

Field Enhancement Determination of Near-field Probes Through Photoemission Electron Microscopy

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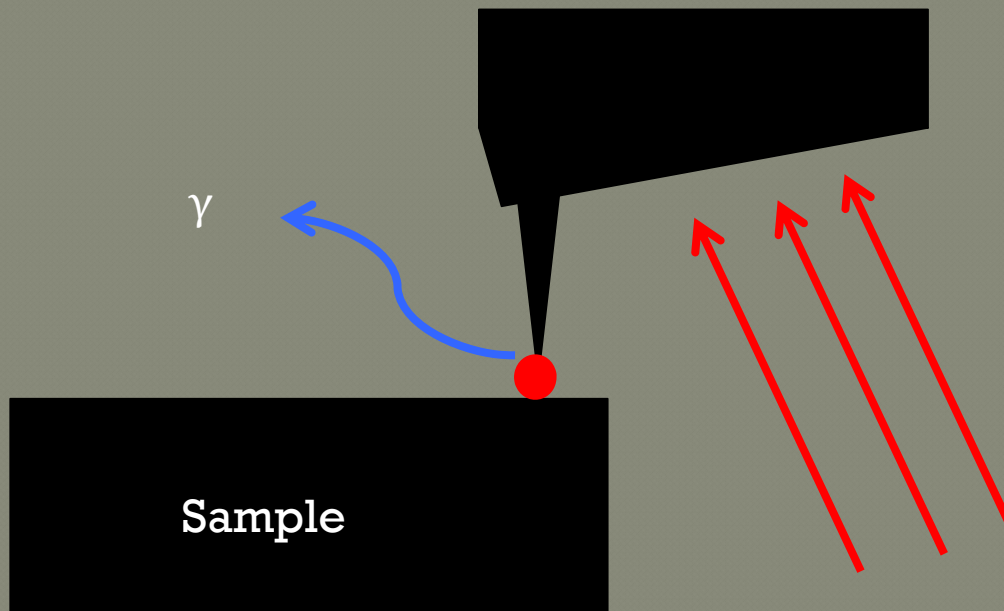
Agenda

- Theory Overview
- Project Overview
- Detector Issue and Re-design
- Milling Project

TENOM

- Tip Enhanced Near-field Optical Microscopy
 - Diffraction Limit
 - Optical microscope with nano-scale resolution
 - Photoemission Electron Microscope (PEEM)

Theory Overview



Project Overview

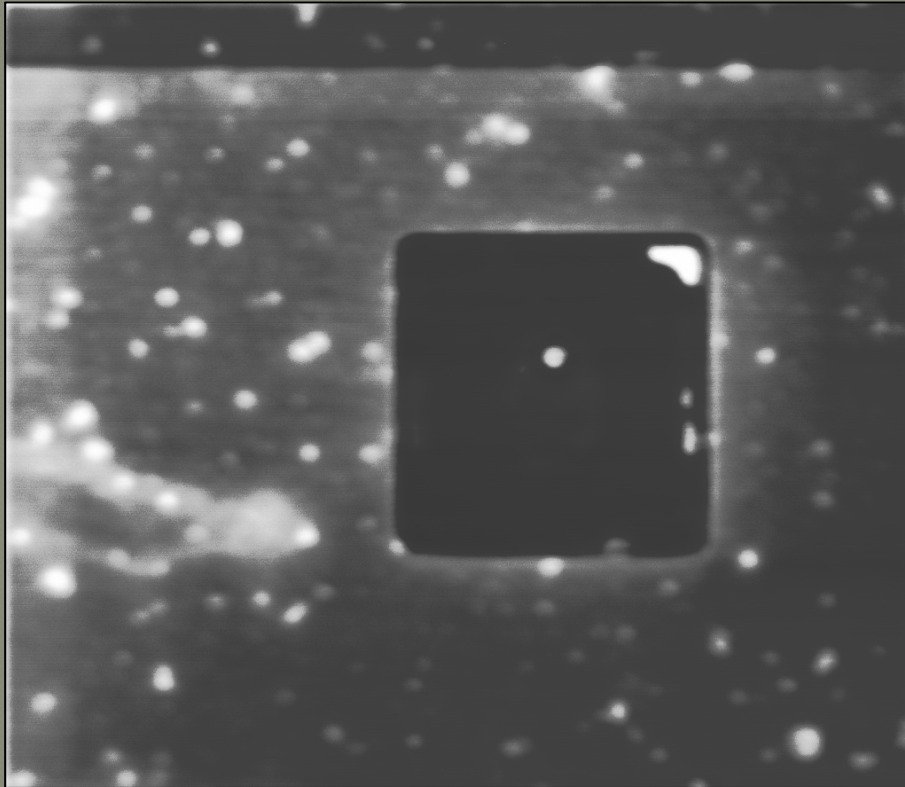
- Fabricate near-field probe tips
 - Focused Ion Beam (FIB)
- Grayscale bitmap template
 - 'Bird's eye view'

