Wesleyan University

Department of Physics

Wave Transport in Complex Systems Lab

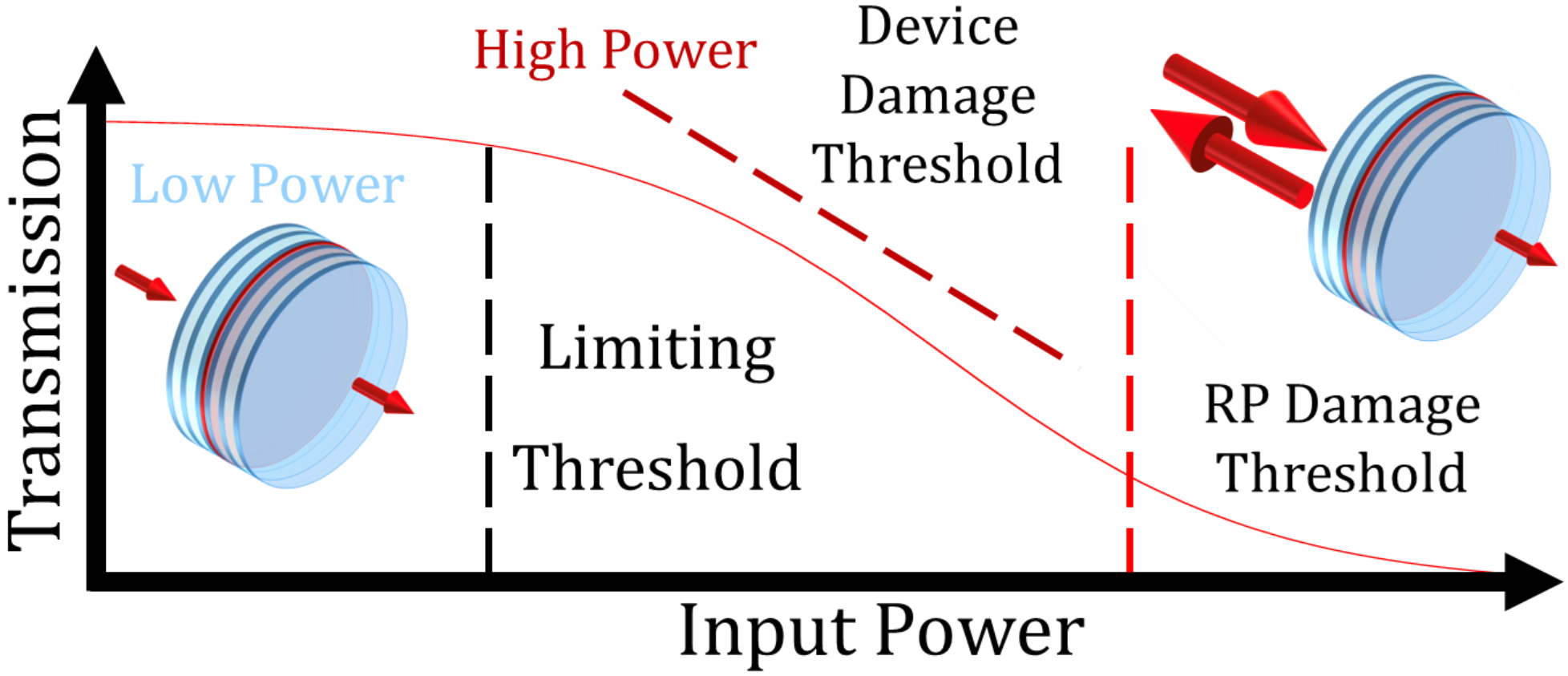
Topological Broadband Receiver Protectors Based on High Order Exceptional Point Degeneracy

Shahid Iqbal

W. Tuxbury A. Dowling M. Reisner U. Kuhl T. Kottos

Receiver Protectors Review and Objective

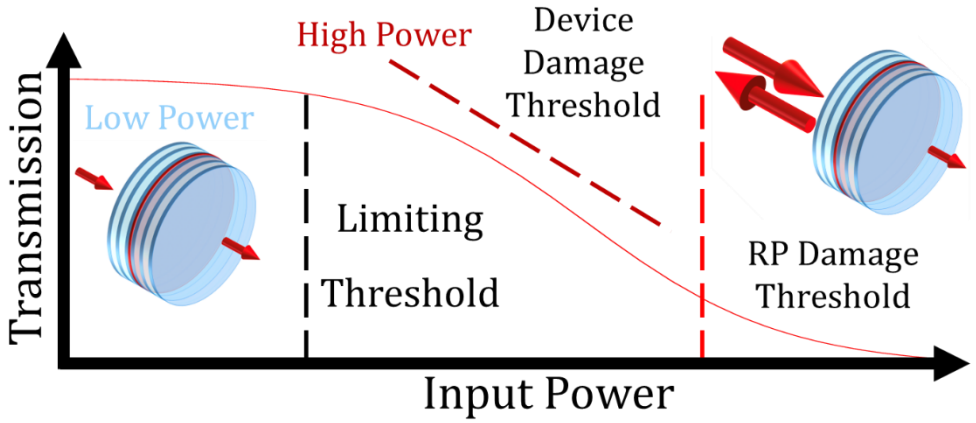
Receiver Protectors Concept:



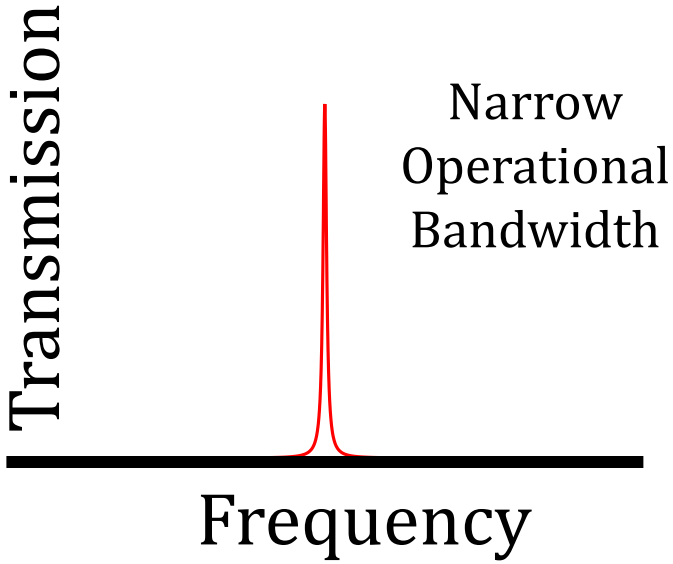
$$\text{Dynamic Range} = \frac{\text{Damage Threshold}}{\text{Limiting Threshold}}$$

Receiver Protectors Review and Objective

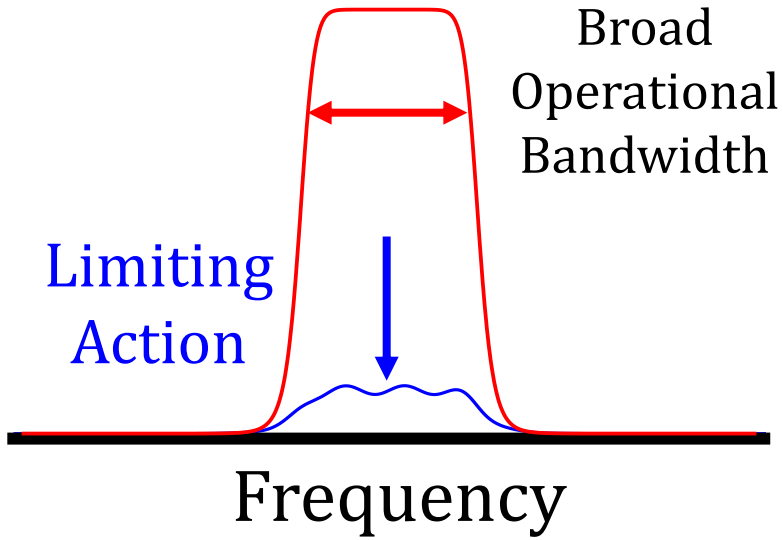
Receiver Protectors Concept:



