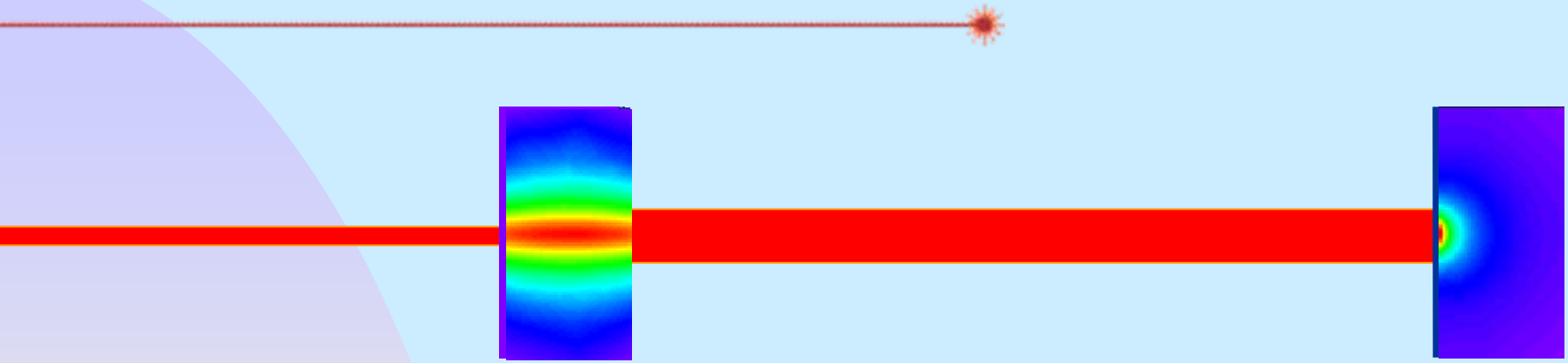
Thermal lensing and the Gingin test 1

Jérôme Degallaix

Gingin international workshop
October 2005

LIGO-G050514-00-Z

Presentation of the first test

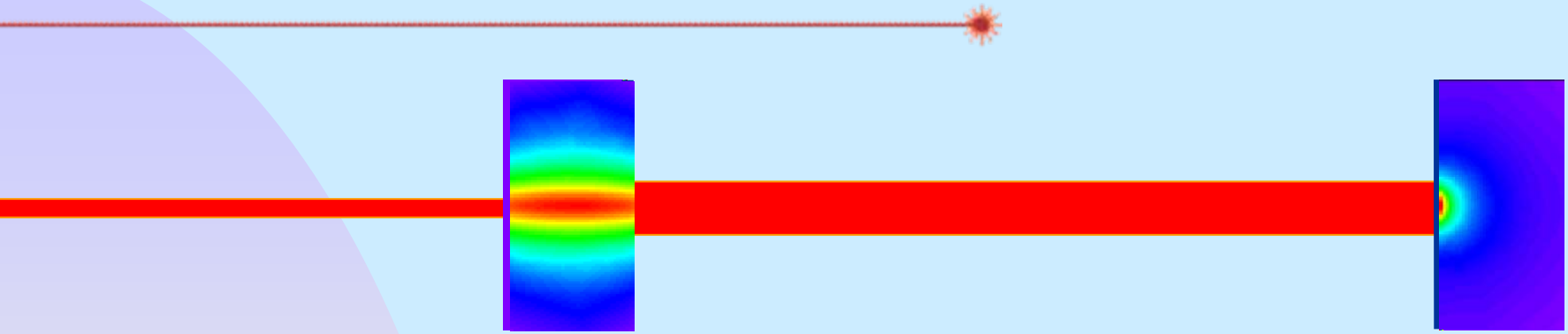


- 80 meters long cavity
- 6W input laser
- 5kW circulating power
- Strong thermal lensing

Abs = 50ppm/cm
Uniform absoprtion

- Sapphire test mass
- Diameter: 100 mm
- Waist size: 8 mm

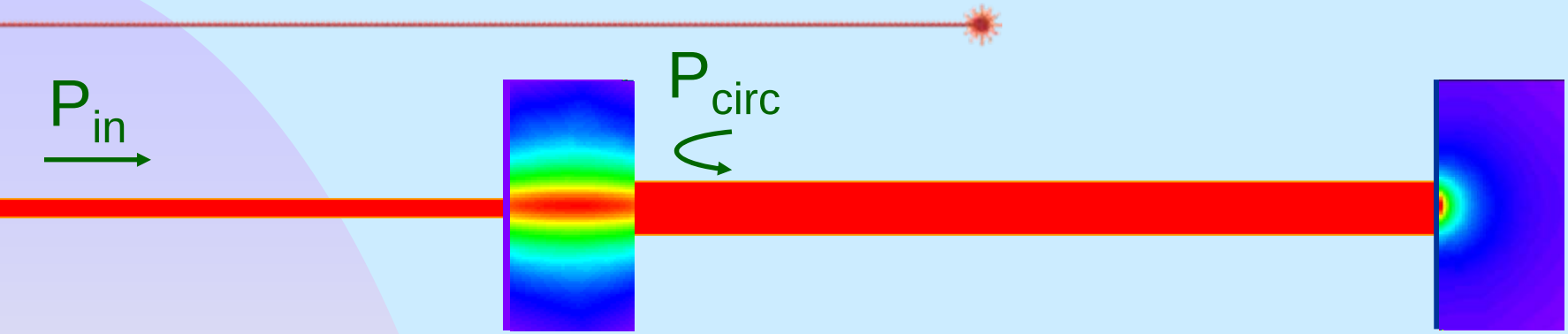
Effect of thermal lensing



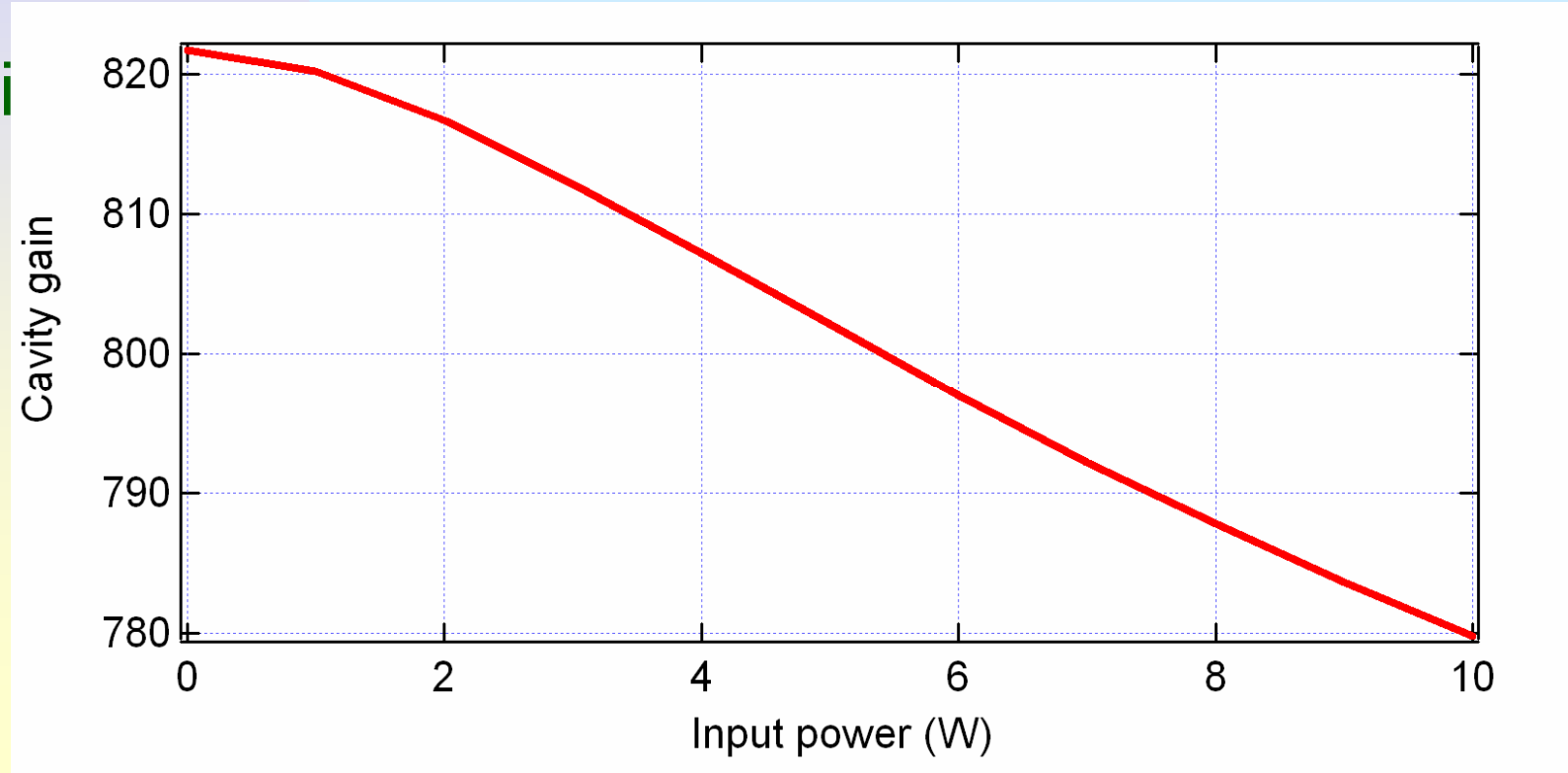
Change the apparent ITM Radius
$\Rightarrow$ Change cavity modes

Example: 6W input power, 5kW circulating power
$P_{absorbed}$ = 2.5 W
F_{ITM} = 472 m

