GenISys
Advancing the Standard

BEAMER

Part 1: Introduction and Basic operations

Outline

- Corporate Introduction
- BEAMER Introduction
- Data Fracturing
- Proximity Effect Correction
- Field Stitch
- Summary
- Q & A

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

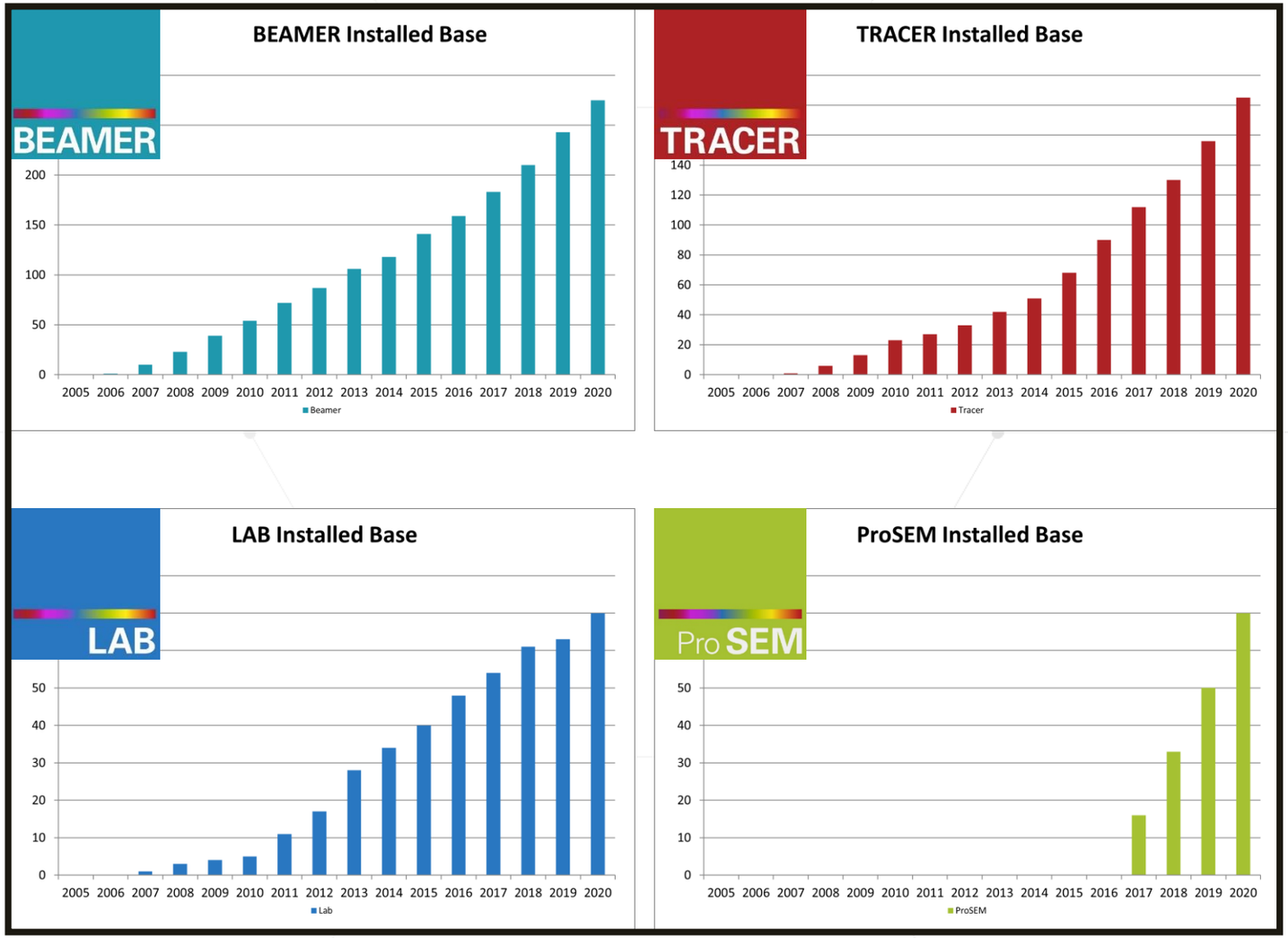
- Dedicated MDP for mask house, high performance (hierarchy, parallel processing, mask process correction…)
- Special Application: Flat Panel Display, Photonic IC, non-IC

MASKER

Products Installed Base

Growing Customer Base (> 500)

- BEAMER and TRACER
  - **~ 250 BEAMER installation**
  - **~ 150 TRACER installation**
- LAB Lithography Simulation
  - **~ 65 LAB installation**
- ProSEM SEM Metrology
  - **~ 55 ProSEM installation**



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

Strategic Partnerships

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

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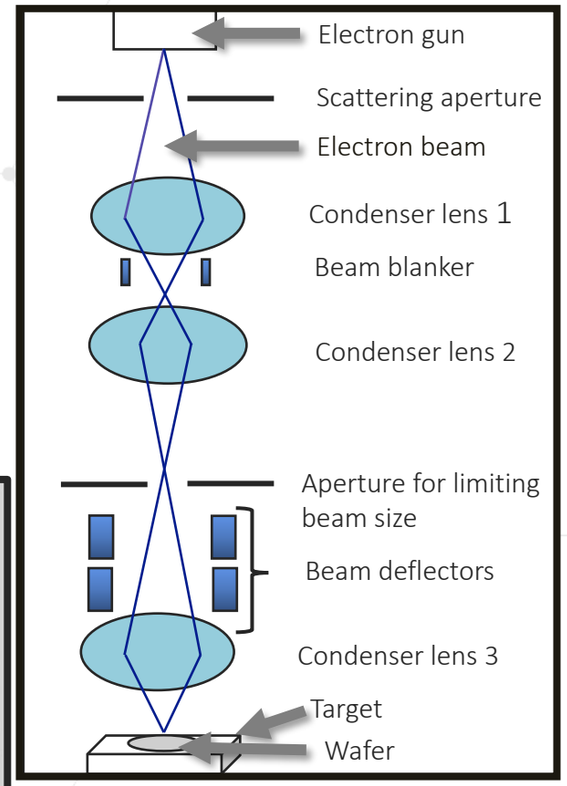
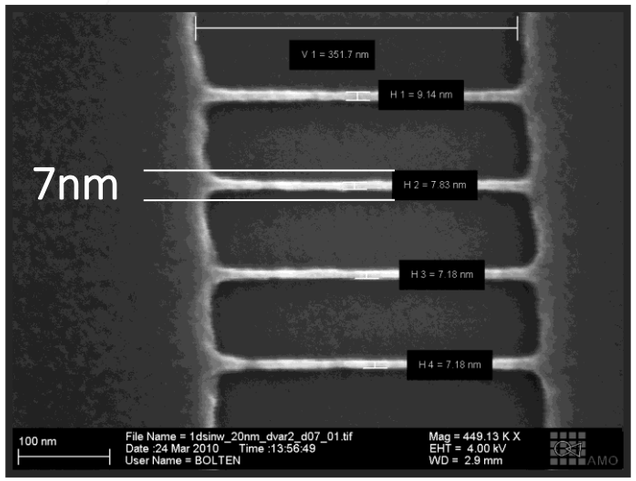
Electron Beam Lithography

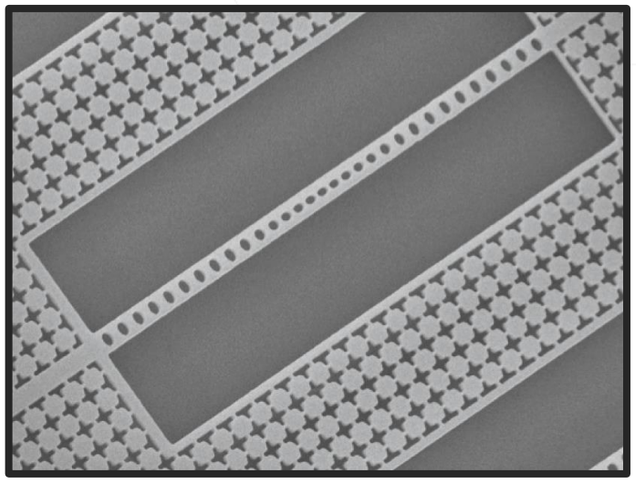
E-Beam lithography (EBL) is the most utilized technology for patterning nano-scale (Quantum) devices