Existing RPs:



Objective:



Strategy: $R \sim \nu^{2\mu}$

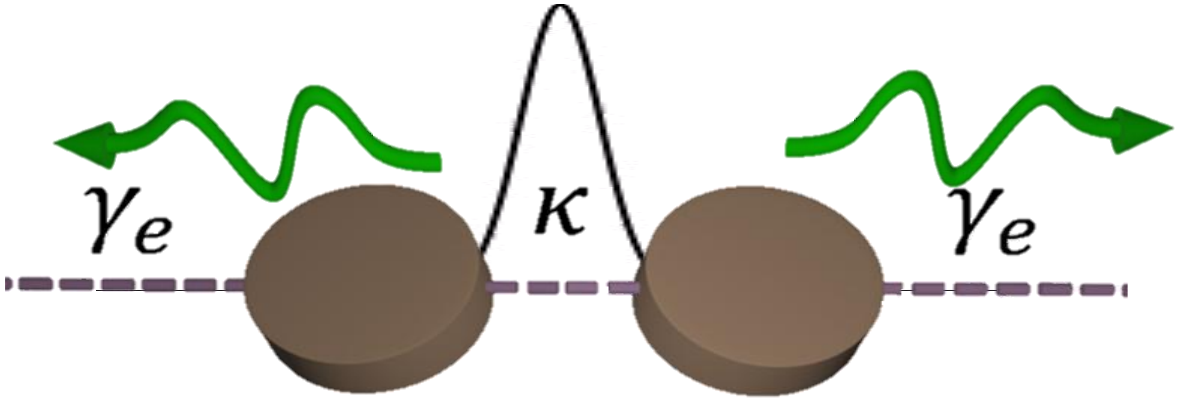
Symmetry Induced Broadening

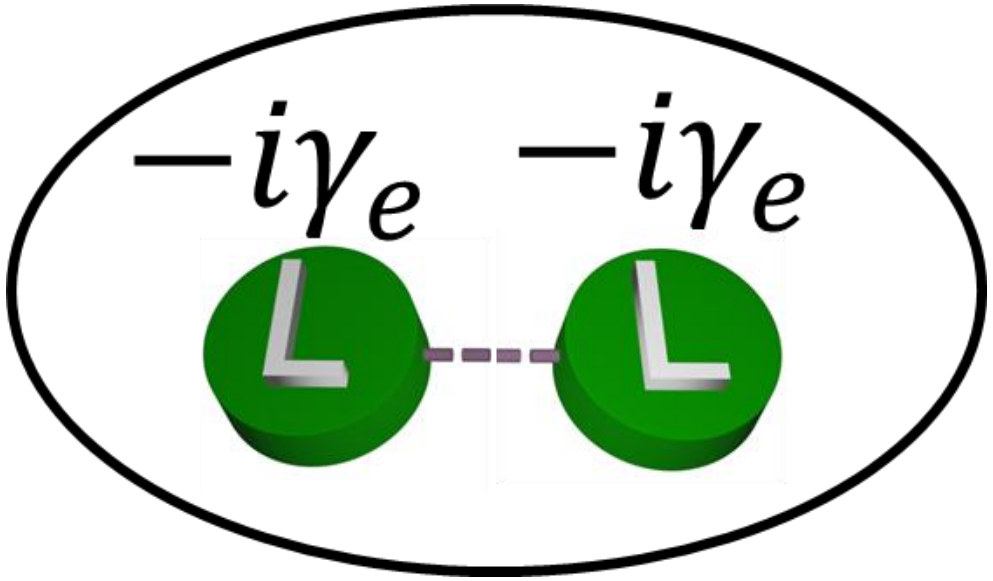
$T = 1 - R$

1. High Transmission
2. Broadened Line Shape
3. Limiting Action

Reflectionless Scattering Modes in Dimer

Outgoing Solutions

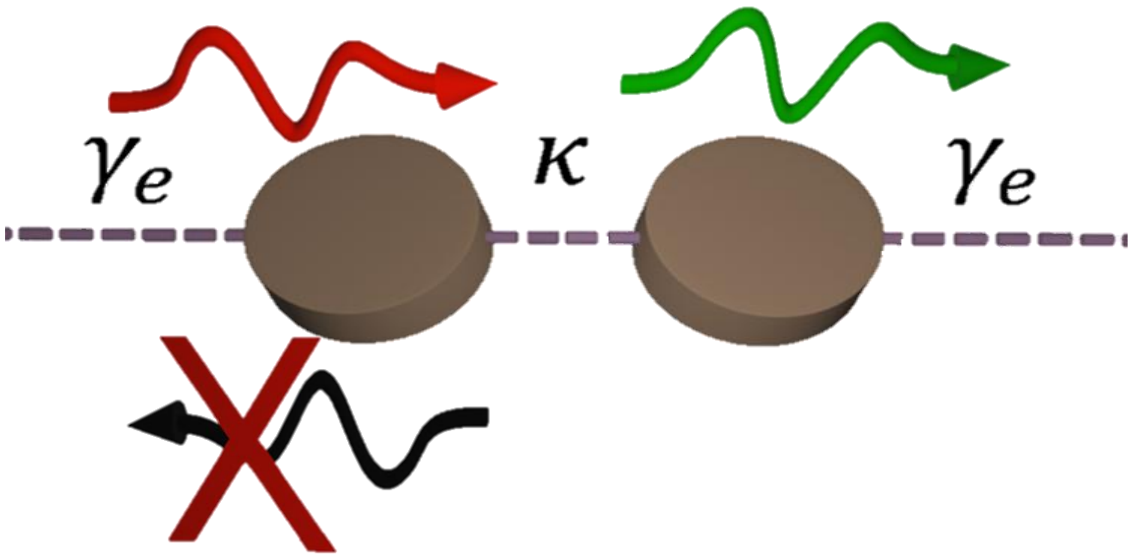




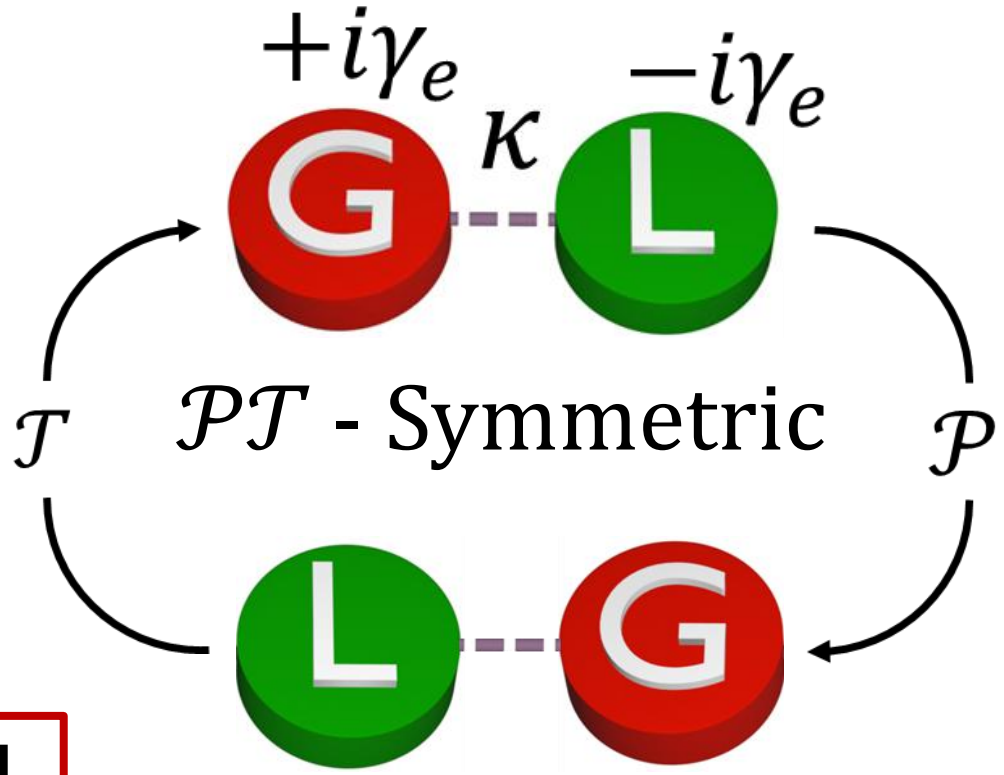
Effective Hamiltonian

Reflectionless Scattering Modes in Dimer

Reflectionless Solutions?



