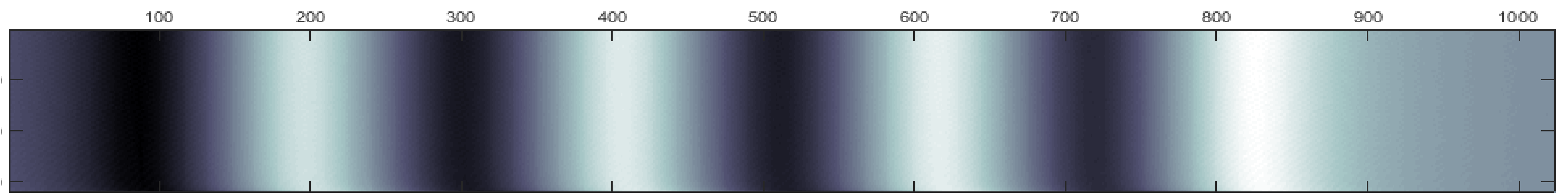
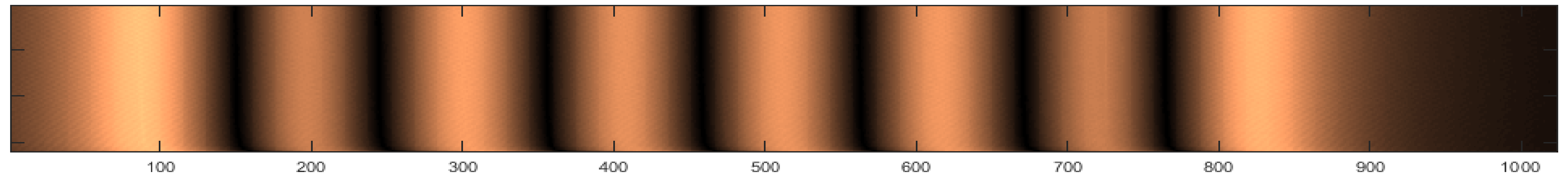


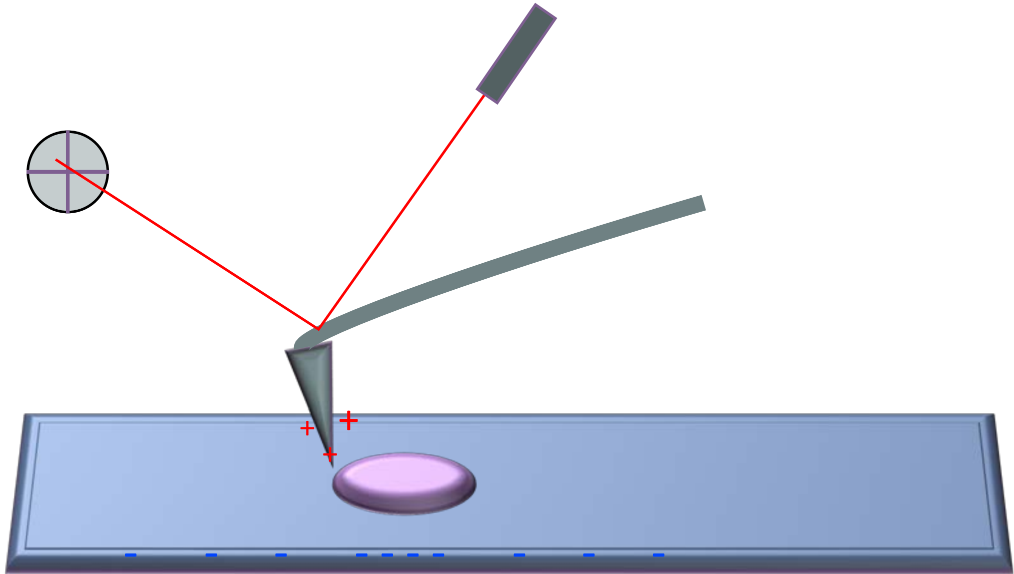
Remote Bias Electrostatic Force Microscopy: Seeing the Invisible