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

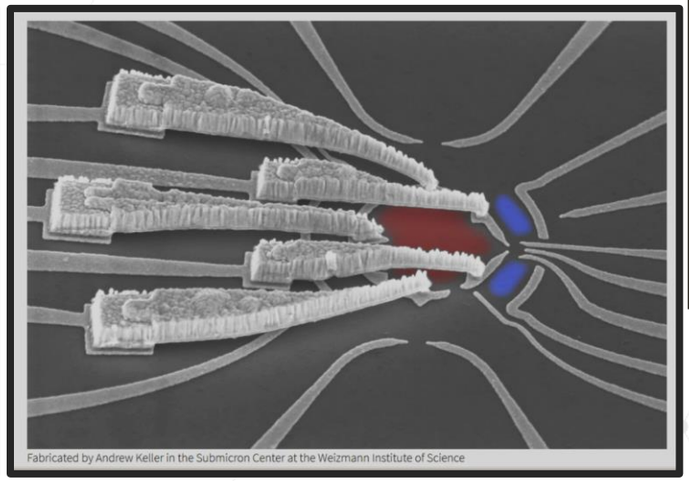




Source: AMO GmbH - Germany



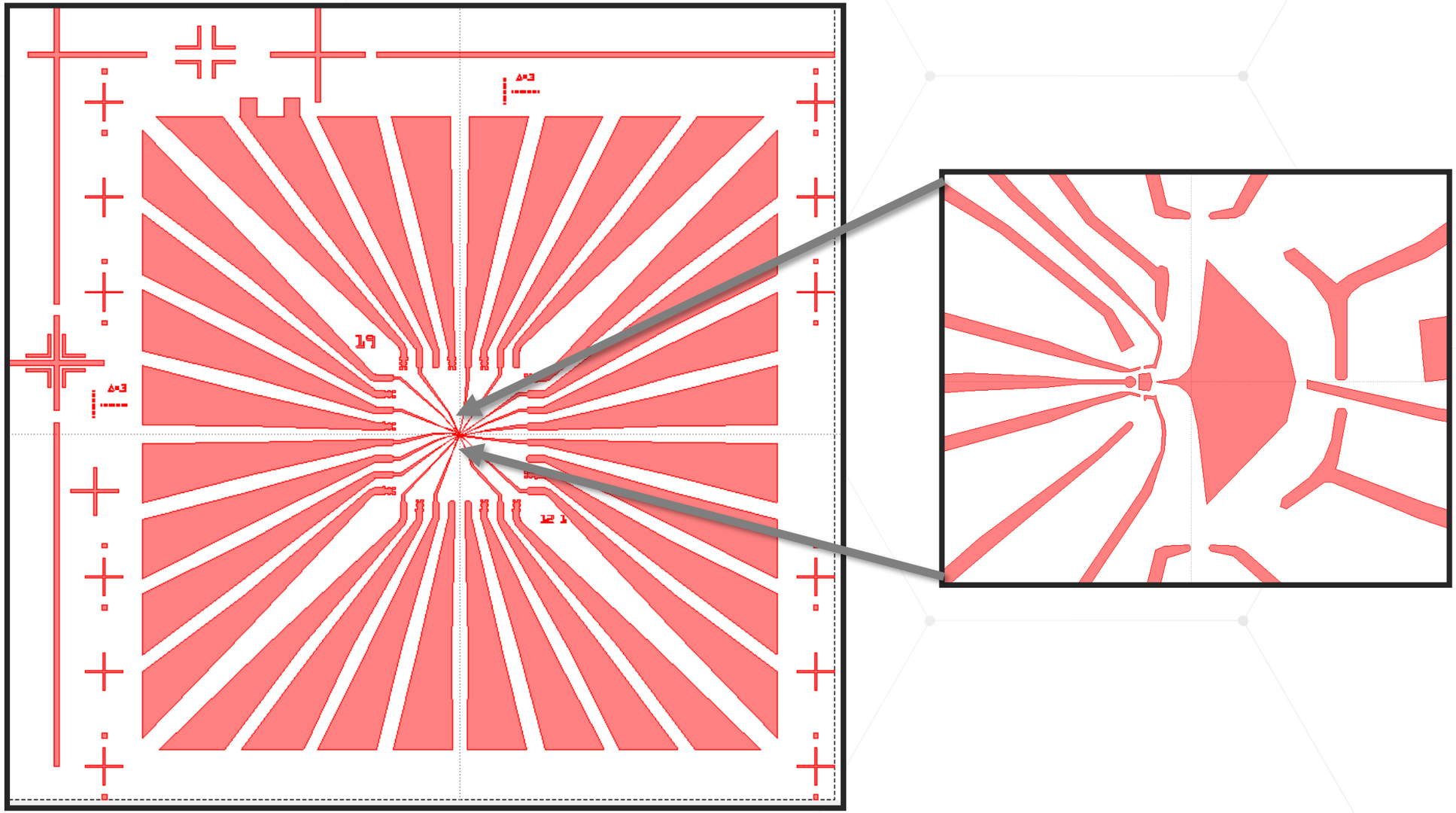
Source: NIST CNST - USA



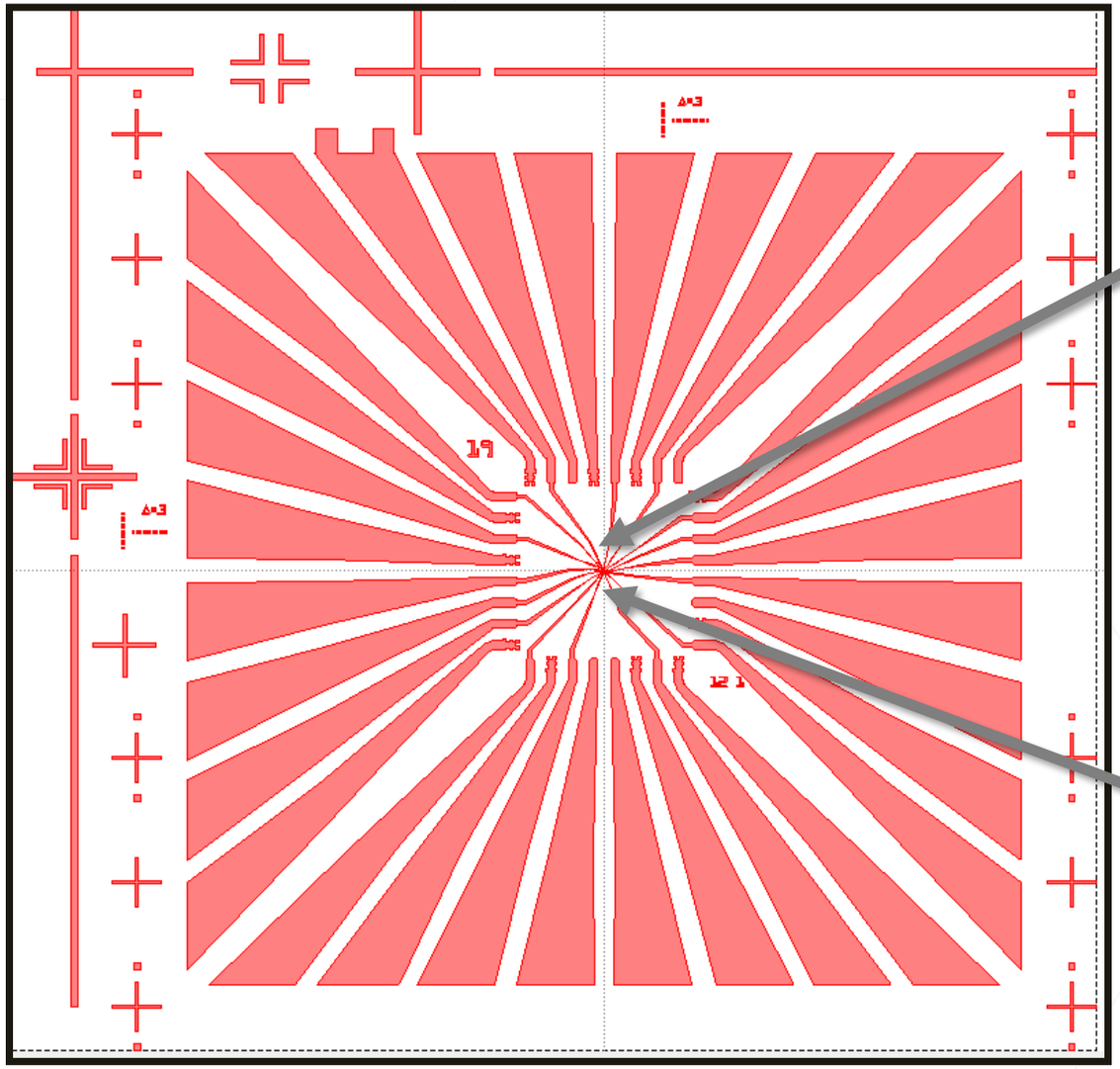
Source: Weizmann Institute – Israel
Stanford University, USA

