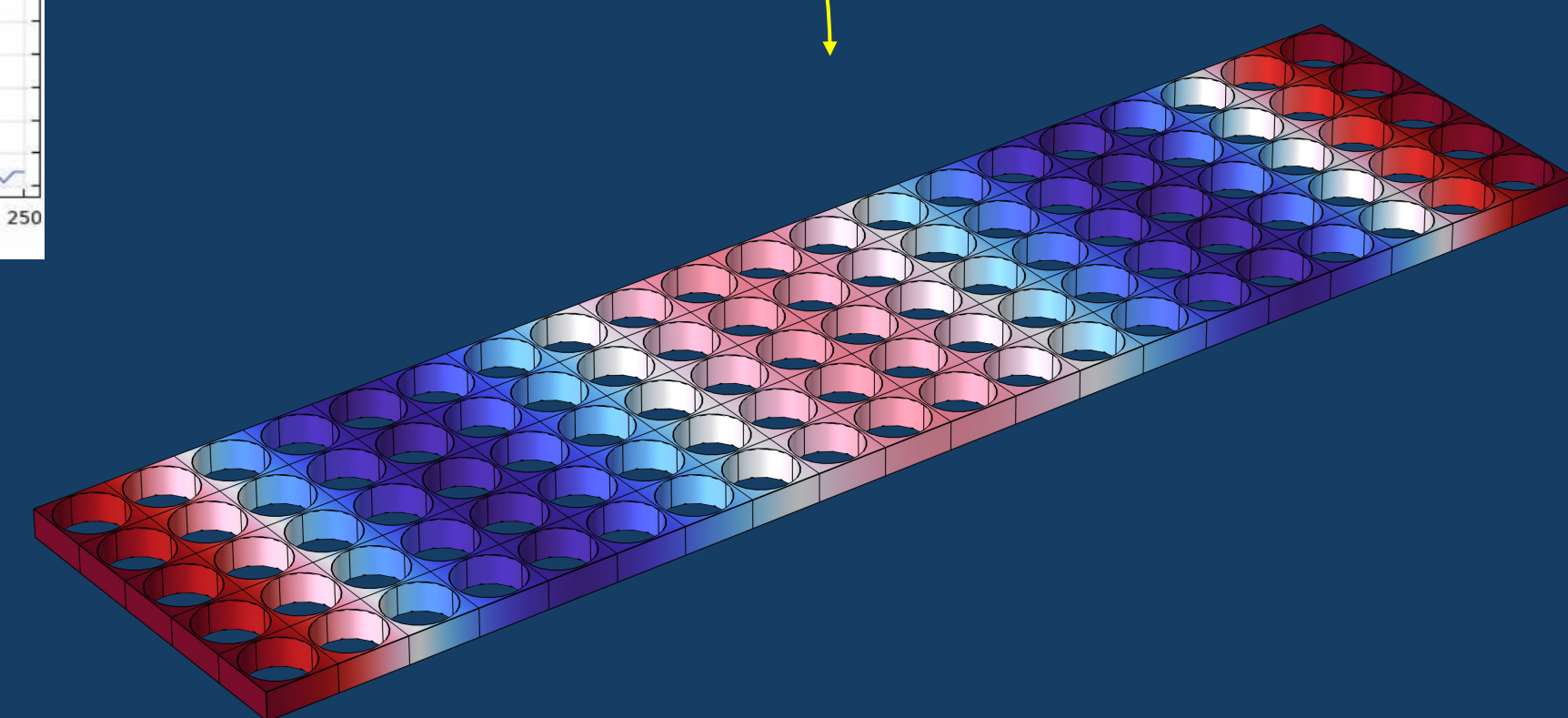
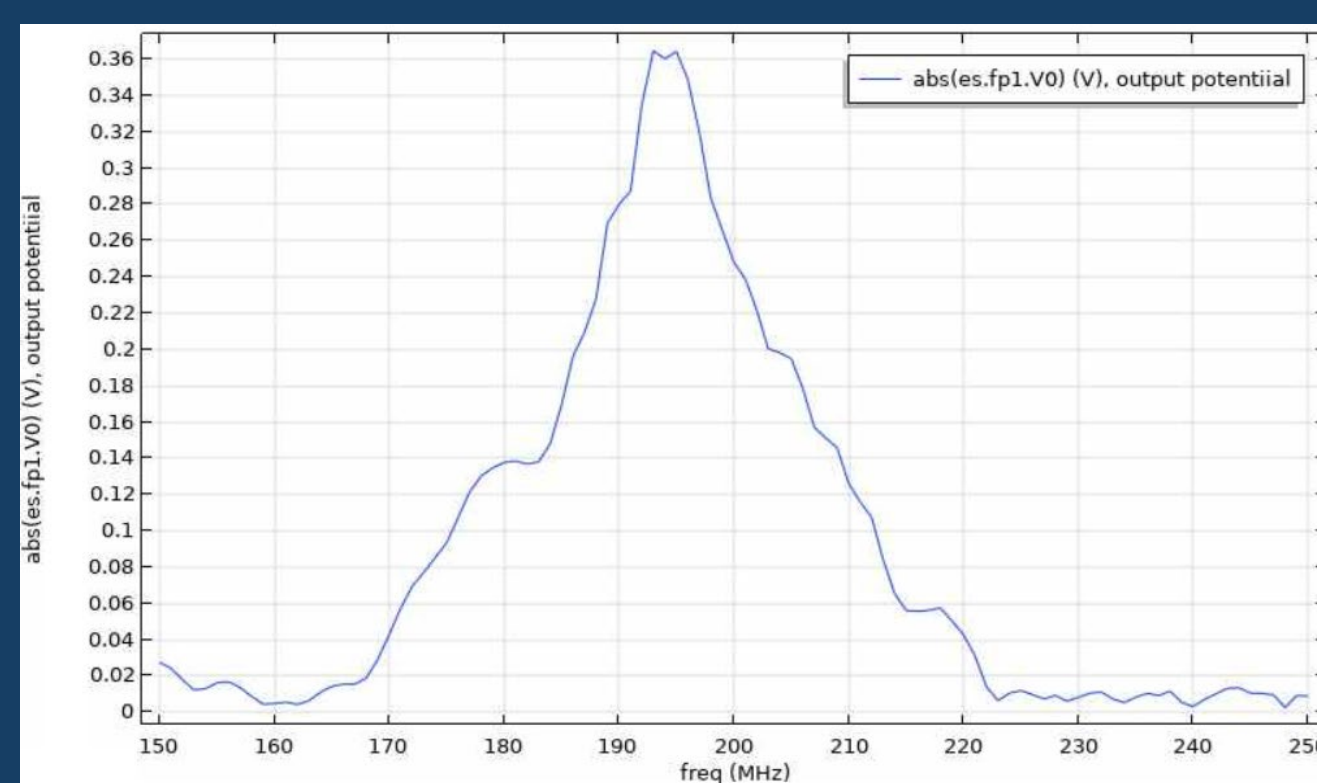
