

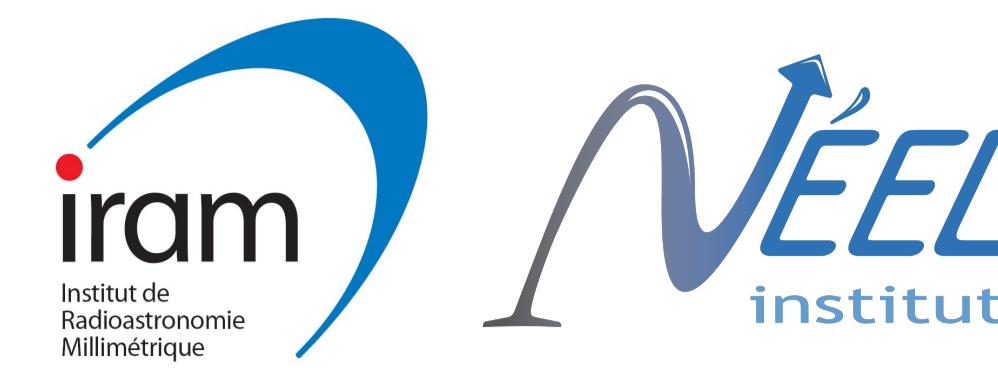
# Applying capacitor trimming technique on kilo LEKIDs

Talk 146

Wednesday 10:45

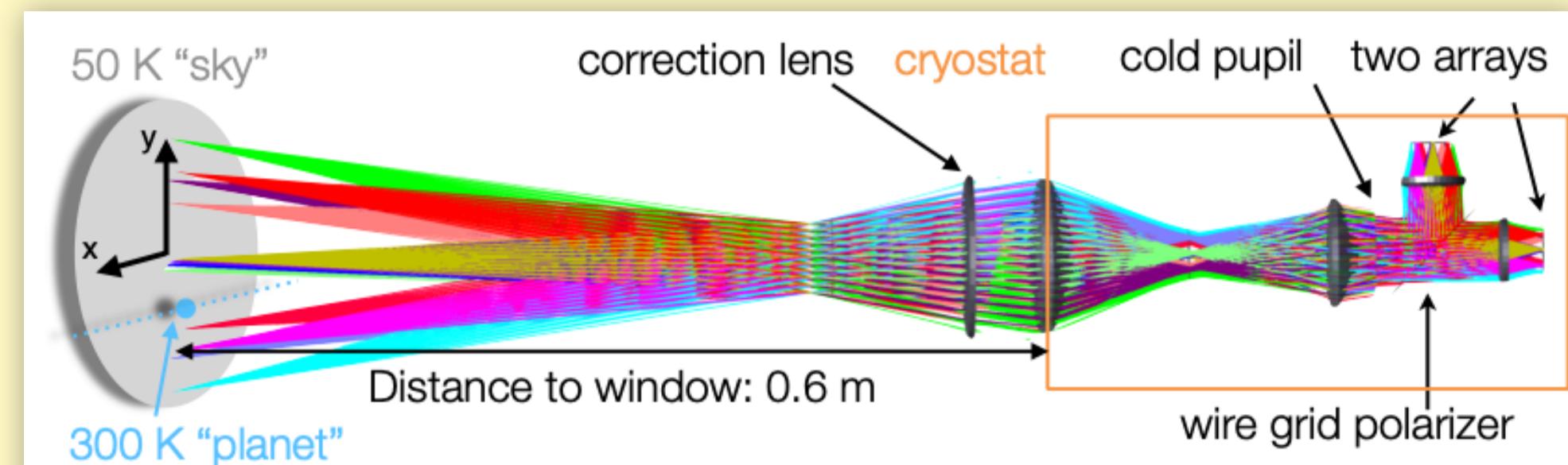
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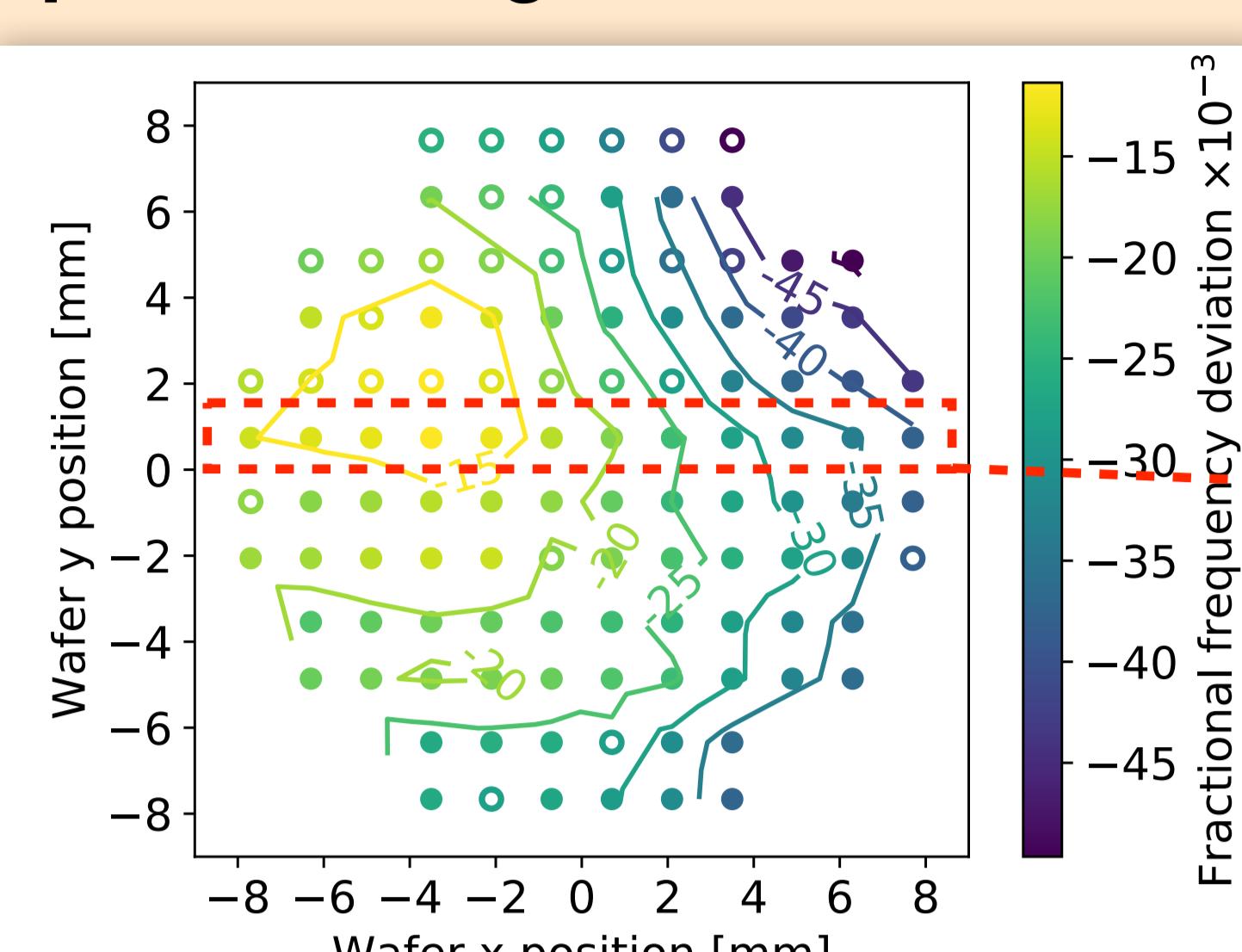
Crosstalk due to frequency scatter is a major problem for superconducting resonator arrays. A trimming technique to reduce this crosstalk has been demonstrated by Liu et al.<sup>1-3</sup> We have extended this technique to the case of quasi-lumped element arrays and 4-inch kilo-pixel arrays.<sup>4-5</sup>