Project Overview

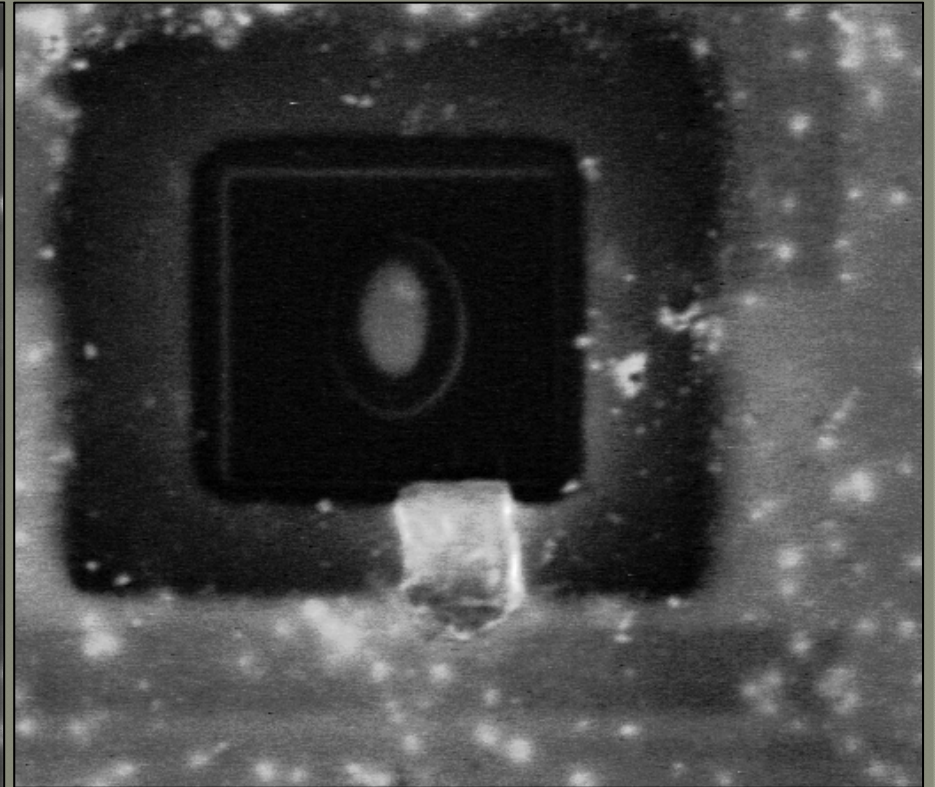


Si

Detector Issue



1 mm

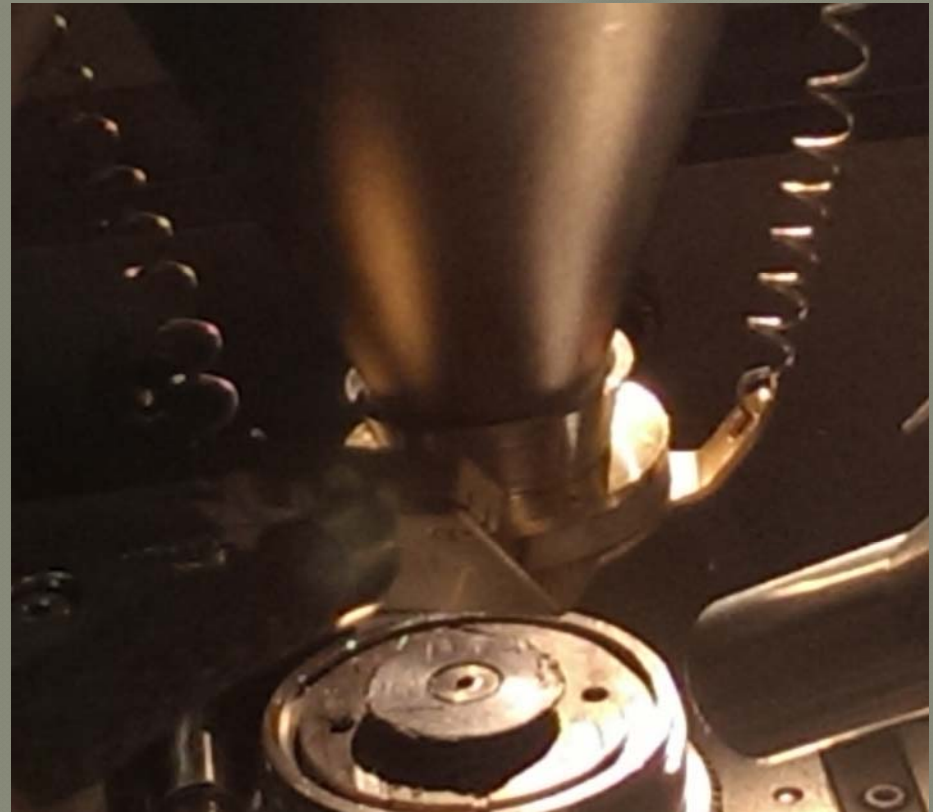


500 µm

Detector