Auxiliary System



Symmetry-Breaking

Transition Induced

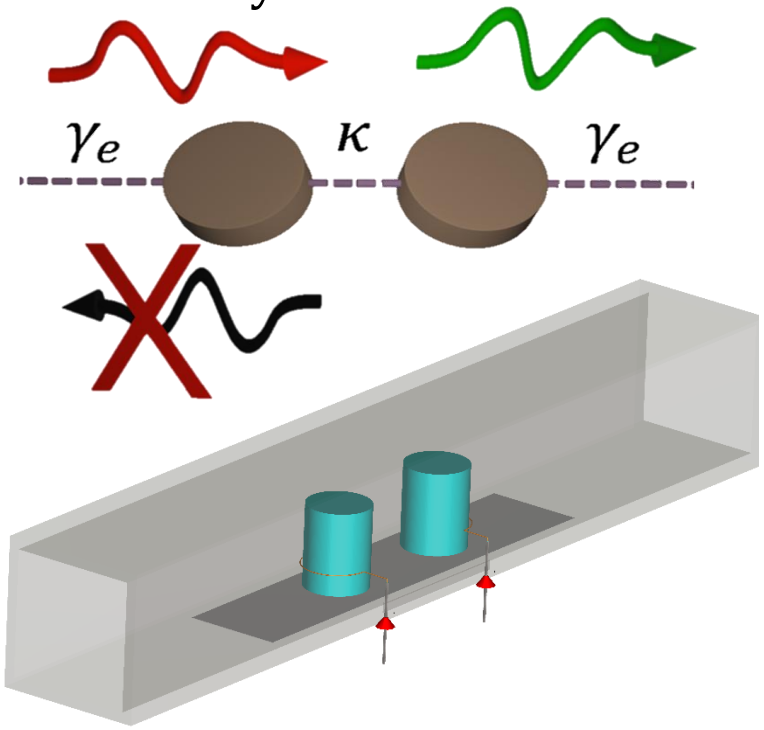
Degeneracy

Effective Hamiltonian

$$R \sim \nu^4$$

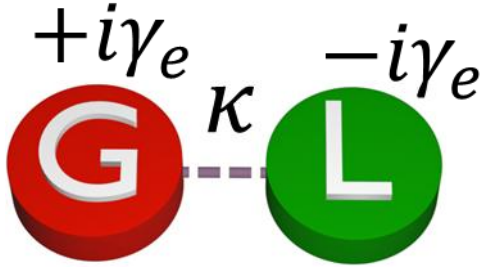
Degeneracy Induced Broadening in Dimer

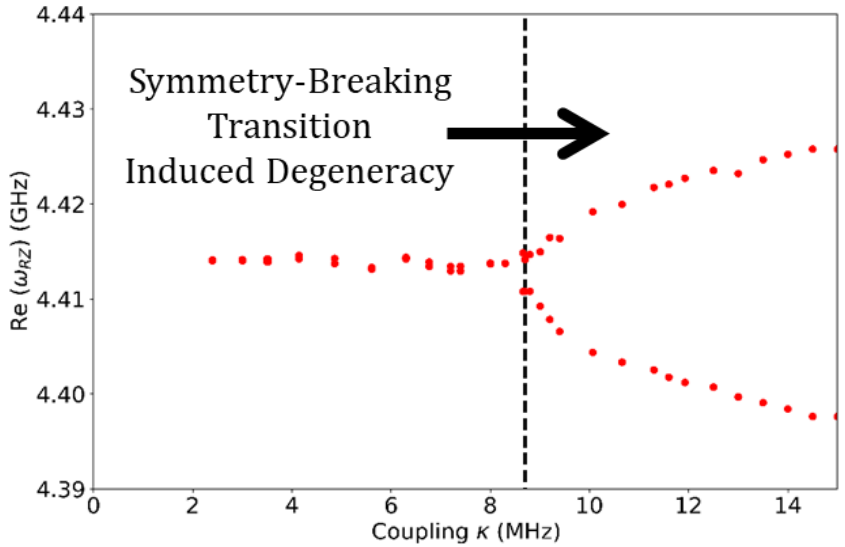
Physical Scattering System

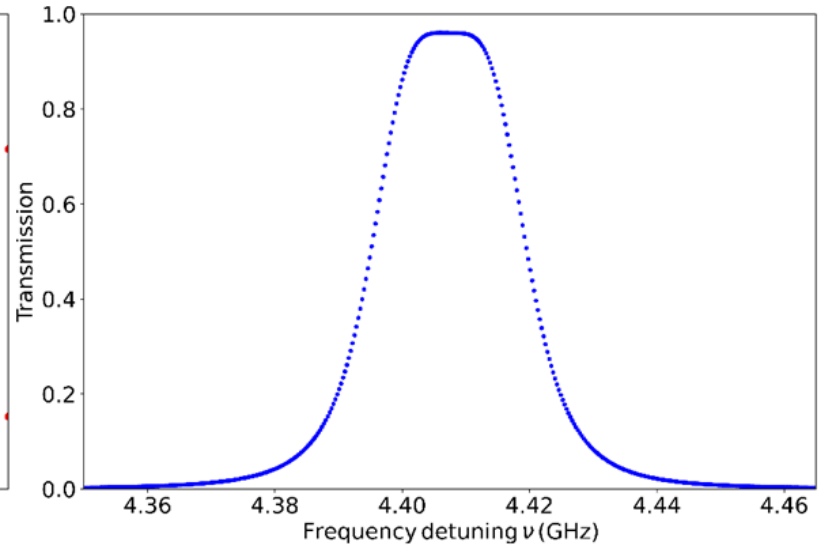


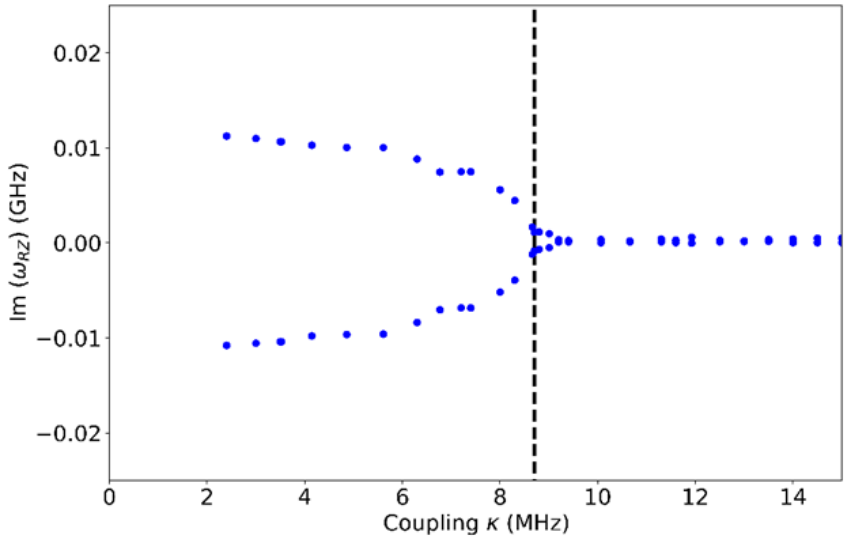
Auxiliary System

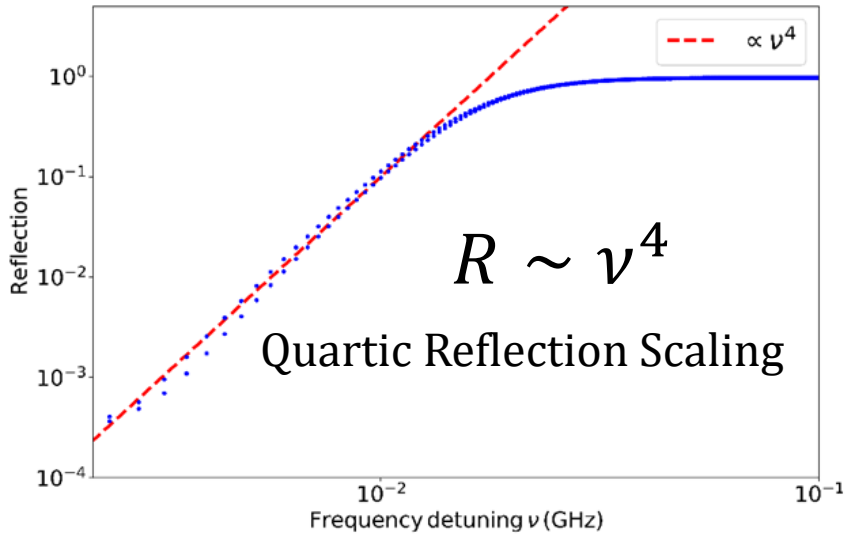
H_{RZ}





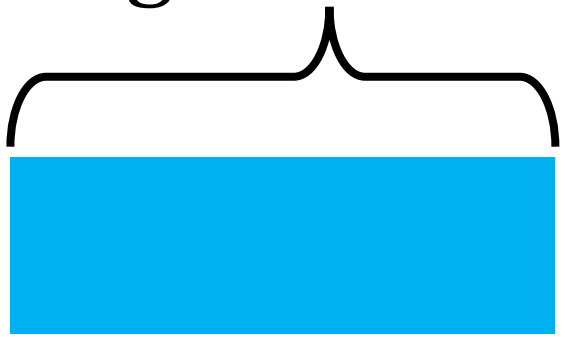