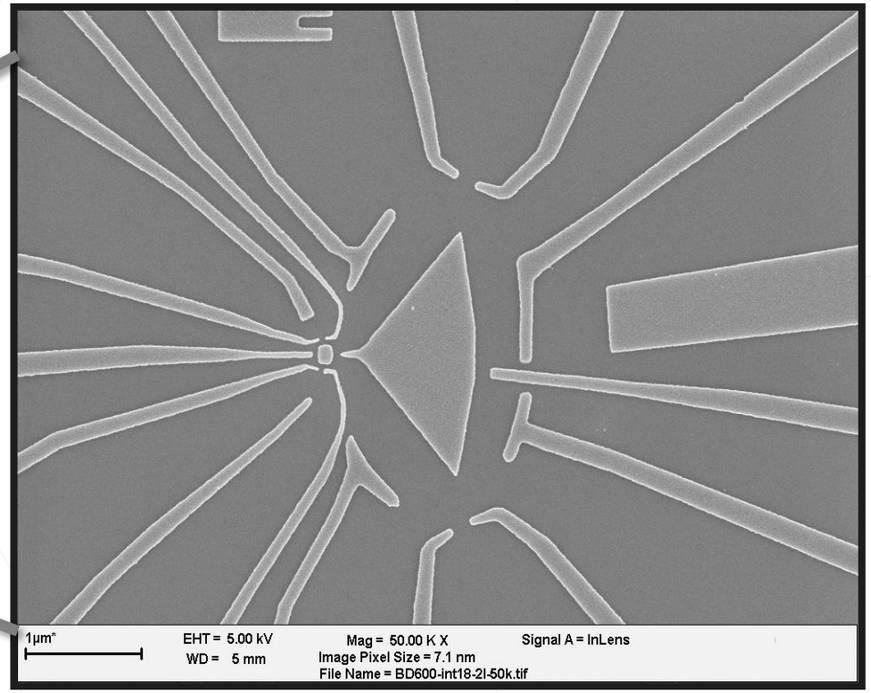
GOOD DATA IN → GOOD SAMPLE OUT

From Design To Sample



From Design To Sample

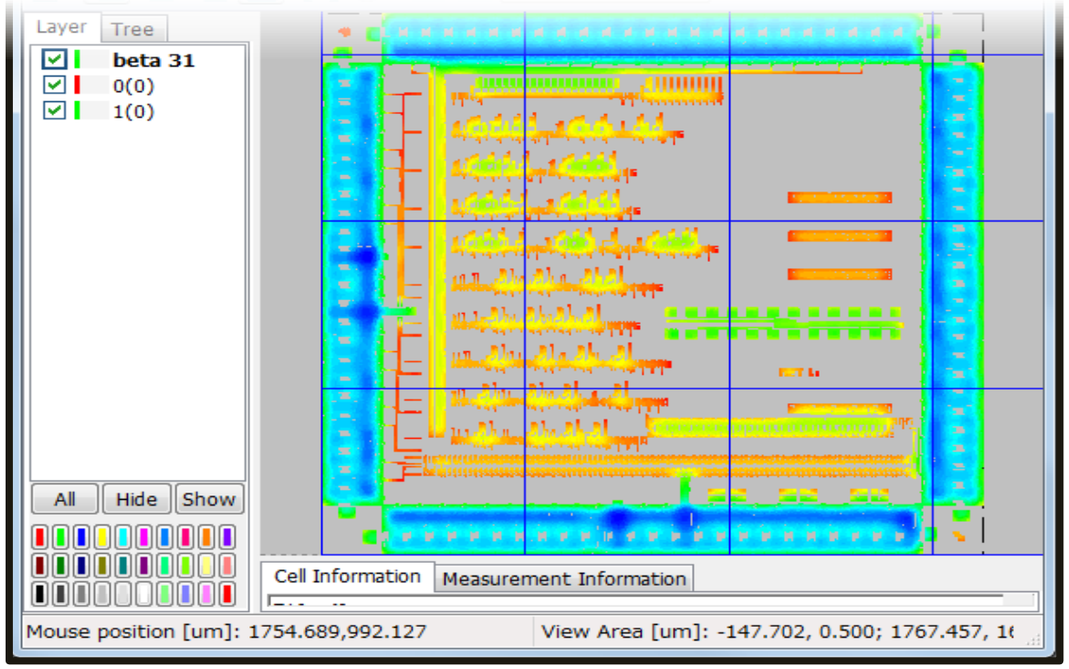


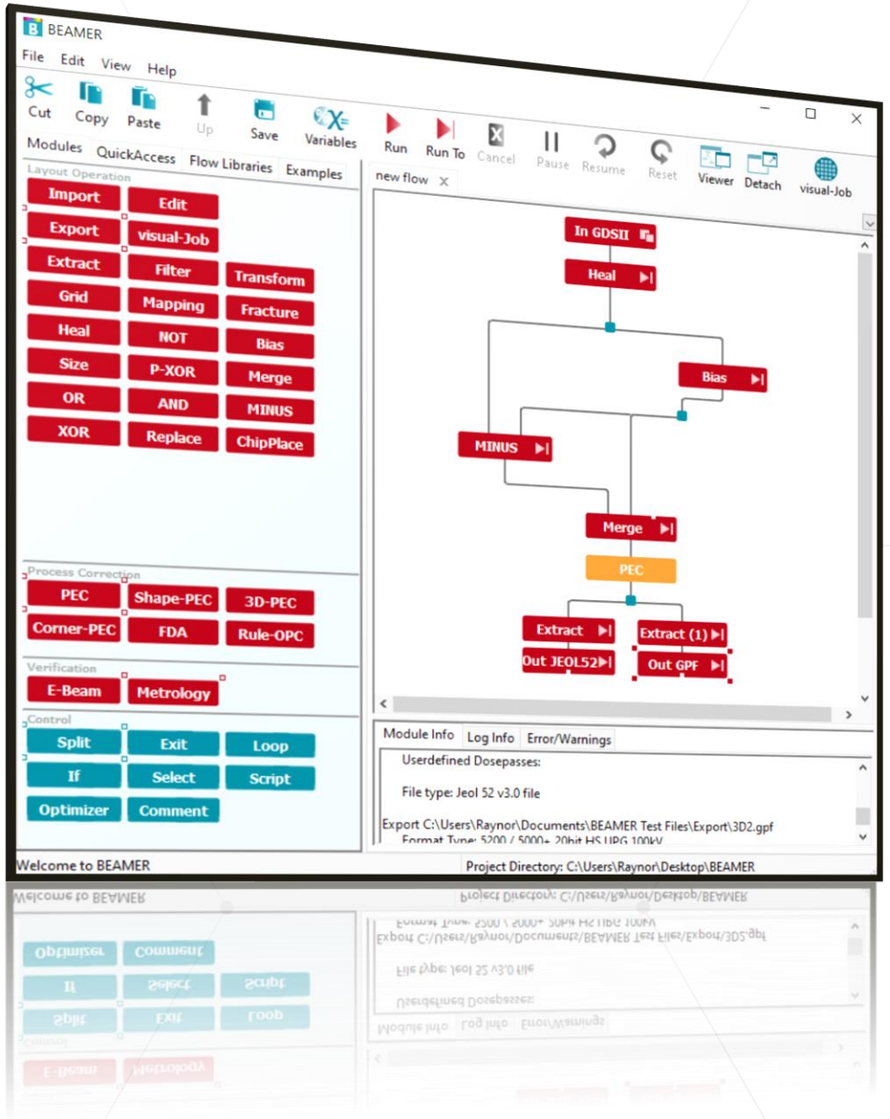


BEAMER

Unique VisualFLOW user interface

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





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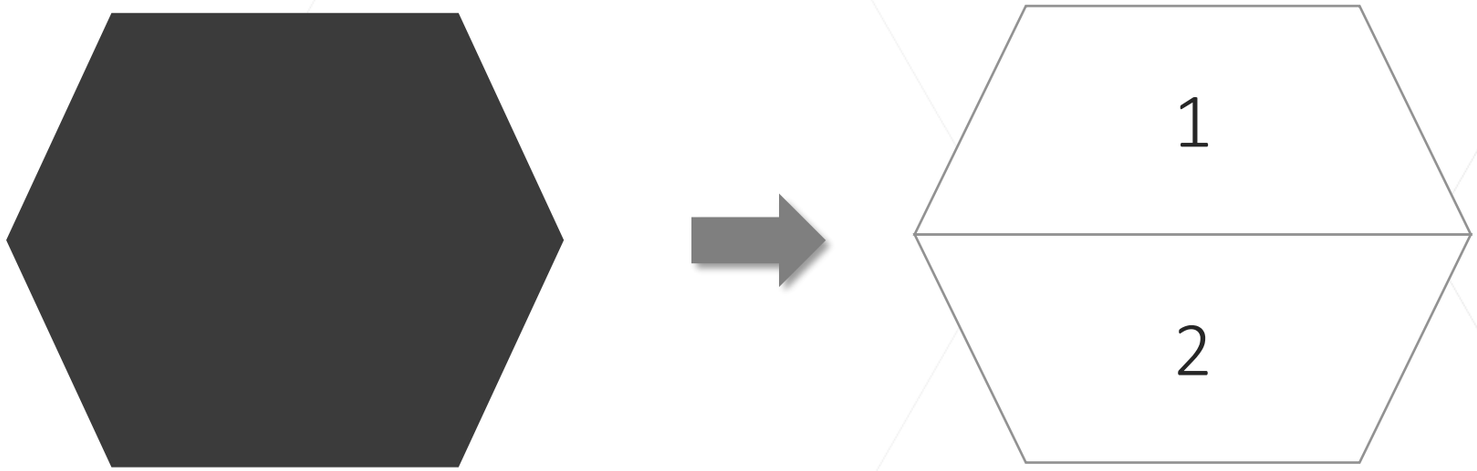
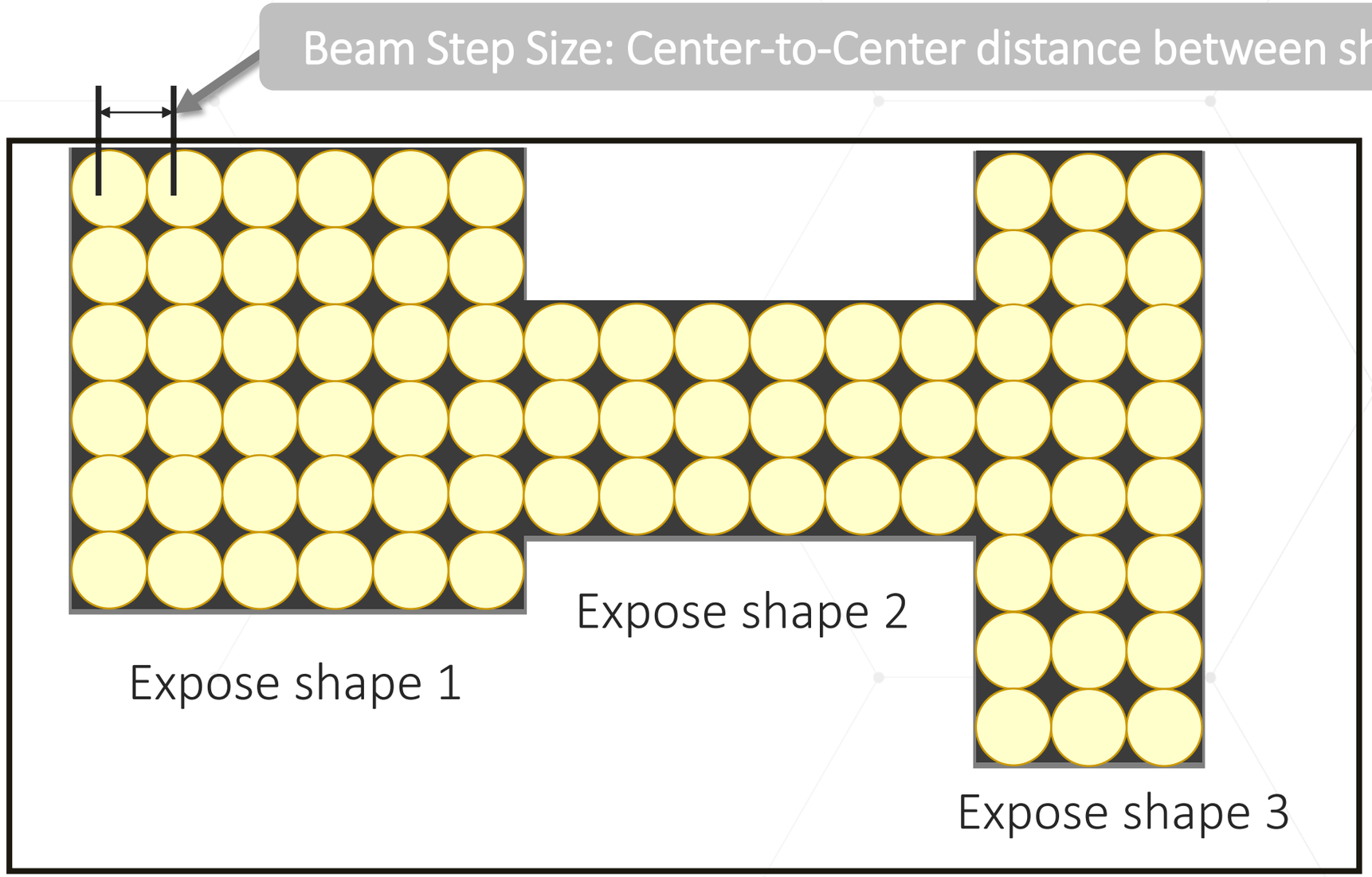
Fracturing

