GenISys
Advancing the Standard

BEAMER

For advanced electron beam lithography

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Agenda

- GenISys Introduction
- E-Beam Lithography: From Layout to Wafer
- BEAMER Basics
- Basic Pattern Preparation
- Fracturing
- Field Control
- Proximity Effect Correction (PEC)

About GenISys

GenISys offers software solutions for optimization of micro- and nano-fabrication processes

Company:

- Founded in 2005, joined RSBG Group in 2018
- Headquartered in Taufkirchen - Munich, Germany
  - Additional development location in Jena – Germany
  - Subsidiaries for customer support in USA and Japan
- Fast, Flexible, Responsive

Products

Electron and Laser Beam Direct Write Software

- Market leader for Gaussian beam direct write systems
- Installed at most major nano-fabrication centers worldwide, has become a MUST for advanced e-beam lithography

BEAMER

Monte Carlo simulation software

- MC-Simulation of electron distribution for e-beam lithography modeling and correction
- Process Calibration, PSF visualization, extraction and management

TRACER

3D lithography simulation & OPC software

- Proximity Lithography (mask aligner) & Projection Lithography (stepper / scanner)
- Electron Beam Lithography, Laser Beam Lithography (Heidelberg Instruments laser systems)

LAB

SEM Image Analysis & Metrology

- Metrology software for SEM based metrology and inspection

Pro SEM

Mask Production Software

- Dedicated MDP for mask house, high performance (hierarchy, parallel processing, mask process correction…)
- Special Application: Flat Panel Display, Photonic IC, non-IC

MASKER

Selected Installed Base

- Major nanofabrication centers worldwide
  - Universities, Research Centers
- Industrial R&D and special production
  - Advanced FPD manufacturers
  - Mask manufacturer

Europe - Middle East

Japan - Asia

North America

500 commercial licenses worldwide

- 230 BEAMER (83 EU, 80 APAC, 70 US)
- 140 TRACER
- 65 LAB
- 30 ProSEM

Strategic Partnerships

GenISys is a independent software supplier working with all major lithography and inspection system manufacturers.

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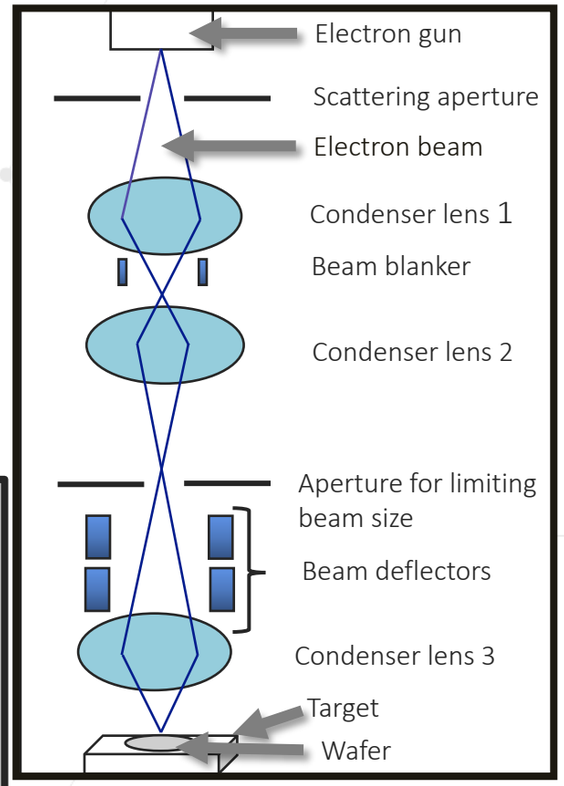
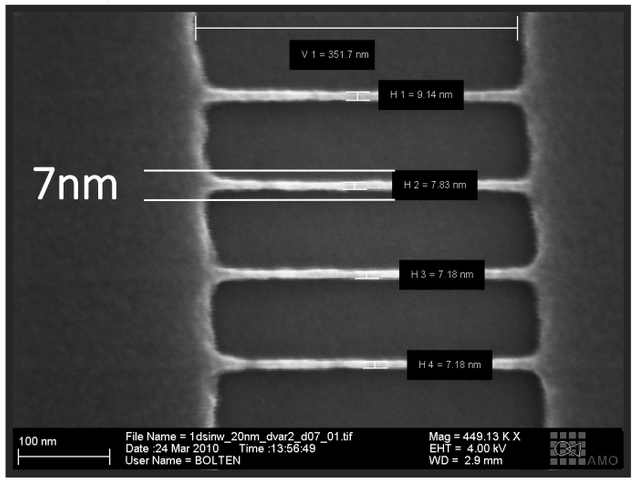
Electron Beam Lithography

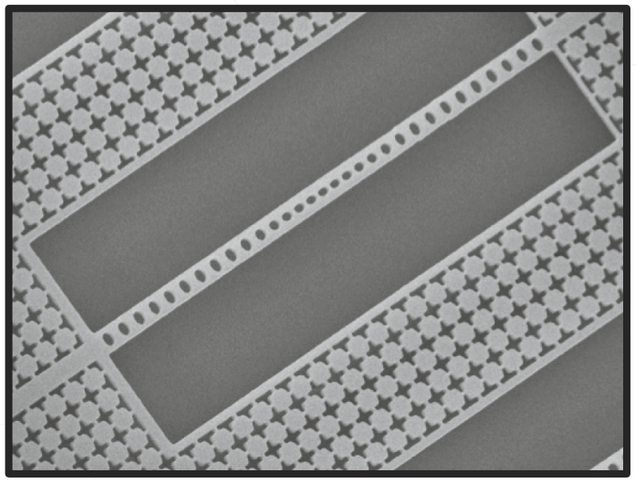
E-Beam lithography (EBL) is the most utilized technology for patterning nano-scale (Quantum) devices

- Beam size down to few nano-meter
- Most flexible pattern and substrate
- Direct Write from CAD data to sample

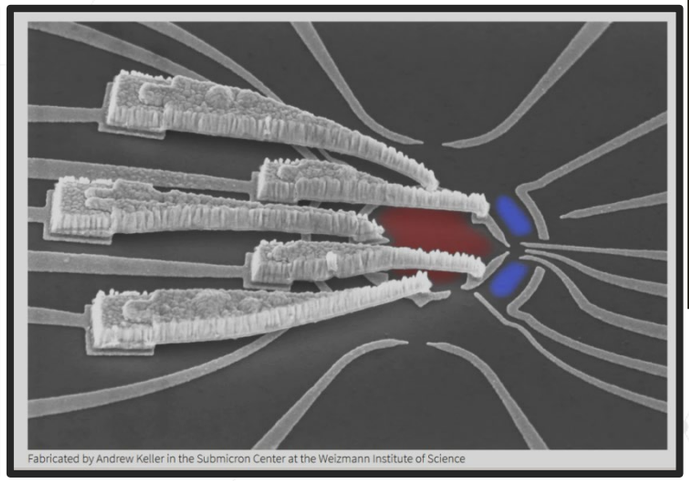




Source: AMO GmbH - Germany



Source: NIST CNST - USA



Source: Weizmann Institute – Israel
Stanford University, USA

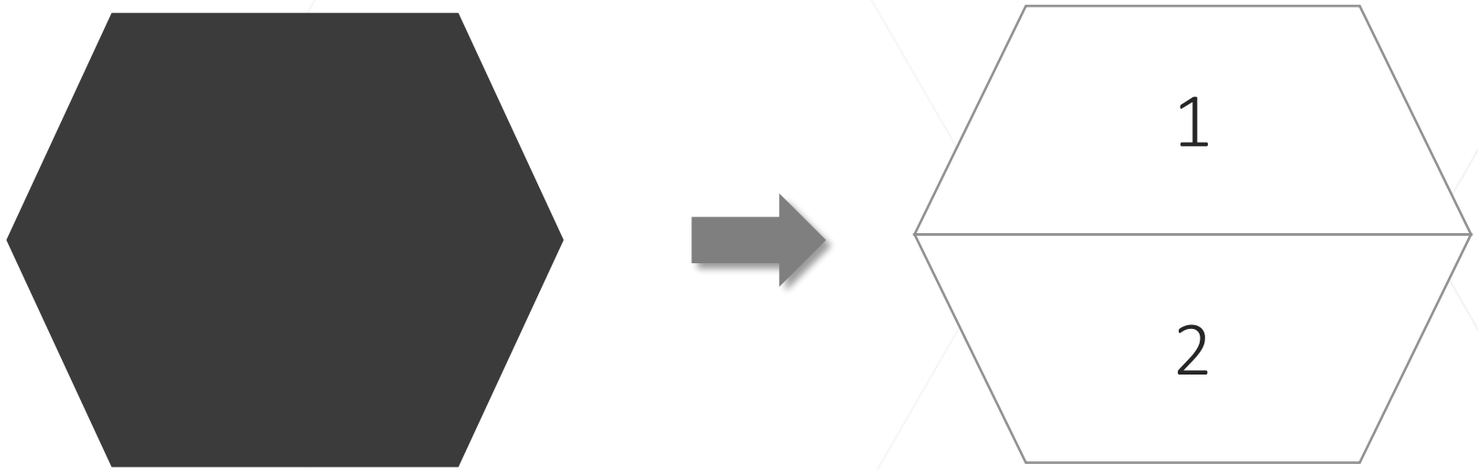
GOOD DATA IN → GOOD SAMPLE OUT

Lithographer´s Reality

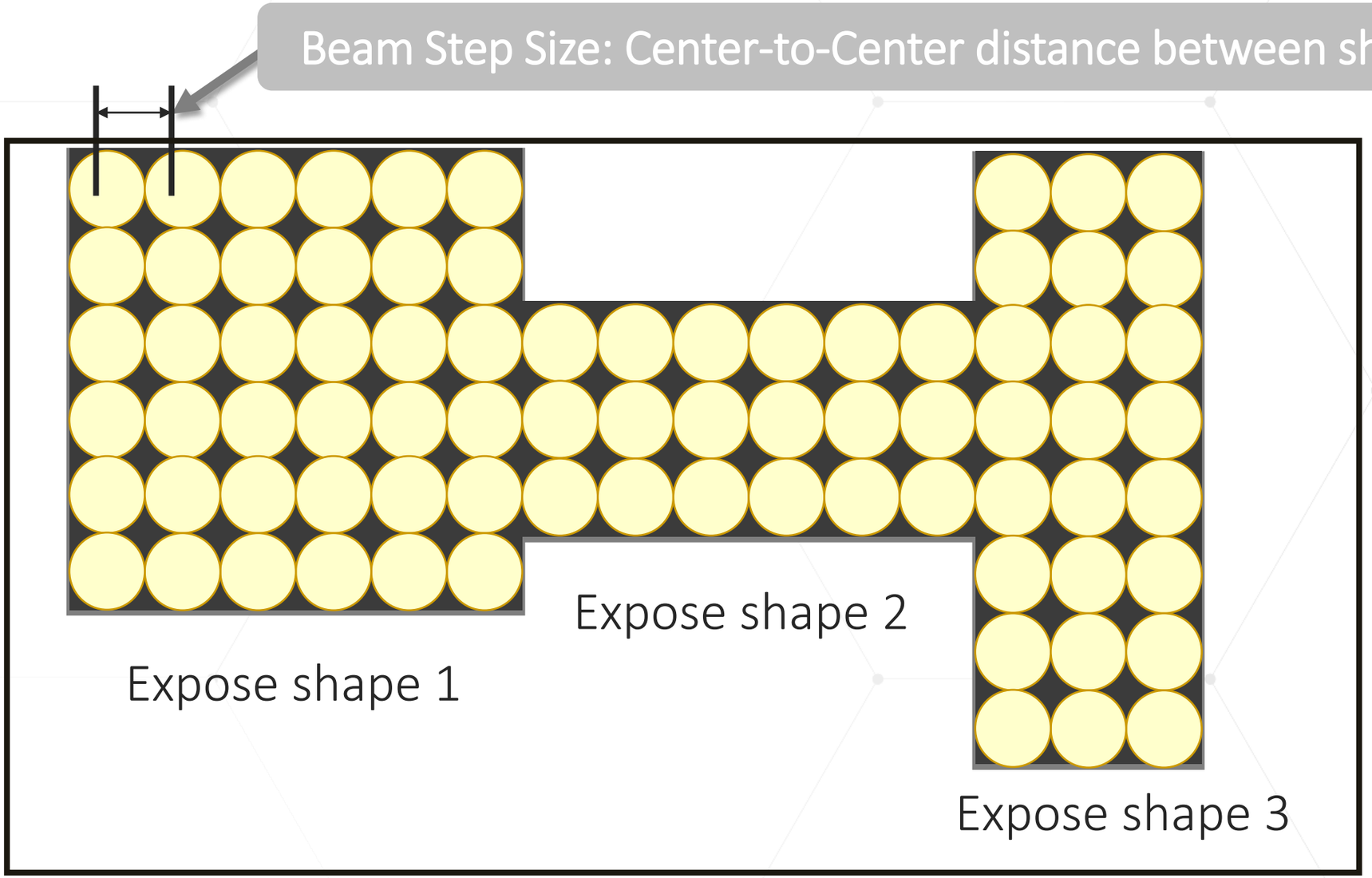
- Electron beam systems are not “office printers”
  - Many application and process specific effects to fight
- Easiest (but expensive) way until now: trial-and-error
  - Using smallest possible beam current, accepting long write times
  - Required many iterations to determine best exposure dose
- BEAMER established new data preparation “best practices”
  - Enables faster and more accurate writing using advanced error correction and data preparation techniques
- Good data preparation requires understanding key concepts…

Fracturing

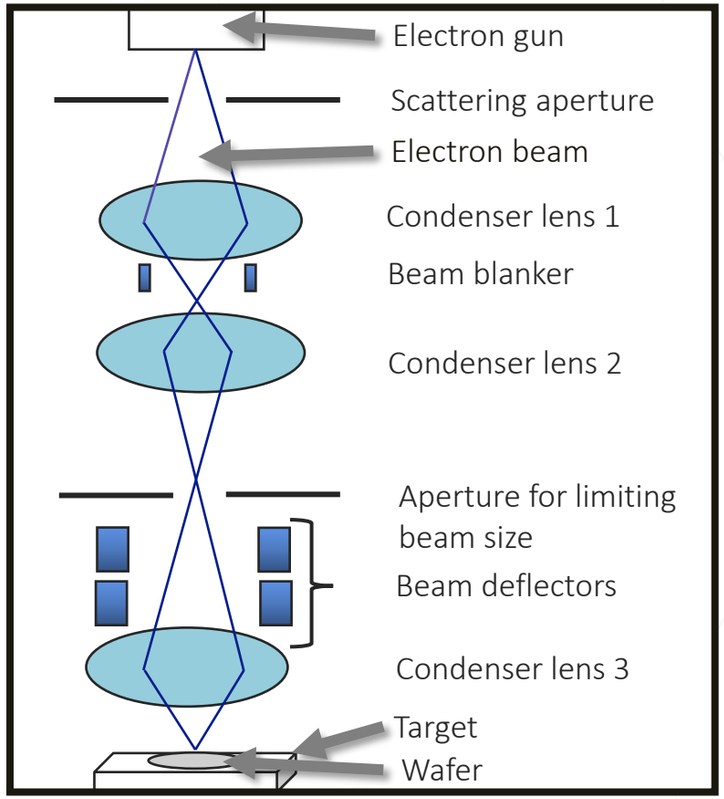
- The data (GDSII, DXF, etc.) is your design, the layout.
- The act of converting the data to the machine format is often referred to as fracturing.
- What is fracturing?
  - Fracturing is the method by which a complex shape is broken down into simple (primitive) shapes (trapezoids).
  - Most e-beam tools can only accept trapezoids



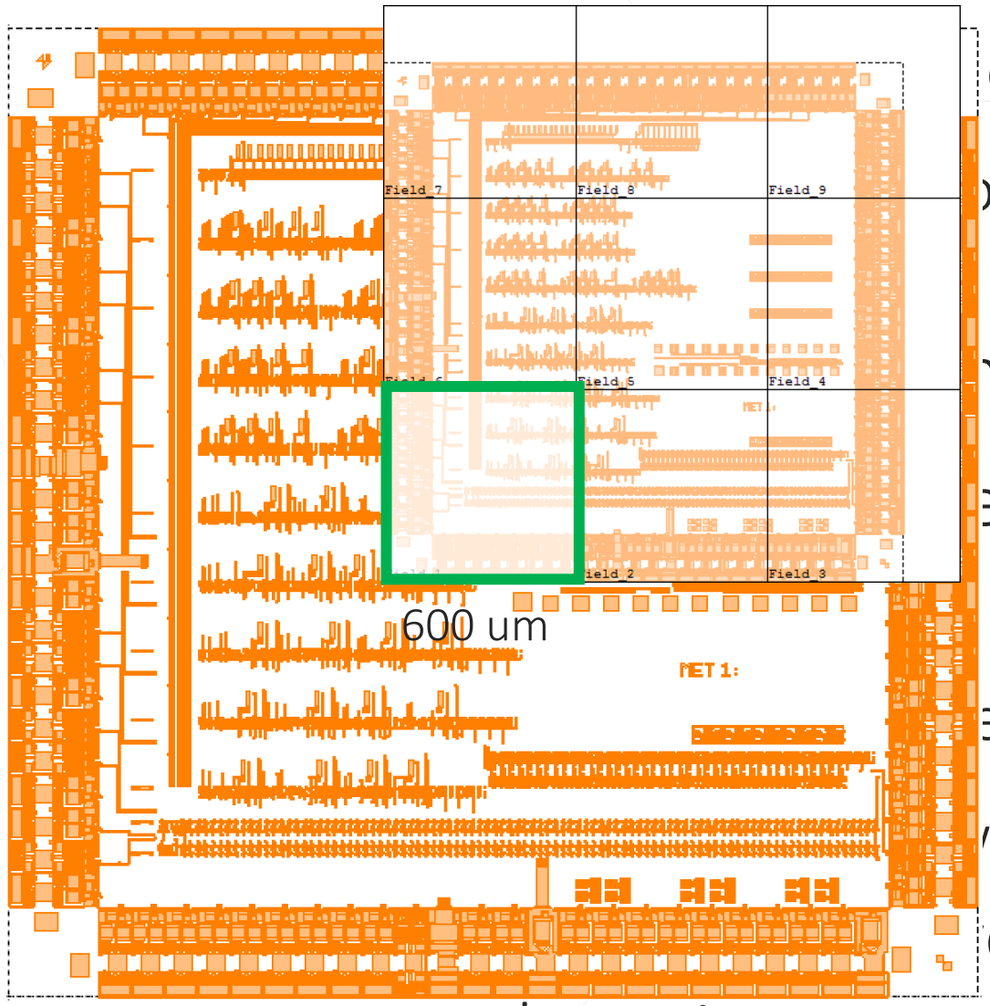
Shape Fracture/Exposure



Exposure in Write Fields



- Exposure requires scanning



echanical)

n (electro-static or –

has limited range

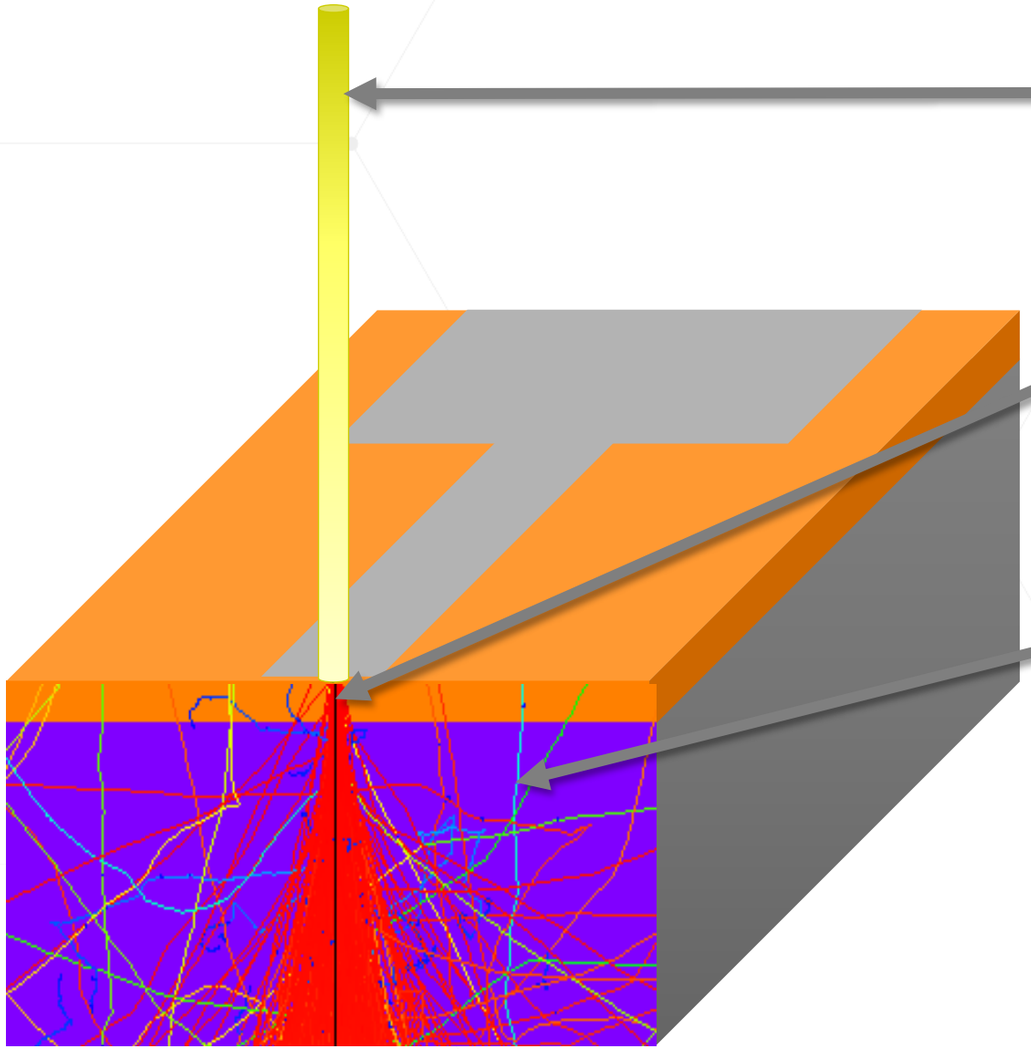
en accuracy and

e move / no scan is slow

/ stage steps is faster

es you control over the write sequence of field by field

Electron Scattering

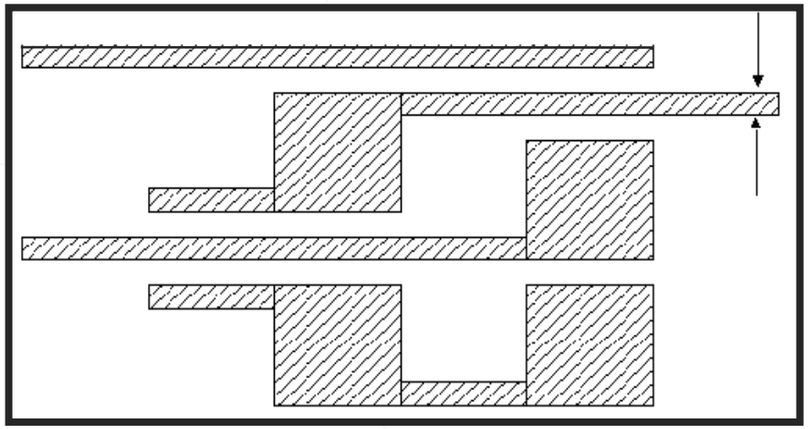


Beam Blur: 1-50nm:Current/ Aperture/Column design

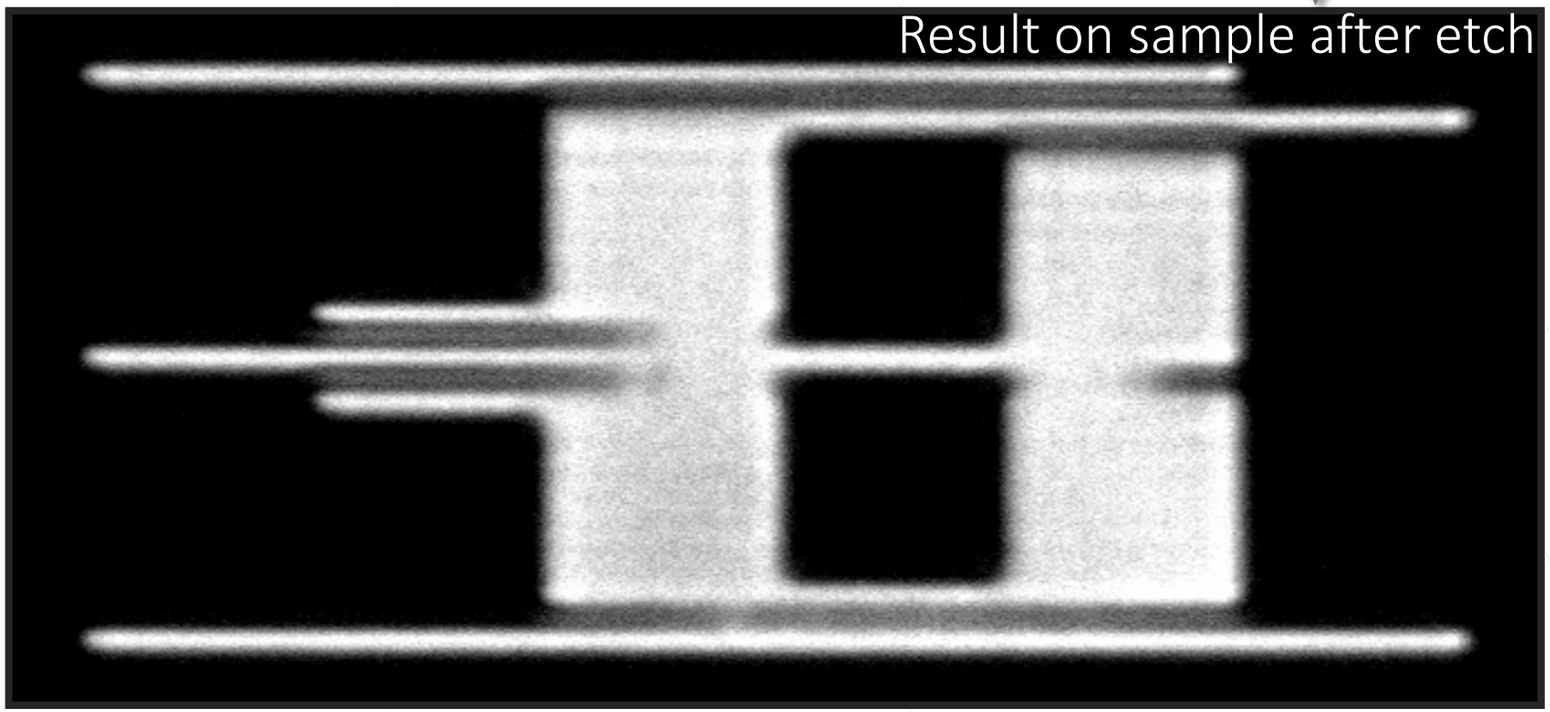
Forward Scatter: 1-10nm: Acceleration Voltage/Resist Material/Material Thickness

Backscatter: 10-30µm: Acceleration Voltage/ Substrate Material

E-beam Lithography Distortion



What you get is NOT what you design



Data Preparation

BEAMER enables clever data preparation…

- Mitigate e-beam artifacts
  - Shot Filling, Field Positioning Errors (aberration/stitching)
- Correct for proximity effects
  - Long-Range, Short Range, Process Effects, 3D PEC
- Improve
  - Wafer: Resolution, Linearity, Line Edge Roughness, Uniformity
  - Process: Repeatability, Write Time
- Essential for writing high precision devices

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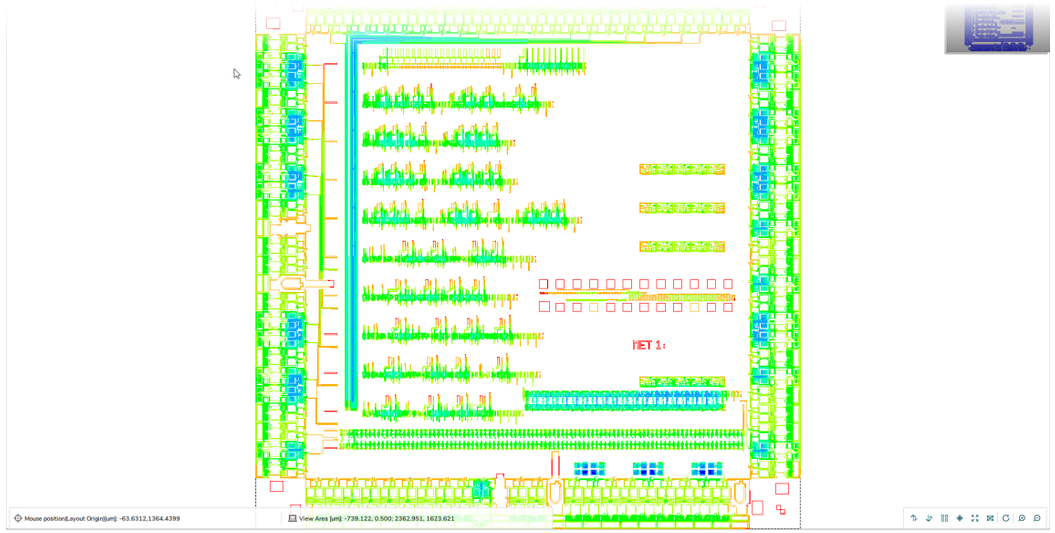
BEAMER

Unique VisualFLOW user interface

- Comprehensive functional library
- Easy and fast operation
- Supports Windows & Linux
- Flexible licensing

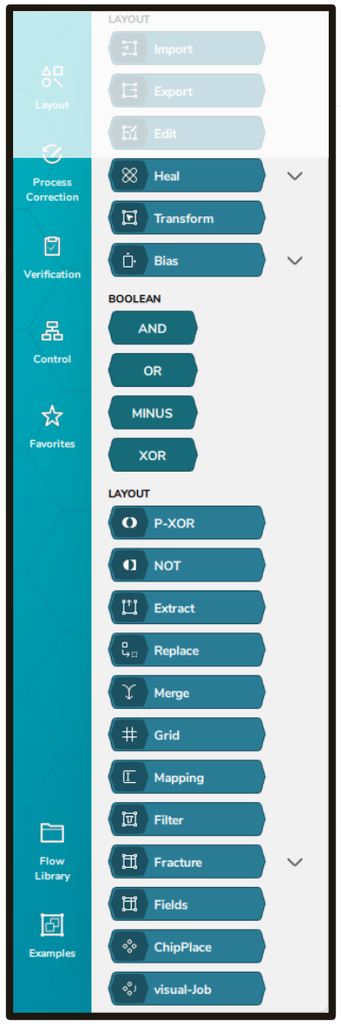


Data Formats

Supports all major data formats

- Import / Export of all major layout formats
  - GDSII
  - OASIS
  - DXF (AutoCad)
  - CIF and Ltxt (text-based formats)
  - Bitmap
- Export / Import of all major e-beam machine formats (optional)
  - Raith EBPG (GPF/IWFL), VB (VEP/FRE), Voyager, Raith GDS
  - JEOL (v30, j51, j01)
  - Elionix, Crestec (cel, con)
  - Heidelberg Laserwriter
  - ADVANTEST e-beam lithography system
  - MEBES mask writer
  - KBTEM exposure systems

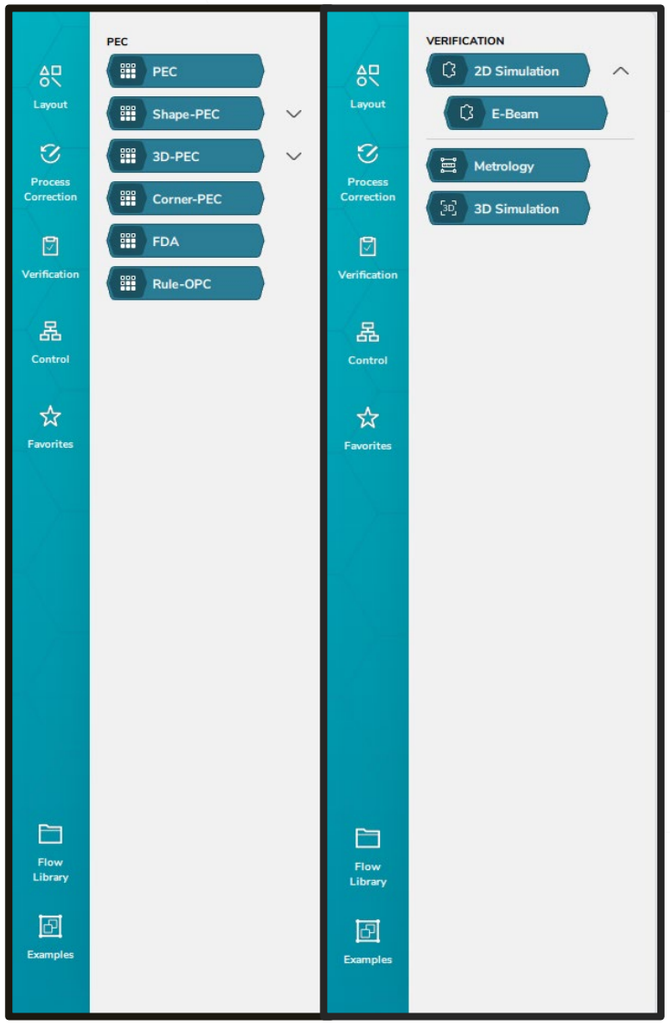
Layout Operation



BEAMER offers a rich library of data preparation functionality

- Extract layout elements, layers, cells, regions
- Filter layout elements by width, height, area
- Transform layouts: scale, mirror, rotate, shift
- Grid optimization control
- Map layer names / numbers
- Fracture with extensive controls (machine independent)
- Heal layout elements or remove overlaps
- Reverse tone
- Bias or resize intelligently
- Apply Boolean operations: XOR, P-XOR, OR, AND, MINUS
- Merge layouts

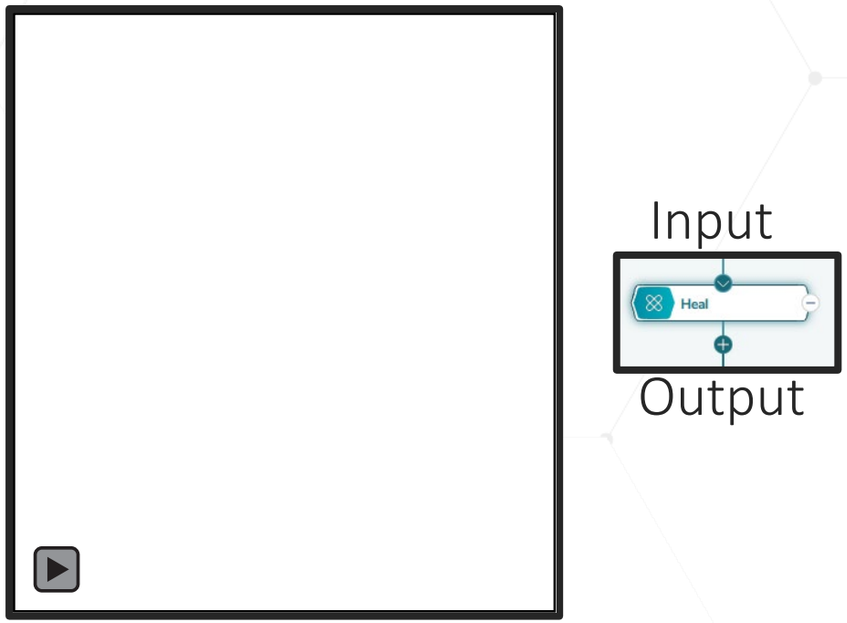
Correction and Simulation



BEAMER offers comprehensive correction and simulation:

- Standard Dose Proximity Effect Correction (PEC)
- Shape PEC
- 3D PEC
- Corner PEC
- FDA
- Rule-OPC
- E-Beam simulation
- Metrology

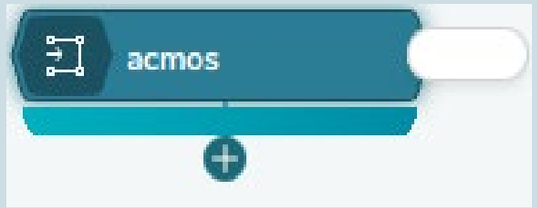
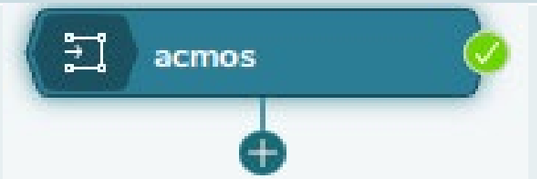
Flows



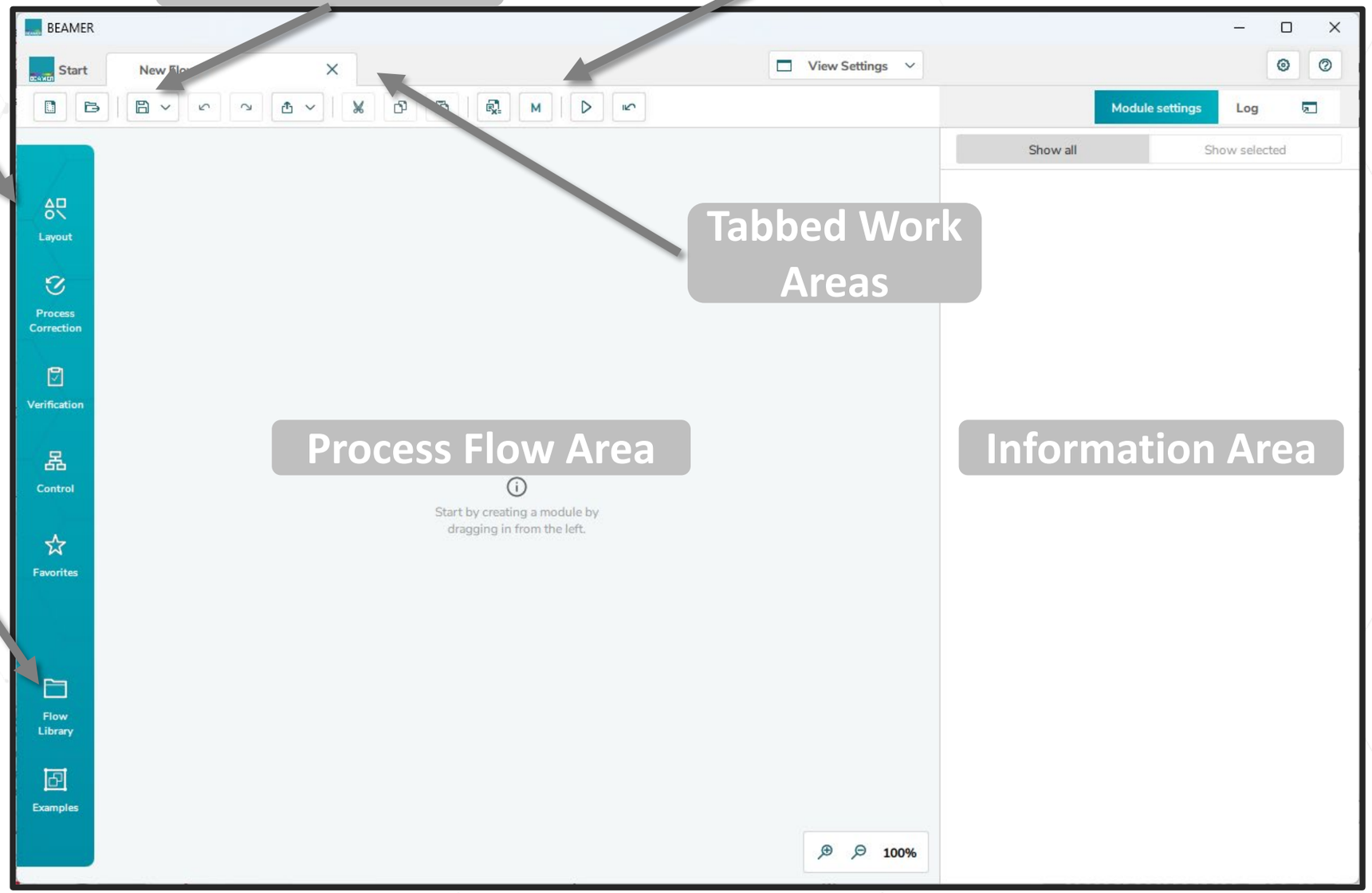
- We call each BEAMER “project” a flow
- Flows are constructed of connected modules
- A module takes an input pattern and produces a single output pattern
- The data “flows” from module to module along each connector line
- The processed pattern is exported to a chosen file format

Module States

The status of a module is shown by the module color and the icon marker located at the right side of the module.