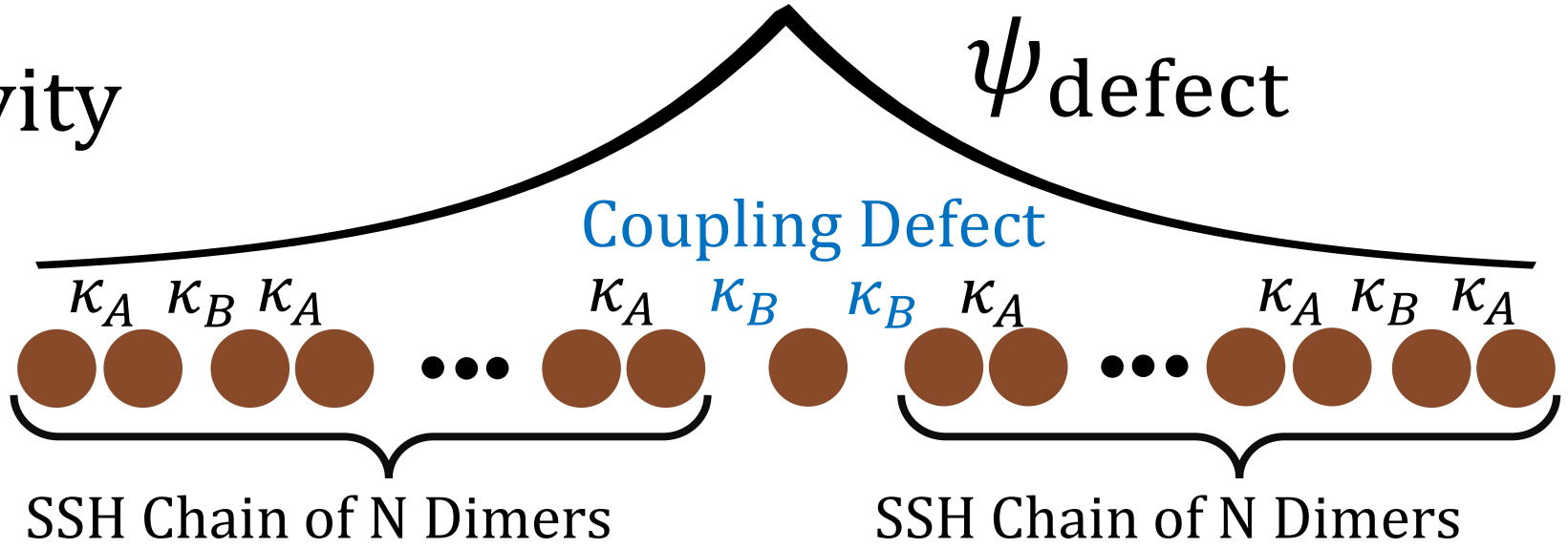




Coupled Defect System

Single Defect Cavity





$$R \sim \nu^{2\mu}$$

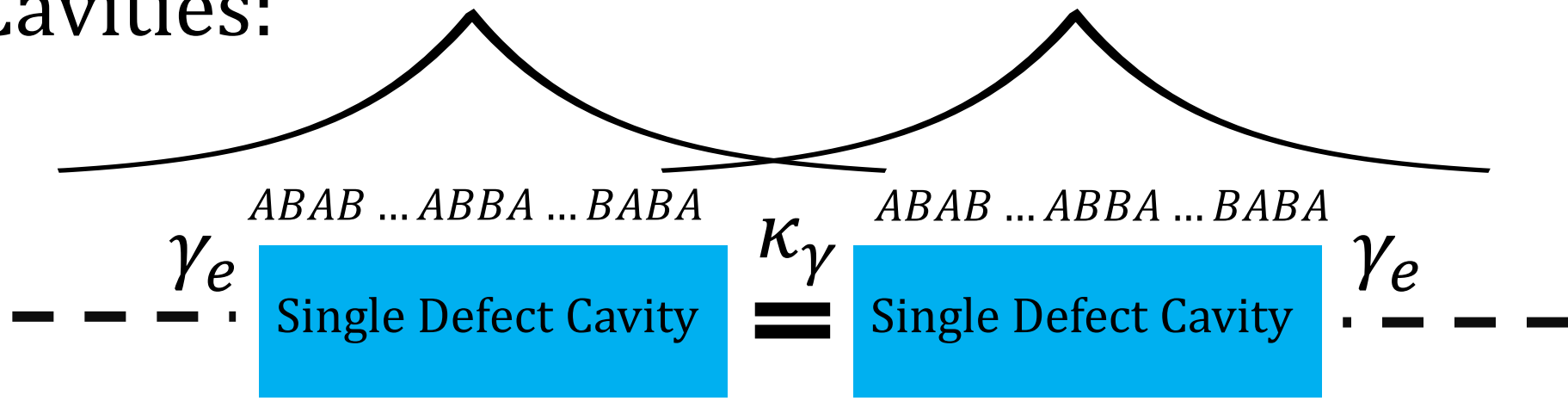
Exponential Field Enhancement

Robustness to Positional Disorder

Symmetry Induced Degeneracies

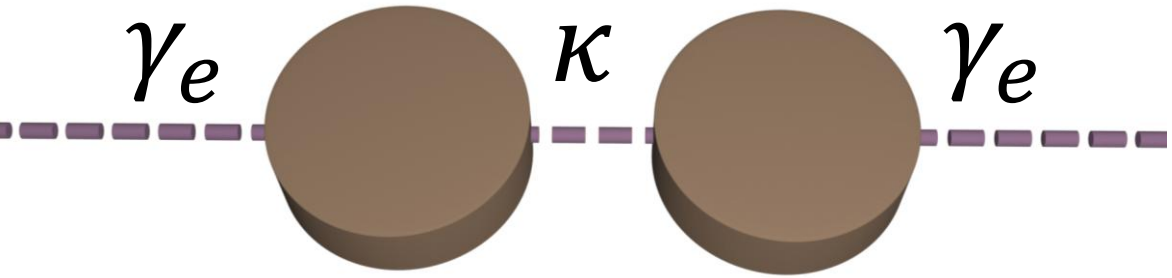
Coupled Defect System

Coupled Defect Cavities:



Analogy with Dimer:

EPD: $\kappa = \gamma_e$



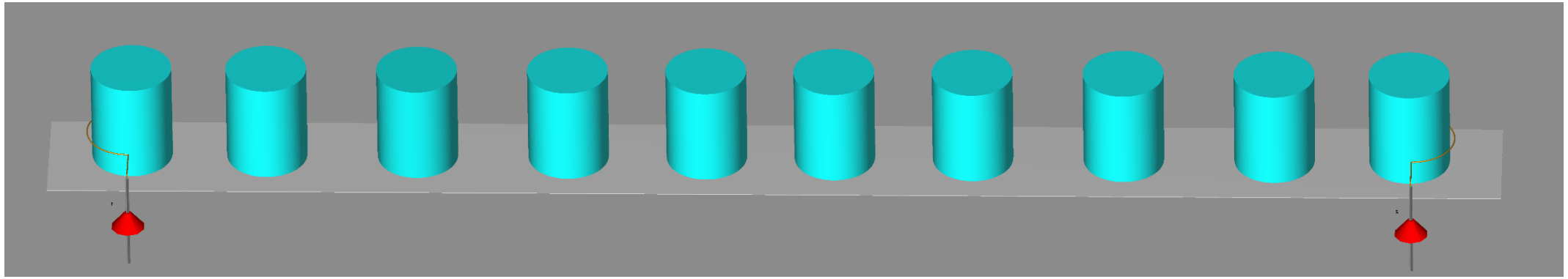
$\mu = 2$ condition:

$$\kappa_\gamma = \gamma_e$$

Simplest Case: $N = 1 \rightarrow L = 10$

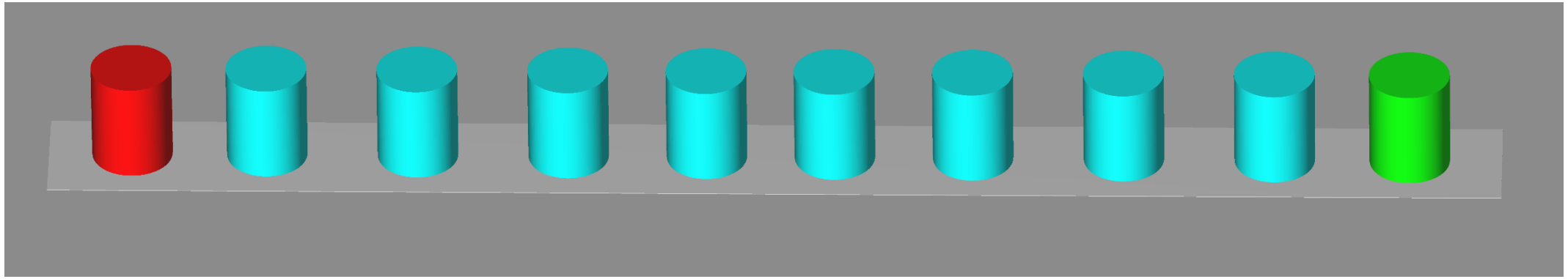
Simulation Results

Simplest Case: $N = 1 \rightarrow L = 10$



Simulation Results

Simplest Case: $N = 1 \rightarrow L = 10$

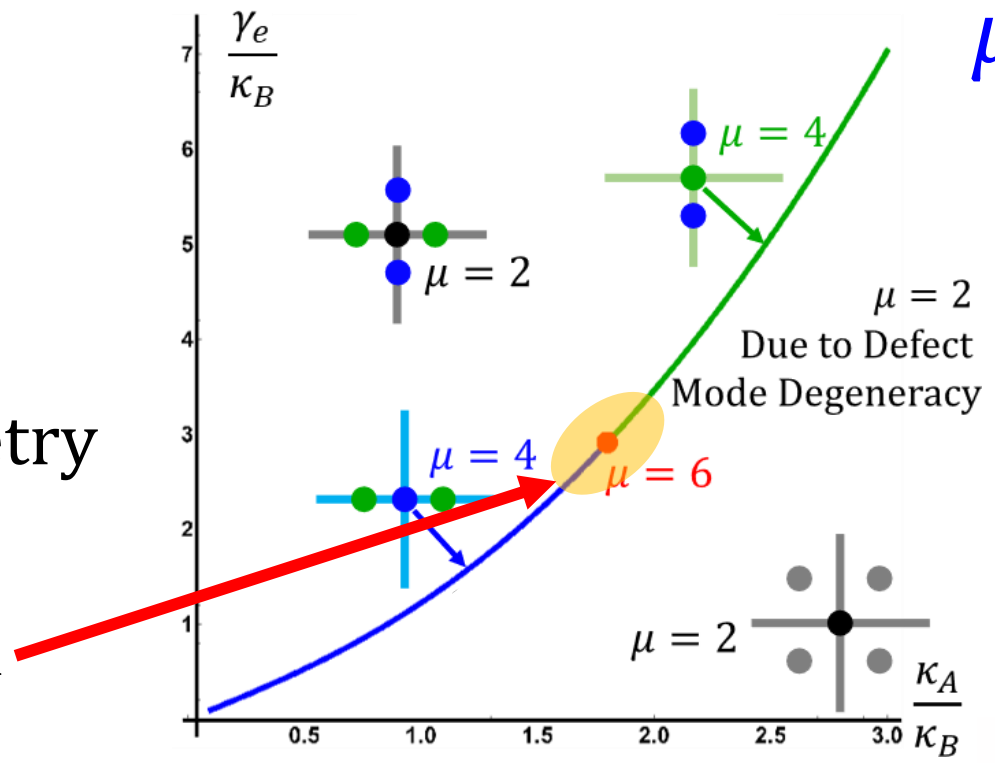


Auxiliary System
Anti-Linear Symmetries

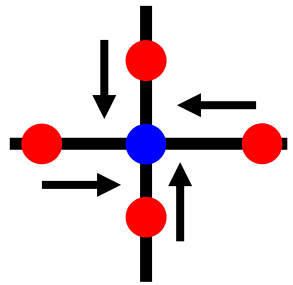
