

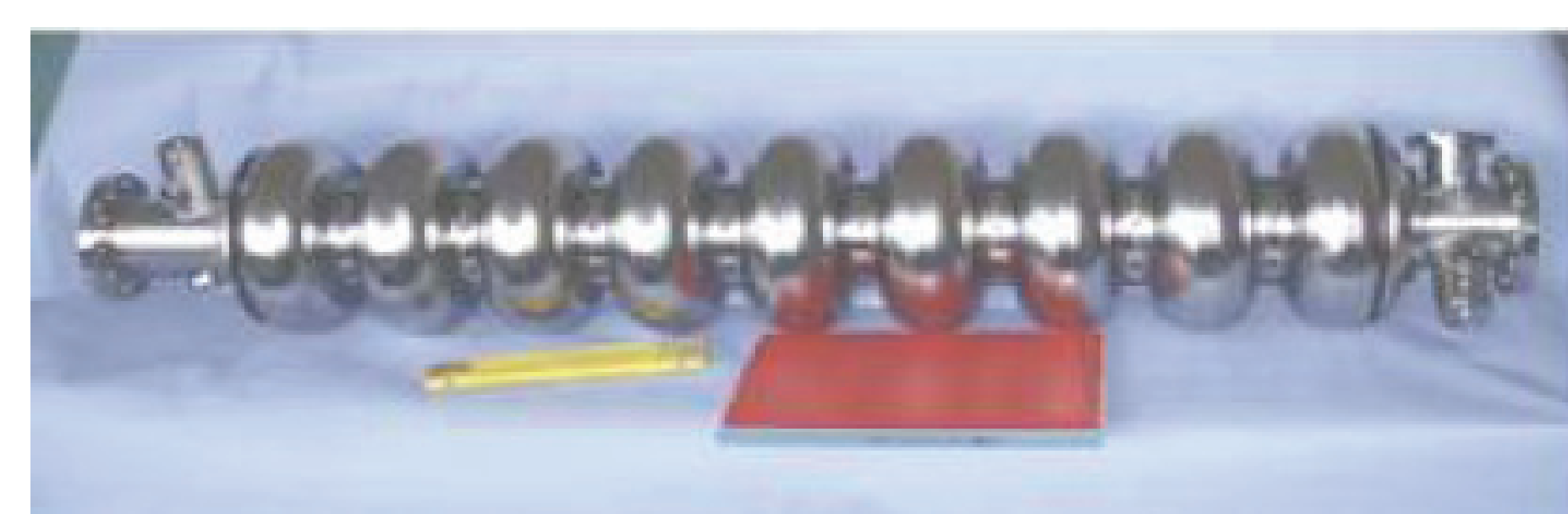
**Abstract:** The actual cell shapes of the TESLA cavities differ from the ideal due to fabrication errors, the addition of stiffening rings and the frequency tuning process. Cavity imperfection shifts the dipole mode frequencies and alters the Qext's from those computed for the ideal cavity. Qext increase could be problematic if its value exceeds the limit required for ILC beam stability. To study these effects, a cavity imperfection model is established using a mesh distortion method. The eigensolver Omega3P is then used to find the critical dimensions that contribute to the Qext spread and frequency shift by comparing predictions to TESLA cavity measurement data. Using the imperfection parameters obtained from these studies, fiducial cavity imperfection models are generated for the studies of wakefield effects.

