Design and Construction of Fabry-Perot Cavity

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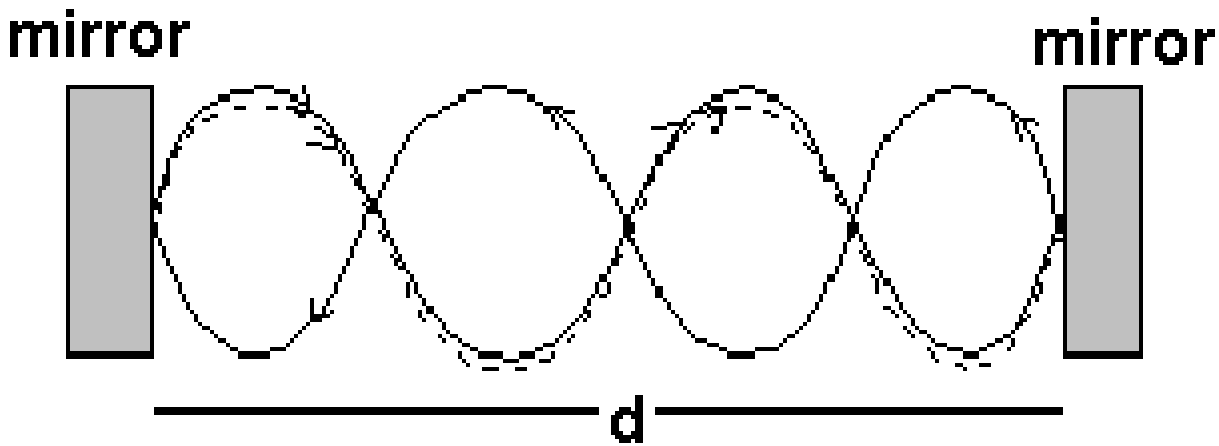
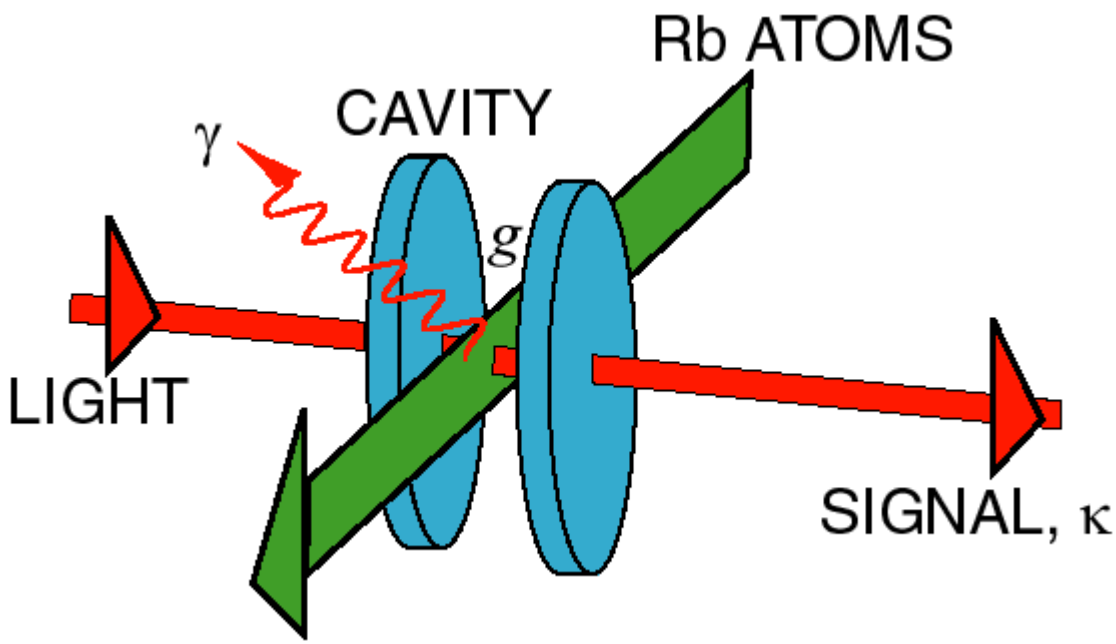
Fabry-Perot Cavities