◉ Design

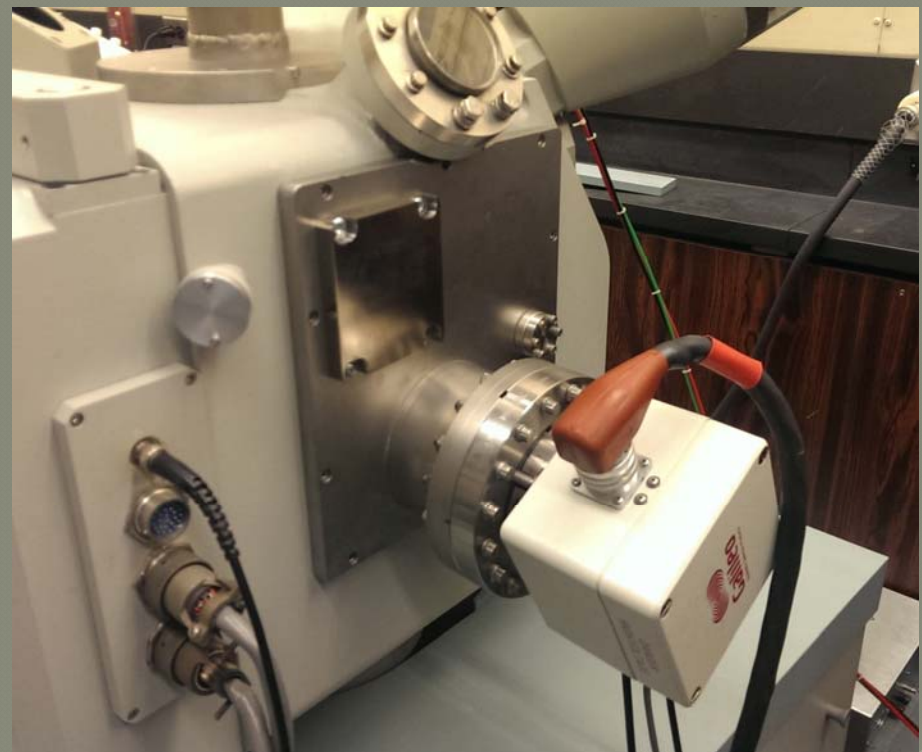
- SEM Micro Channel Plate Detector
 - JEOL Galileo Detector
- Reconfigured for FEI 611 FIB