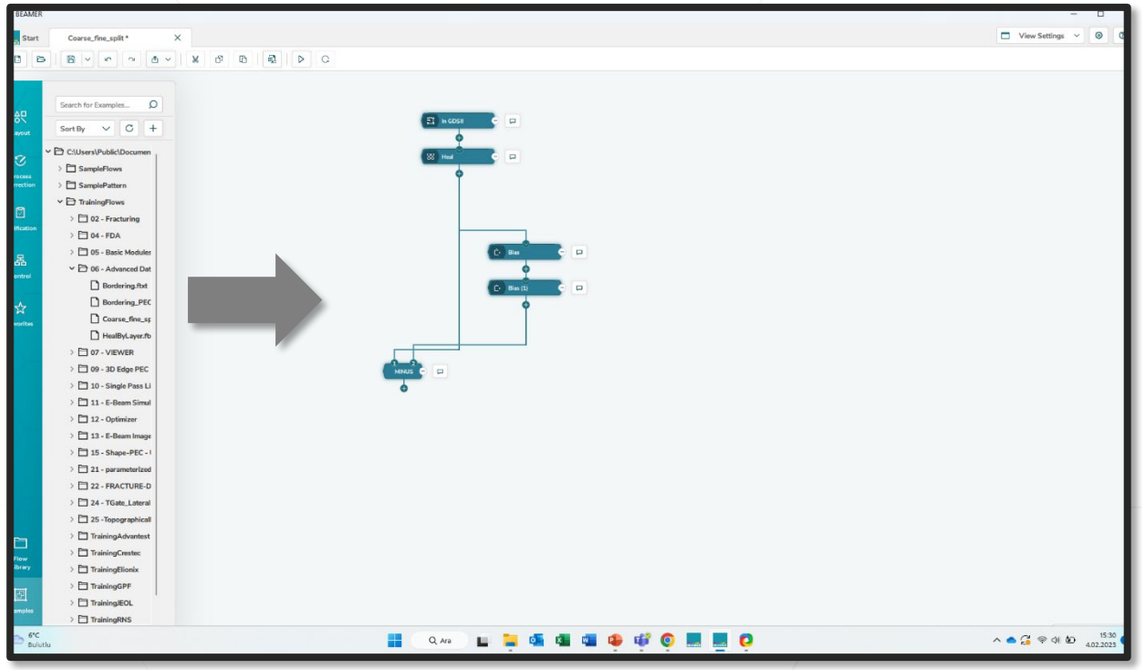
Module State	Description
	A module which has not had its parameters set is identified as a module missing its inputs and outputs.
	The minus sign to the right of the module signifies that parameters have been set and a layout named acmos is chosen but the module has not been run yet.
	A progress bar is shown while the process is being computed and the time passed is shown on the bar to the right.
	A module which has been run and the results are ready, is shown with a box View icon.

Graphical User Interface



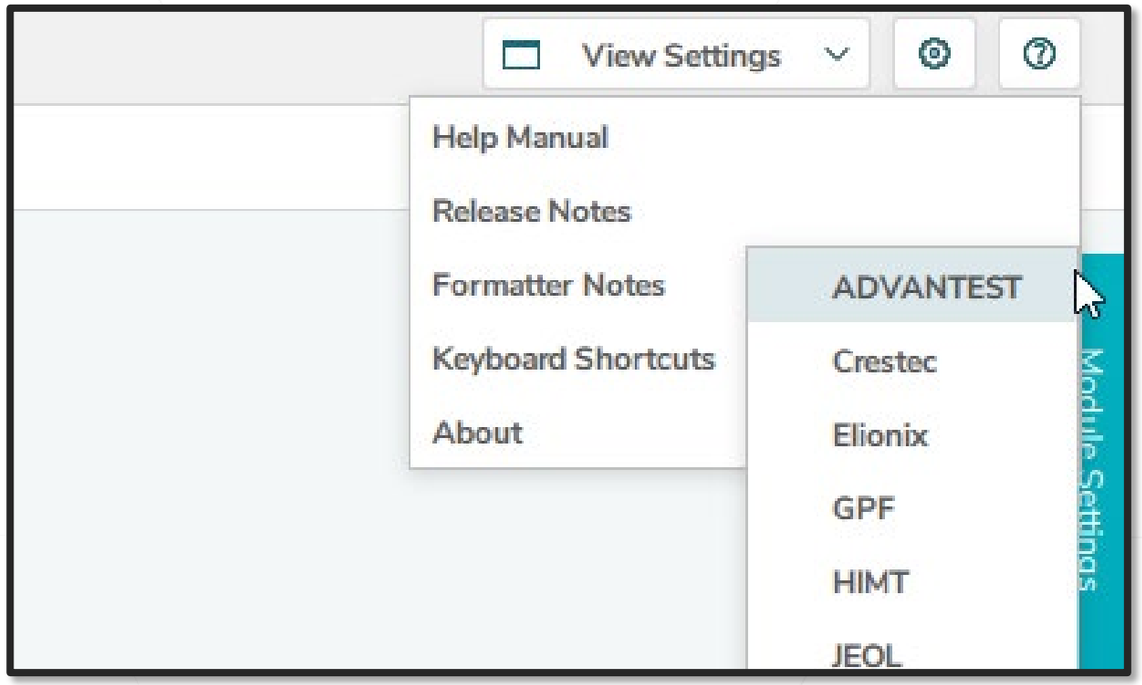
Sample Flows

- Sample flows, sample patterns and training flows in Examples tab
- Drag and drop into flow
- Every flow is pre-set with all needed parameters and patterns



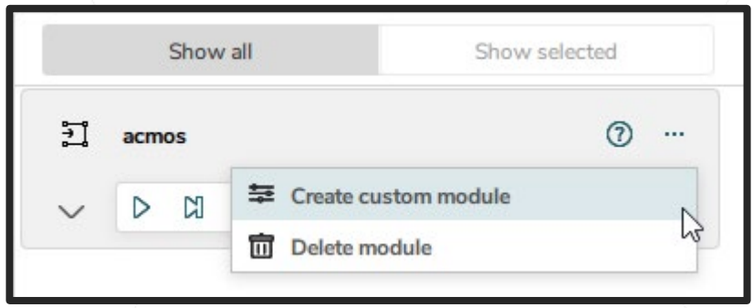
Help

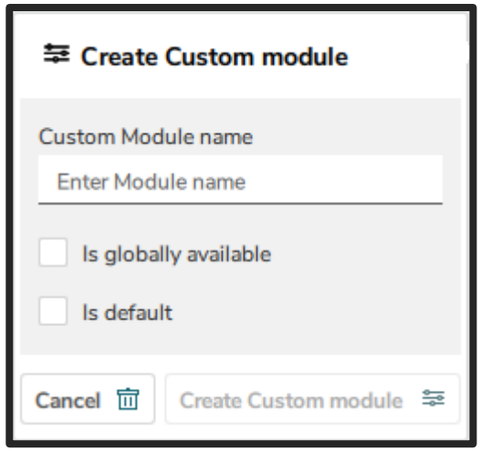
- Help Manual, Release Notes and Formatter Specific Notes available under “Help”
- Select the needed formats to send PDF versions of these to a directory for later viewing.



Customizable Defaults

- Choose the settings item on the right side of BEAMER to reach customizing properties.
- Resetting defaults can also be done through the context-menu.





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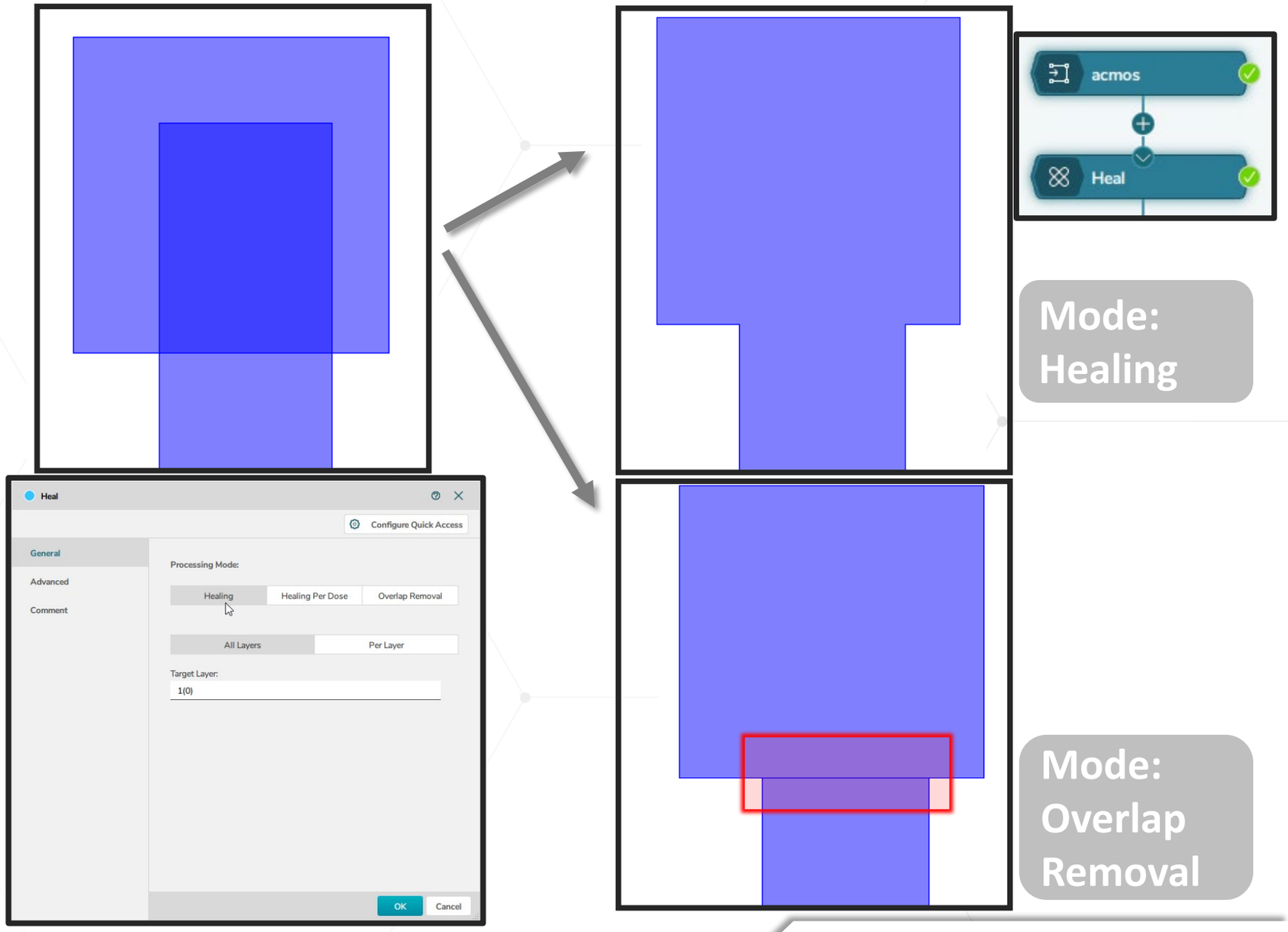
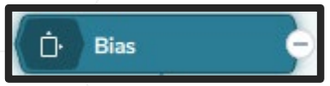
Heal

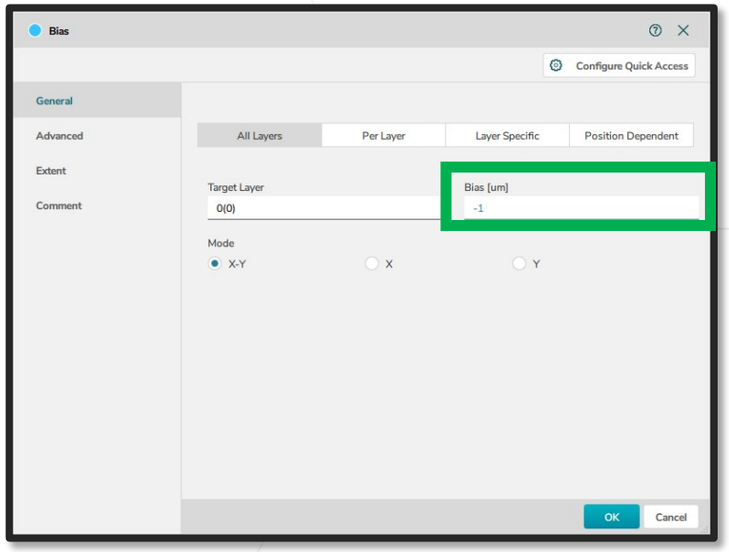
- Heal removes overlap between shapes
- Two processing modes:
  - “Healing” removes overlap and merges adjacent shapes
  - “Overlap Removal” does not merge adjacent shapes
- Can be applied on all layers, individual layers or by dose

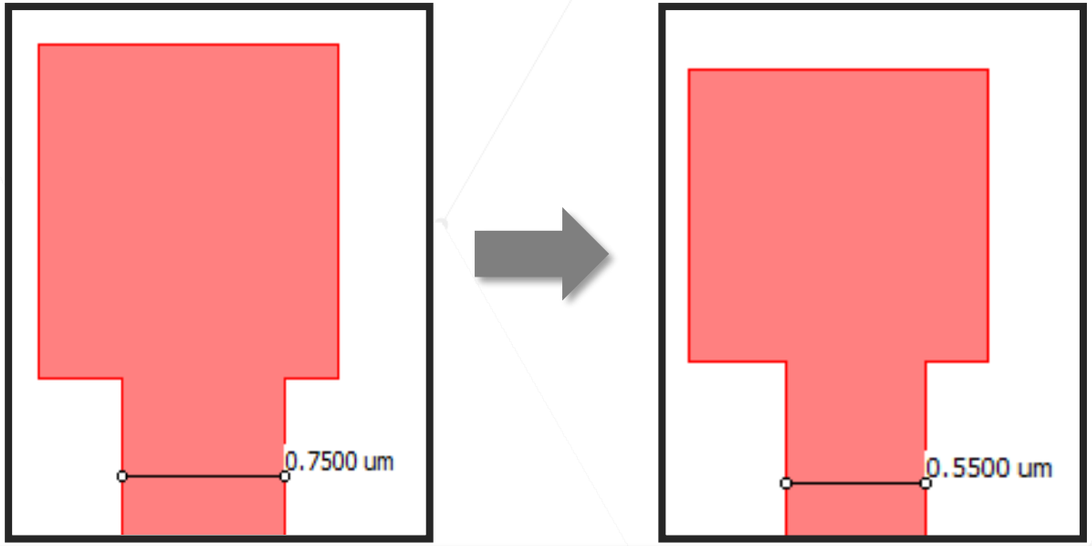


Bias

- Correct for process bias by “growing” or “shrinks” shapes by adjusting shape edges
- All layers or individual layers
- Be careful…
  - A negative bias can erase parts of a layout.
  - Shapes that “grow” into each other are merged
  - Adjacent shapes are not separated

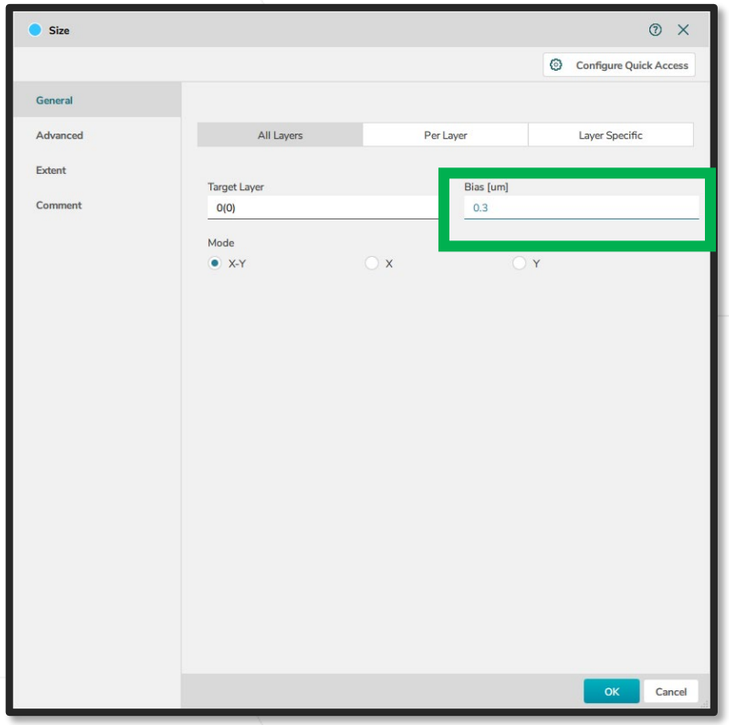


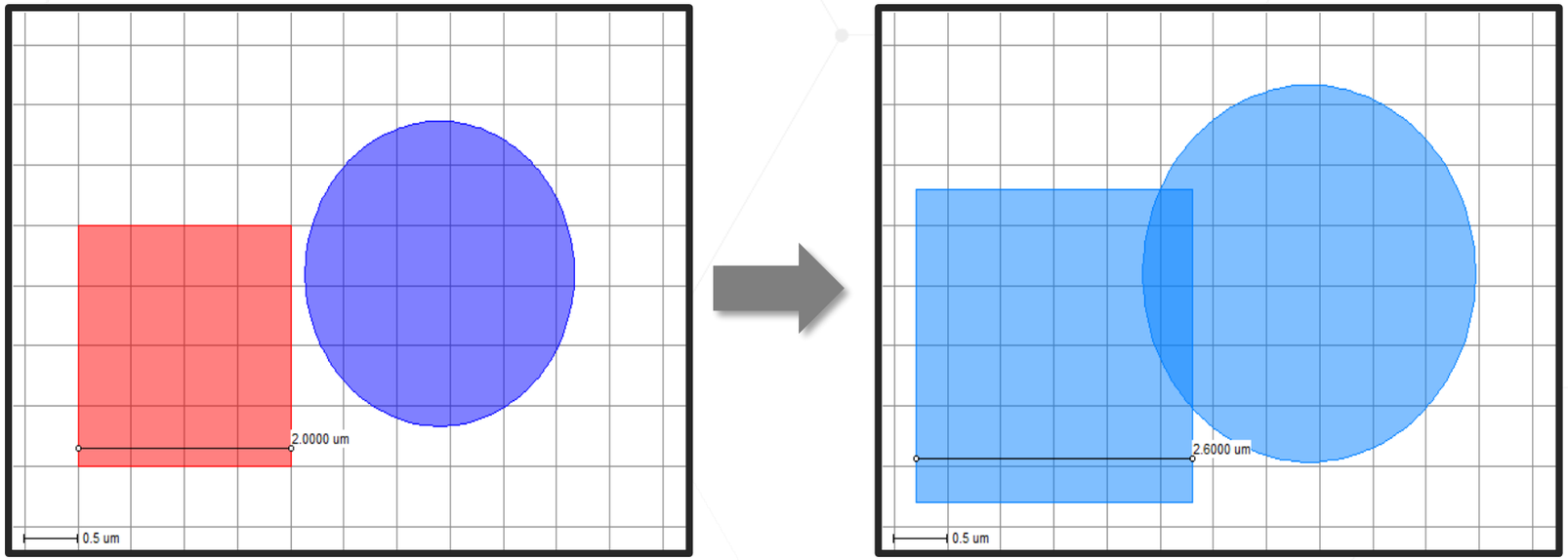




Size

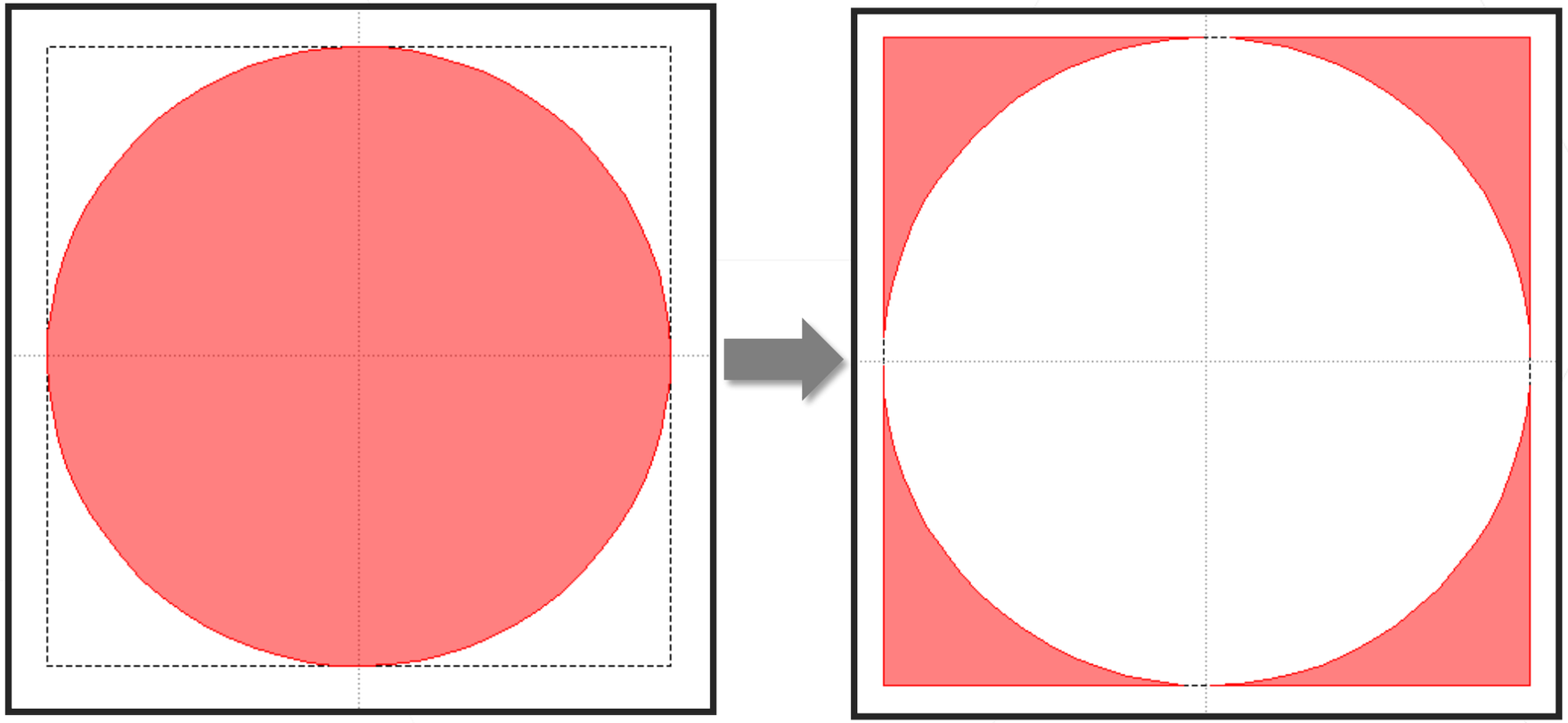
- Resizes shapes by moving every edge like bias
- Unlike BIAS:
  - Does not merge shapes that “grow” into each other
  - Will pull apart adjacent shapes





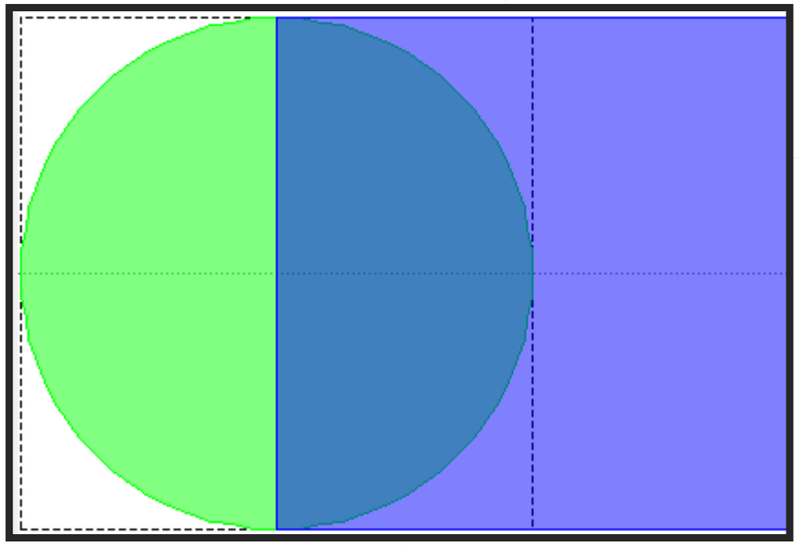
NOT

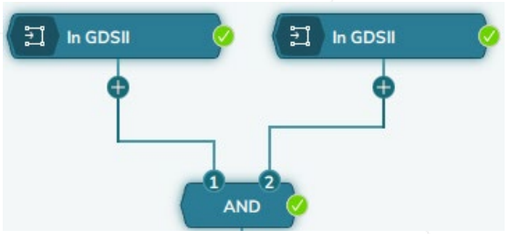
NOT allows tone reversal of one input pattern.

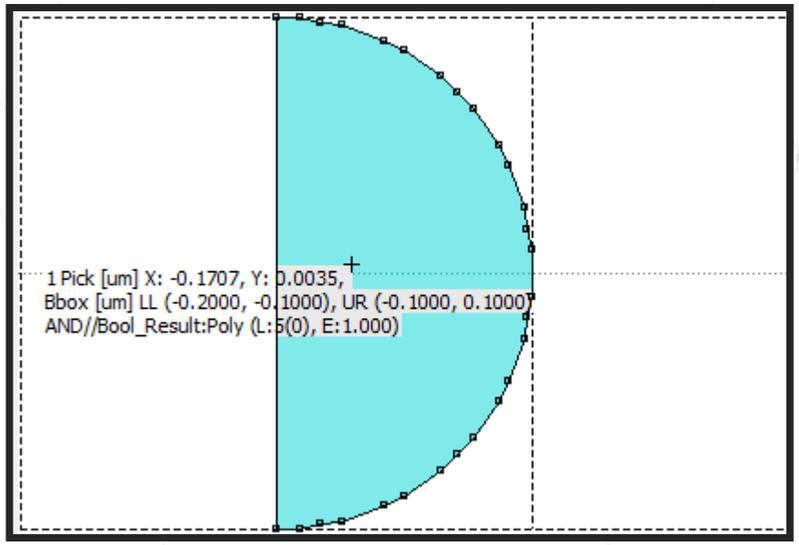


AND

AND keeps what's in common between two inputs patterns.

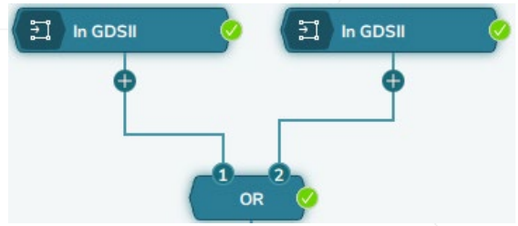


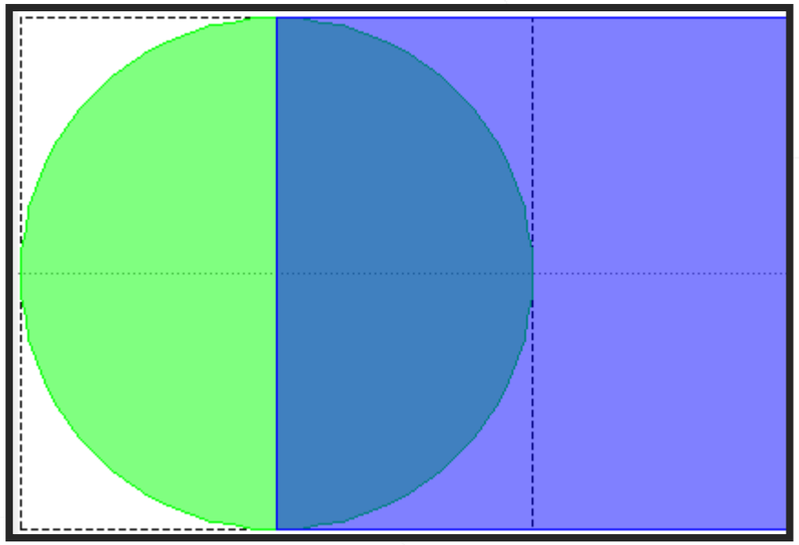


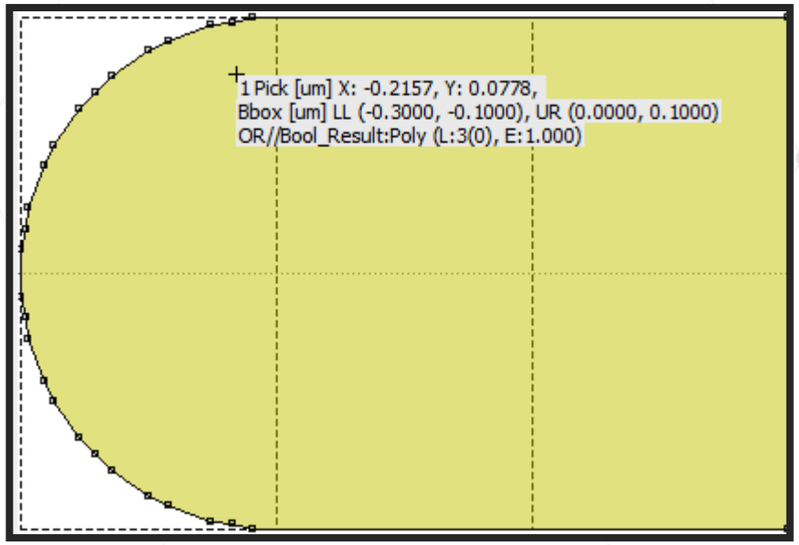


OR

OR performs a merge and heal between shapes with two input patterns.

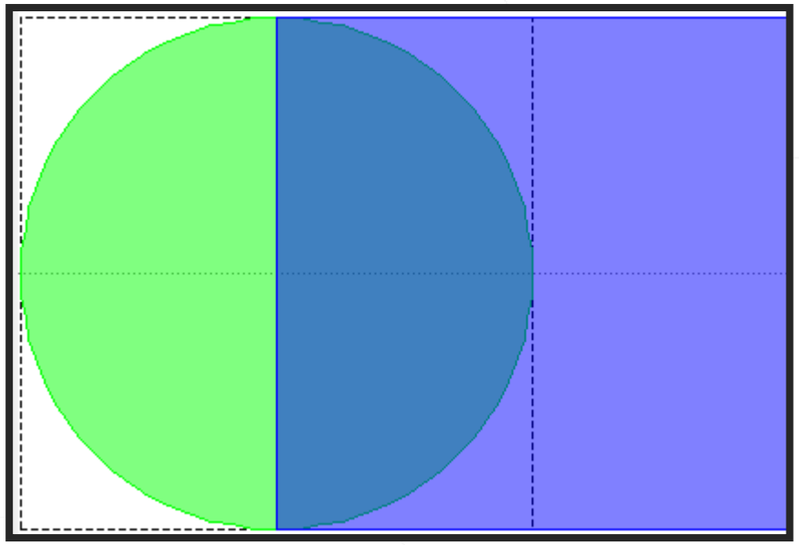


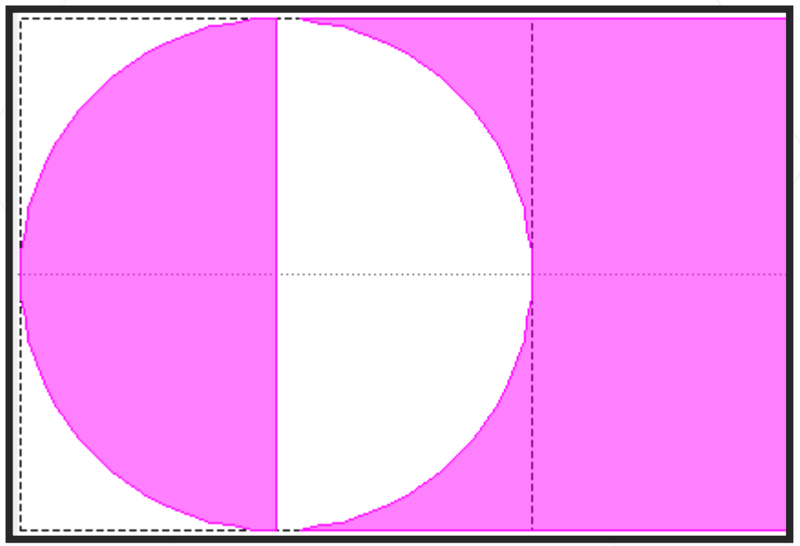


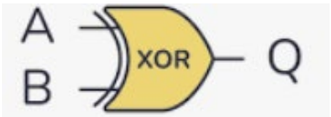


XOR

XOR removes any areas that are over-layed on the two input patterns.



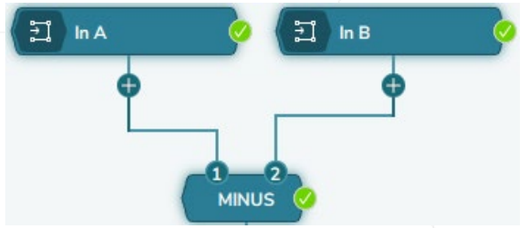


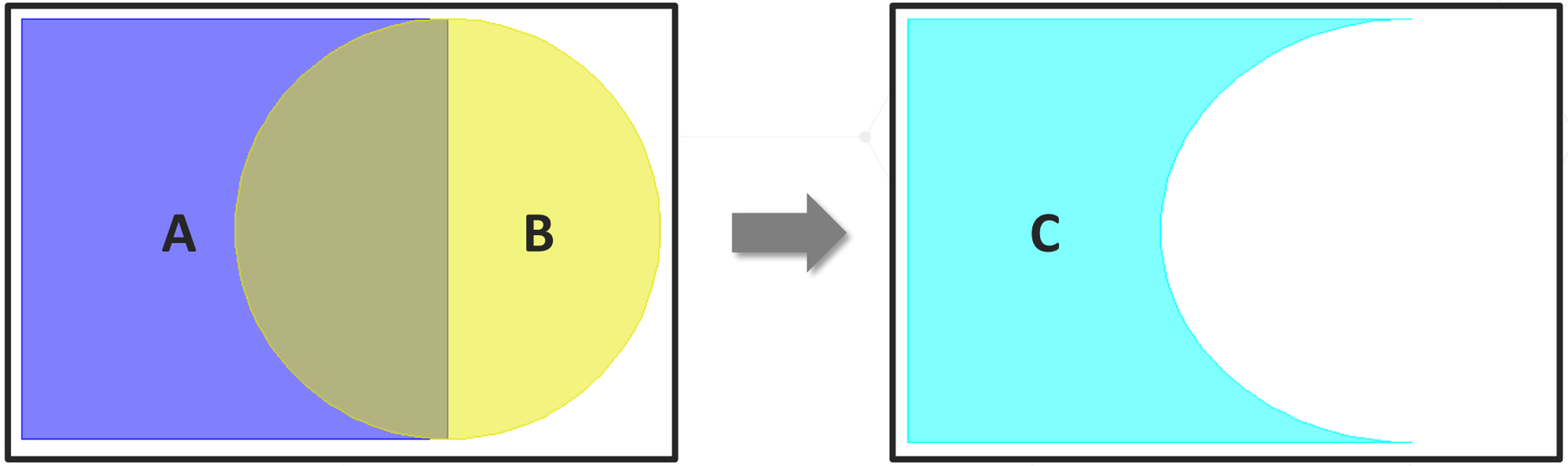


A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

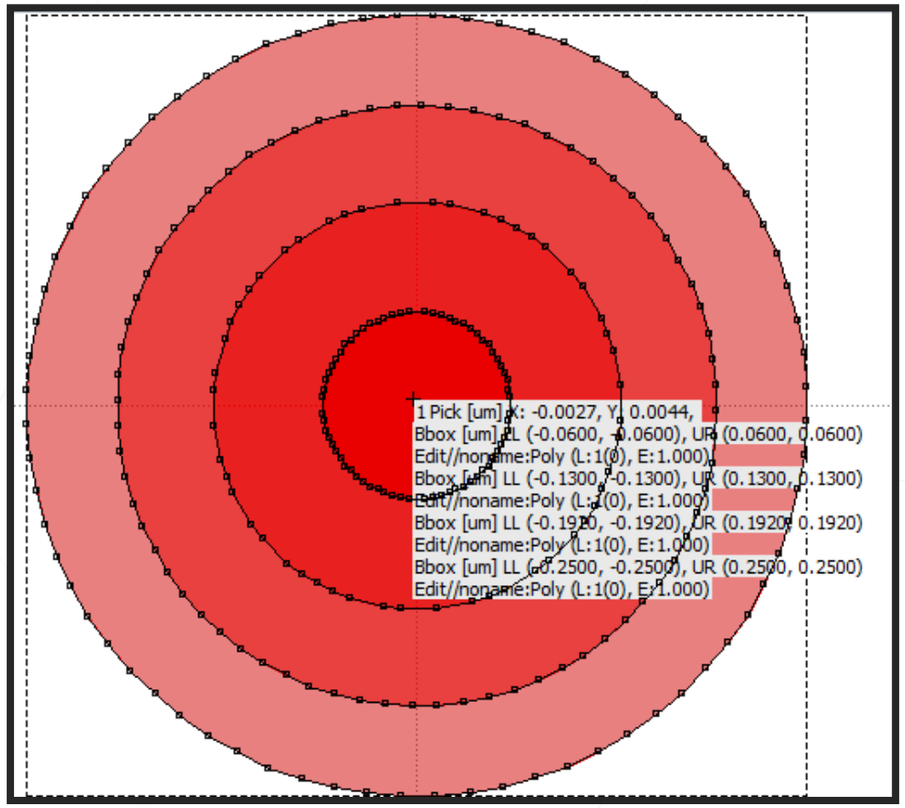
MINUS

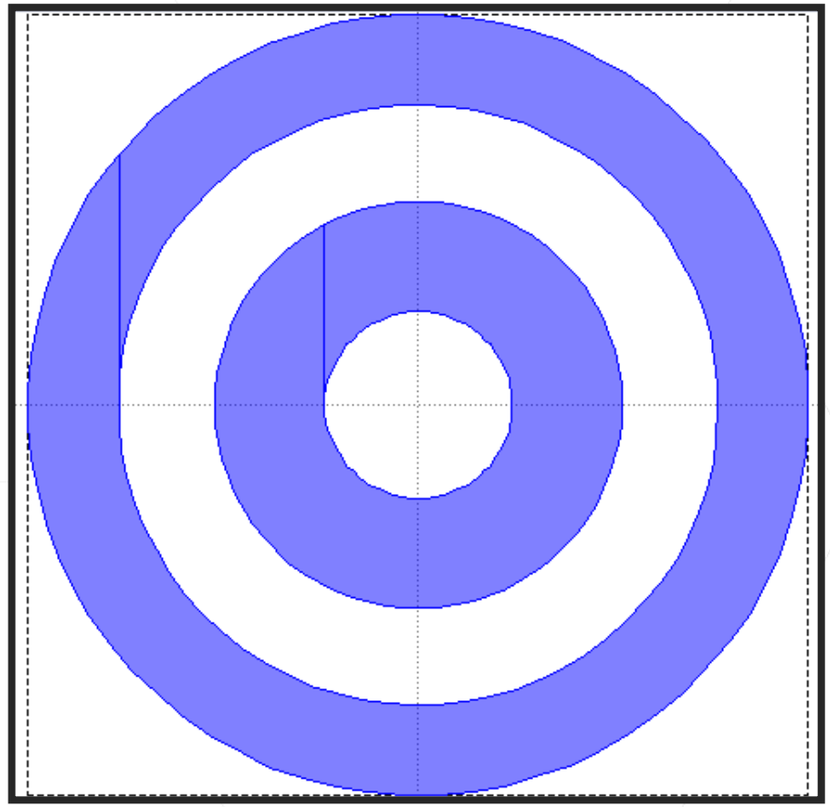
- MINUS subtracts input B (on the right) from input A (on the left)
- Order matters.