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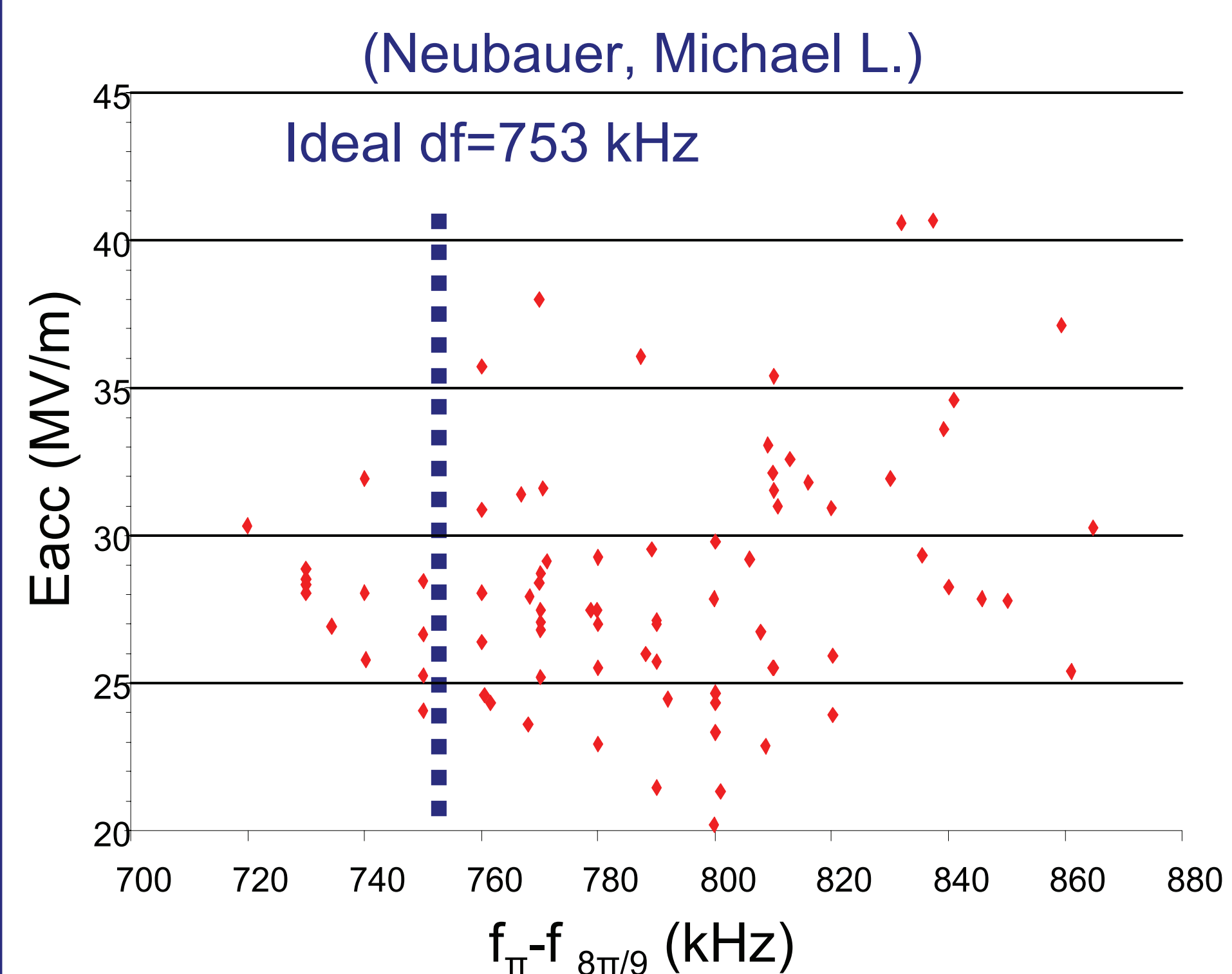
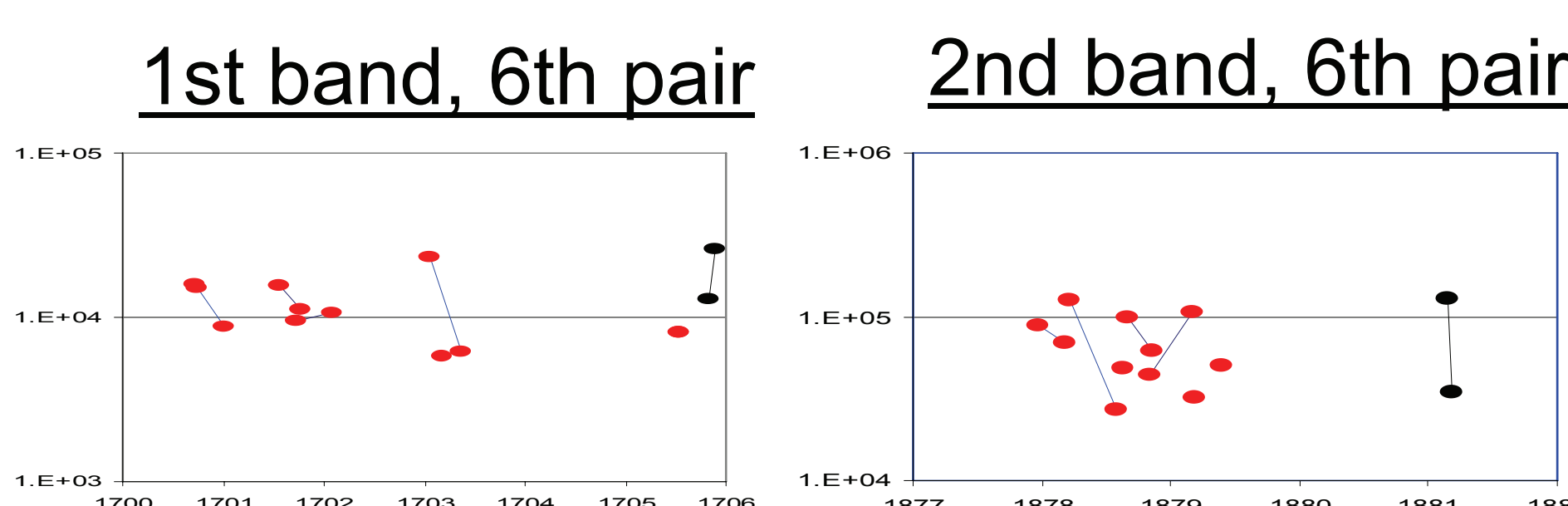
## Introduction

