# On the use of Genetic Algorithm to Design and Optimize Graphene-based Absorbers

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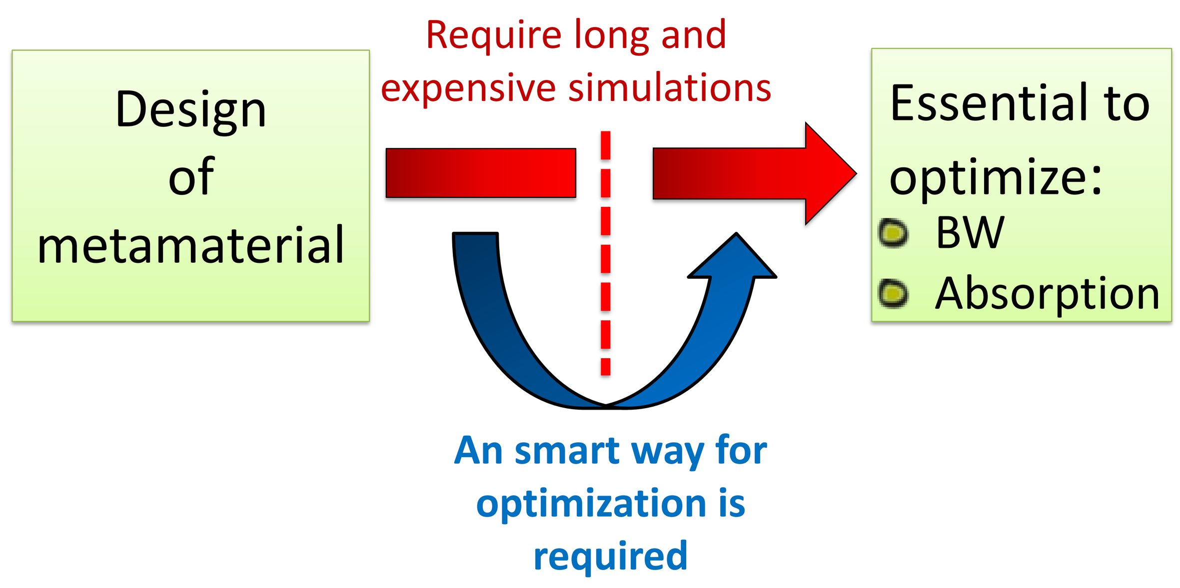
## I. Introduction

### Motivation

- Absorbers are widely used in diverse applications such as antenna pattern shaping, stealth technology and mid-infrared converters.
- Enabled by graphene's electrical tunability, THz absorbers have also been developed.
- Most designs are limited to concept proofs and, as we will see, are not ultimately optimized.
- Reaching high band width (BW) is difficult as metamaterials are intrinsically narrowband structures.

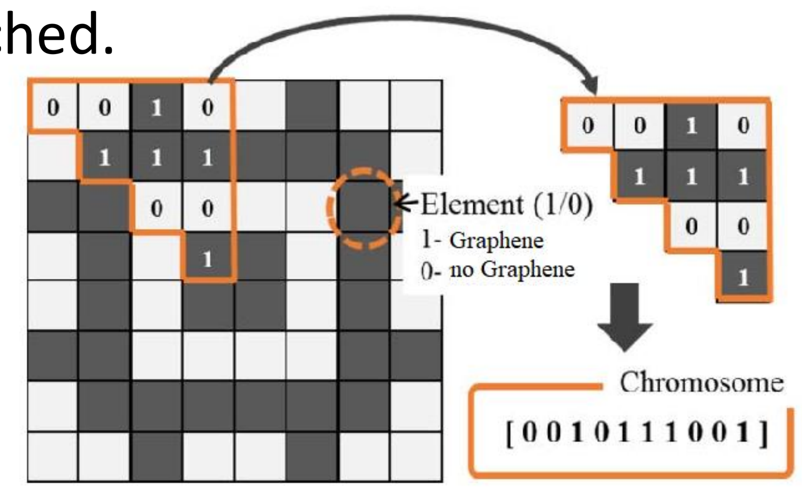
### Problem and solution




- In this communication, we propose the use of Genetic Algorithm (GA) to find optimal topologies for metamaterial-like absorbers with graphene-based unit cells.