Joseph Tibbs
SPS NIST Research Intern
August 2nd, 2019

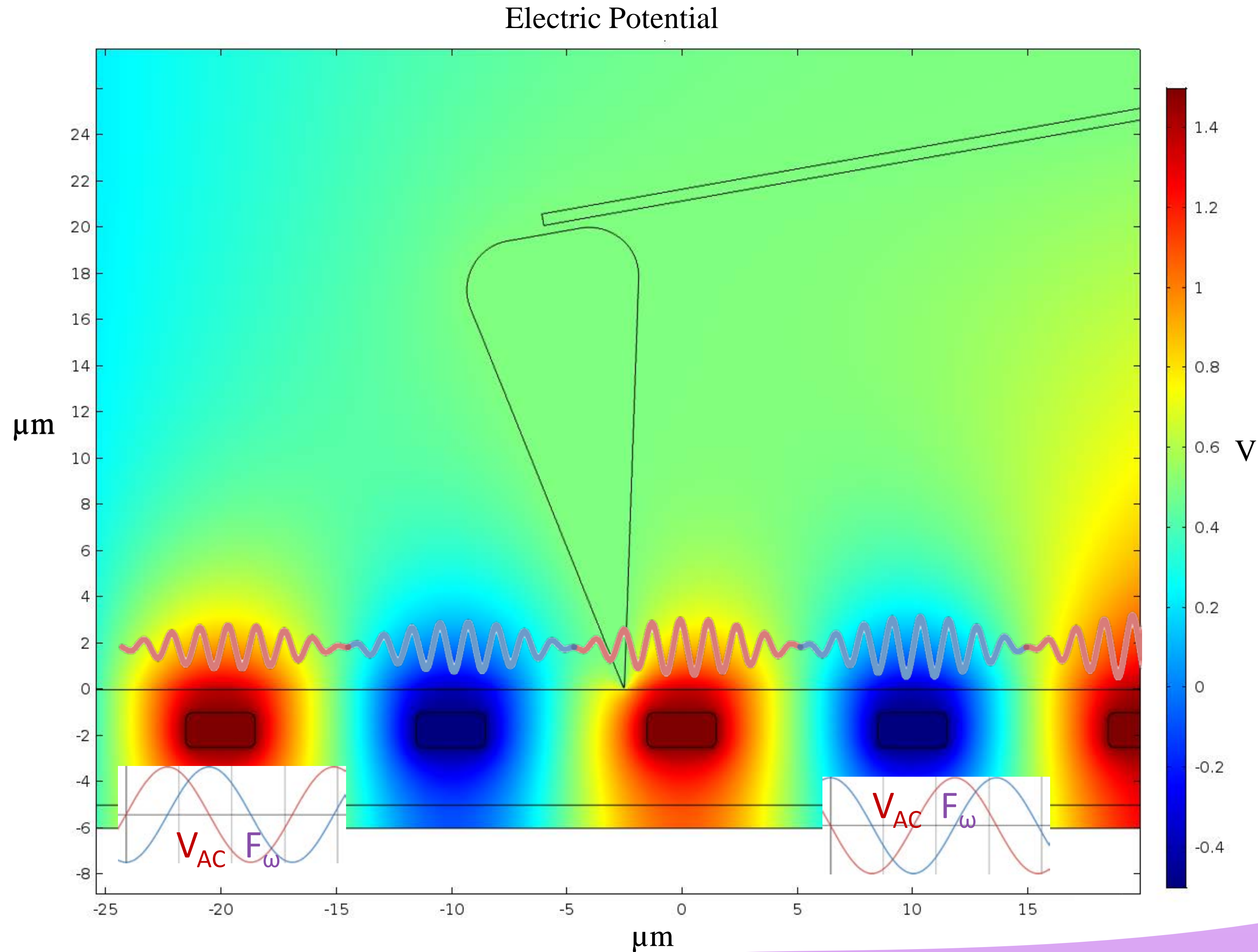


~~Atomic~~ Force Microscopy