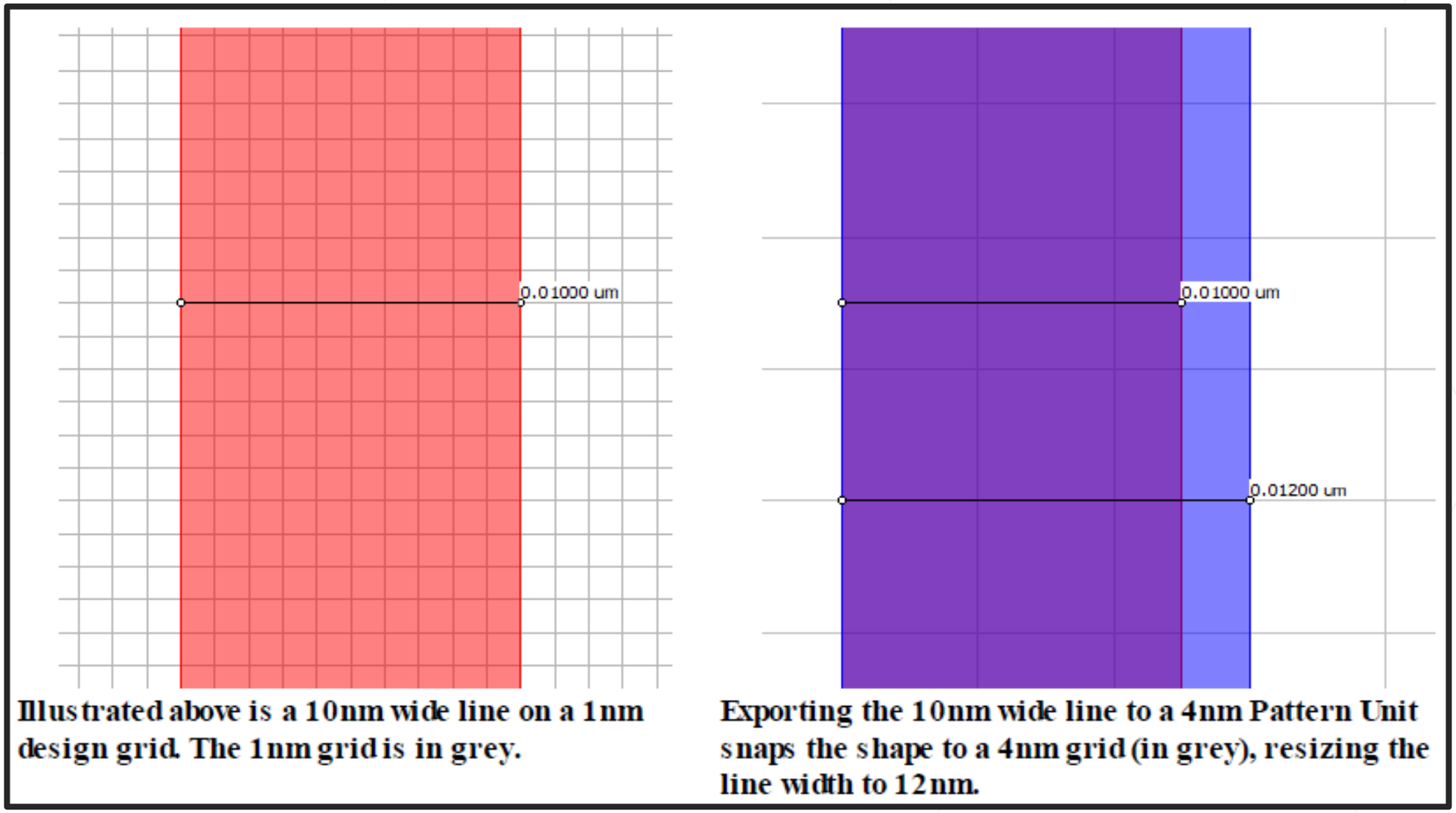
- The data (GDSII, DXF, etc.) is your design, the layout.
- The act of converting the data to the machine format is often referred to as fracturing.
- What is fracturing?
  - Fracturing is the method by which a complex shape is broken down into simple (primitive) shapes (trapezoids).
  - Most e-beam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



Shape Fracture/Exposure



Design vs Exposure Grid



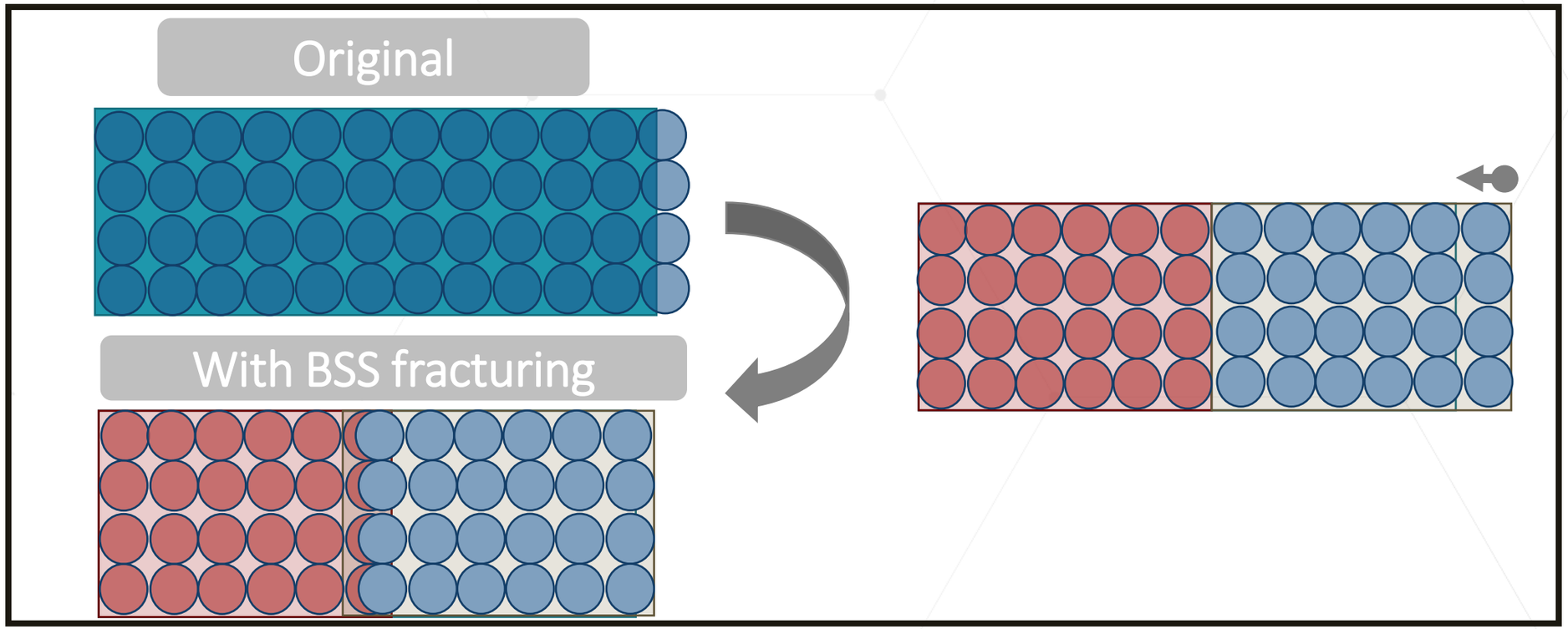
Illustrated above is a 10nm wide line on a 1nm design grid. The 1nm grid is in grey.

Exporting the 10nm wide line to a 4nm Pattern Unit snaps the shape to a 4nm grid (in grey), resizing the line width to 12nm.

