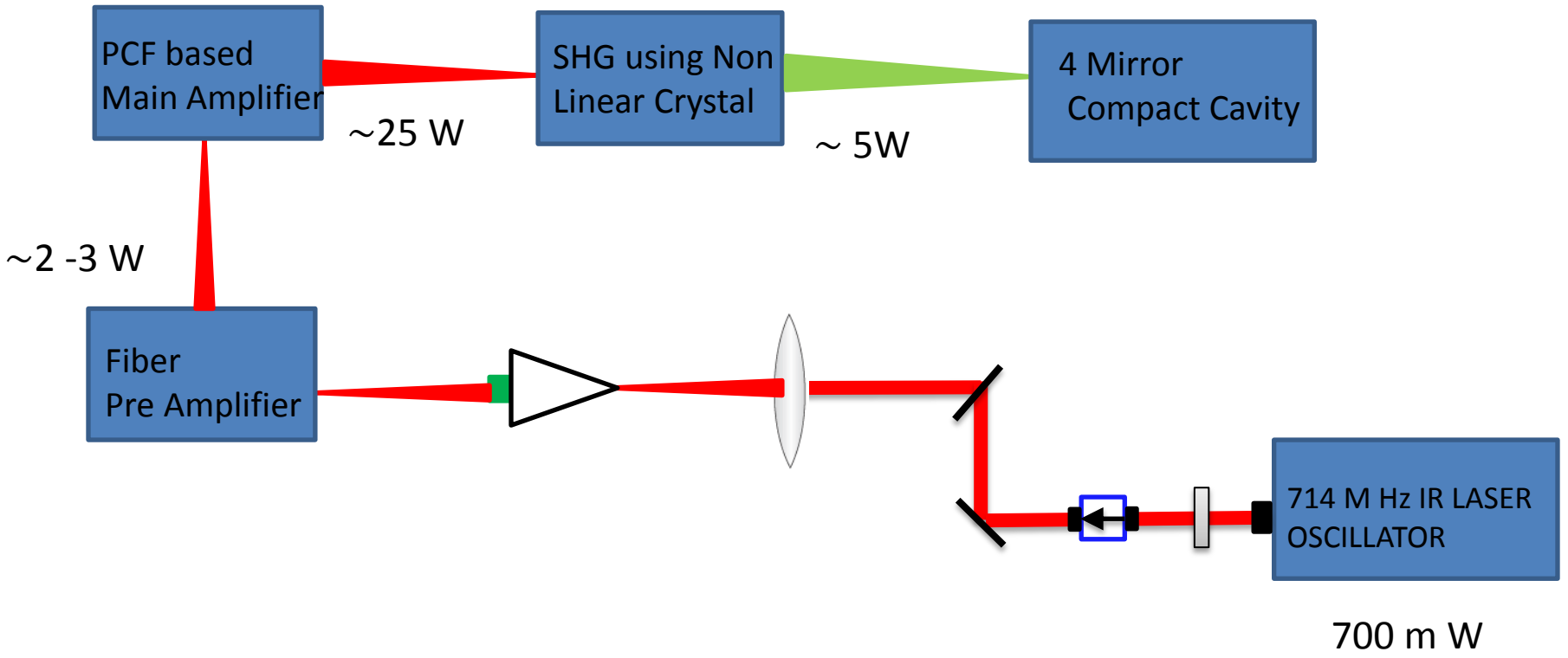
Conversion of IR pulsed laser into Green laser



Conversion efficiency (IR to Green) of 20 % is achieved using Non linear crystal.

If we amplify the injection IR power , we can obtain high second harmonics conversion.