## Mapping system



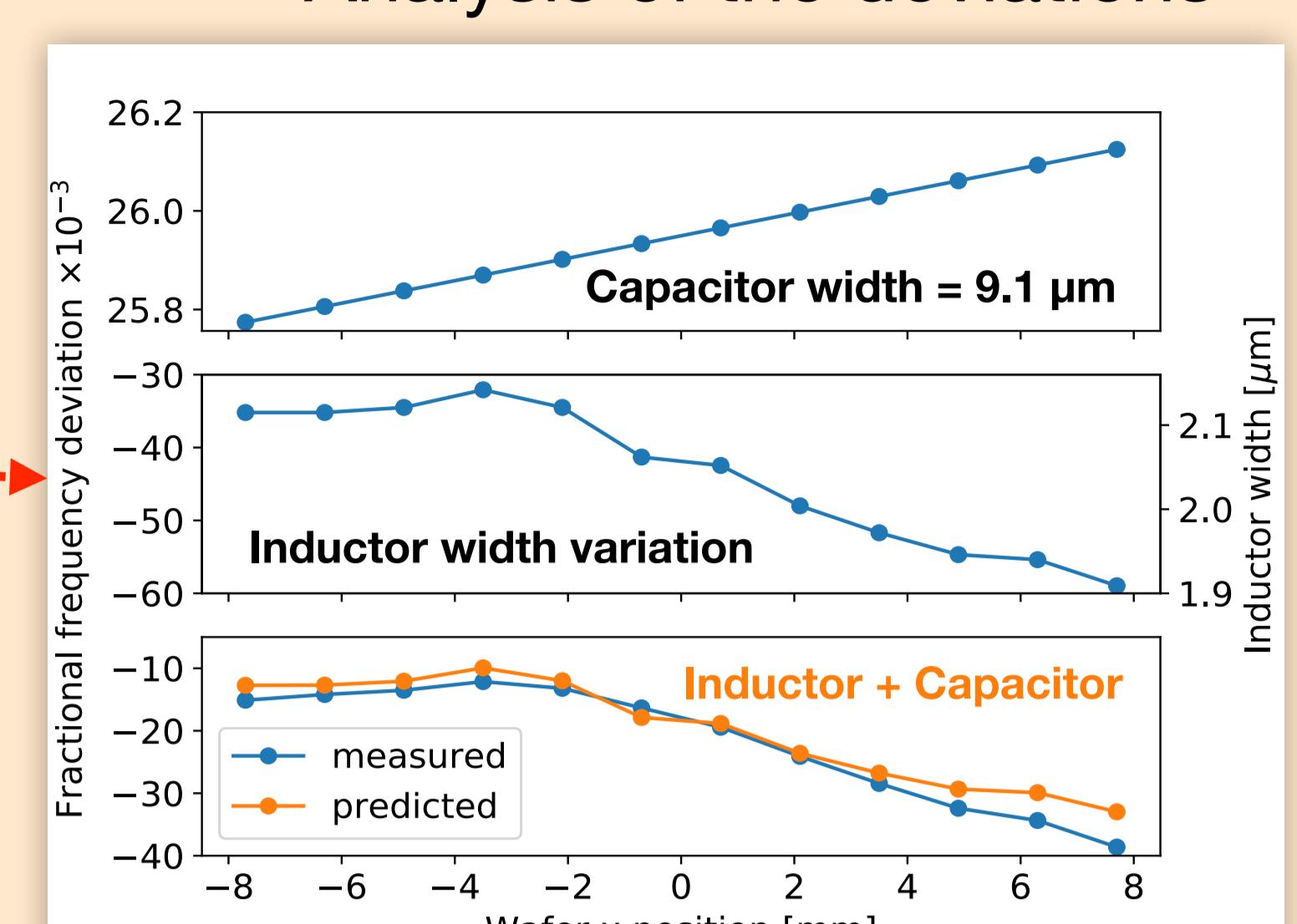
- X step: 1 mm = 0.17 mm on the array
- The metal ball diameter: 4 mm (0.68 mm on the array)