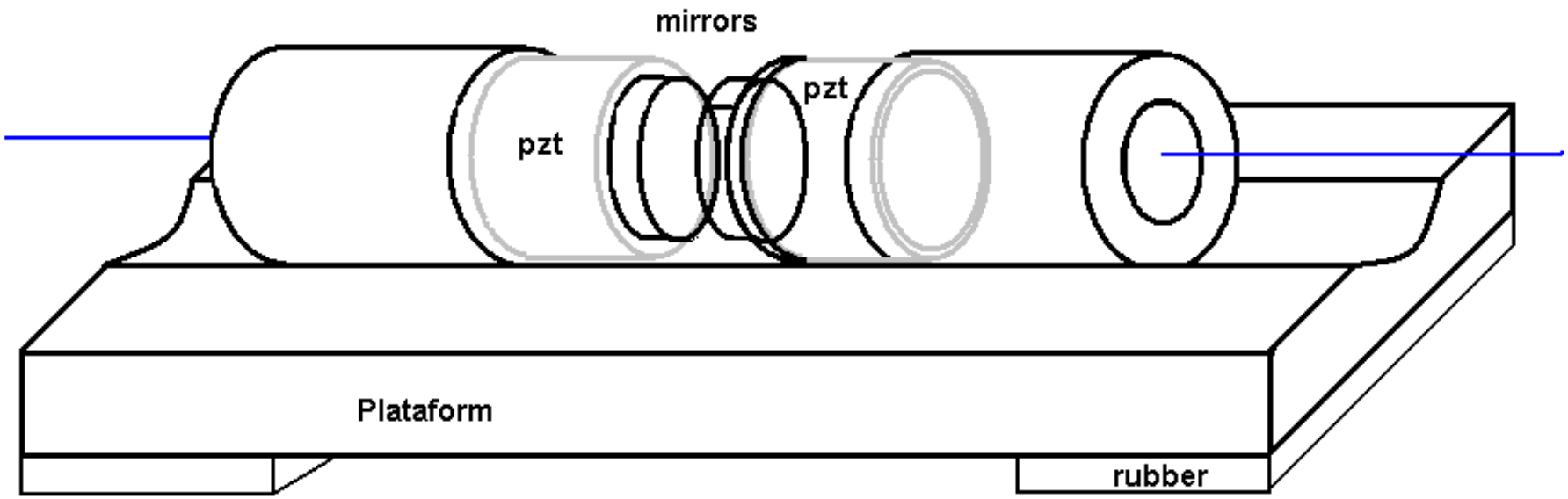


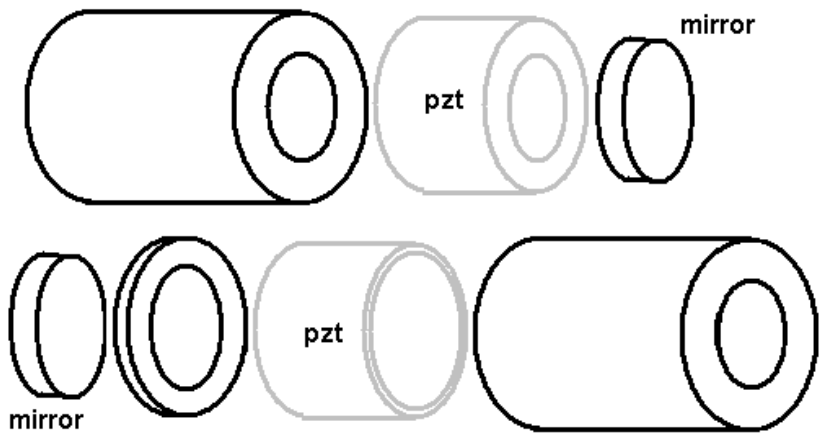
$$d = m\lambda/2$$

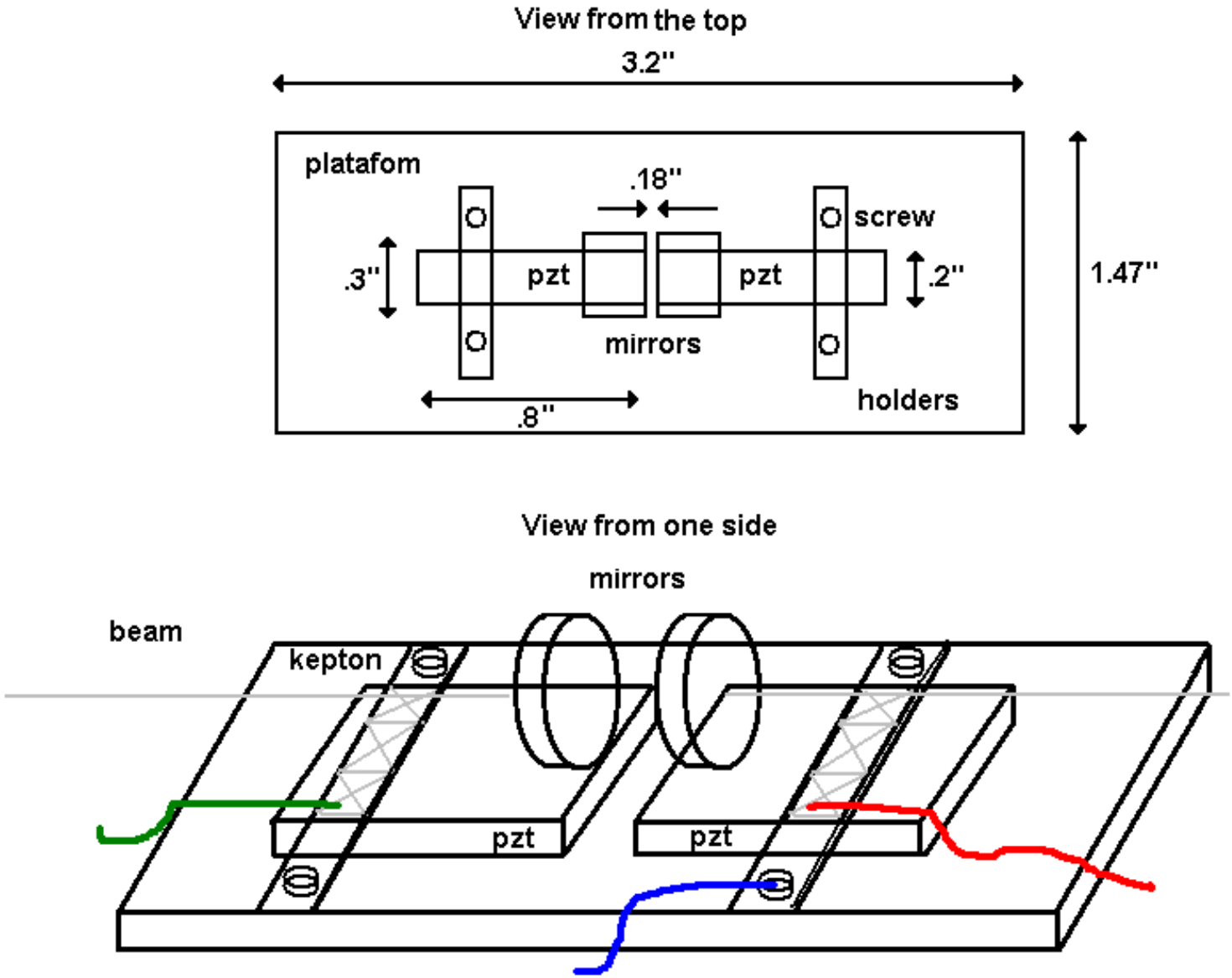
Requirements of our Cavity

- Small mirrors separation.
- Lateral access for an optical lattice.
- Vacuum compatibility.