Electrostatic^



Electrostatic Force Microscopy



Motivation and Goals

- Back End of Line Testing
- Tip characterization
- Standard Structure

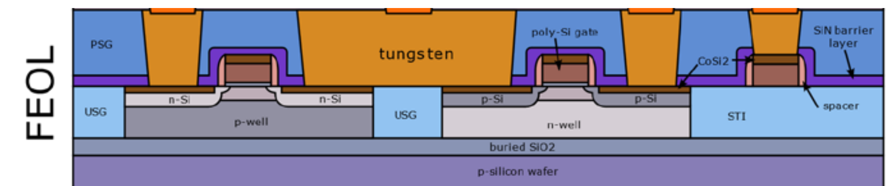
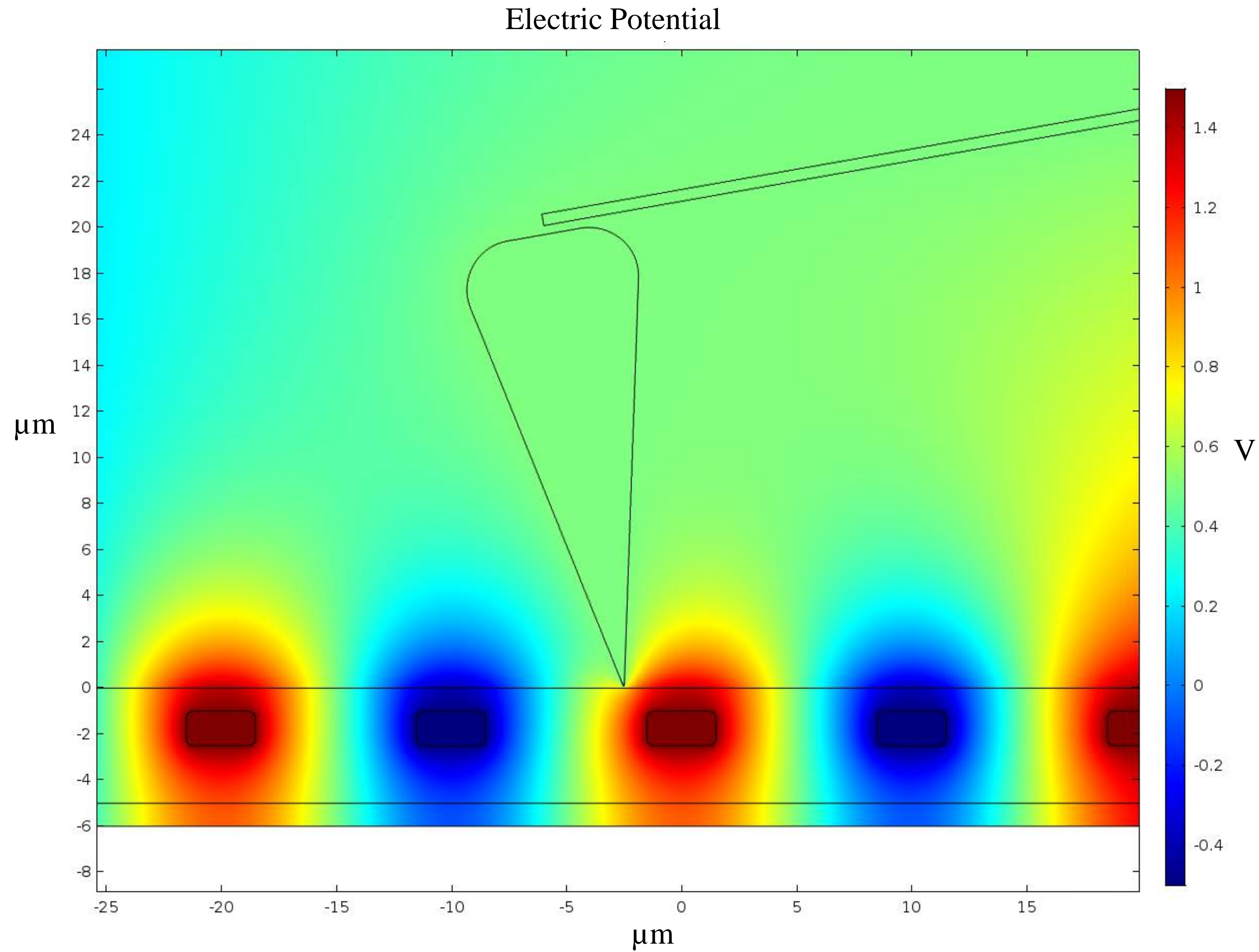
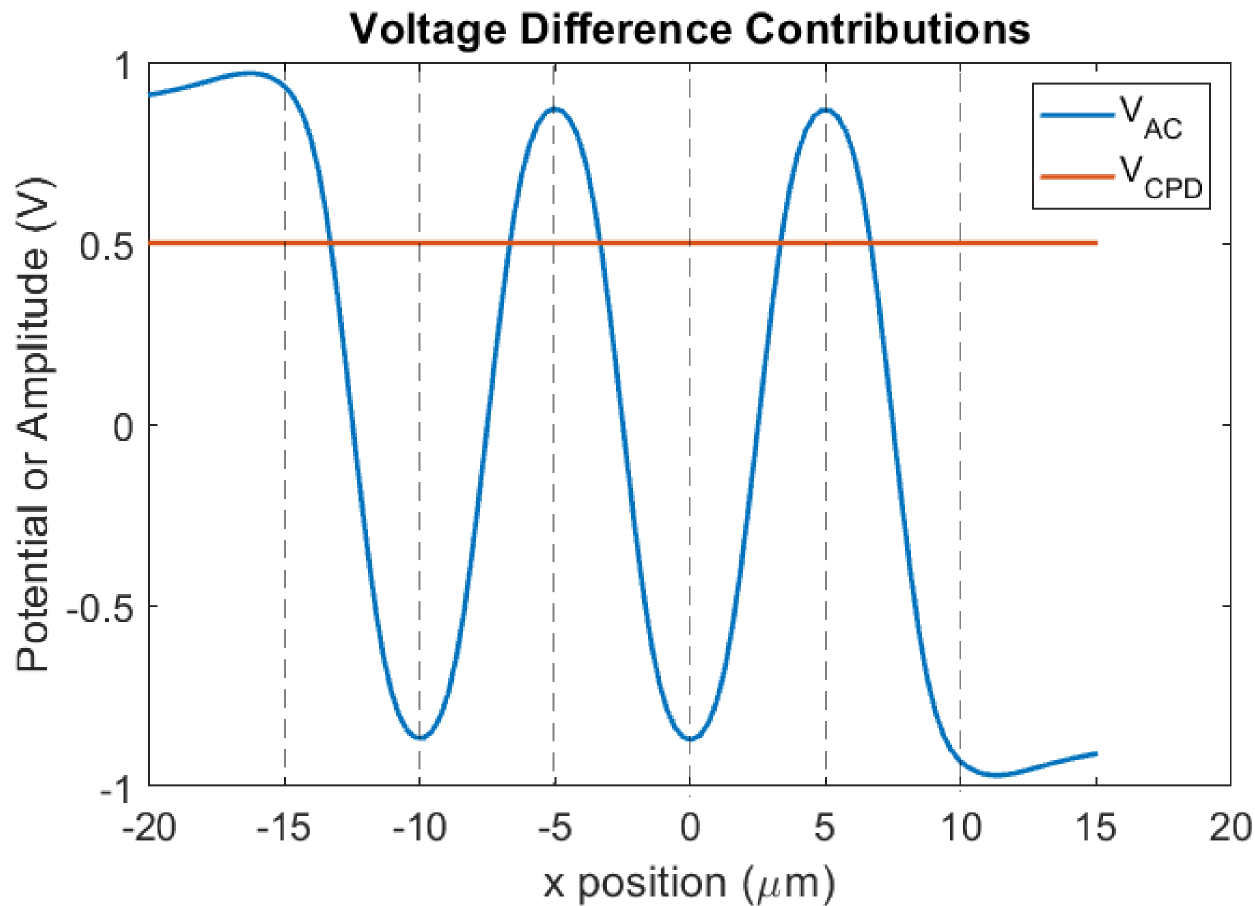