## Step 1: Locating resonances to resonators



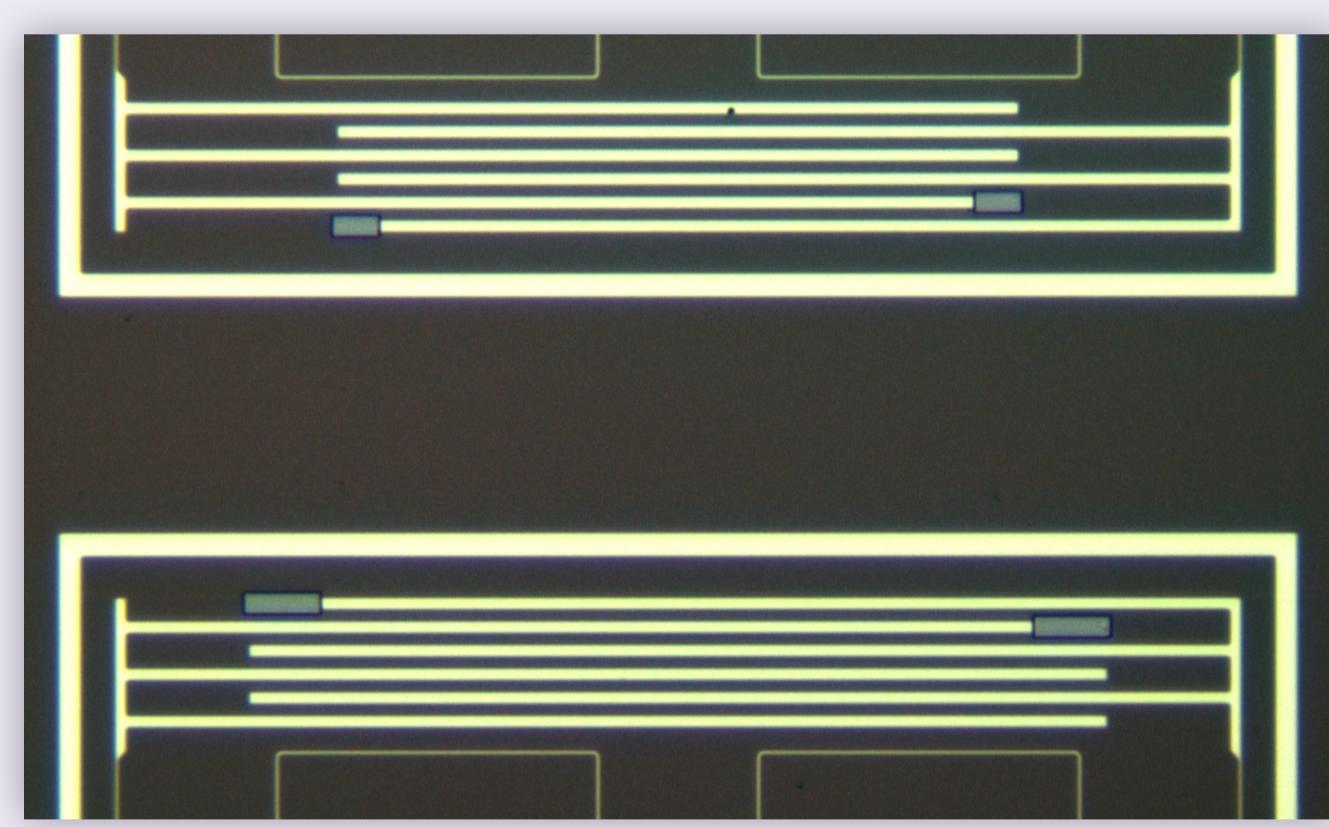
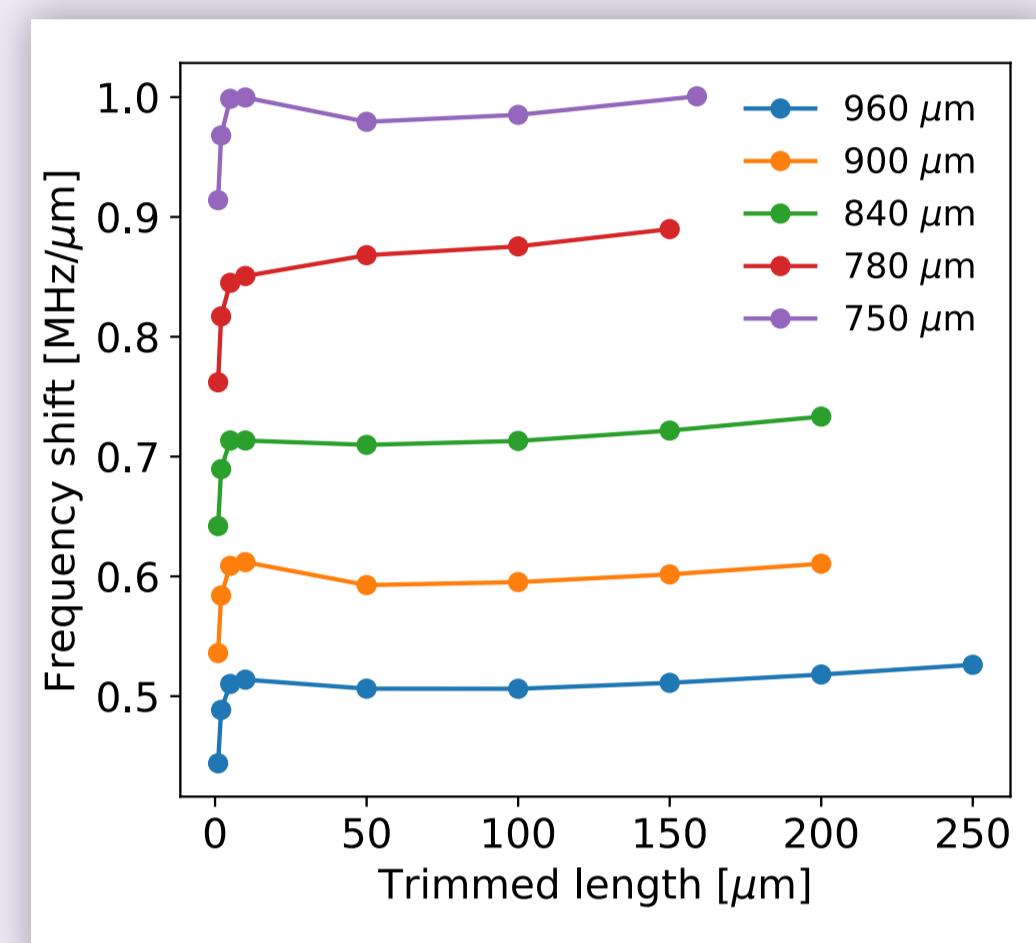
$$\frac{\Delta f}{f} = \frac{f_{\text{meas}} - f_{\text{des}}}{f_{\text{des}}}$$

