Superradiance in Non-Weyl Microwave Graphs

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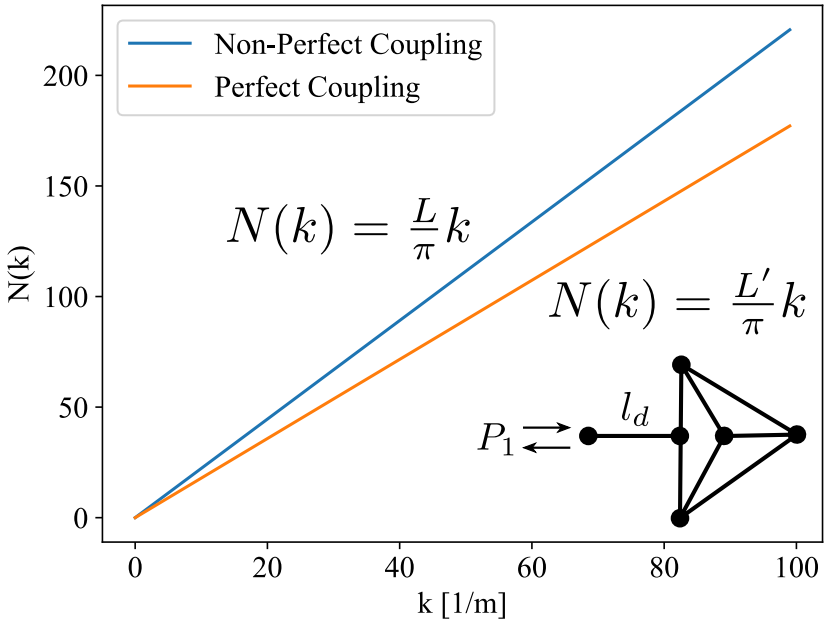
Non-Weyl Graphs

- Counting function or IDOS:
  $N(k) = \frac{L}{\pi}k + const$
  k : wave number
  L : total length of bonds/cables
- Non-Weyl condition : Balanced vertices
  # of internal = # of external connections
  Neumann boundary conditions
- Using a 4 vertex experimentally done by Lawniczak, Lipovský, Sirko, PRL 122, 140503 (2019)
- Problem how to be sure to find all resonances



