



# Electromagnetic Modeling Of Finite Pixels

## Cross-talk, segmented ground planes, and finite pixel effects

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### Introduction

#### Need:

Assess if finite pixel effects hinder the sought detection capability

#### Premise:

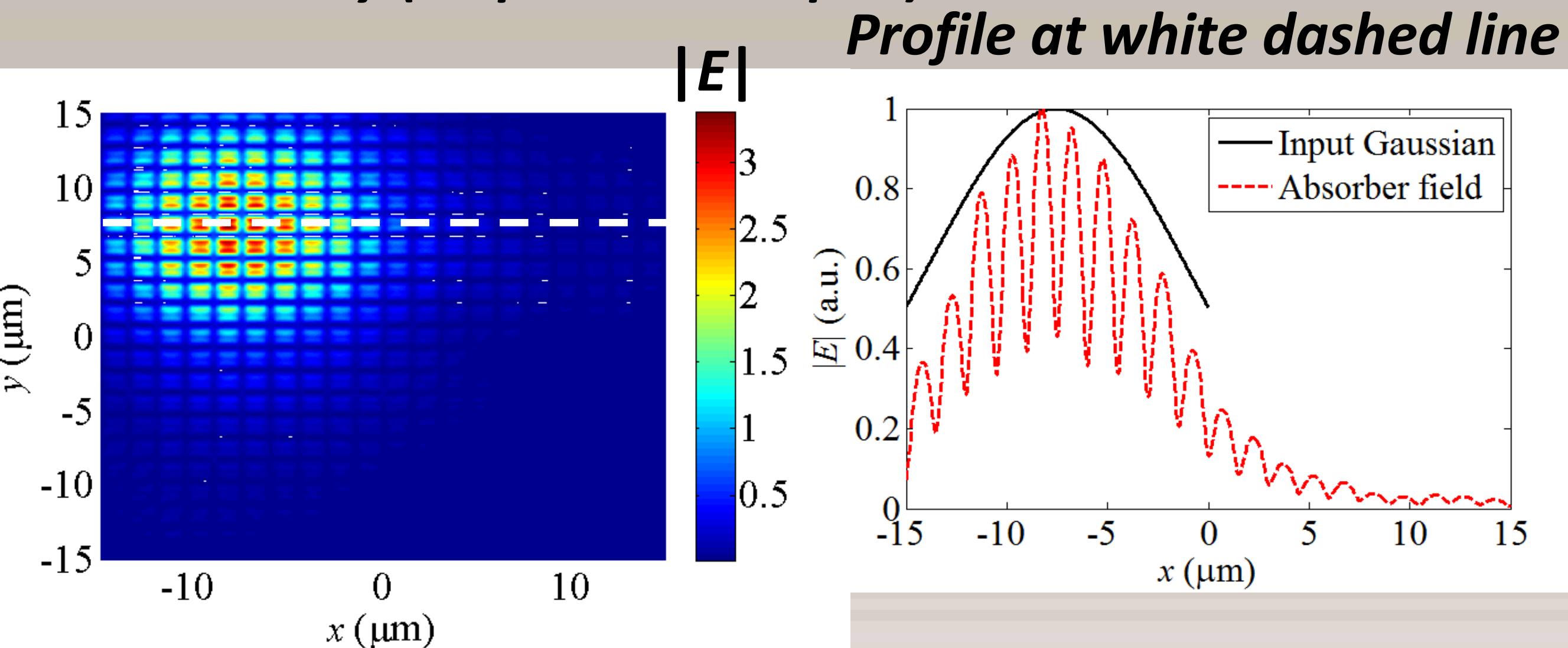
Model large pixelated arrays, periodic ground breaks, and finite array radiation quality factors and assess cross-talk

#### Impact:

The final fabricated device will contain finite size pixels and the assessment of sought operation is fundamental