## Analysis of the deviations



$$f = \frac{1}{2\pi\sqrt{LC}} \quad \frac{\delta f}{f} = \frac{1}{4} \frac{\delta w}{w} \quad w: \text{width of inductor}$$

## Step 2: Trimming process

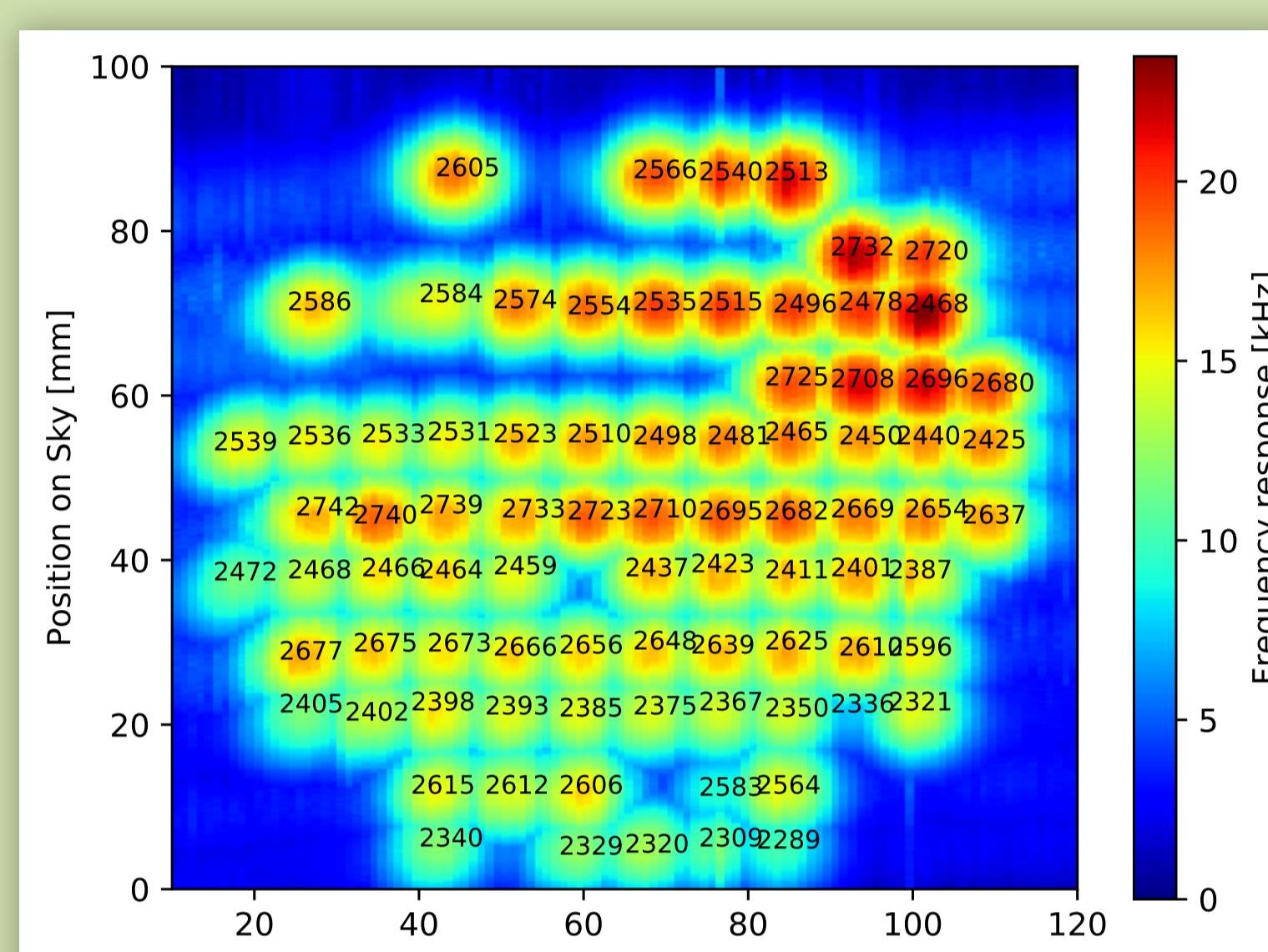


- Frequency shifts: 1-110 MHz
- Trimming lengths: 5-210 μm
- Symmetric trimming
- 1 μm misalignment