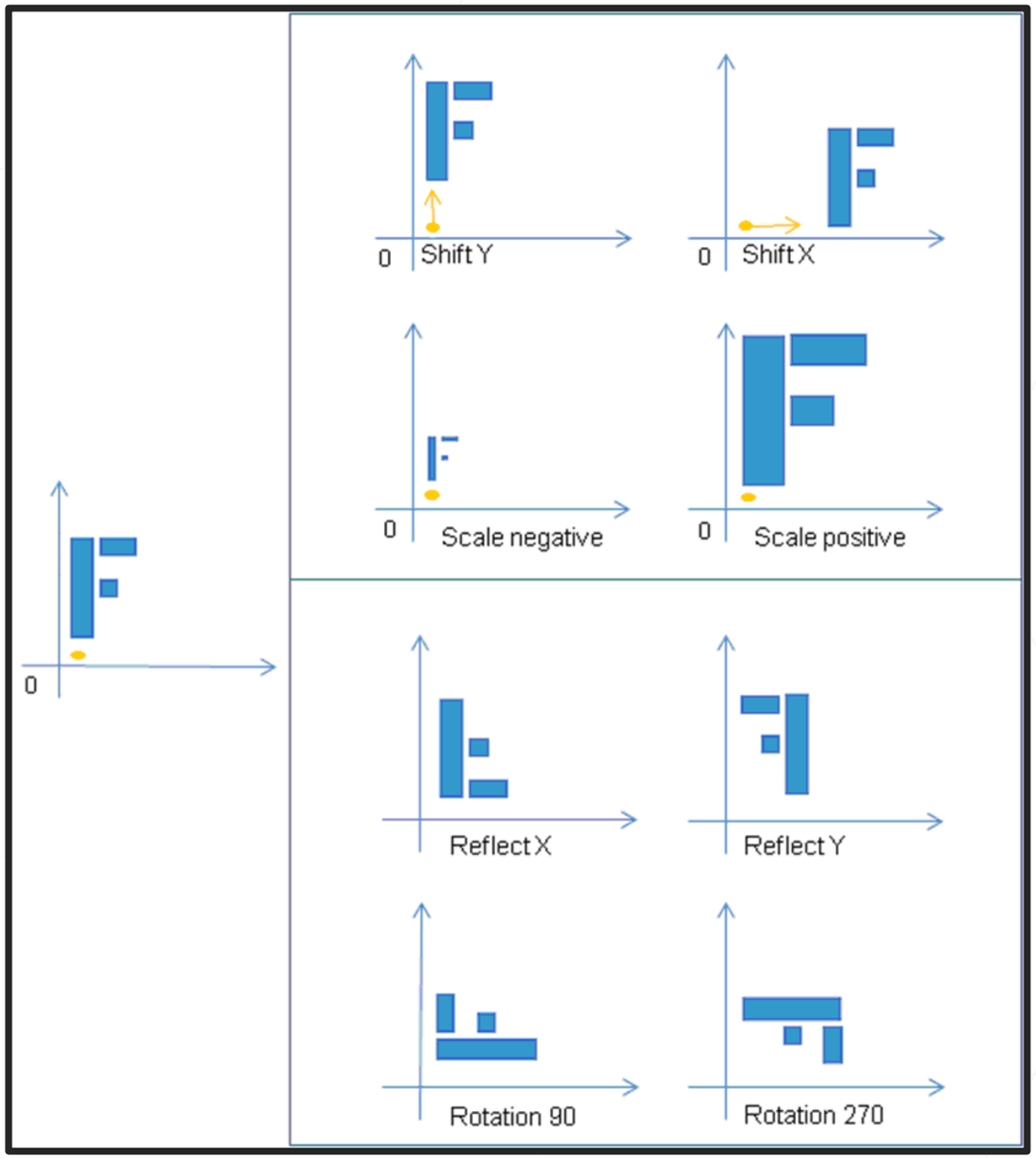
P-XOR





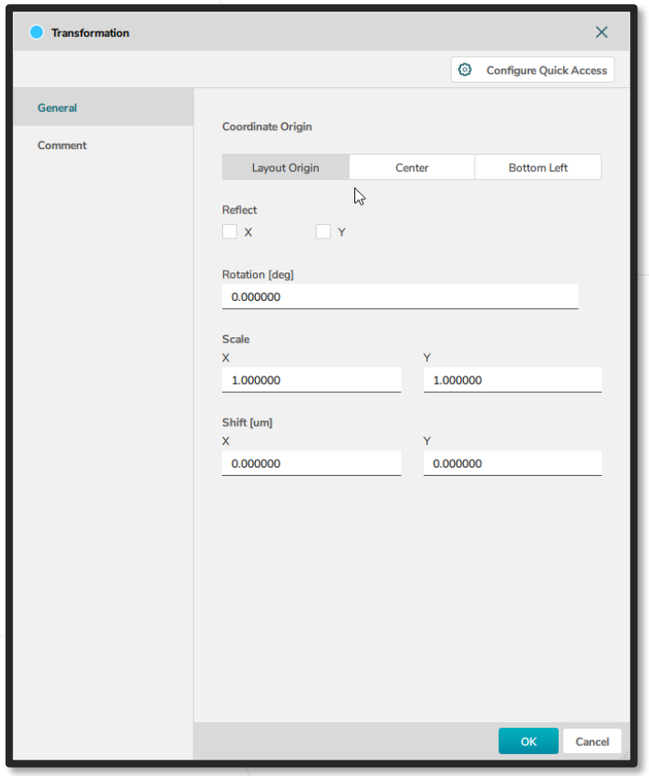
- Odd overlays (1,3,5, …) are kept.
- Even overlays (2,4,6, …) are removed.

Correction and Simulation



Transform allows standard pattern transformations

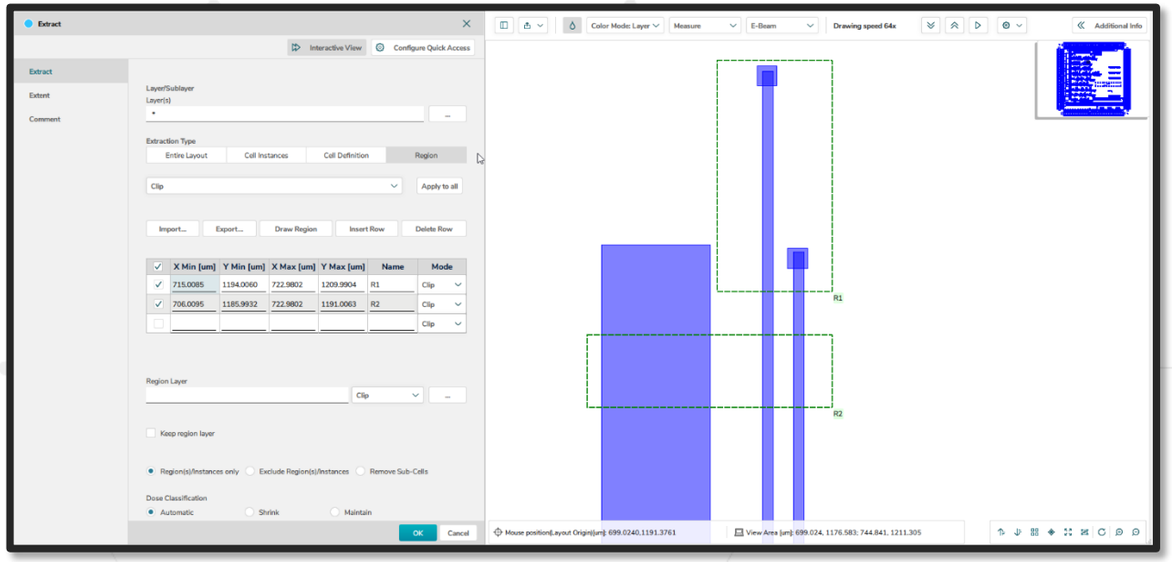
- Center
- Rotate
- Reflect
- Scale
- Shift



Extract

Extract allows shape extraction while preserving hierarchy

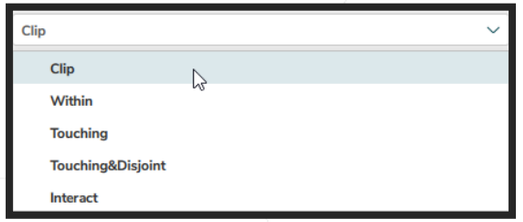
- Cell Extraction
  - Instances
  - Definitions
- Layer Extraction
- Region Extraction
  - By Region Layer
  - Visually
    - Start/End Region Selection: Shift + Left Mouse Click
    - Region coordinates are placed in the table to the left

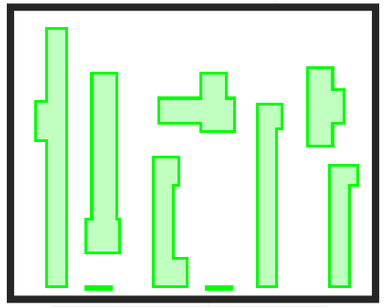


Region Extract Modes

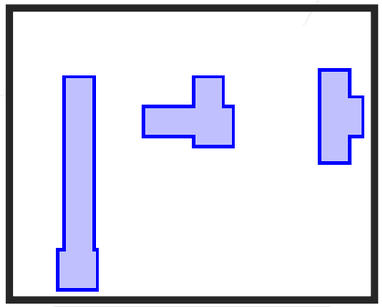
Region Extract Options:

- Clip cuts all elements at the region border
- Within extracts only polygons that are completely inside the region
- Touching extracts all polygons that are partially inside the region





Clip

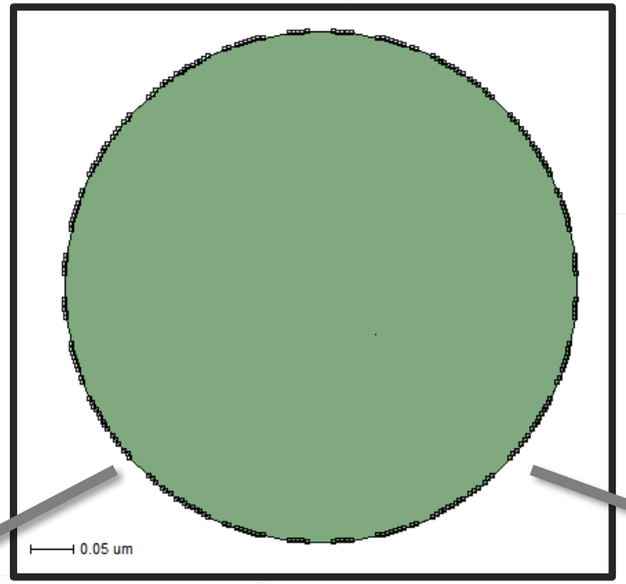


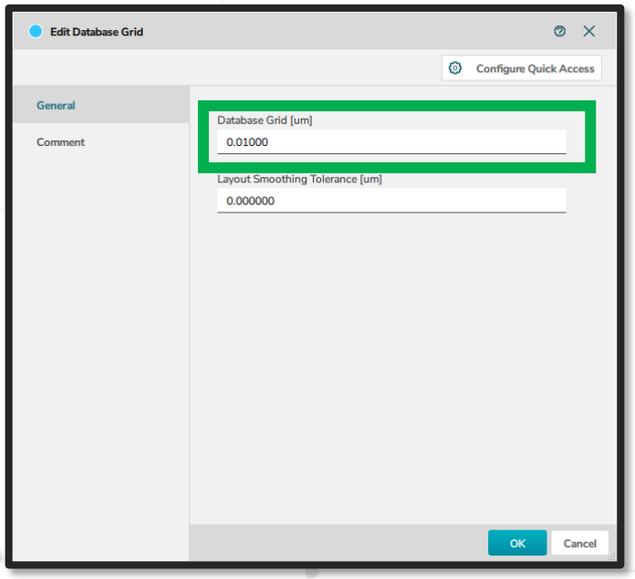
Within

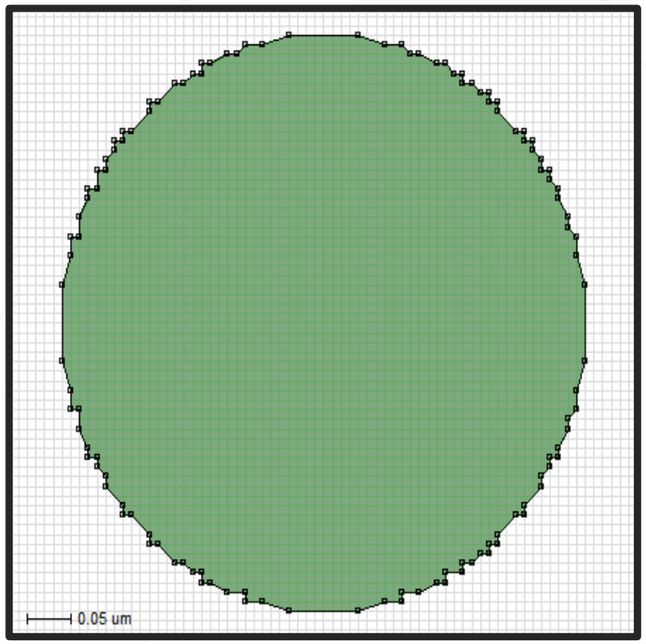
Touching

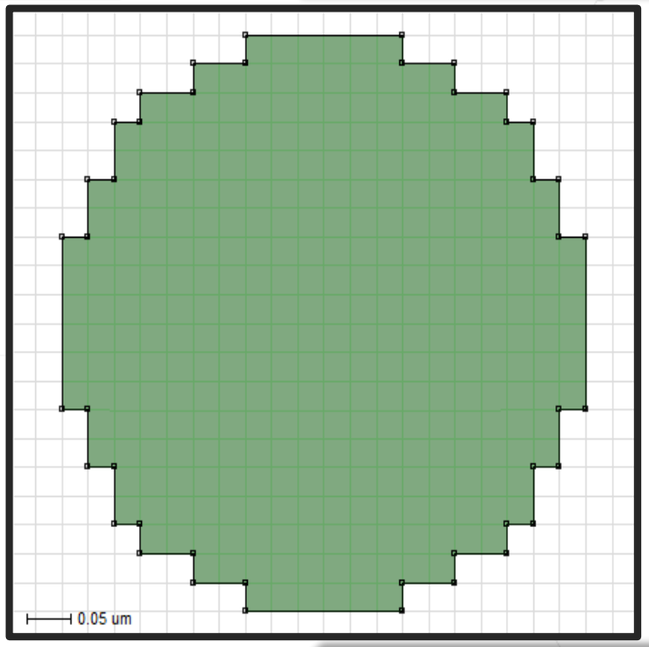
Grid

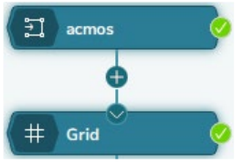
- Changing “Database Grid” adjust the layout’s base unit
  - Vertices must be on grid
  - Setting a coarser grid may cause grid snapping
- Merging patterns requires setting the same database grid



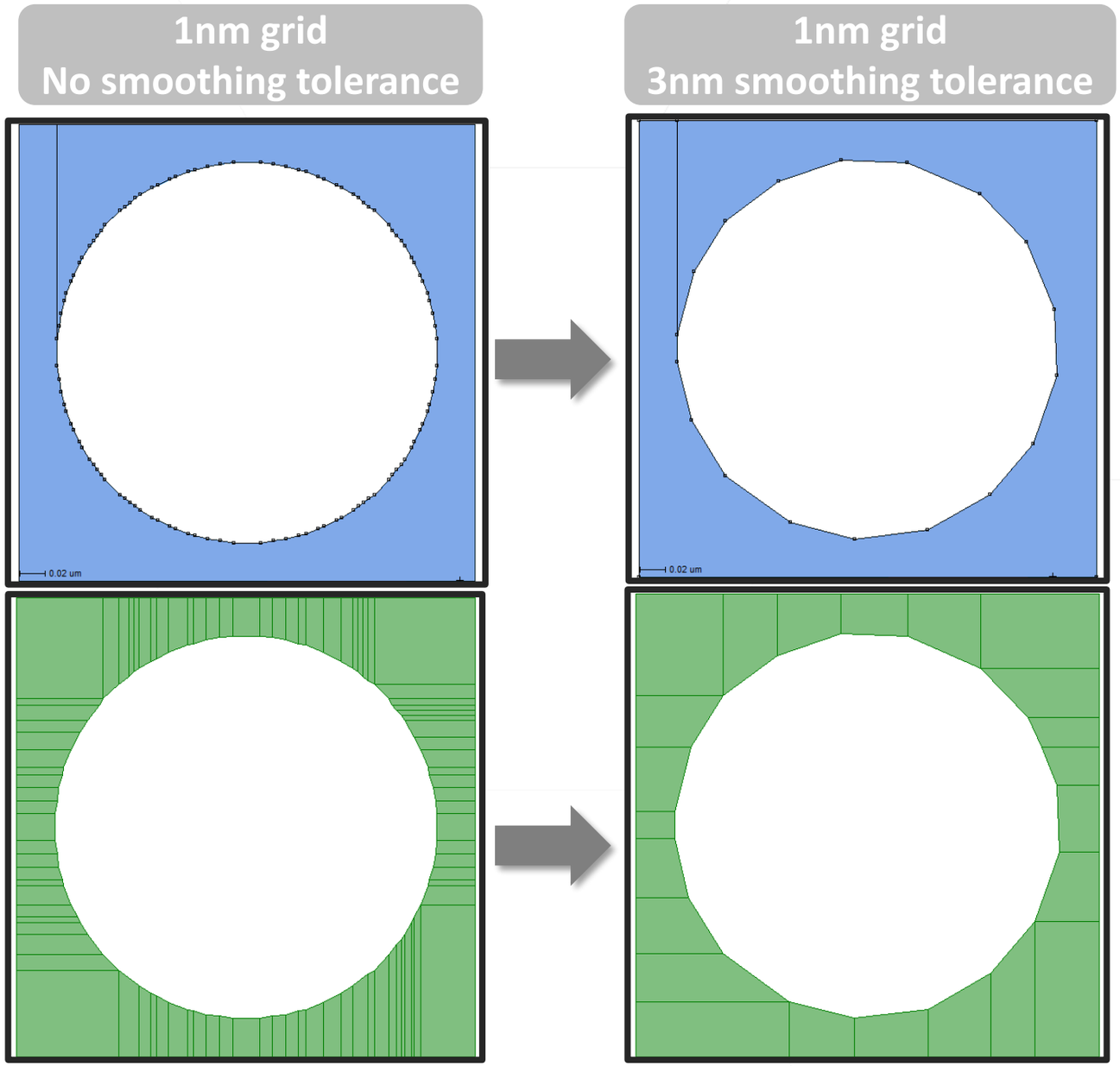


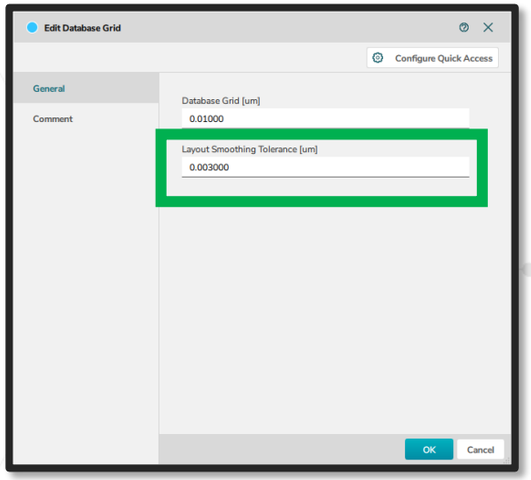


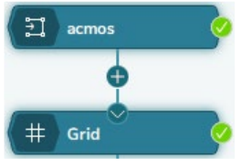




Grid







- Layout Smoothing reduces vertex count
  - Smooths shape edges, tolerance is allowed deviation of edges of smoothed shape from designed shape
  - Can reduce fracturing time, post-fracture shape count and total data volume
  - Inspect result!

Edit Module

Opens fully functional Layout Editor

- Edit a pattern in a workflow
- Create a new pattern

Things to remember:

- Saving the Edit module in the flow does not save your pattern if you close and re-open your flow.
- EXPORT and then IMPORT to save modifications or newly created patterns.

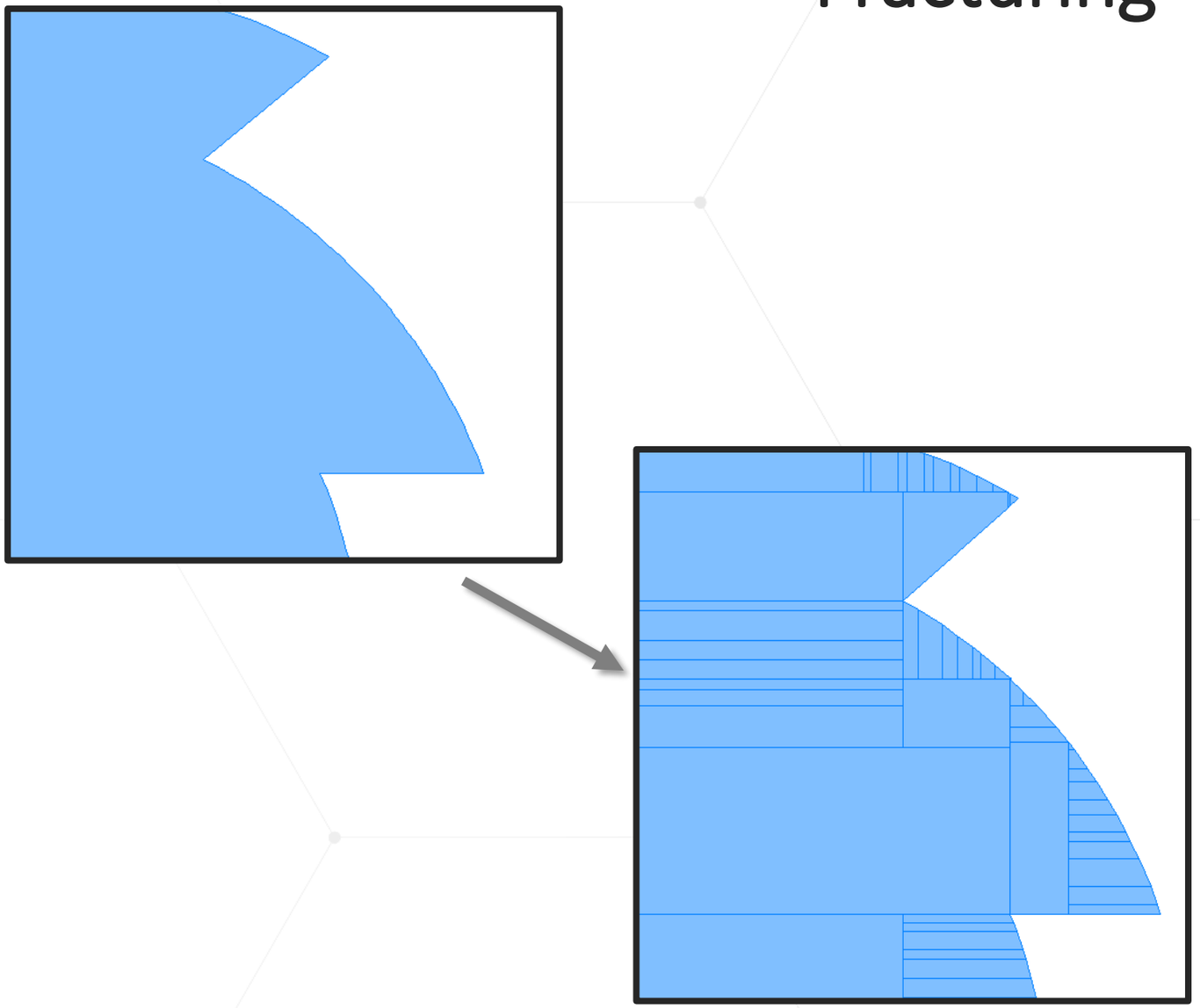
Cooperation with Juspertor

Agenda

- GenISys Introduction
- E-Beam Lithography: From Layout to Wafer
- BEAMER Basics
- Basic Pattern Preparation
- Fracturing
- Field Control
- Proximity Effect Correction (PEC)

Fracturing

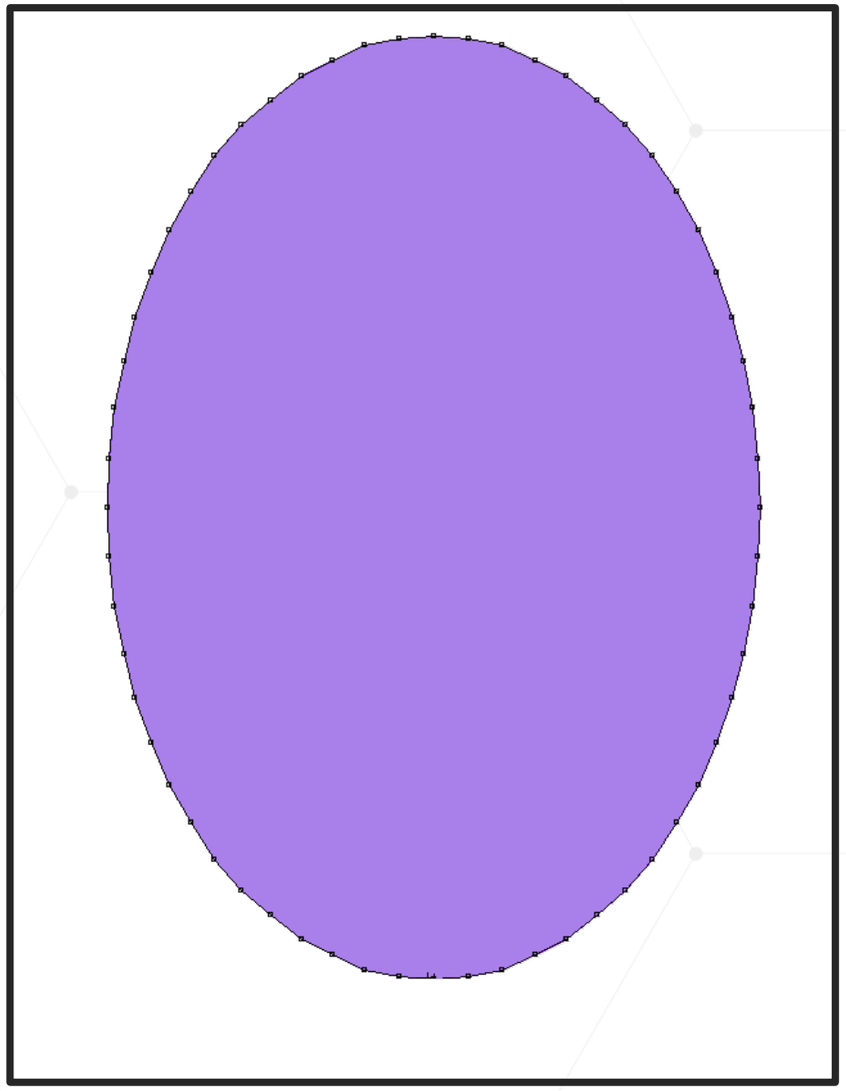
- Fracturing is breaking up single complex polygons into simple “primitive” shapes, usually trapezoids
- E-beam tools expose primitives shape-by-shape
- BEAMER allows controlling:
  - Fractured shape count
  - Optimizing shot filling of fractured shapes
  - Writing order from shape to shape

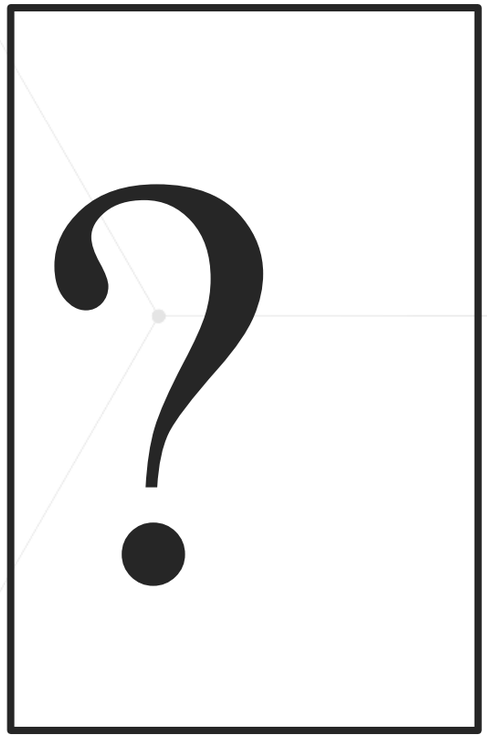


Fracturing Modes

Three Fracturing Modes:

- Conventional
- LRFT – Large Rectangle Fine Trapezoid
- Curved

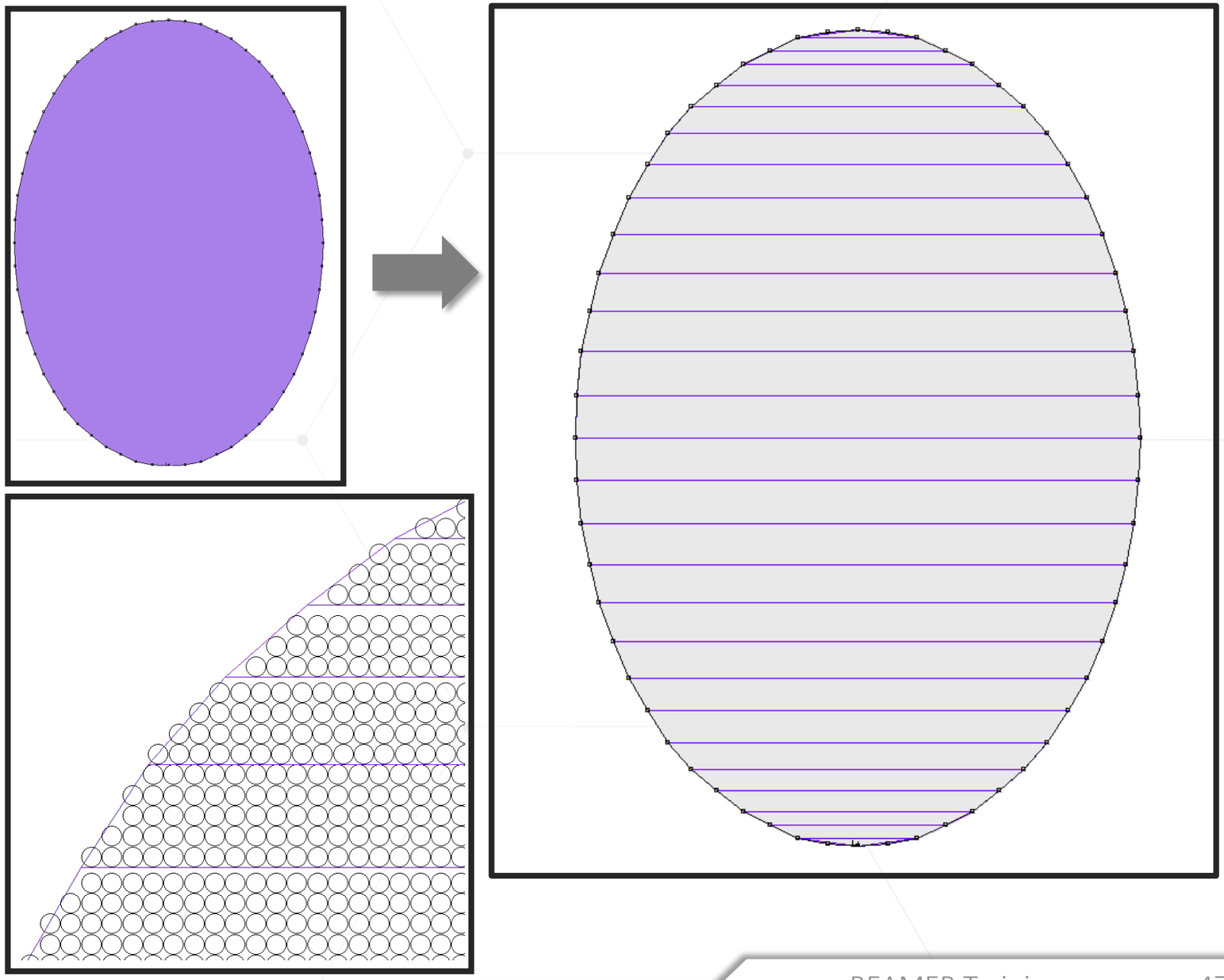




Fracturing Mode: Conventional

Conventional

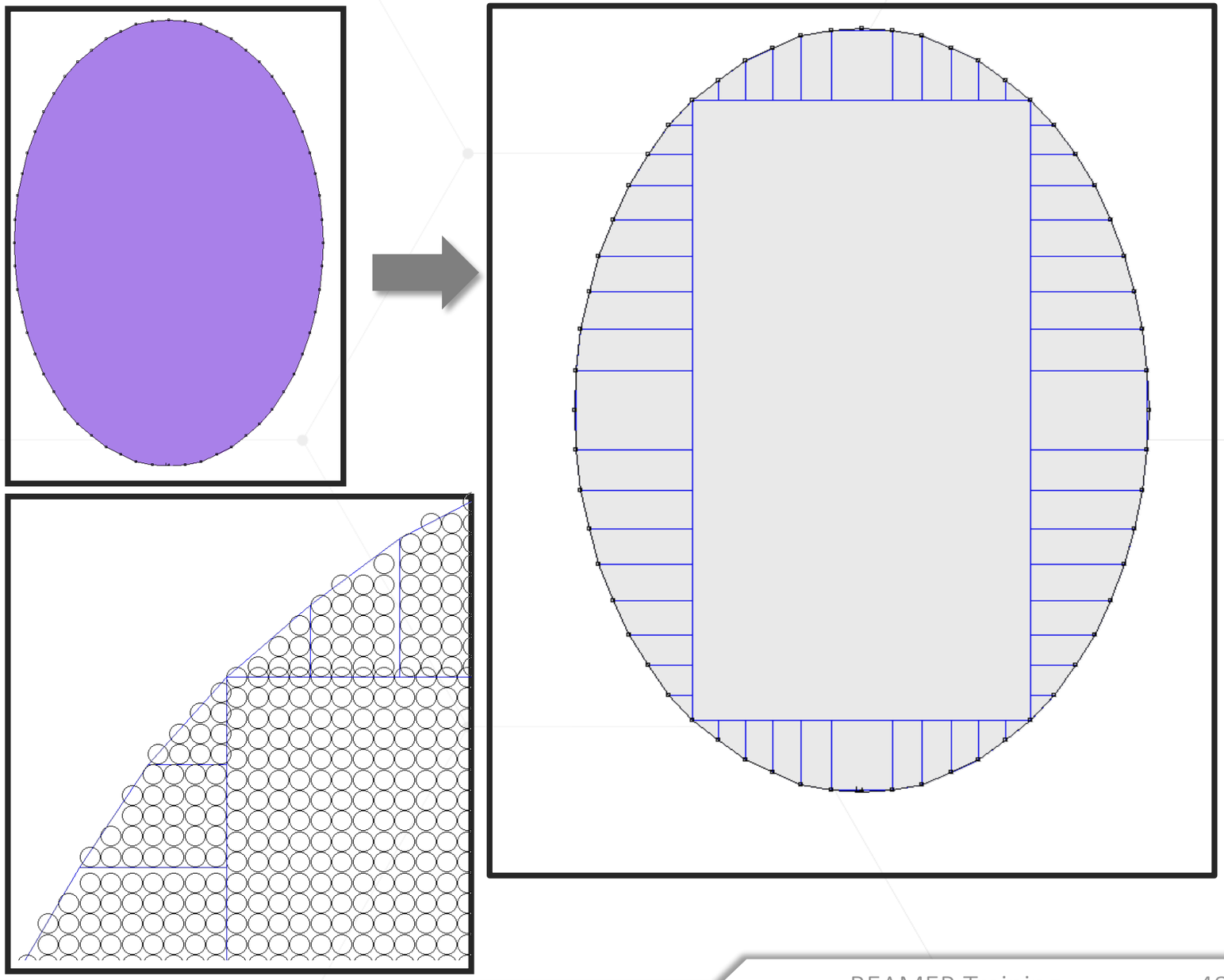
- Mostly horizontal or vertical slices of polygons
- Can cause result in some asymmetry and/or shot filling problems



Fracturing Mode: LRFT

LRFT

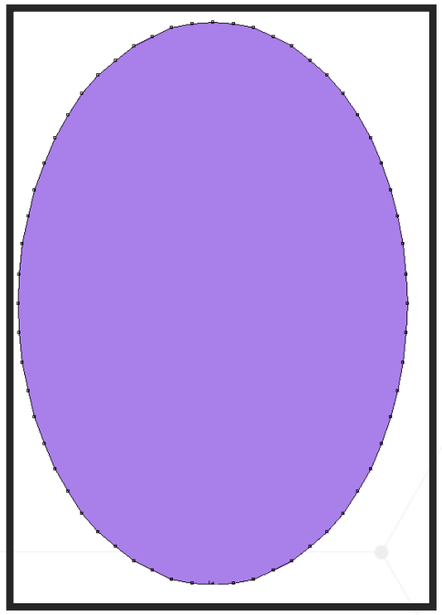
- Fractures with as many Large Rectangles as possible
- Fills rest of shape with Fine Trapezoids
- Can improve symmetry and shot filling

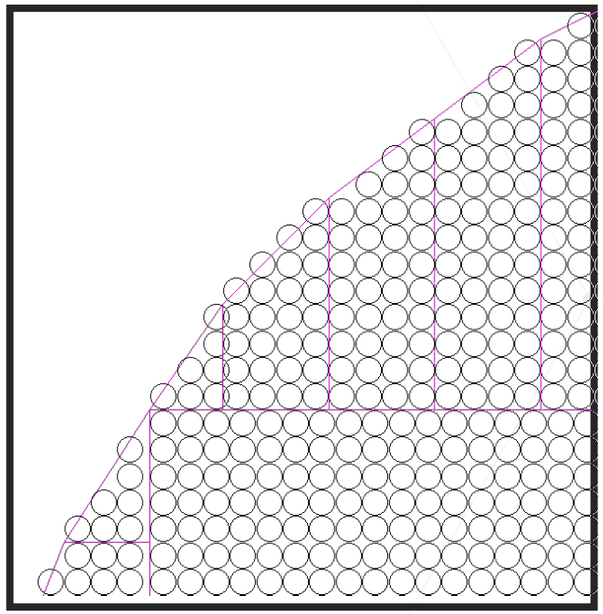


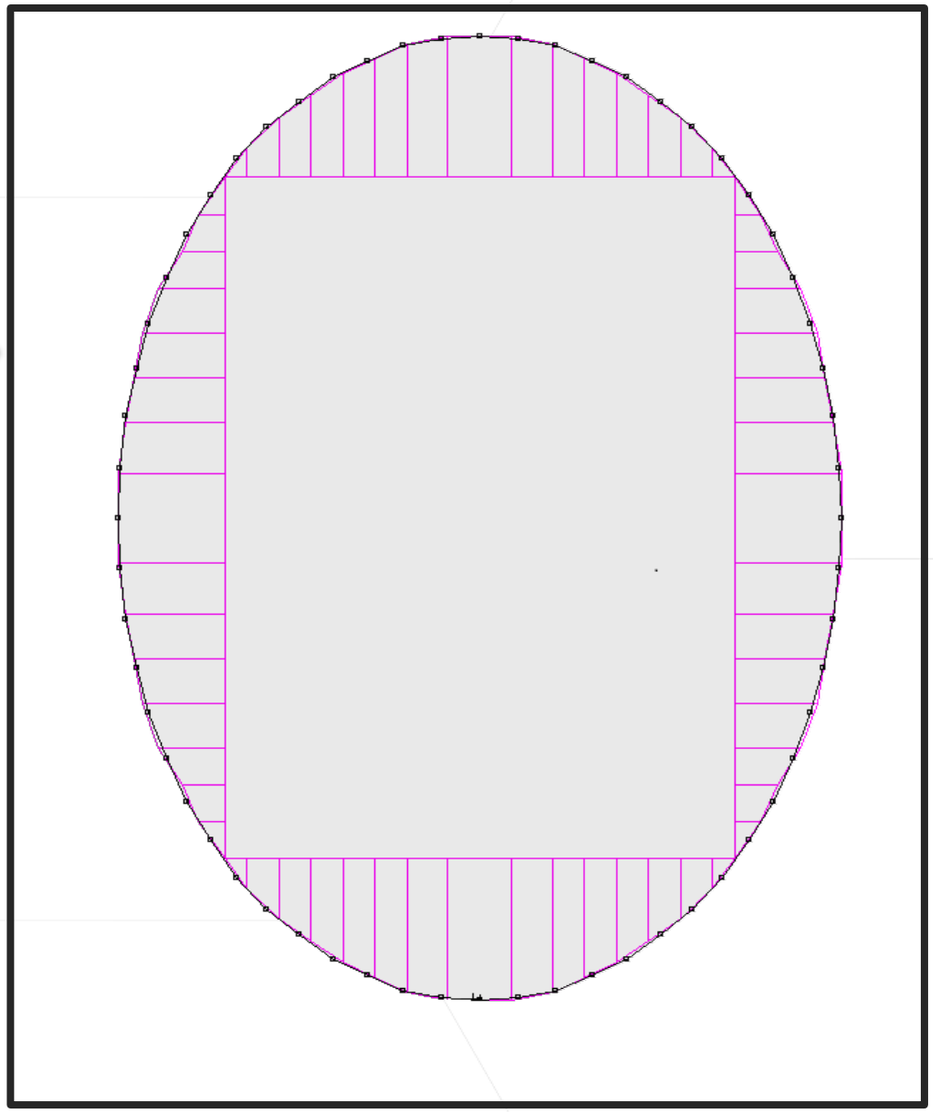
Curved Fracturing

Curved fracturing

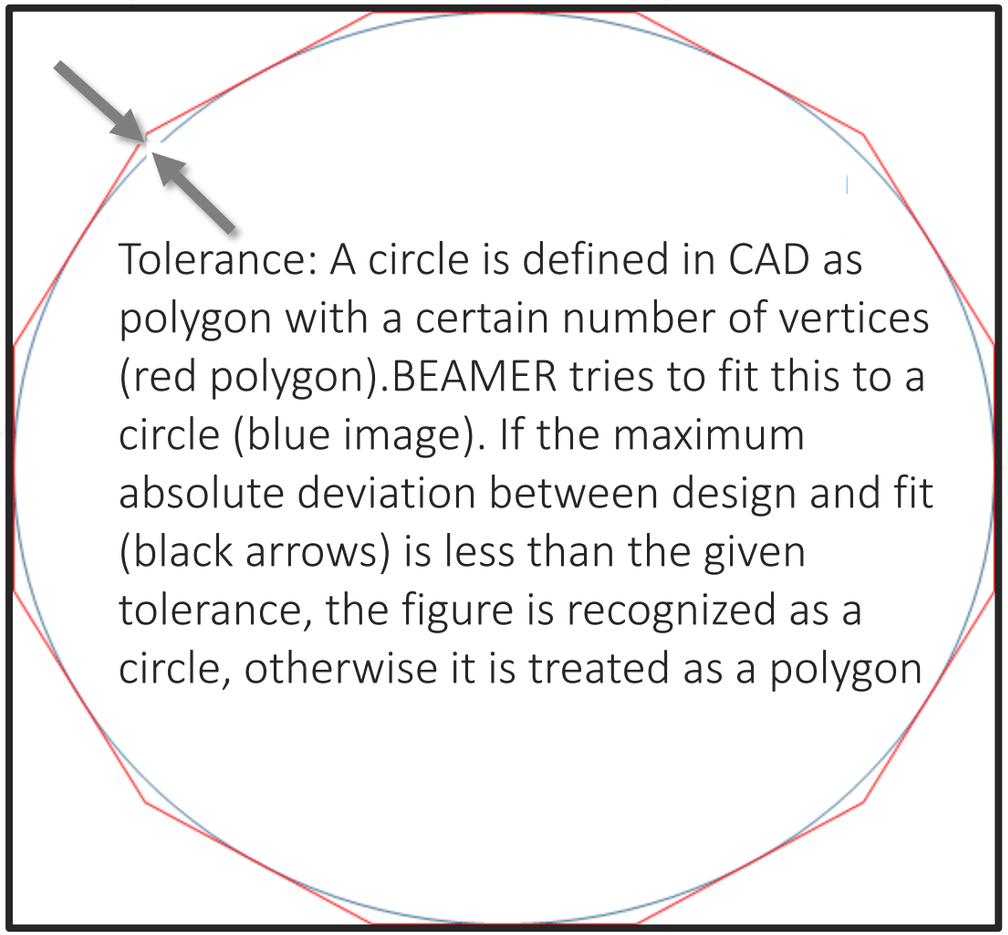
- Remove and/or shift shape vertices while considering resolution and beam step size
- Fewer vertices create fewer fractures
- Just enough vertices to create smooth curve is ideal
- Can improve shot filling