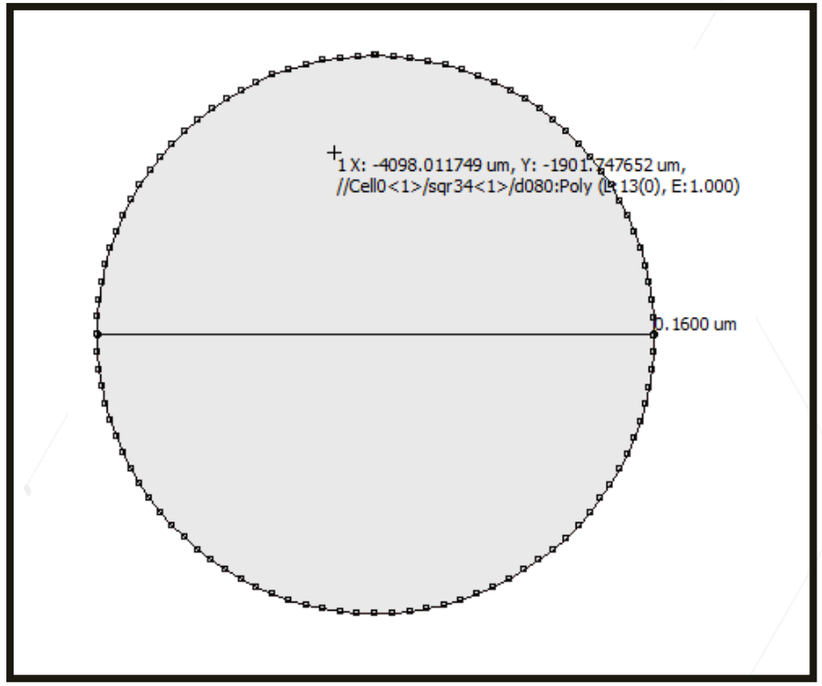
Grid snapping can occur if your exposure grid is not a multiple of your design grid. Always verify the exposure grid of your tool and take it into account when setting up your design grid.

BSS Fracturing

- BEAMER offers a feature called BSS fracturing (Split&Bury) for the case where Resolution < BeamStepSize.
- Creates only shapes that are a multiple of the BSS and maintains the designed outline contour or size by allowing an overlap in the center.