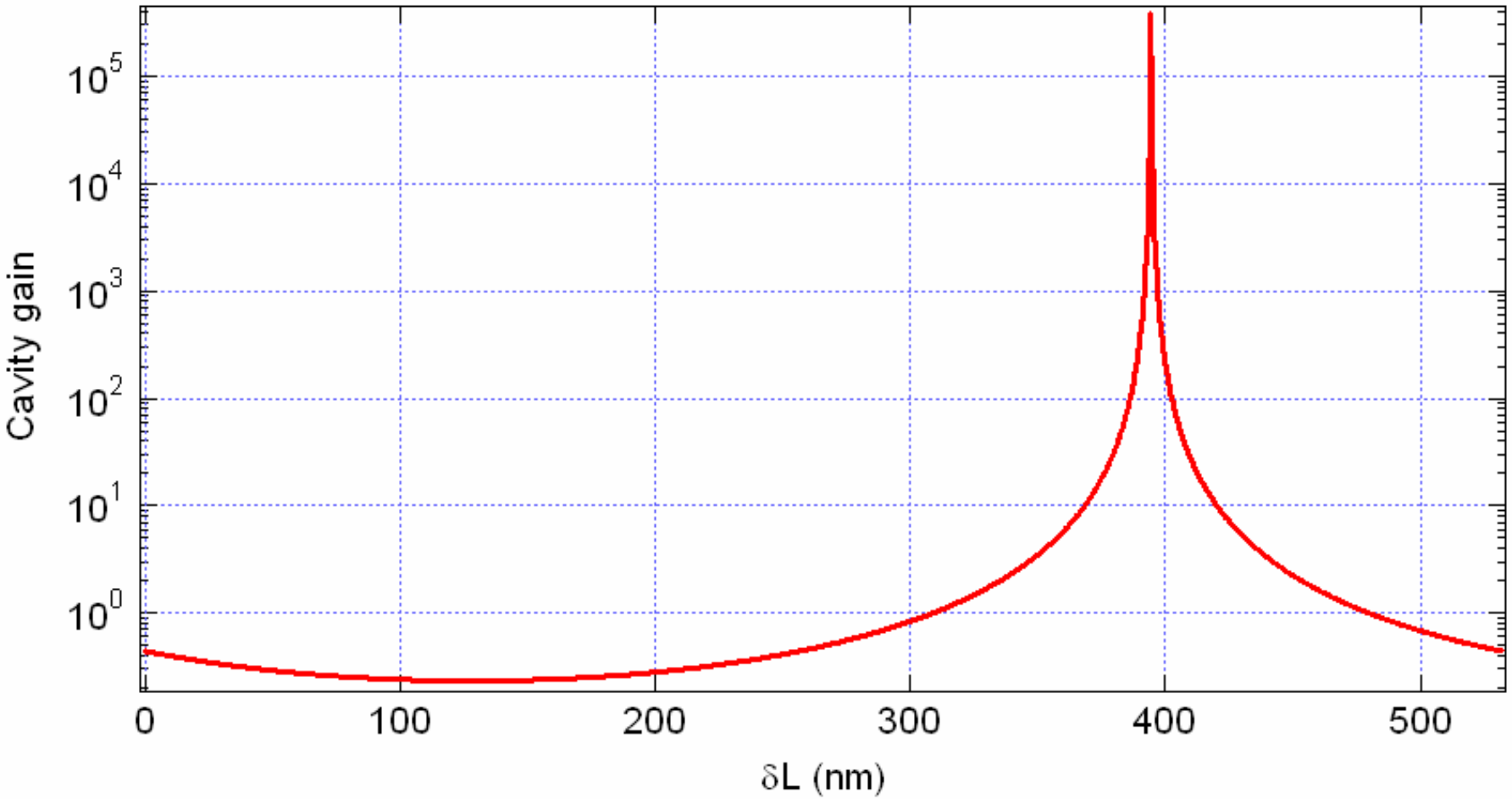
Presentation of the first test



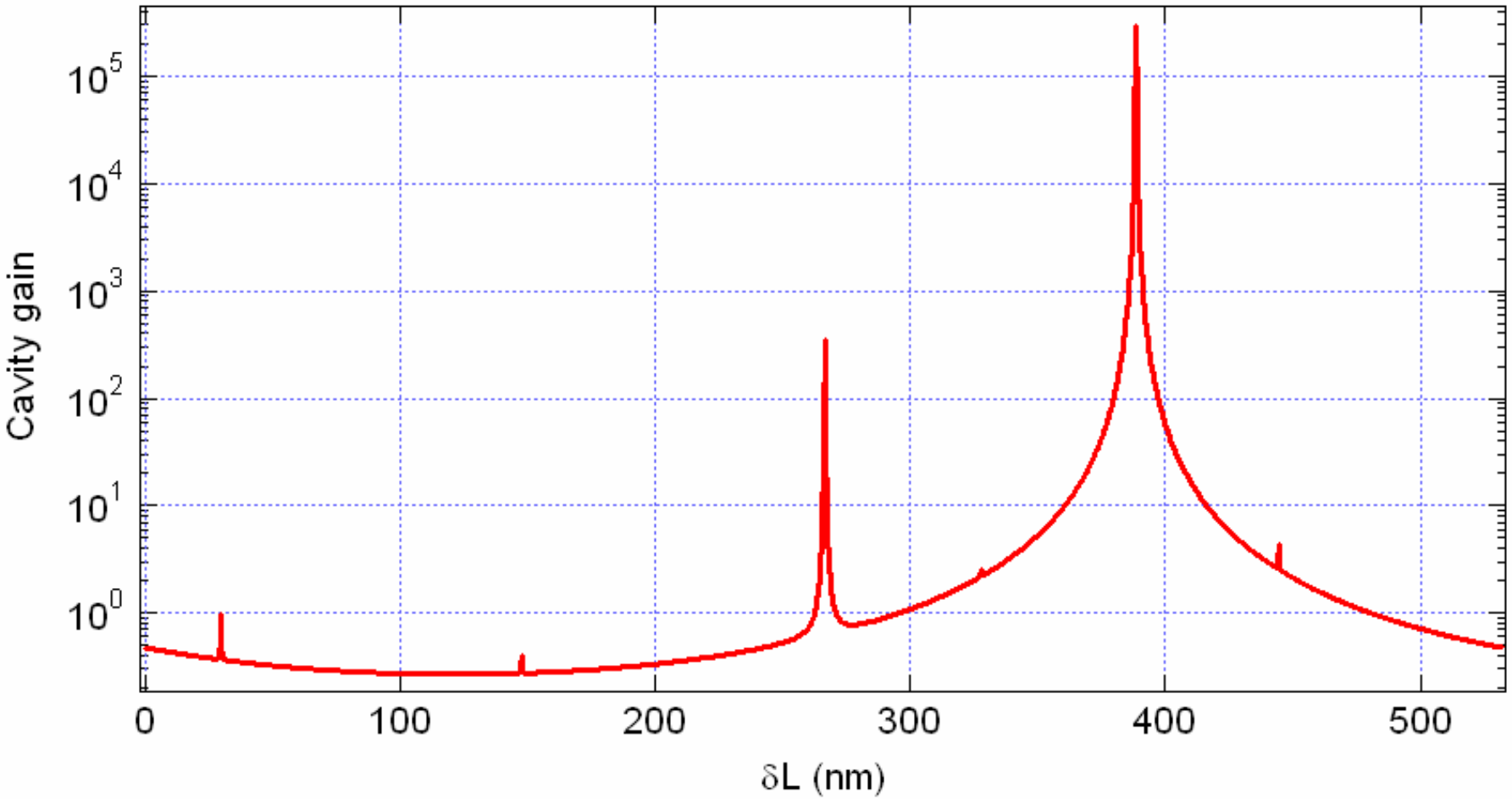
Gai



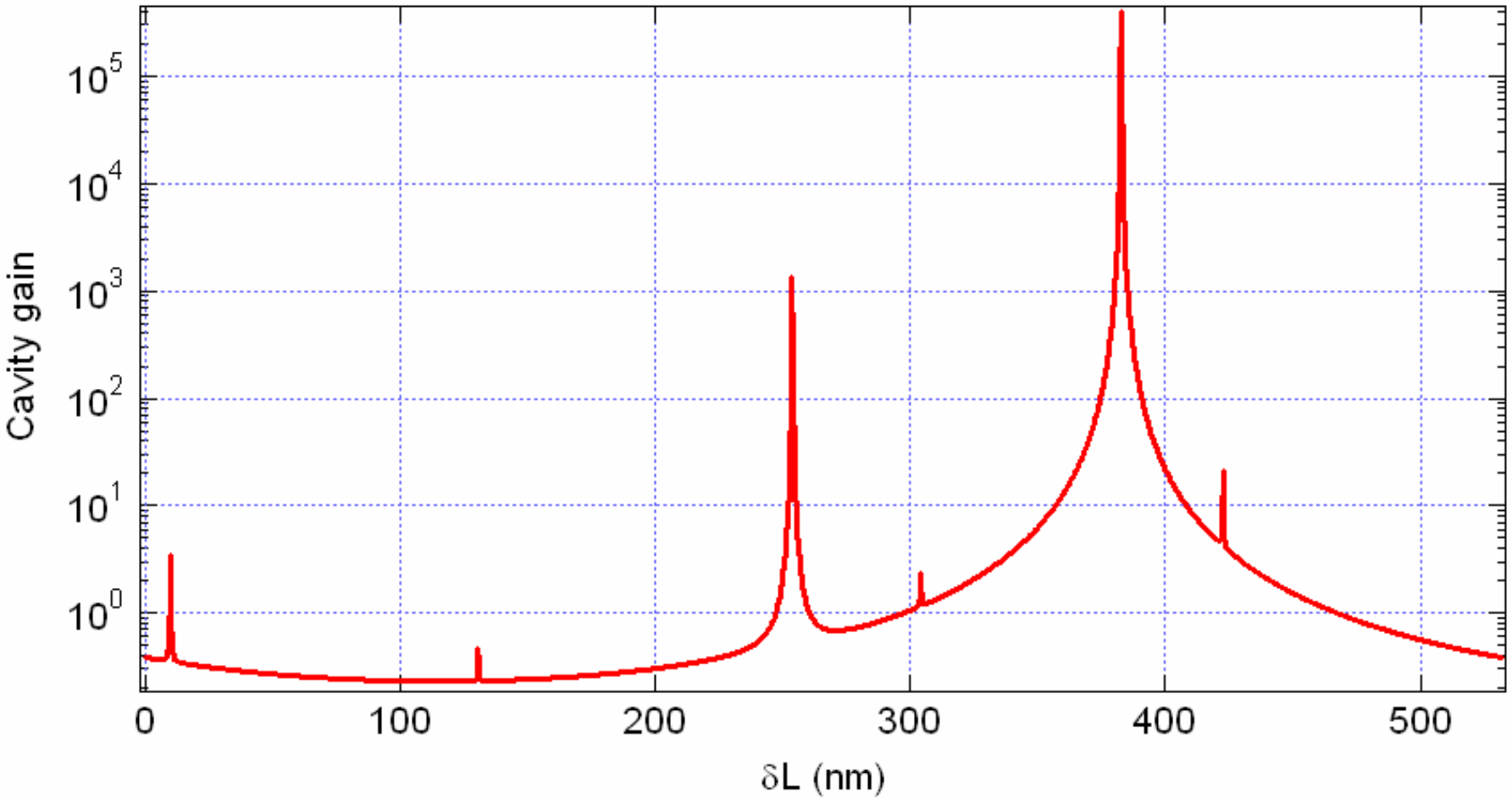
No thermal lensing



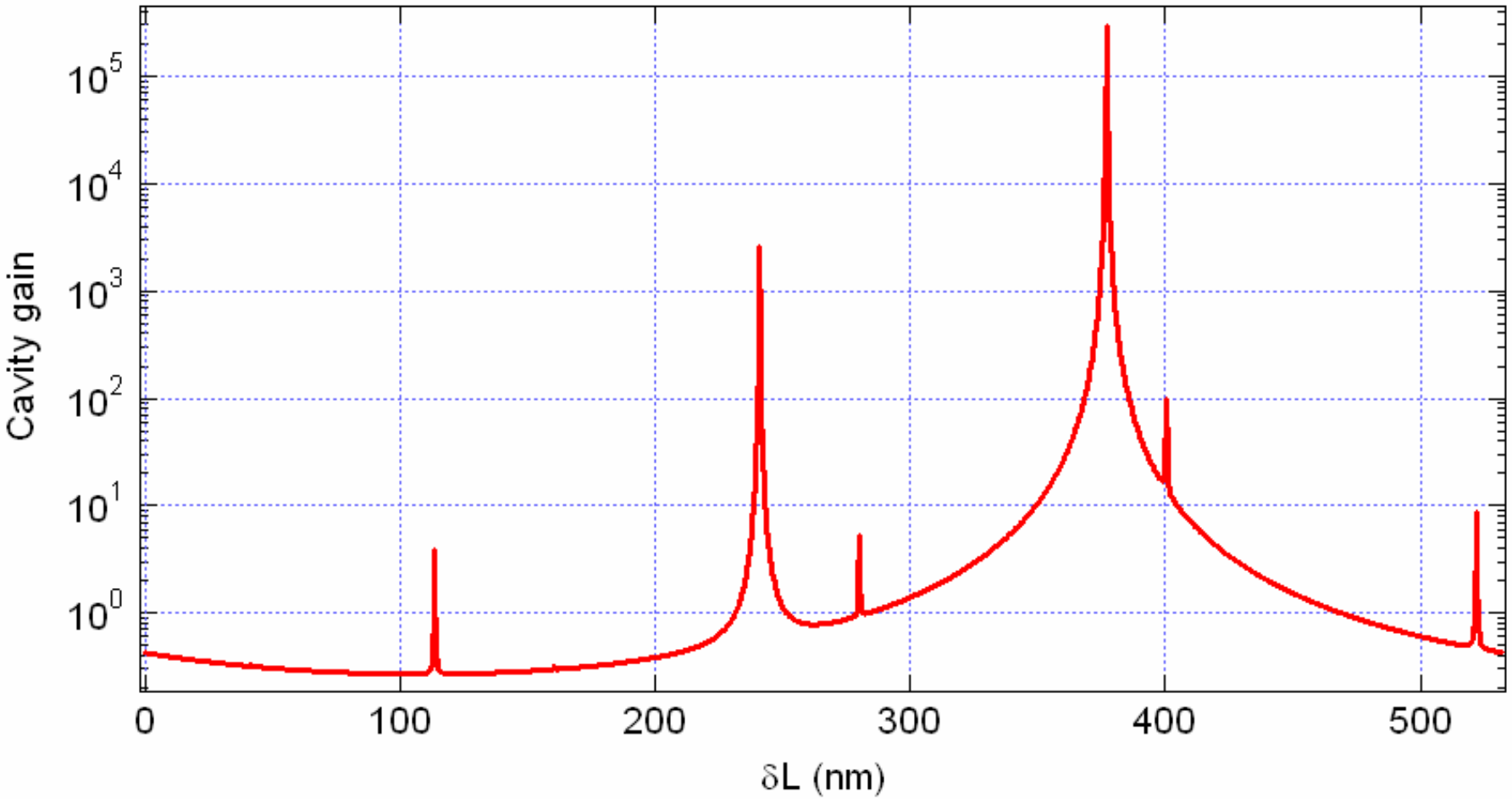