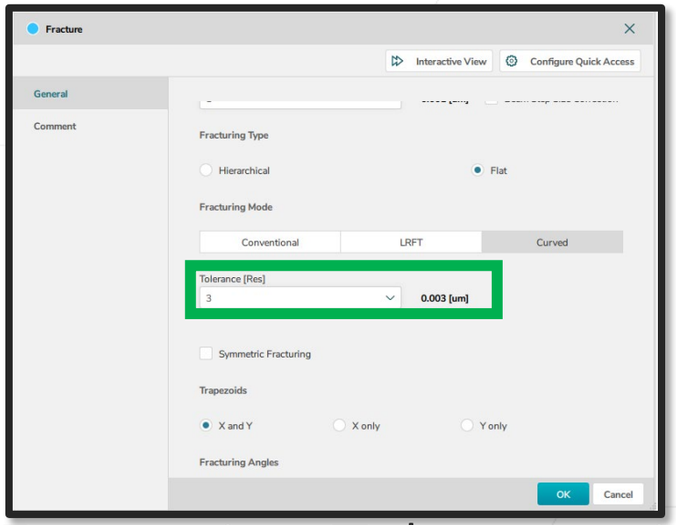






Curved Fracturing Tolerance





- Curved Fracturing Tolerance is manually adjusted
- “Allowed deviation” between design and fitted curve
- Inspect result to find optimal value

Agenda

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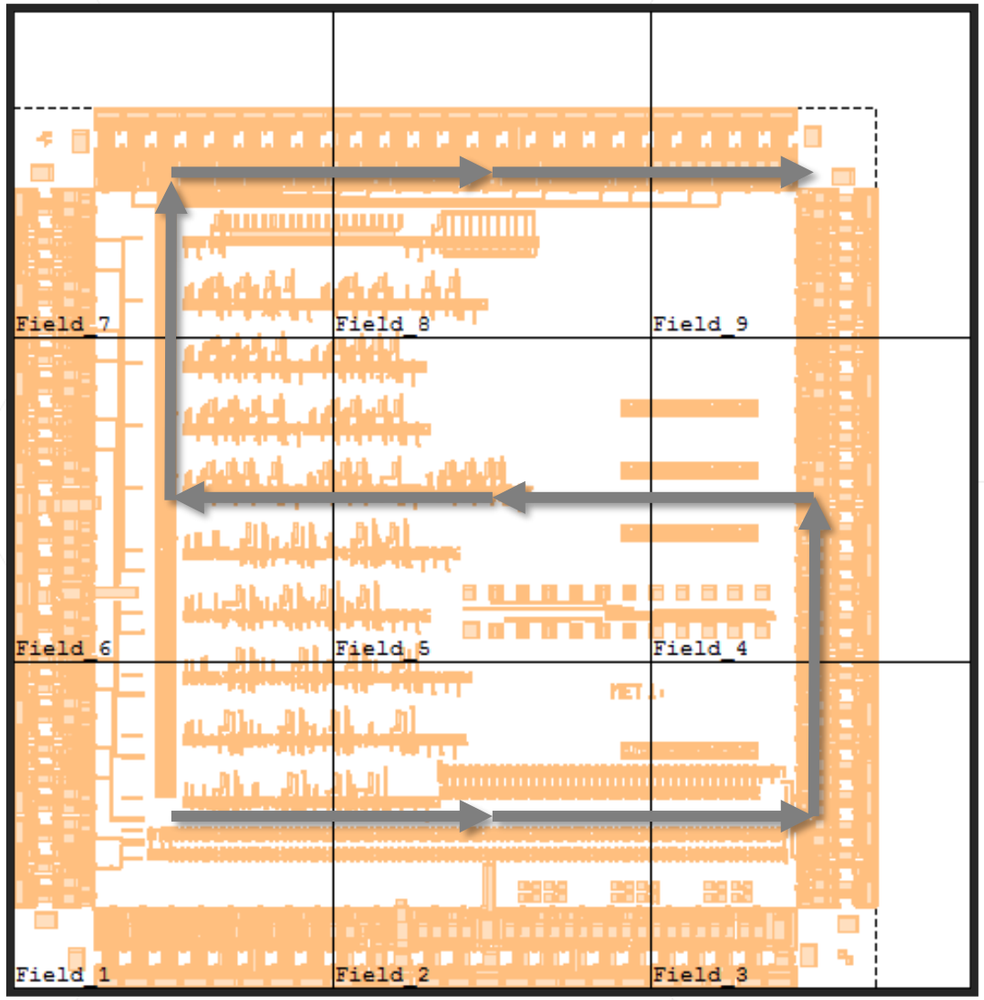
Writing Strategy Artifacts

- A Gaussian beam fills the pattern with discrete pixels. The exposure quality depends on:
  - Proper shape filling
  - Position of shapes in field/sub-field (aberrations/distortions)
  - Accurate field stitching
- Poorly controlling these things can result in:
  - Defective shapes
  - Line edge roughness
  - Shape distortions at field borders
  - Field/sub-field stitching errors

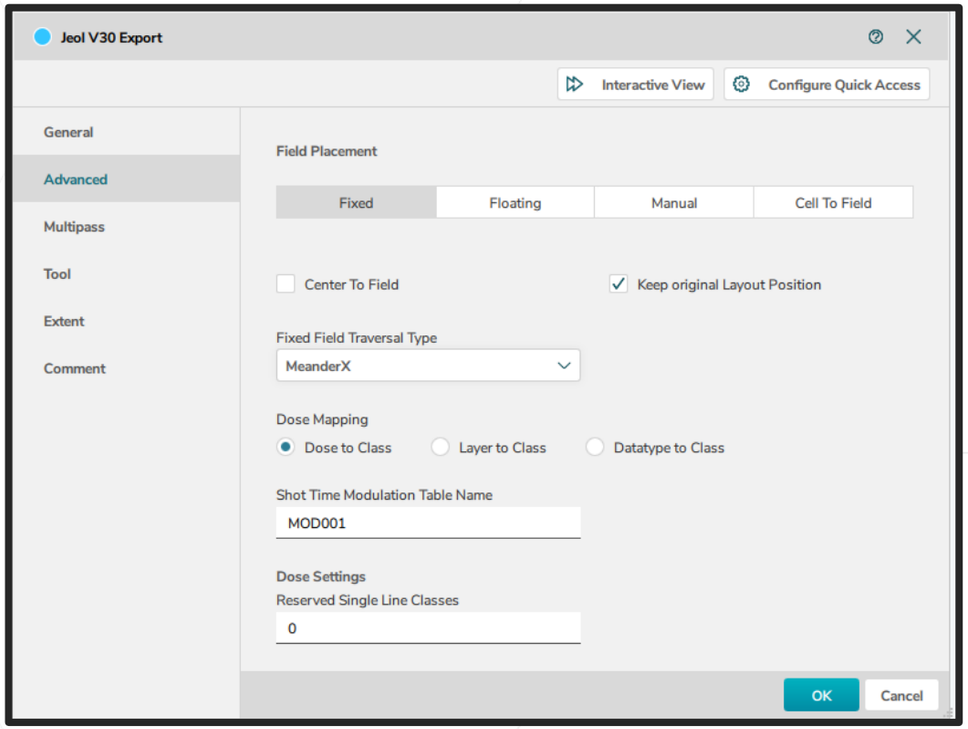
E-Beam Exposure Fields

- Field size is tool limited so large layouts are tiled
- Default field sorting:
  - Uniform tile size
  - Start in one corner and meander fill
- Not always optimal…



Field Placement Types

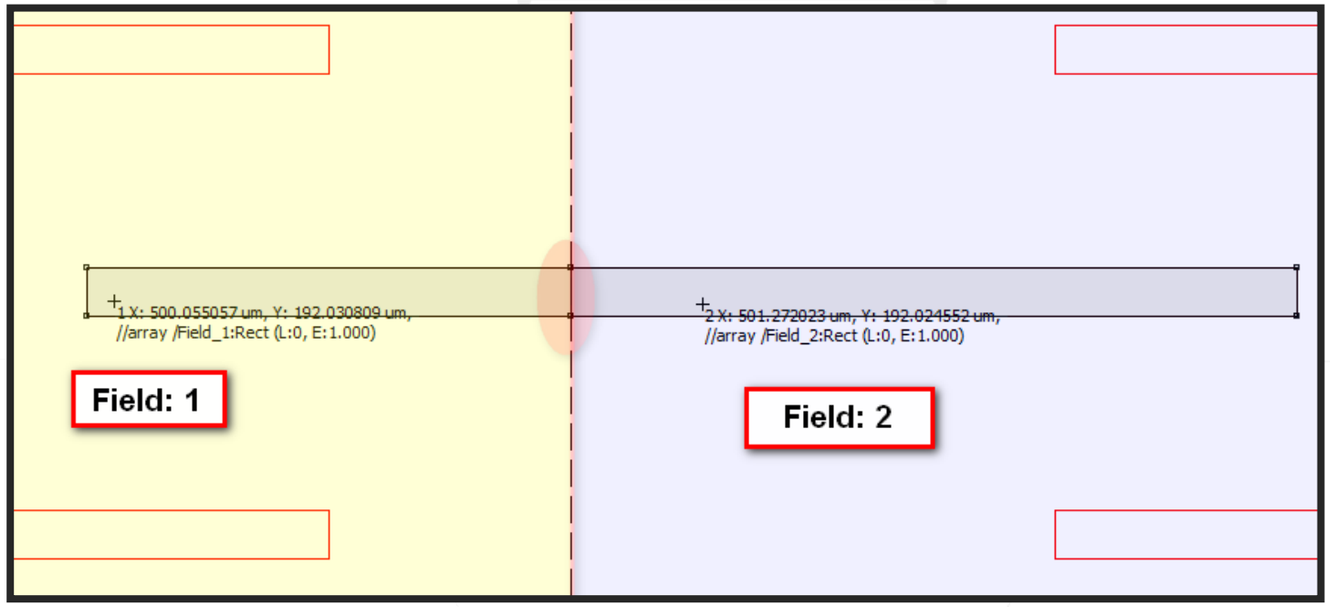
- Fixed
  - Standard Fixed Grid
- Floating
  - Fields positioned to enclose shapes
- Manual
  - Free positioning of fields



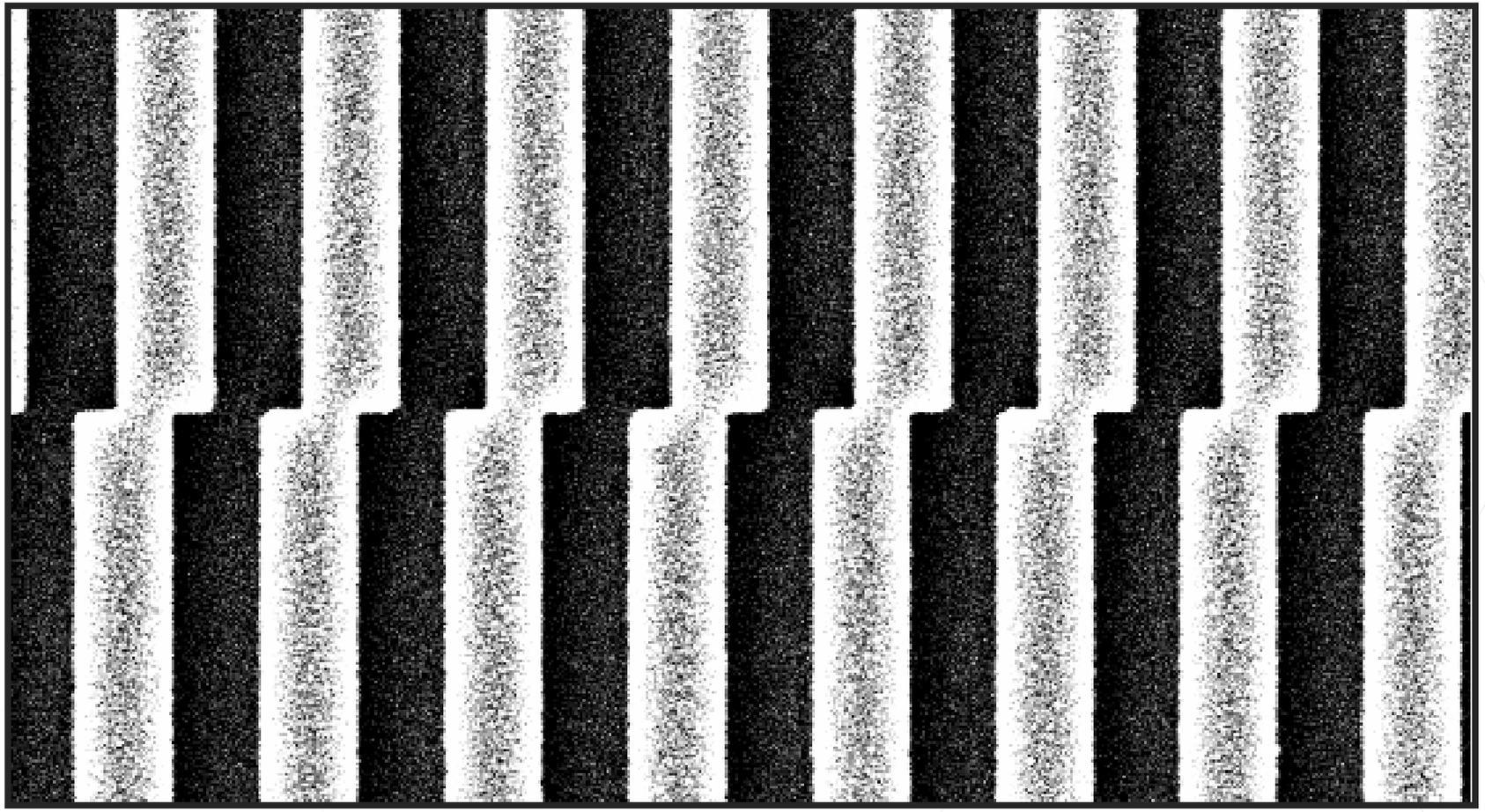
Issues at Field Borders

Field Stitching:

- Moving between fields requires a mechanical stage move.
- Elements crossing the field border are split and exposed in two fields.
- Lower quality at field border due to abberations/distortions.
  - Field center has highest accuracy; field edges have lower accuracy.
- More time/stage movements between feature writing



Issues at Field Borders

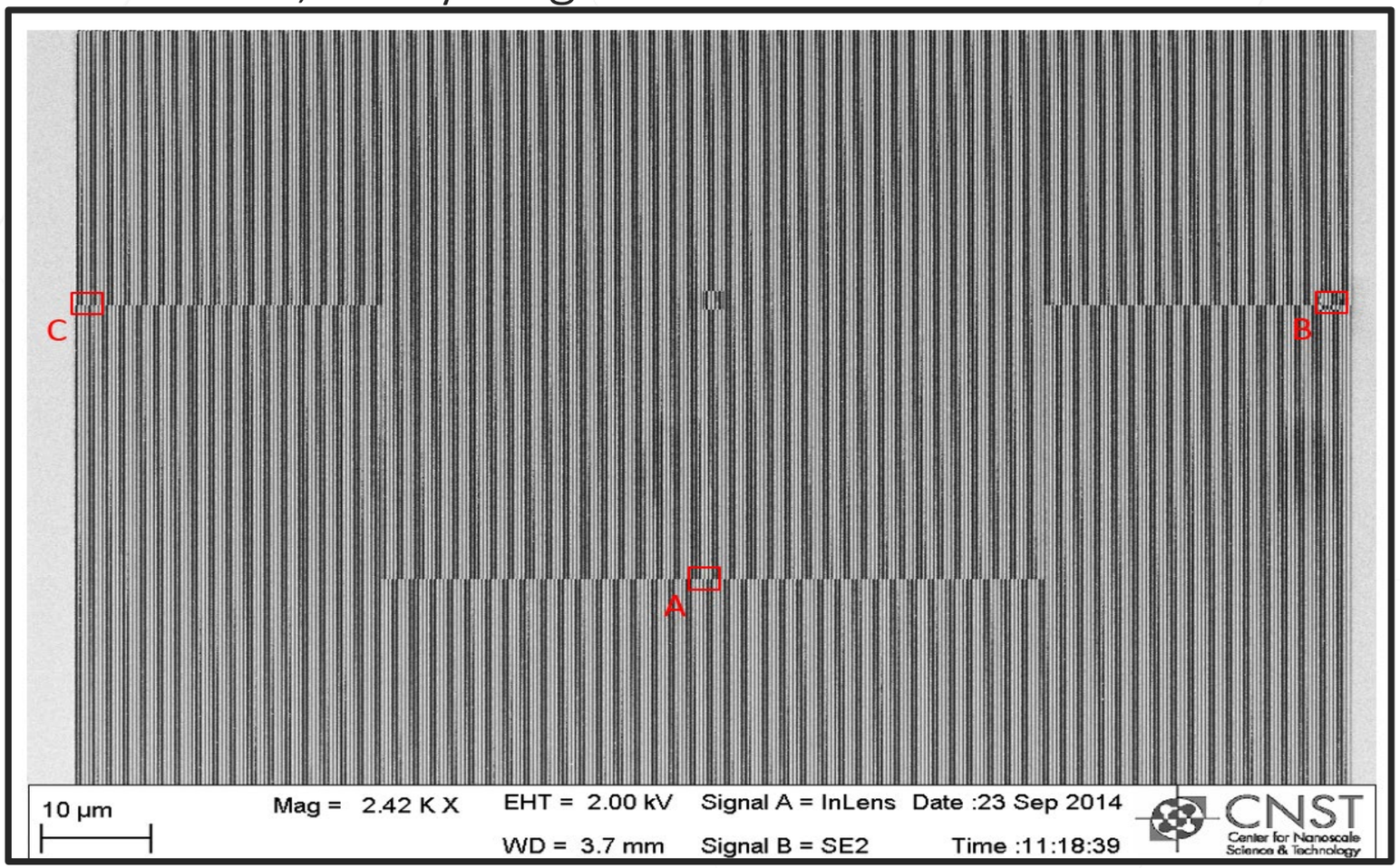


Courtesy: Nikolai Klimov, NIST

Issues at Field Borders

Stitching errors more likely if there is more time between writing both parts of a feature

- Tool drift, many stage movements...



Courtesy: Nikolai Klimov, NIST

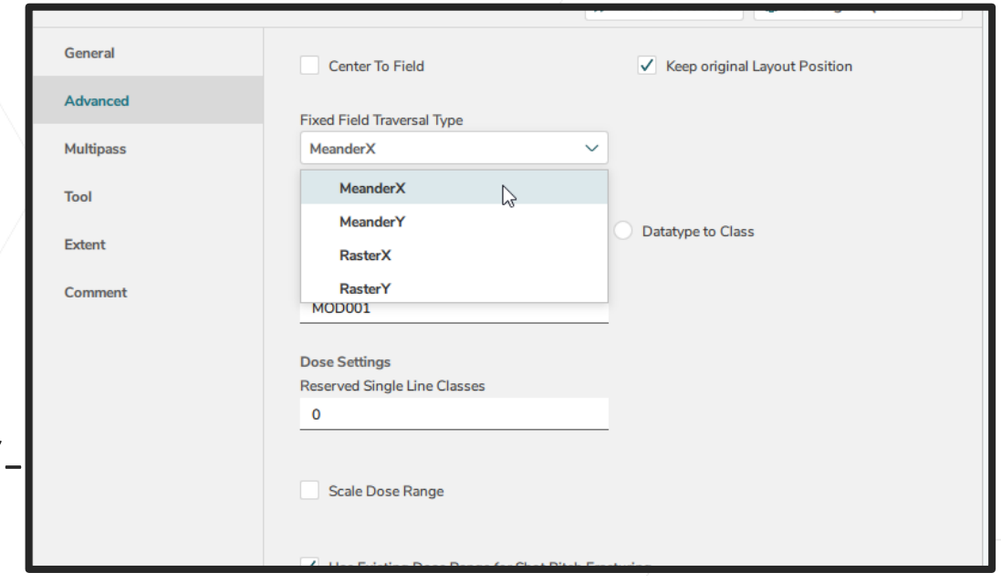
Fixed Field Traversal

Field Ordering determines stage motion and impacts delay between fields

Meander X, Meander Y, Raster X and Raster Y

Example:

- X-Meander is not optimal for a grating oriented in Y-direction



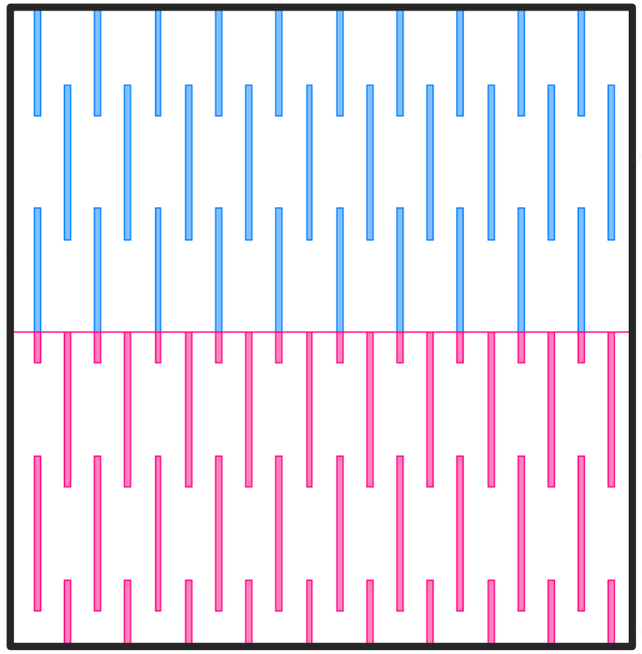
Meander X

Raster Y

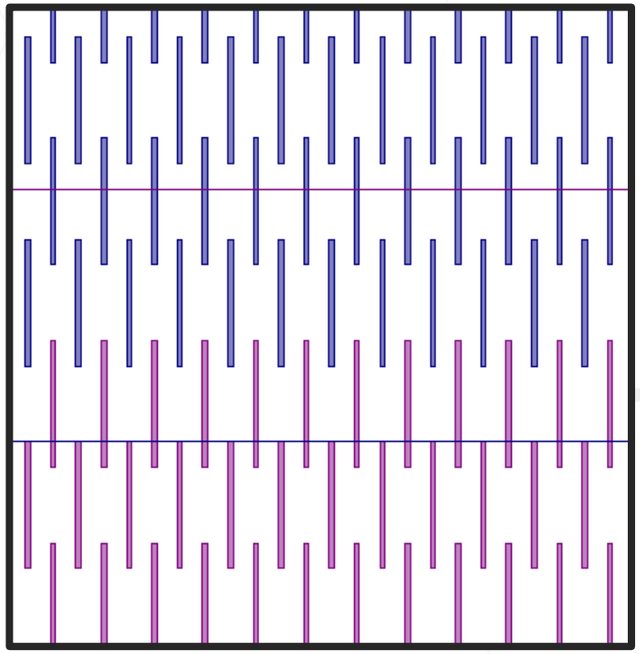
Field control – Overlap

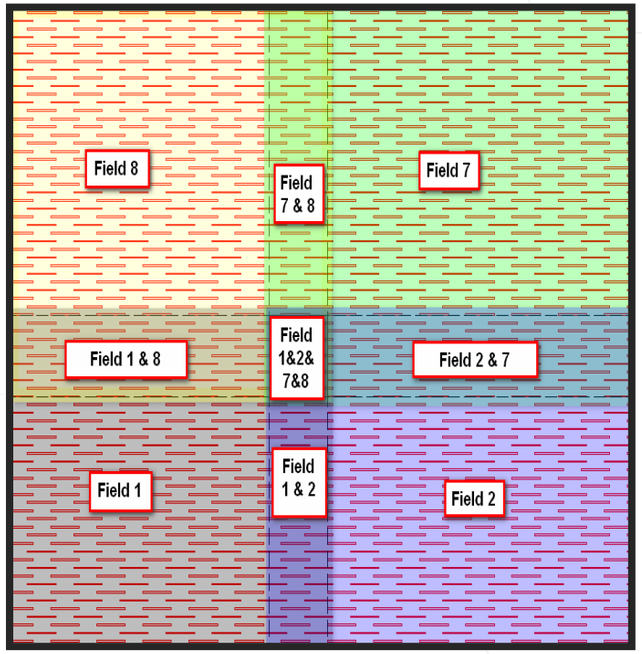
- The Field Overlap defines “mutual“ area between fields:
  - Elements in overlap are not split, but exposed either completely in one or the other
  - Only elements exceeding the overlap area to both sides need to be cut

Standard Fracture
Shapes Cut

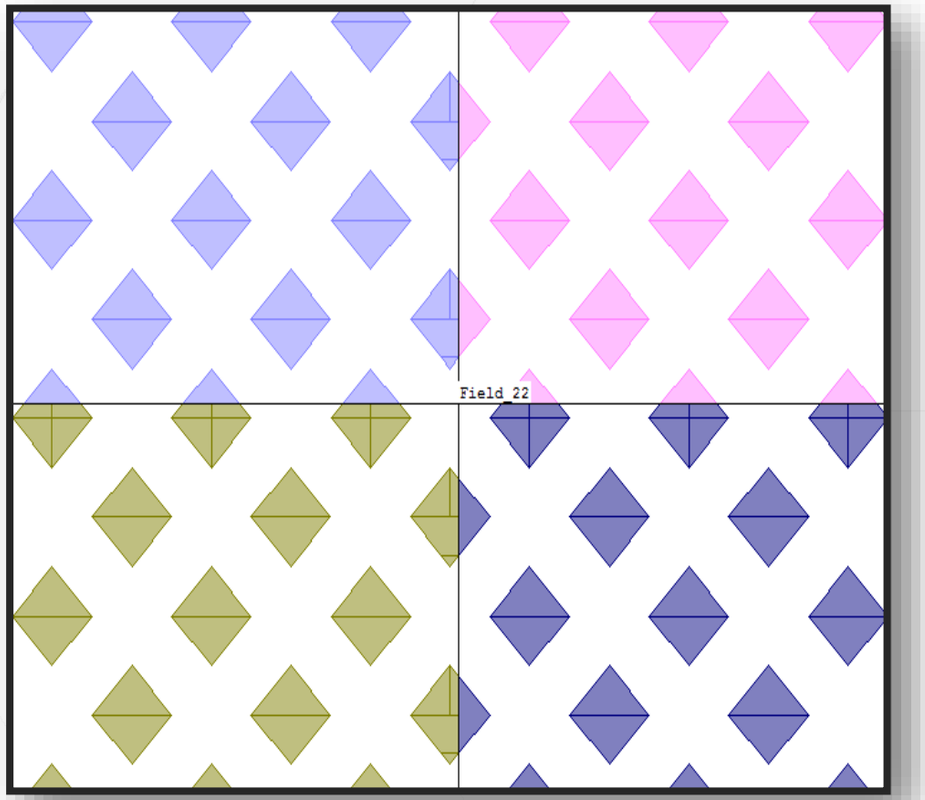


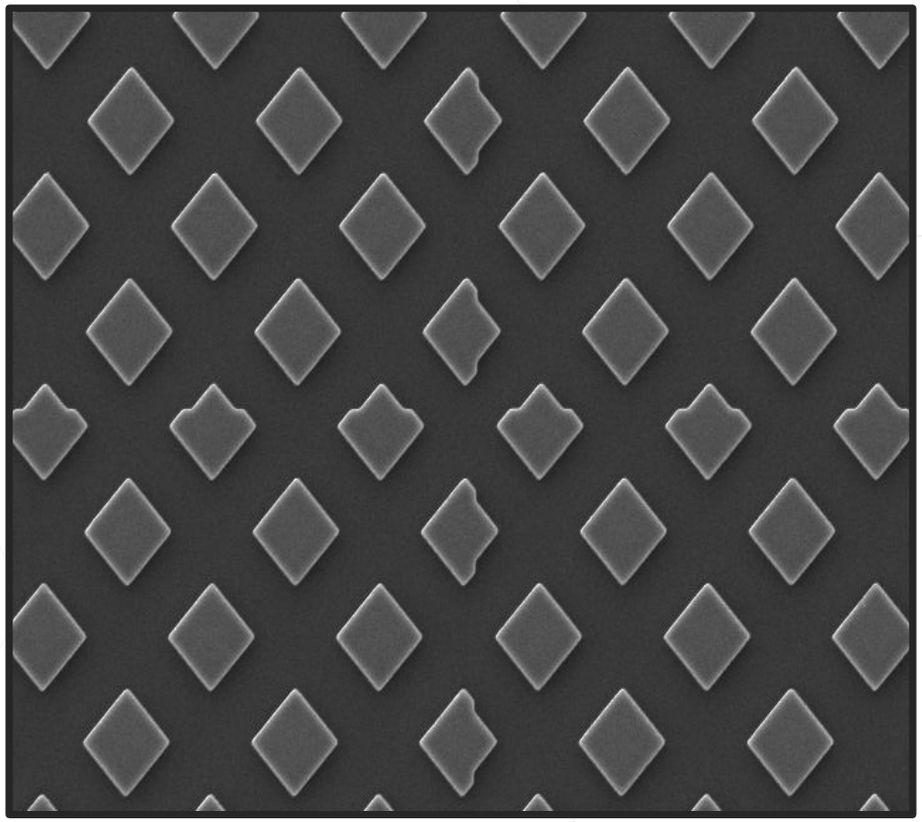
Overlapping Fields
No Shapes Cut



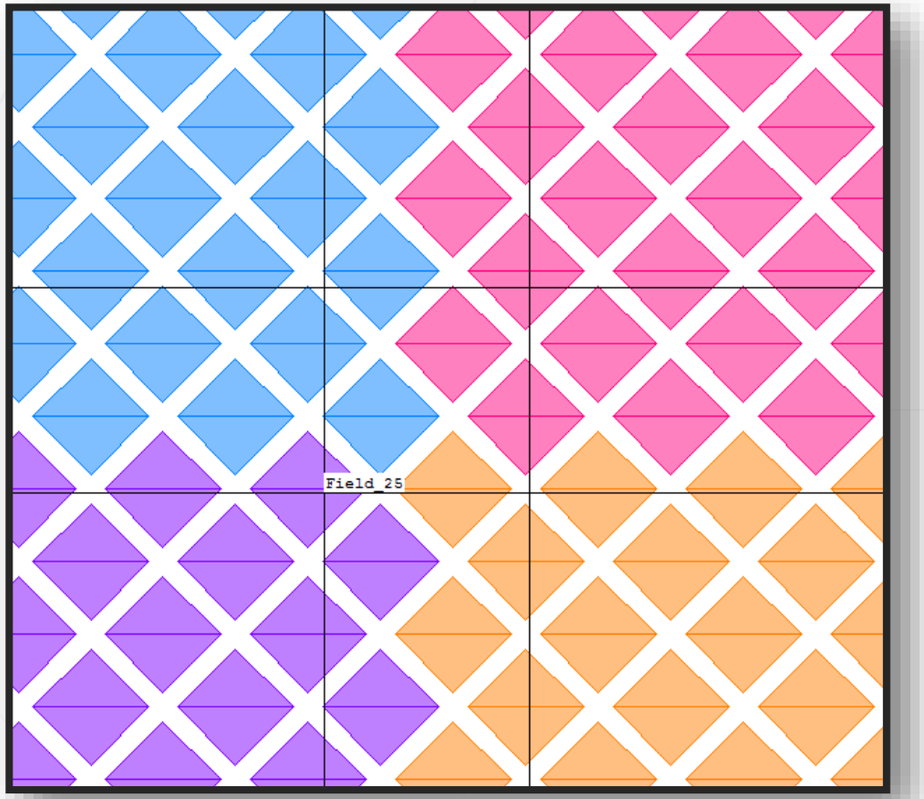


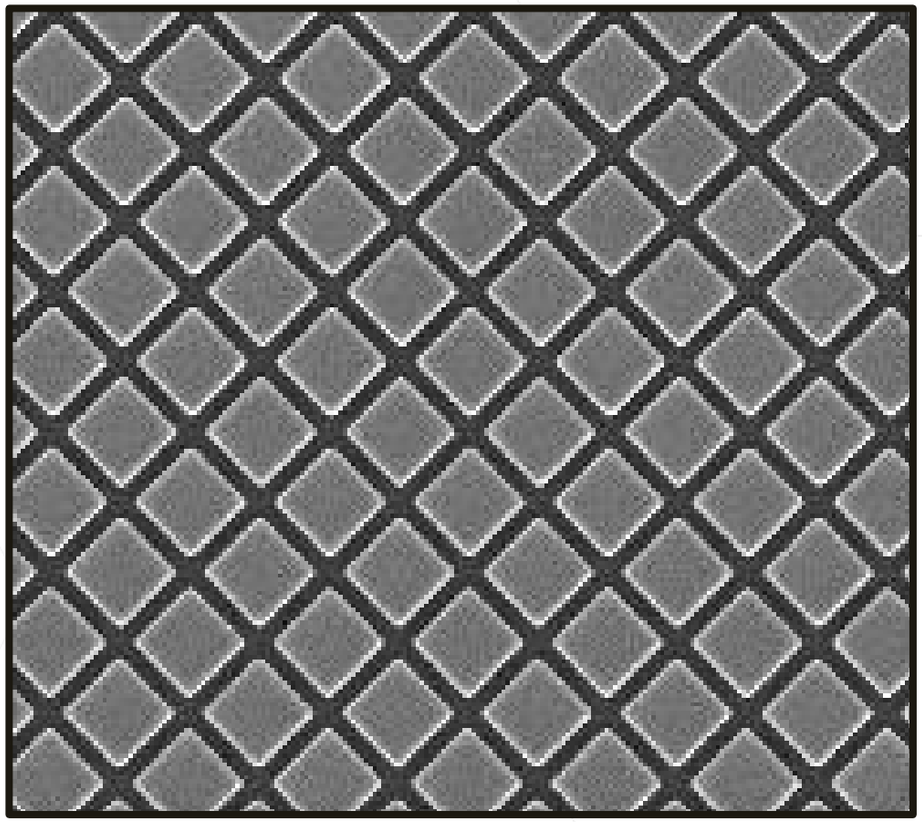
Overlapping Fields





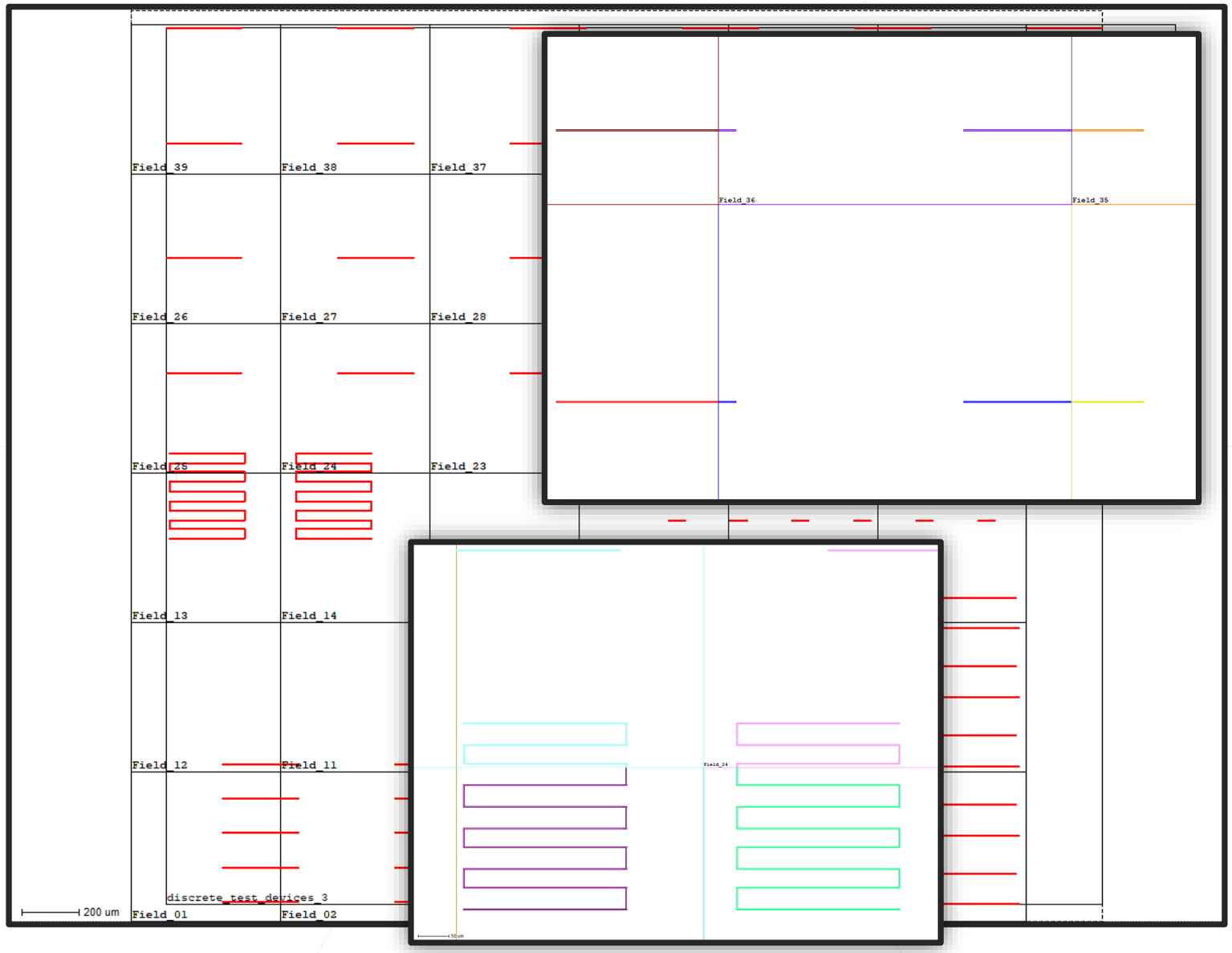
Overlapping Fields





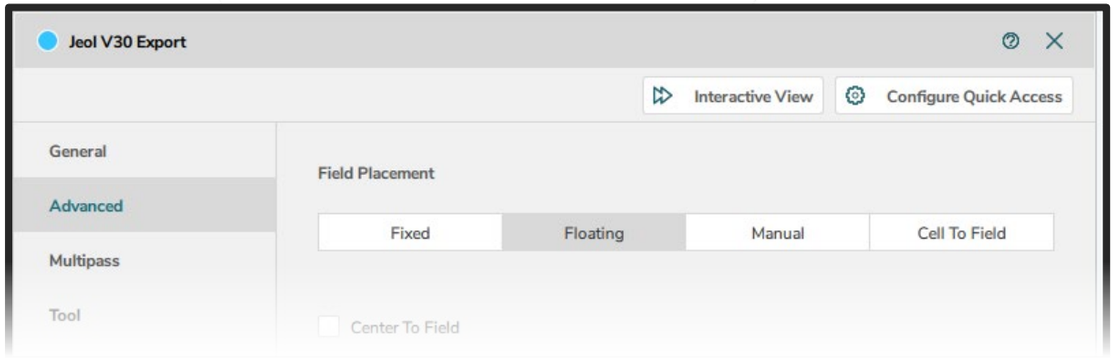
Floating Fields

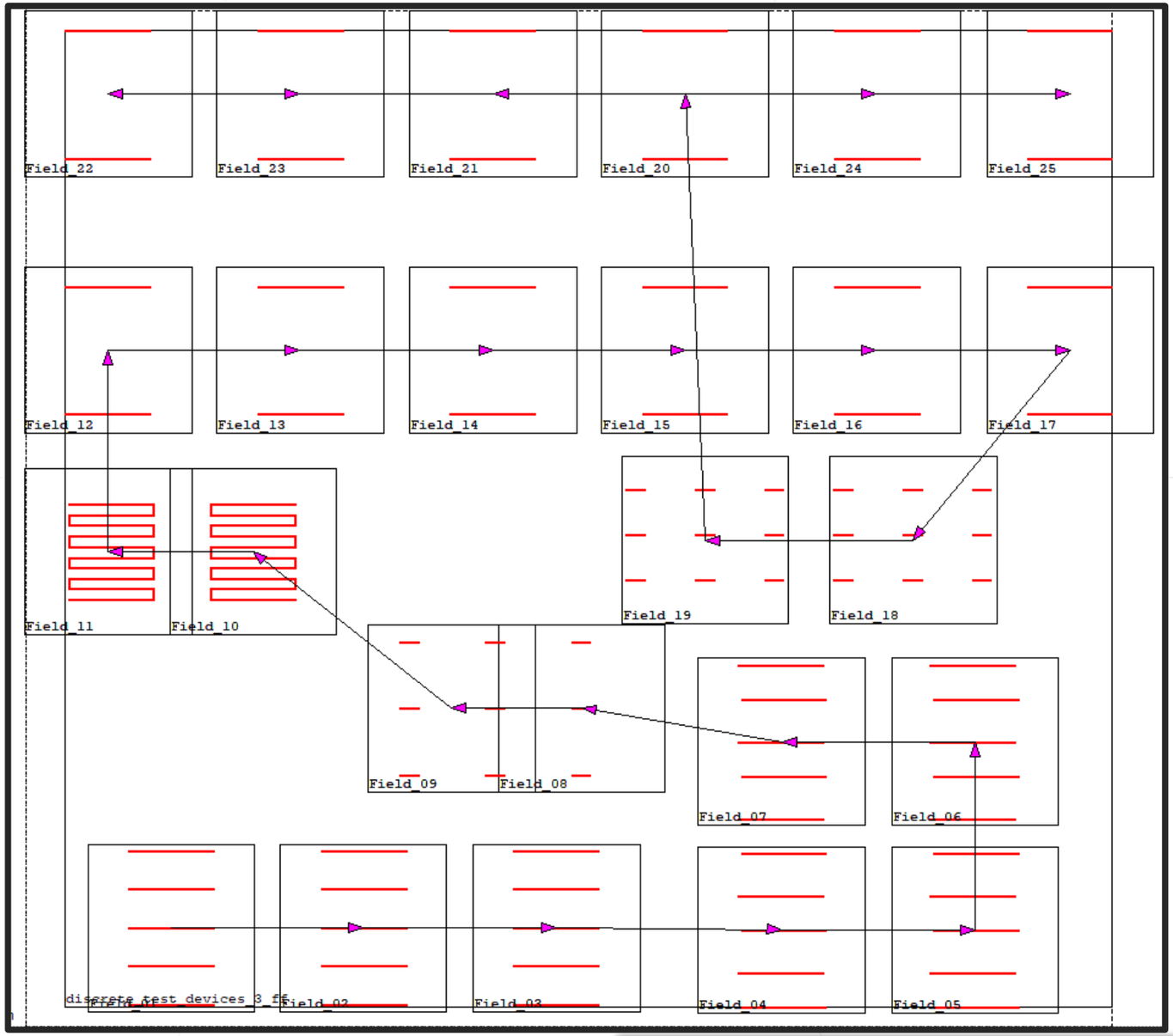
- What is best field sorting method for this kind of pattern?
  - Sparse features
  - “Large shapes” (relative to field size)
- Fixed Fields sorting is not optimal…
  - Shapes are not centered in field where write quality is higher
  - Shapes cross field boundaries which can introduce stitching errors