### Genetic Algorithm

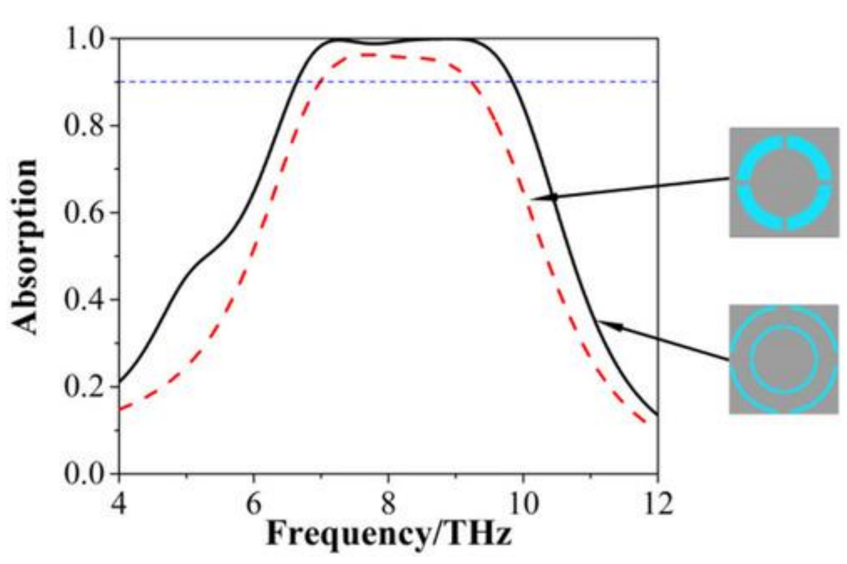
- The idea is to break down the unit cell into a matrix of pixels.
- Use the GA to iteratively improve the topology.
- The GA is coupled to a full-wave solver to evaluate the absorption BW and the topology evolves until an optimal solution is reached.




