

EBL Basics: Spin, Contrast and Exposure Latitude Curves

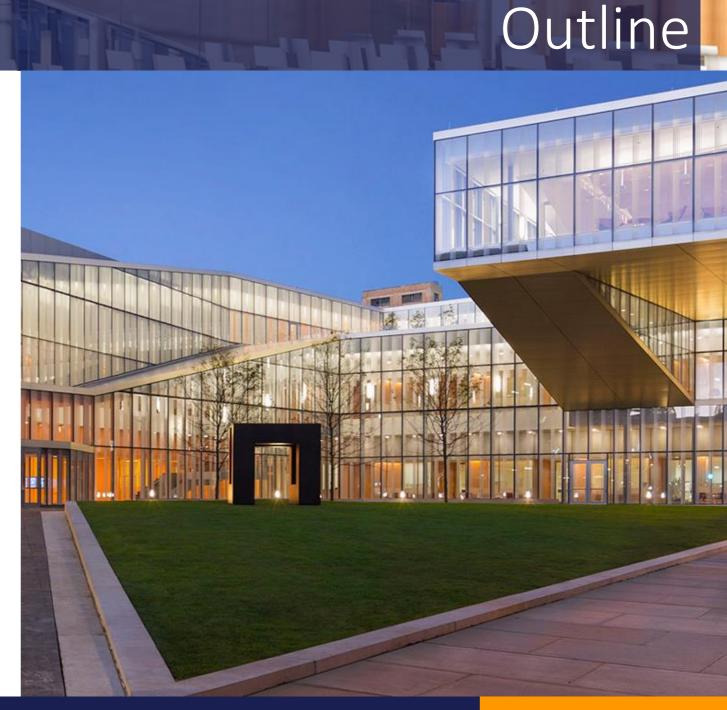
Gerald G. Lopez, Ph.D. QNF Senior Manager, Lithography and Process Engineering



School of Engineering and Applied Science



- Motivation
- Basics:
 - Spin Curve
 - Contrast Curve
 - Exposure Latitude
- Exposure Latitude and The Effective Process Blur
- Exposure Latitude + Pattern Density
- Summary





You've never done e-beam.

You've maybe done e-beam.

You've done e-beam but made it up as you went along.

l've been a grad student before.



Lithography Competencies

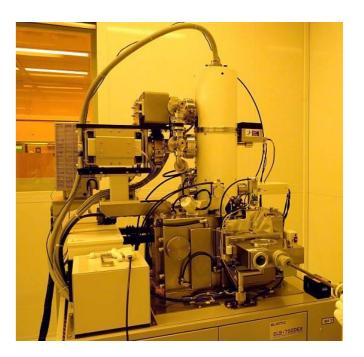
CAD

Data Preparation





Tooling/Process





Process Characterization

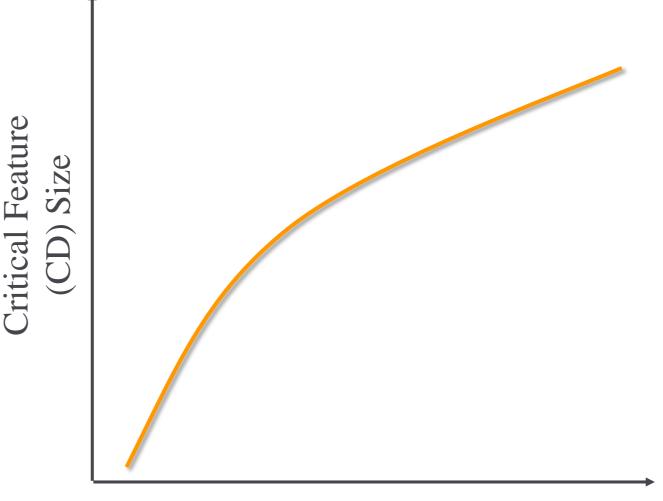
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Mid-Atlantic Electron Beam Lithography 2017 Wednesday, April 19, 2017



Lithography Process Characterization

- Spin Curve
 - Speed Dependent
 - Resist Dilution
- Contrast Curve
 - Developer Concentration
 - Developer Temperature
 - Development Time
- Exposure Latitude
 - Developer Concentration
 - Developer Temperature
 - Development Time