Floating Fields

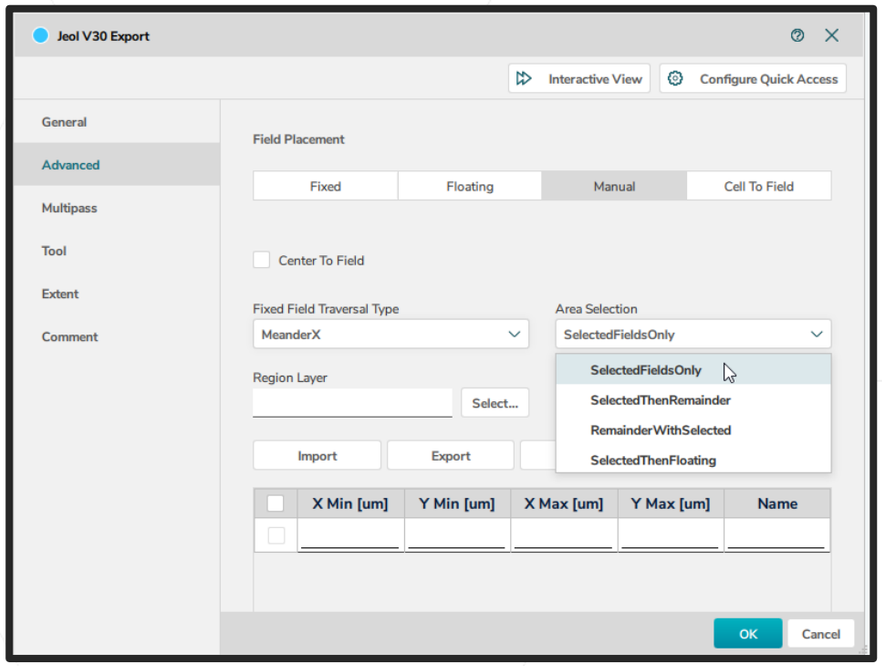
- Automatic Floating Field sorting is available
- Fields are automatically placed to surround shapes
  - Features are centered in fields if possible
  - Stage moves are optimized



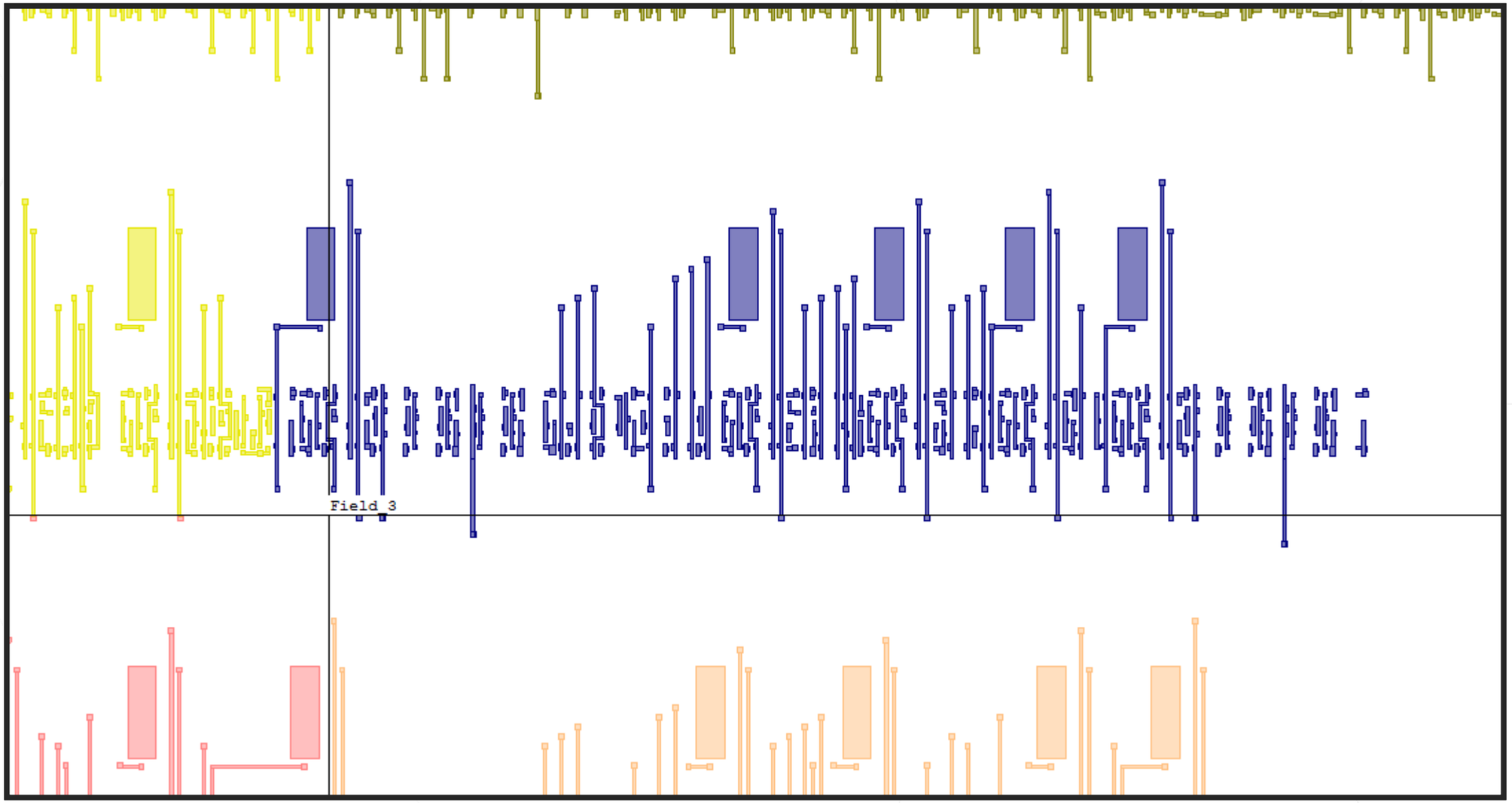


Manual Field Placement

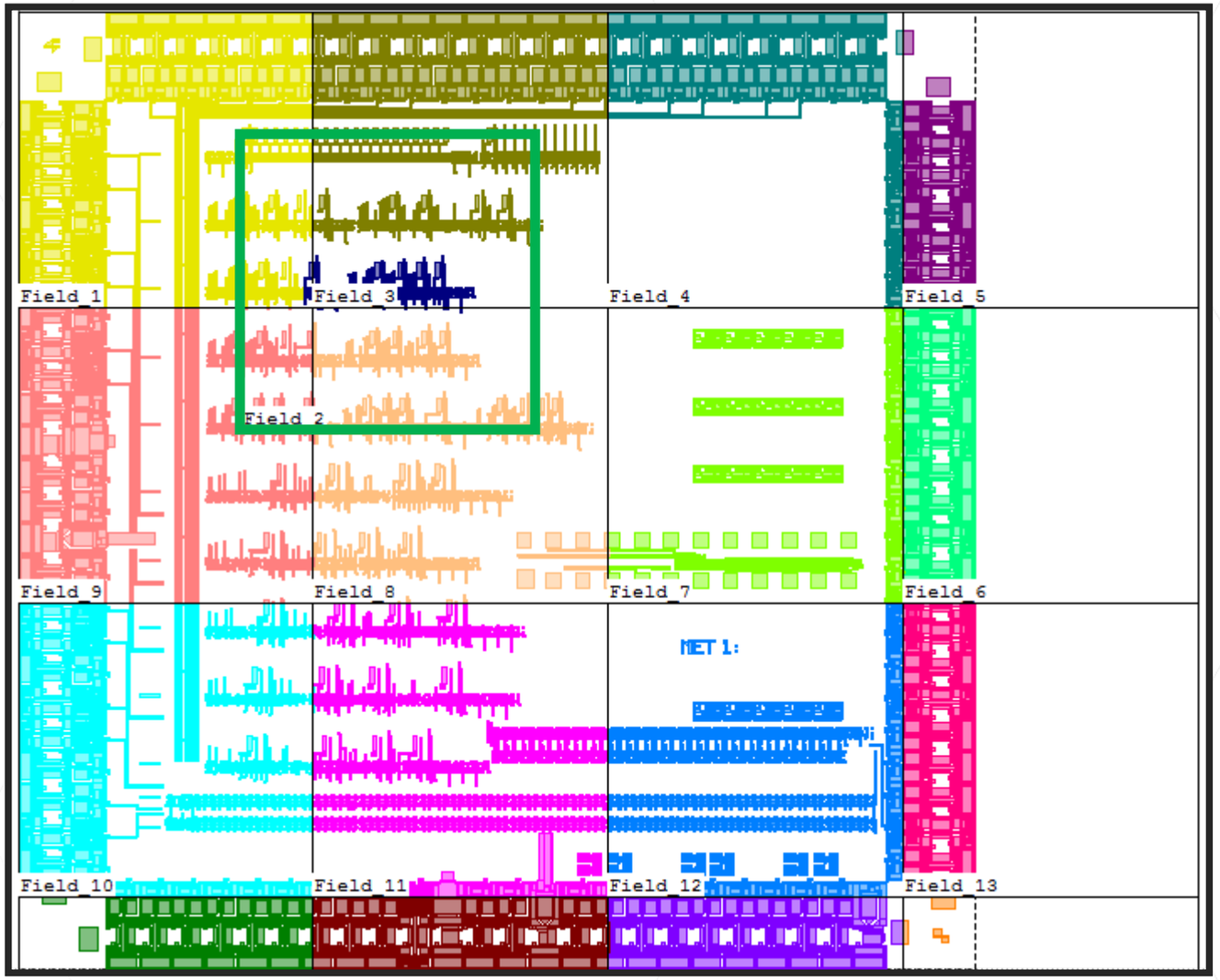
- Manually select fields
  - Region selection as in Extract
  - Use “Region Layer” definitions to select region
- Various Sorting Options
  - Selected Fields Only
  - Selected Then Remainder
  - Remainder With Selected
  - Selected Then Floating



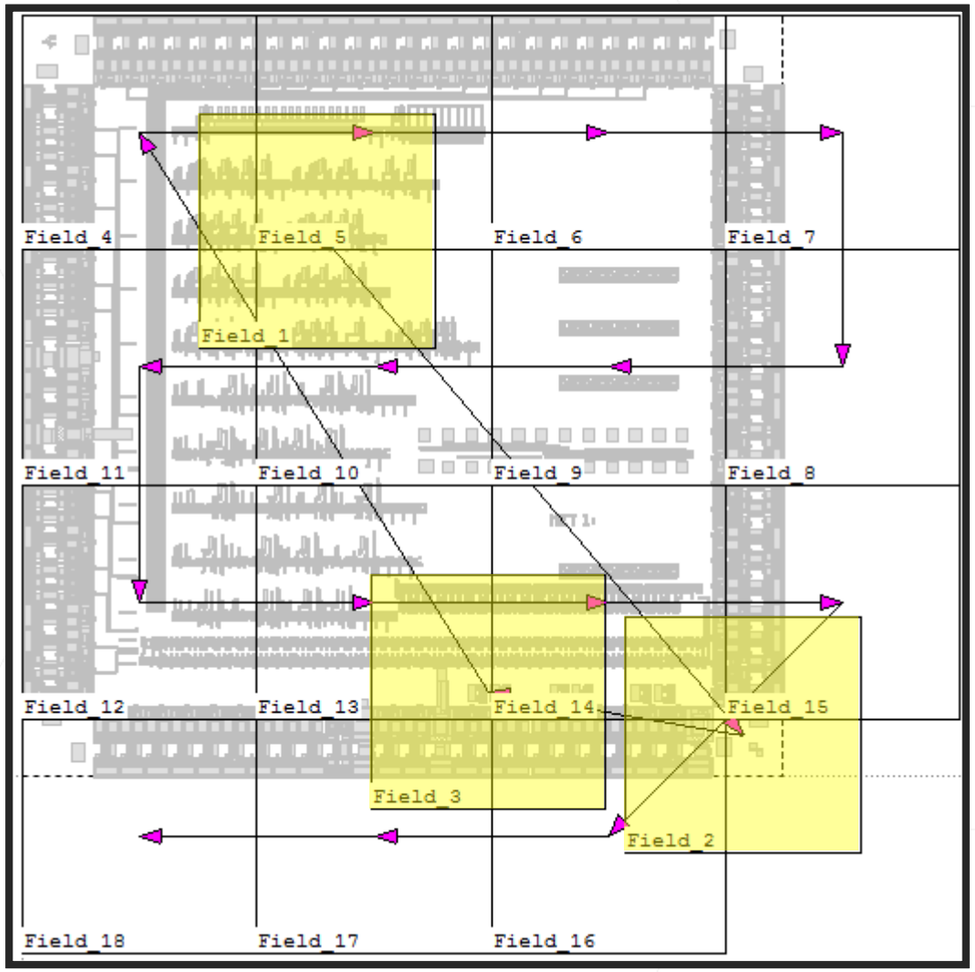
Manual Fields



Manual Fields



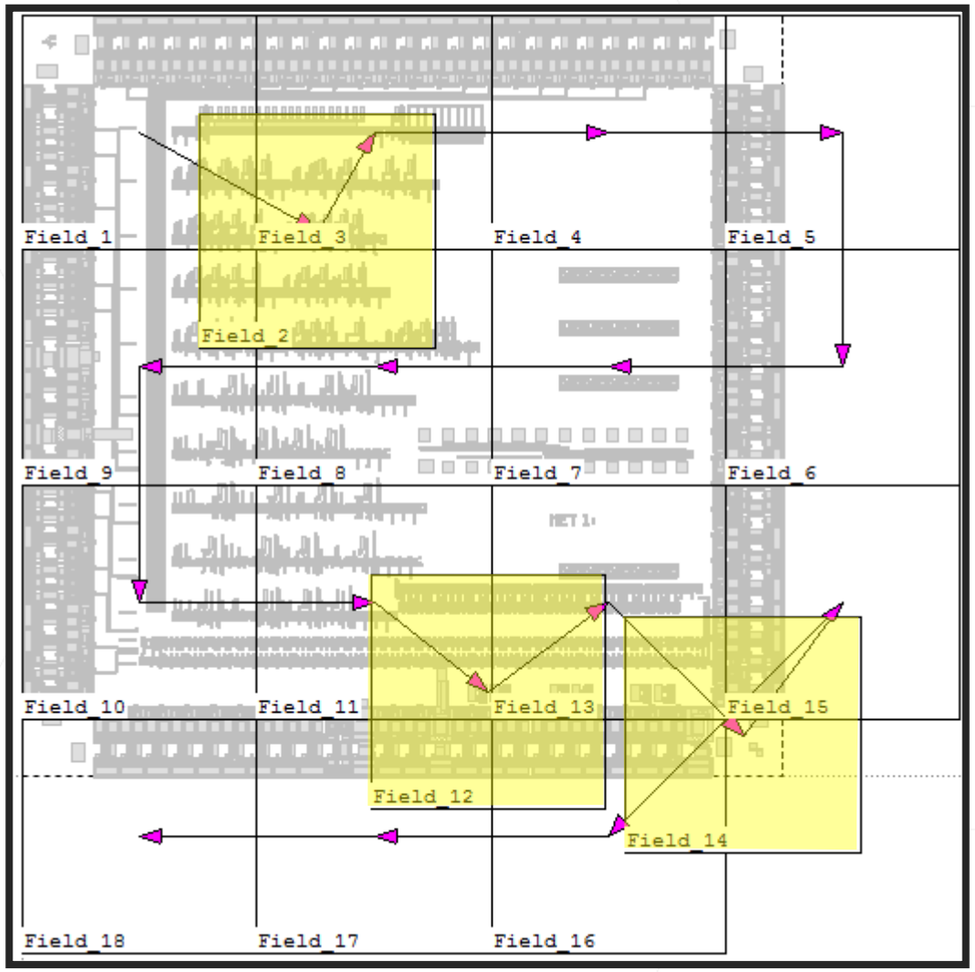
Manual Fields



Selected Then Remainder

Selected fields are written first, then the rest of the pattern is exposed

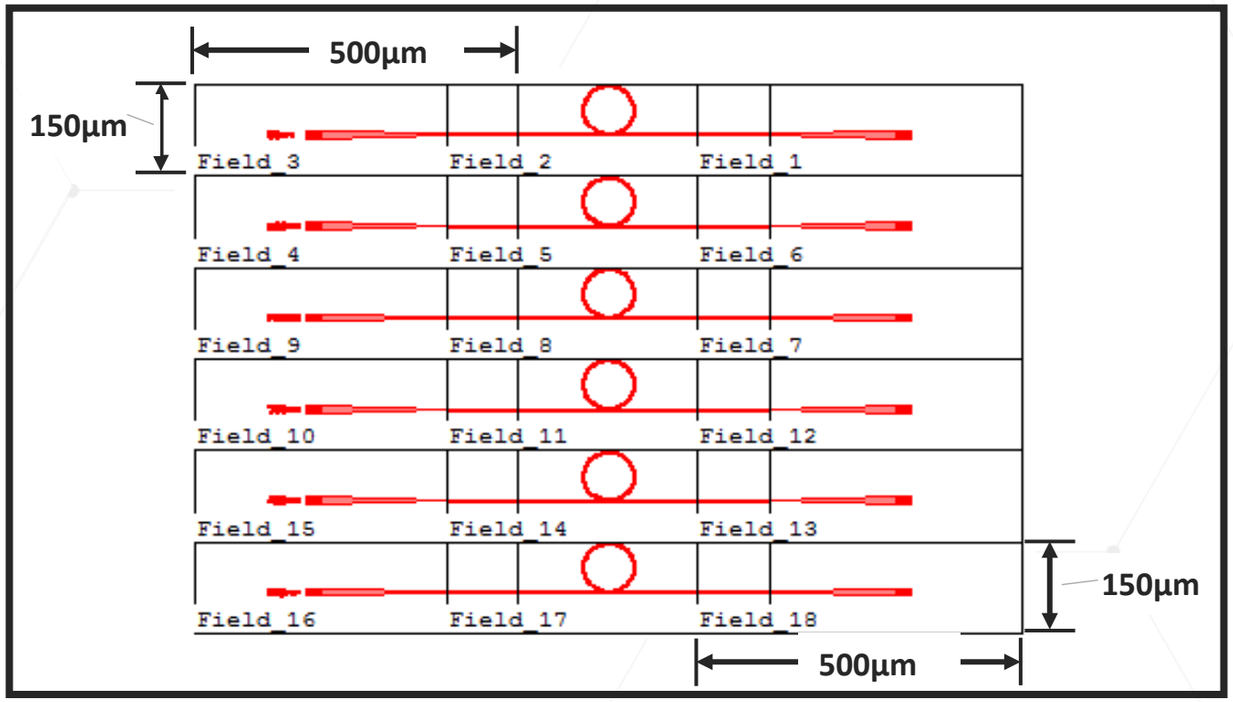
Manual Fields

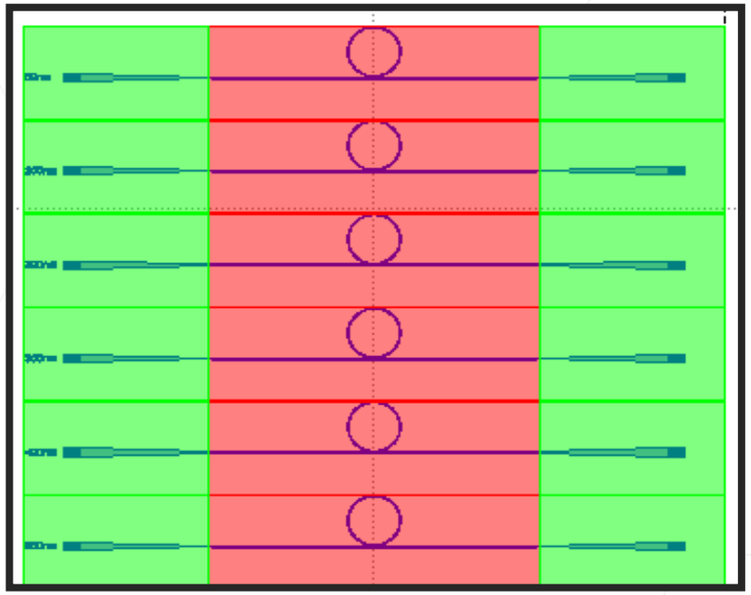


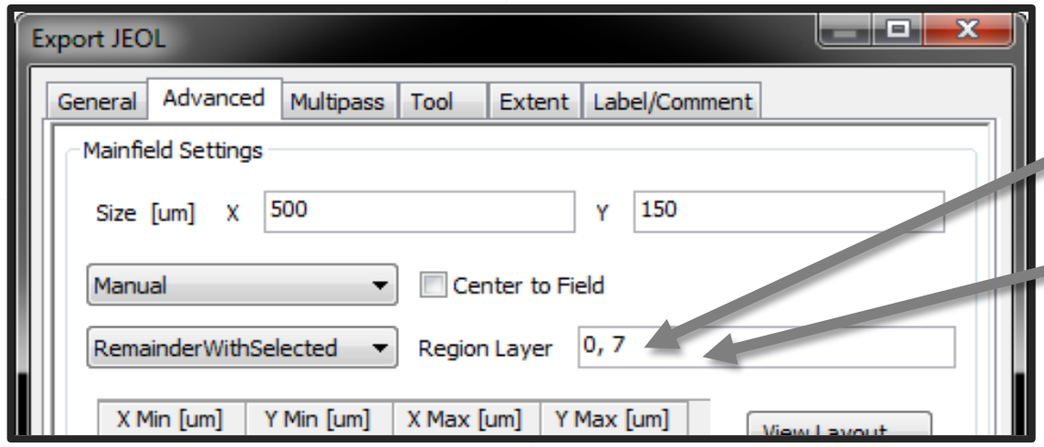
Remainder with Selected

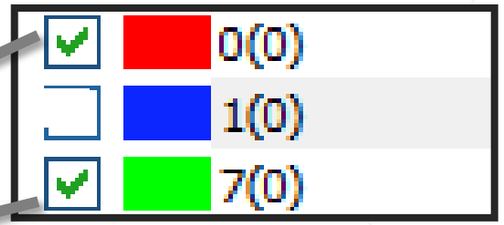
The standard field traversal picks up the selected floating fields during exposure.

Manual Field Control: Layers





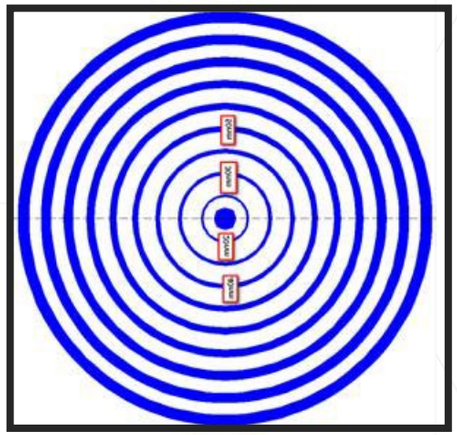


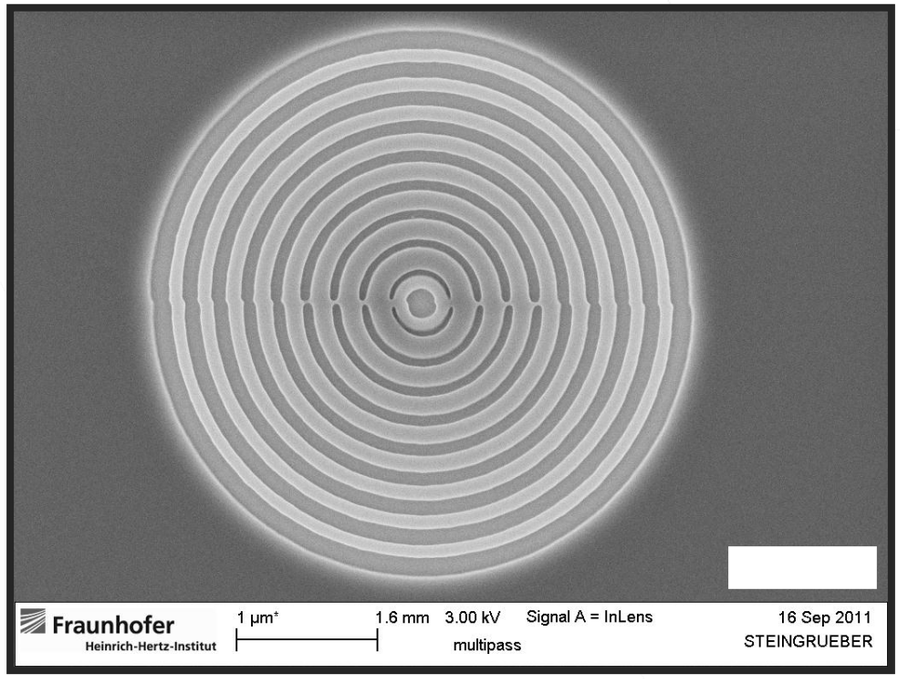


Multipass

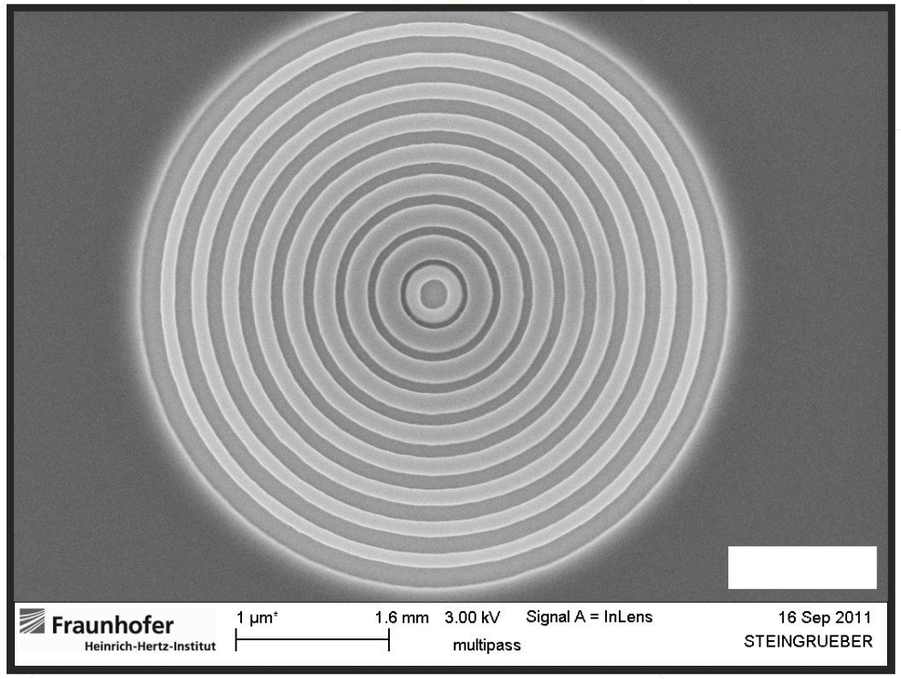
Multipass works by exposing the same shape multiple times at a fractional dose

- Reduces LER, improves resolution
- Mitigates stitch errors (with offset)





Single pass exposure with stitch errors



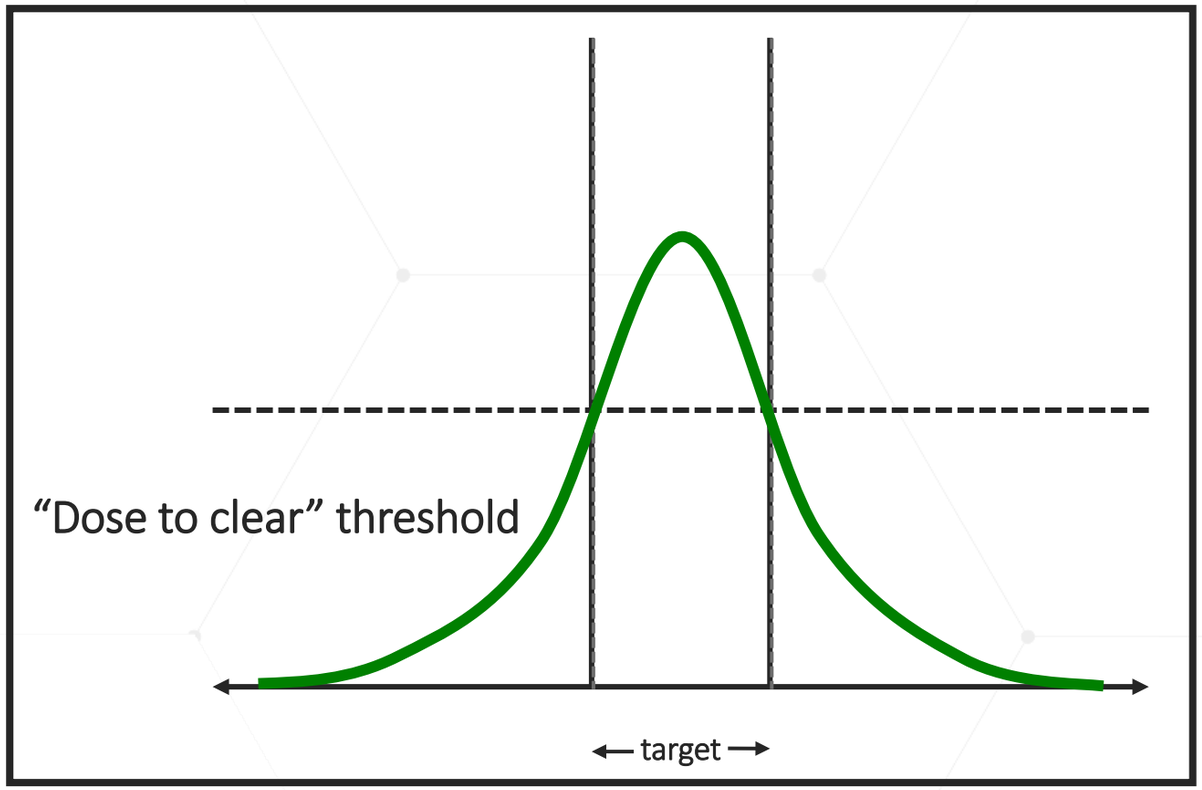
Same pattern fractured with multi-pass

Multipass: Theory of Operation

- Writing Errors are either systematic or statistical…
- Statistical errors include:
  - Beam Current Fluctuations
  - Beam Jitter, Beam Drift
  - Stage Position Errors, mechanical vibrations, …
- Systematic errors include
  - Field Distortion and Field Aberrations
  - Scan Non-Linearities
  - X/Y asymmetries due to discrete spots in Y / dragging in X
  - …
- Multipass reduces statistical errors by averaging
- In addition, systematic errors can be reduced by offset strategies

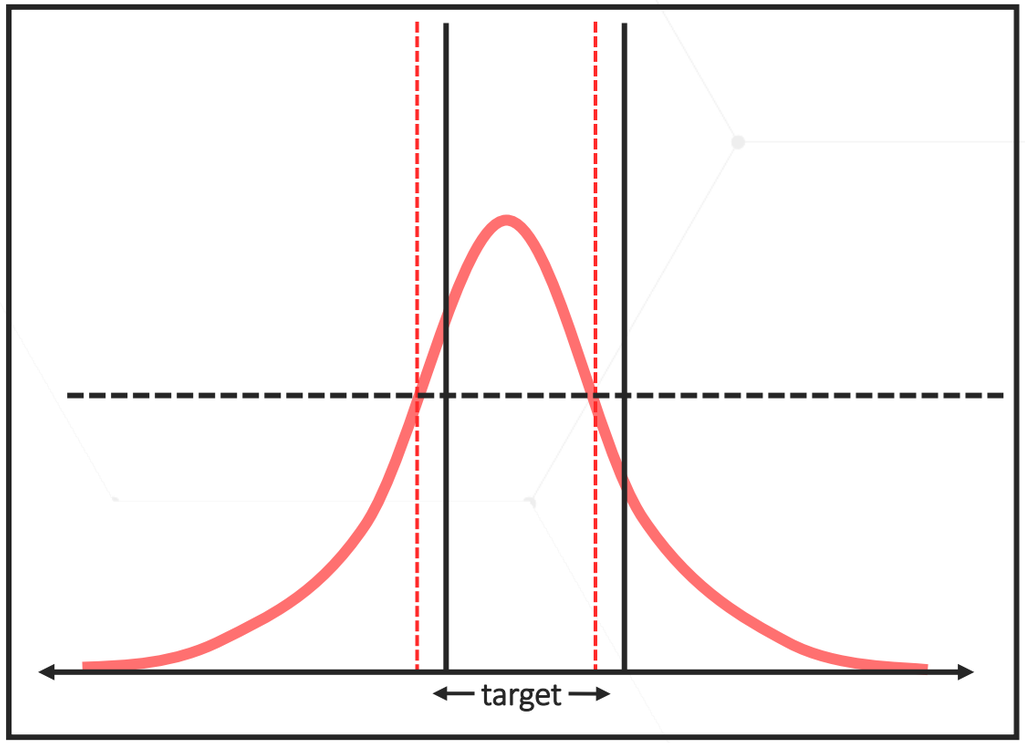
Multipass

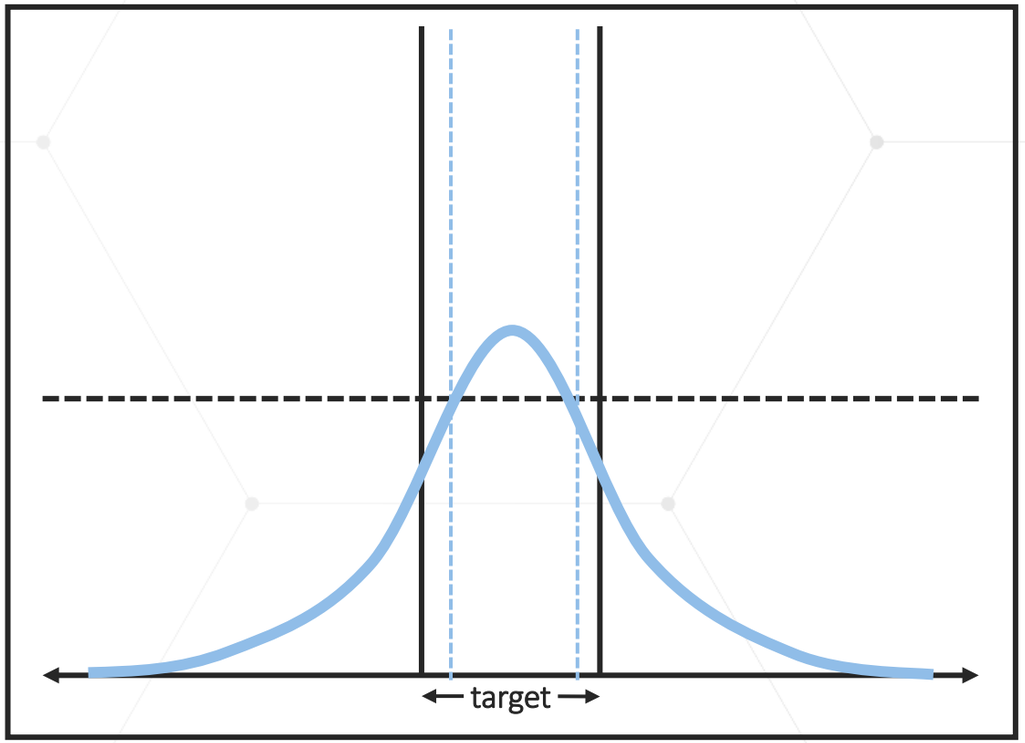
- Resist edge at dose to clear threshold
- Accurate dose and shot placement results in correct CD