## II. Optimization case

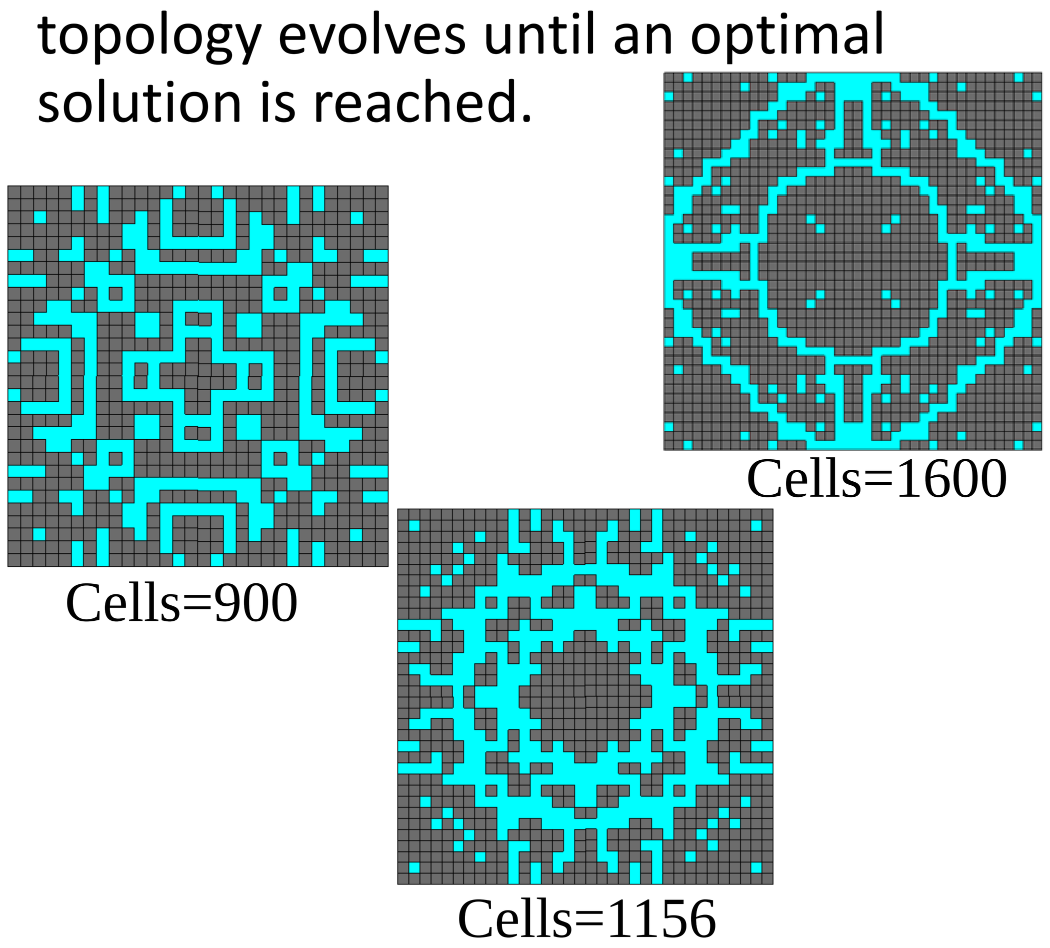
### Initializing

- We take an example and maintain its chemical potential, relaxation time and dimensions.