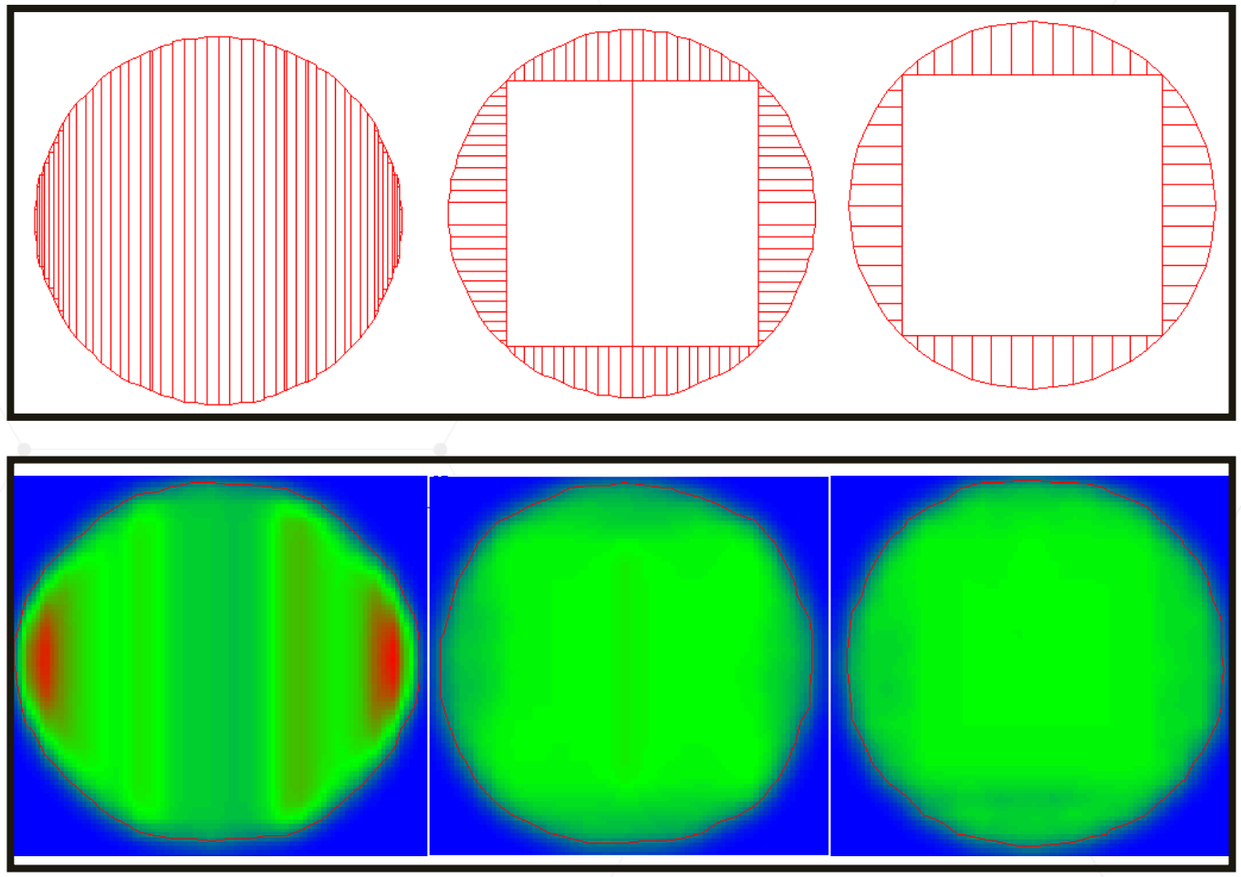


Curve Fracturing



Shot Simulation with 4nm Beam Step Size

Resolution = 1nm, BSS = 4nm



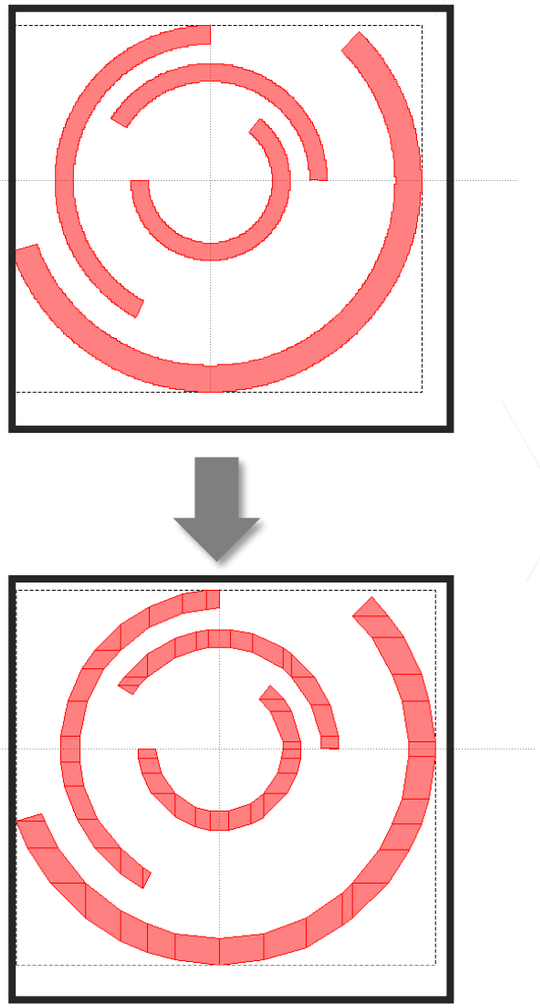
Conventional Fracturing

LRFT Fracturing

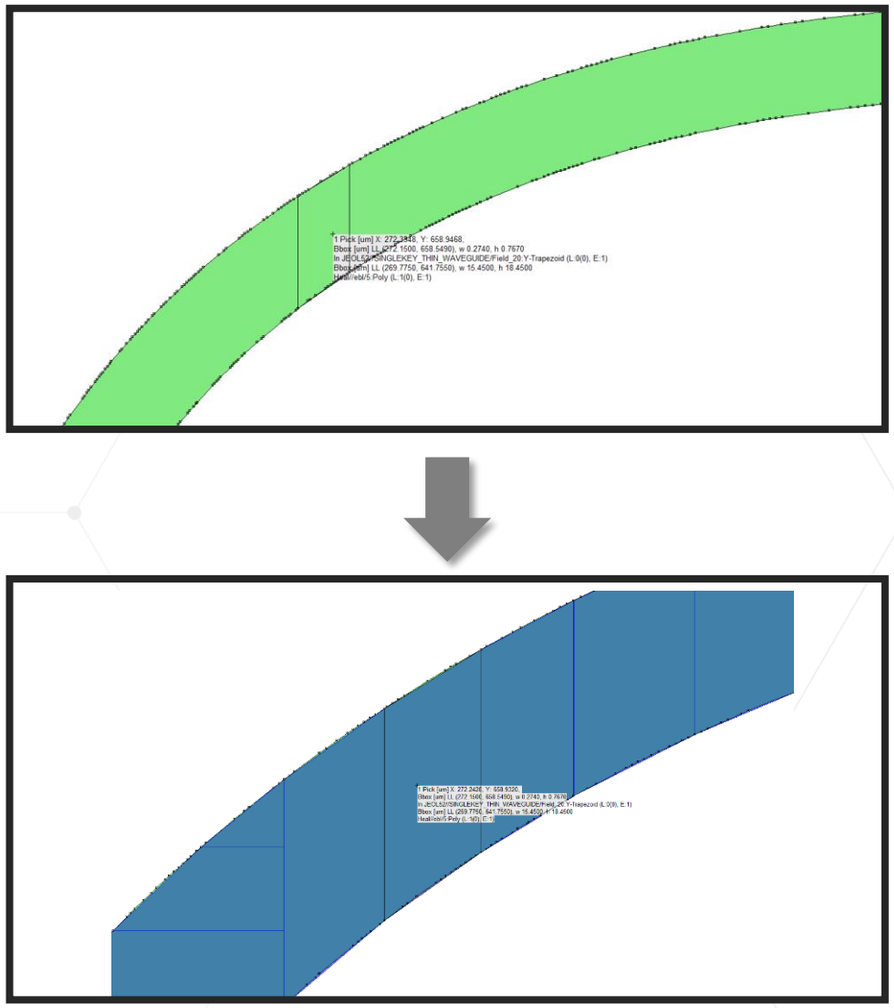
Curved Fracturing

Simple “wisdom” – fewer shapes is better

Curve Fracturing



Partial arcs with Curved Fracturing



Waveguides with Curved Fracturing