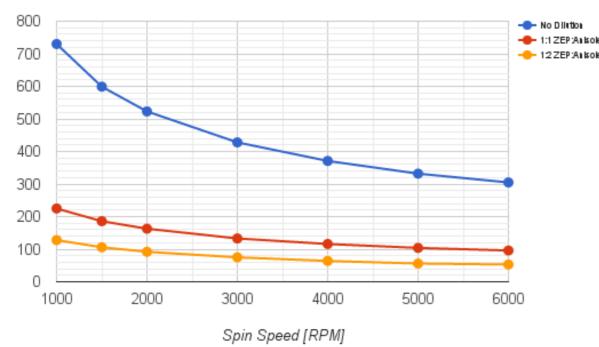






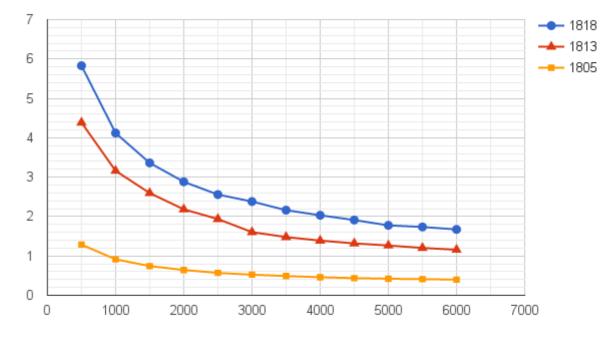
Resist: Spin Curves

Electron Beam Lithography



No Dilution, 1:1 ZEP:Anisole and 1:2 ZEP:Anisole

Laser or Mask Aligner Lithography

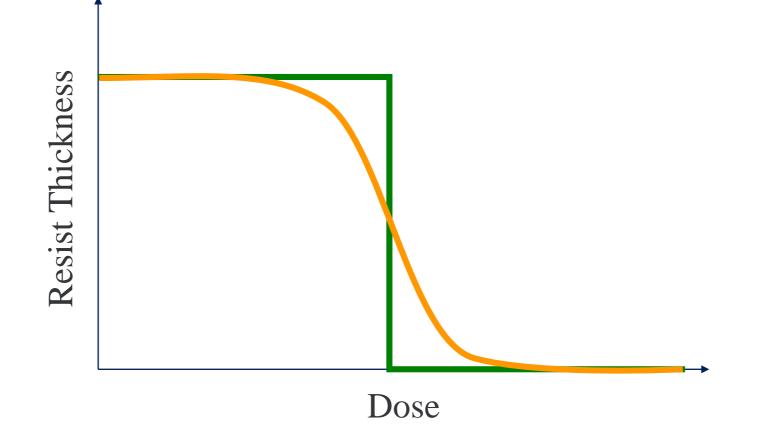


MicroChem S1800 Resist Spin Curves

Spin Speed [RPM]