Cavity imperfection resulting from fabrication errors leads to

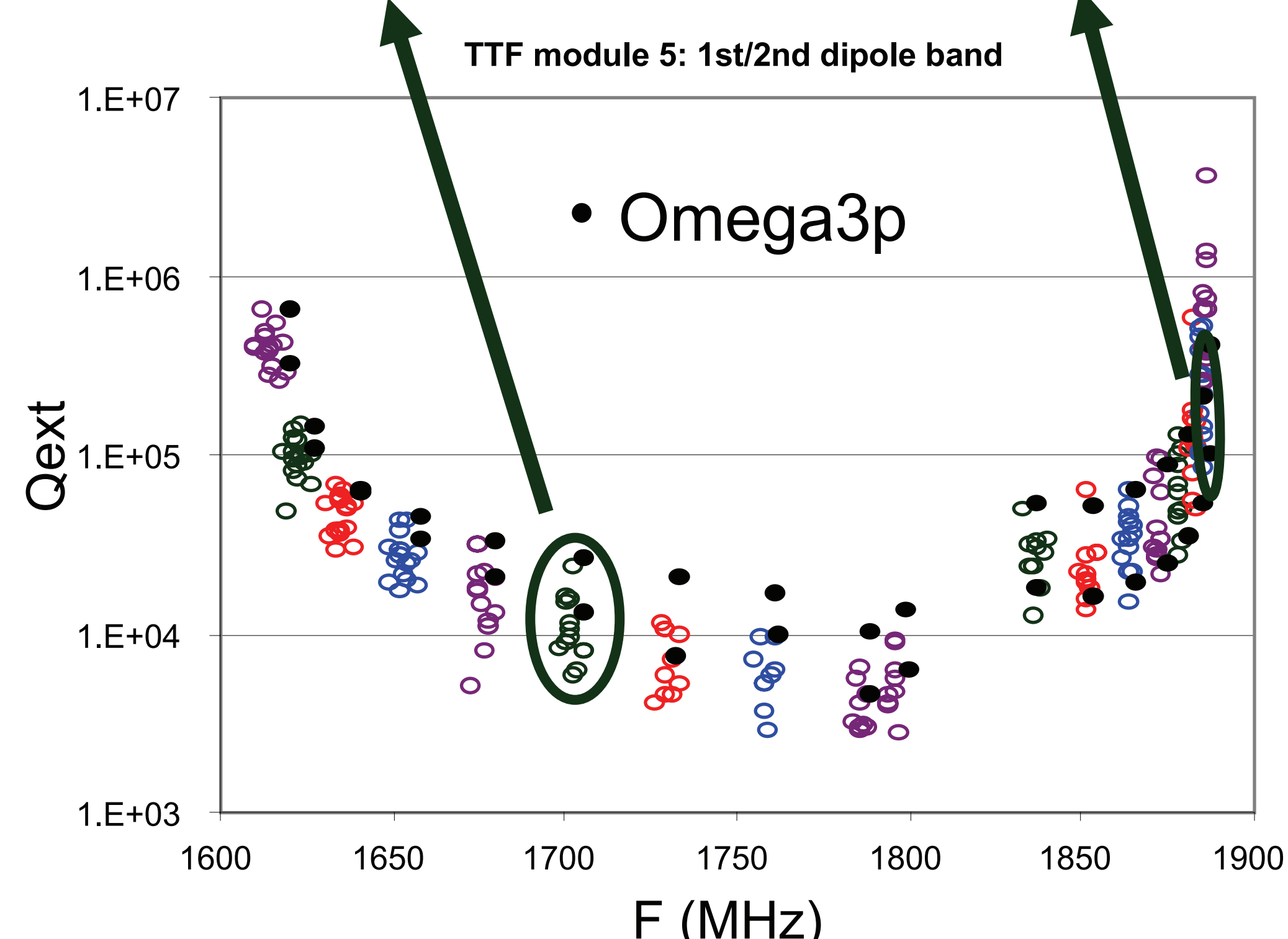
- scatter in spacing between operating and nearby monopole mode
- shift of dipole mode frequencies to lower values
- increase in splitting of dipole pair frequencies
- scatter in dipole mode Qext, which could cause beam instability