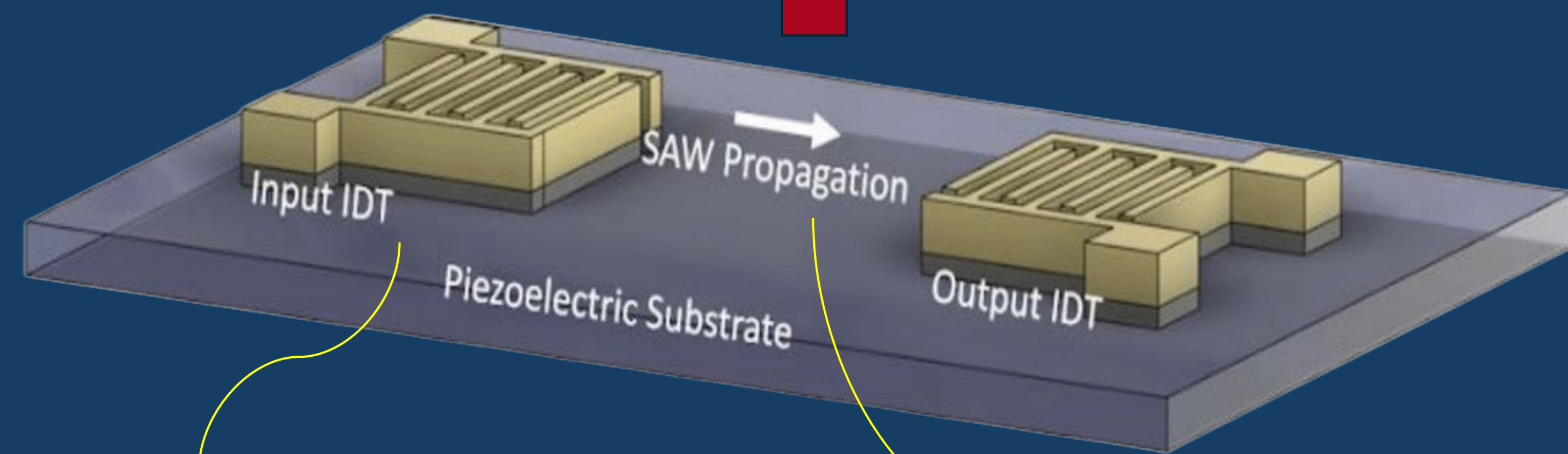
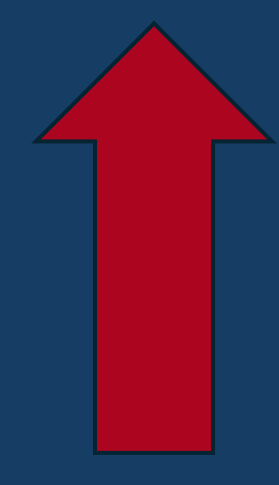


