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# 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:

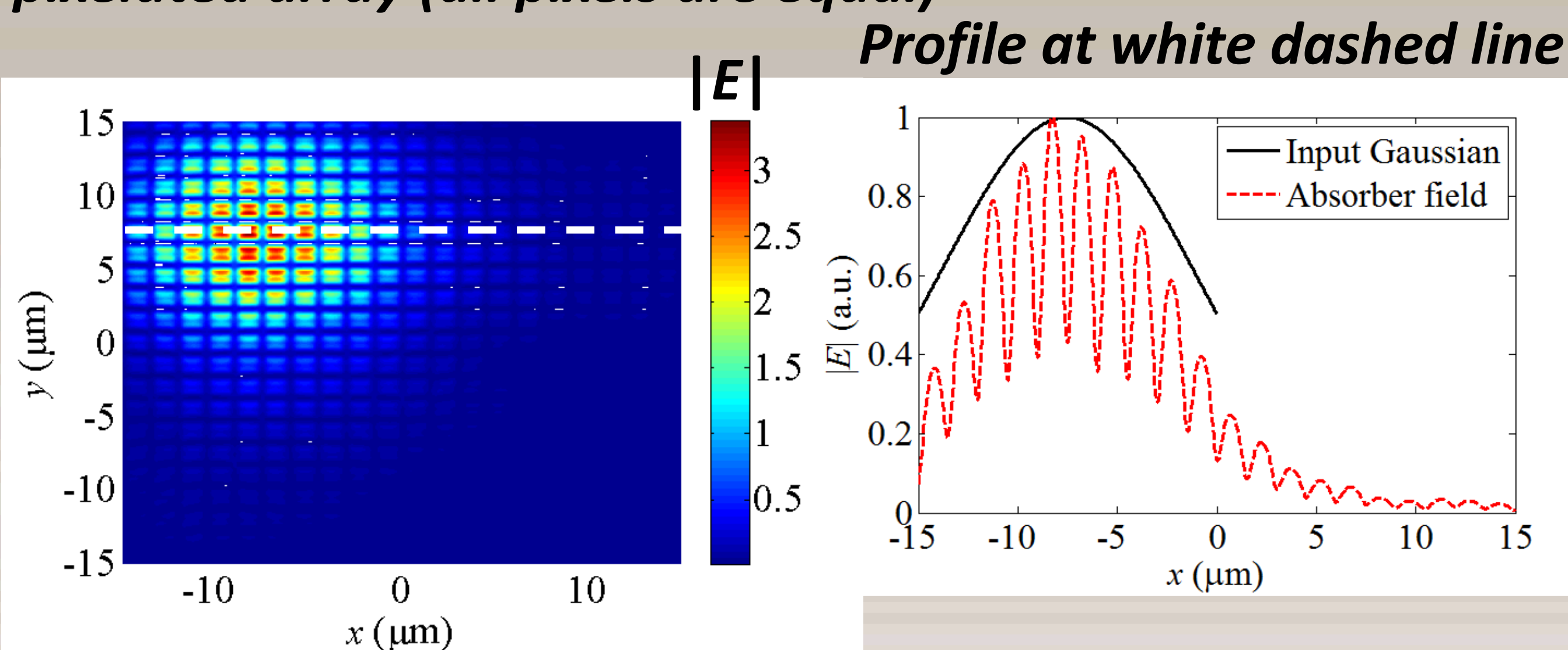
Model large pixelated arrays, periodic ground breaks, and finite array radiation quality factors and assess cross-talk