1W input power



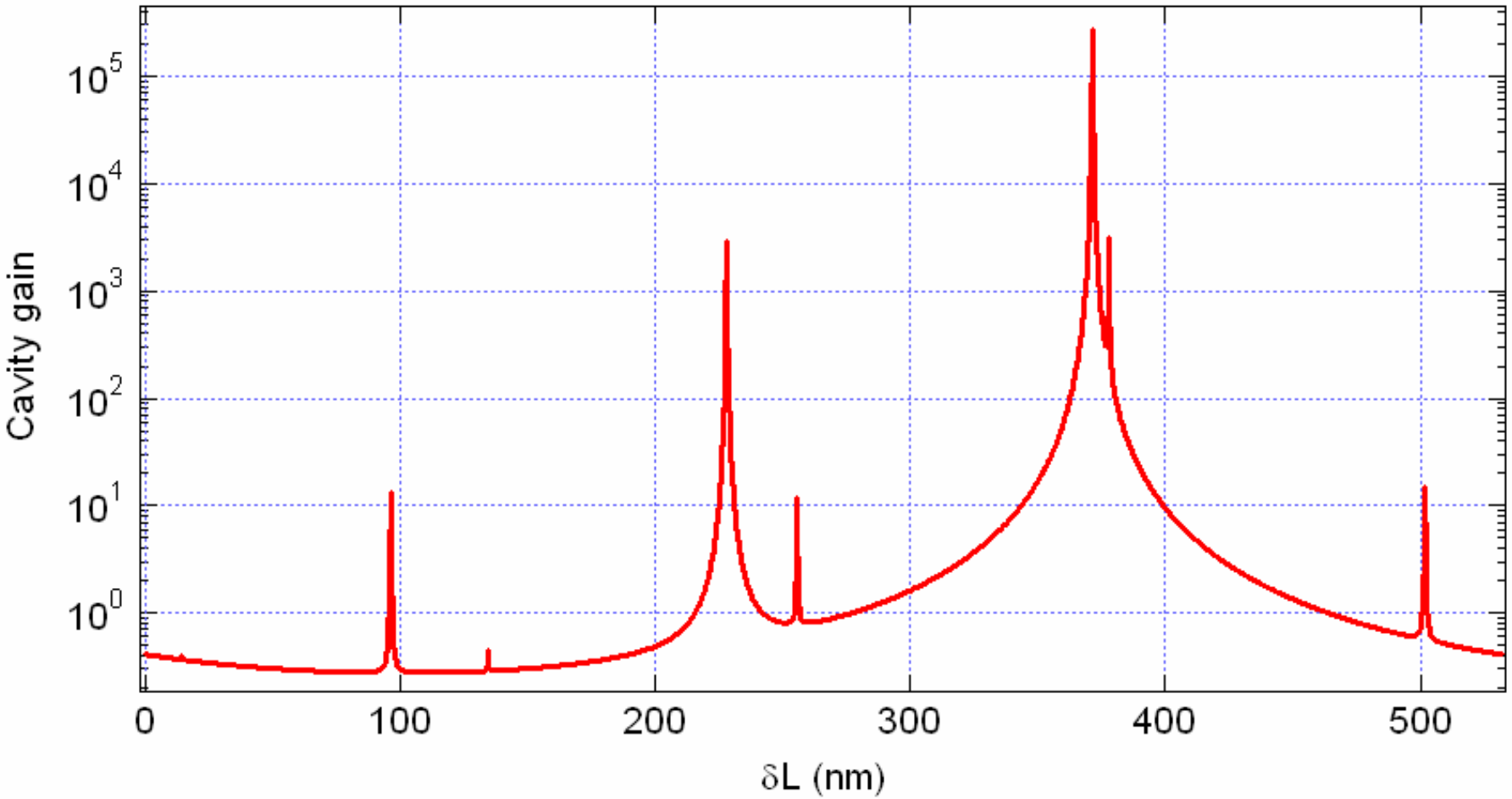
2W input power



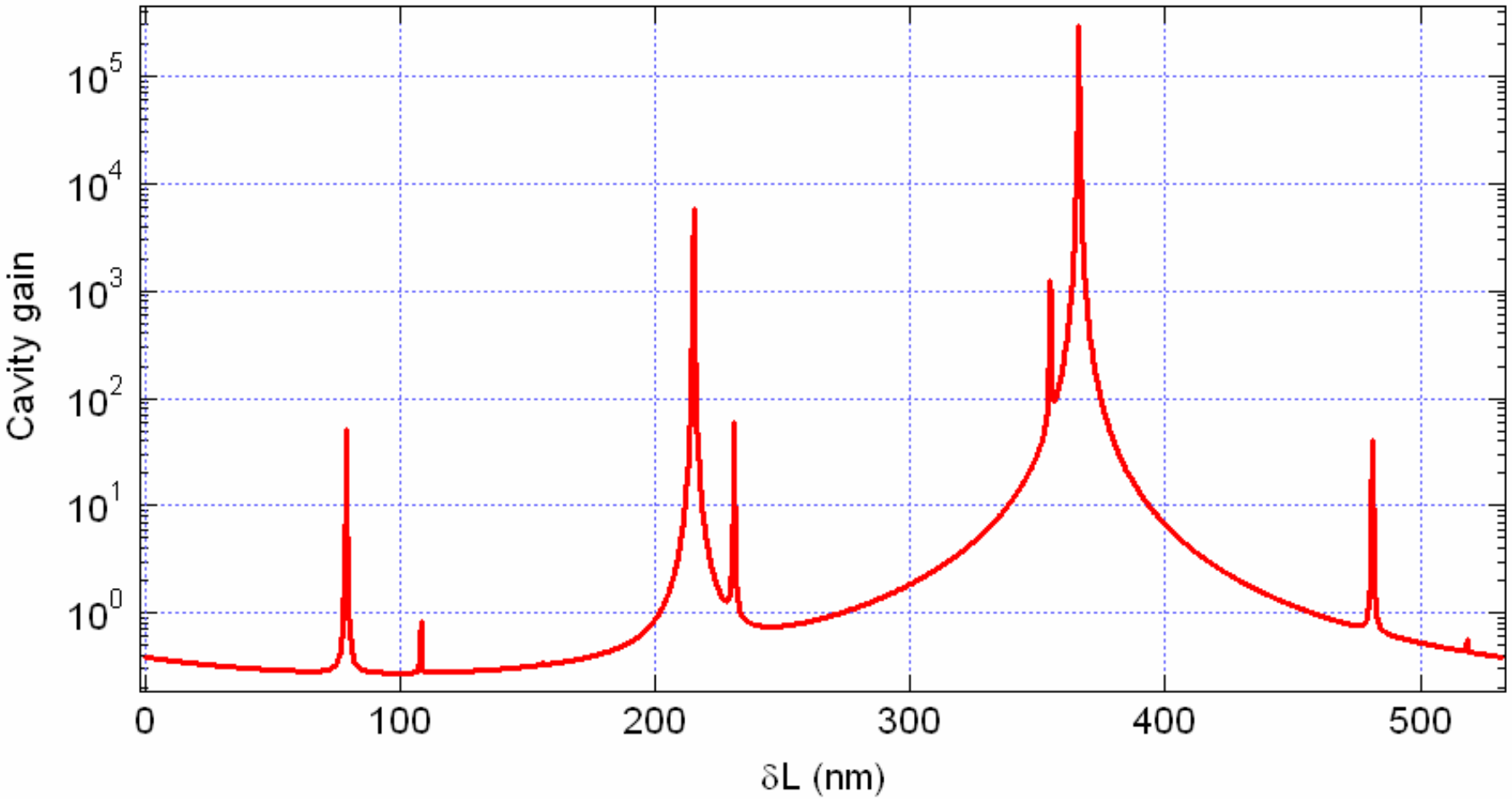
3W input power



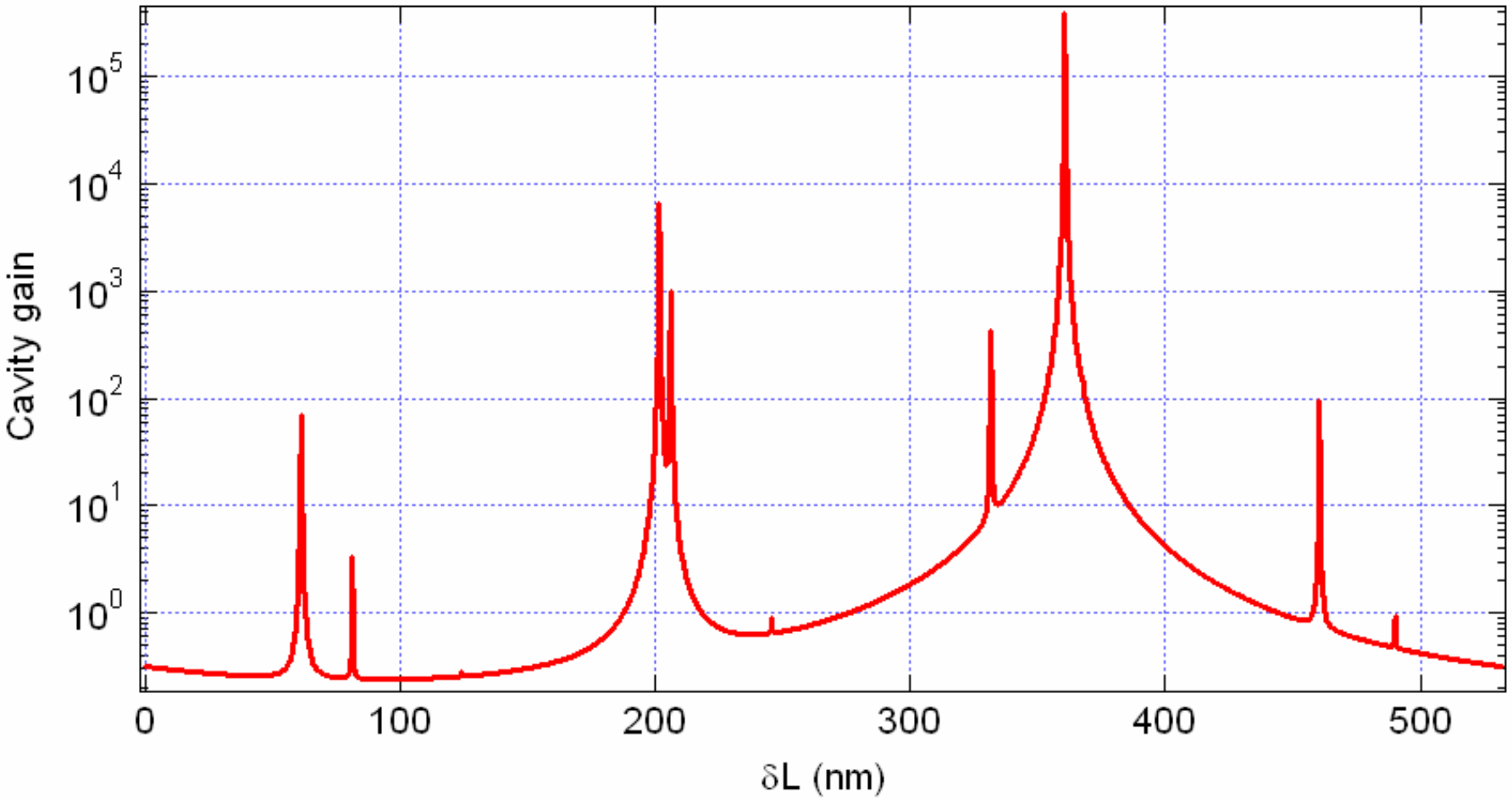
4W input power



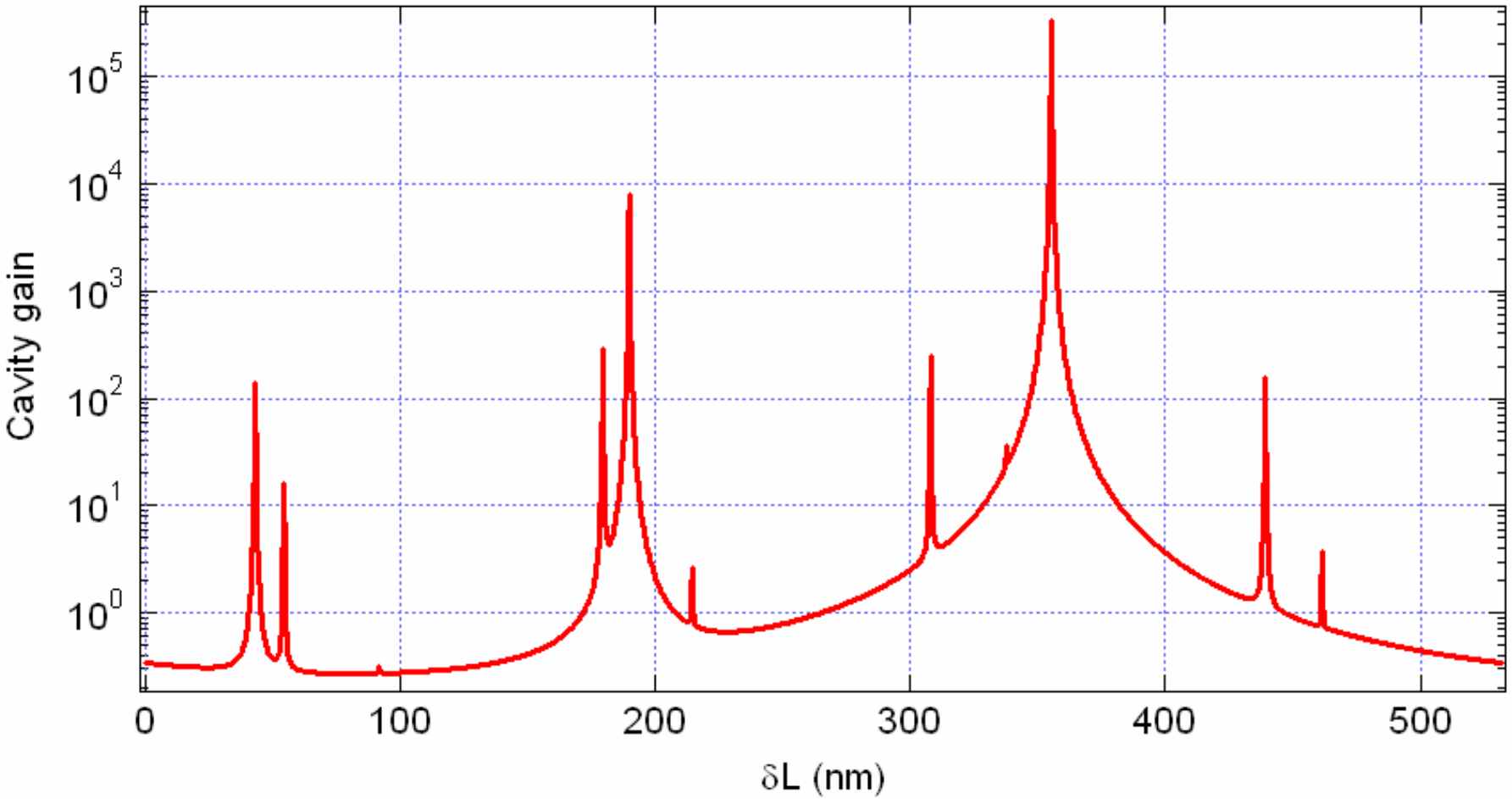
