

# Optomechanical vibrations in asymmetric resonators

Soheil Soltani<sup>1</sup>, Alexa Hudnut<sup>2</sup> and Andrea Armani<sup>1</sup>

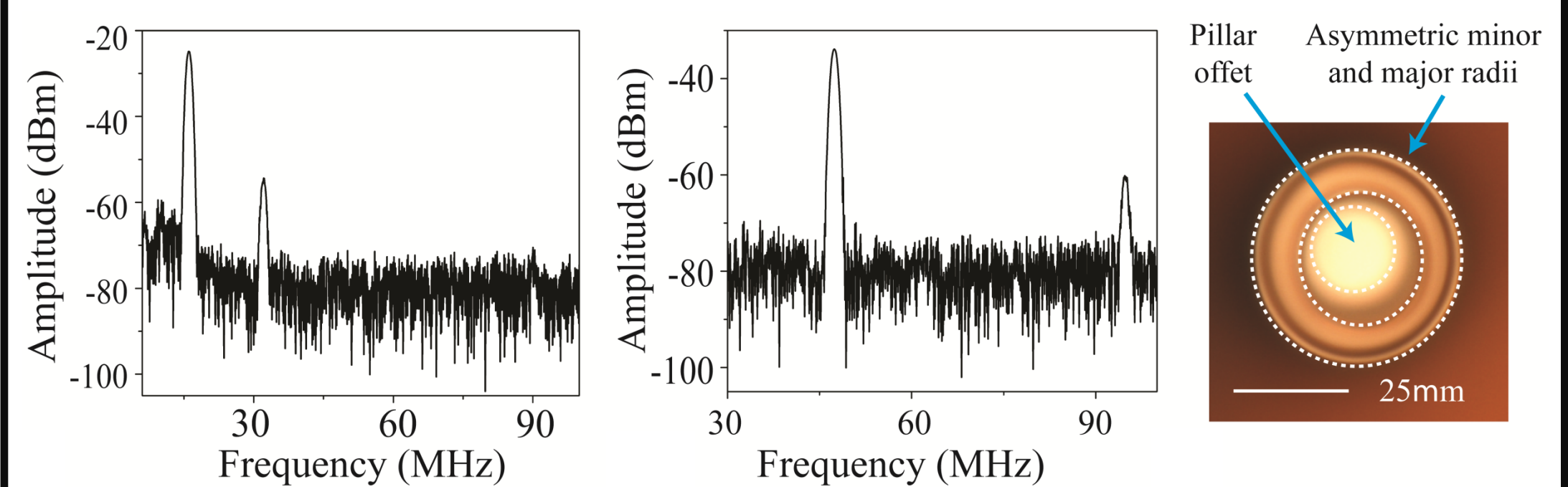
<sup>1</sup>Ming Hsieh Department of Electrical Engineering-Electrophysics, University of Southern California, Los Angeles, California

<sup>2</sup>Department of Biomedical Engineering, University of Southern California, Los Angeles, California