Modeling and Validation of Phononic Crystals for Next-Gen Wireless Tech



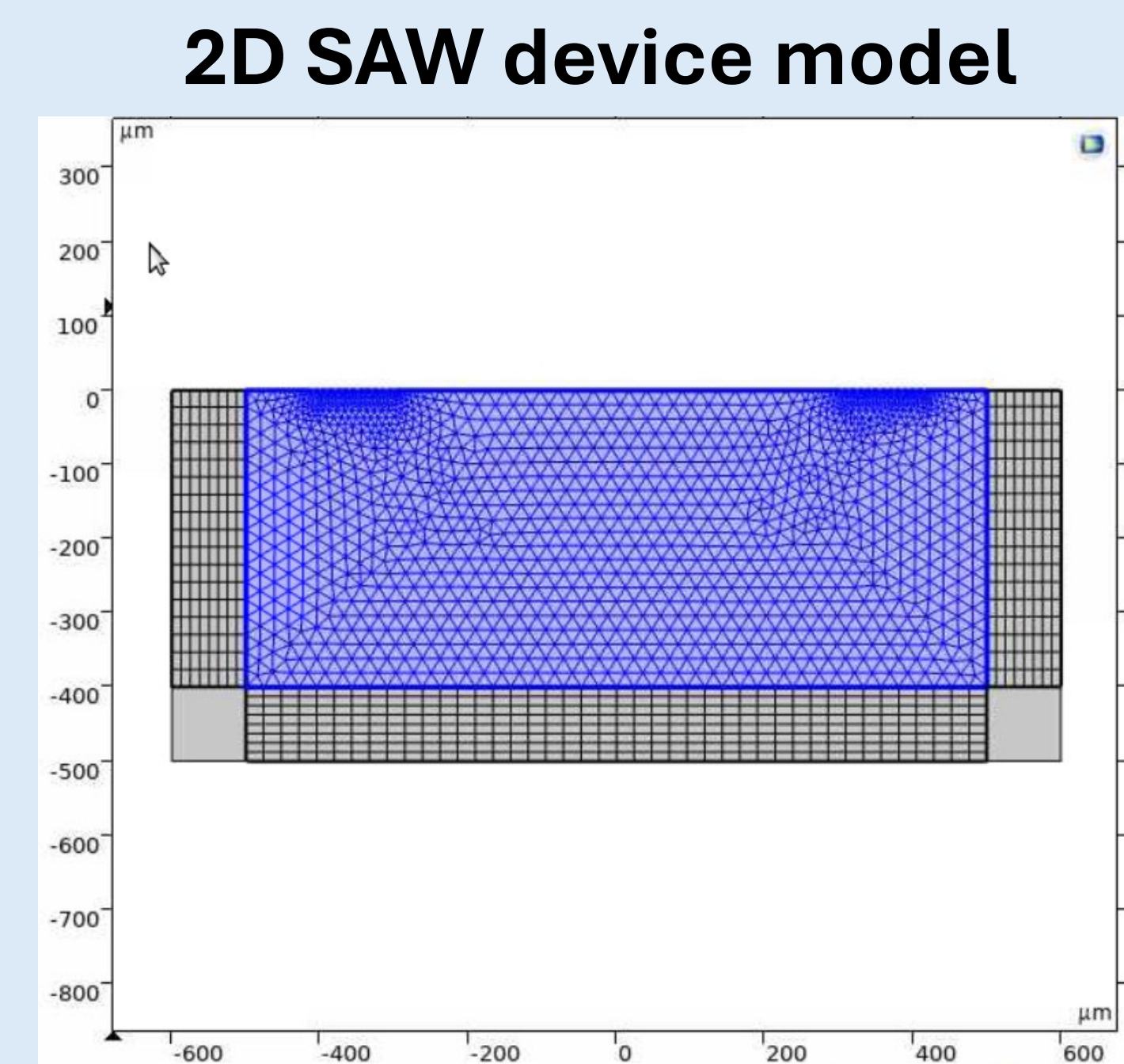
Background

- Improves surface acoustic wave (SAW) devices used in wireless technologies by integrating **phononic crystals (PnCs)** that control sound waves and adding additional **interdigitated transducer (IDT)**
- Enhance signal filtering, reduce power consumption, and enable tunable operation