TDR cavity



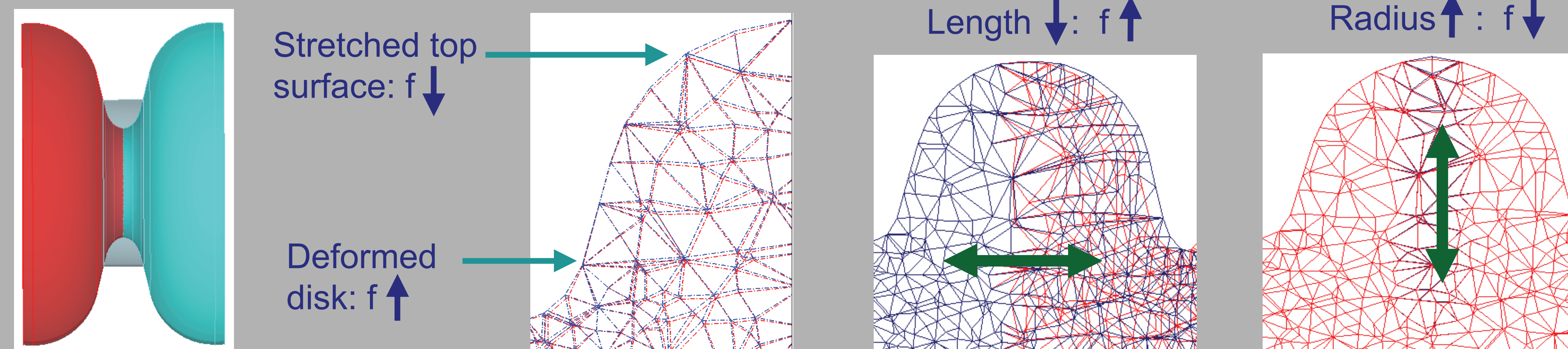
Cavity performance (80 cavities)