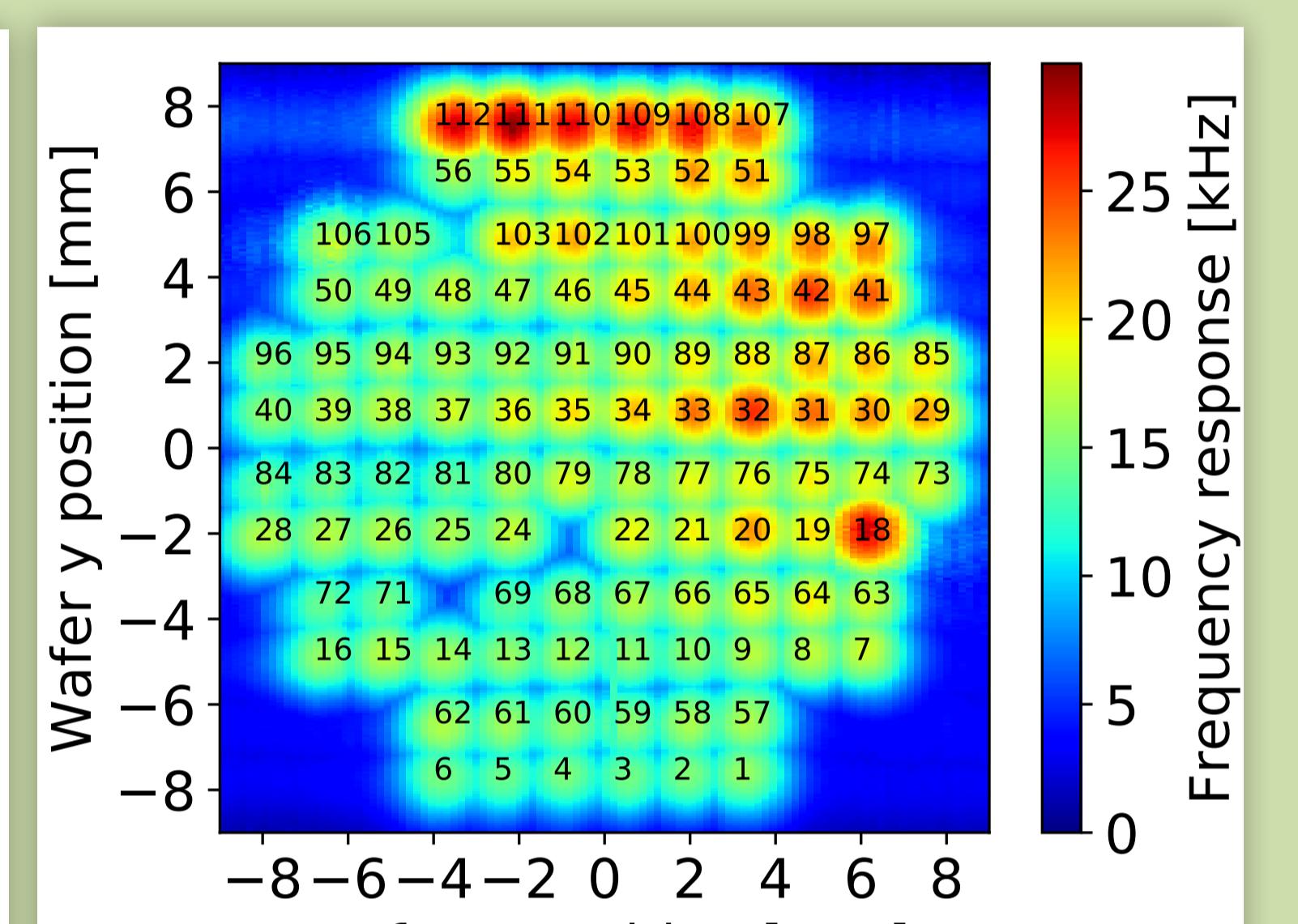
Quasi-lumped element capacitor

$$\frac{f_{\text{meas}} - f_{\text{des}}}{f_{\text{des}}} = \frac{f_{\text{fremeas}} - f_{\text{fredis}}}{f_{\text{fredis}}}$$