- Supports clearer signals, longer battery life, and future wireless systems like 6G

Goals & Motivation

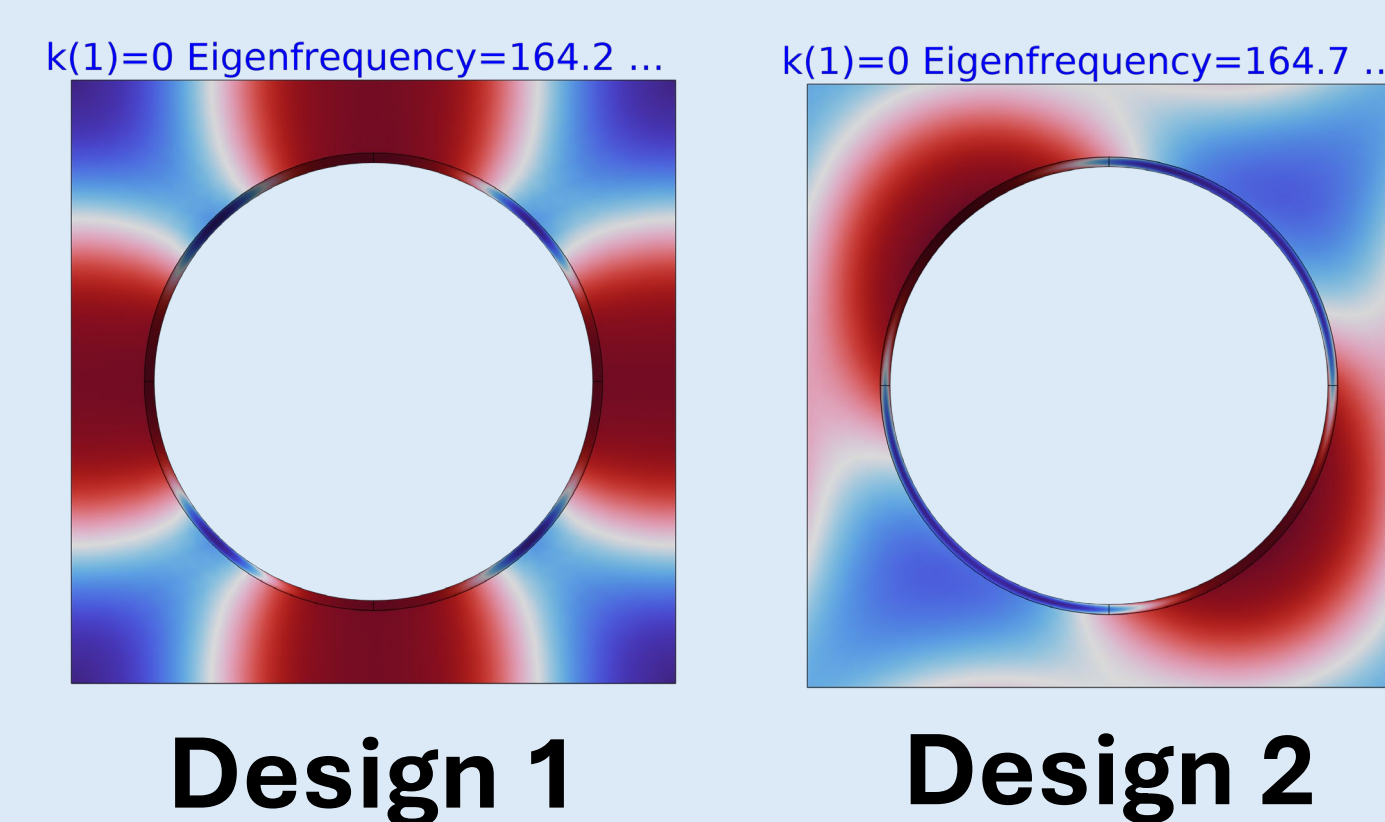
- Demonstrate the **tunability of PnCs** and their bandgap
- Design a PnC lattice that can isolate and **guide sound waves** around 195 MHz
- Integrate the PnCs into SAW device to simulate a waveguide
- Explore impact of number of IDTs on **wave propagation**