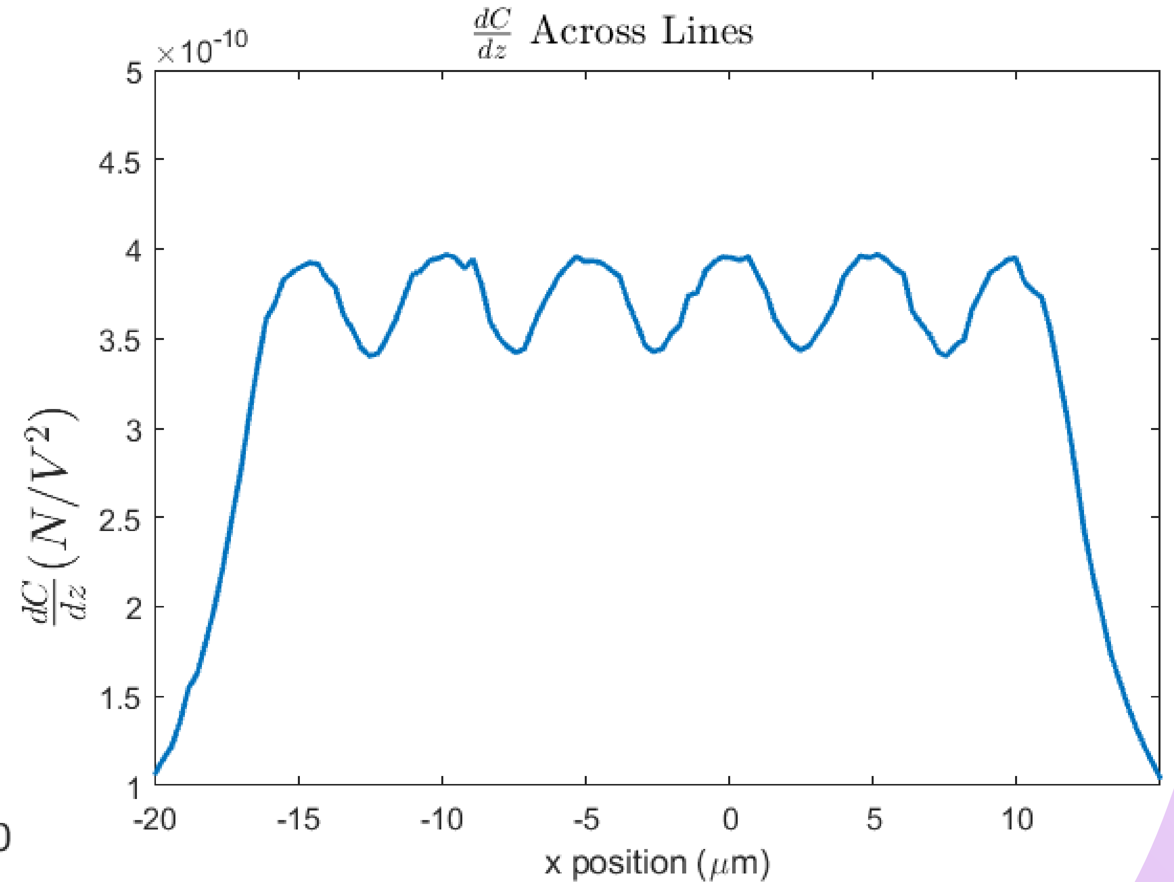
Image credit: Cepheiden [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0/)]