## Mapping results

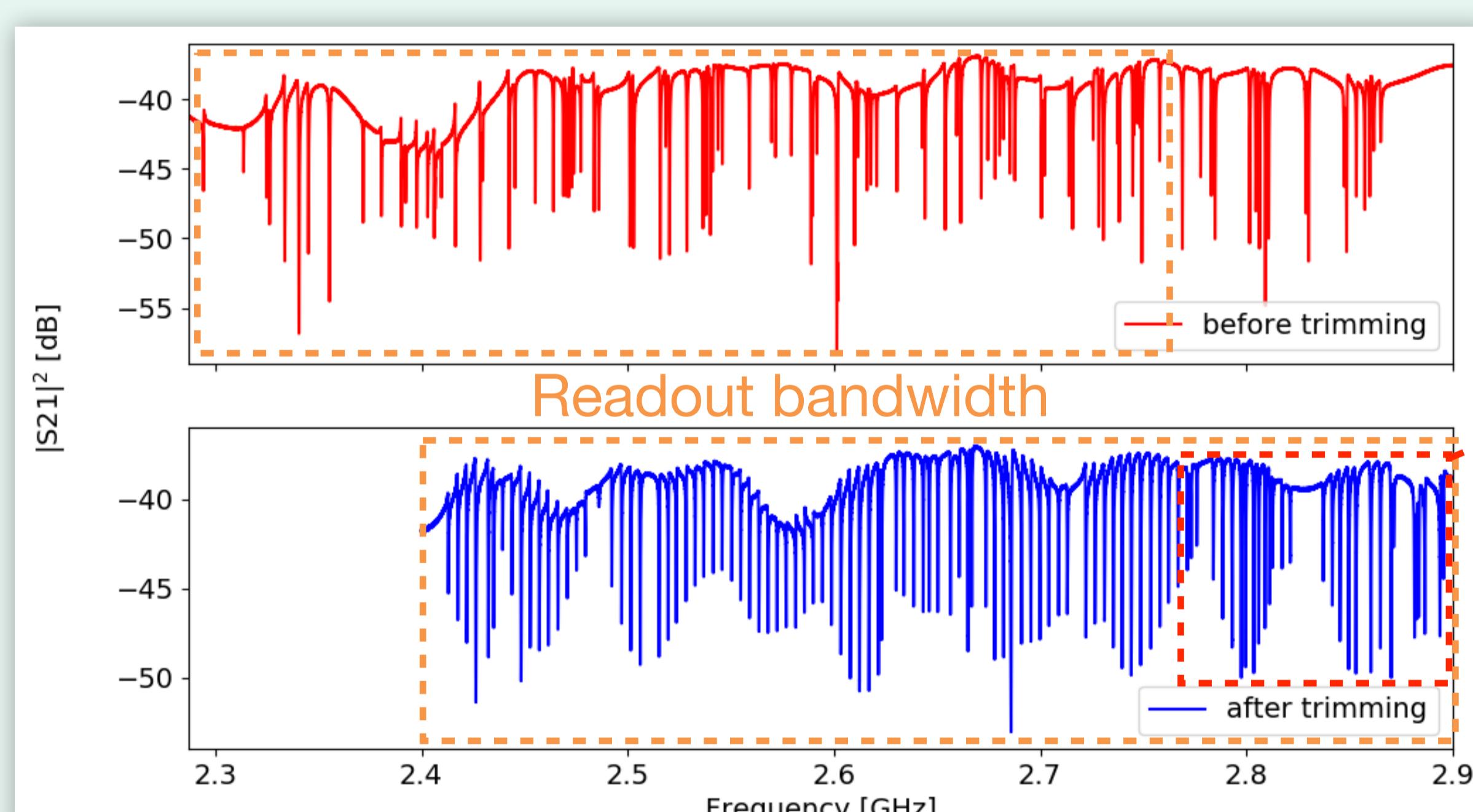


before trimming: 70.5%