5W input power



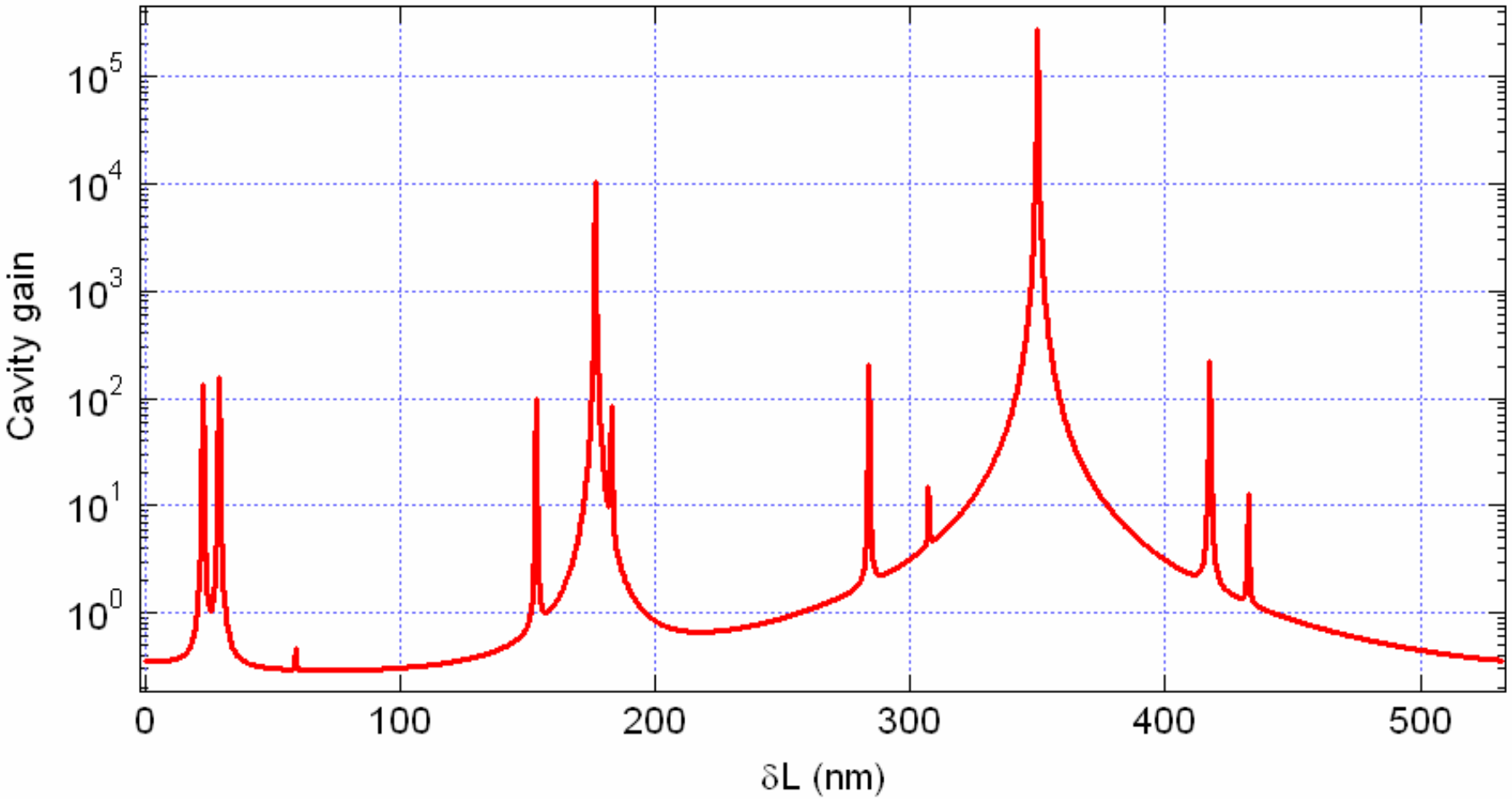
6W input power



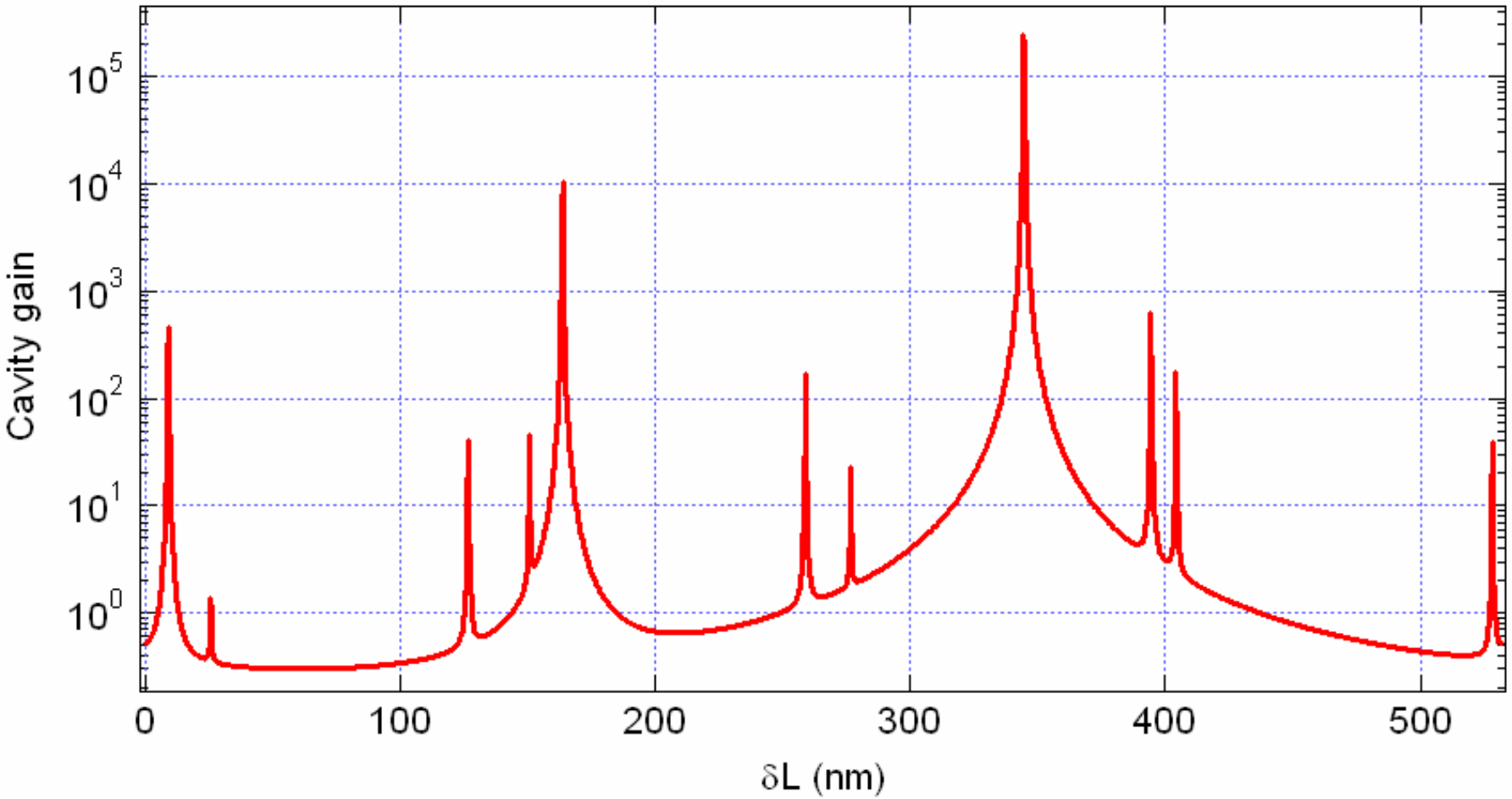
7W input power



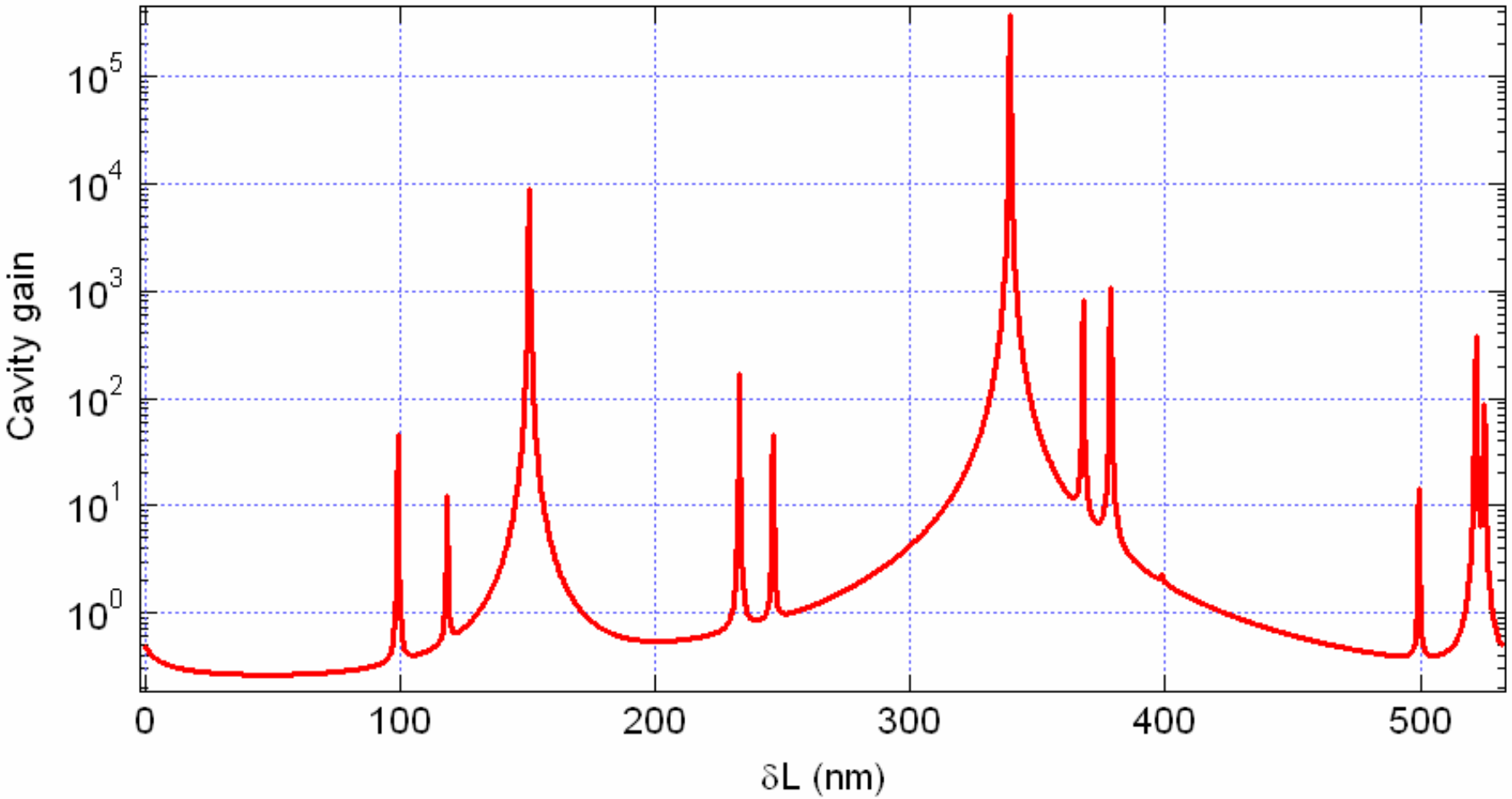
8W input power



9W input power