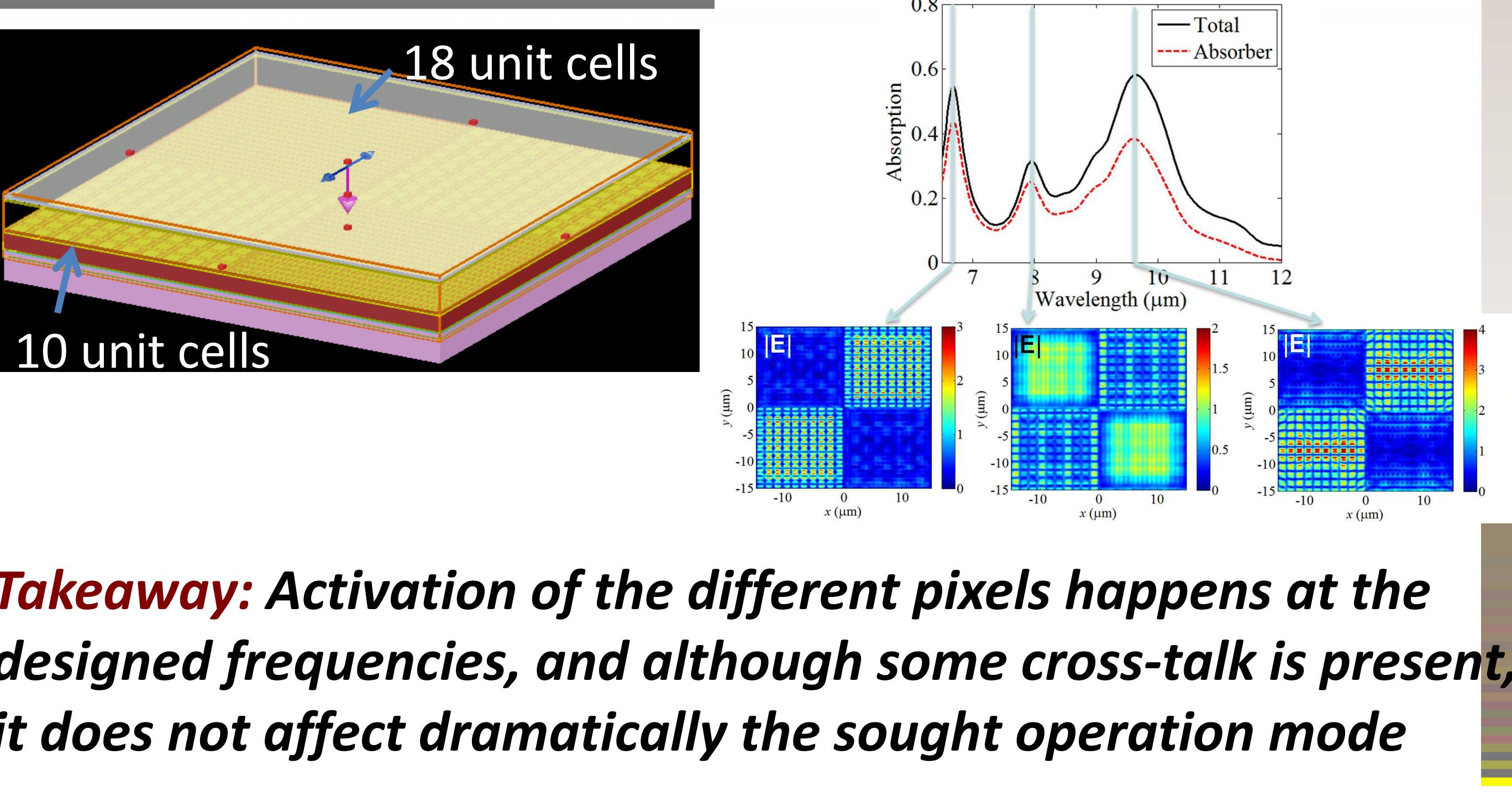
### Large pixel resonator array geometries

**Cross-talk estimation:** Gaussian beam illumination of a 2x2 pixelated array (all pixels are equal)



**Takeaway:** There is no evidence that the resonators lead to an increase in spreading of the energy vs the beam (for the horizontal dipoles associated with these resonators)