Computational Work



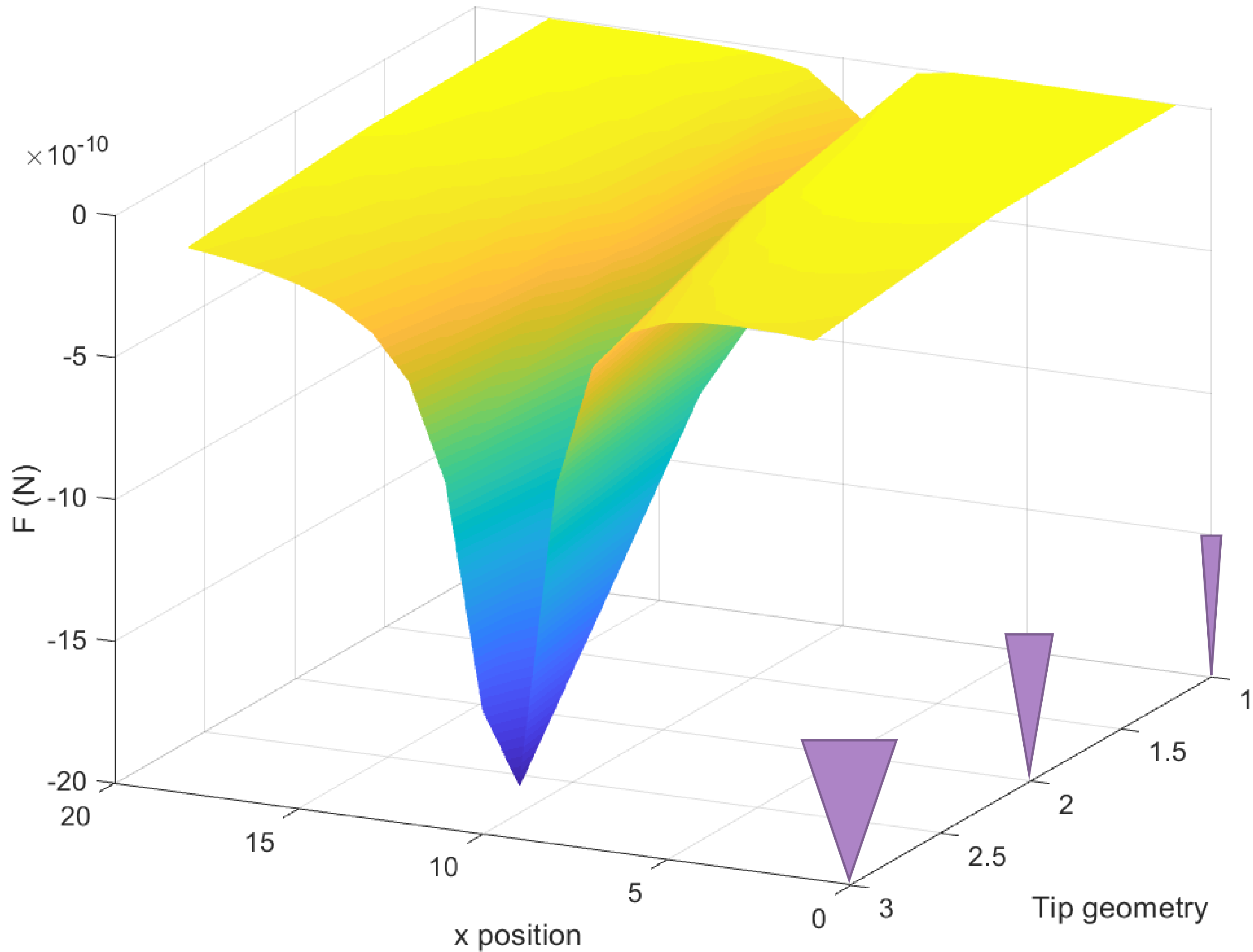
Extracted Values



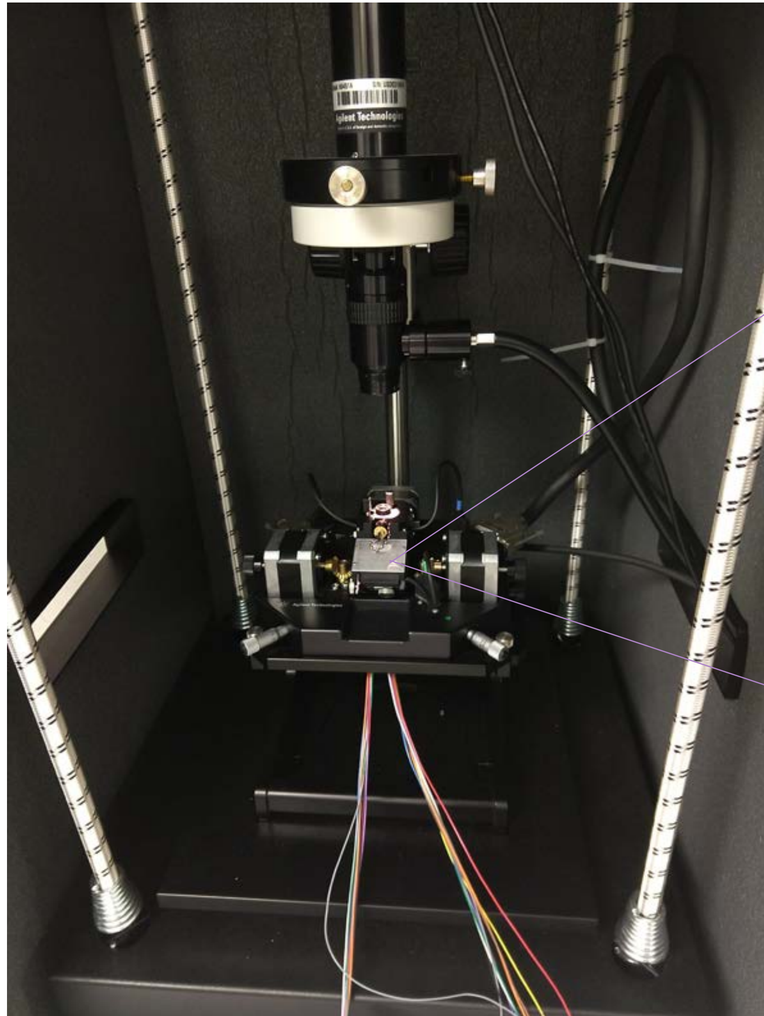