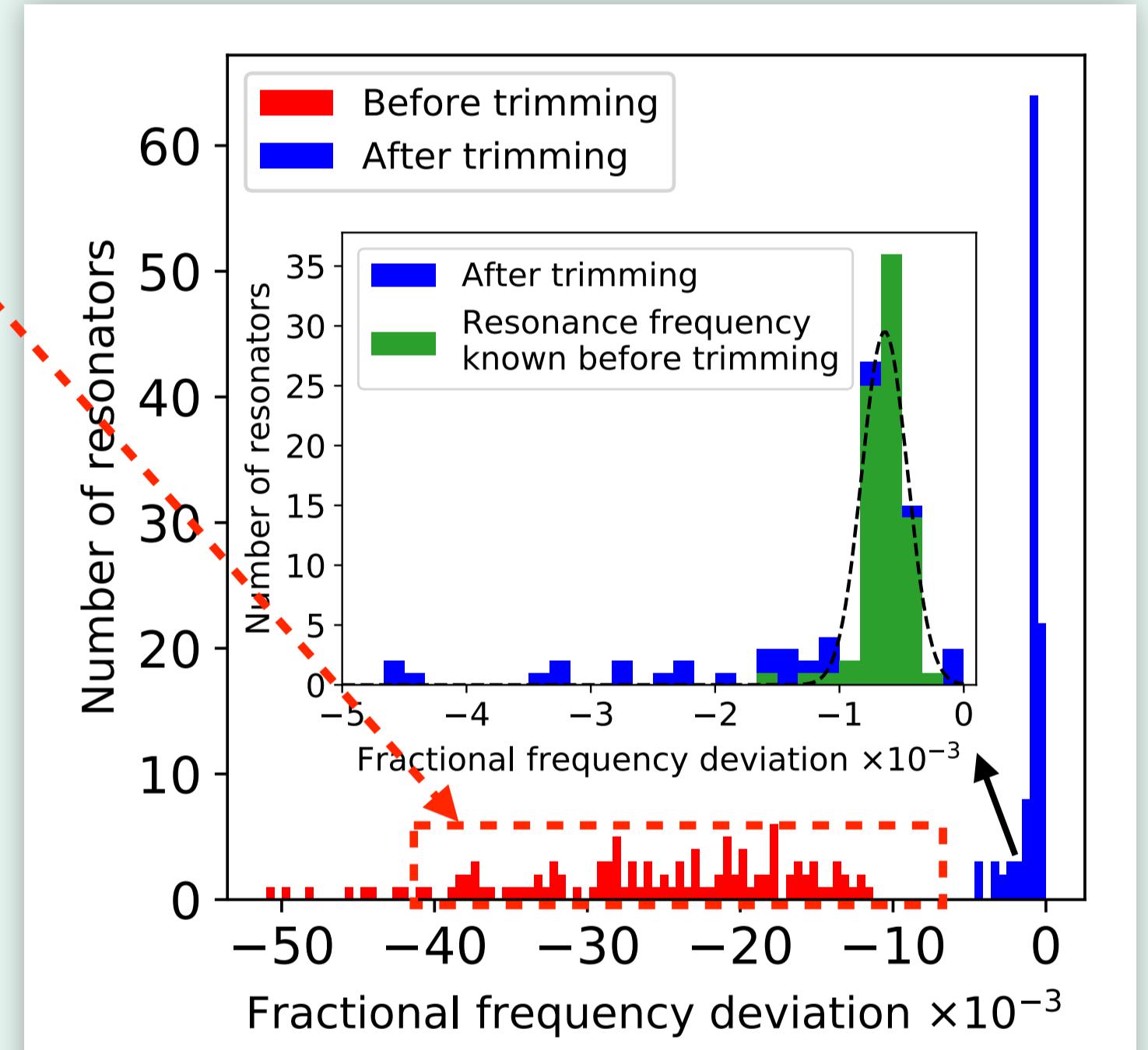
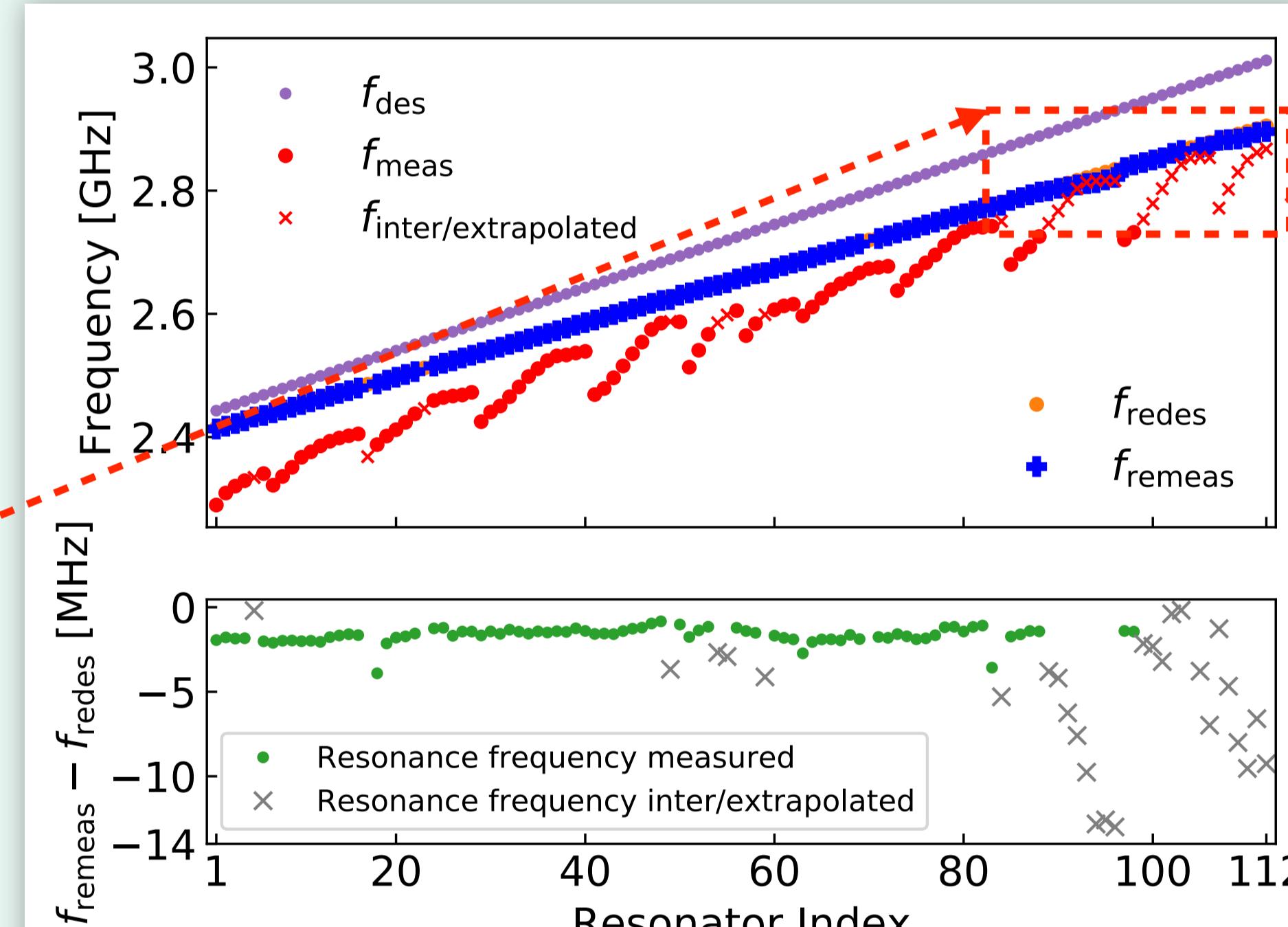