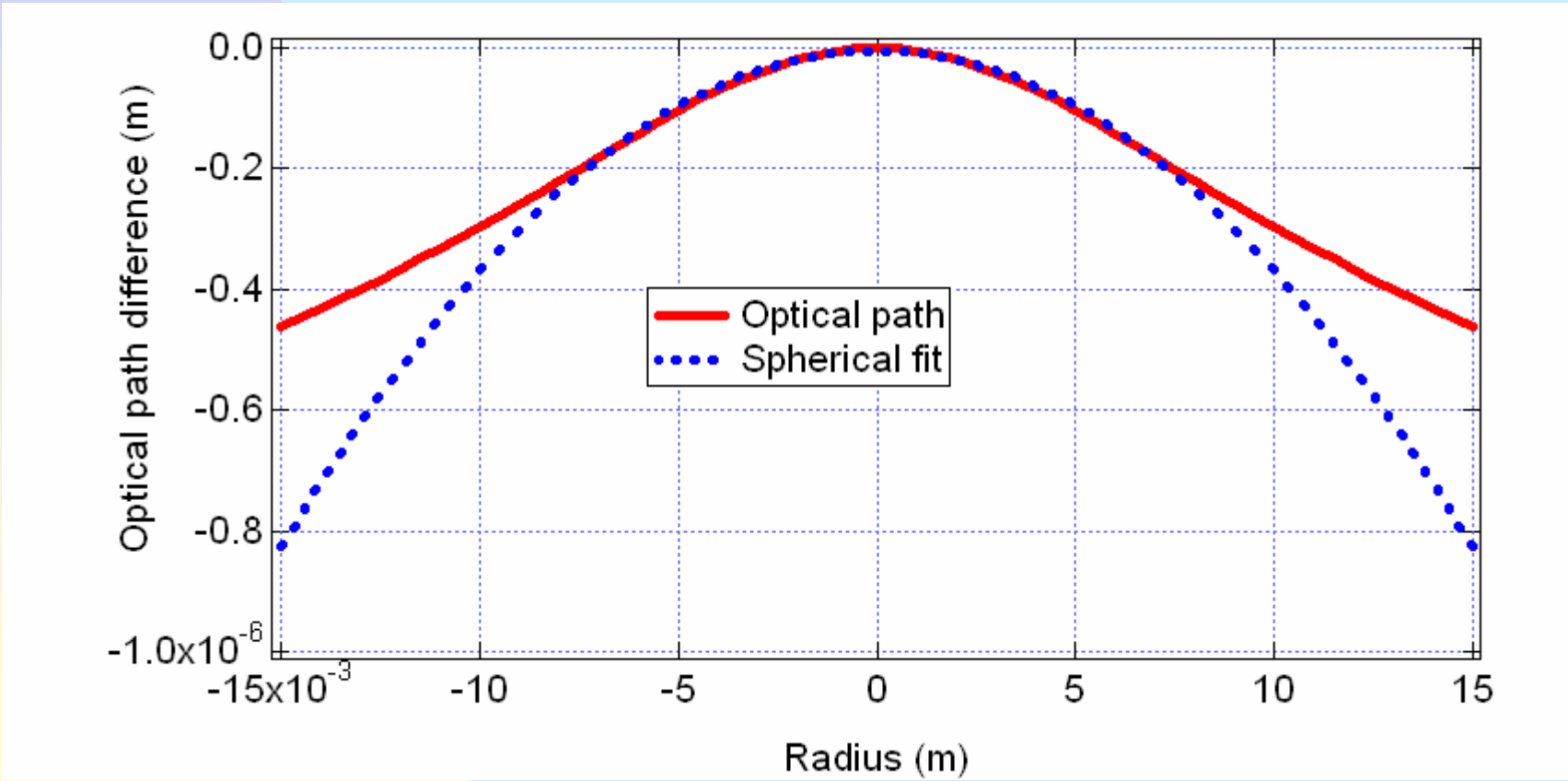


10W input power

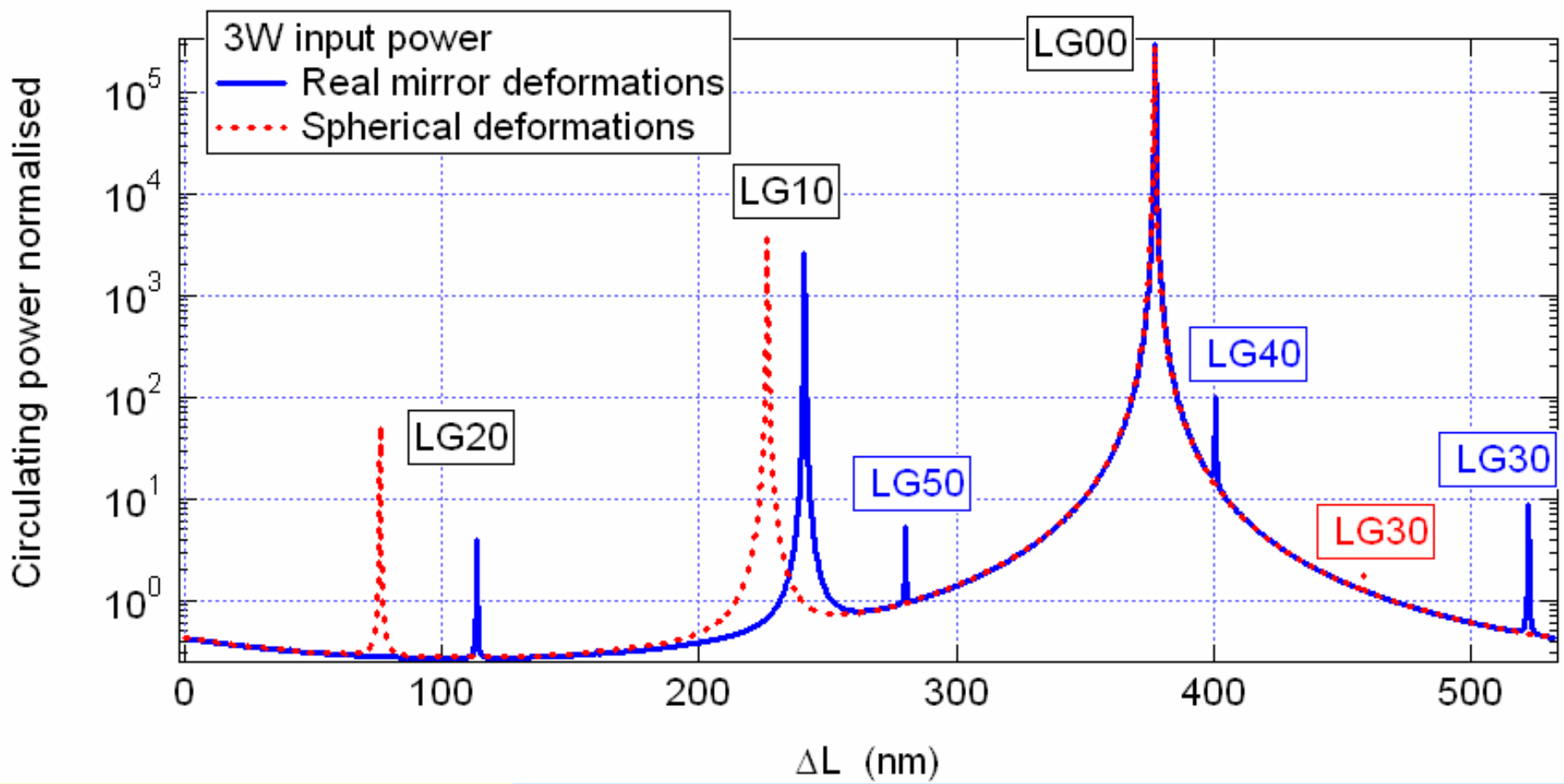


Do we need a FFT simulation ?

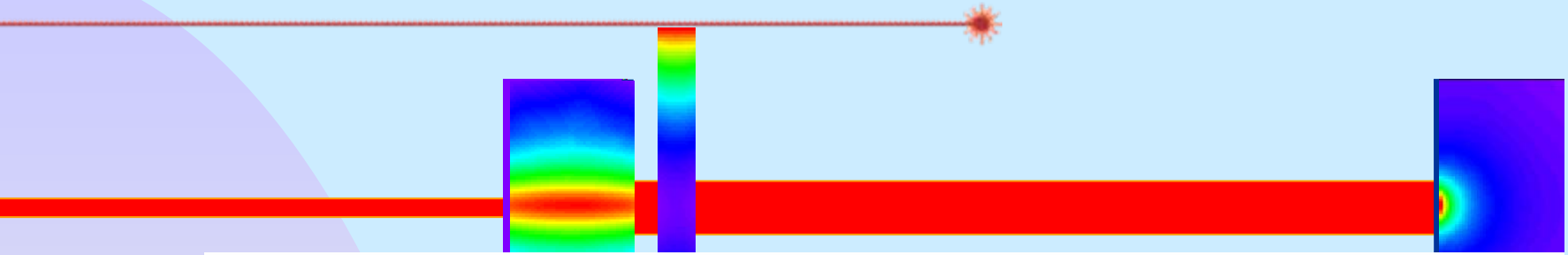
Thermal lensing deformations: non spherical!

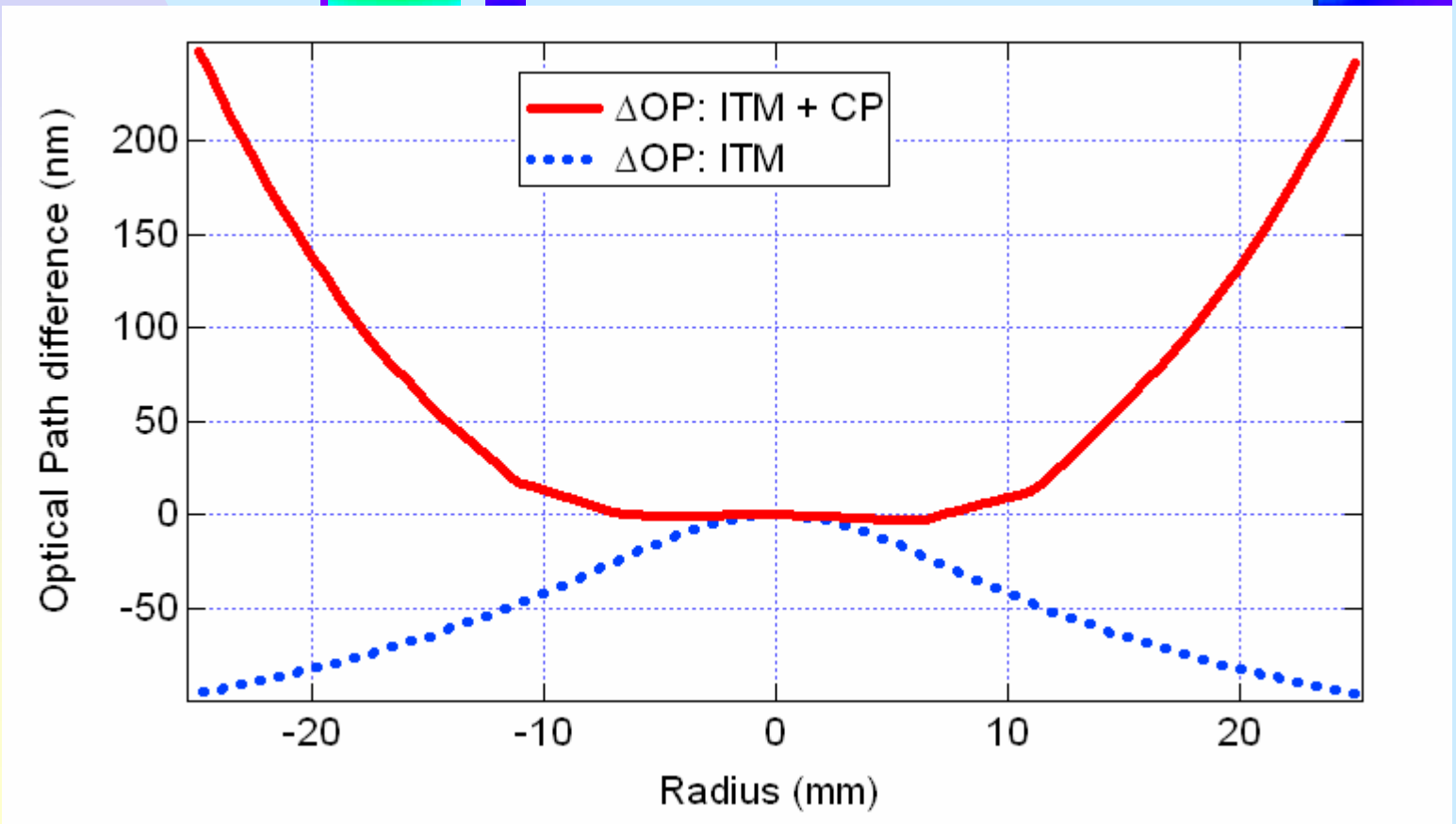