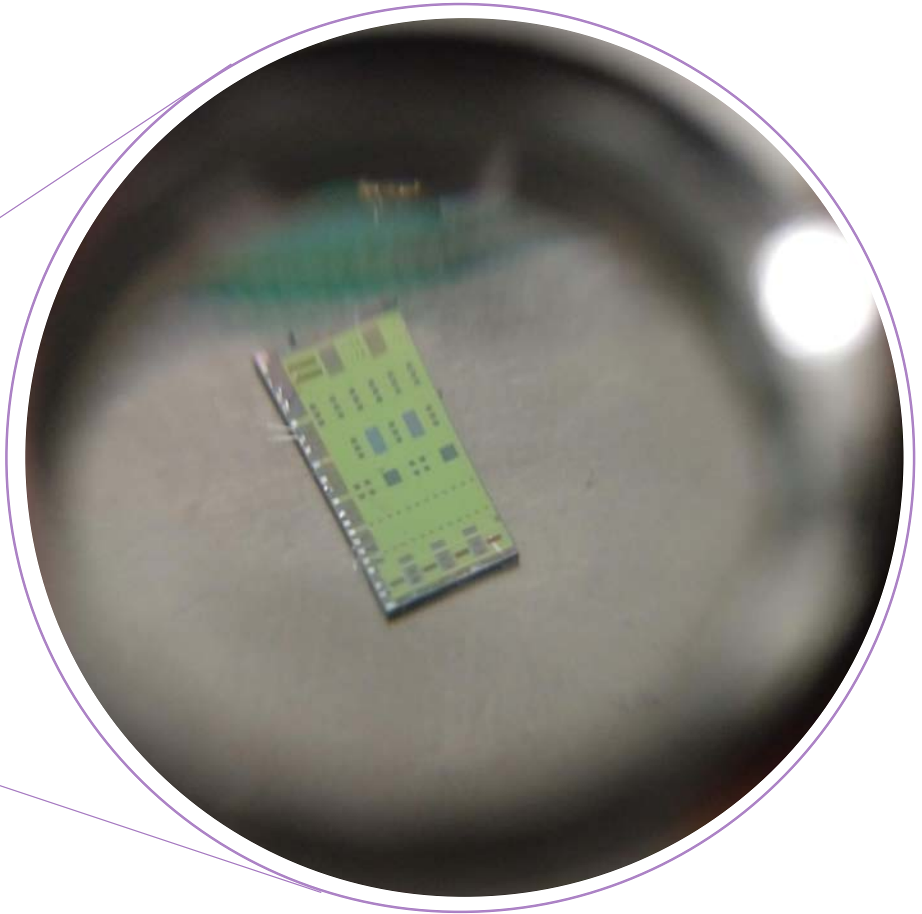
$$F(z,t) = -\frac{1}{2}[(V_{CPD} - VD_C) + V_{AC} sin(\omega t)]^2 \frac{dC(z)}{dz}$$