after trimming: 96.4%

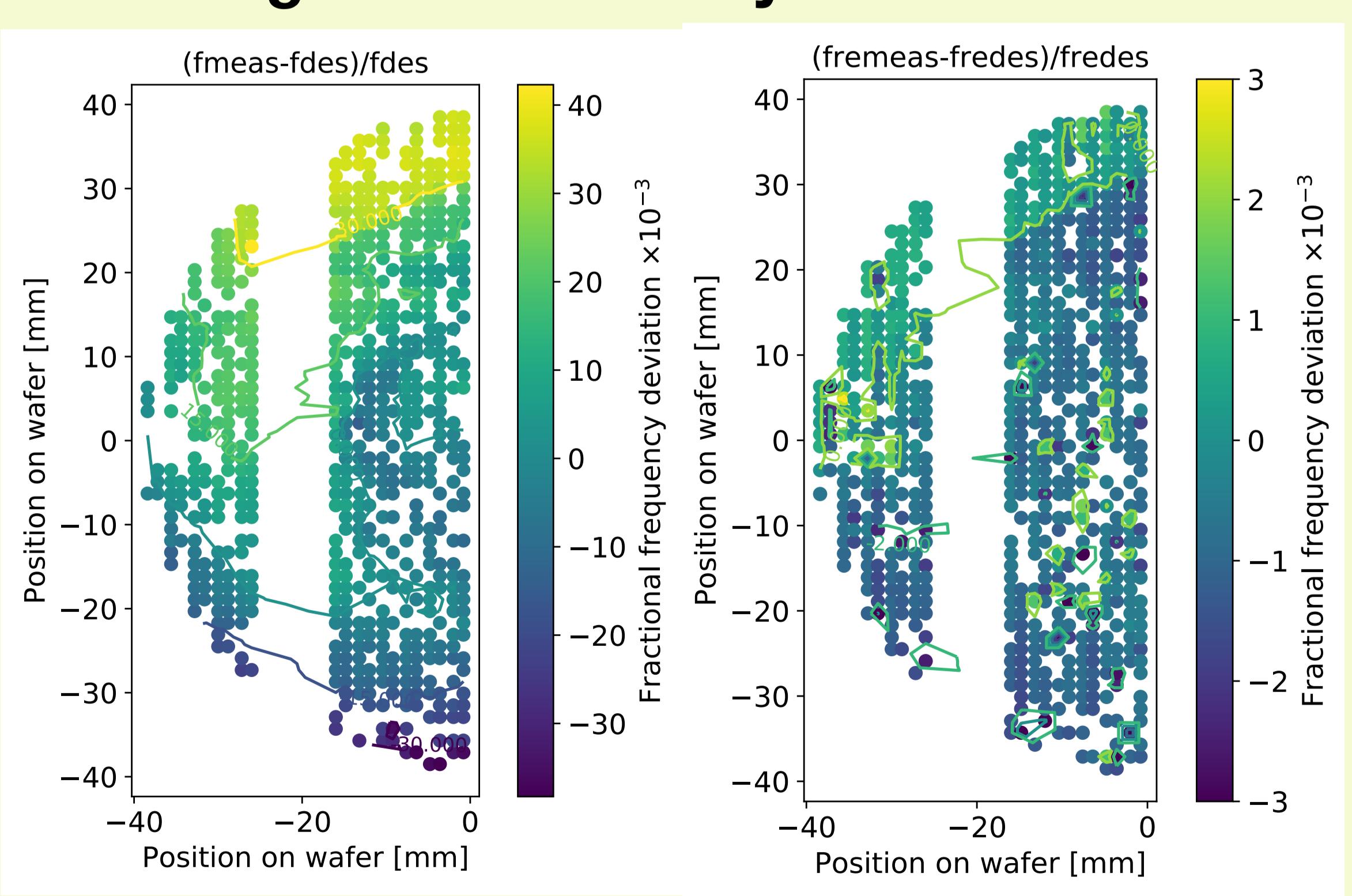
## Step 3: Re-characterization



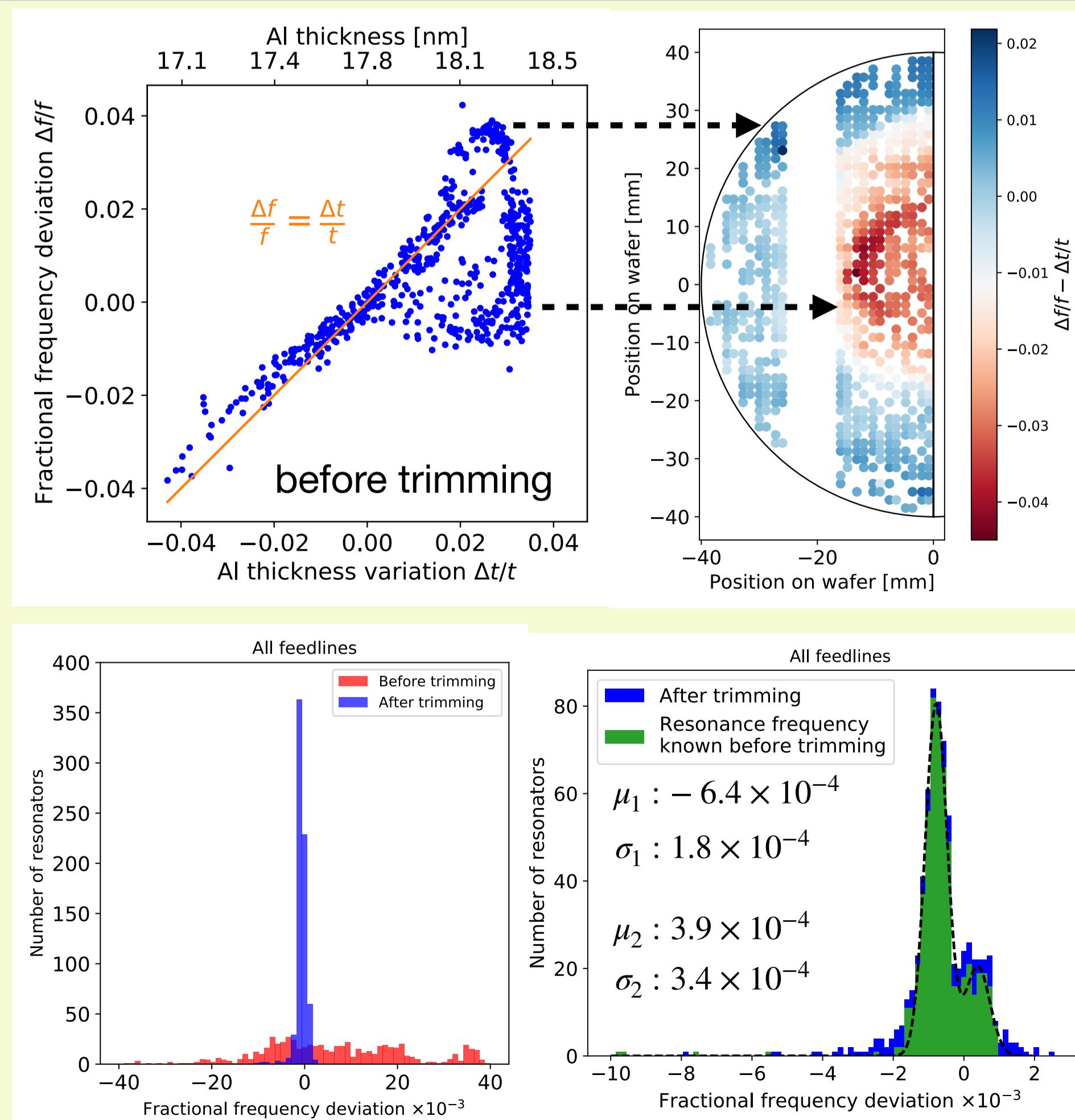
- Absolute deviation  $f_{\text{meas}} - f_{\text{des}}$ :  $\mu = -1.7 \text{ MHz}$   $\sigma = 0.46 \text{ MHz}$   $\rightarrow$  comparable to the resonance width
- Fractional deviation  $(f_{\text{meas}} - f_{\text{des}})/f_{\text{des}}$ :  $\mu = -6.4 \times 10^{-4}$   $\sigma = 1.8 \times 10^{-4}$



## Trimming on 4-inch array



- Absolute deviation:  $\mu_1 = 0.88 \text{ MHz}$   $\sigma_1 = 0.71 \text{ MHz}$   
 $\mu_2 = -1.71 \text{ MHz}$   $\sigma_2 = 0.72 \text{ MHz}$



## Conclusion

- Before trimming the frequency deviation is dominated by film thickness and the possible inductor width variation
- Trimming is mature for kilo-pixel arrays
- Trimming technique could be applied on any kind of capacitor design
- The trimming accuracy is limited by film properties and the possible aging effect

## References

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