Modeling



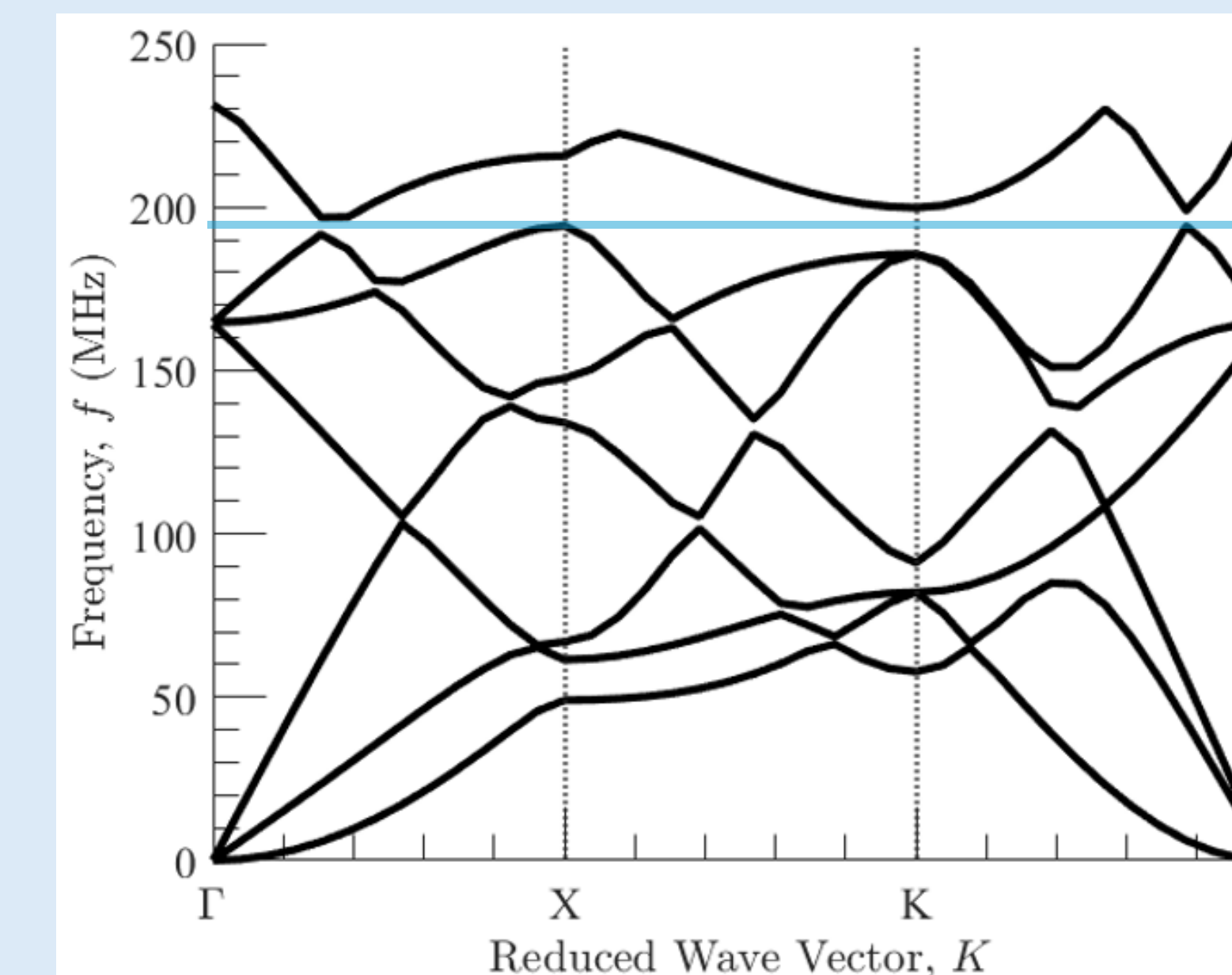
- Preprocessing**
- Geometry creation
 - Material assignment
 - Physics selection
 - Boundary condition
 - Meshing