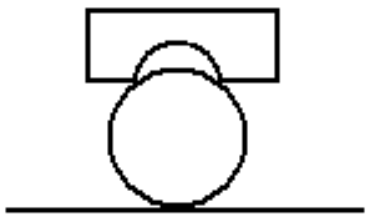


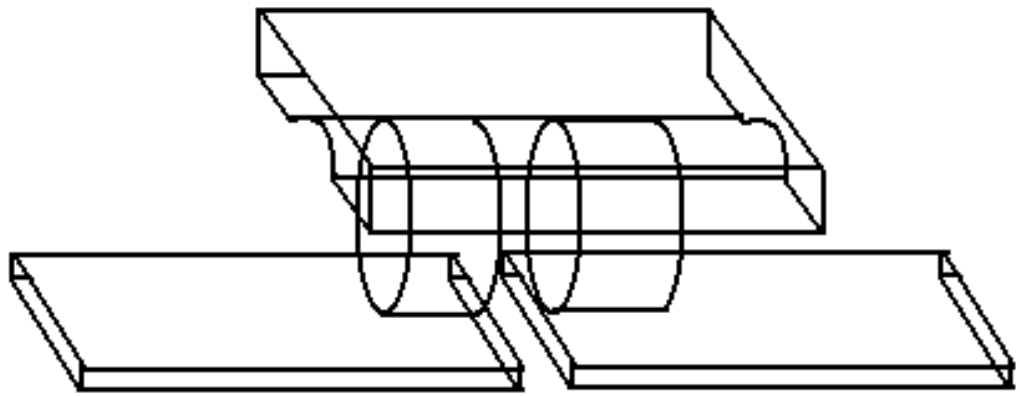

mirrors
pzt
pzt
Plataform
rubber


mirror
pzt
pzt
mirror

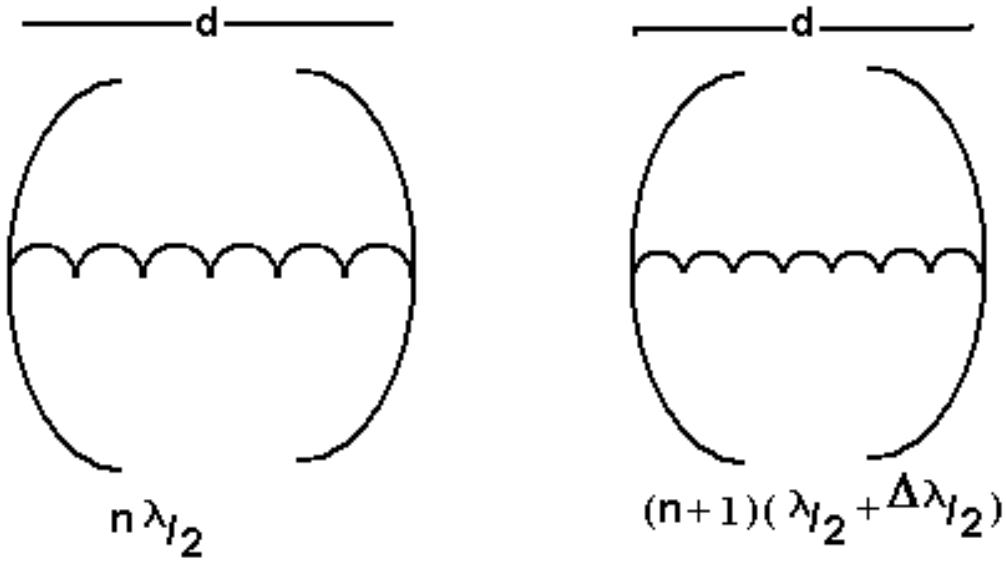

View from the top
3.2''
platafom
.18''
screw
.3''
pzt
pzt
.2''
1.47''
mirrors
holders
.8''
View from one side
mirrors
beam
kepton
pzt
pzt