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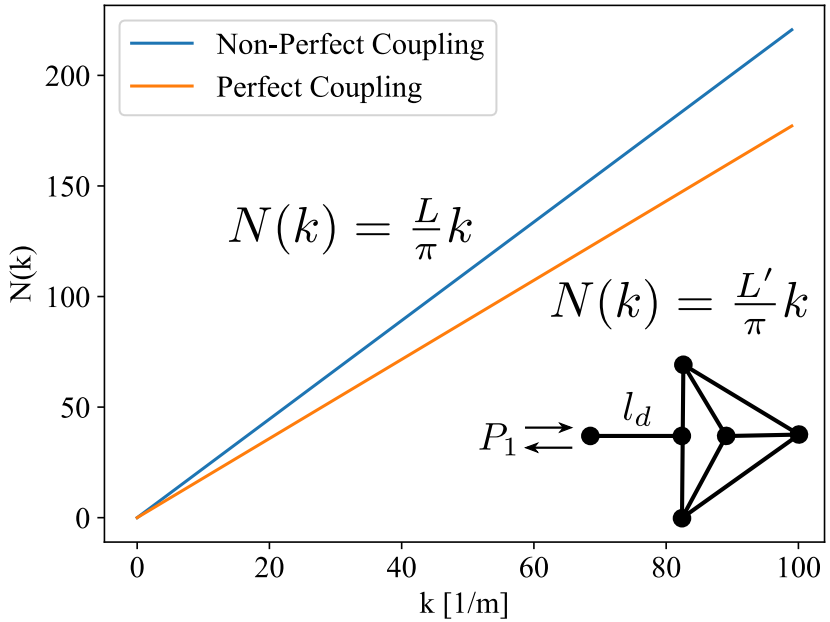
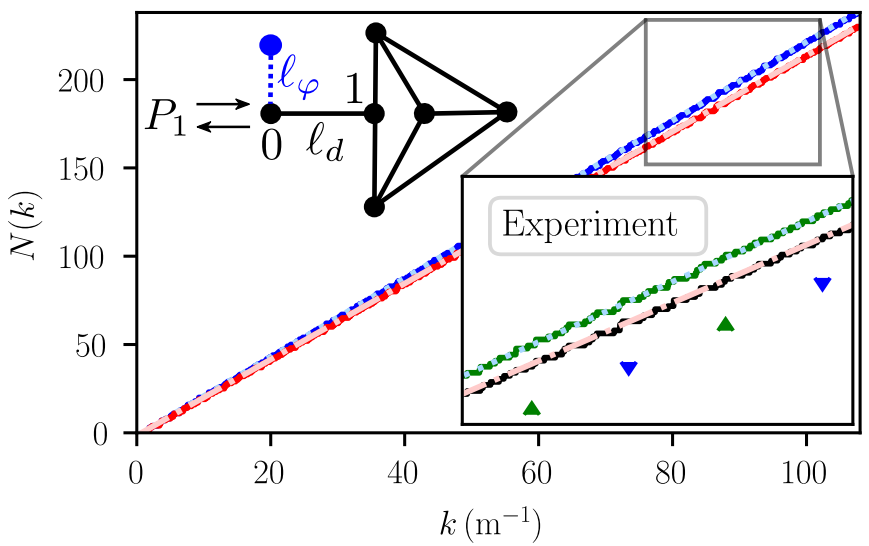
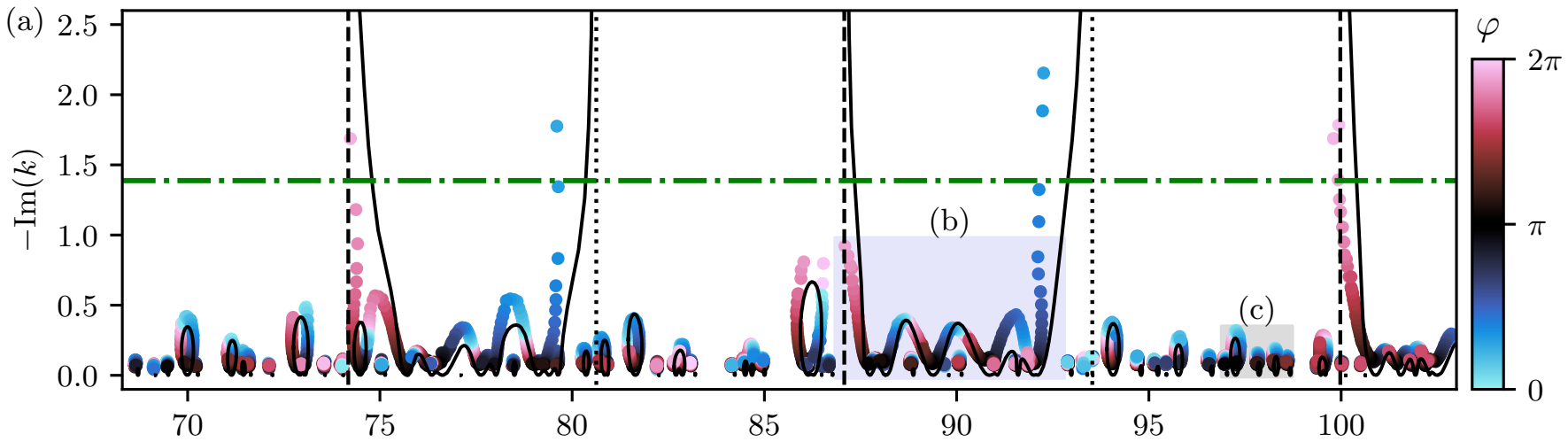
- Idea: see resonances vanishing parametrically
- Problem: Need broad band coupling variation
- Idea: Add bond with phase variation
  Varies BC condition
- Inset: experimental data
- In this range all resonances could be extracted
  (remark just outside two are missing)
- Parametric dependence on coupling
  Triangles: "resonances with infinite width"
  leading to the difference in slopes