$\mathcal{PT}$-Symmetry

$X\mathcal{T}$ - Anti-Symmetry

Extreme Broadening at
Symmetry Breaking Transition



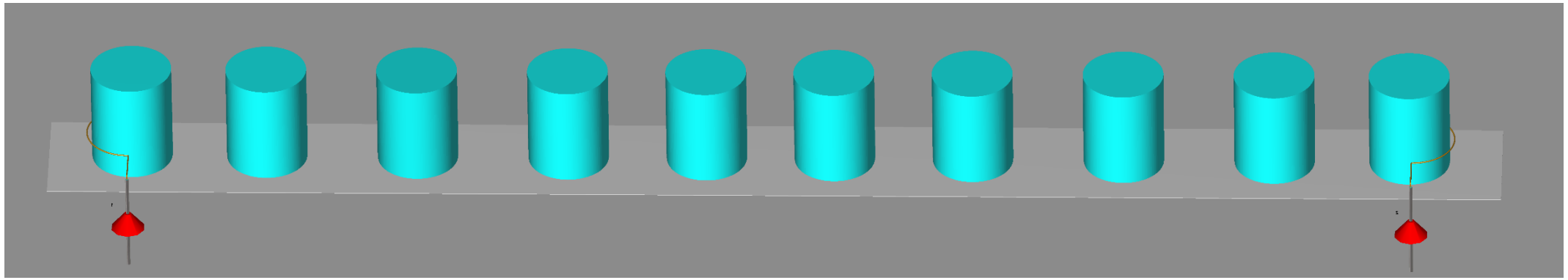
$\mu = 2 \rightarrow 6$

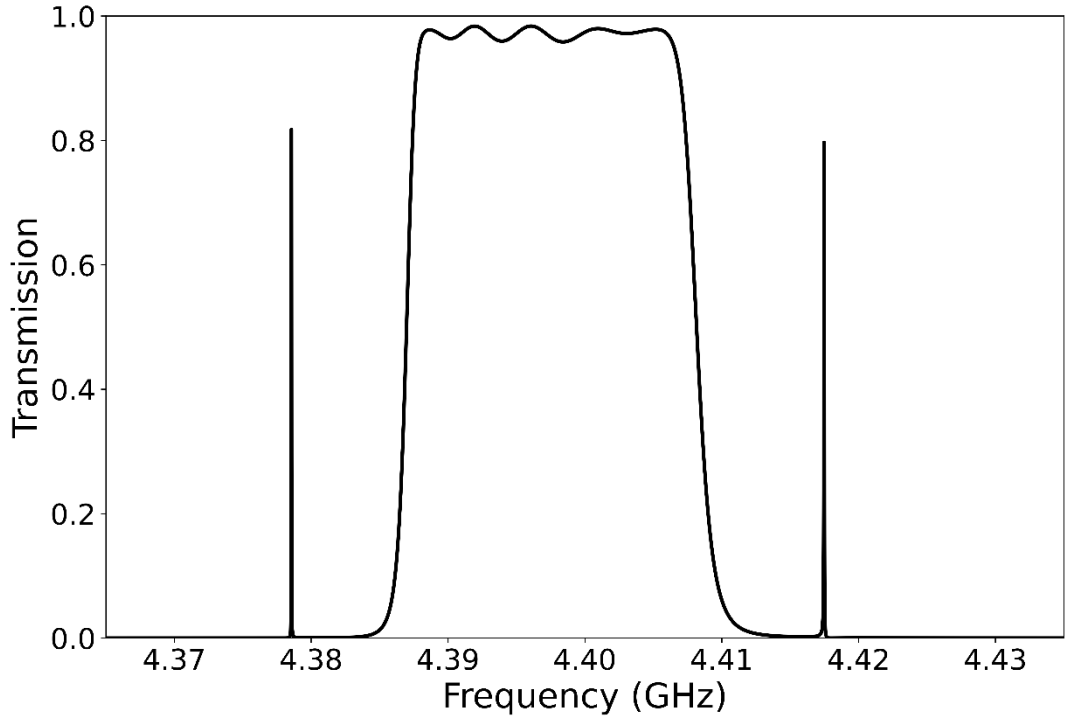


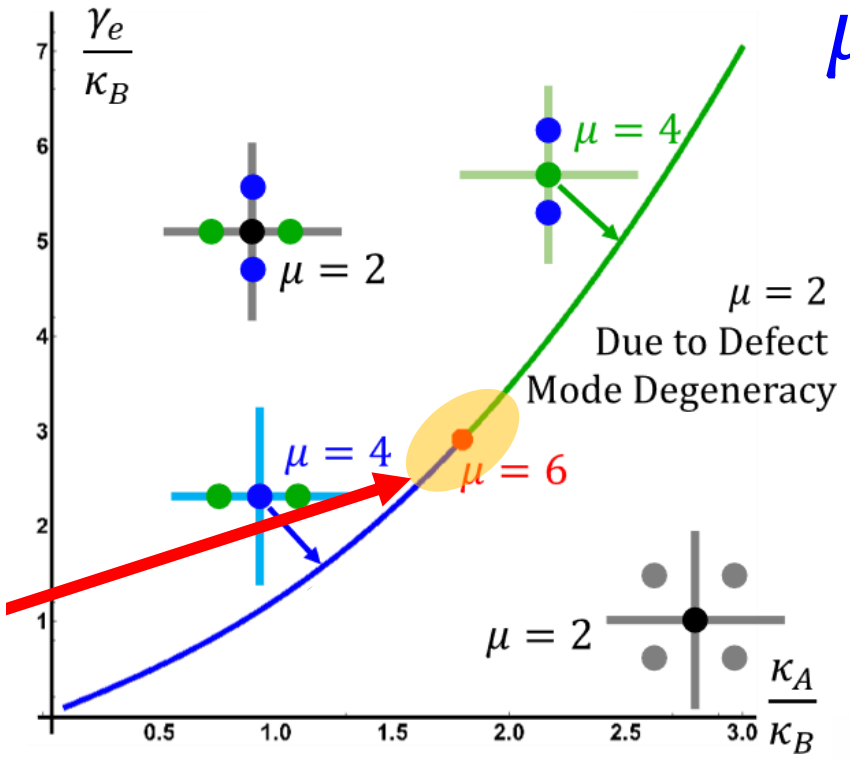
$R \sim \nu^{12}$

Simulation Results

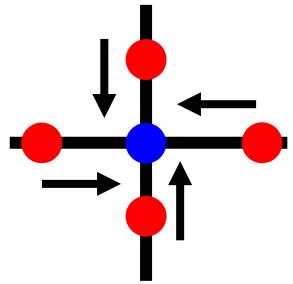
Simplest Case: $N = 1 \rightarrow L = 10$