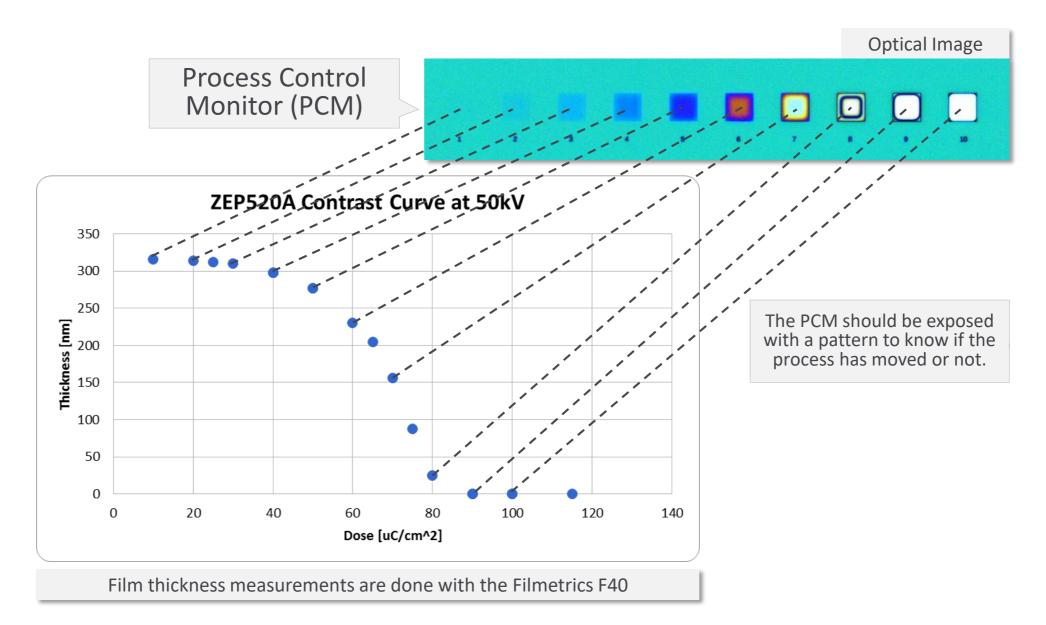


Contrast Curve



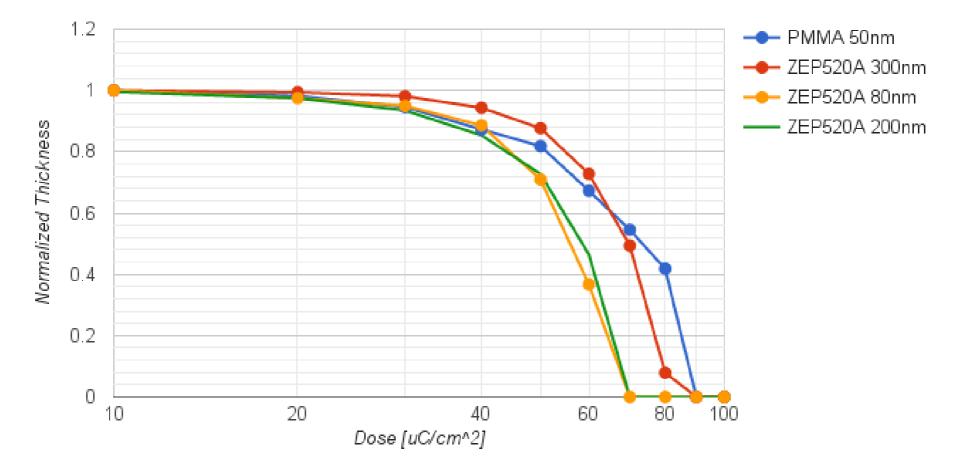


Contrast Curve: ZEP520A





Contrast Curves: PMMA A2 and ZEP520A