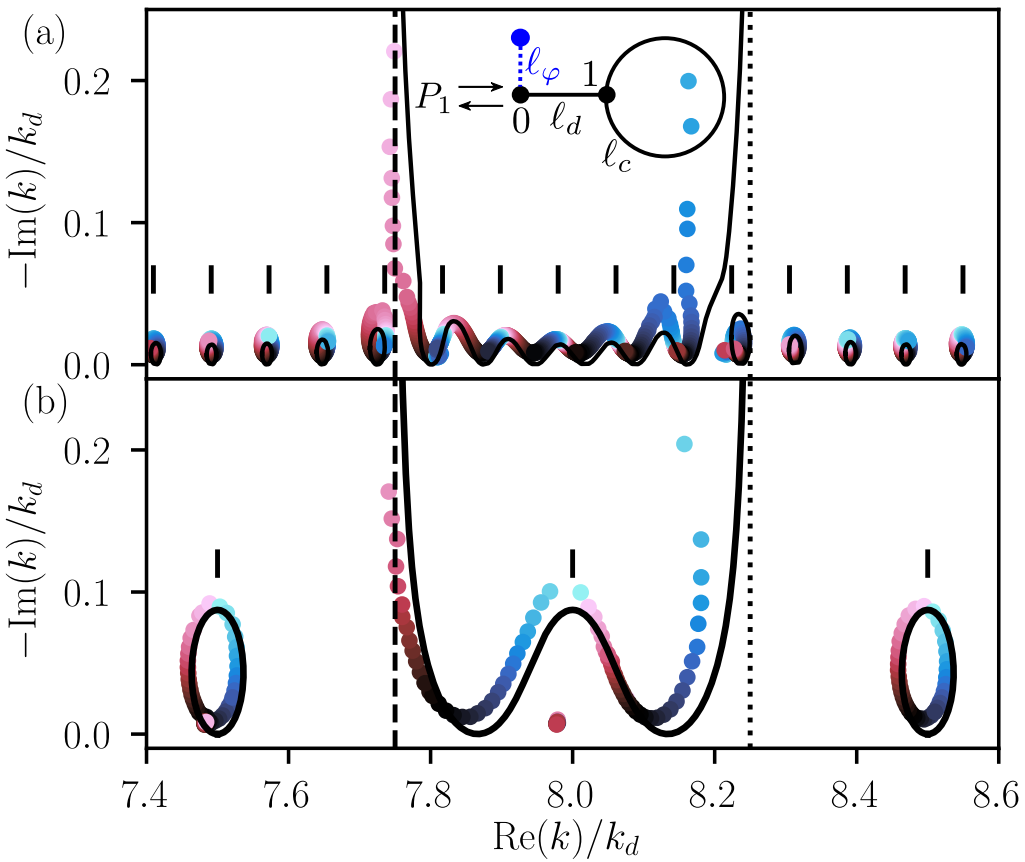
Resonances as a function of Coupling and Boundary Condition



- Circles extracted resonances from experiment
  Color indicates BC condition
- At $\varphi = 0$ and 2π infinite resonance width $\Rightarrow$ Non-Weyl
- Broad resonances are superradiant
- Dashed line: $(n + 1/4)k_d$ where $k_d = \pi/\ell_d$
- Dotted line: $(n + 3/4)k_d$
- Solid line numerics without absorption
- Non-Weyl shows up experimentally already for $\varphi \approx 0$ or π

Toy Model Lasso Graphs

- Upper: Lasso length similar to Tetrahedron
- Similar global structure found
- Analytic solution by solving transcendental equation (solid line)
- (bottom) $\ell_c = 4\ell_d$
- Even simpler theoretical description



- Structure and superradiant states still present (dotted or dashed lines)
- Bound states in the "continuum" (vertical solid lines)
- Both are missing in the scattering

For details see Poster and thank you for your attention