Measured dipole modes in TTF module 5

## Models of Cavity Imperfection

Cell shape parameters contributing to frequency shift

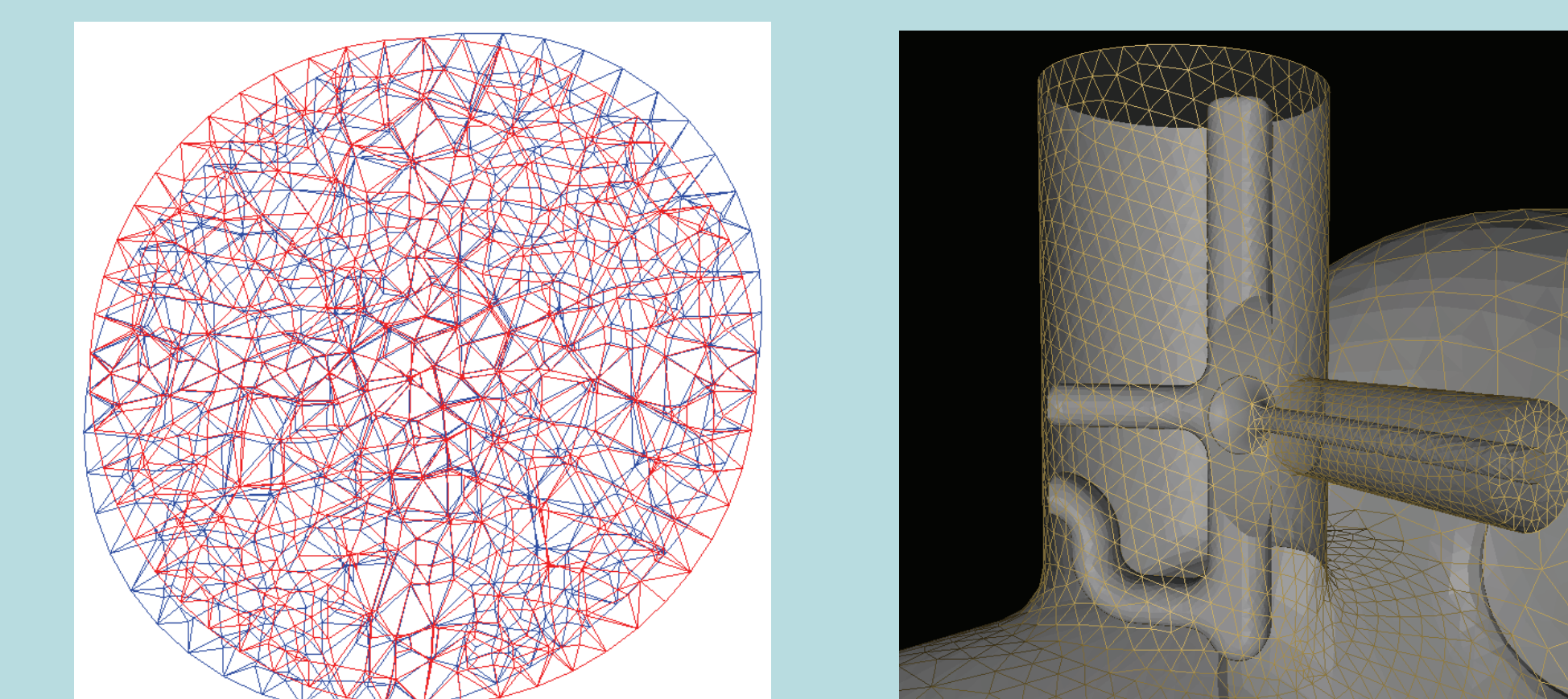


Deformed surface from welding of stiffening ring on dumbbell