## Introduction

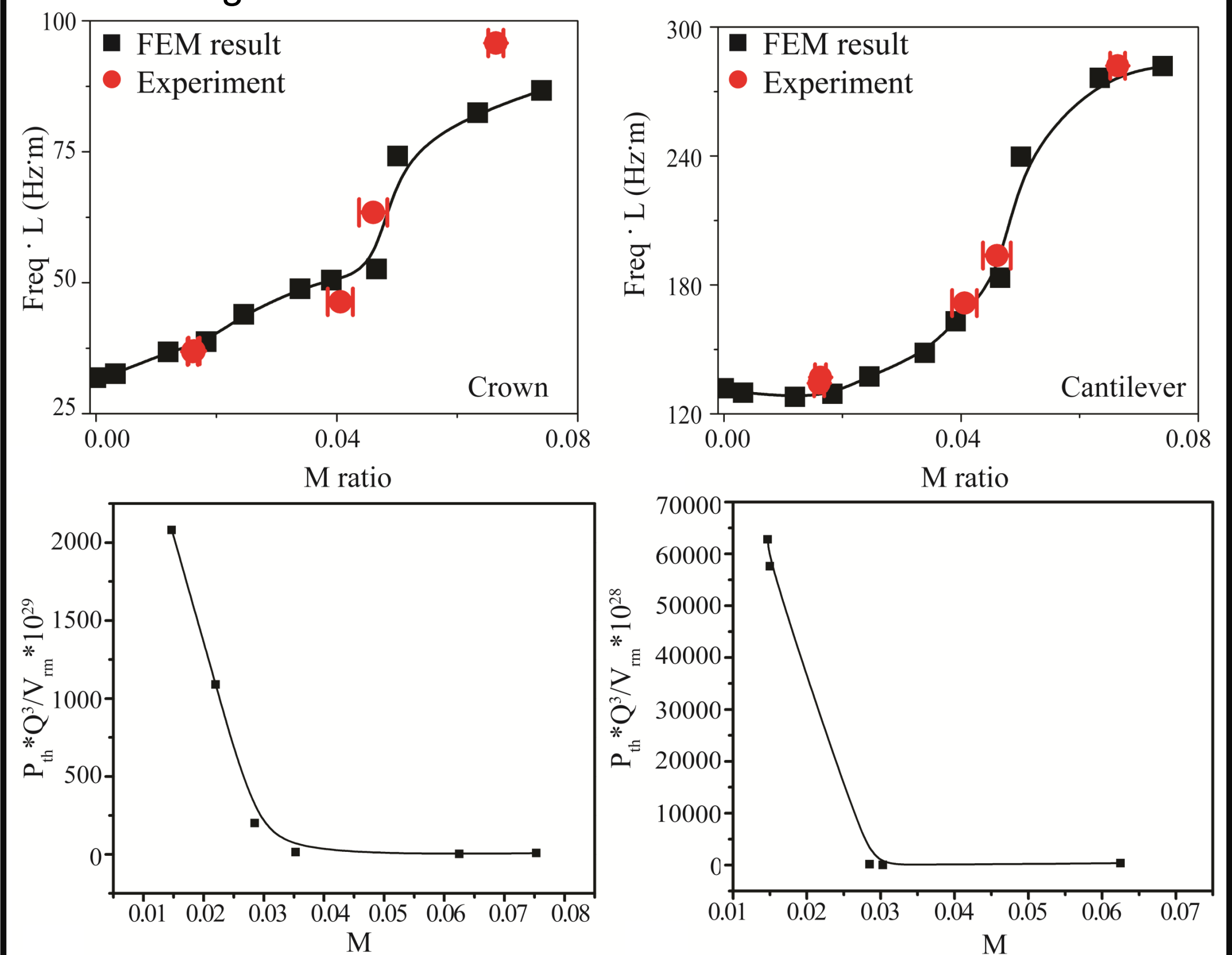
Whispering gallery mode resonators are capable of storing light around their periphery enabling existence of stable high quality optical modes. Since the circulating intensities in these resonators is very high, the force exerted to the side walls starts to vibrate the device and optomechanical vibrations are observed. In most of the whispering gallery resonators so far only two modes are regeneratively excited. In this work we show that by introducing asymmetry it is possible to regeneratively excite new mechanical modes. We have shown that by controlling the degree of asymmetry it is possible to control the threshold value of the new modes.