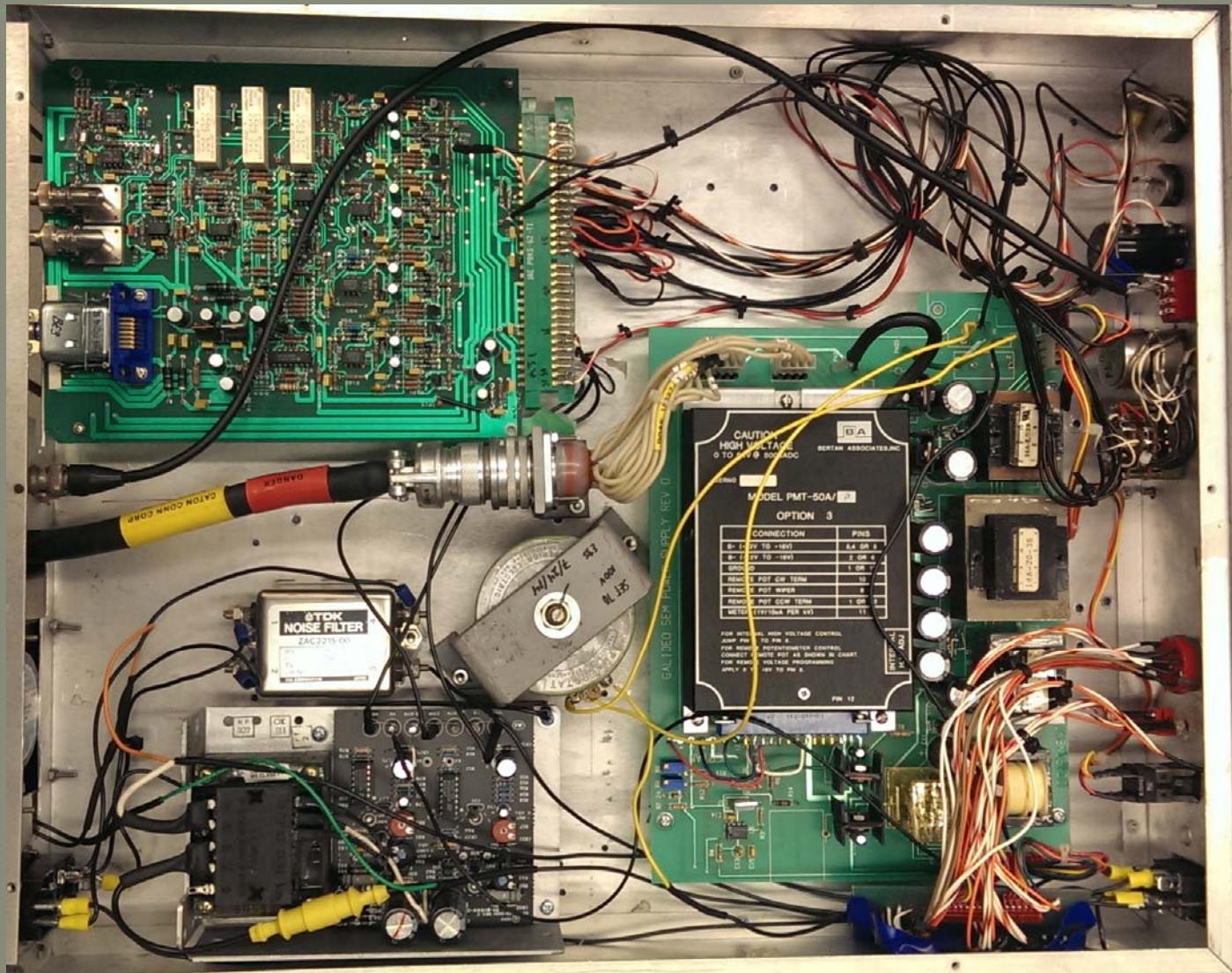
Detector

Construction

- Rewired and machined
- 19" rack mount
- Control board
- Power Supply
- Switches and knobs