Higher order modes comparison

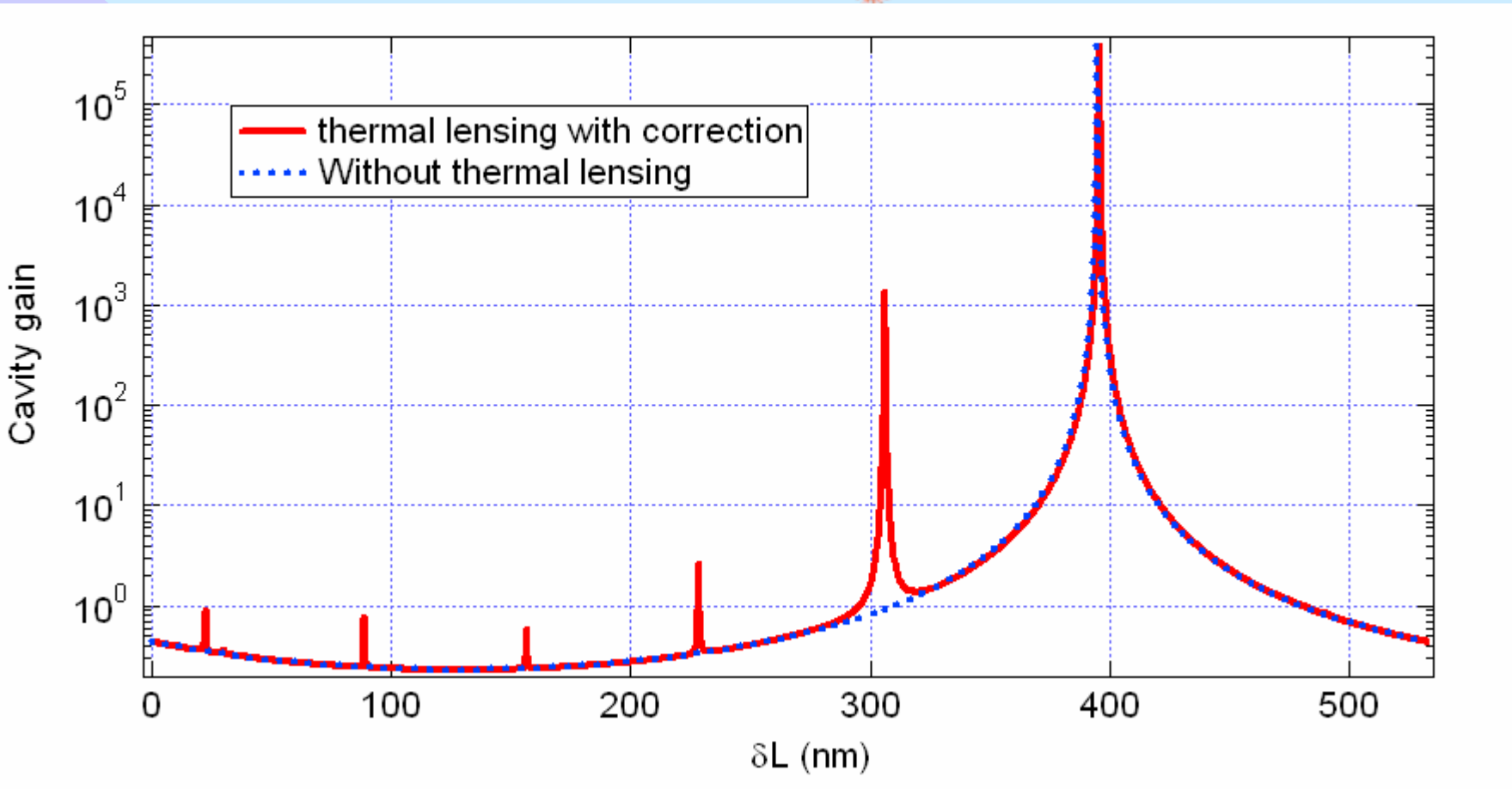


Idea of compensation





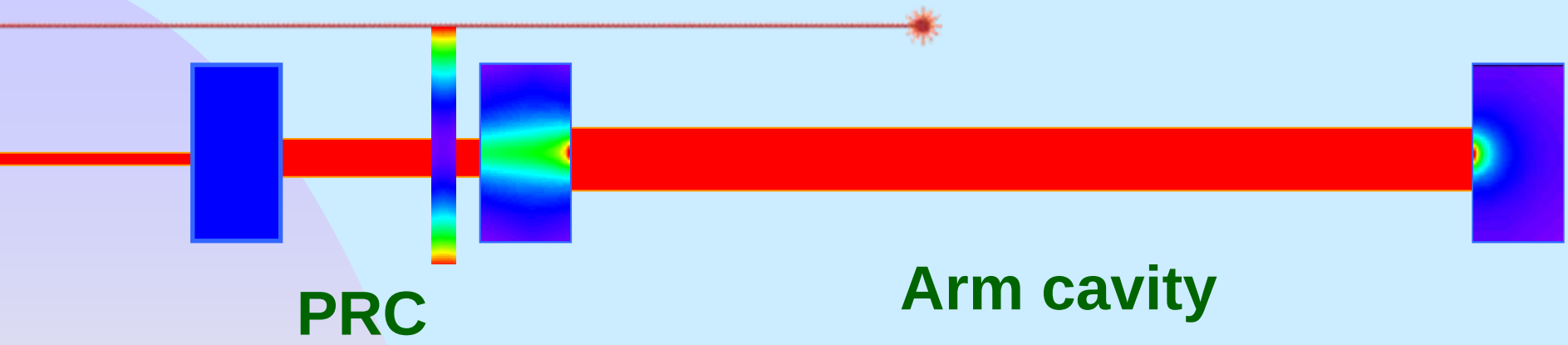
HOM spectrum with CP



CP works fine for TEM00

Make higher order mode worst!