## Results and Discussion



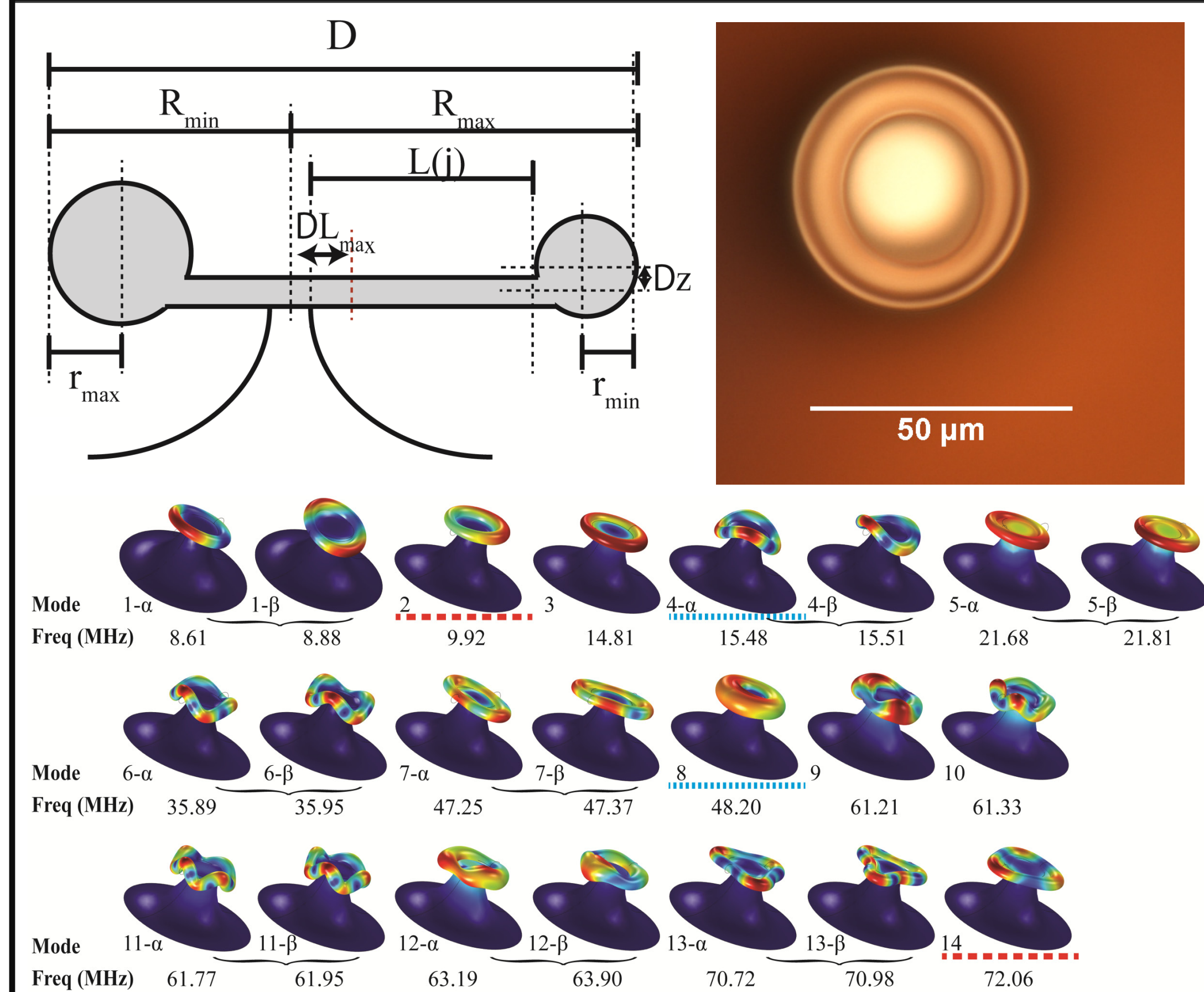
Mechanical mode (symmetric)	Maximum Energy Ratio (symmetric)	Mechanical mode (asymmetric)	Maximum Energy Ratio (asymmetric)
First Cantilever mode	1	First Cantilever mode	1
Second Crown mode	0.00297	Second Crown mode	30.075
Second Cantilever mode	0.17376	Second Cantilever mode	8.75
Radial Breathing mode	47.1629	Radial Breathing mode	1.12

The force transduction calculations show that by introduction of asymmetry the Energy stored in Second crown mode and Second Cantilever mode increases and these modes are excited at much lower energies.