Detector



Detector

Implementation

- Software
 - Look Up Table error



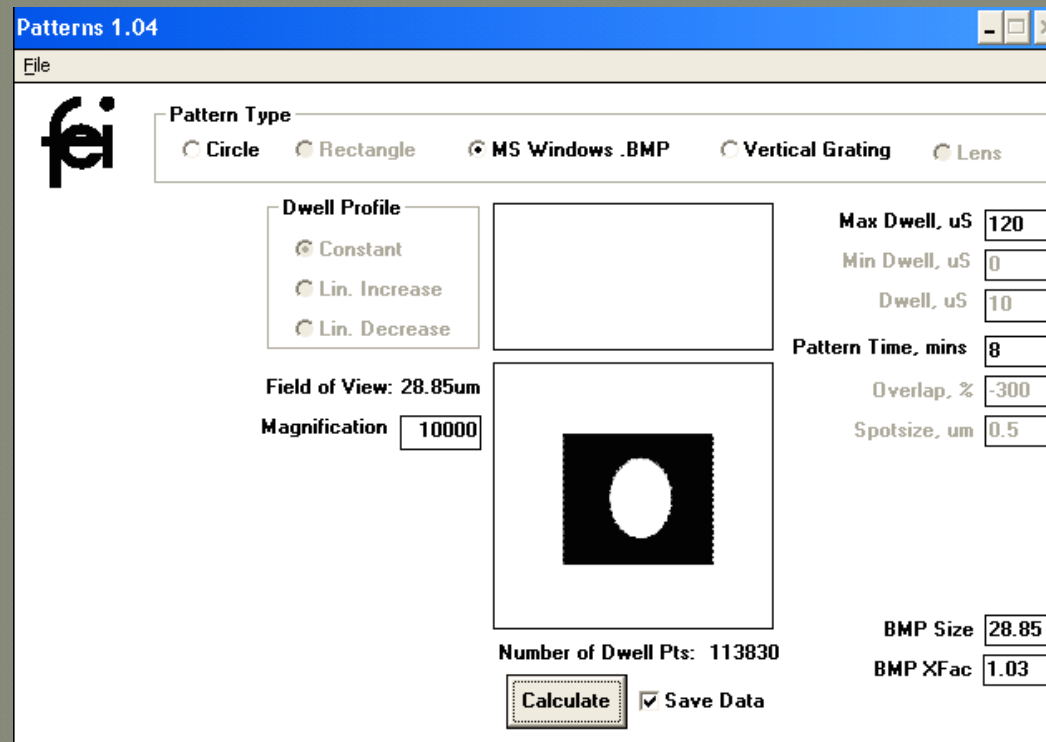
Milling

- Optimizing Pattern
 - Lens 1 Voltage (Beam Current)
 - Max Dwell
 - Pattern Time
 - Magnification

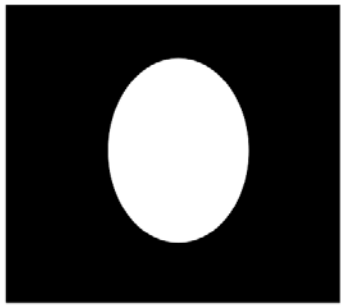


“Patterns 1.04”

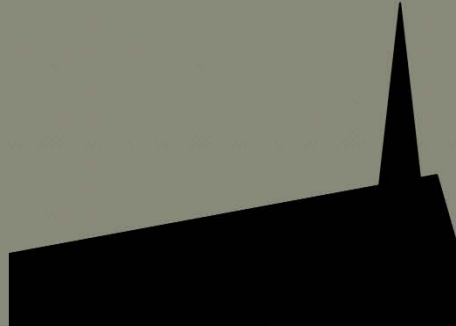
- 1995 FEI Visual Basic 4 program
- Converts bitmaps to FEI Stream files