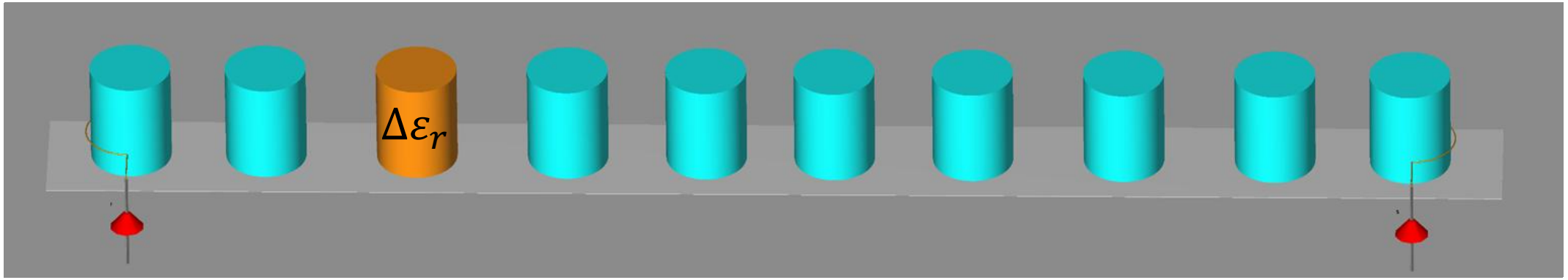


$\mu = 2 \rightarrow 6$

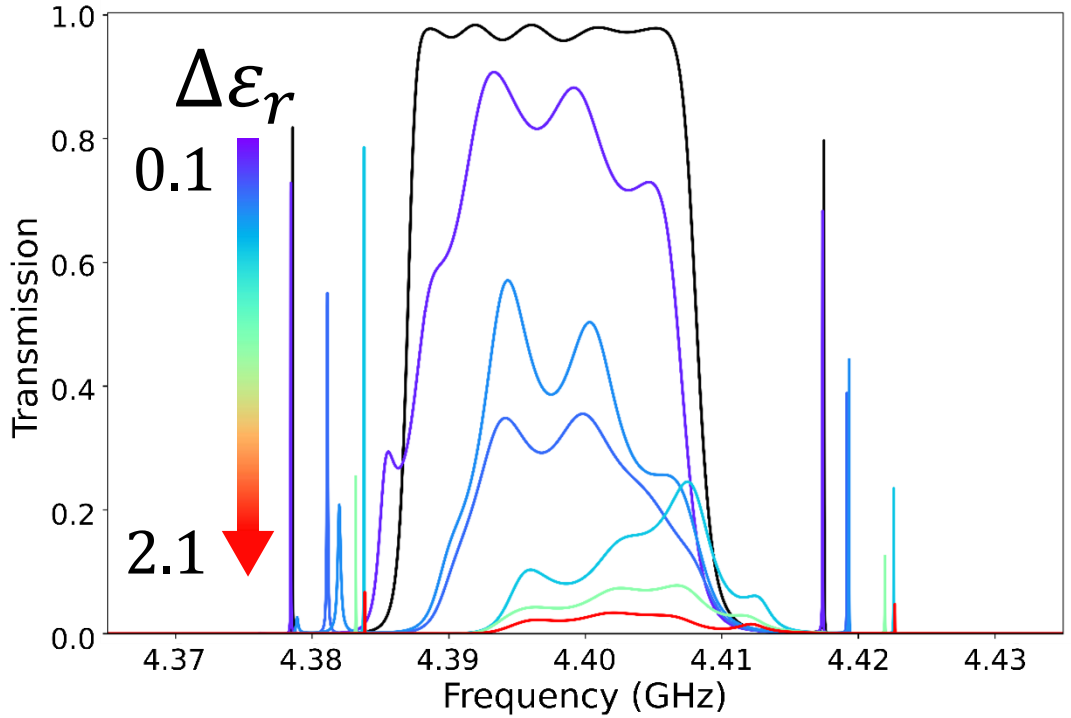


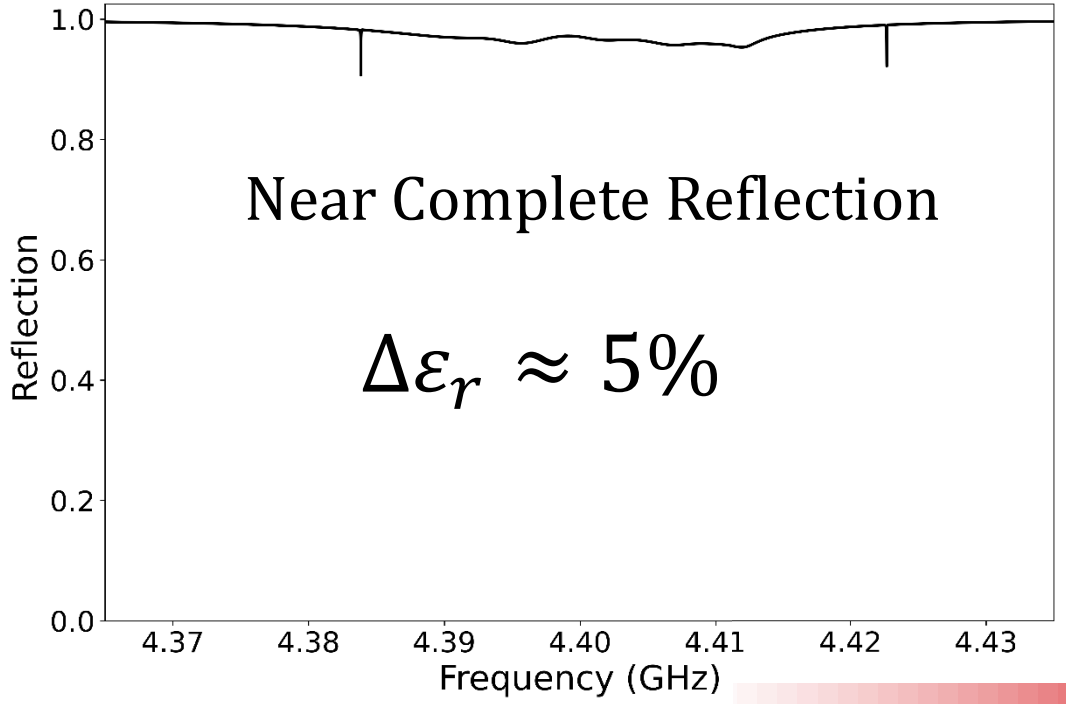
$R \sim \nu^{12}$

In-Situ Symmetry Violation

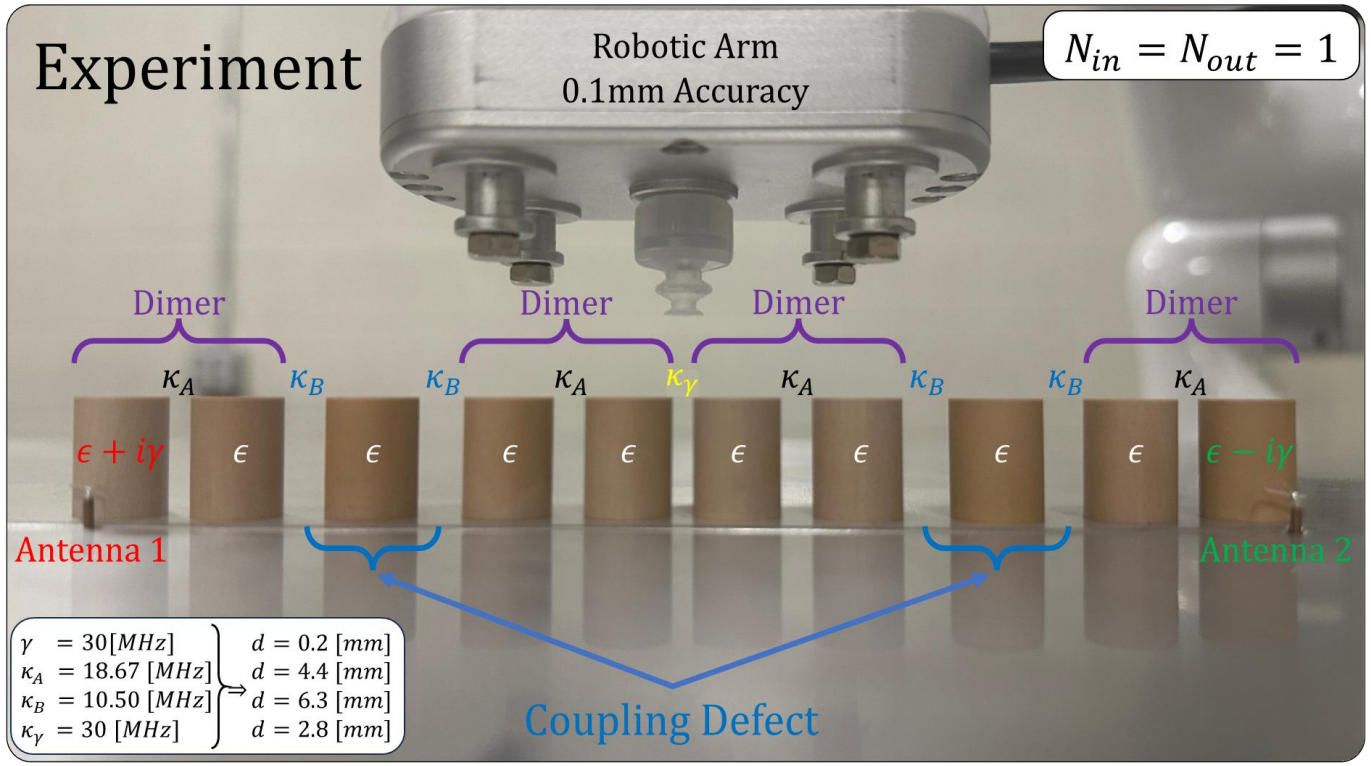