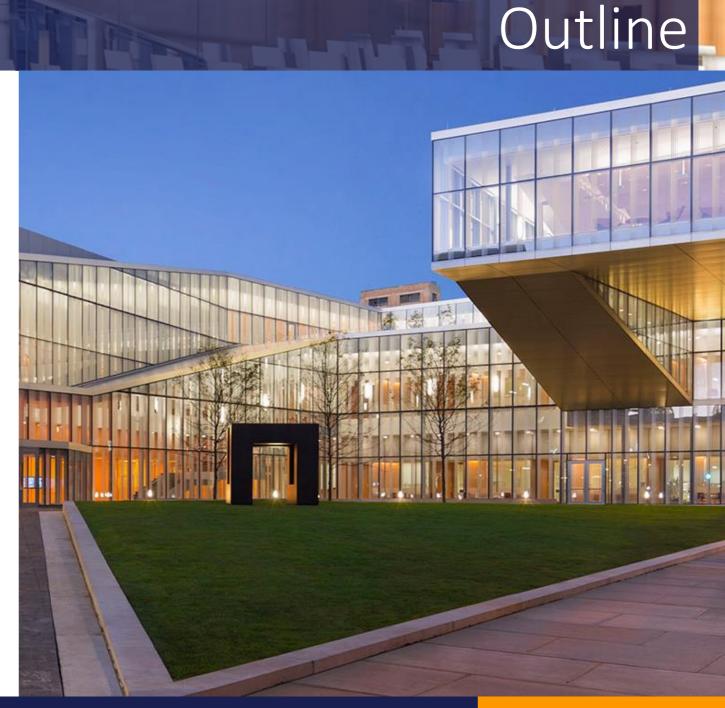


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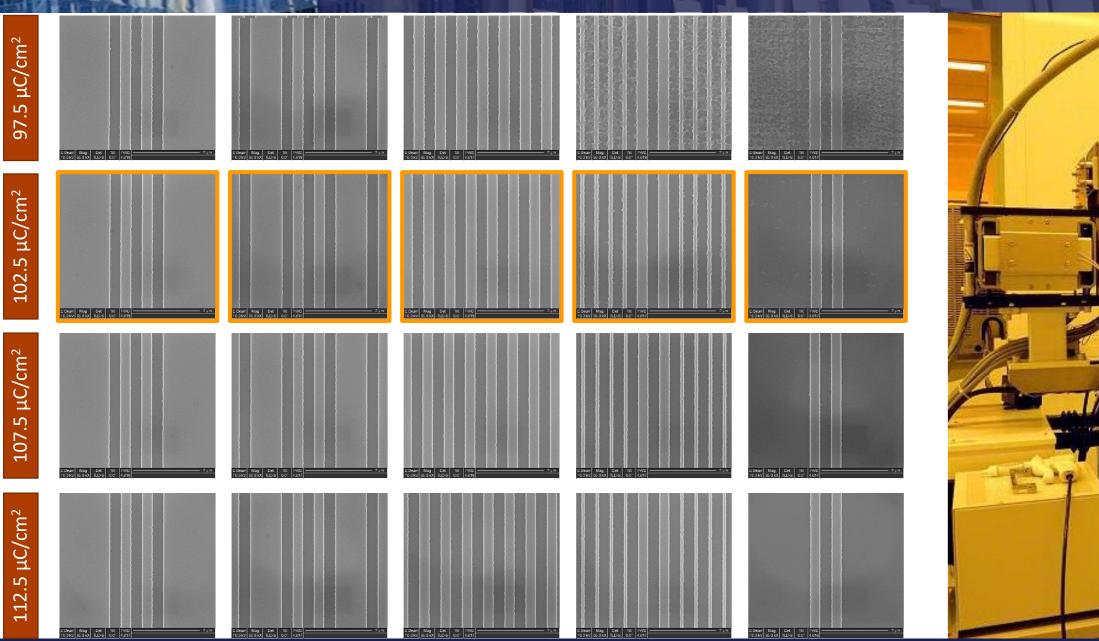
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Dose Matrix