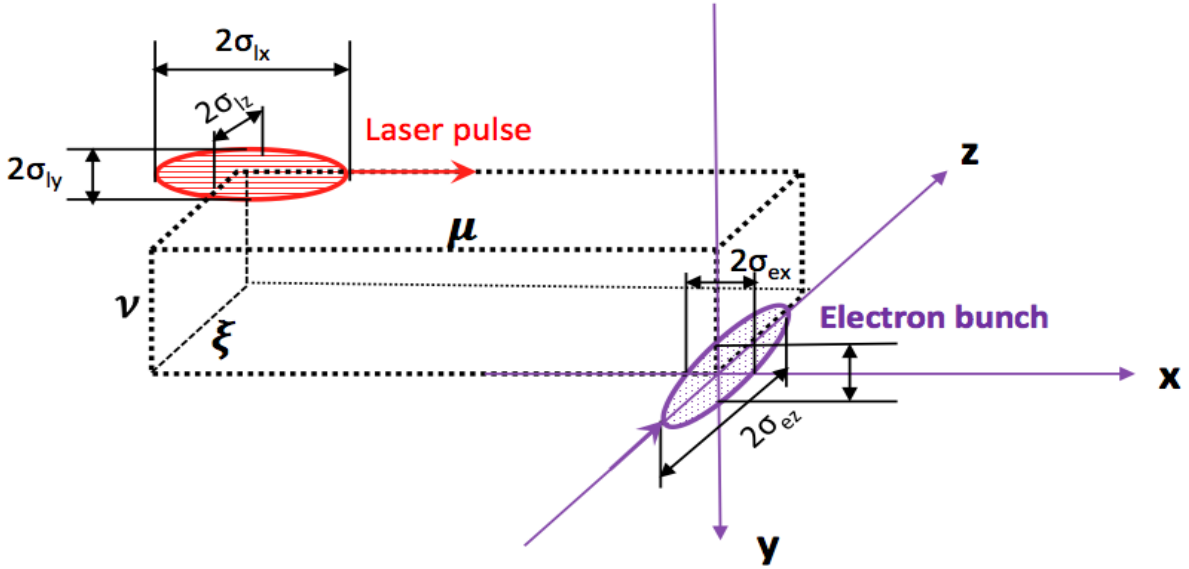
Preparation of Green Laser oscillator



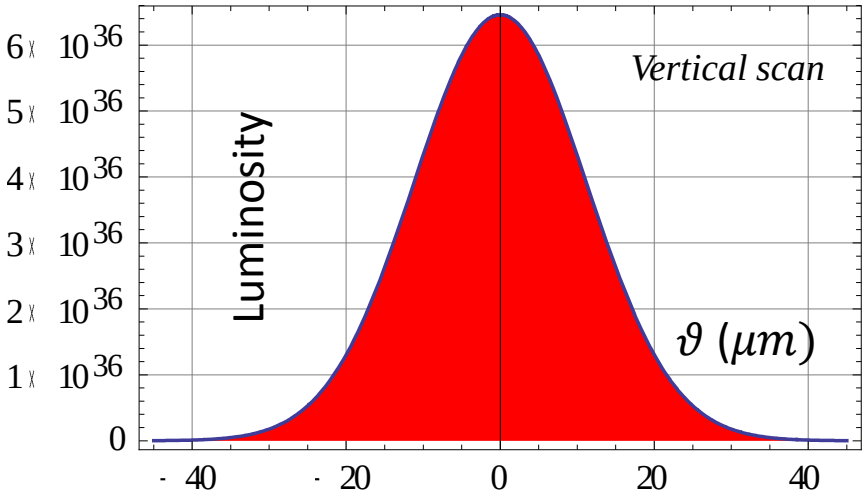
We are now working on development of fiber amplifier in order to obtain high power green laser beam.

Simultaneously, feed back operation to be done.