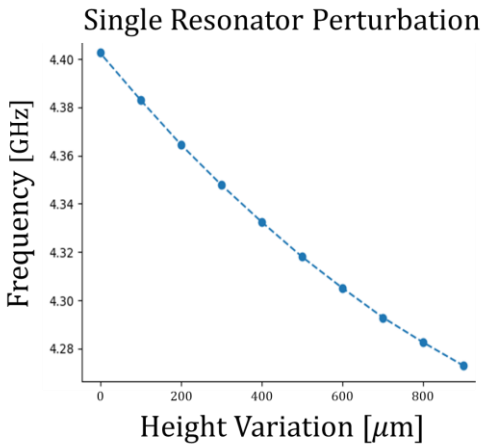
Limiting Action via Symmetry Violation

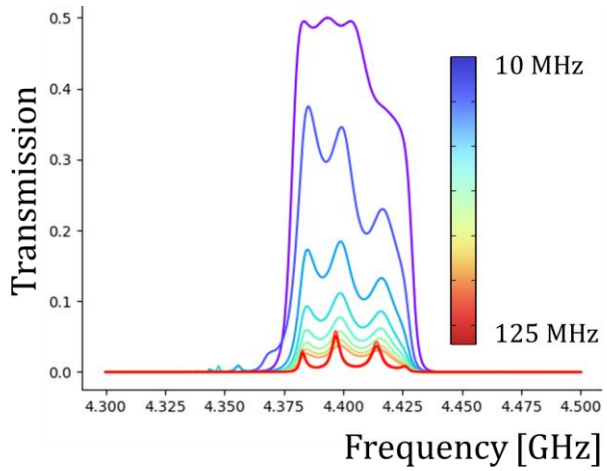




Preliminary Experiment

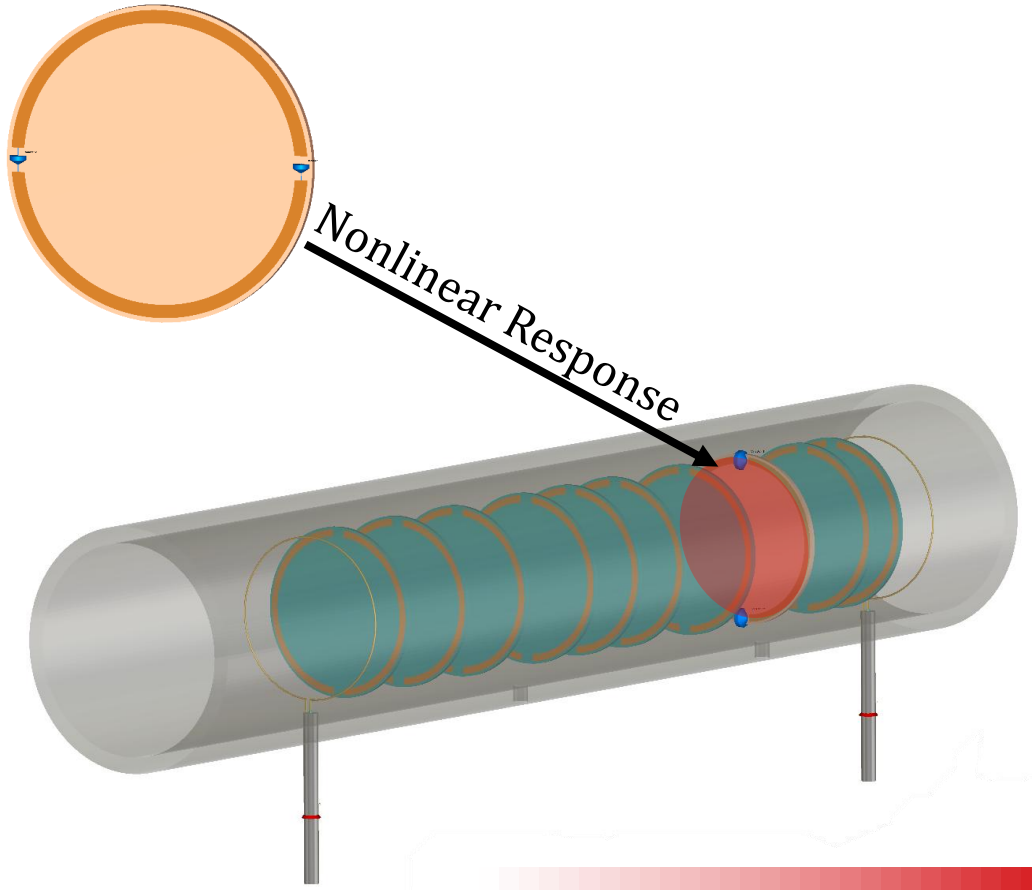






Outlook

Varactor embedded Meta atom for Self-induced Symmetry Violation



Thank you