- Align the mirrors





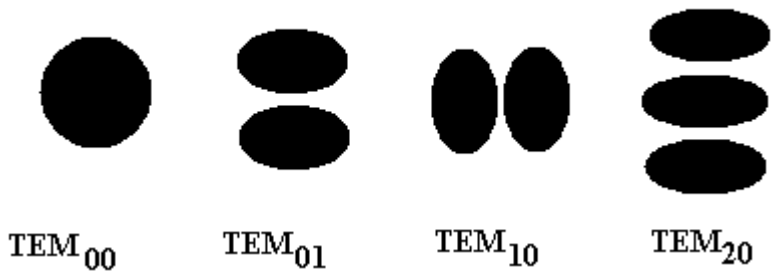
Cavity Characteristics

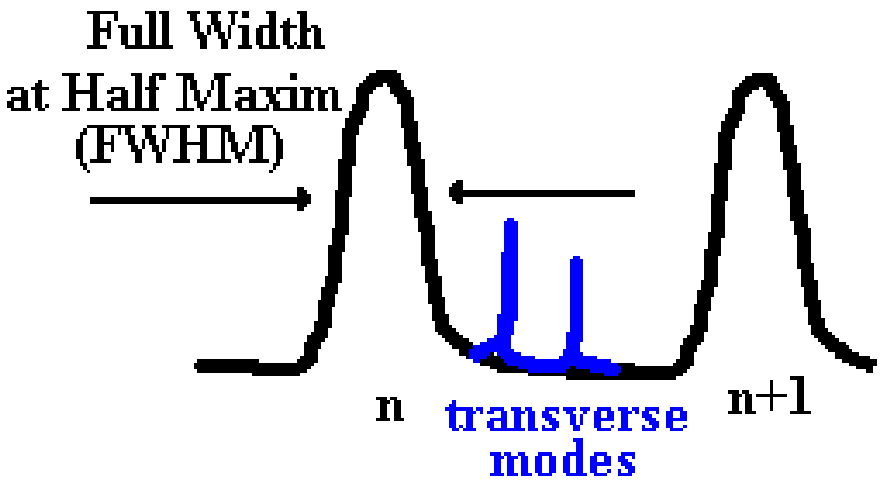


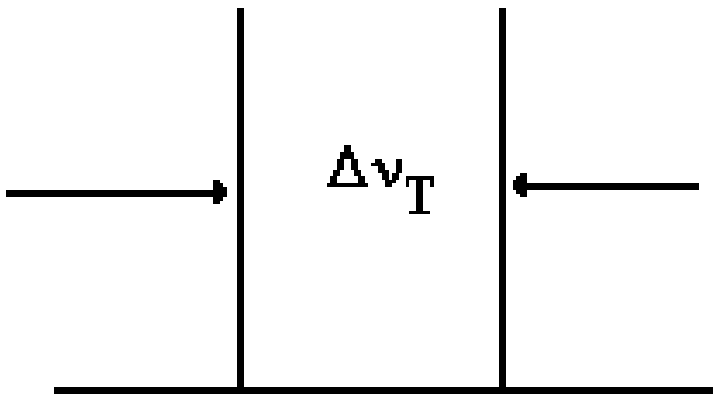
$\Delta\lambda \rightarrow$ free spectral range