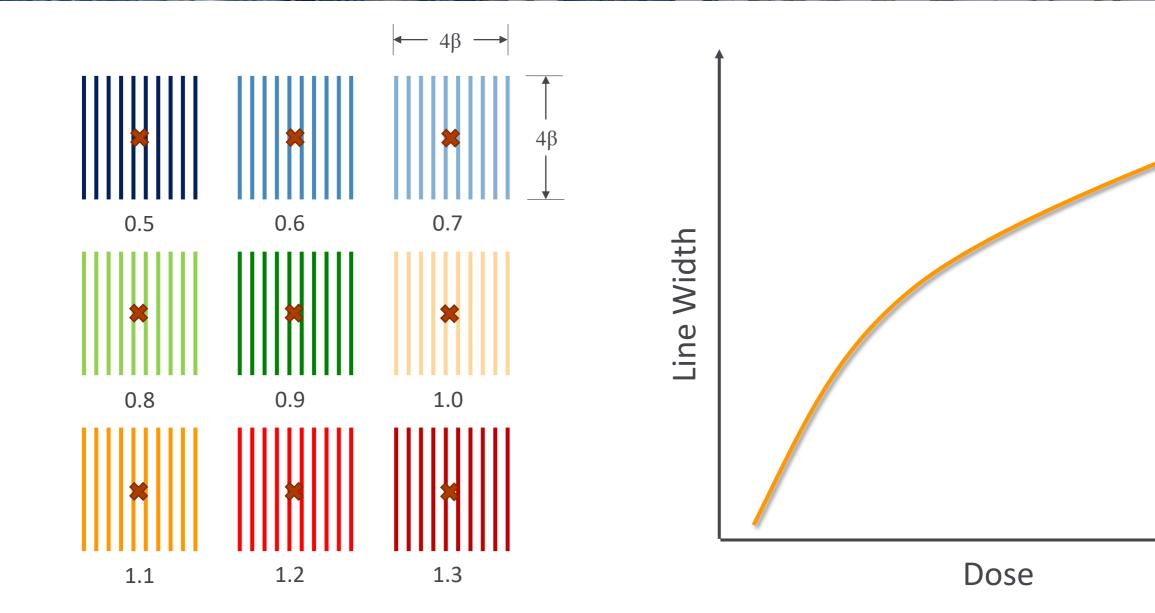
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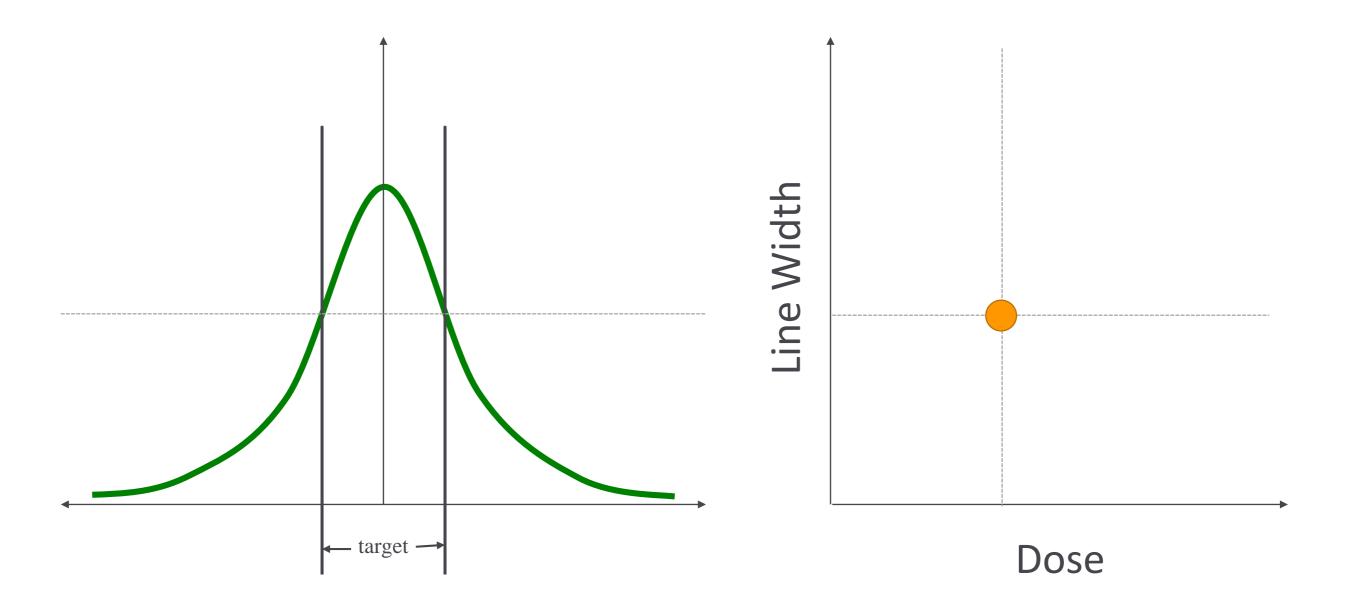
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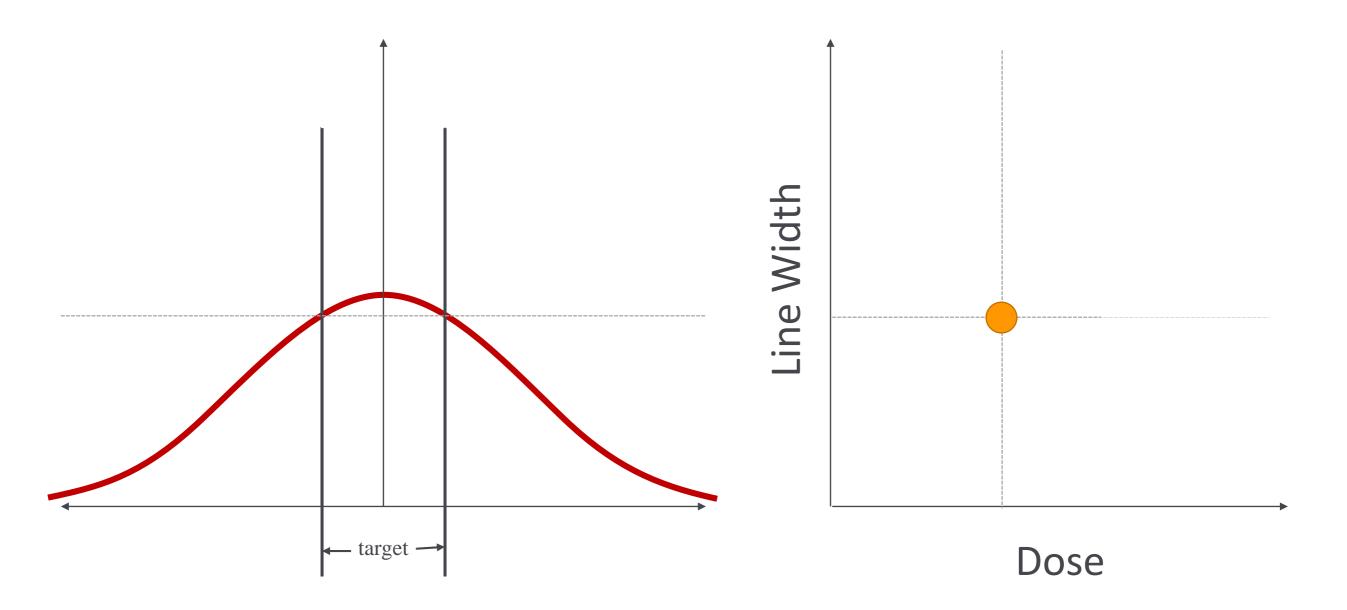