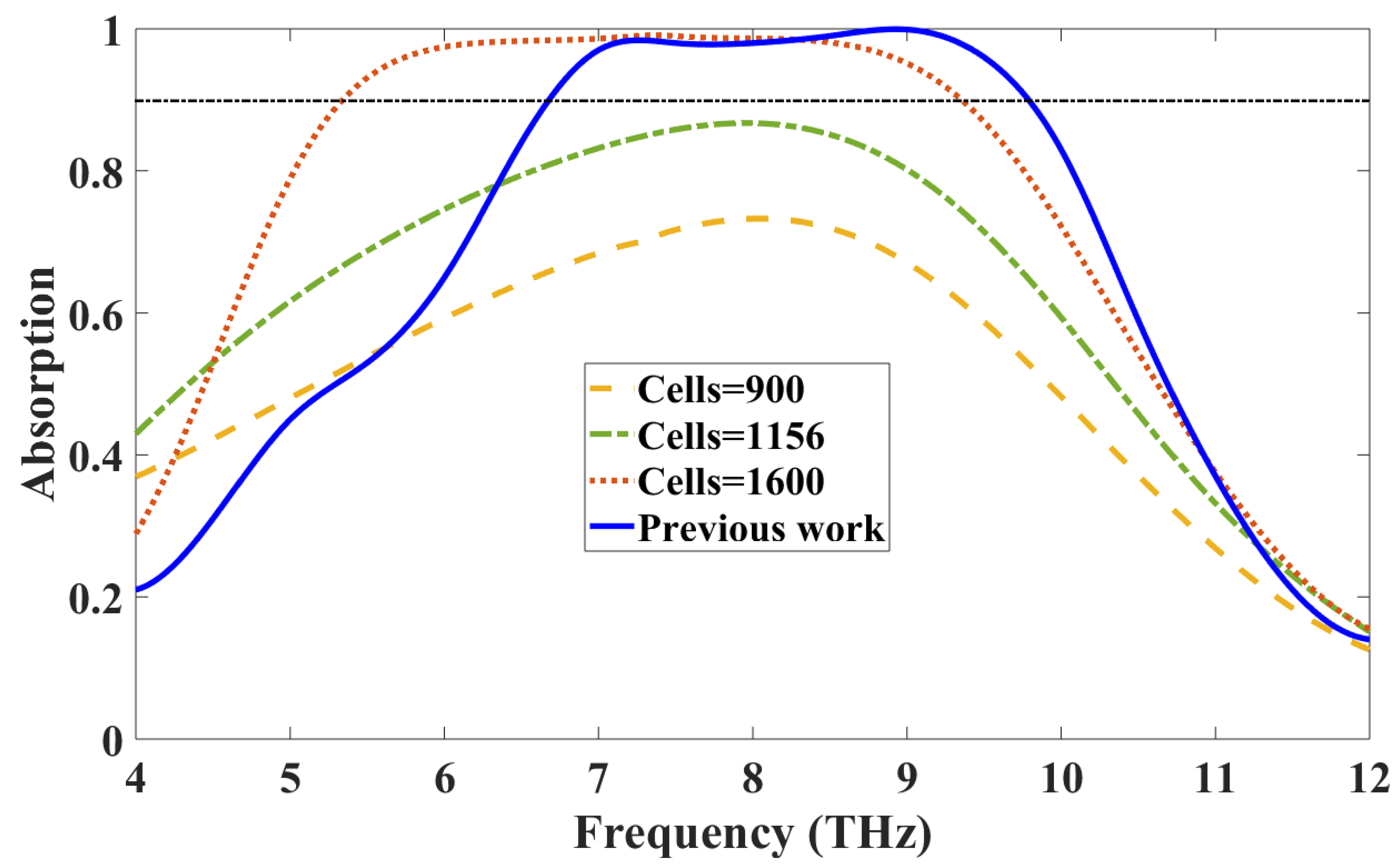

### Run the iterations

- The GA is coupled to a full-wave solver to evaluate the absorption BW and the topology evolves until an optimal solution is reached.




### Increase the number of cells

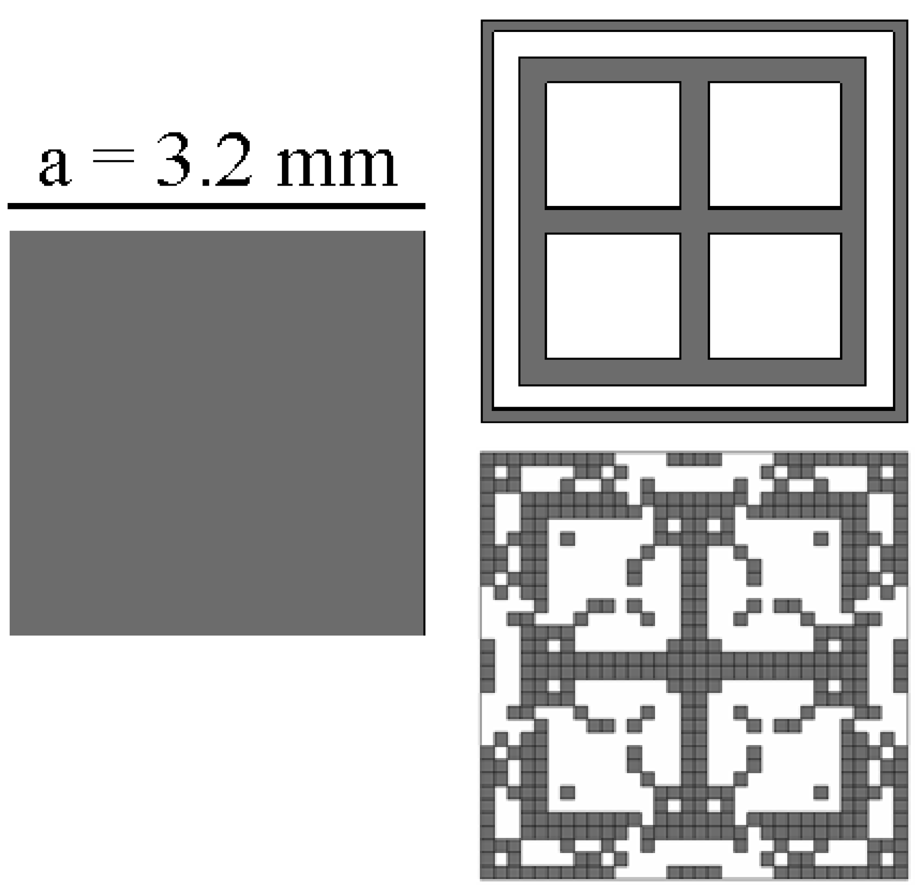
- In the near field region of the transmitting antenna, the prior equations do not hold.