Trimming cell length on equator

E-beam welding on equator

Shape parameters contributing to dipole polarization effects



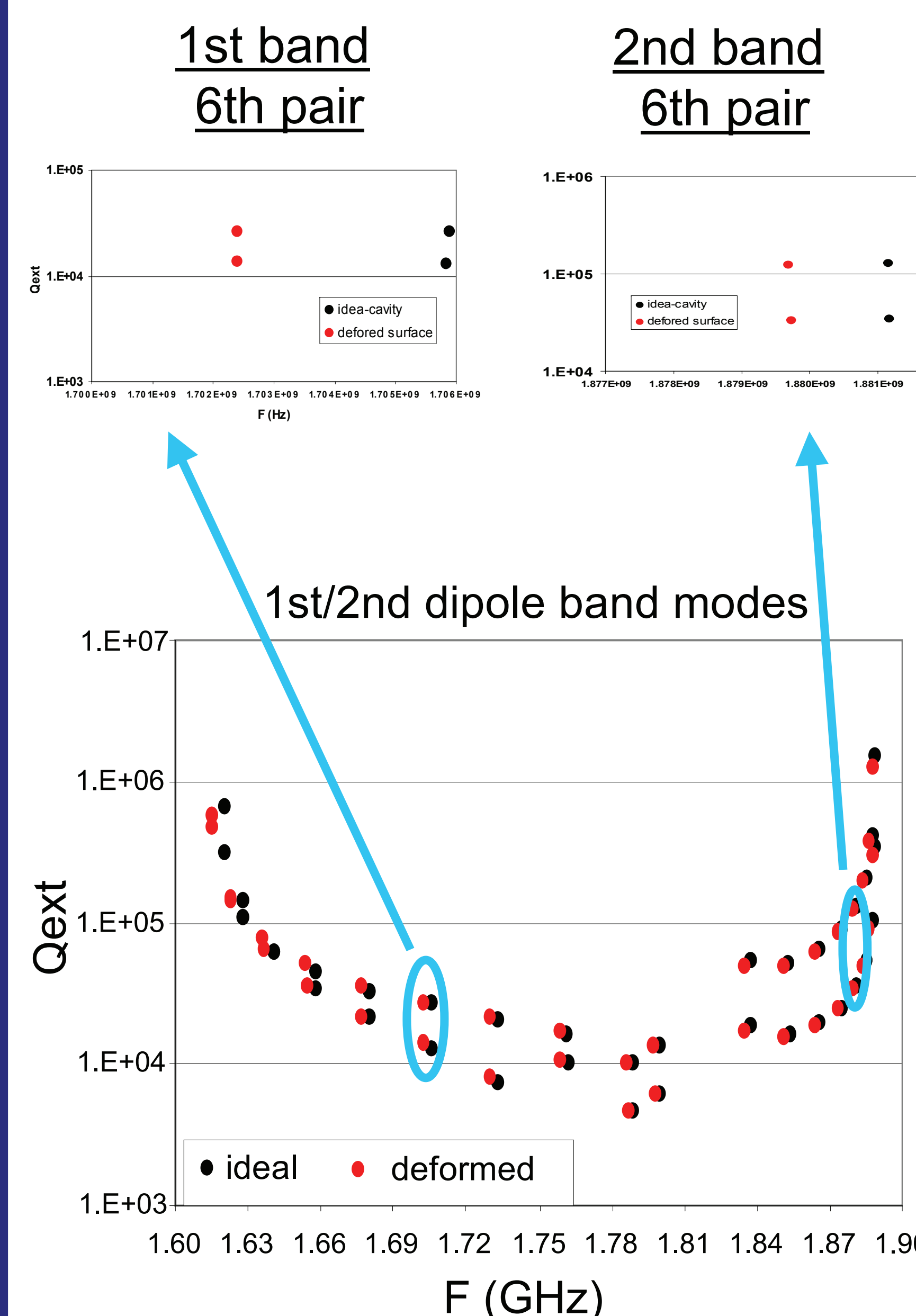
Cell ellipticity (frequency split/Qext)

HOM pickup gap (damping)