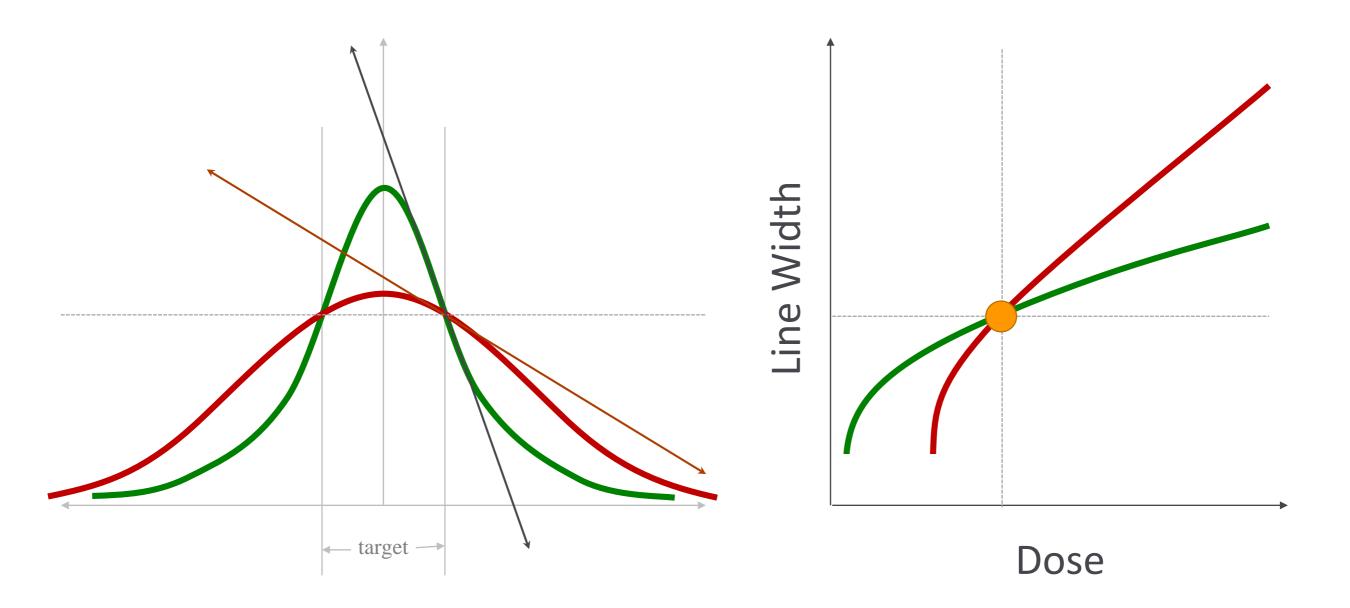


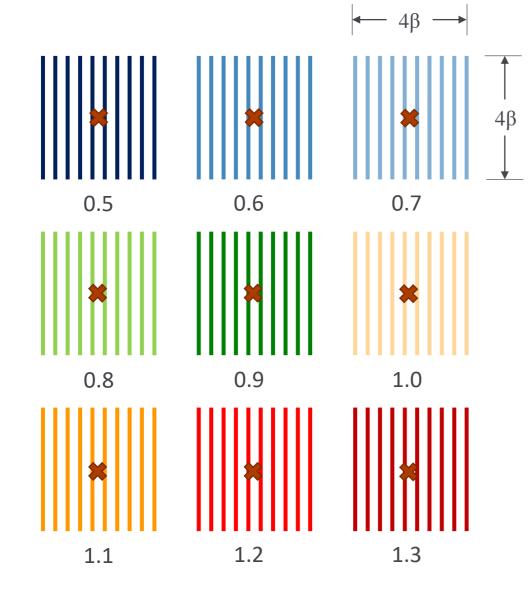
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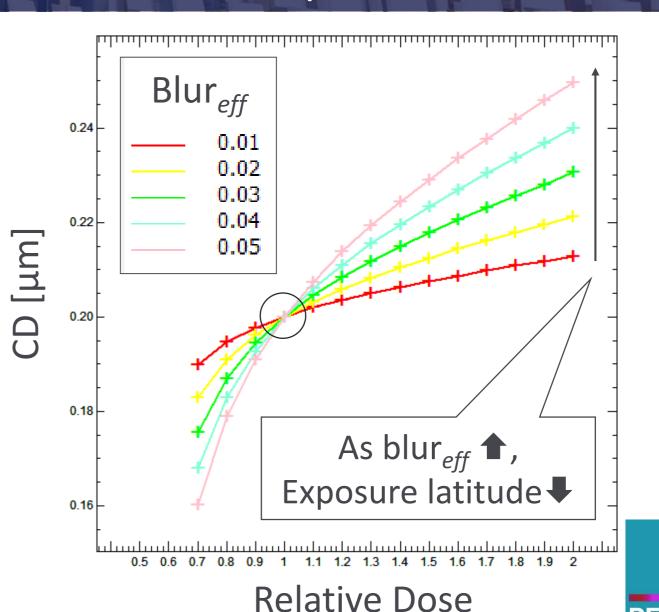
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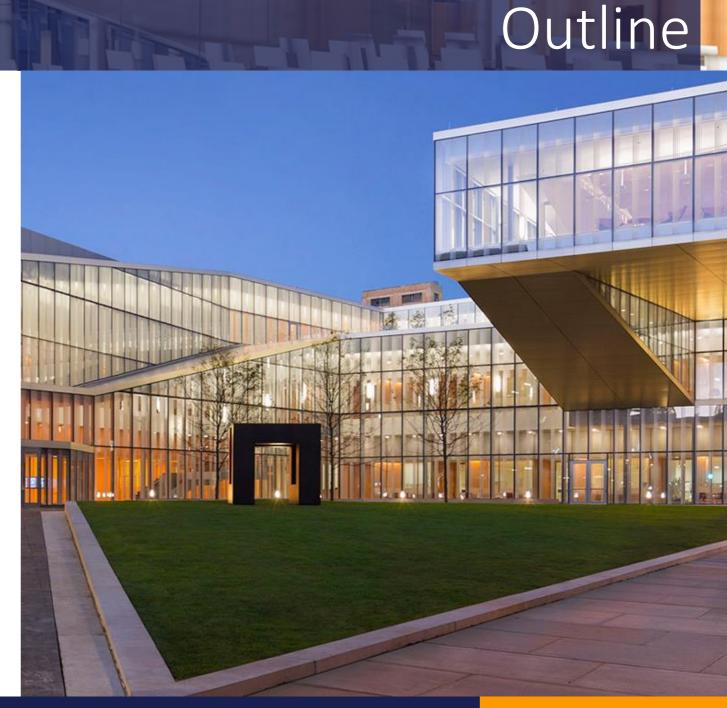