Electron bunch and Laser pulse collision

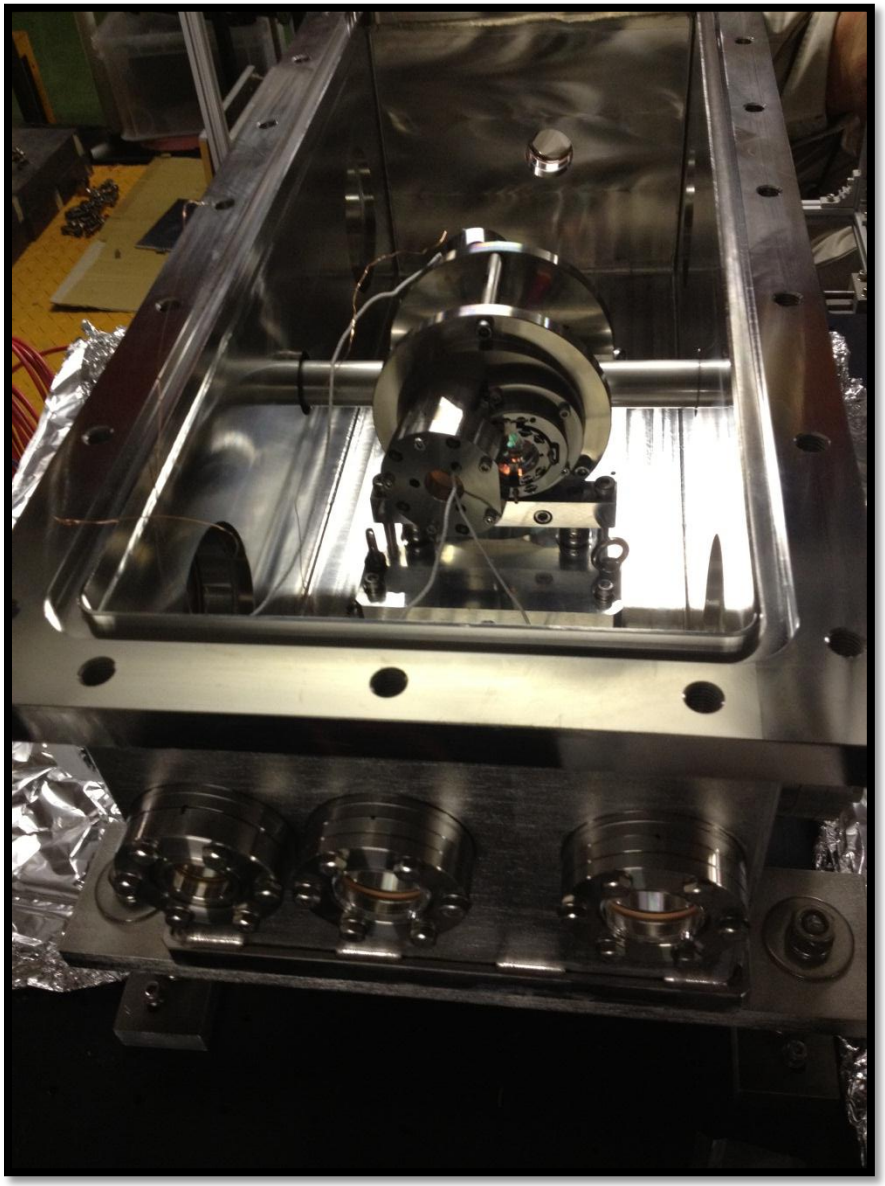


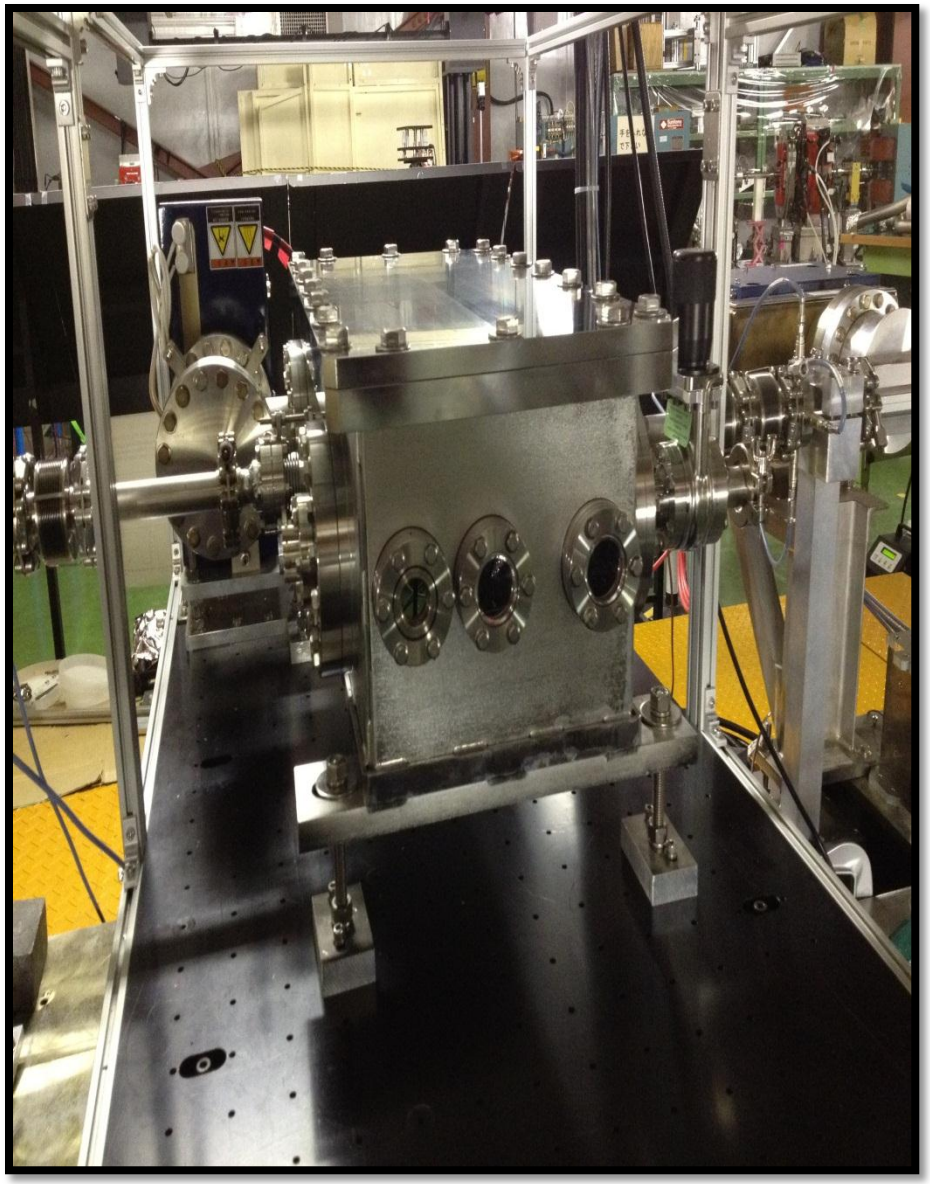
Electron bunch and laser pulse collision angle will be 90°



According to Model Calculations

Installation of compact resonator inside DR





Merits of Compact Resonator

1. Four mirror resonator reduces the sensitivity to the misalignment of mirror compared to two mirror resonator, thus more stable.

2. When CW Laser wire is replaced with pulsed laser wire, more efficient laser-beam collision can be realized.

3. CW laser wire system takes more time in scanning of electron beam compare to Pulsed laser. Pulsed Compact resonator will take less than one minute to scan electron beam profile

Conclusion

- Green Laser amplification by fiber amplifier system(via 2nd harmonics generation) is under development.

- Beam waist of compact resonator can be reduced to smaller size , once we experimentally determine mirror curvature value