#### Impact:

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

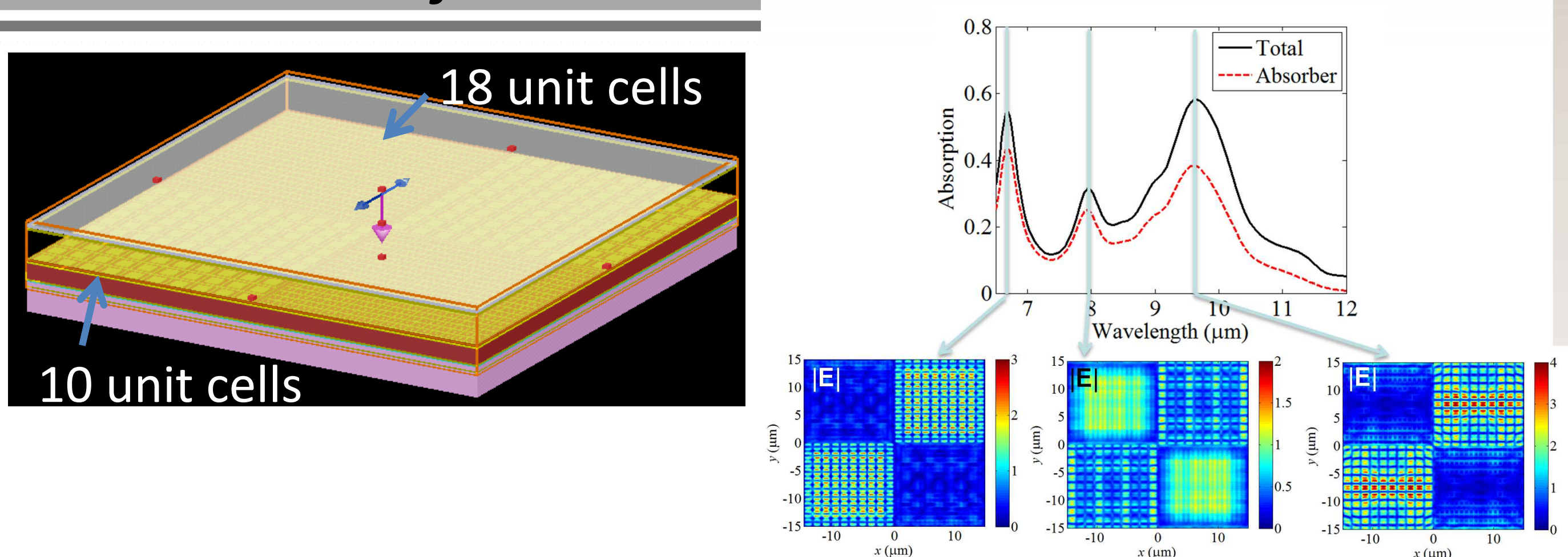
### Large pixel resonator array geometries

**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)

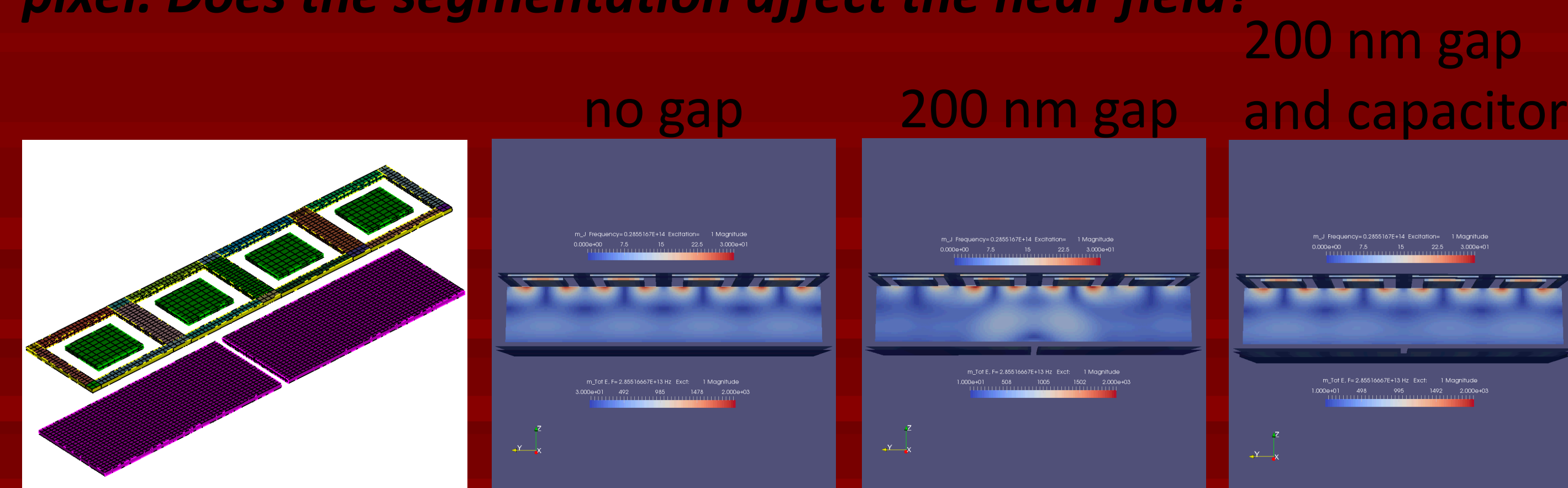
**Dual-band pixelated array:** Simulate plane wave excitation of checker board detector device comprising a 2x2 sub-array, where each pixel (15 $\mu\text{m}$  x 15 $\mu\text{m}$ ): 18 unit cells for Color 2 and 10 unit cells for Color 1