Multipass

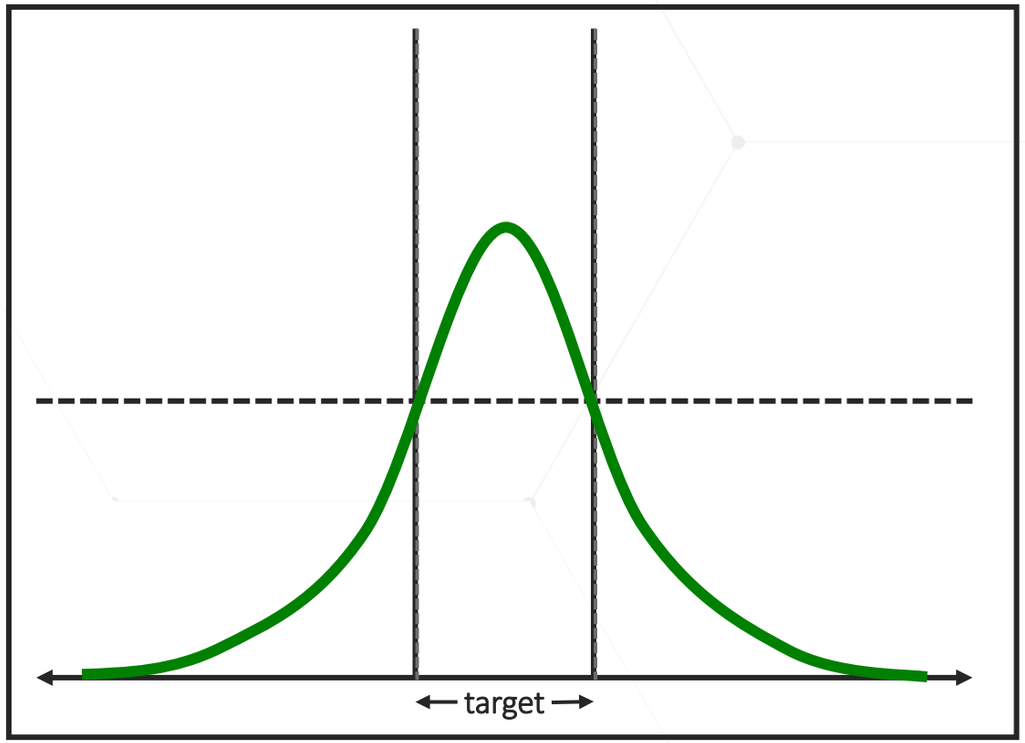
- Errors can result in…
  - misplaced shots that shift the feature edges
  - fluctuations in dose applied at each shot that causes oversized or undersized features

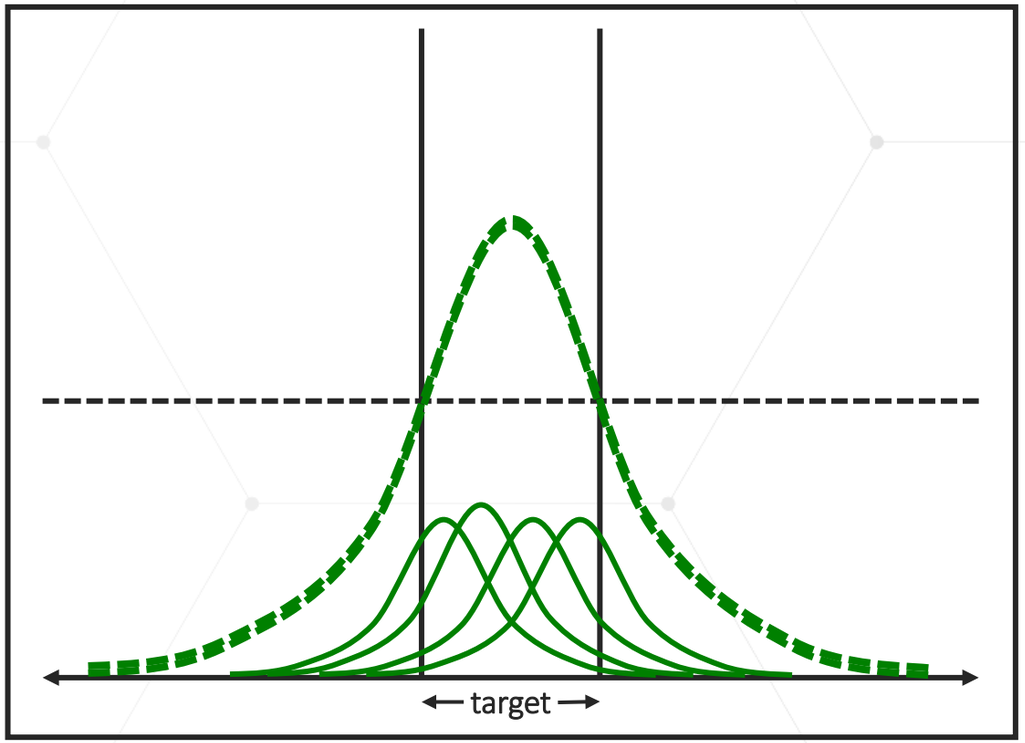




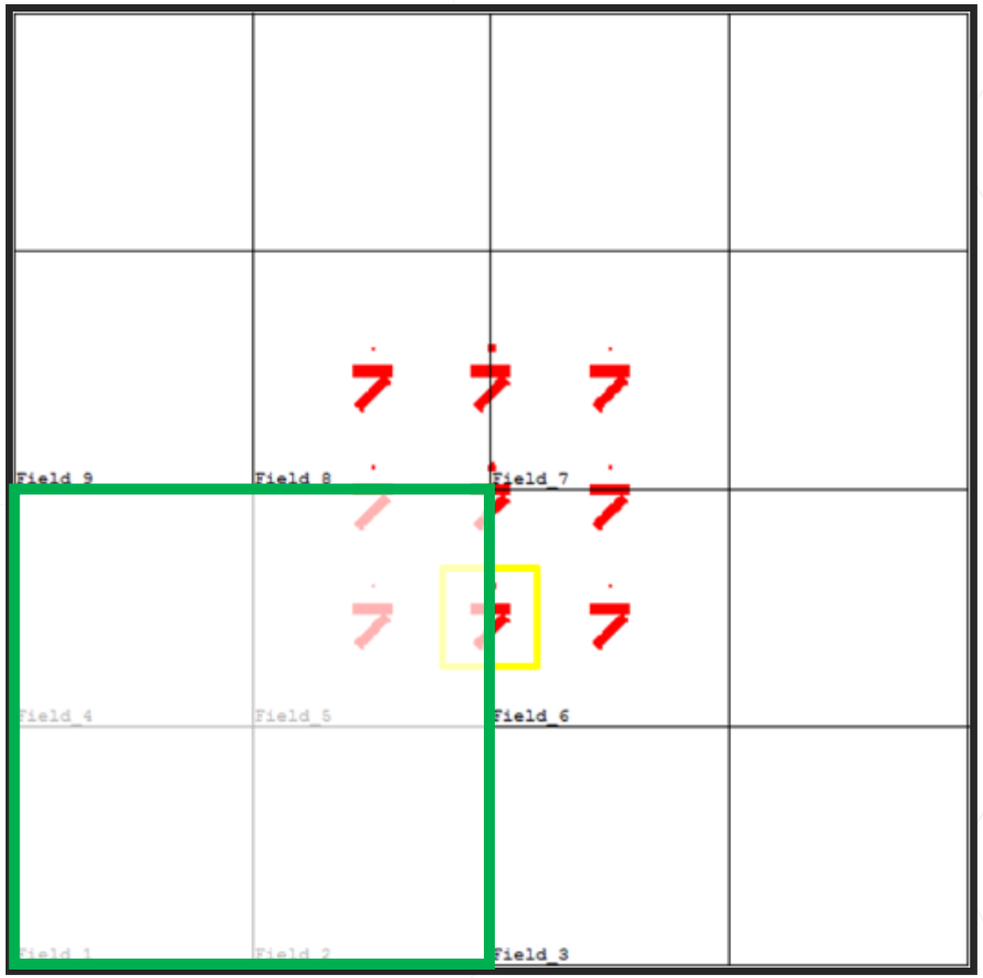
Multipass

- Multipass works by exposing the same spot multiple times at a fractional dose
  - (e.g. 4 pass at ¼ dose per shot)
- Doses from each pass sum





4X Pass with ½ Field Shift in X/Y



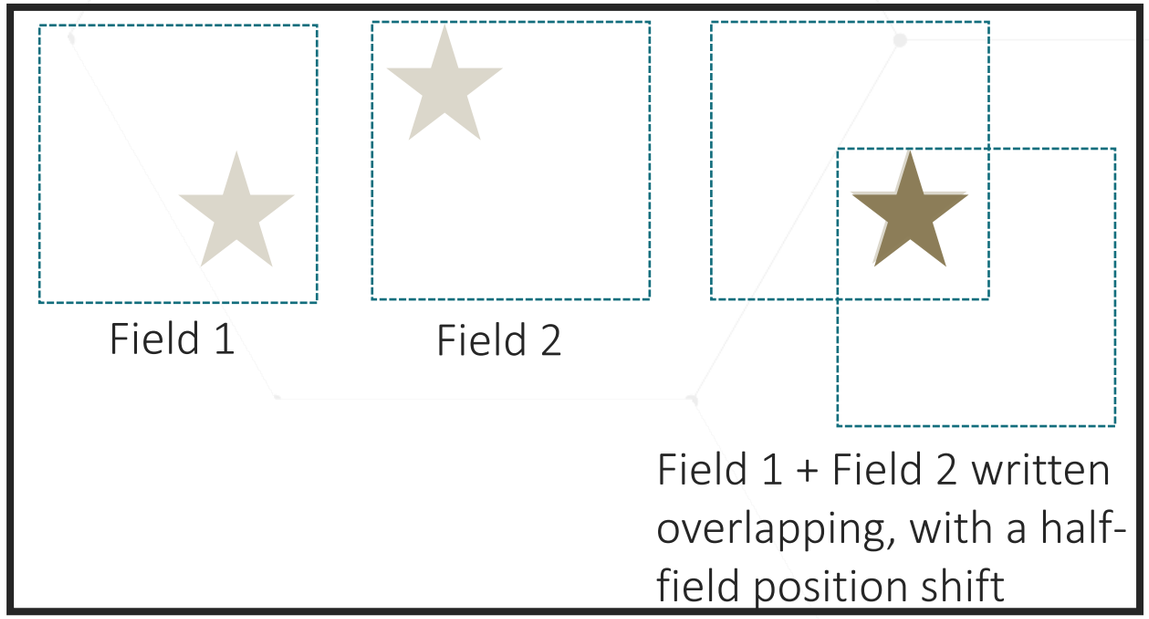
Left half of Yellow area exposed

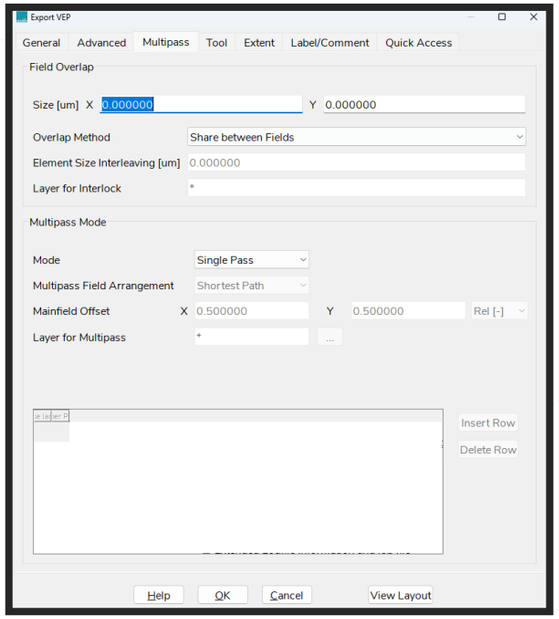
4th time

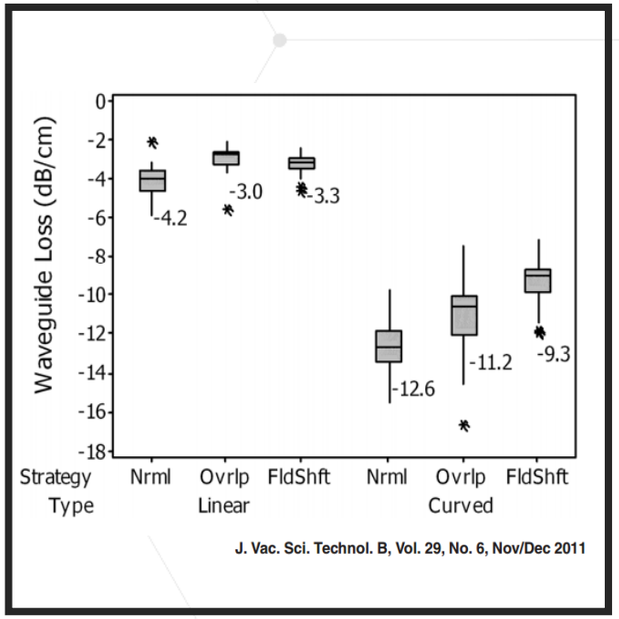
One E-Beam Exposure Field

Multipass

- In multi-pass writing, shapes are written multiple times, averaging both temporal and spatial variations, improving uniformity.
- (Use half the dose for each pass)

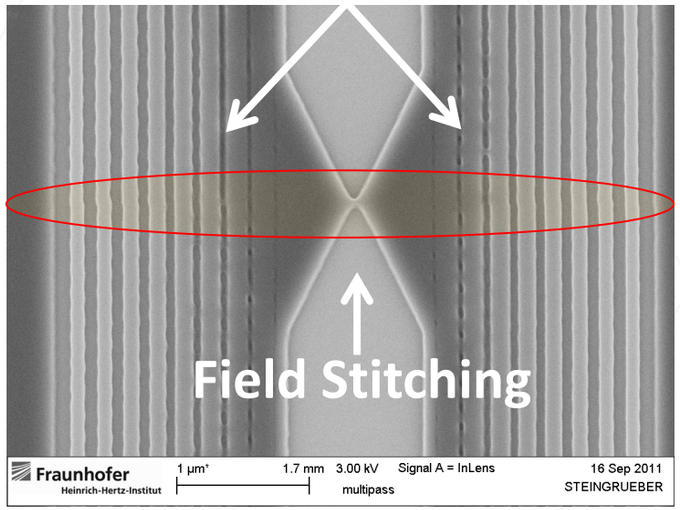






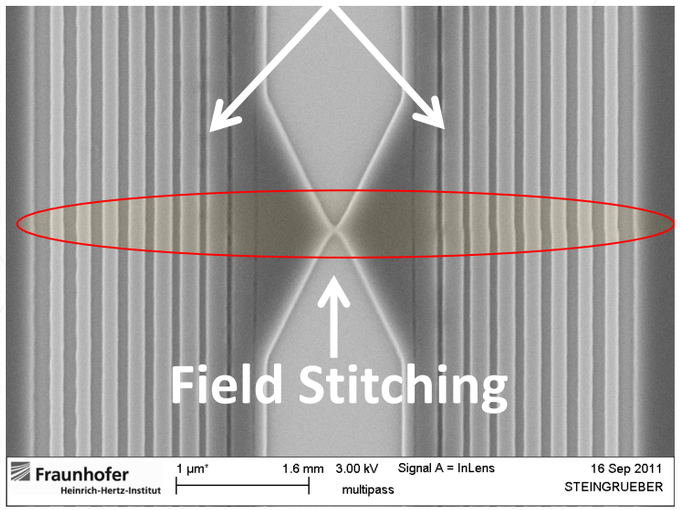
Multipass

High LER



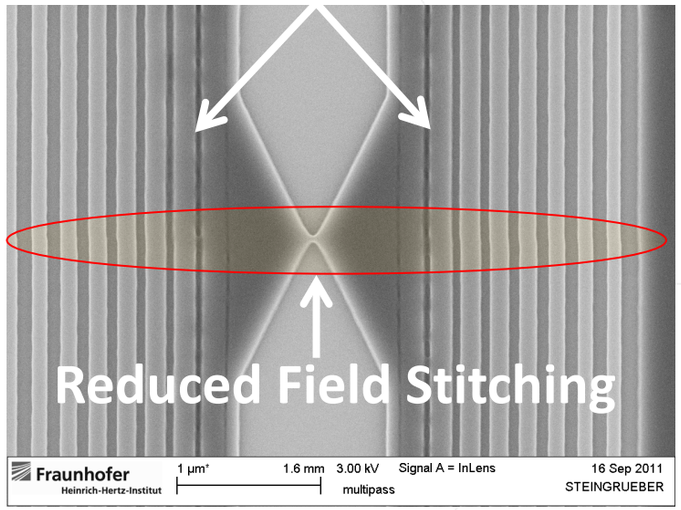
Single Pass 100µC/cm²

Low LER



4-pass with stationary field 100µC/cm²

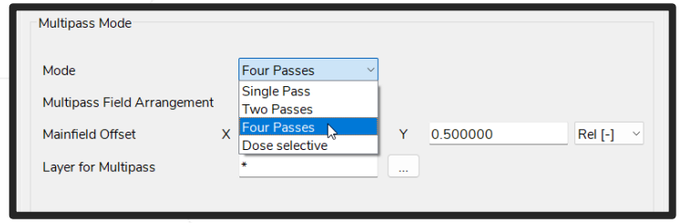
Medium LER

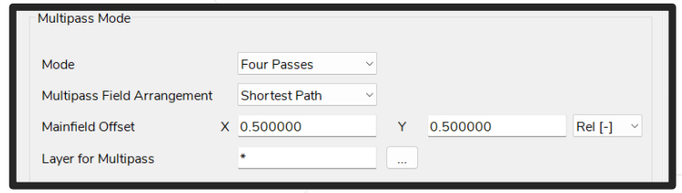


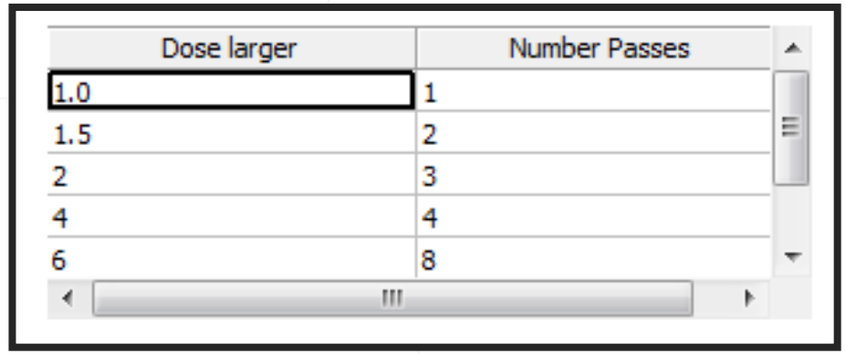
4-pass with field shifts 100µC/cm²

Multipass Mode

- Multipass Mode
  - 1 – writing with a single pass
  - 2 – every element is written twice
  - 4 – every element is written quadruple times
  - Dose Selective – For each defined dose value the number of passes can be specified
- Mainfield offset
  - Defines the shift of a field against another (Units are field sizes)
- Subfield offset
  - Defines the shift of a subfield against another (Units are field sizes)
- Layer for Multipass
  - Applies multipass only to specified fields





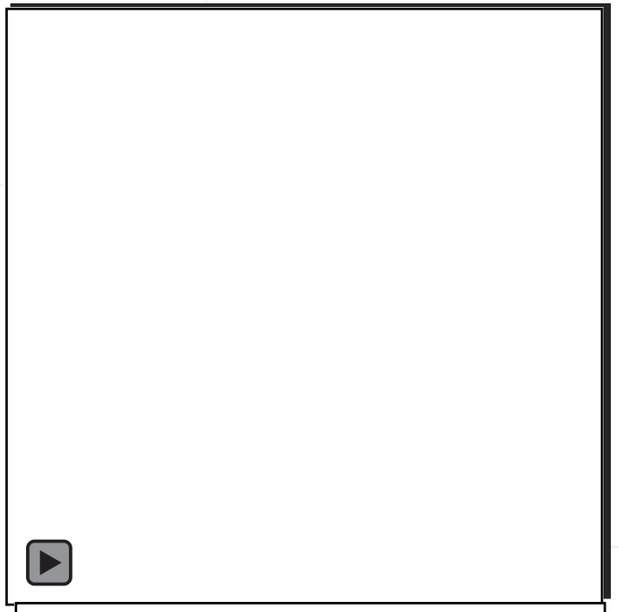


Dose larger	Number Passes
1.0	1
1.5	2
2	3
4	4
6	8

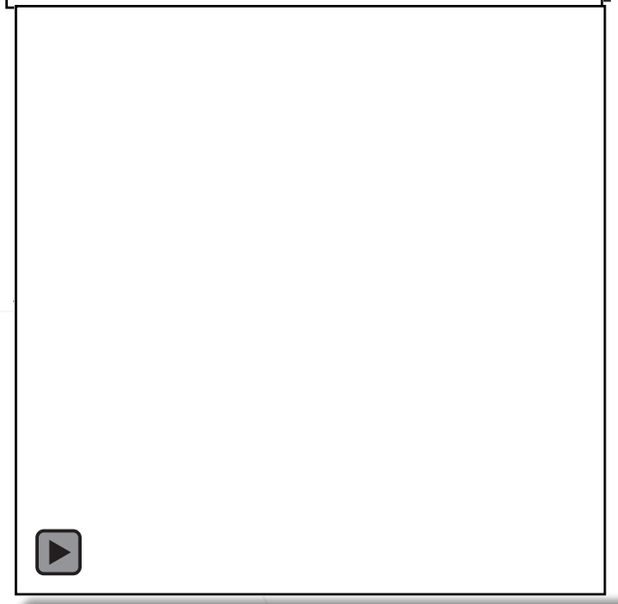
Feature Sorting in Field

- Feature Order is the order shapes are exposed within each field
- No Compaction – Default, takes data as is
- Array Compaction – Compacts data by recognizing identical shapes
- Writing Order – “Nearest neighbor” exposure
- Follow Geometry – Follows long lines, good for contiguous structures
- Random – Random shots, causes sub-field jumping but can reduce charging effects

No Sorting



Follow Geometry



Agenda

- GenISys Introduction
- E-Beam Lithography: From Layout to Wafer
- BEAMER Basics
- Basic Pattern Preparation
- Fracturing
- Field Control
- Proximity Effect Correction (PEC)

Electron-Solid Interactions

Incendent Electron Beam

Secondary e⁻

Backscatter e⁻

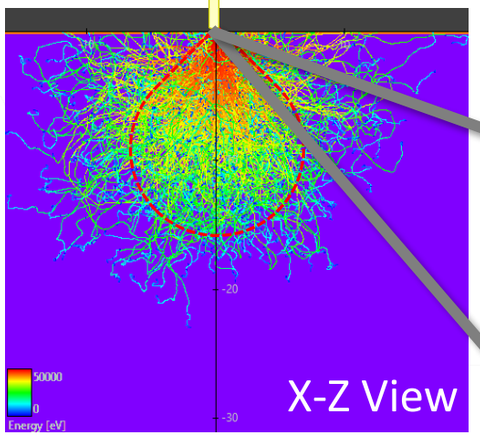
Y

X-Rays

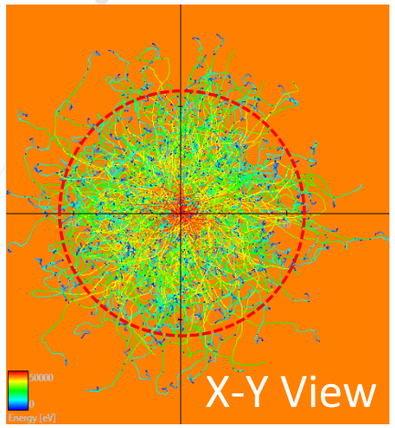
Beam Blur: 1-50nm:Current/ Aperture/Column design

Forward Scatter: 1-10nm: Acceleration Voltage/Resist Material/Material Thickness

Backscatter: 10-30µm: Acceleration Voltage/ Substrate Material



Excitation Volume



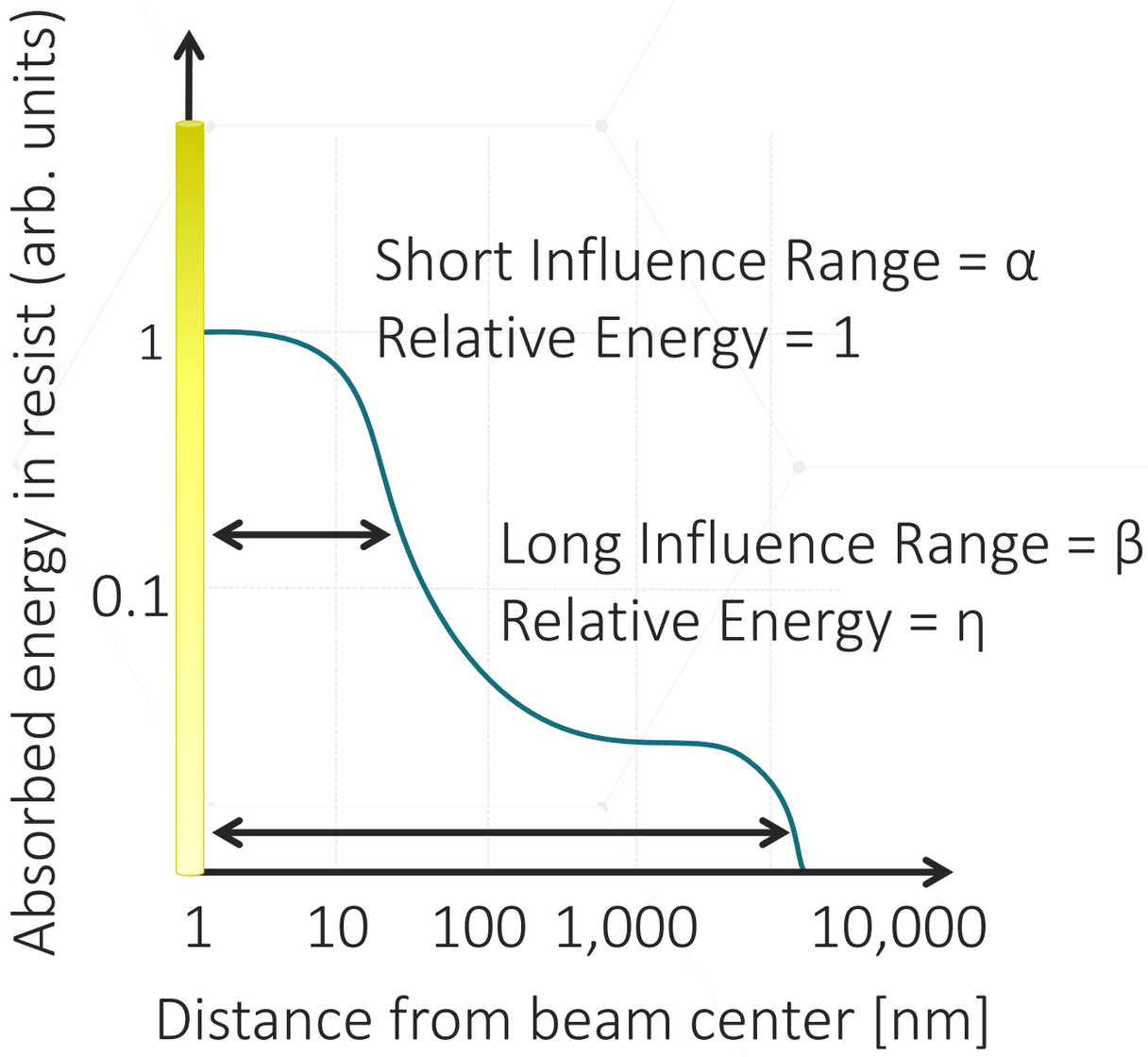
Backscatter Range

Effects Summary

- Short-Range Effects(5-50 nm)
  - E-Beam: beam blur + forward-scattering
- Mid-Range Effects(30-500 nm)
  - E-Beam: mid-range scatter for complex material
  - Resist blur/diffusion 30-100 nm
  - Development/Etch loading 200-500 nm
- Long-Range Effects(10-35 µm)
  - E-Beam: back-scattering

Effects can be summarized by a Point Spread Function – PSF:
Spread of Energy from the incidence of exposure.
The adjacent features interact with each other: Proximity Effect

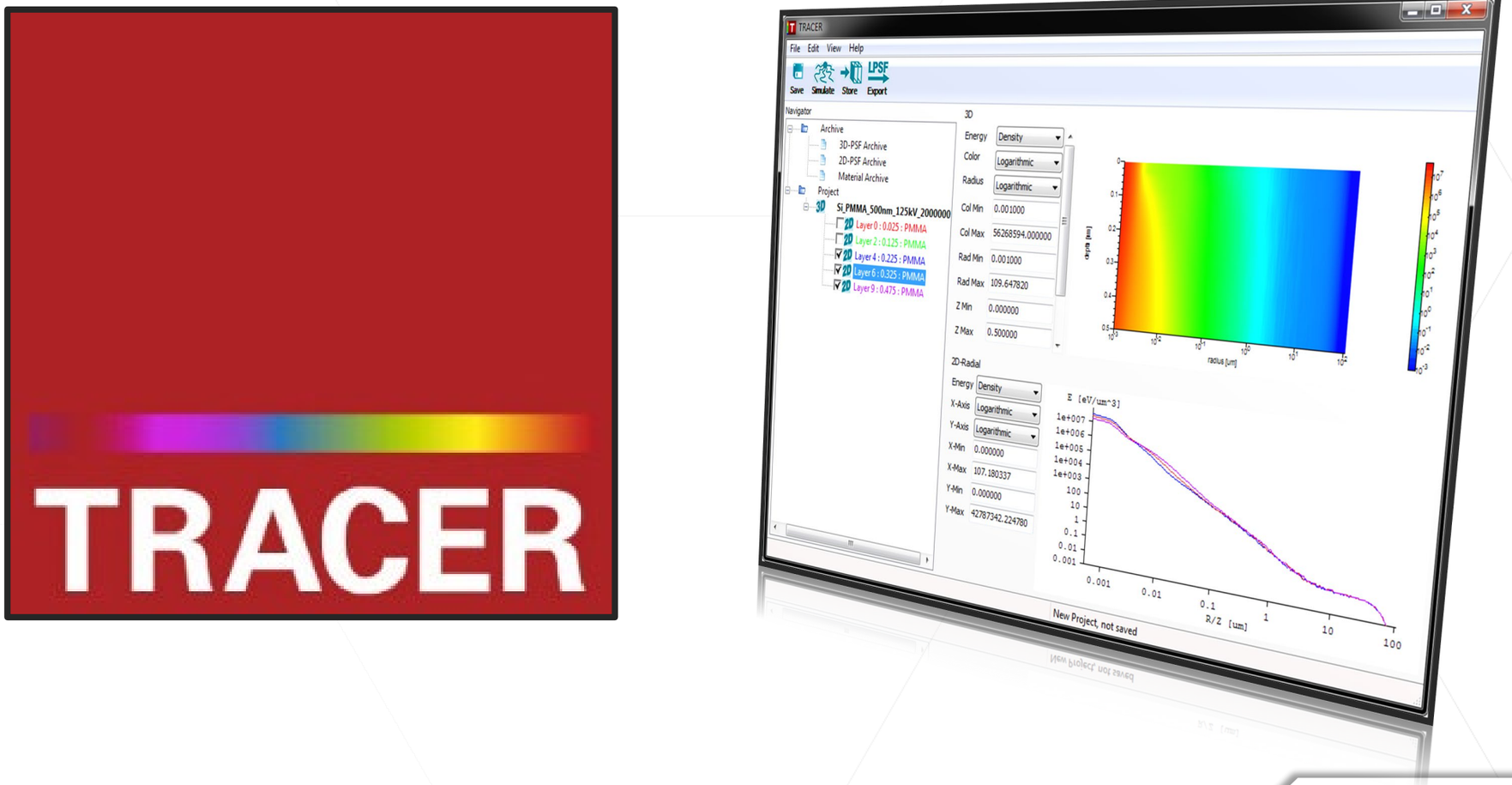
Point Spread Function - PSF



$$PSF(r) = \frac{1}{\pi(1+\eta)}\left[\frac{1}{\alpha^2}e^{-\frac{r^2}{\alpha^2}} + \frac{\eta}{\beta^2}e^{-\frac{r^2}{\beta^2}}\right]$$

3D TRACER PSF

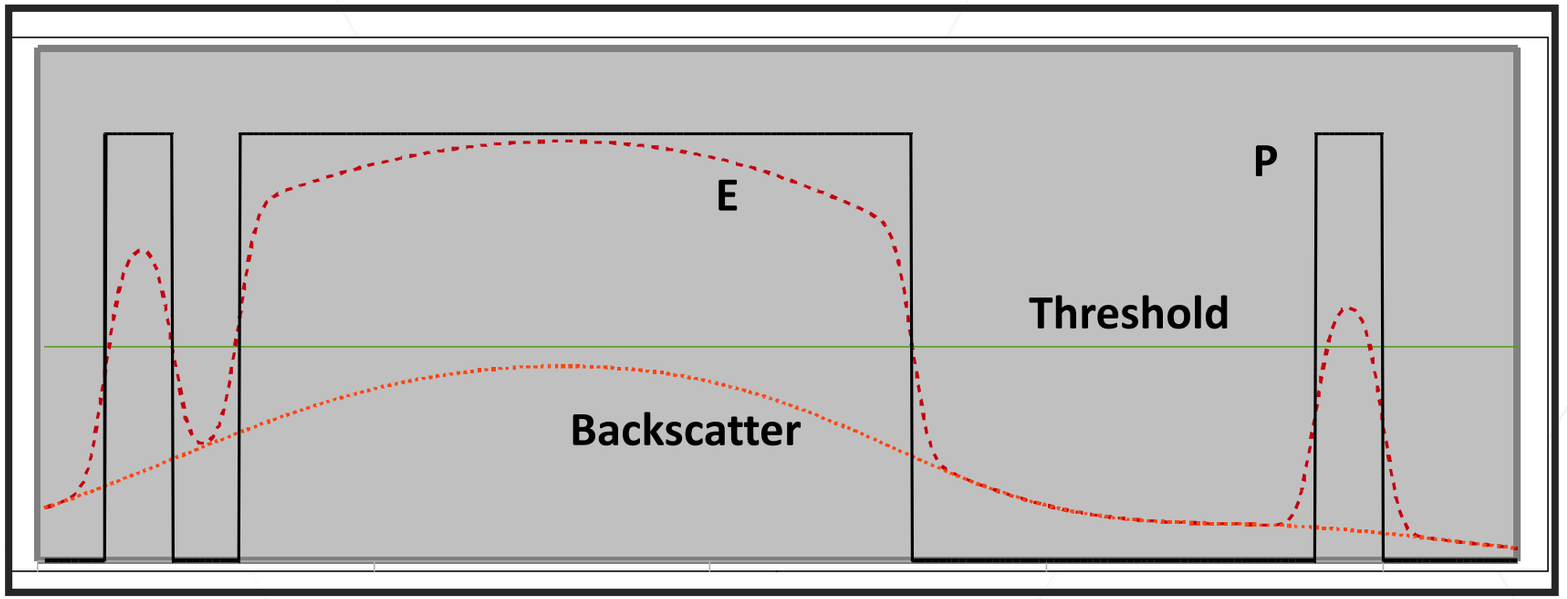
TRACER calculates the absorbed energy distribution over resist thickness and distance.