Simulation: Exposure Latitude

BEAMER

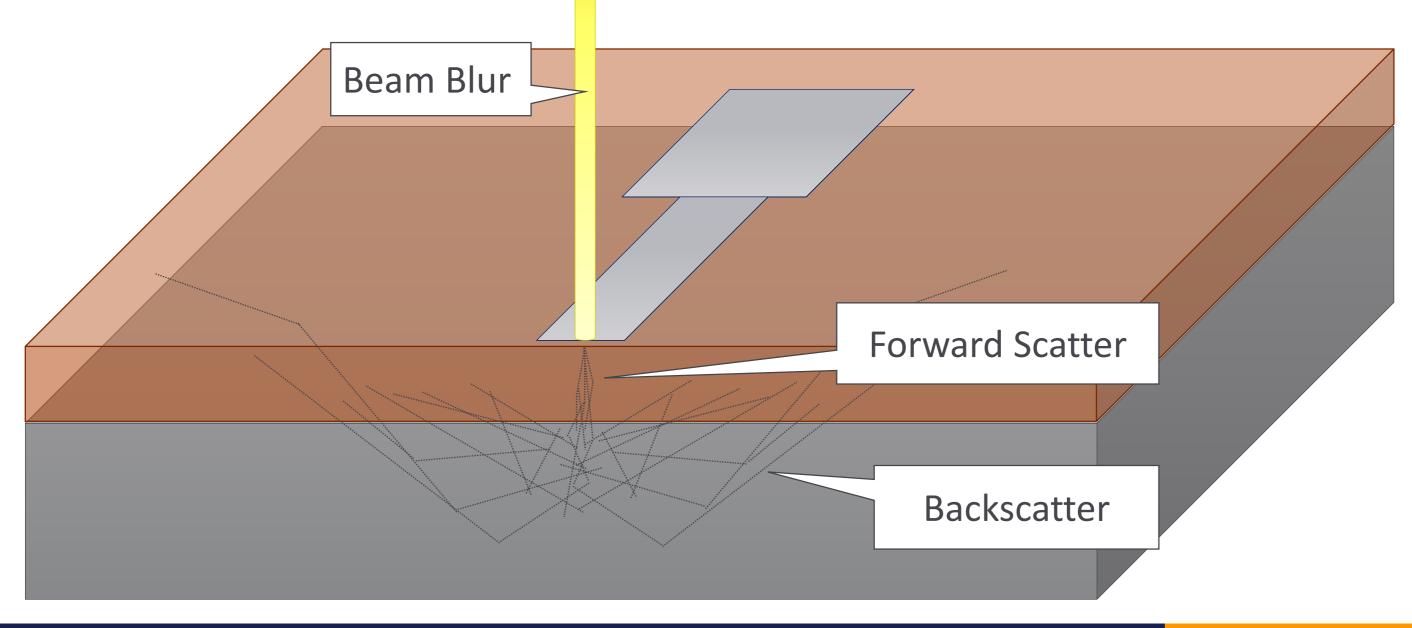


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Electron Scattering

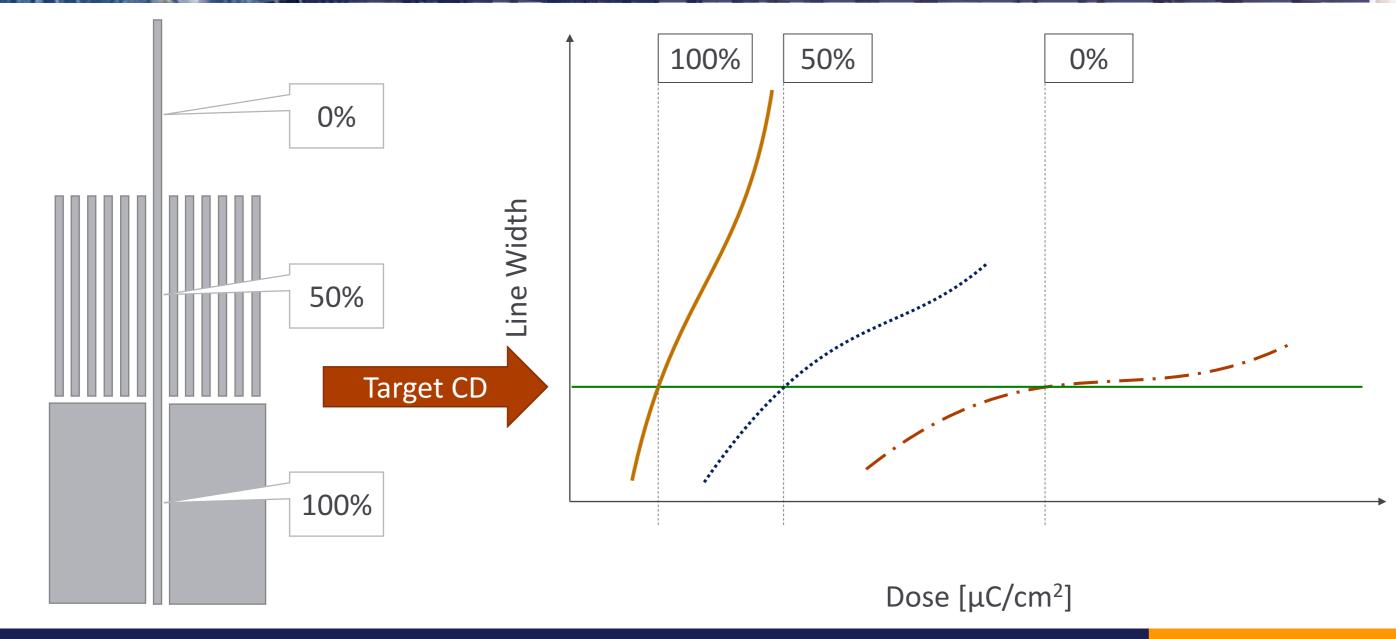


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QNF Littliographictron Beam Lithography 2017 Wednesday, July



Exposure Latitude

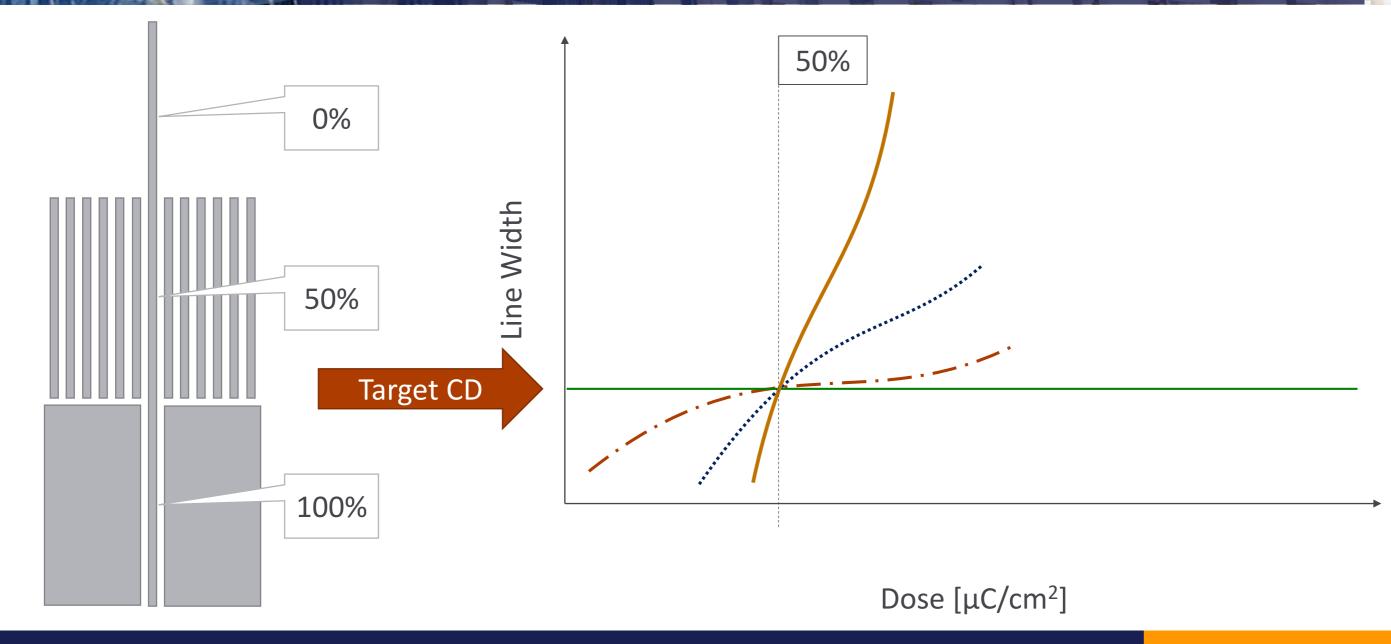


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Exposure Latitude + PEC





Summary

- Getting Started
 - Spin Curves
 - Contrast Curves
 - Exposure Latitude
- Exposure Latitude
 - Effective blur
 - Pattern density
- Proximity Effect Correction (PEC) is a superposition of the pattern density dependent exposure latitudes



Mask Fabrication Services

Congratulations on 10 years Congratulations on some serving the litho community 2005-2015

Soda Lime*	>2um	>10um
5" Mask	\$300	\$200
7" Mask	\$400	\$300
	* (add \$75 for Quartz

Soda Lime*	>2um	>10um
5" Mask	\$450	\$300
7" Mask	\$650	\$400
*add \$75 for Quartz		



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