Problem with the PRC

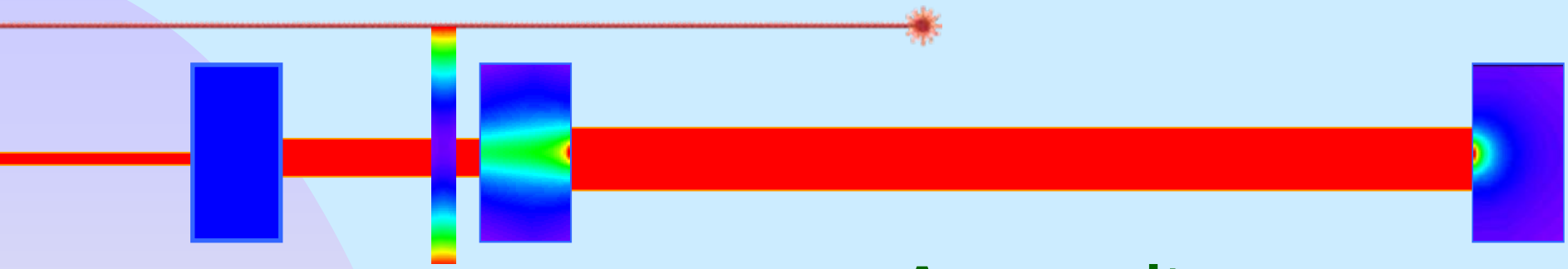


PRC degenerate $\Rightarrow$ Higher order mode resonant!

g factor PRC = 0.999995

Frequency separation between HOM
δf = 10 kHz
($FWHM_{PRC}$ = 130 kHz)

Make the PRC non degenerate



PRC

Arm cavity

For example:

$g = 0.995 \quad \Rightarrow \delta f = 340$ kHz $\quad (> 2 * FWHM_{PRC})$

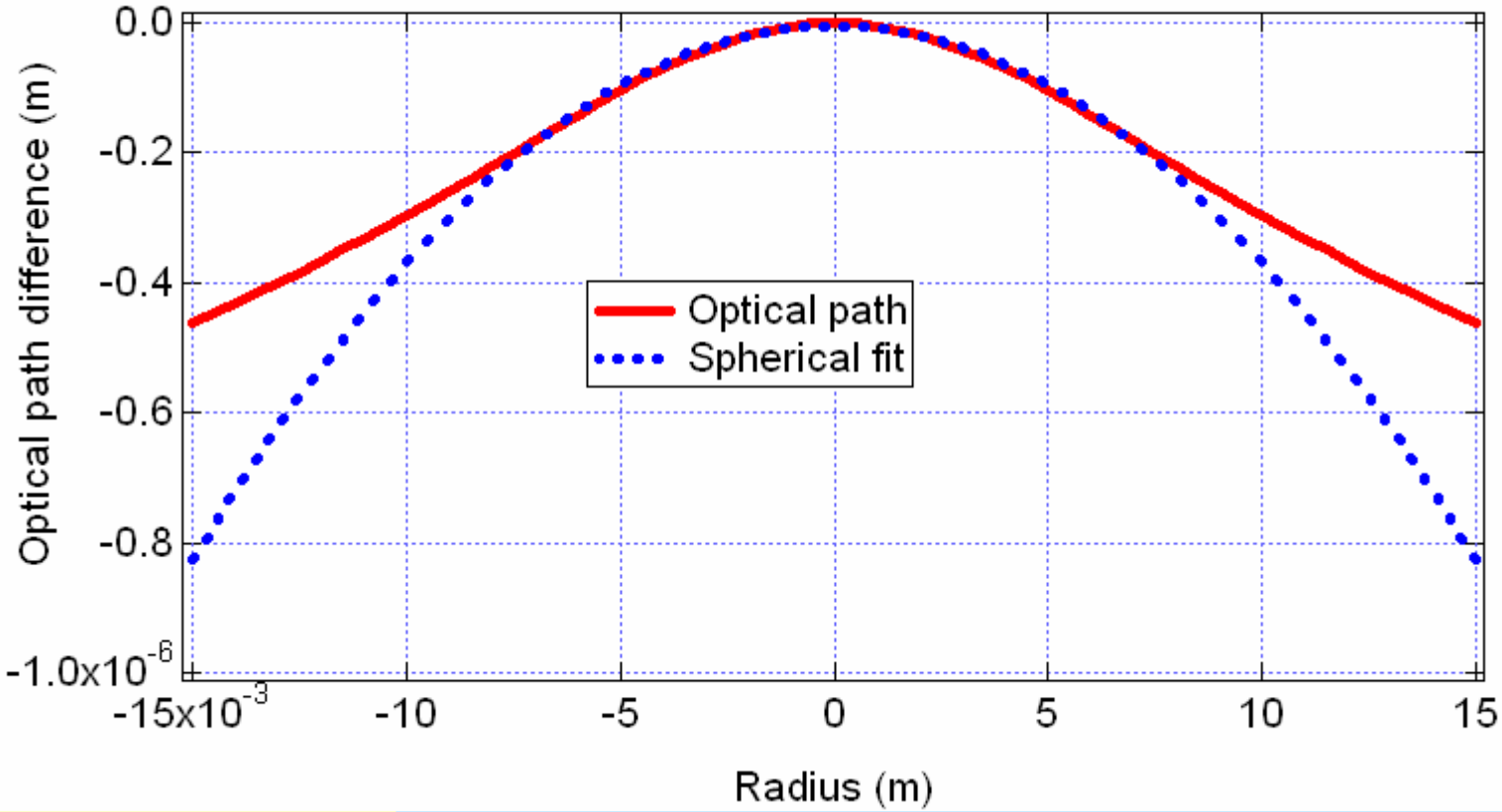
Do not compensate totally thermal lensing

$f_{ITM} = 10$ km

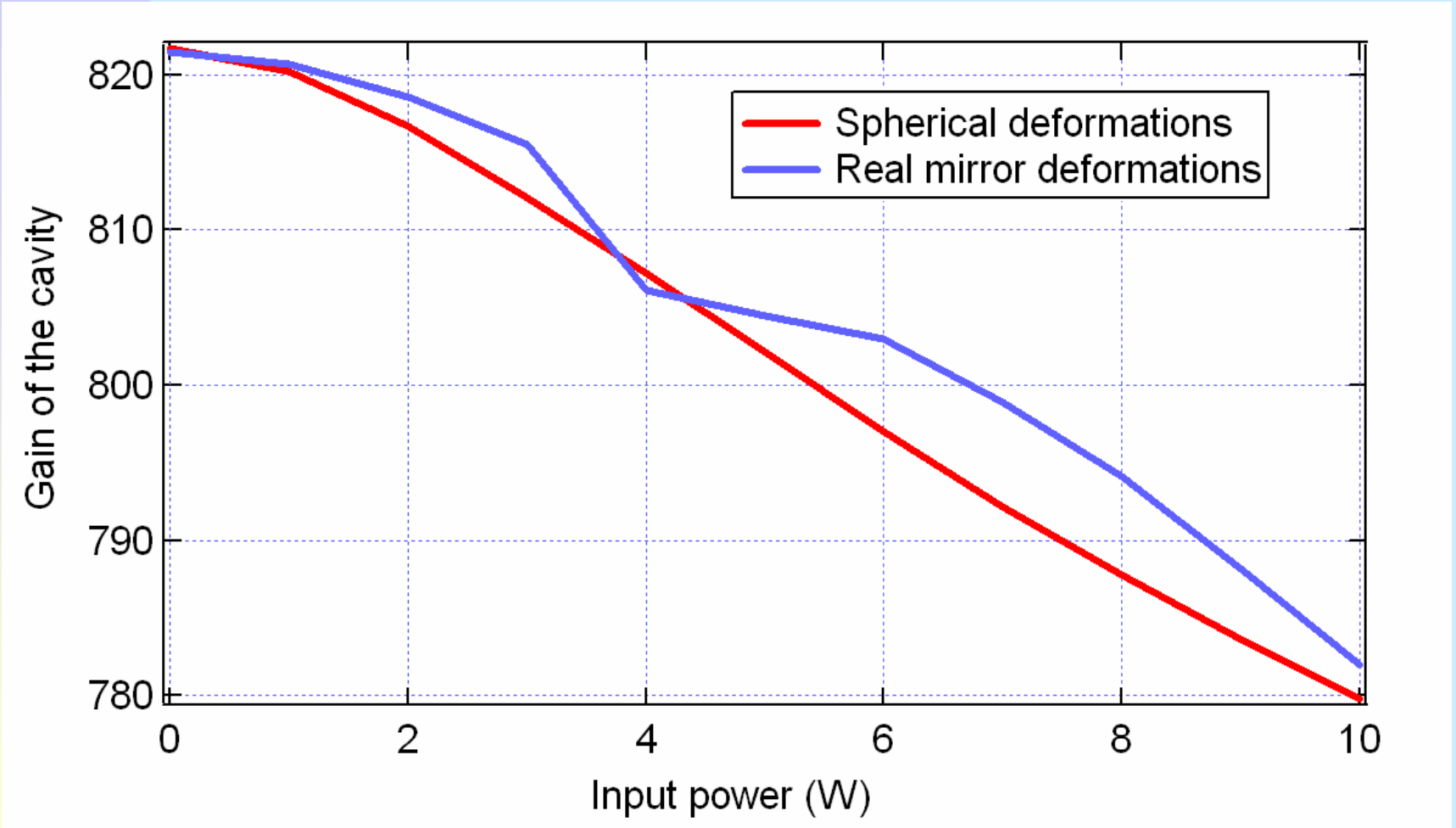
- Compensation plate works (for TEM_{00})
- Need to investigate the behavior of HOM
- Does not any correct any inhomogeous absorption