Milling Patterns



Si



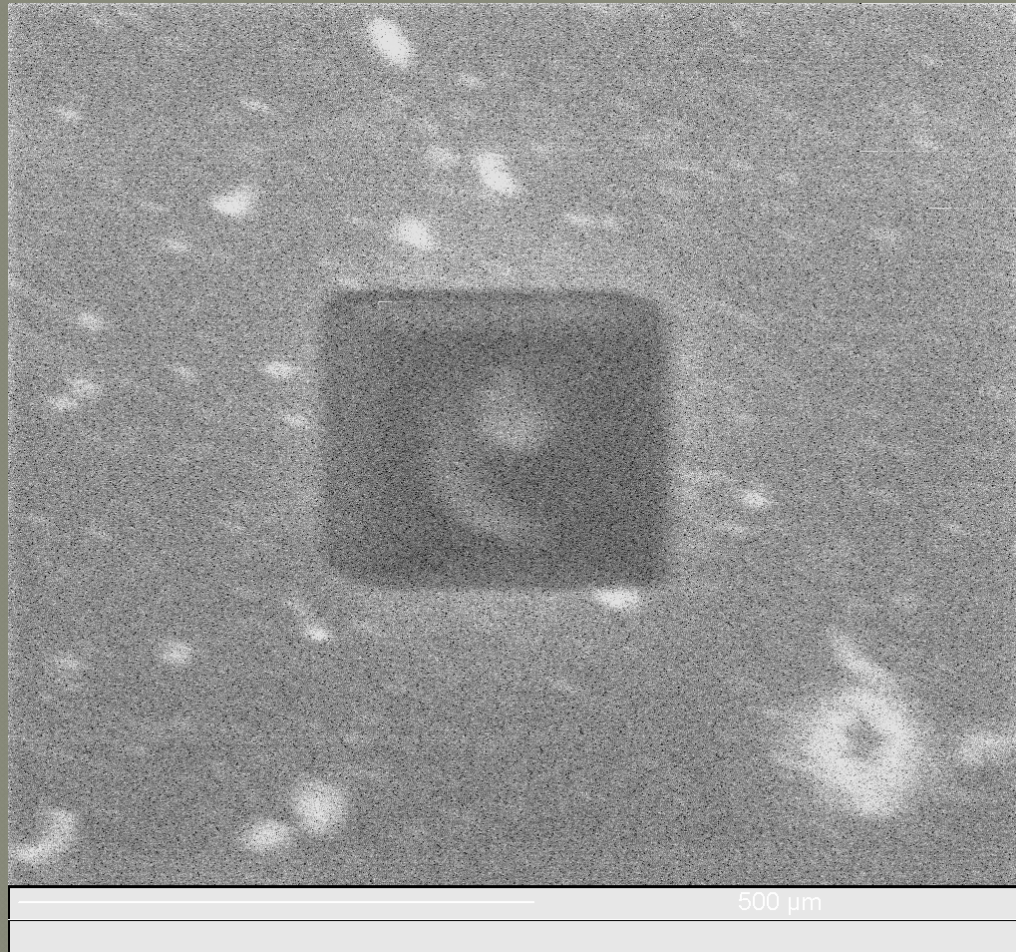
Milling Results



Milling Results



Milling Results



Conclusions

- Another new detector
 - Different MCP designed for a FIB
 - New Charge Detection Electron Multiplier (CDEM)
- Work will be continued until the project is complete

Acknowledgments

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- NSF



References

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- Richards, David. "Near-Field Microscopy: Throwing Light on the Nanoworld." *Mathematics, Physics and Engineering* 361.1813 (2003): 2843-857. JSTOR. The Royal Society, 15 Dec. 2003. Web. 06 Aug. 2014.
- Sánchez, E., A. Dunham, D. Nowak, J. Straton, and J. Doughty. "Enhanced Image Contrast with Delocalized Near-Field Excitation." *Crystal Research and Technology* DOI 10.1002/crat.201300325 (2014): n. pag. Wiley Online Library, 9 Jan. 2014. Web. 13 Aug. 2014.