## III. Design case

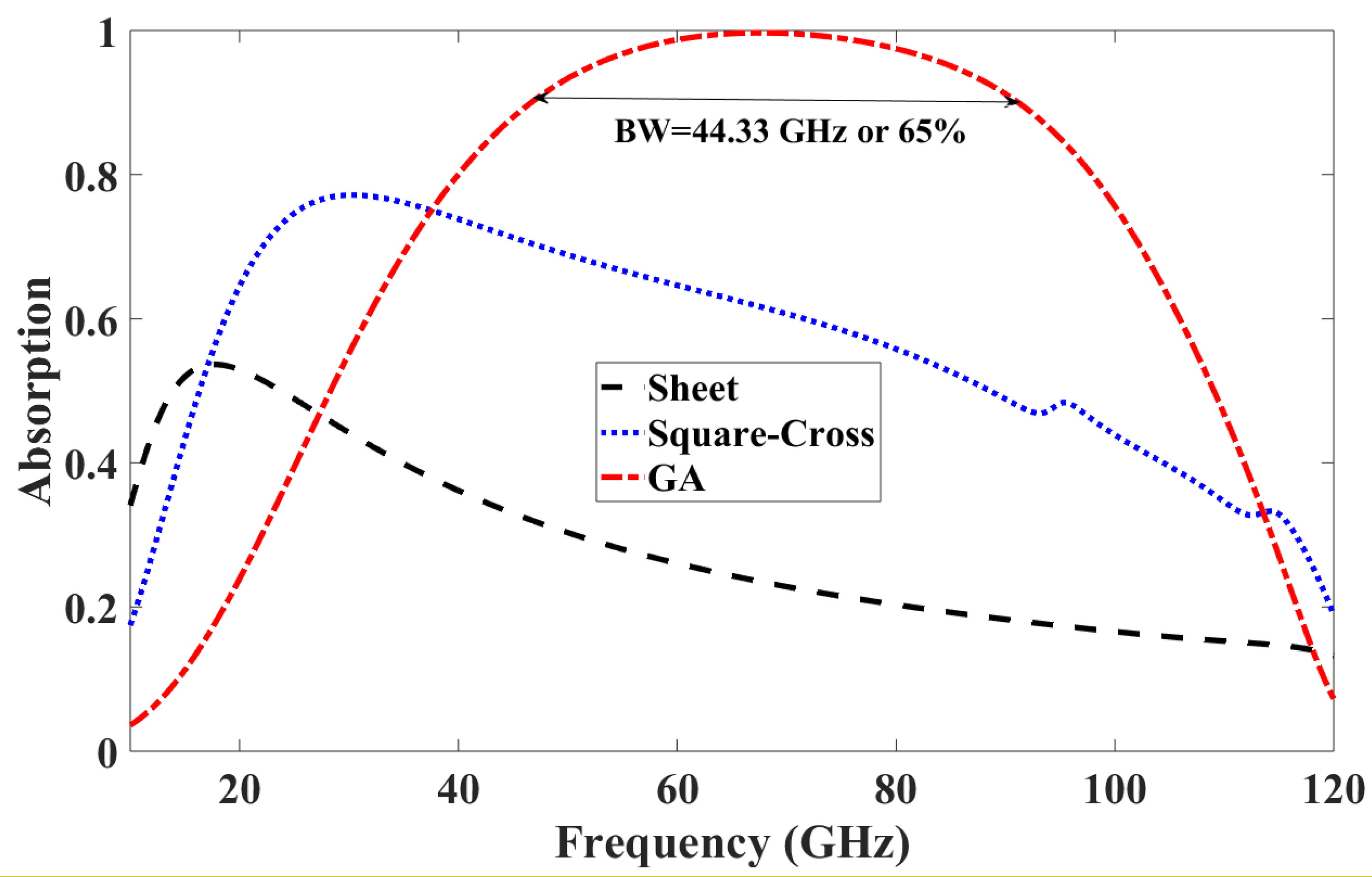
### Start from blank

- Lossless substrate (e.g. air) to model the worst-case scenario




### Result

- Even in such adverse conditions, our method achieves a BW of 65%.




### Conclusion

- Executable for designing of any metamaterials.
- Getting advantage of tunable materials for the control of unit cell, along with the GA.
- Diverse objectives such as cloaking and beam steering.

Visor SURF

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