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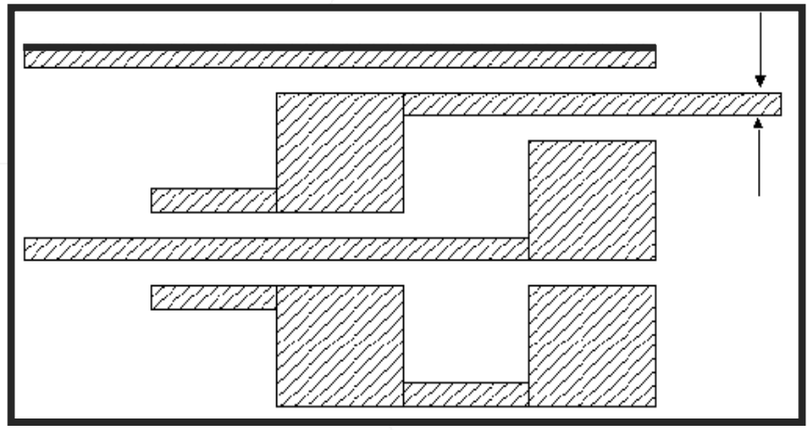
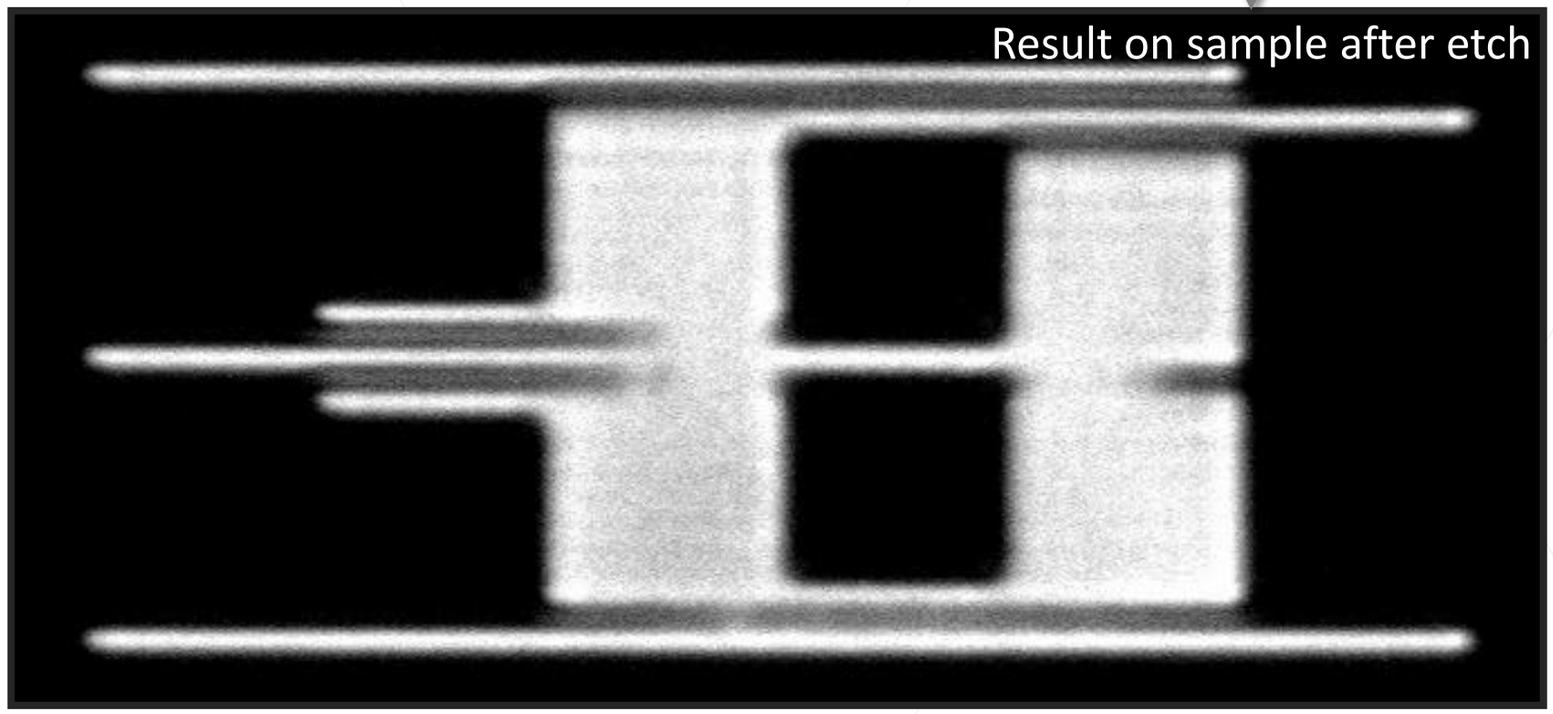
E-beam Lithography Distortion



What you get is
NOT
What you design



Electron-Solid Interactions

Incident Electron Beam

Secondary e⁻

Backscatter e⁻

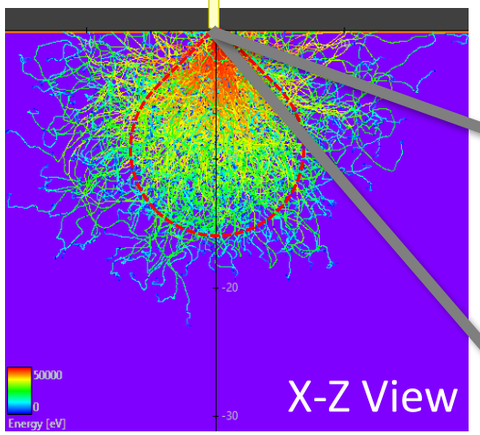
γ

X-Rays

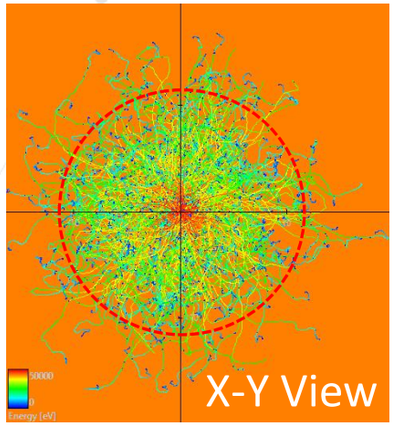
Beam Blur: 1-50nm:Current/ Aperture/Column design