## Effects of Cavity Imperfection

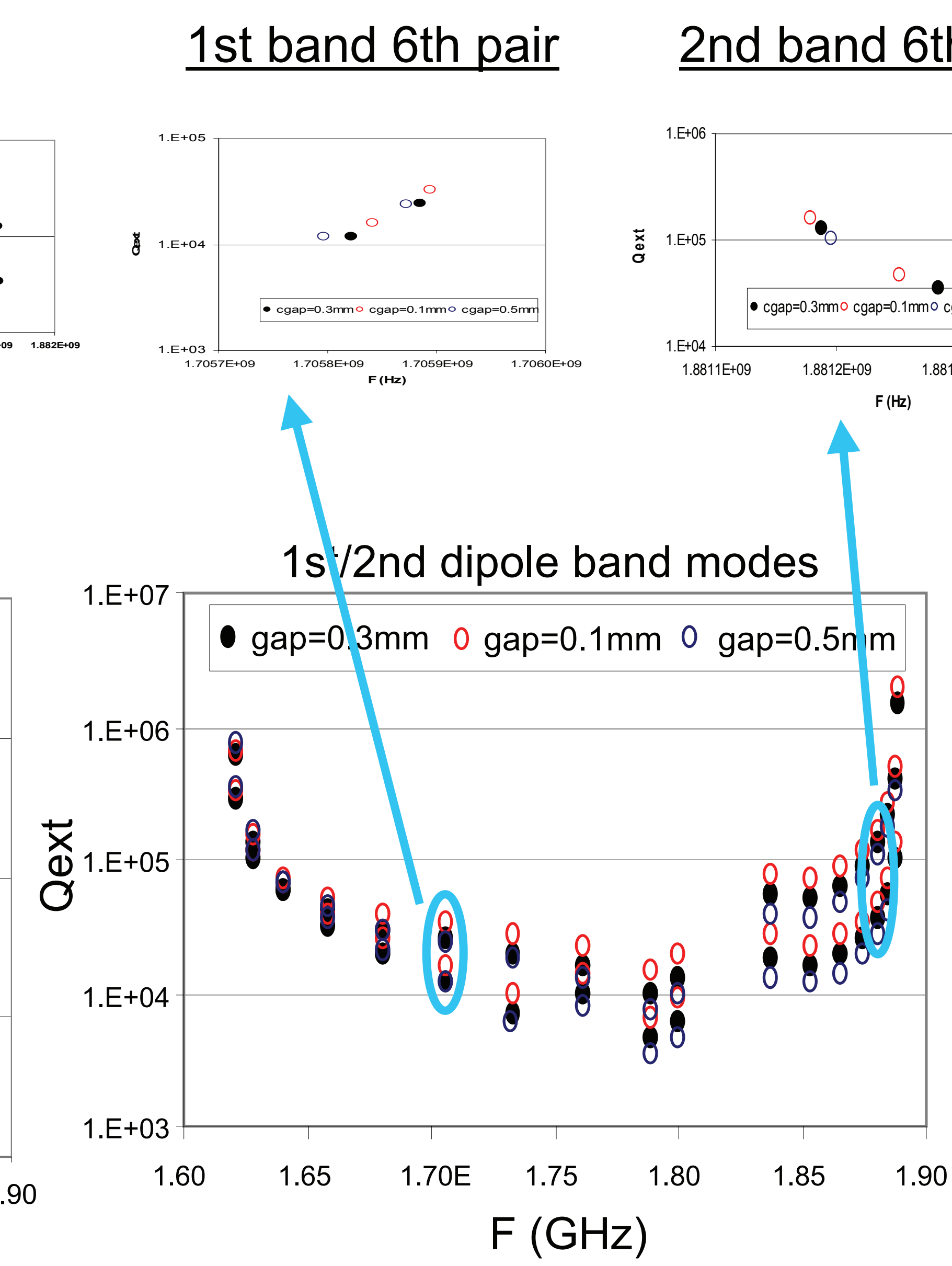
Dipole frequency shift

- Deformed cell surface

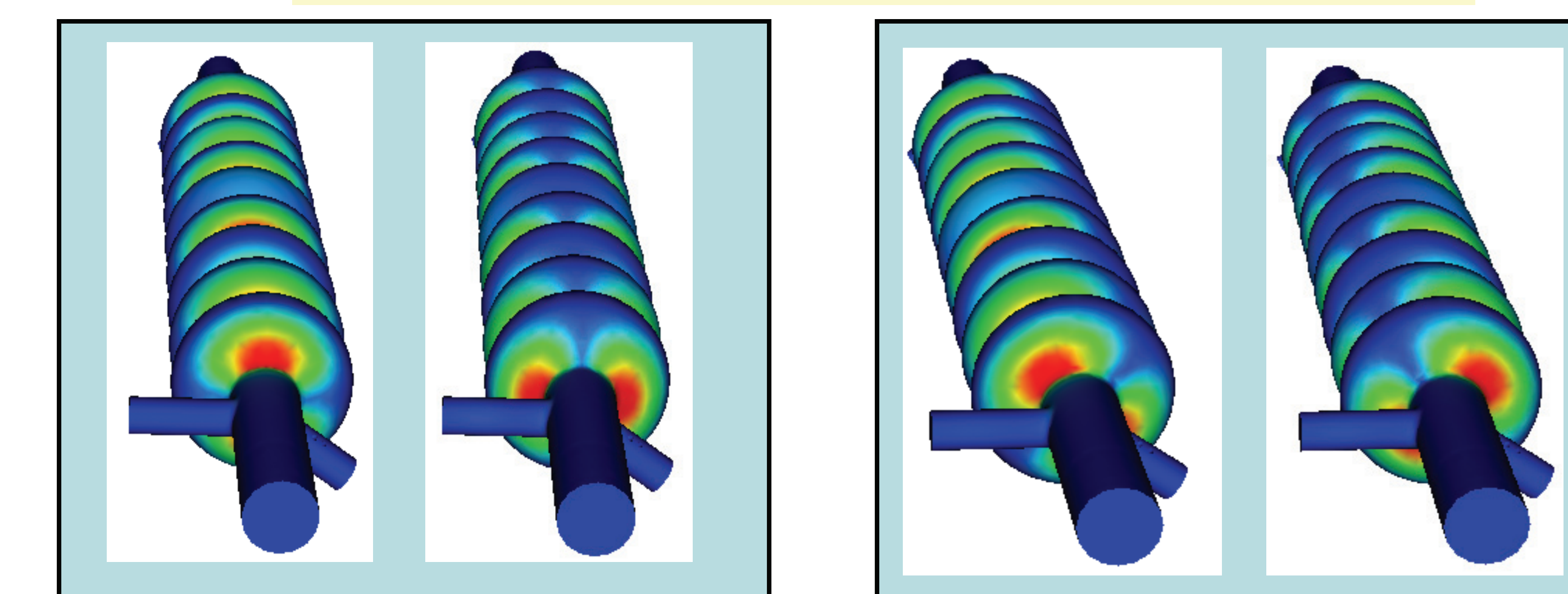


Scatter in Qext

- Elliptical cell shape  
- Variation in HOM pickup gap