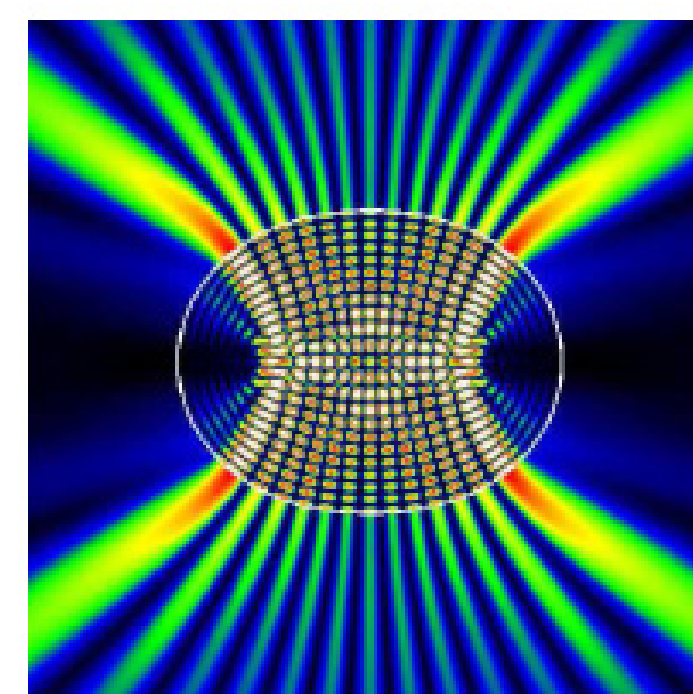
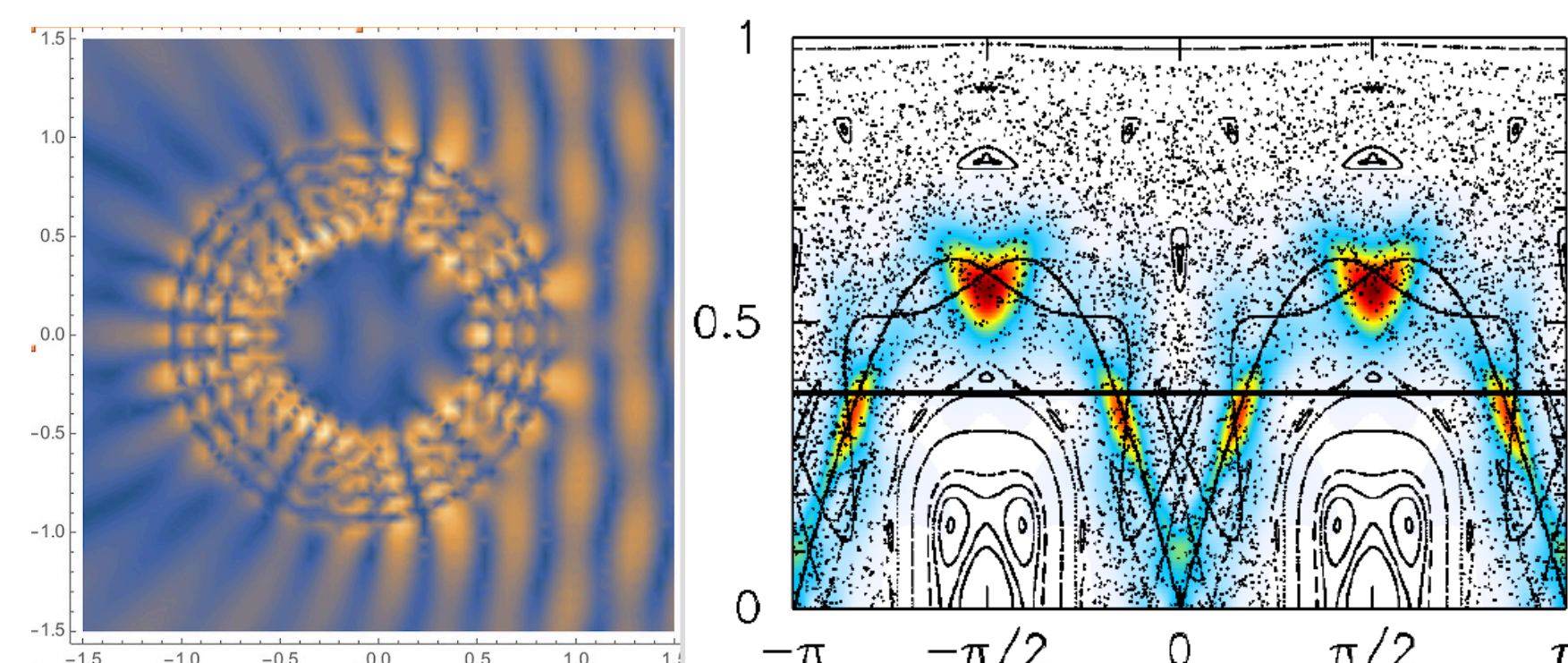
Where  $M = \frac{R_{\max} - R_{\min}}{R_{\max}}$  is the asymmetry ratio.

## Theoretical studies



## Future Work

The asymmetric resonators show unique optical and mechanical properties. These devices could be designed to have directional coupling.



[1] H. E. Tureci, H. G. L. Schwefel, P. Jacquod, and A. D. Stone, Prog. Opt. 47, 75 (2005)

[2] personal emails by JensNöckel