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

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



Excitation Volume



Backscatter Range

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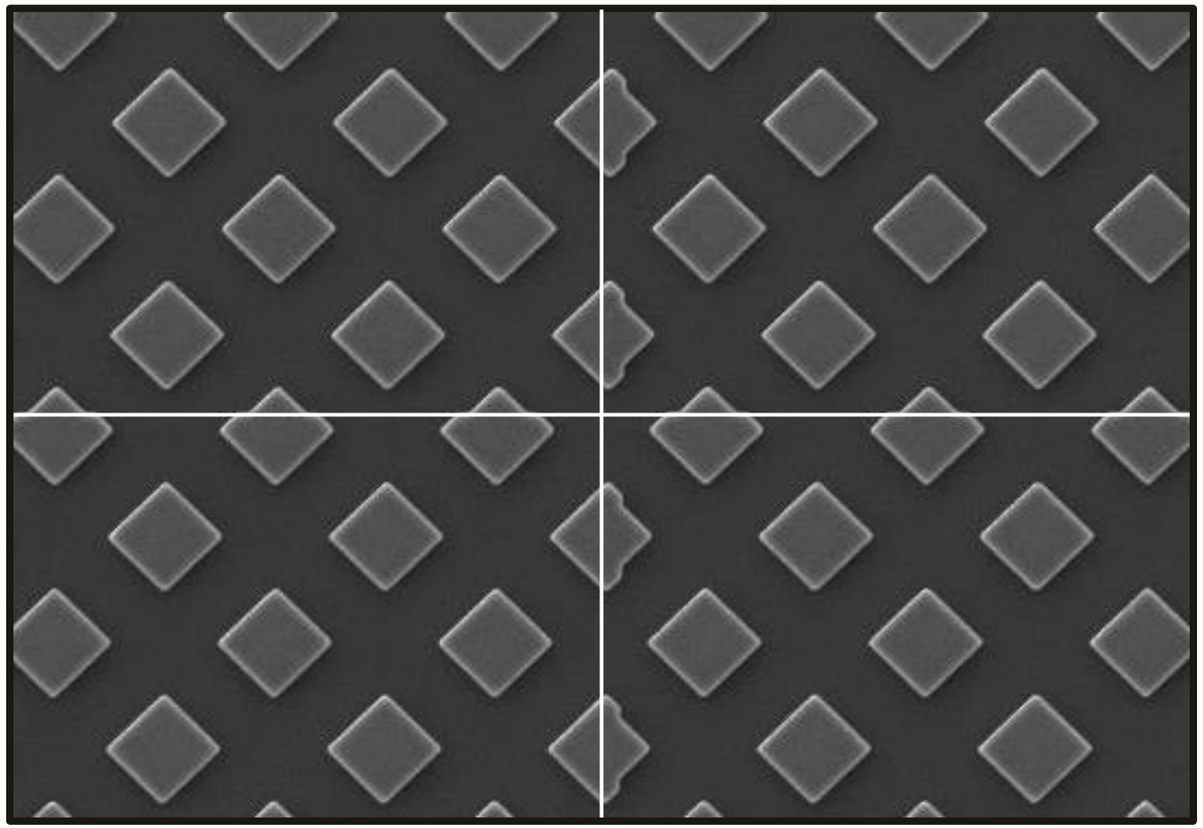
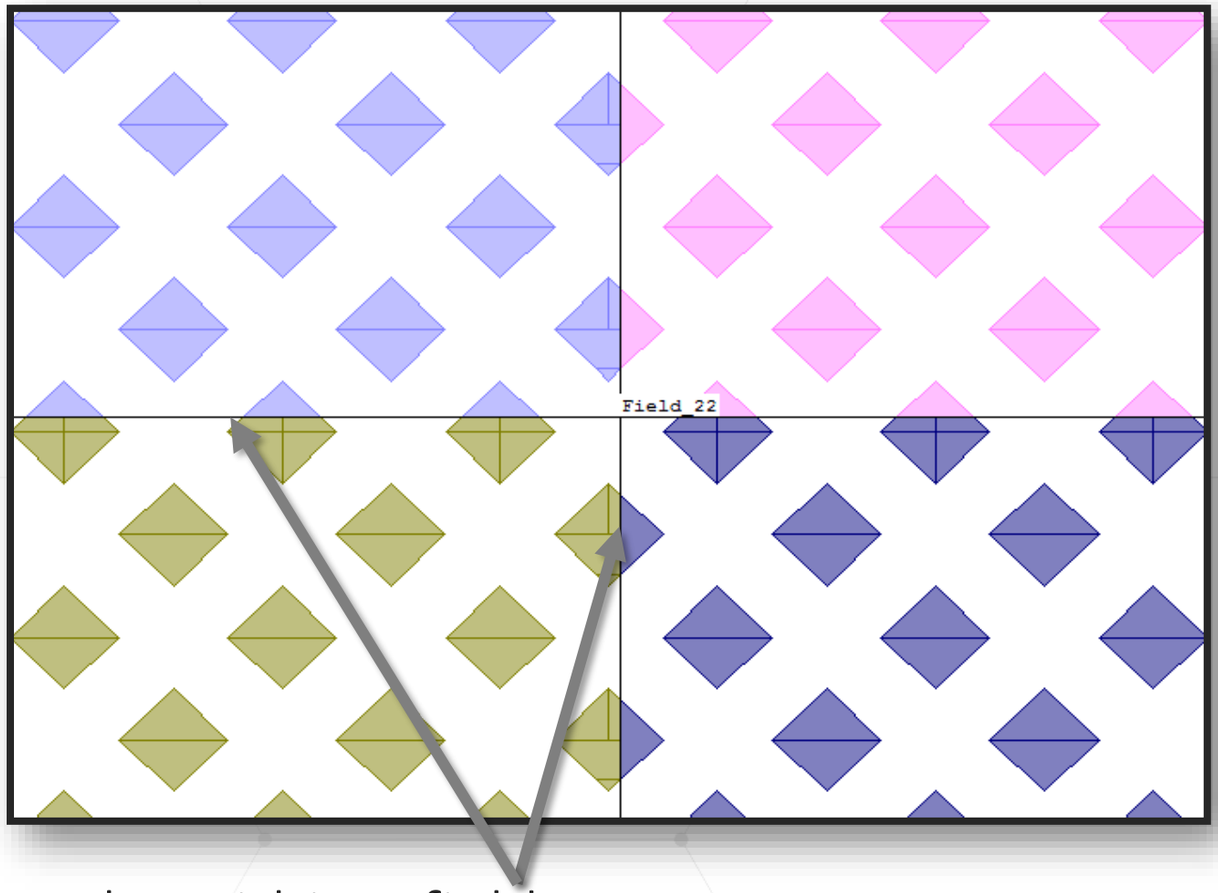
Field Stitching





Data must be within a field

Therefore, figures get fractured at field borders

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Summary

- BEAMER Introduction
  - BEAMER GUI
  - Visual flow concept
- Data Fracturing
  - What is fracturing and why is it needed?
  - BSS fracturing
  - Curved fracturing
- Proximity Effect Correction
  - First steps in PEC – will be expanded in part 4 of this webinar
- Field Stitch
  - Origin of field stiching
  - What can I do to minimize this effect

Outlook

BEAMER training webinar part 2: Optimization – Field Control

- Field Stitching
  - Field Overlap
  - Standard / Interleaving / Dose-Splitting
- Field ordering
  - Fixed Fields / Floating Fields / Manual Fields / Fields Follow Geometry

Thank You!

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