$\Delta\nu = c/2d$

Transverse modes







$$\Delta\nu_T = \frac{c}{2\pi z_0}\Delta(m+n)$$

Finesse=FSR / FWHM

Finesse=π/transmission losses

$z_0^2=(2R-d)d/4$

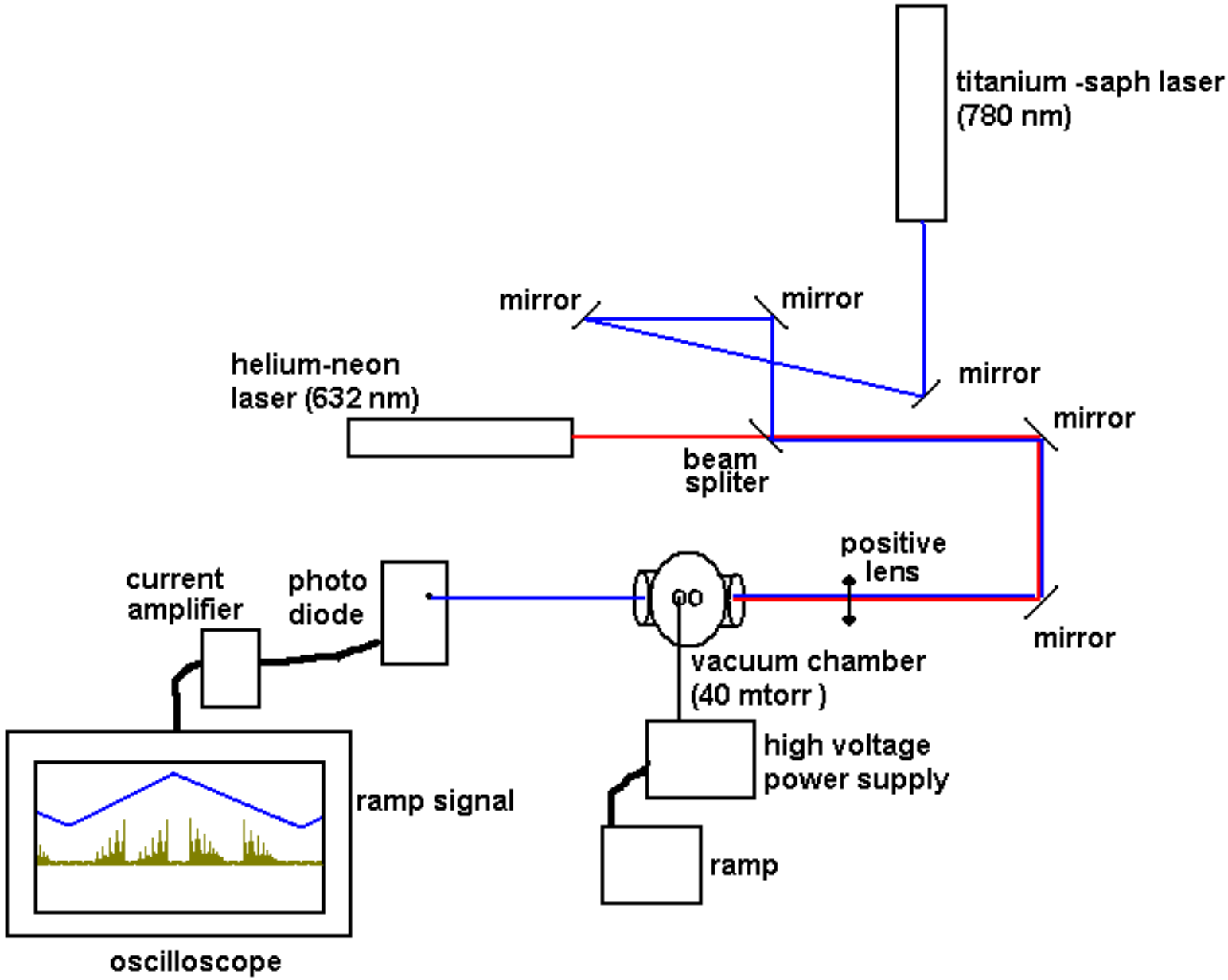
z_0=Rayleigh length

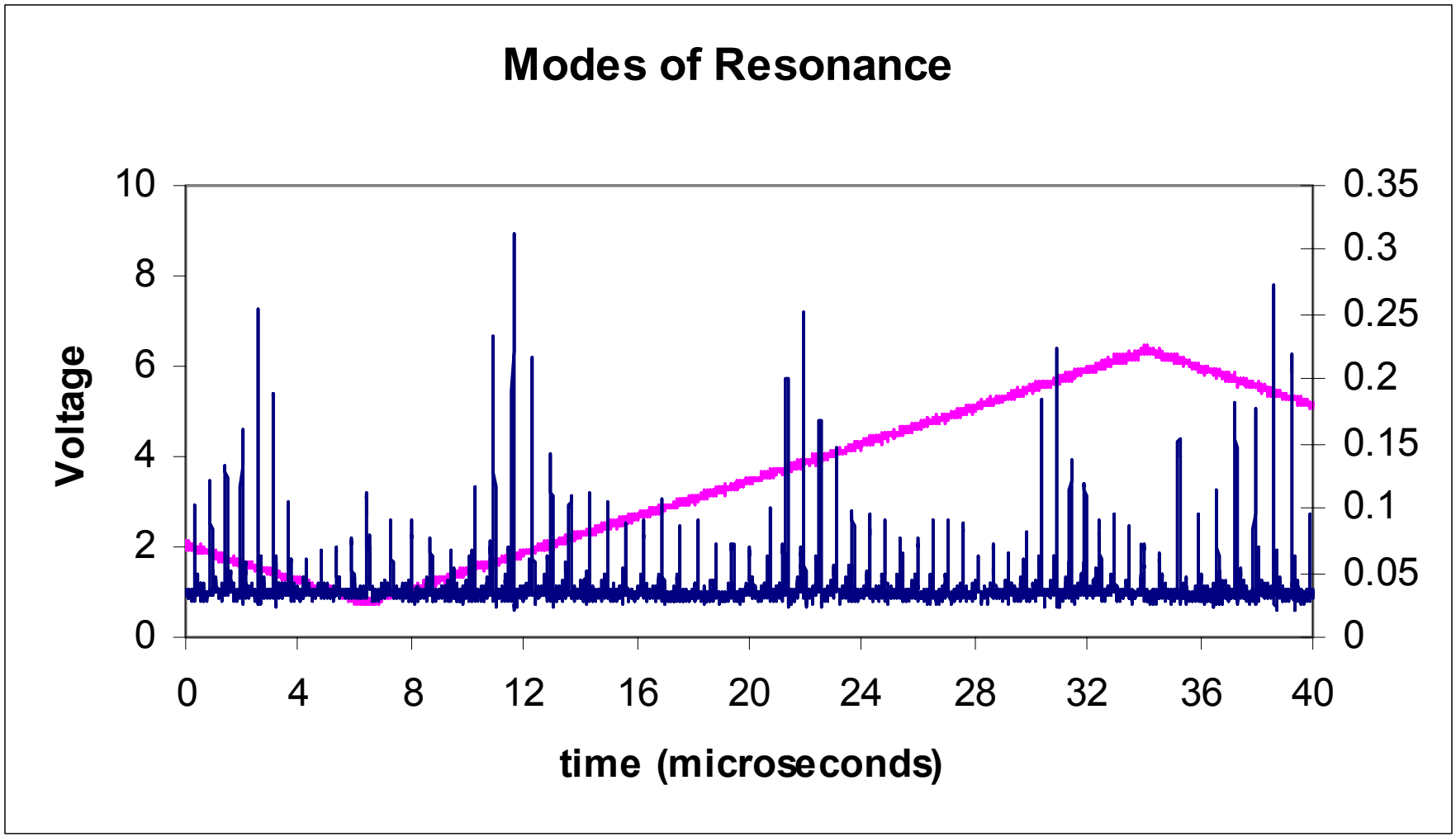
R=radius of curvature

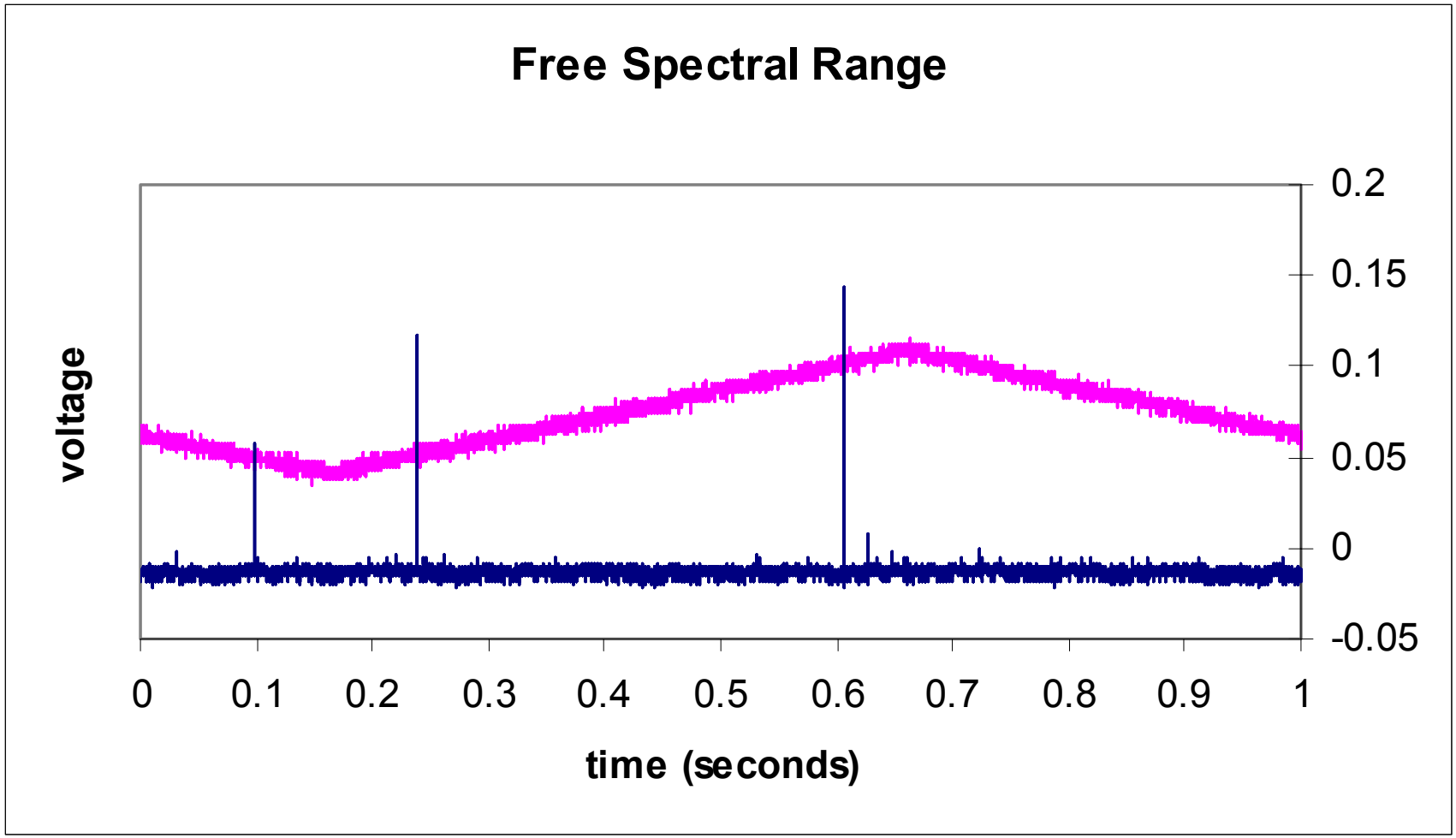