Calculation of Absorbed Energy

Knowing the PSF, the absorbed energy at any position *x* can be calculated:

$$E(x)=P(x)\otimes PSF$$



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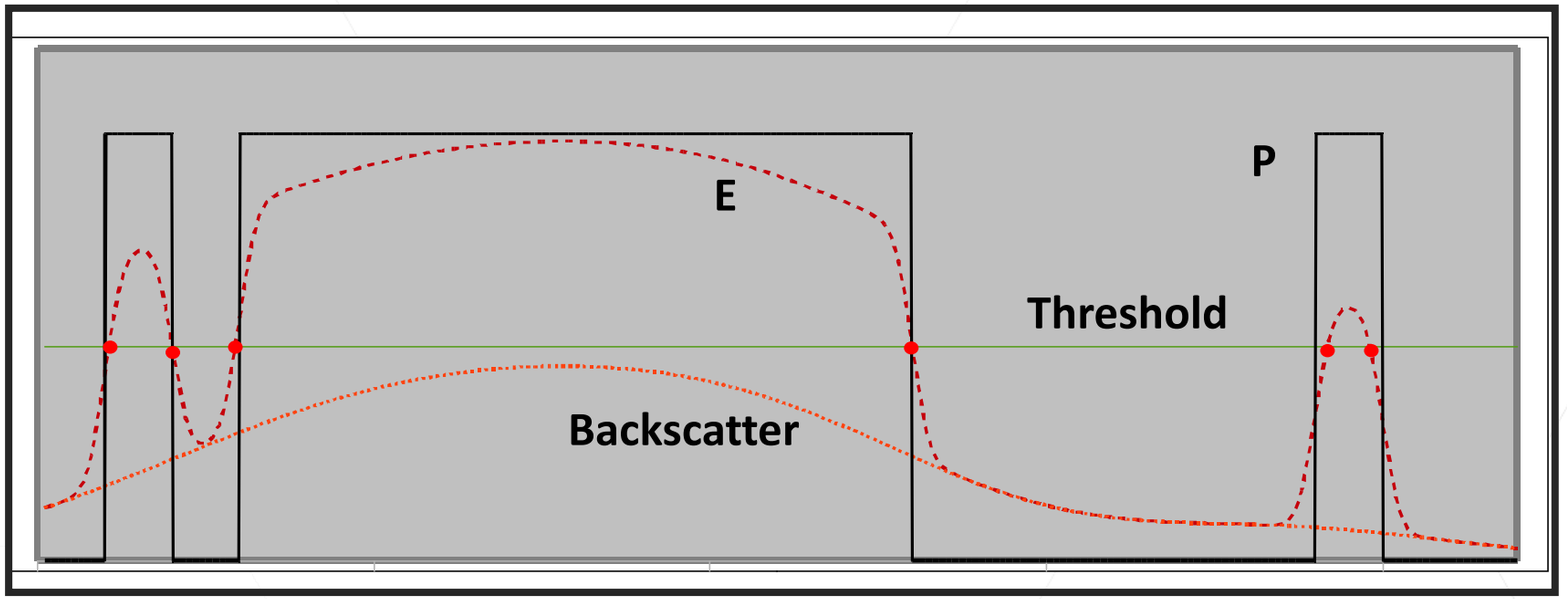

Calculation of Absorbed Energy

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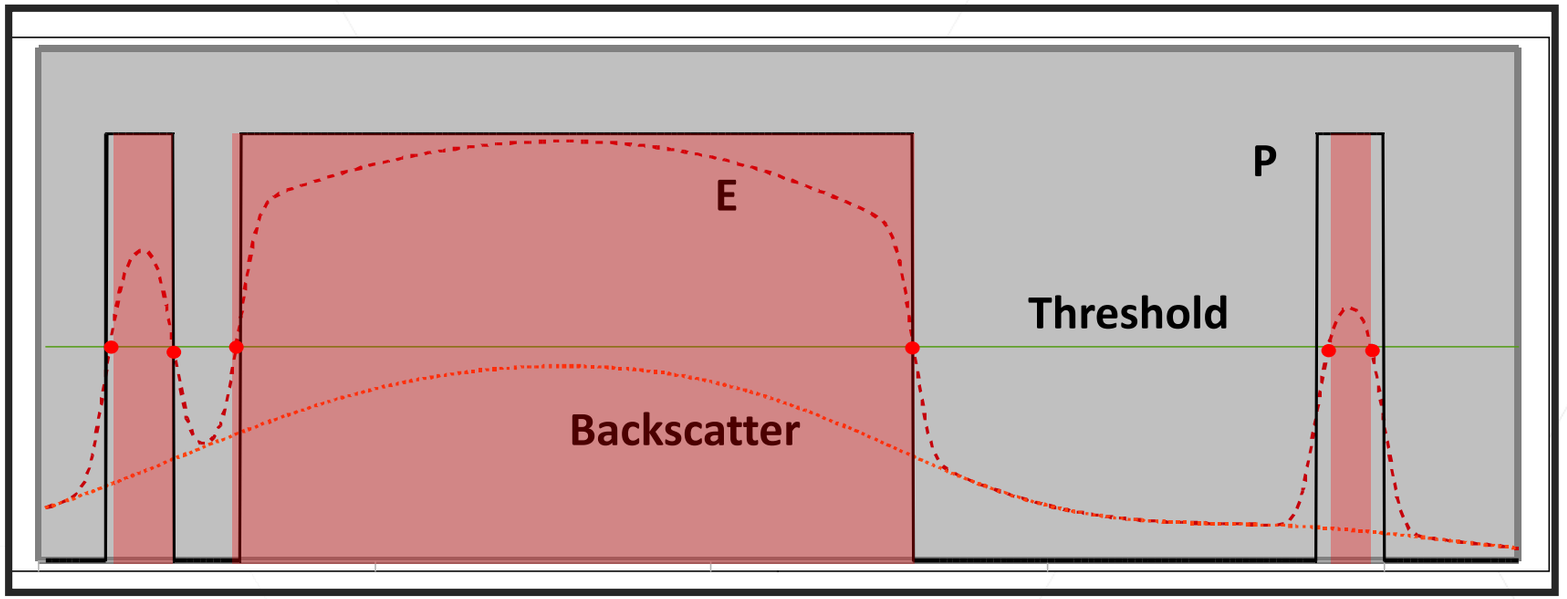
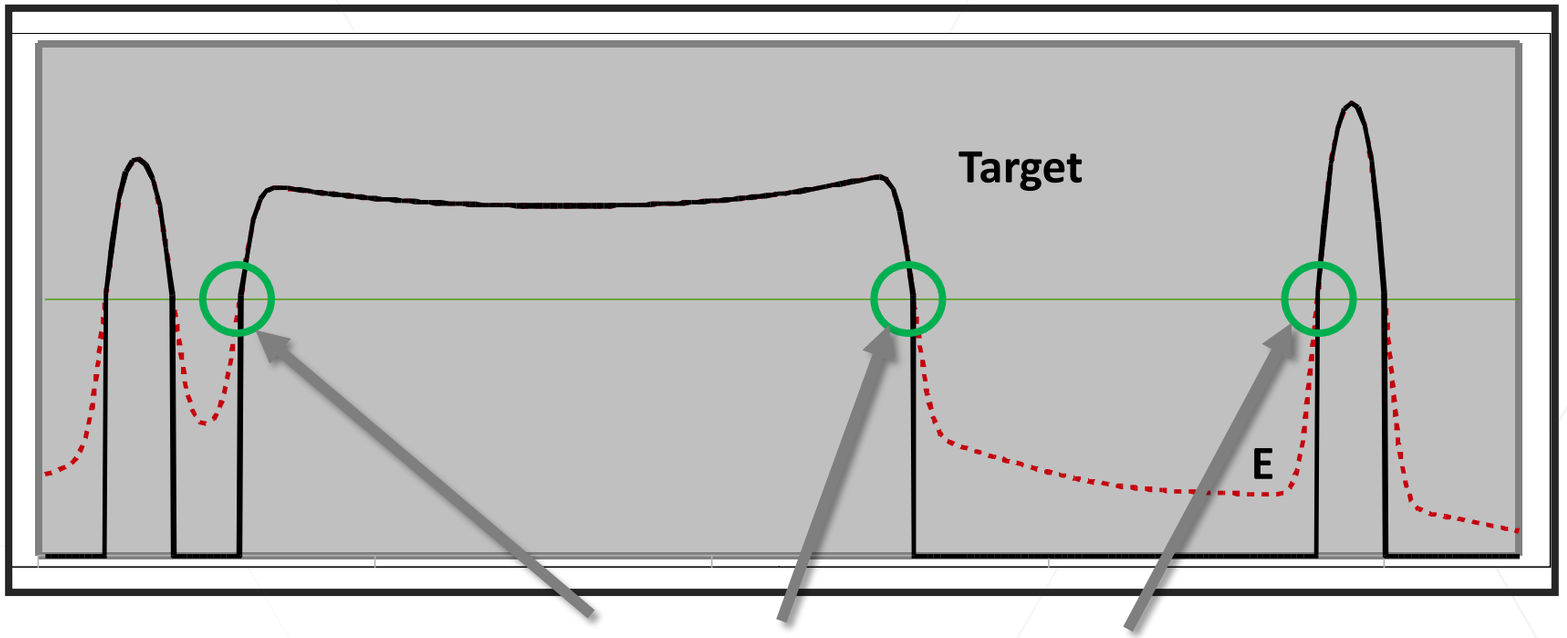


Absorbed Energy after PEC

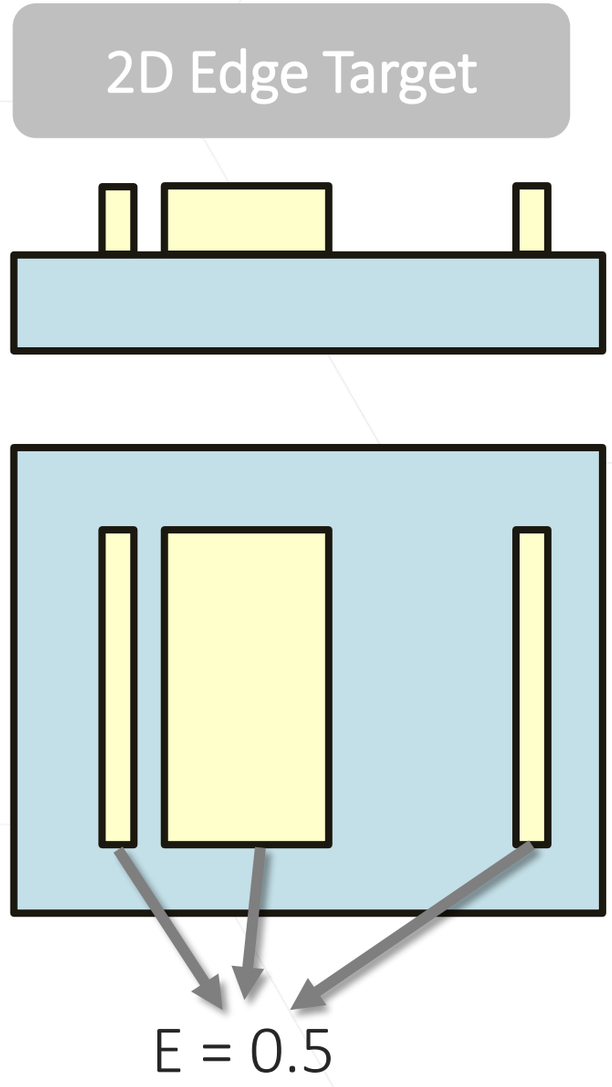
PEC corrects so that that absorbed energy crosses threshold at pattern edge



Method resolves lines and gaps symmetrically by reducing exposure dose in large areas to reduce the scattering into gaps

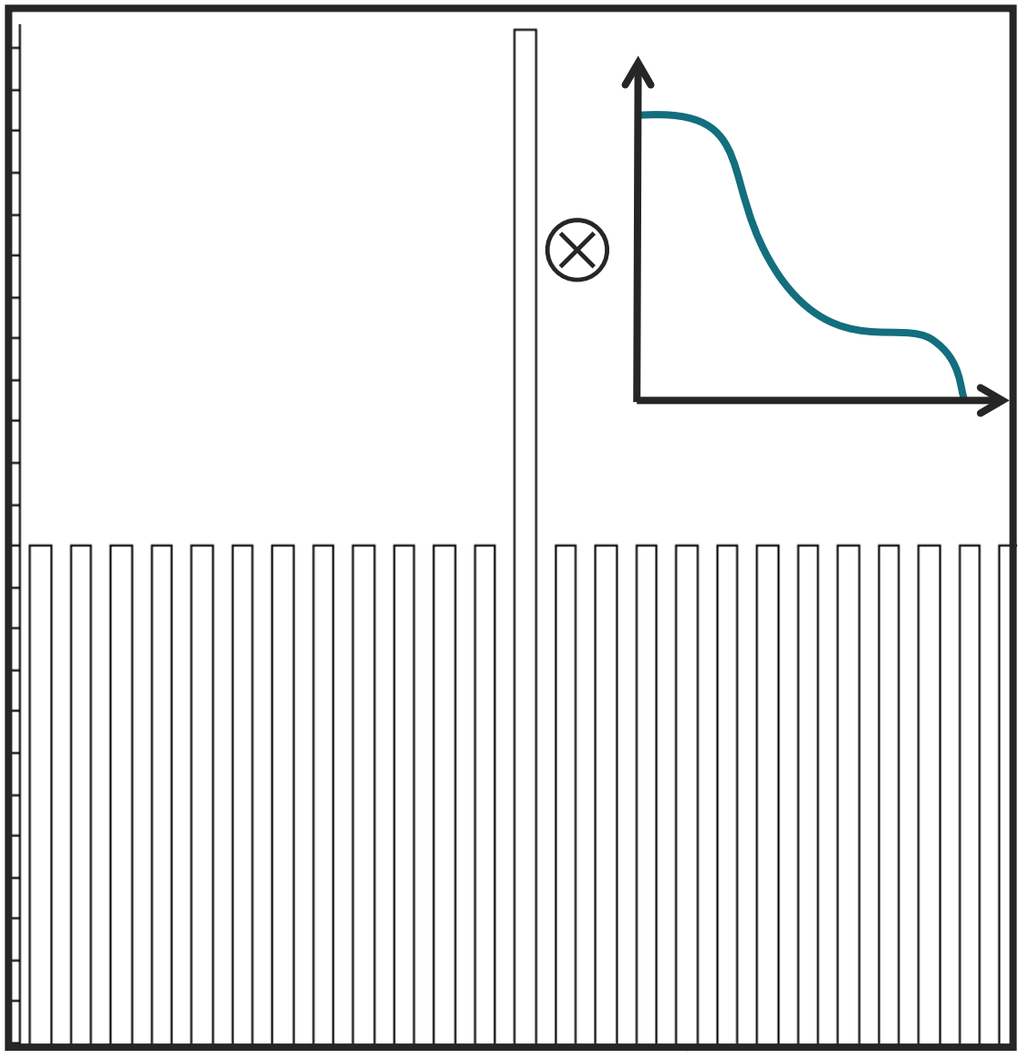
Proximity Effect Correction

- Target of correction:
  - Adjust all feature edges to the same absorbed energy: Threshold Dose of resist
- Inside the feature E(x) > Threshold Dose:
  - Resist will remain (negative)
- Outside the feature E(x) < Threshold Dose:
  - Resist will be removed (negative)
- Correction Equation:
  - $E(edge) = 0.5 = D(x) \otimes PSF$
- There is large number of PEC algorithms. The strongest algorithms are based on:



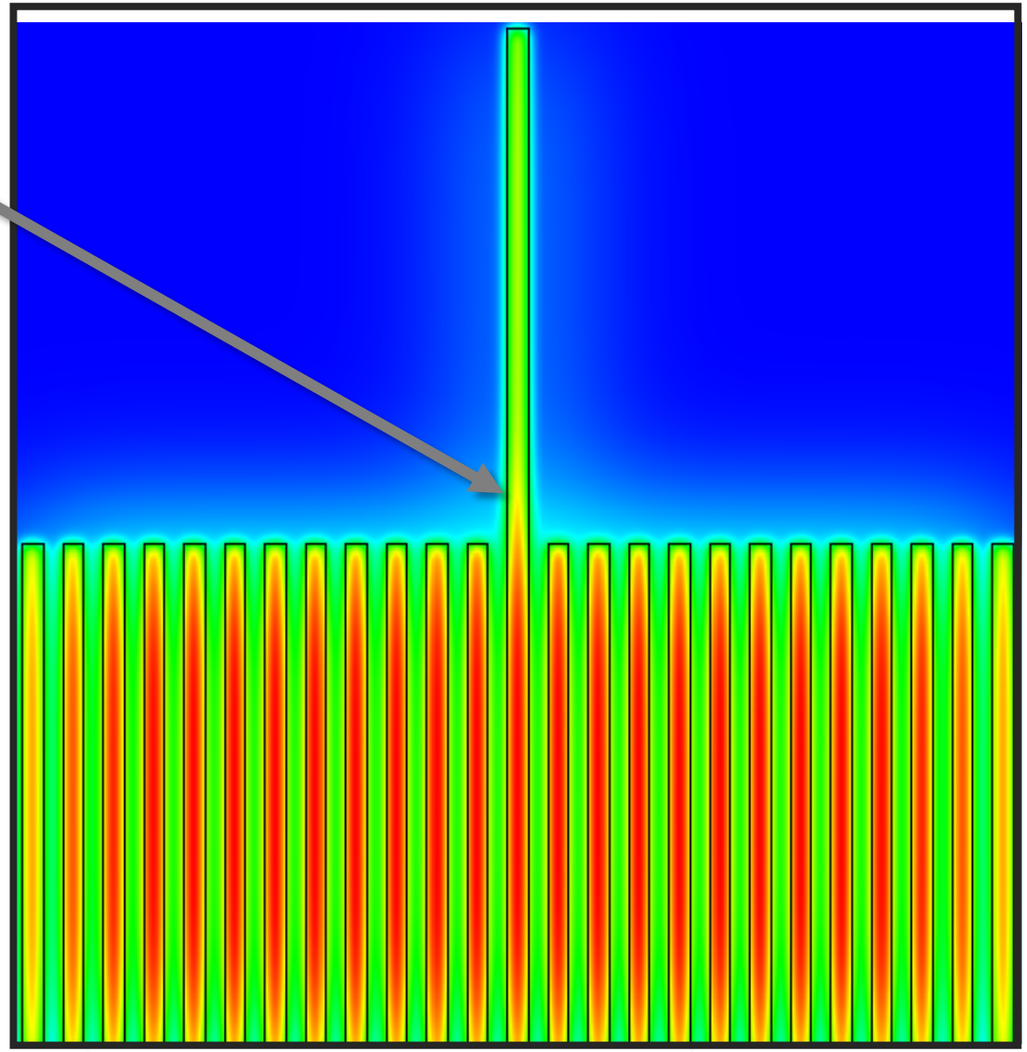
J. Pavkovich, J. Vac. Sci. Techmol., B. Vol 4, No.1, Jan/Feb 1986