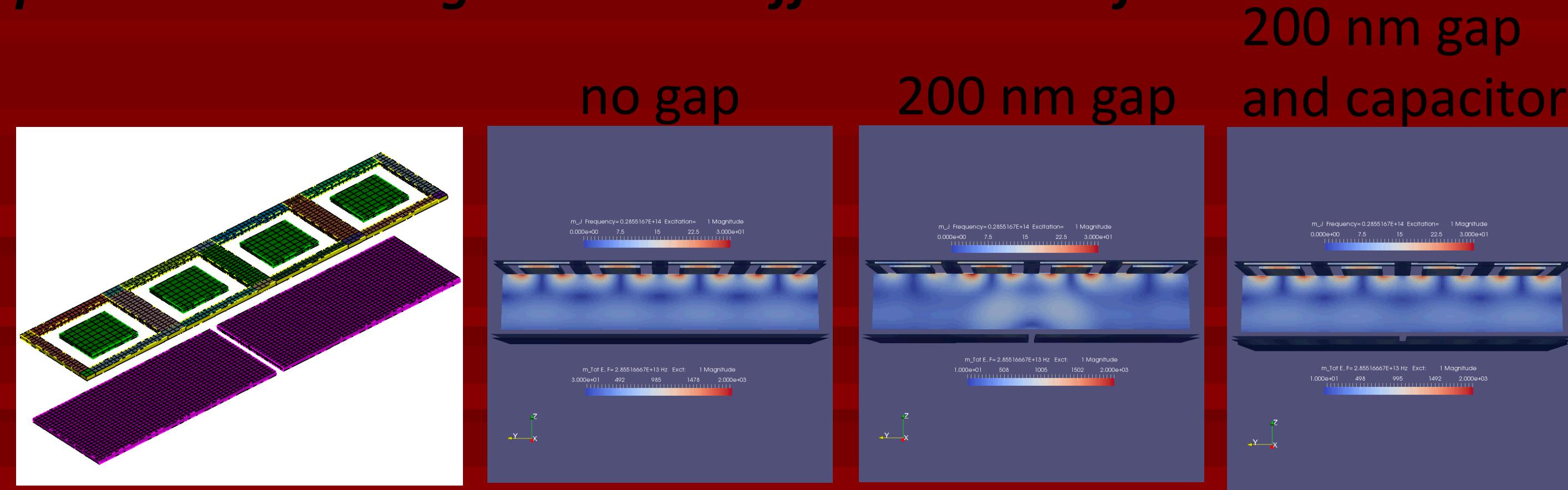
**Dual-band pixelated array:** Simulate plane wave excitation of checker board detector device comprising a 2x2 sub-array, where each pixel (15μm x 15μm): 18 unit cells for Color 2 and 10 unit cells for Color 1



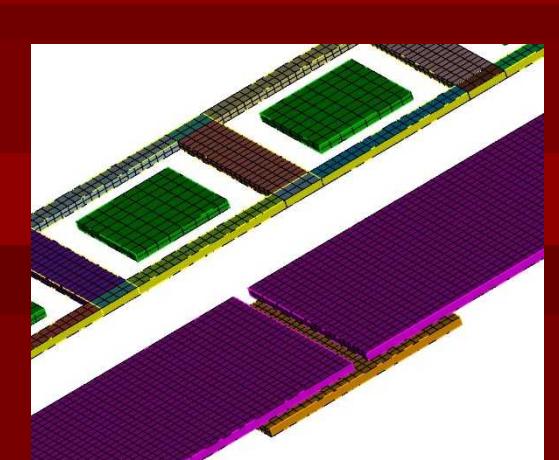
**Takeaway:** Activation of the different pixels happens at the designed frequencies, and although some cross-talk is present, it does not affect dramatically the sought operation mode

### Segmented ground planes

*To frequency tune pixel-by-pixel, a different DC voltage must be applied across each pixel. Does the segmentation affect the near field?*