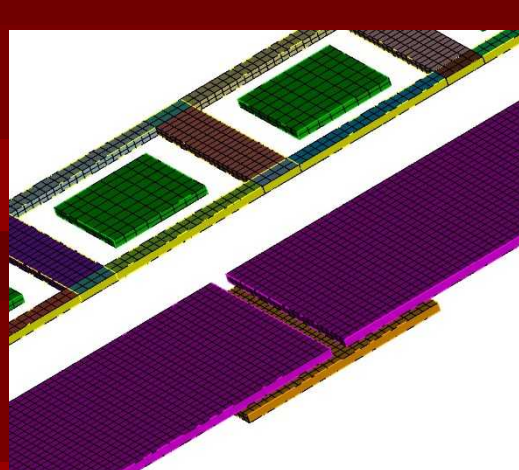
**Takeaway:** Activation of the different pixels happens at the designed frequencies, and although some cross-talk is present, it does not affect dramatically the sought operation mode

### 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?

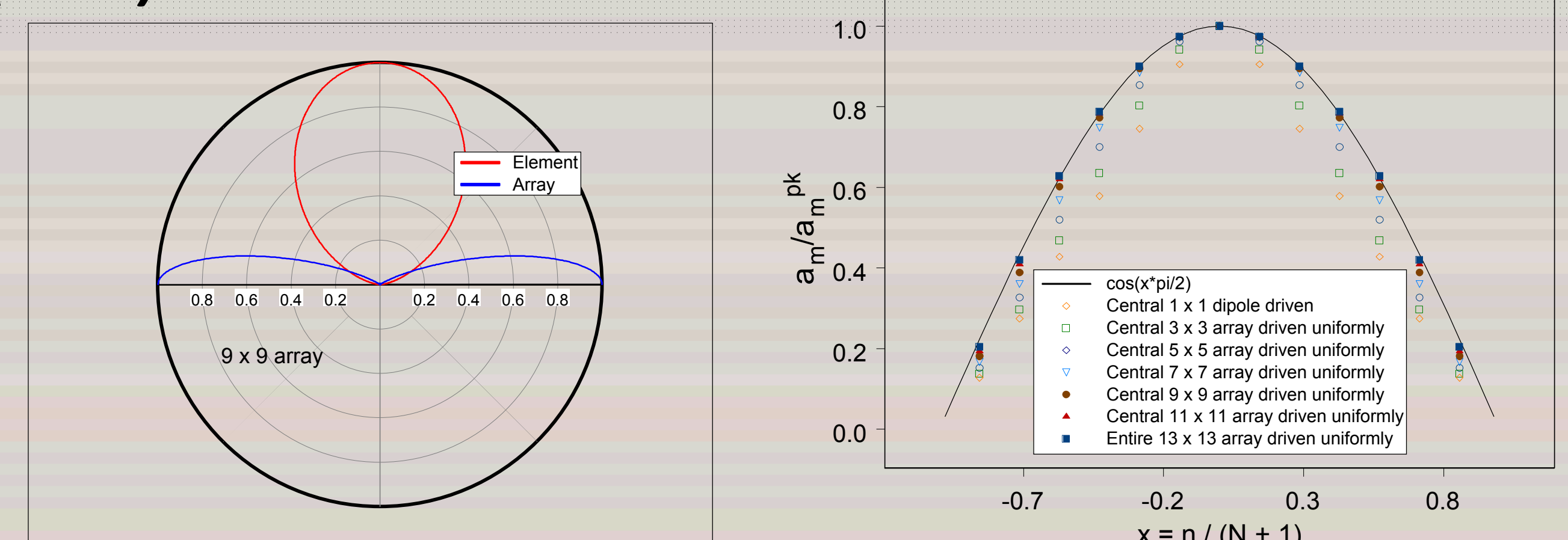


A dielectric layer and a conductor under the gap capacitively connects the ground plane segments at high frequency, but maintains isolation at DC



### 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



Slide 1	
CS1	<div>Comments from D. Peters:</div> <div>Things I would like to see stay in this format:</div> <div><ul style="list-style-type: none"><li>• The banner/title/subtitle/author names</li><li>• Introduction and Future Directions panels</li><li>• Overall look and feel (Calibri font for titles and text)</li></ul></div> <div>Things you can change:</div> <div><ul style="list-style-type: none"><li>• What you put in any of the panels</li><li>• The names of Methodology and Accomplishments panels if those don't fit what you are doing</li><li>• Blue boxes for figures are illustrative, do not feel like figures need a blue background</li><li>• Do not spend time trying to change fonts on figures if you already have them in something else</li></ul></div> <div>I highly recommend you use these after the EAB in labs/hallways. If you do, you must put through formal R&amp;A. For the EAB meeting you can put through programmatic R&amp;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.</div> <div>We are sending these to be printed on 1/11. You must have them programmatically approved by that date and turned in to me!</div> <div>Camptone, Salvatore, 12/13/2016</div>