Modeling Absorbed Energy



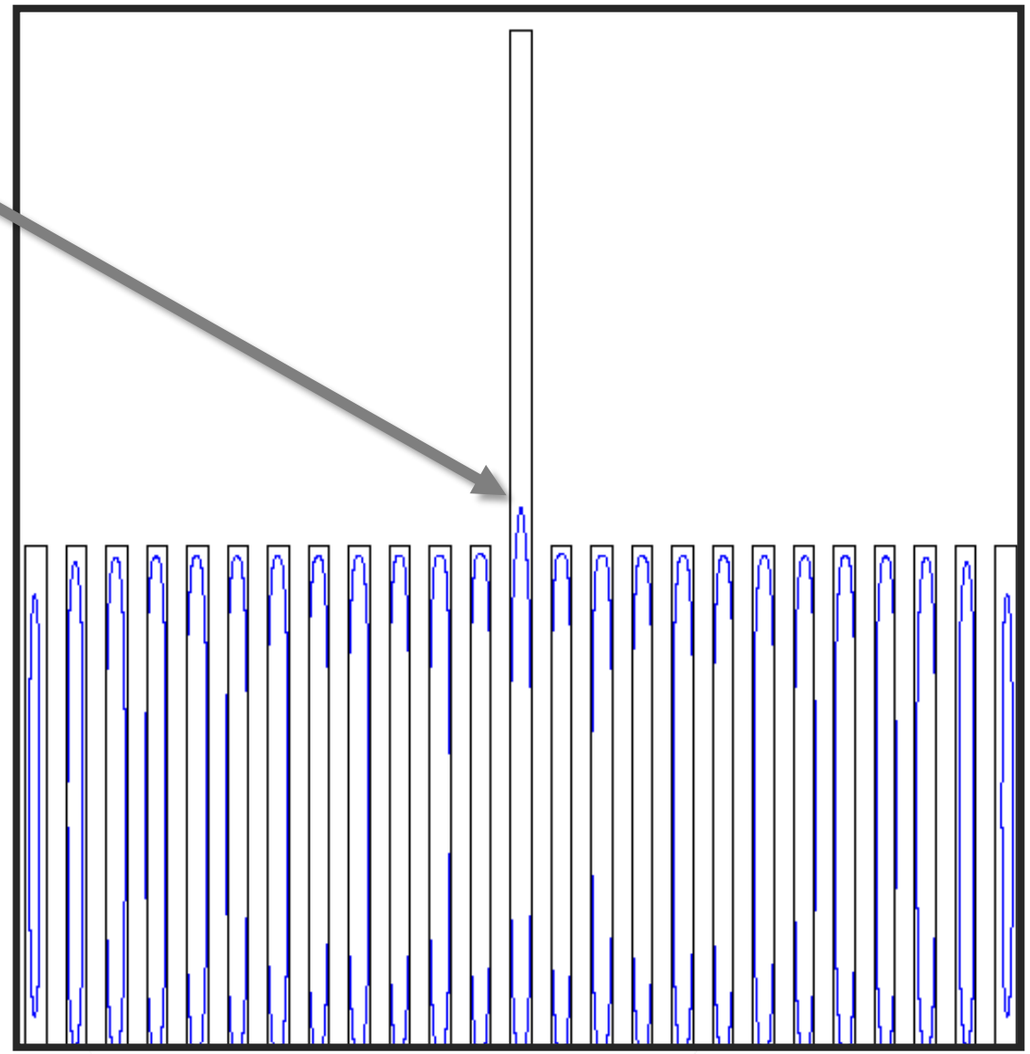
Absorbed Energy in Resist

Assume resist edge falls at constant threshold energy

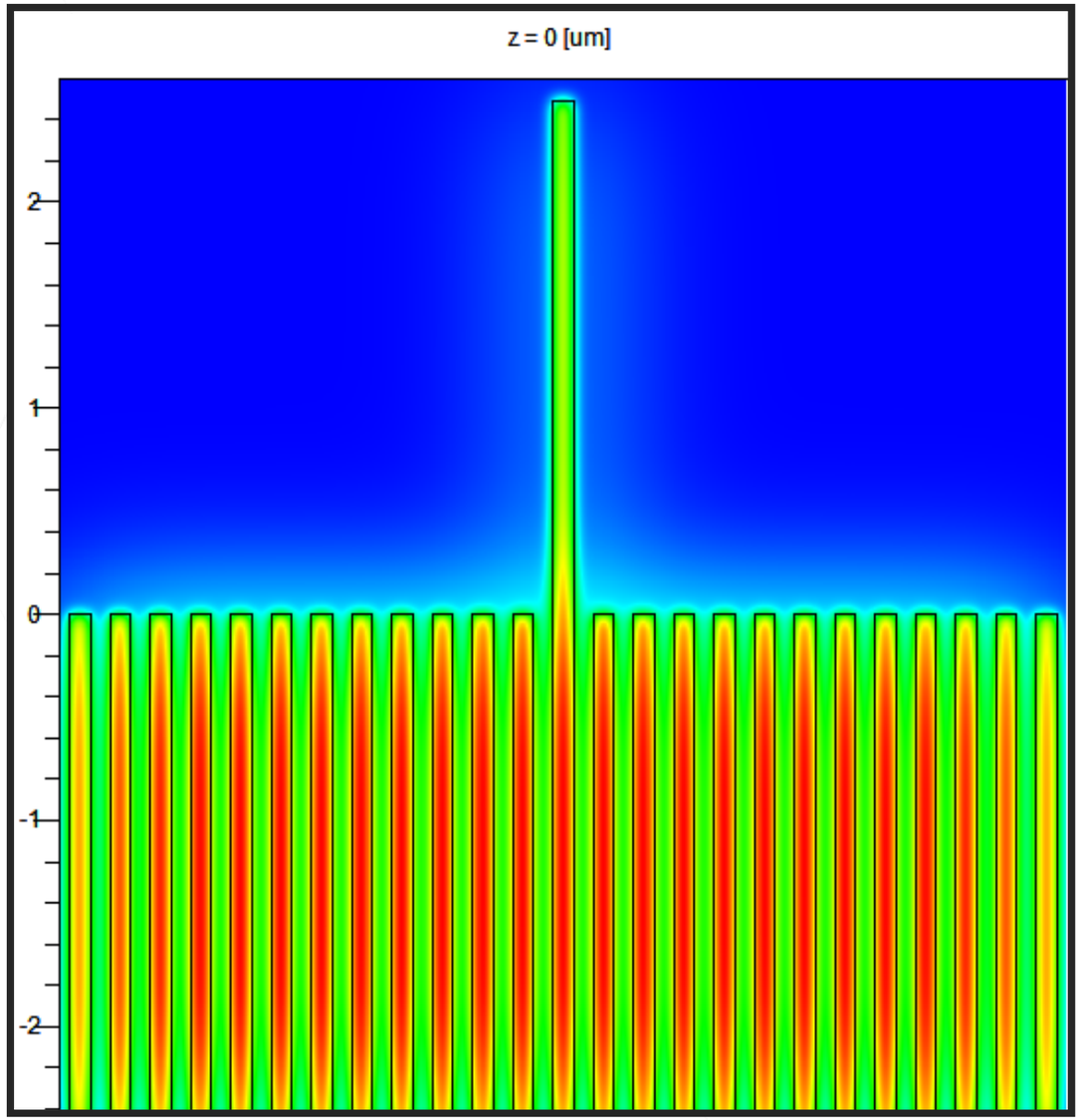


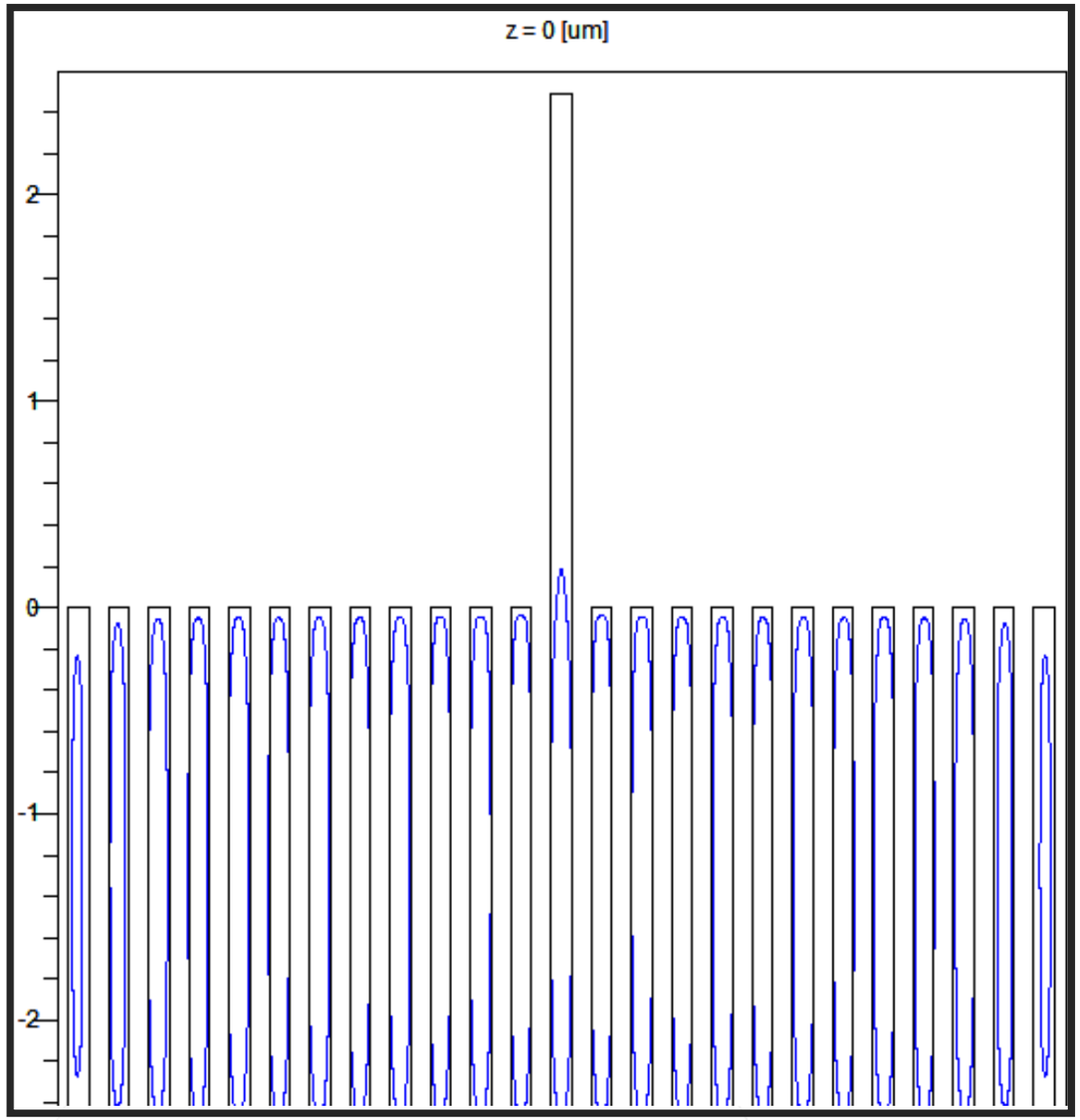
Resist Contour

Assume resist edge falls at constant threshold energy

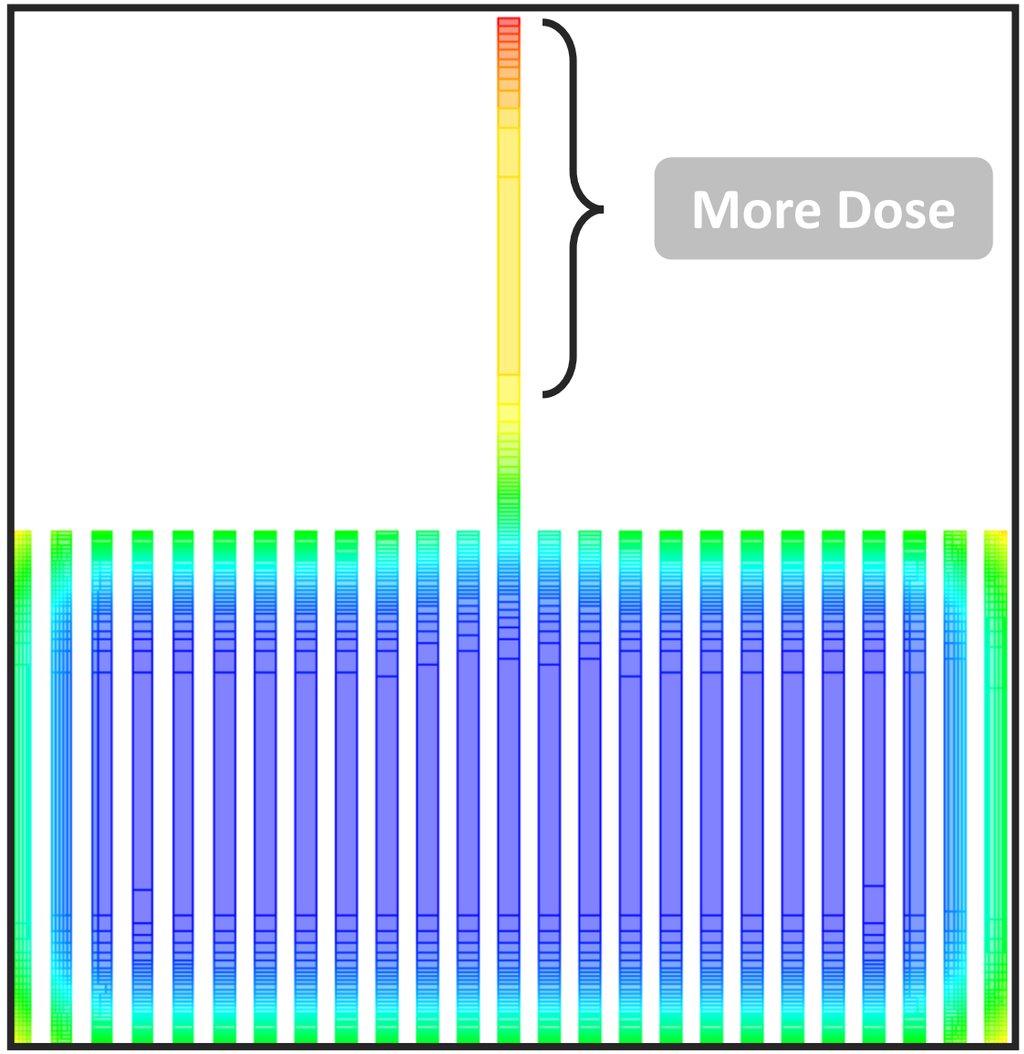


Absorbed Energy in Resist

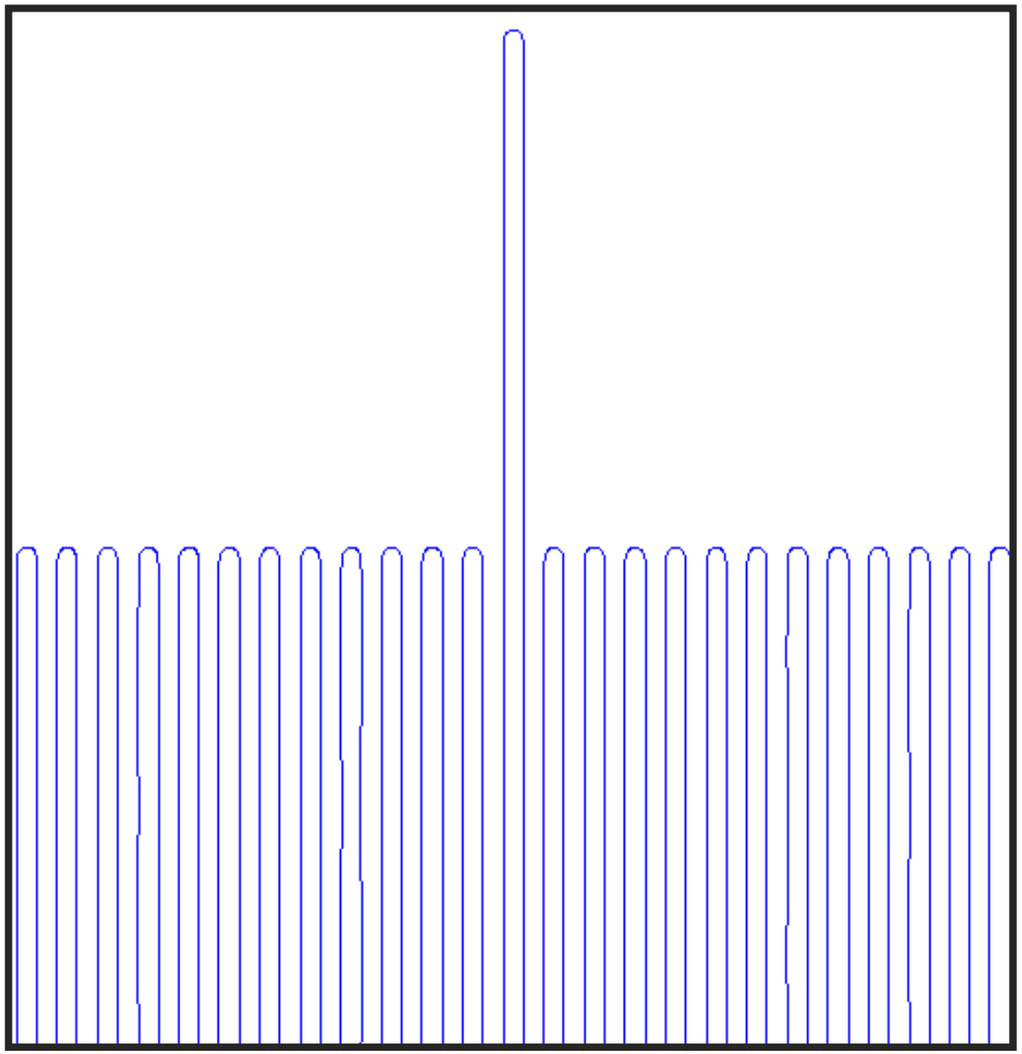




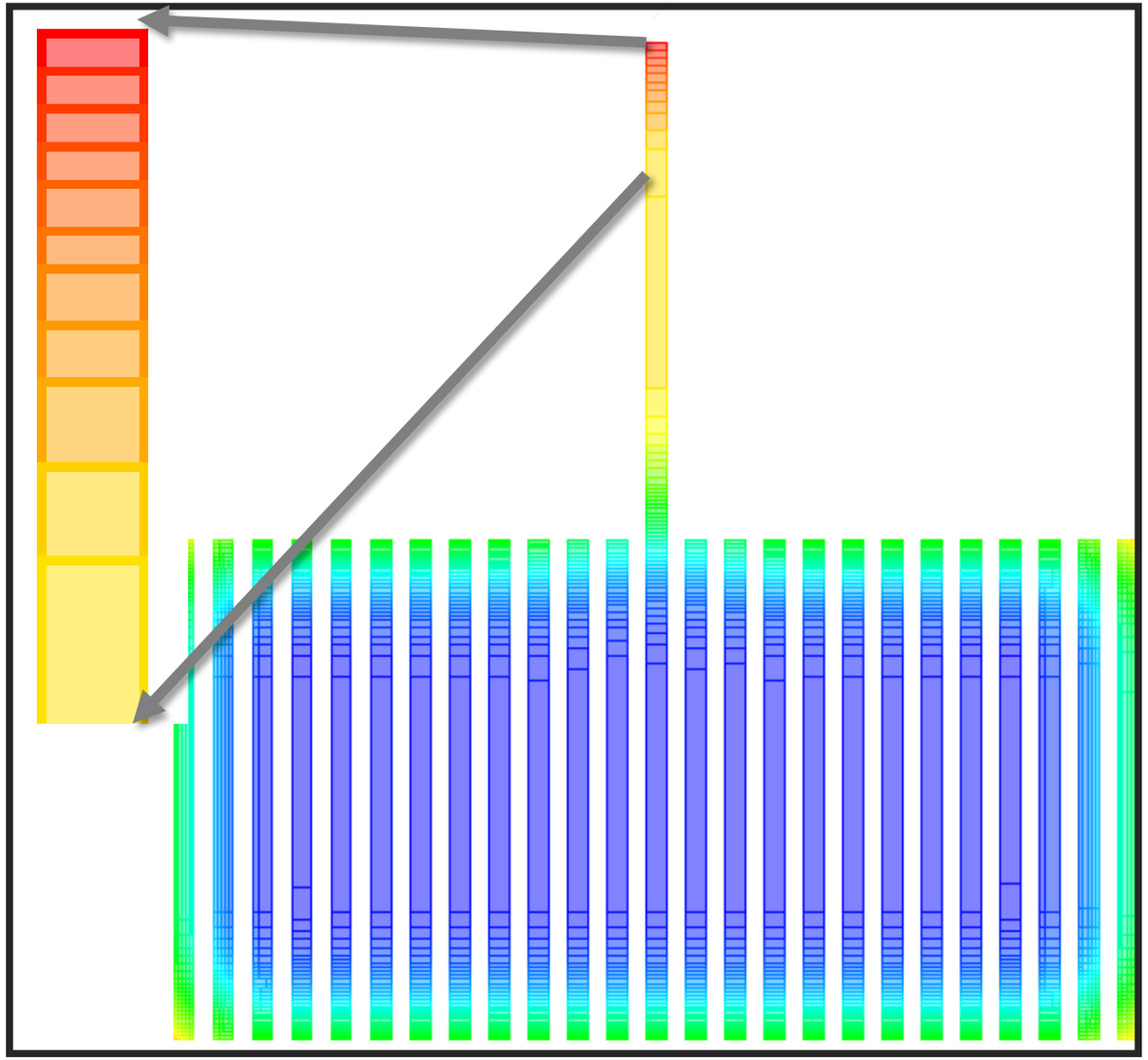
Corrected Exposure Dose

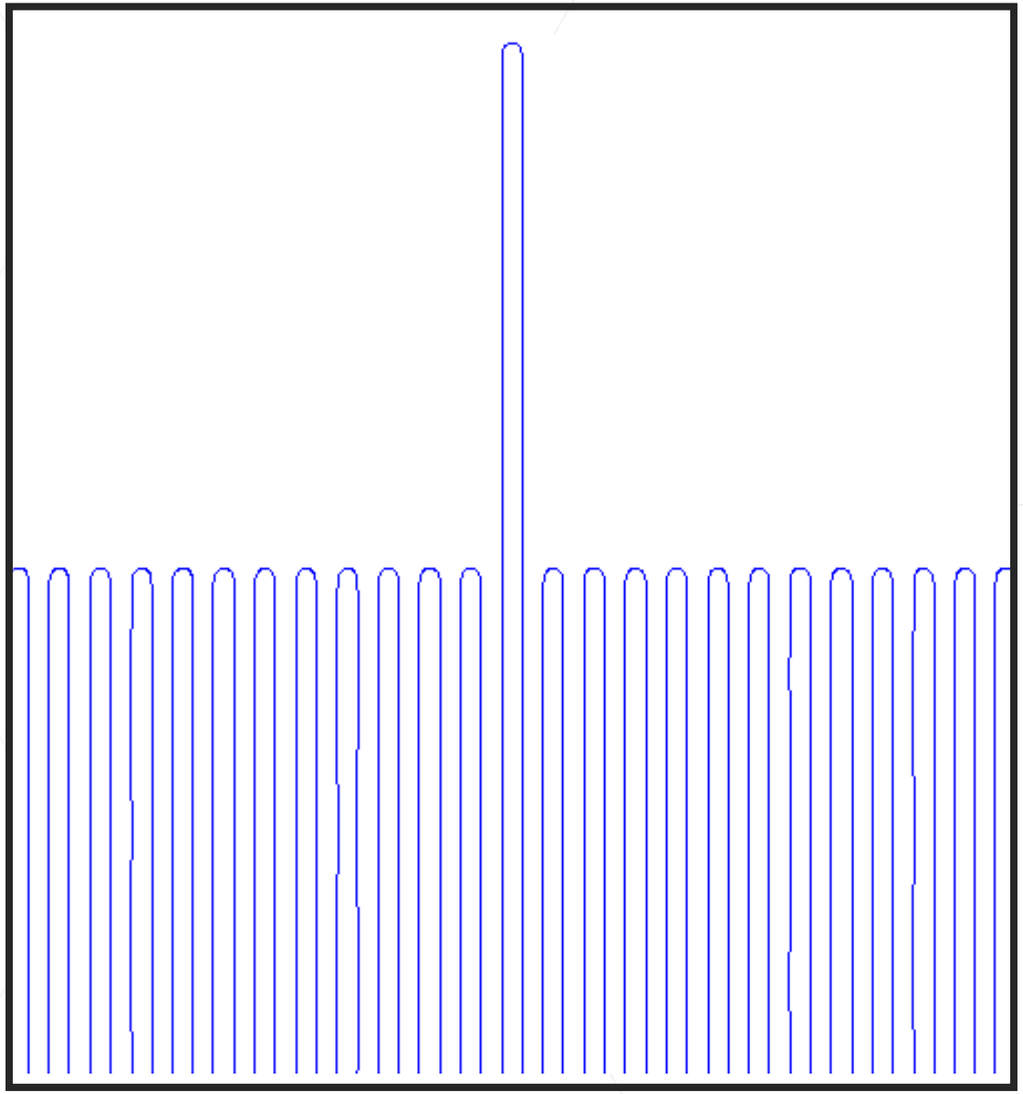


Resist Contour

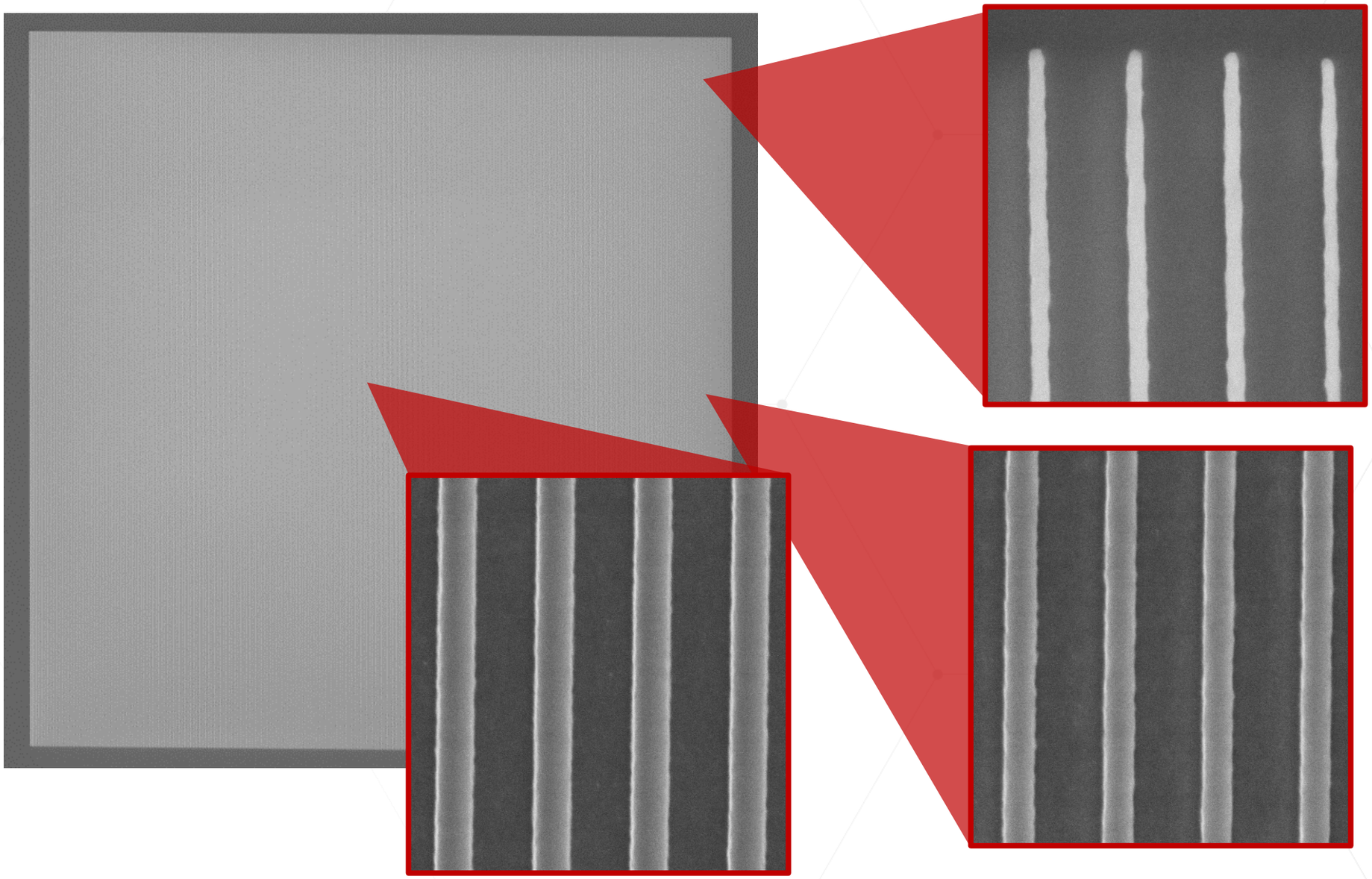


PEC -> Contour

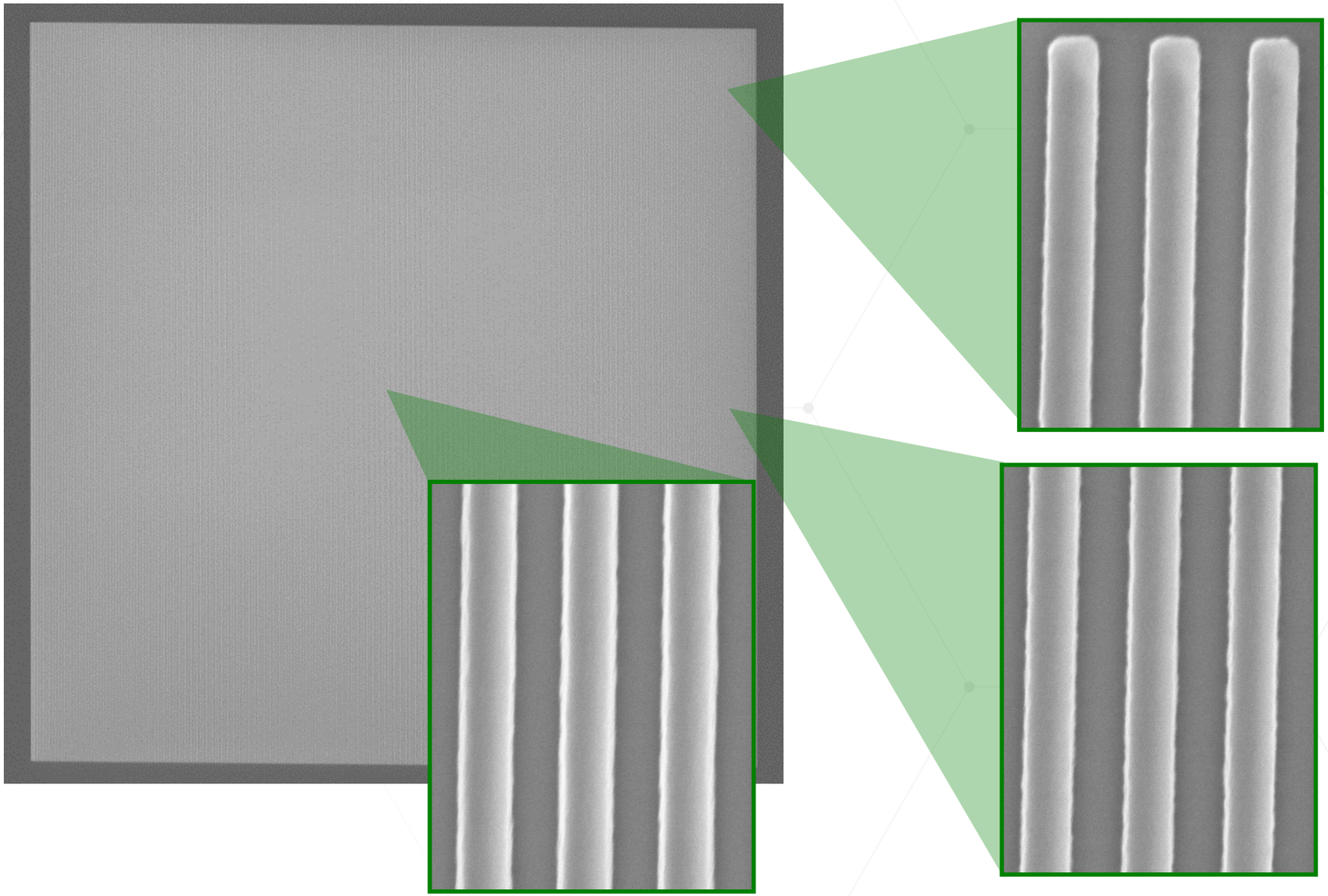




Uncorrected Pattern

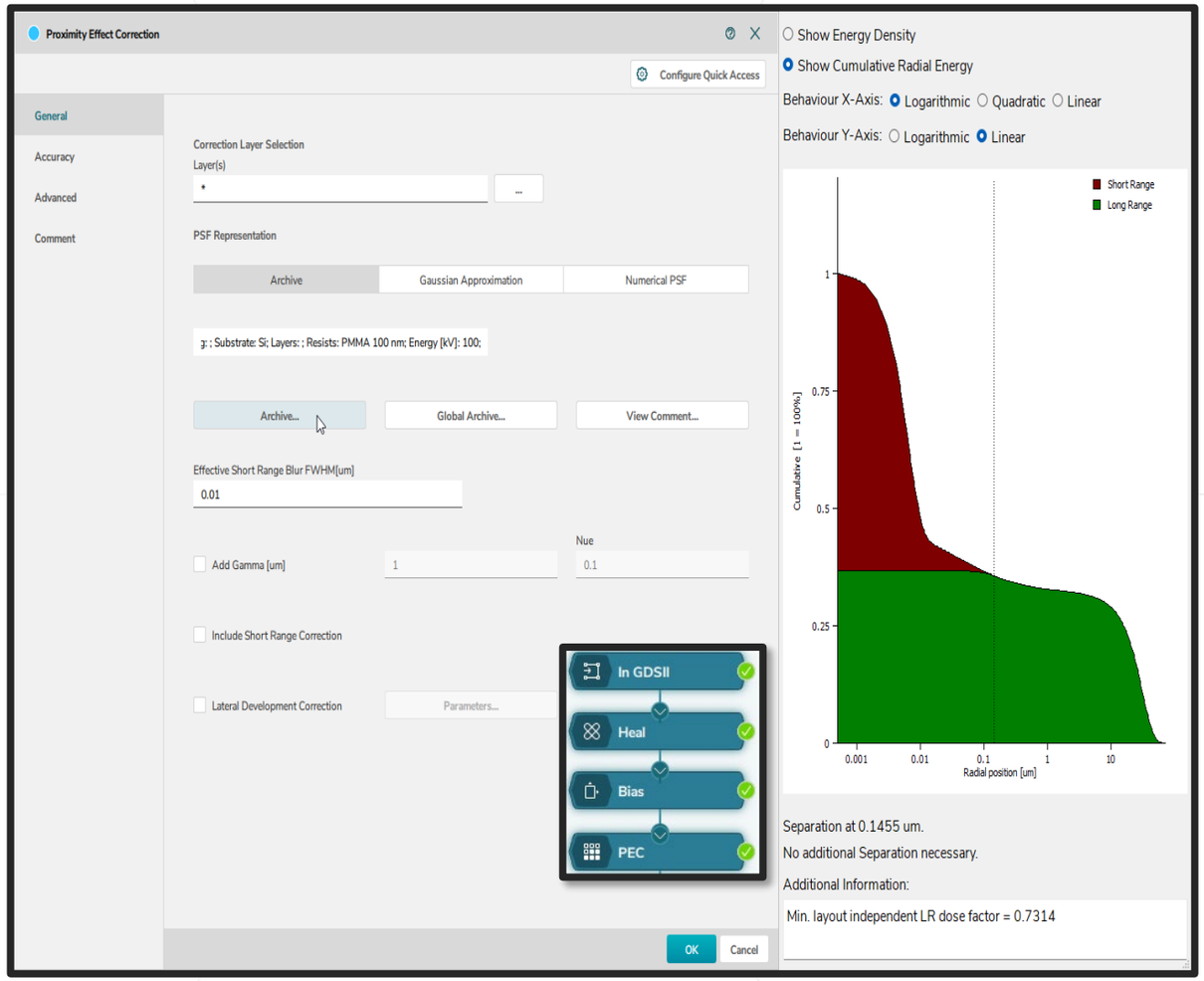


Corrected Pattern



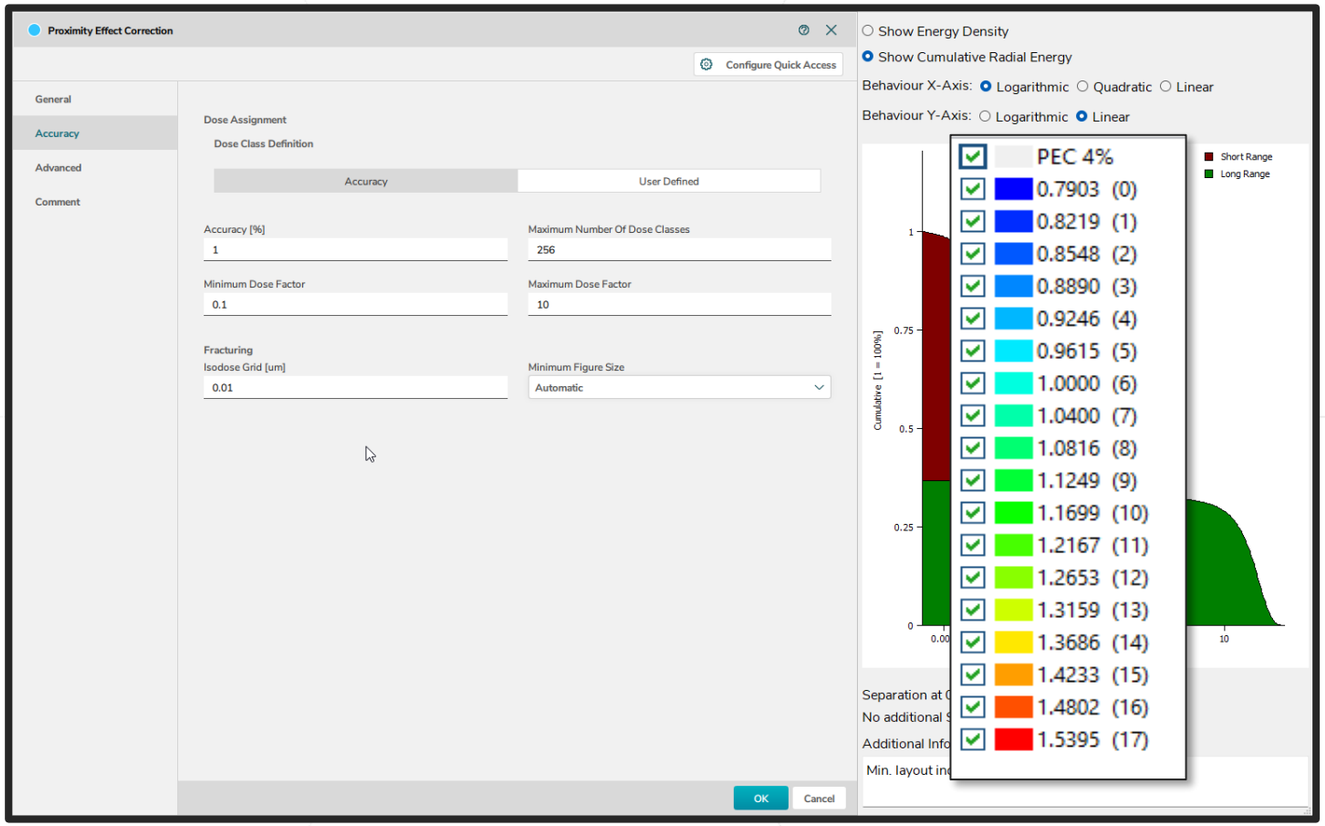
PEC: Key Points

- Always give PEC healed data – no overlaps are allowed for proper correction.
- Always apply PEC after any other layout manipulations (e.g. BIAS, TRANSFORM, MERGE…). You want PEC to correct the actual to-be-exposed pattern.
- Choose the appropriate PSF by selecting from the archive, a gaussian approximation or importing a PSF.
- For most cases, that’s all you need to do!



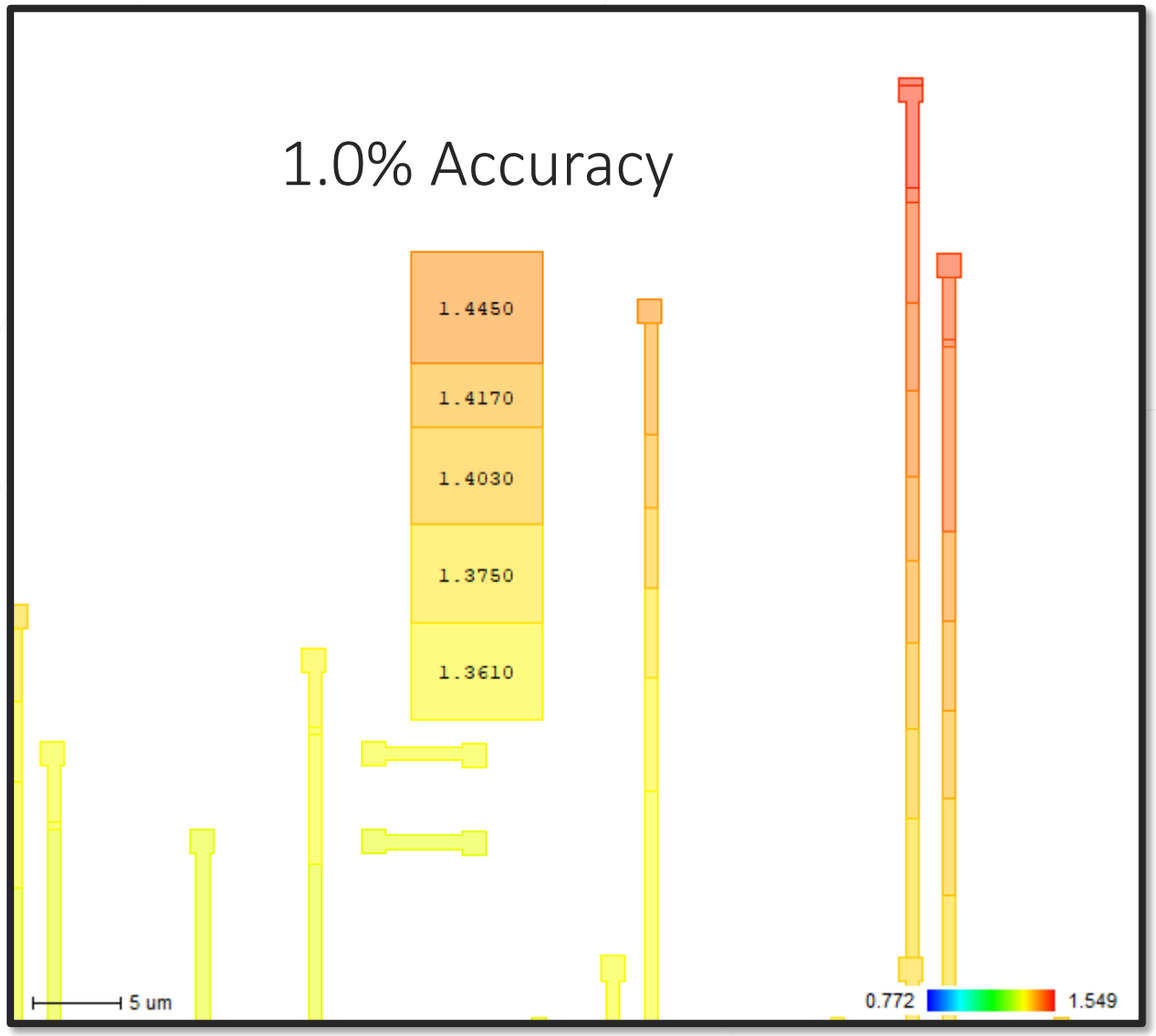
Accuracy

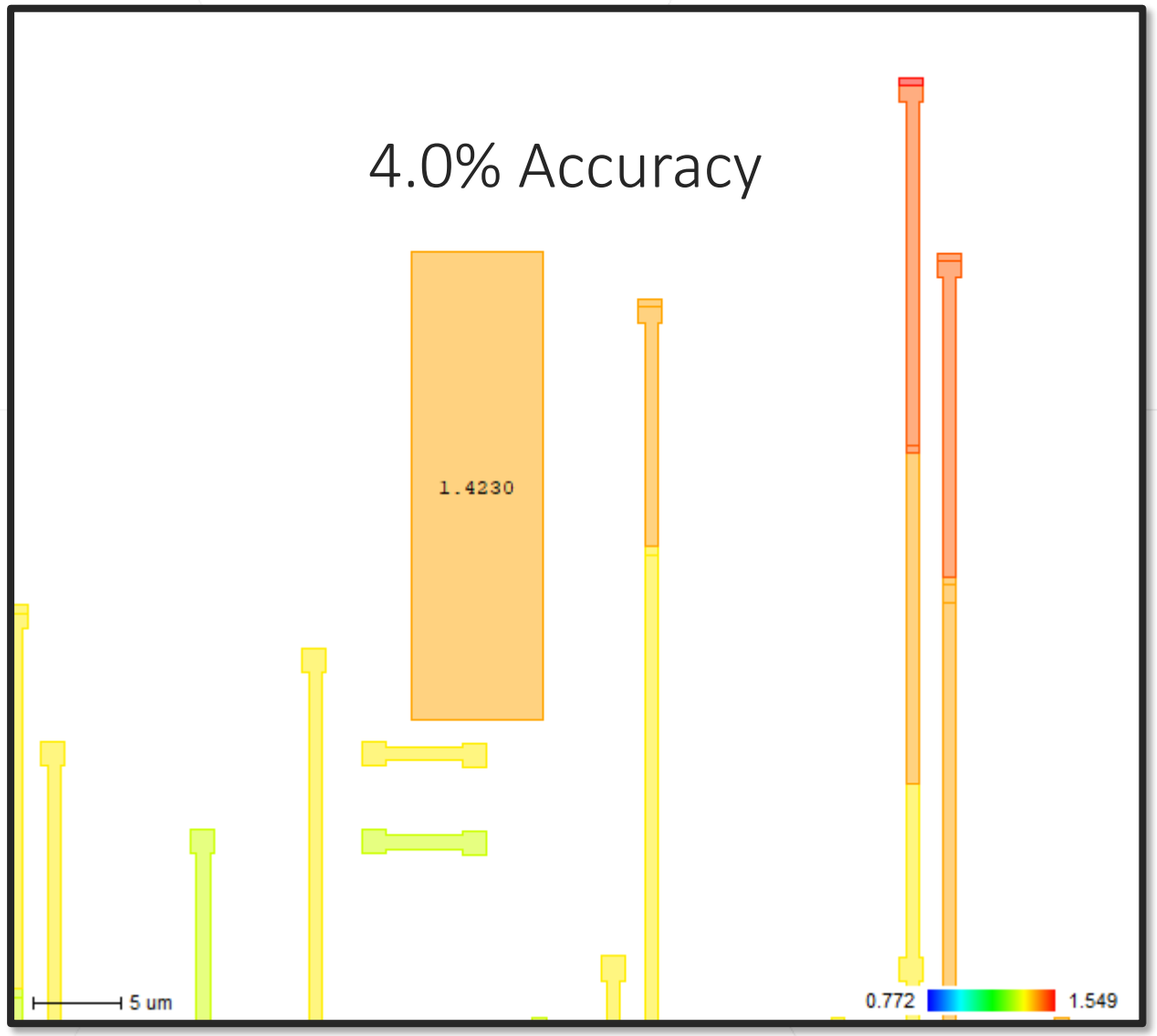
- PEC dose class accuracy is selected on the Accuracy tab
- Fractures are only made when it is required to achieve the specified accuracy
- Smaller value = higher accuracy
- Separation between dose factors is approximately accuracy value
- BEAMER will report the achieved dose accuracy



Accuracy

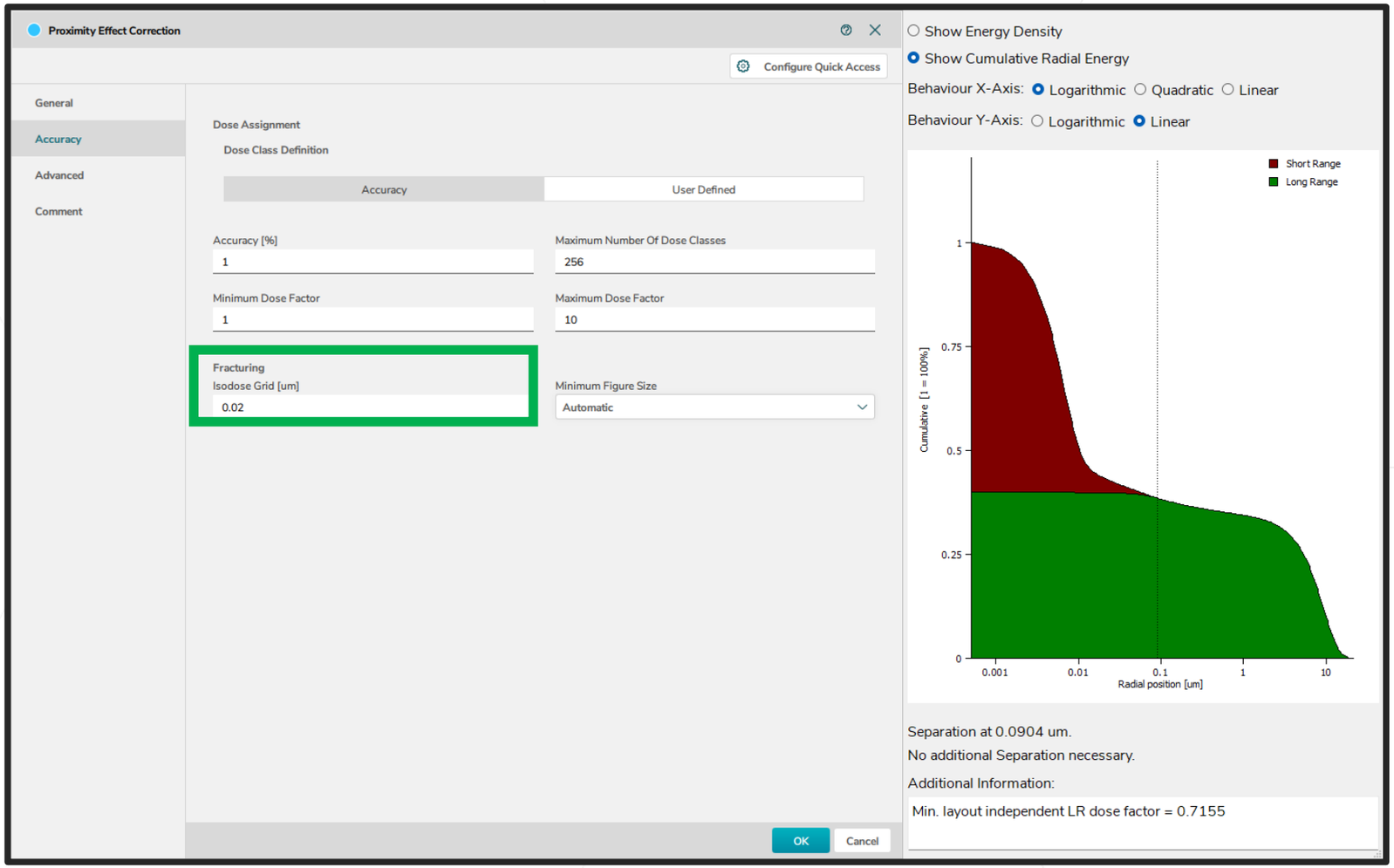
Larger accuracy tolerance reduces shape count





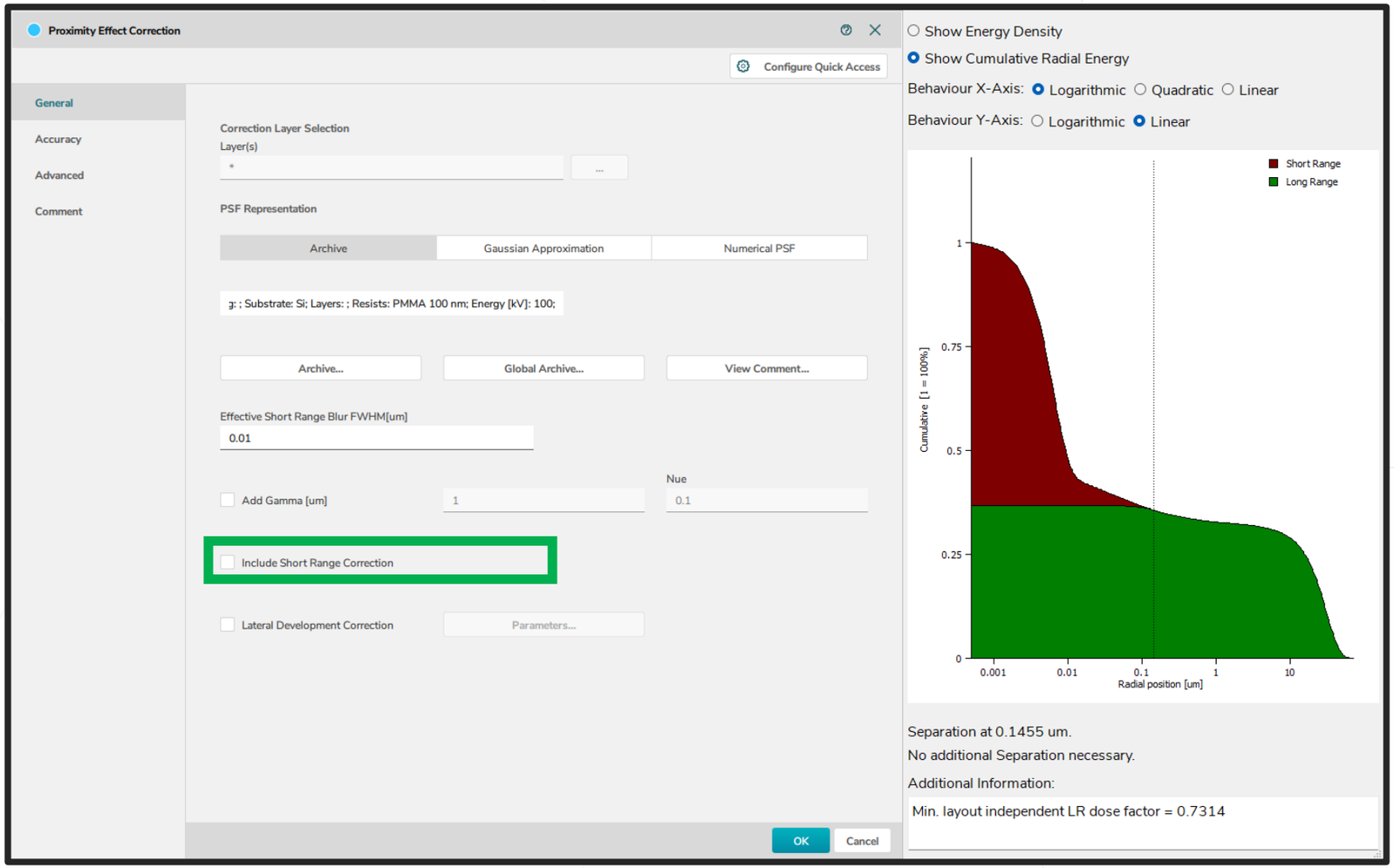
Isodose Grid

- Isodose Grid sets “fracture grid” that fractures can occur on
- PEC steps from grid point to grid point
  - The value should equal a multiple of the shot pitch

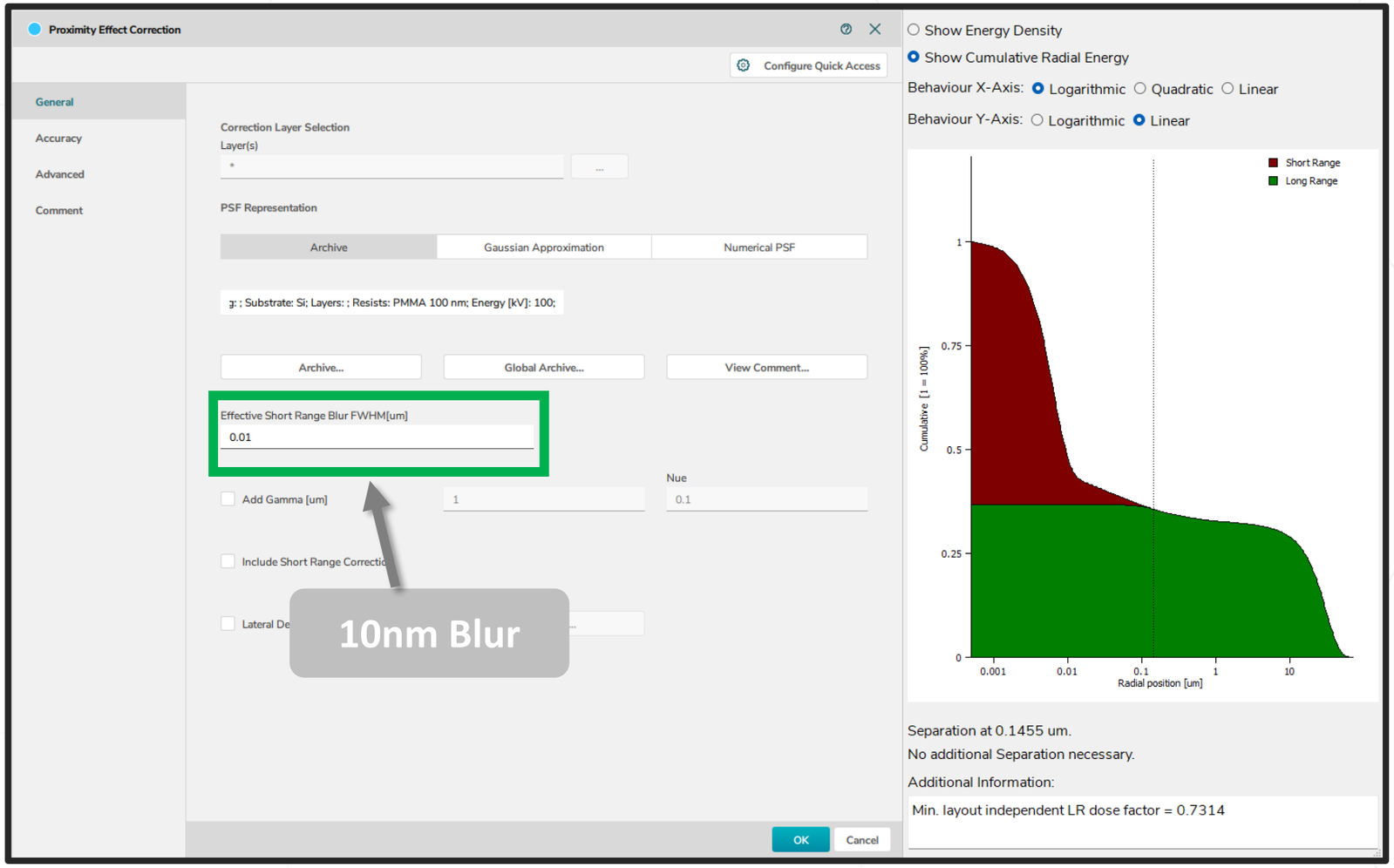


Short Range Correction

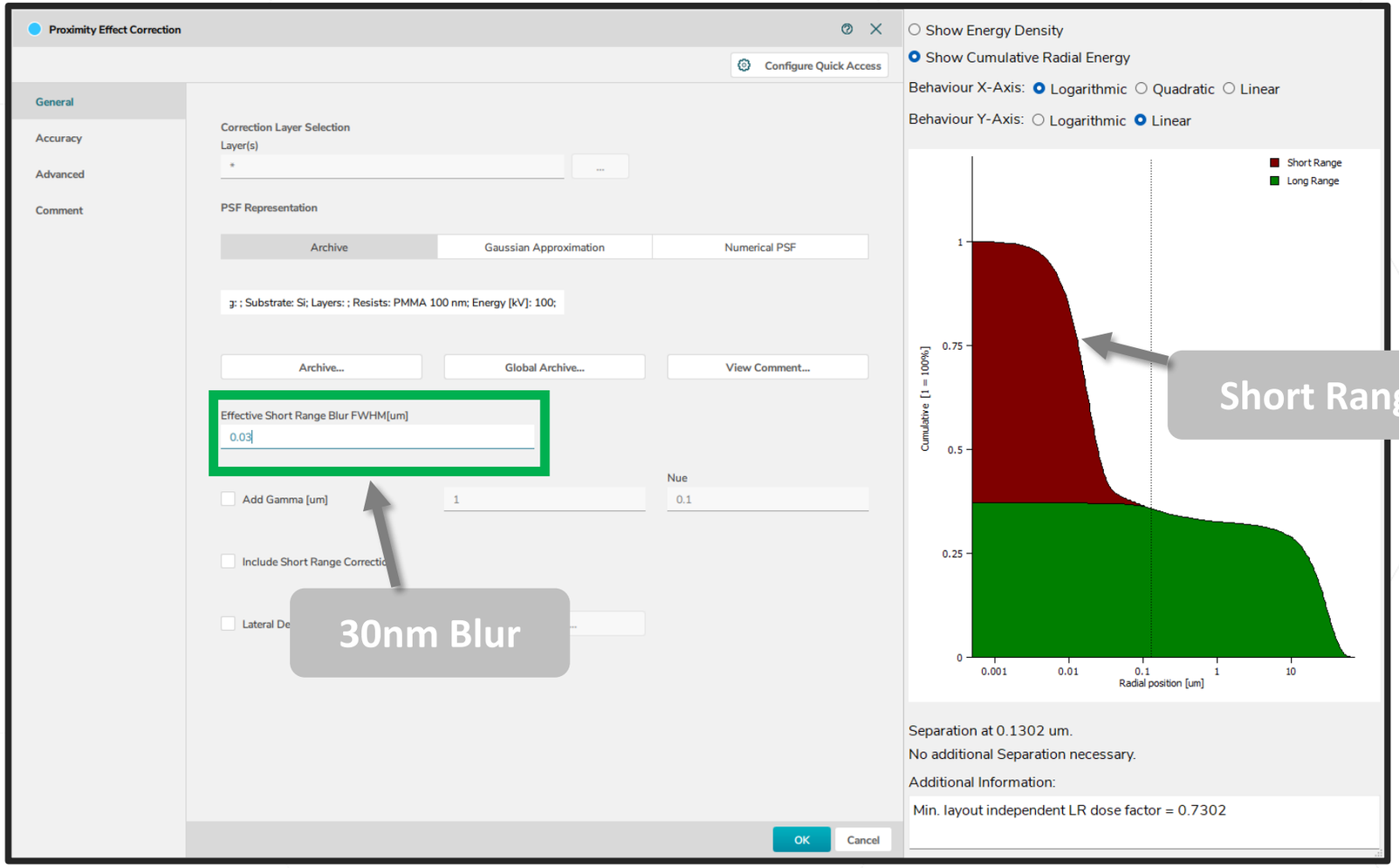
- Include Short Range Correction toggles short range PEC
  - Only necessary when features are on the scale of the blur
  - 20-100 nm for Silicon
- Increases:
  - Calculation time
  - Shape count
  - Dose factor “spread”



Effective Short Range Blur

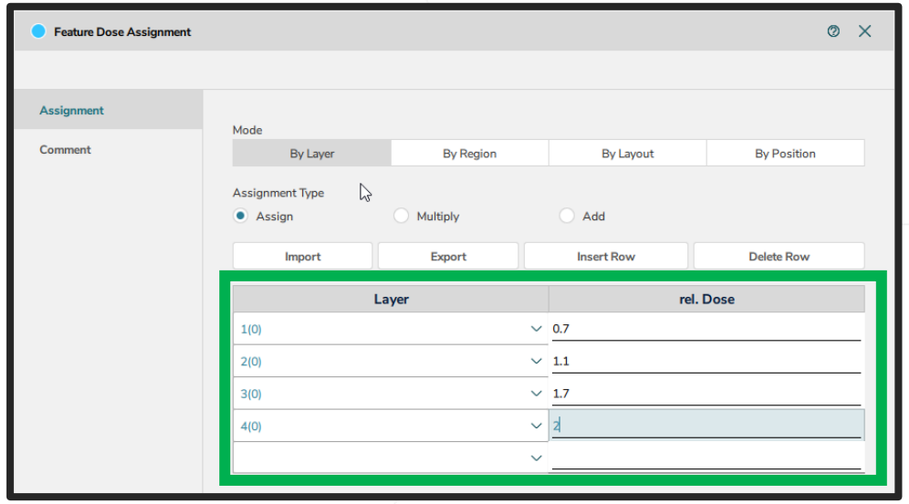


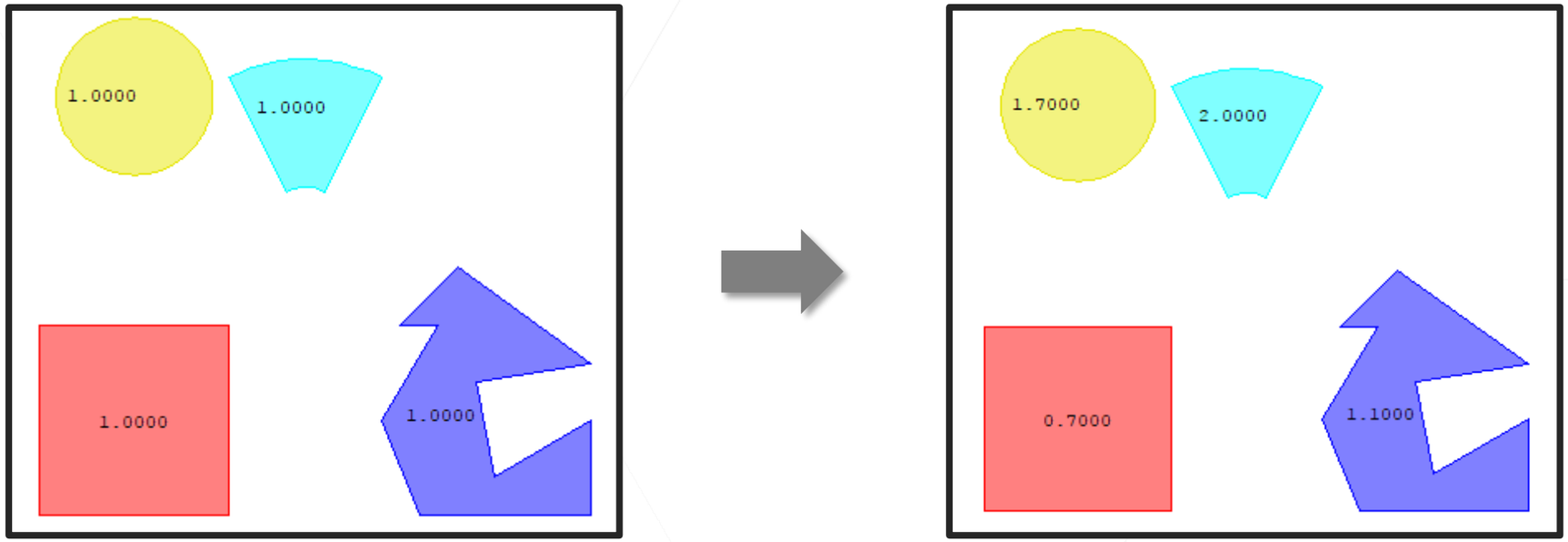
Effective Short Range Blur



FDA

- FDA manually assigns or changes dose assignments
  - Assign a new dose, multiply existing doses by a factor, or add a value to existing doses.
  - Assign by layer or within defined regions.





Thank You!

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