Profile of the deformations

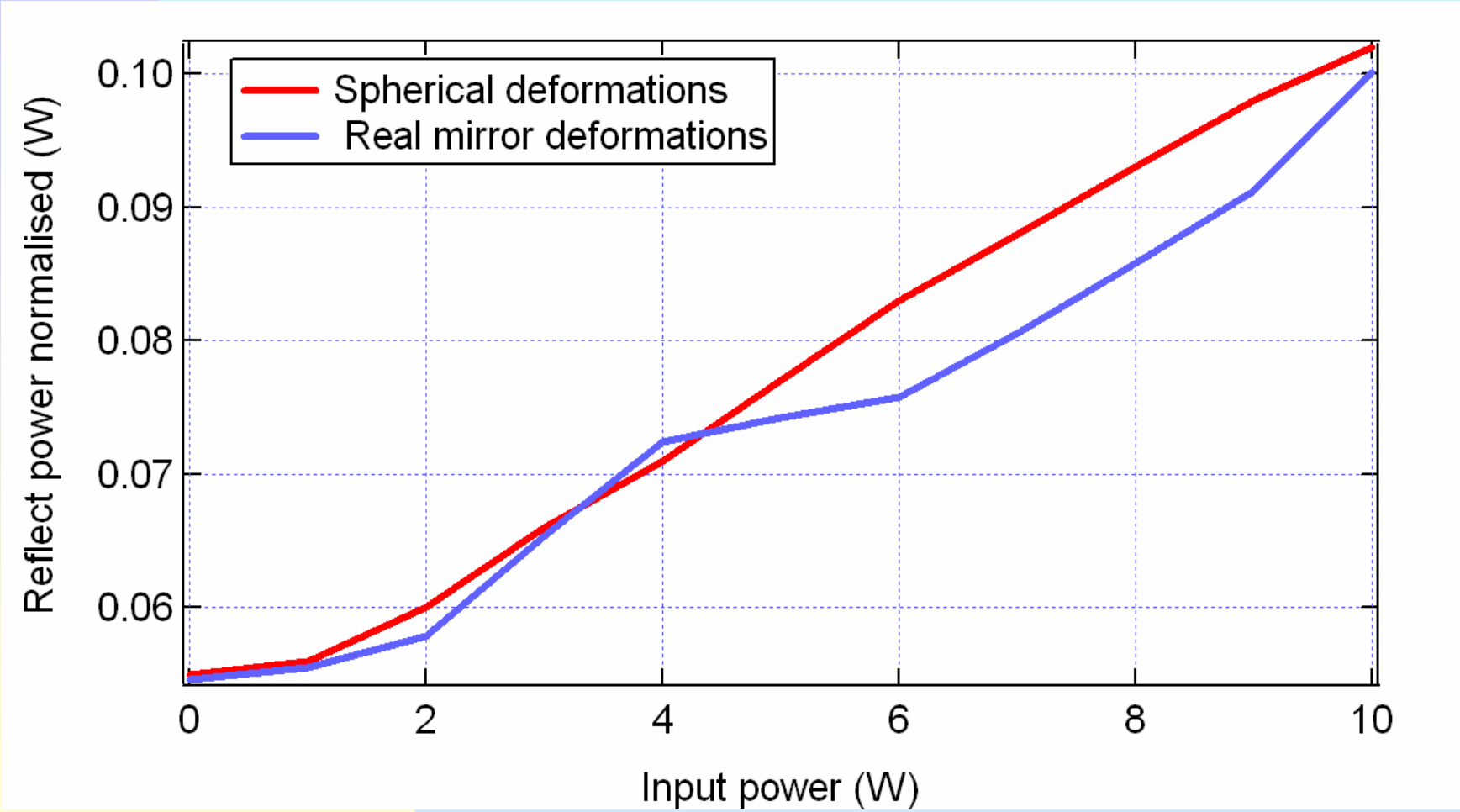
Thermal lensing deformations: non spherical!



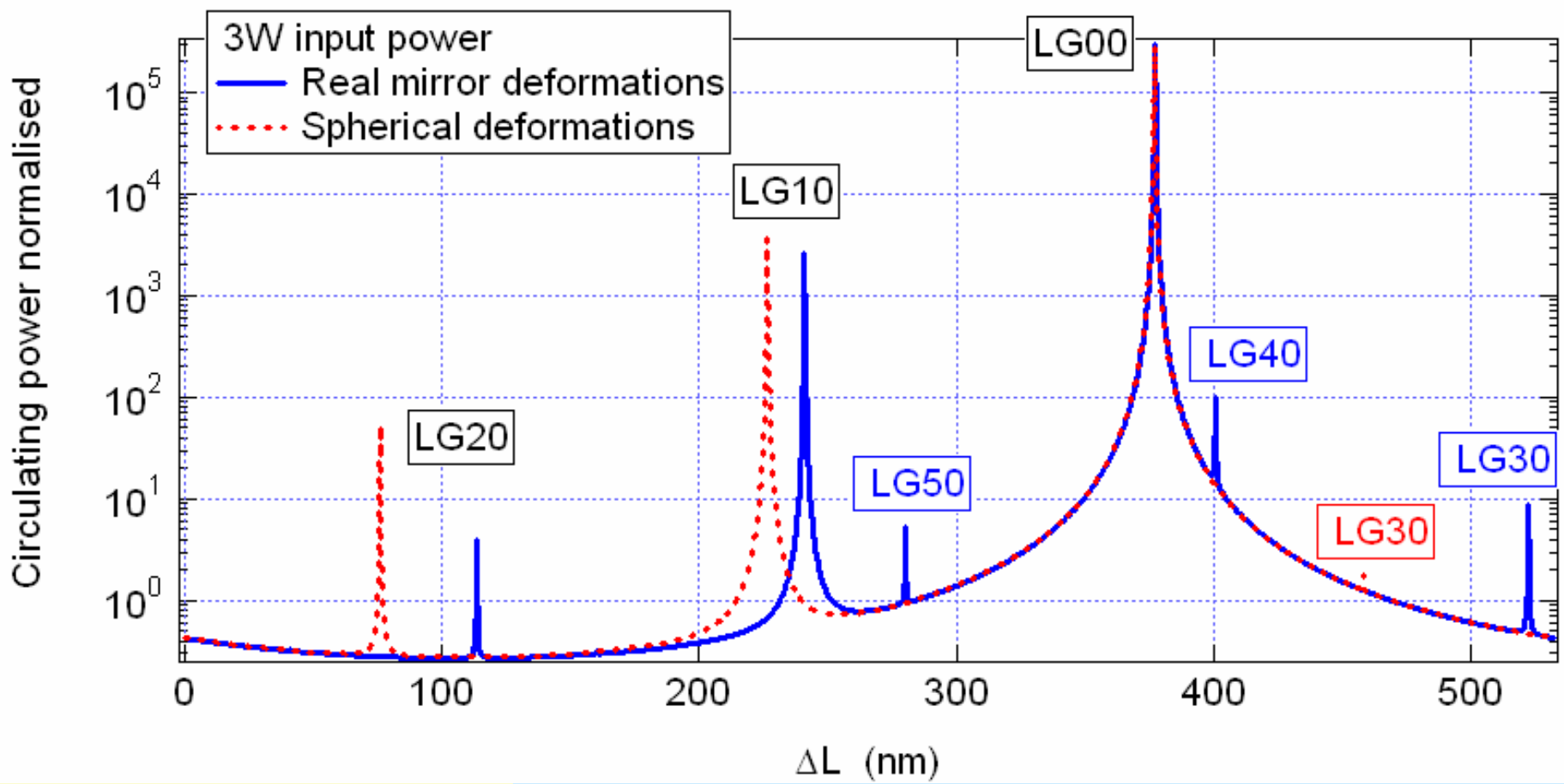
Circulating power comparison



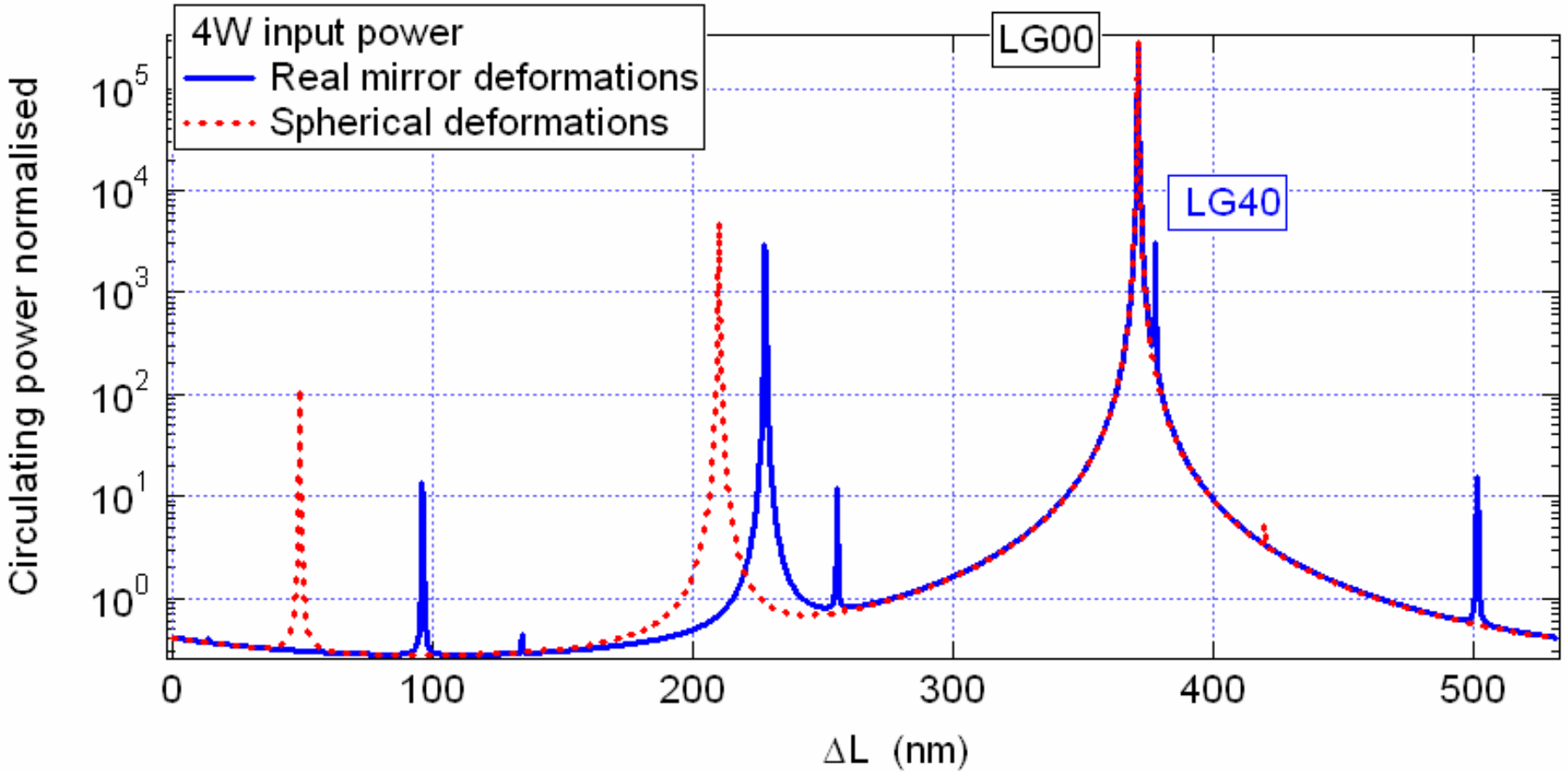
Reflected power



Higher order modes comparison



Higher order modes comparison



4W circulating power profile