w_0=waist of the cavity

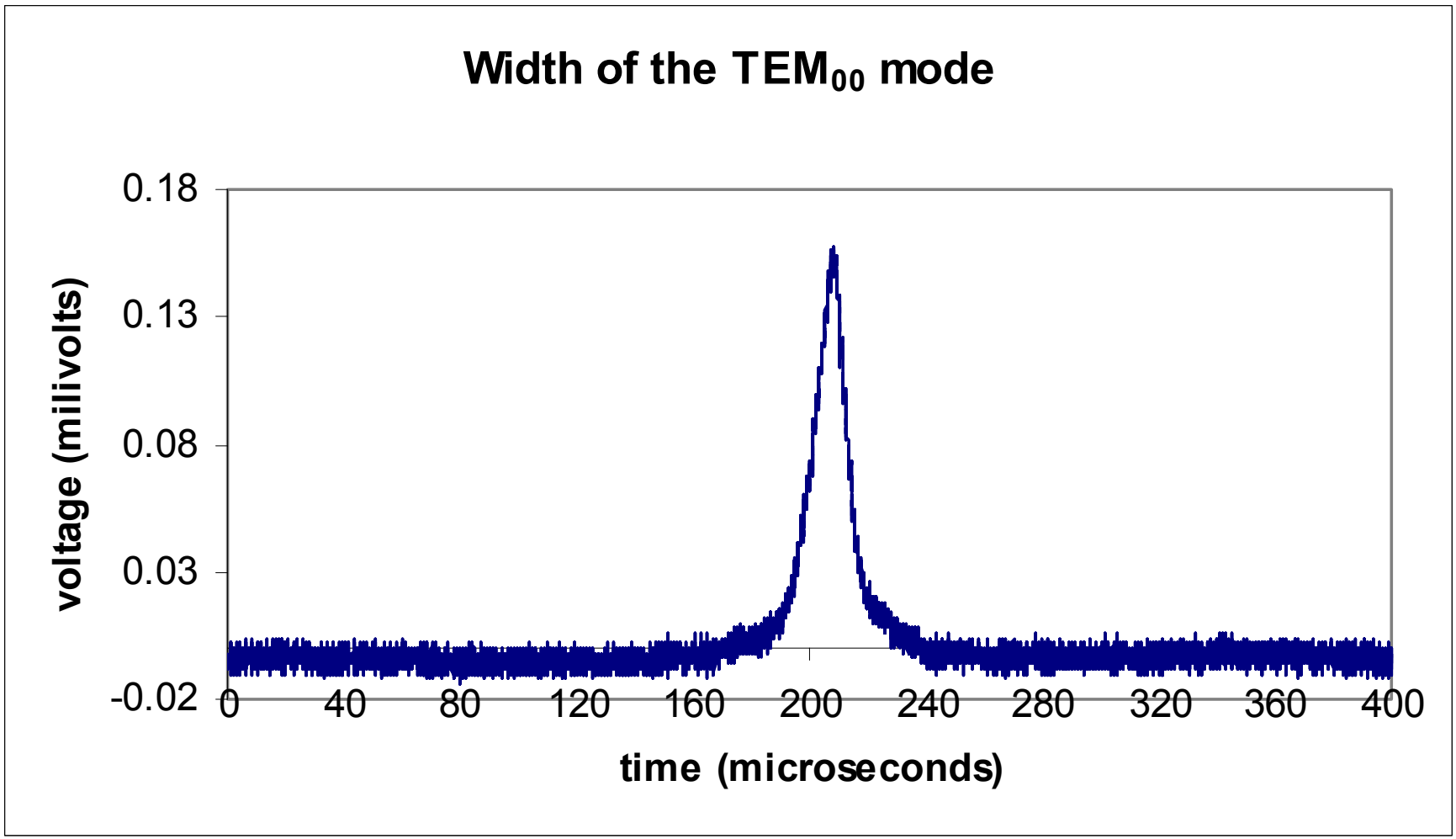
$z_0=\pi w_0^2/\lambda$

λ Wavelength of the light


titanium -saph laser
(780 nm)
mirror
mirror
mirror
helium-neon
laser (632 nm)
mirror
beam
spliter
positive
lens
current
amplifier
photo
diode
mirror
vacuum chamber
(40 mtorr)
high voltage
power supply
ramp signal
ramp
oscilloscope


Modes of Resonance
Voltage
10
8
6
4
2
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
4
8
12
16
20
24
28
32
36
40
time (microseconds)


Free Spectral Range
voltage
0.2
0.15
0.1
0.05
0
-0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
time (seconds)


Width of the TEM00 mode
0.18
0.13
0.08
0.03
-0.02
voltage (milivolts)
0
40
80
120
160
200
240
280
320
360
400
time (microseconds)

Conclusions

- We build a Fabry-Perot cavity, which satisfies the requirements of design imposed by the cavity QED project, but we tested it in air.
- The finesse that we measured is $2.6\times10^{+4} \pm 6.9\times10^{+3}$.
- The size measured from the transverse mode structure is .954 mm.