Change in mode polarization

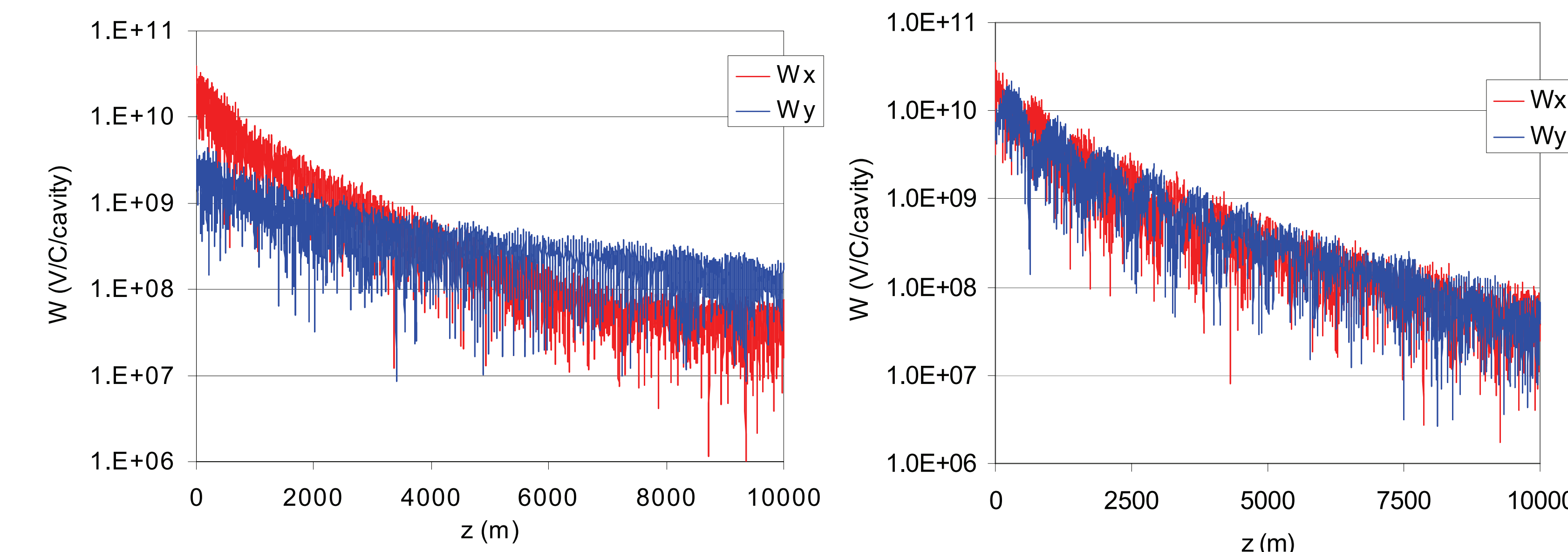


Ideal cell

Elliptical cell

Wakefield in deformed cavity

Beam with 0.5 mm x offset



Ideal cavity

Cavity with one elliptical cell

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