Parameter	Design 1	Design 2
Lattice Constant a	12 μm (1.2×10^{-5} m)	10 μm (1×10^{-5} m)
Hole Radius r	4.55 μm (4.55×10^{-6} m)	4.75 μm (4.75×10^{-6} m)
Unit Cell Thickness d	4 μm (4×10^{-6} m)	4 μm (4×10^{-6} m)

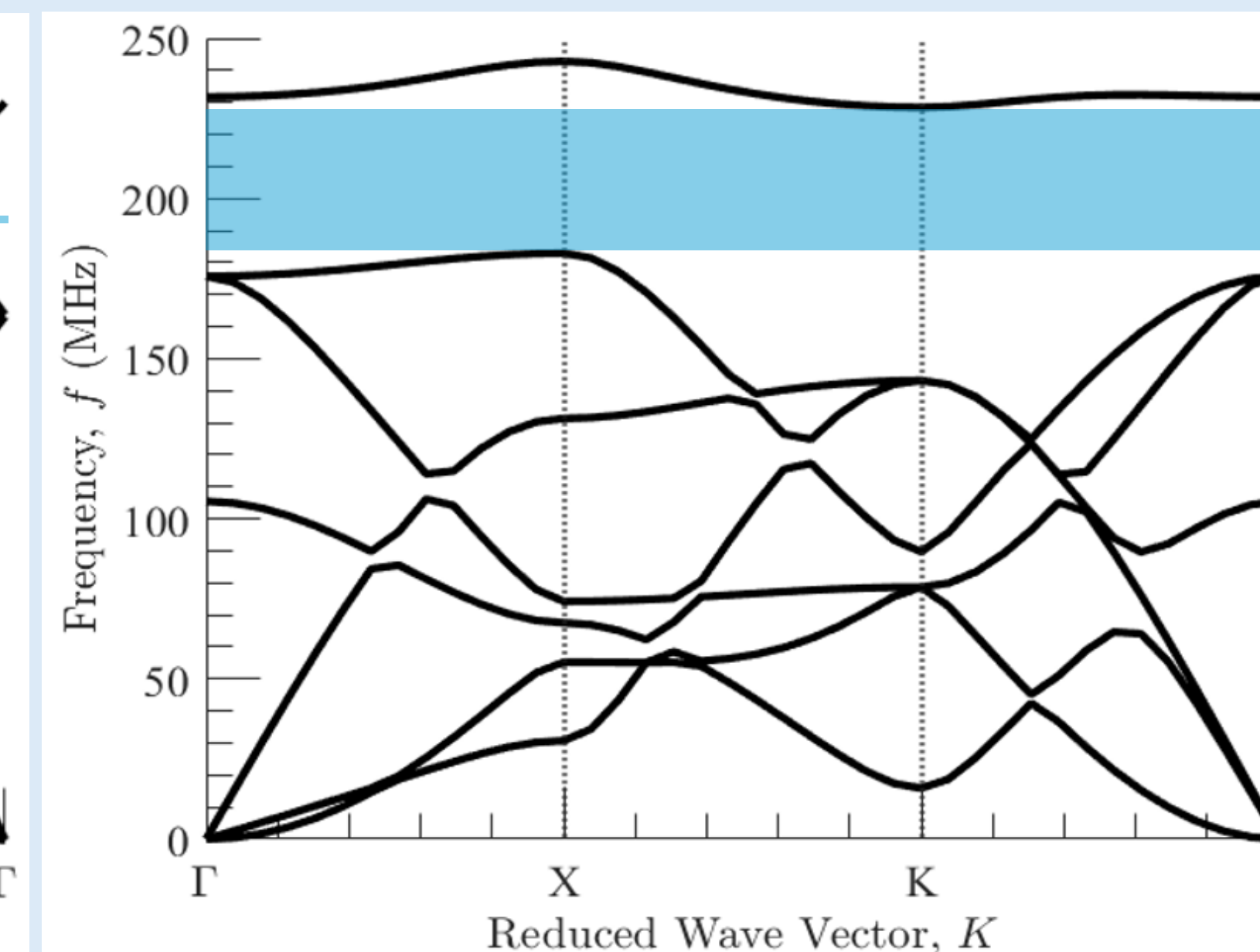


- Postprocessing**
- Derived results
 - Surface fields, line graphs, tables, etc.
 - Animations