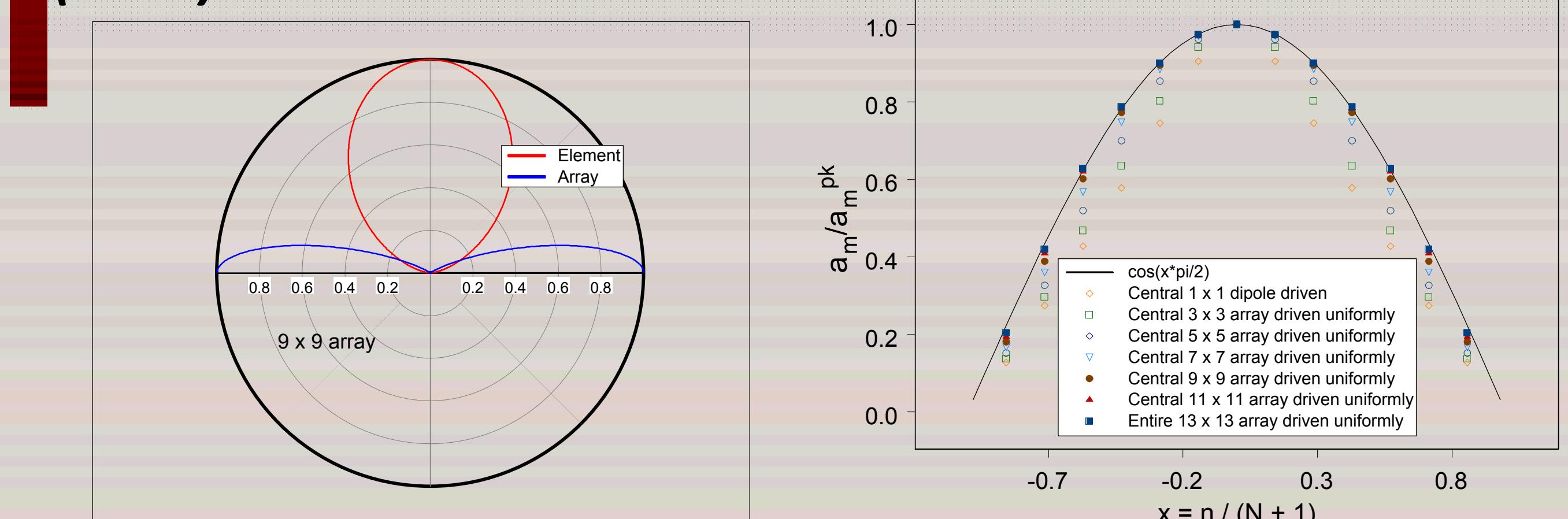


**Takeaway:** A dielectric layer and a conductor under the gap capacitively connects the ground plane segments at high frequency, but maintains isolation at DC



### Finite arrays & normal resonances

**Normal dipoles & cross-talk:** Asymmetric antenna structures which generate normal moments have suppressed radiation due to the dipole element factor, exhibiting high quality factor array (Fano) resonances.



**Takeaway:** Asymmetries can create normal dipole modes which exhibit increasing Q with array size. Cross-talk can be significant for these modes.

### Conclusions & Future Directions

1) Finite pixel interaction of in-plane polarization is limited and does not affect the designed operation mode sought

2) Near field effects due to segmented ground planes can be controlled. We will determine if the segmented ground planes can concentrate the field in the detector.

3) Asymmetries resulting in out-of-plane polarization lead to higher quality factors & cross excitation of the array – should be avoided.

**Next:** Optimize the structure for maximum tuning capabilities

Comments from D. Peters:

Things I would like to see stay in this format:

- The banner/title/subtitle/author names
- Introduction and Future Directions panels
- Overall look and feel (Calibri font for titles and text)

Things you can change:

- What you put in any of the panels
- The names of Methodology and Accomplishments panels if those don't fit what you are doing
- Blue boxes for figures are illustrative, do not feel like figures need a blue background
- Do not spend time trying to change fonts on figures if you already have them in something else

I highly recommend you use these after the EAB in labs/hallways. If you do, you must put through formal R&A. For the EAB meeting you can put through programmatic R&A, which is much faster. I would recommend choosing a manager closest to your area to put through this step as that person will be most familiar with the work.

We are sending these to be printed on 1/11. You must have them programmatically approved by that date and turned in to me!

Campione, Salvatore, 12/13/2016