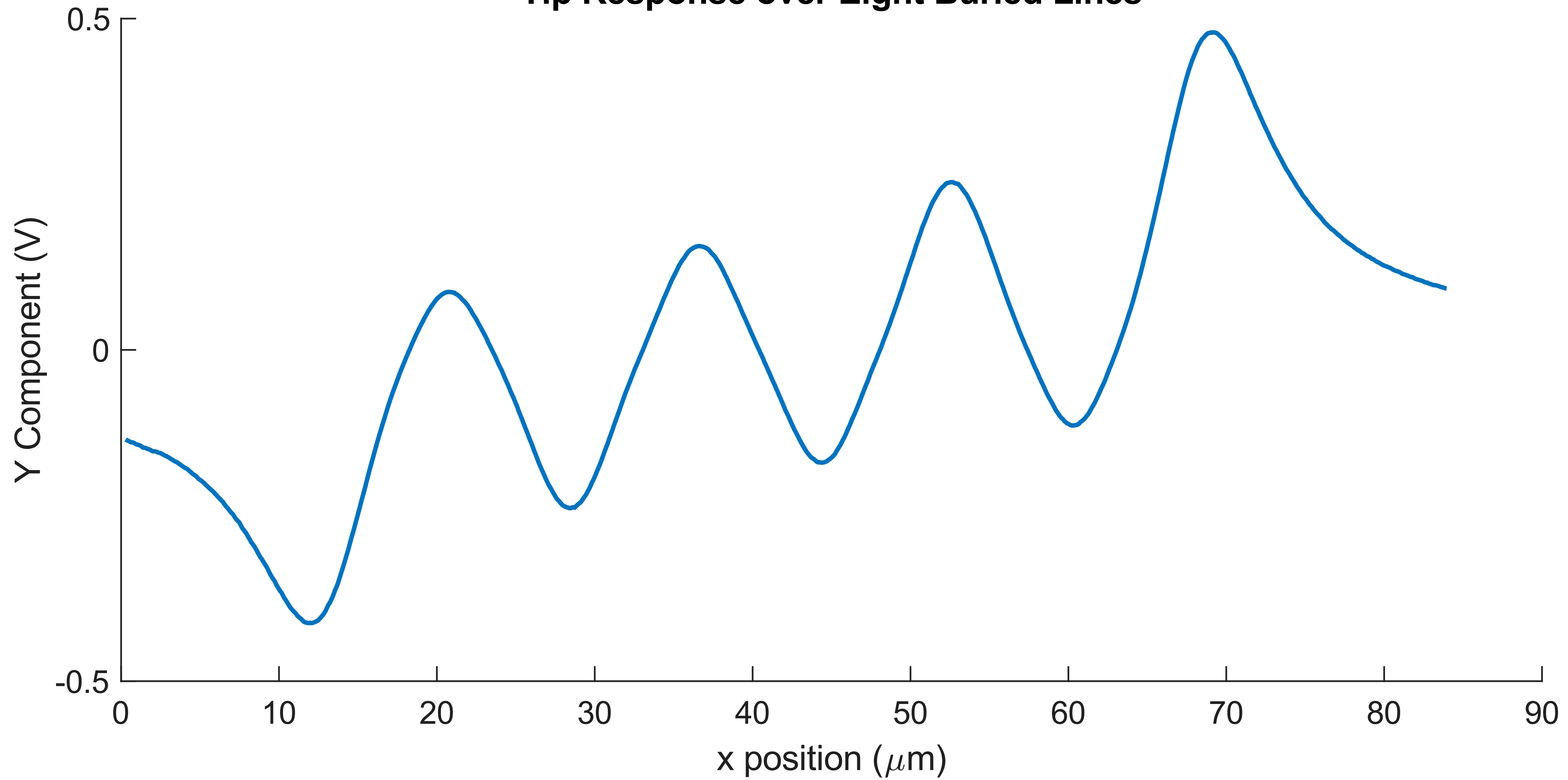
Theory's Limitations



Experimental Work






Tip Response over Eight Buried Lines
Y Component (V)
0.5
0
-0.5
0
10
20
30
40
50
60
70
80
90
x position (μm)

Conclusion

- Theory and modeling
- Instrumentation documentation
- RB-EFM Demonstrated

Acknowledgements

- Joe Kopanski and the Nanoscale Imaging Group at NIST
- The Society of Physics Students Internship Program

References:

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You L., Ahn J-J, Hitz E., Michelson J., Obeng Y. and Kopanski J. Electromagnetic field test structure chip for back end of line metrology. *Int. Conf. on Microelectronic Test Structures* **235-9** (2015).