Results

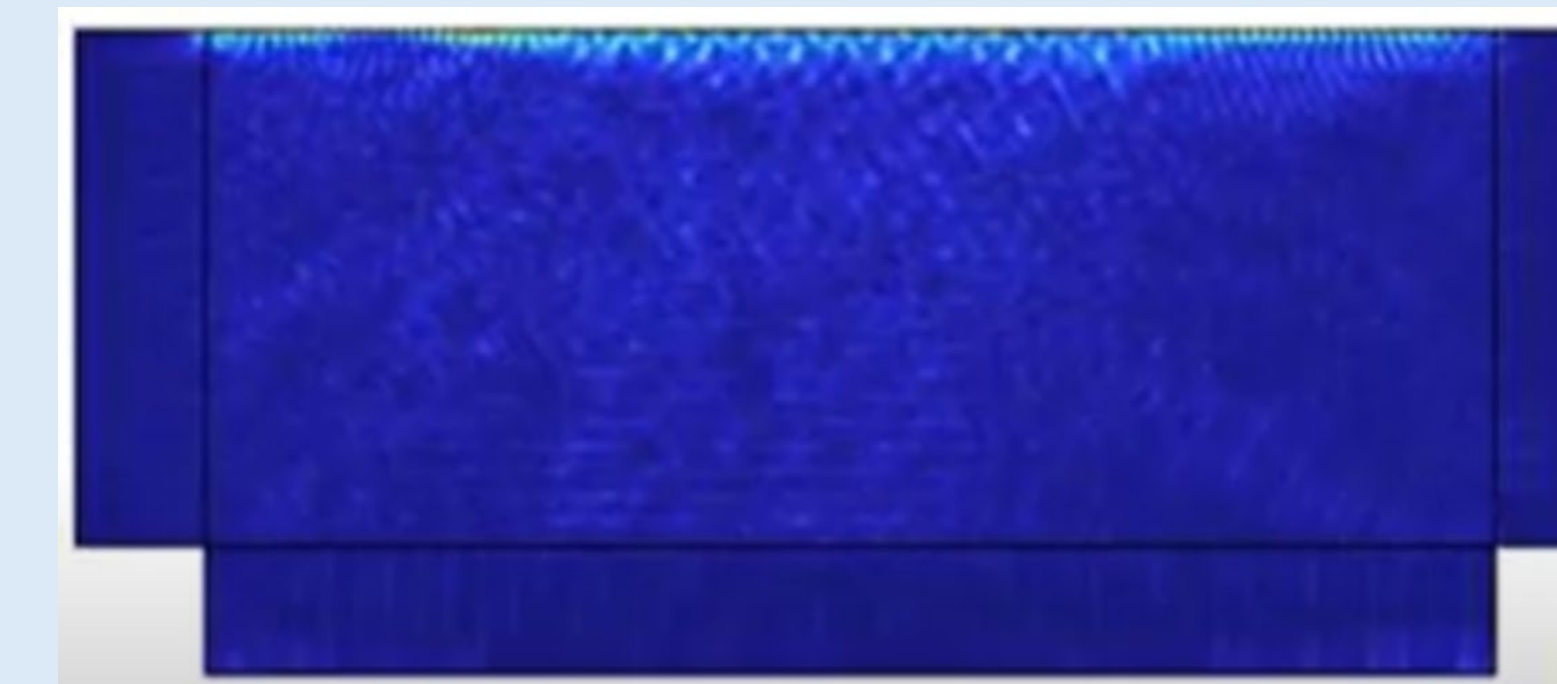


Bandgap graph (small frequency gap) for design 1 with $r/a = 0.379$



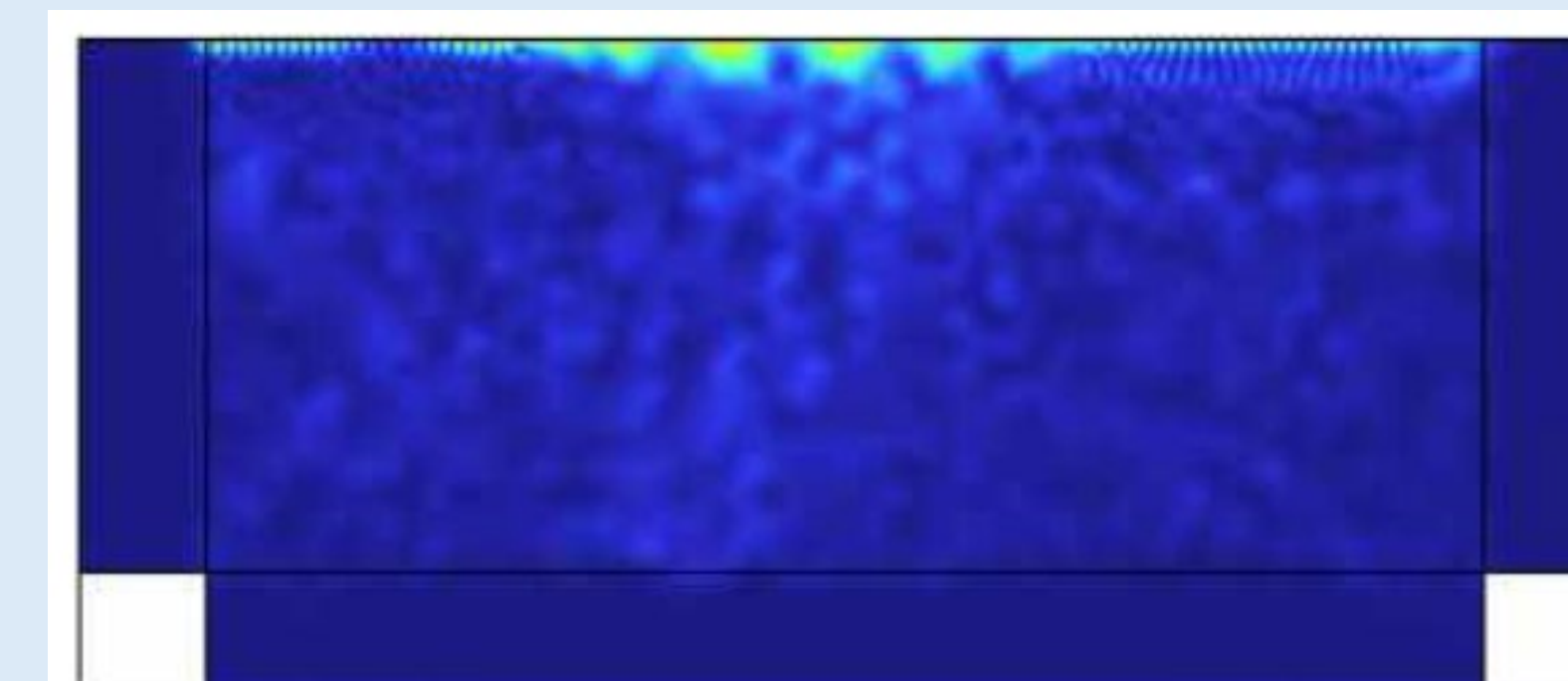
Bandgap graph (big frequency gap) for design 2 with $r/a = 0.475$

SAW Device - 12 finger IDT



Propagation of sound waves in delay line of SAW device at 195 MHz for 12 finger IDT

SAW Device - 20 finger IDT



Propagation of sound waves in delay line of SAW device at 195 MHz for 20 finger IDT

Discussion

- More IDTs result in **smoother output potential**
- Can **control sound frequencies** that propagate through device by **engineering bandgap**
- A bigger bandgap is efficient because it **blocks frequencies** from transmitting

Future Work & Societal Impact

- Explore **advanced geometries**, sizes, materials
- Integrate into SAW device
- Explore IDT fingers & spacing
- More **efficient electronics**, improved sensing, advanced computing
- Reach **6G telecommunications**

