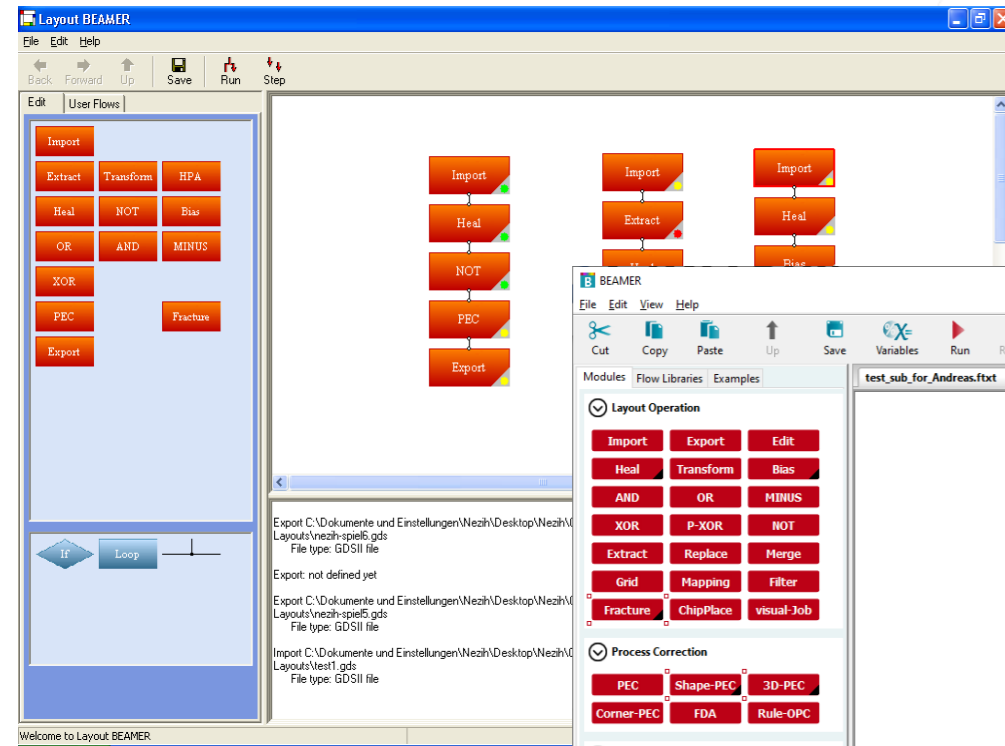
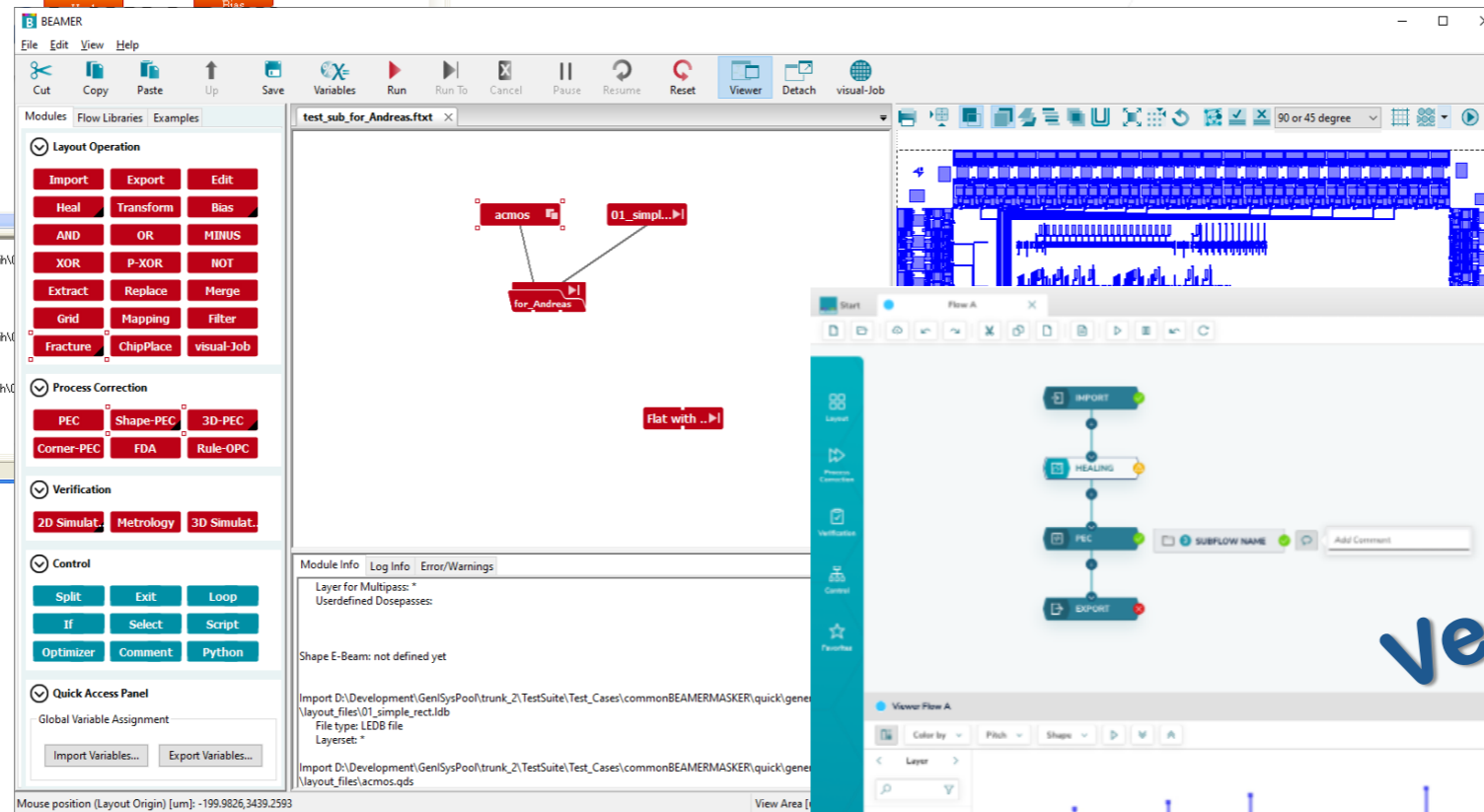


BEAMER

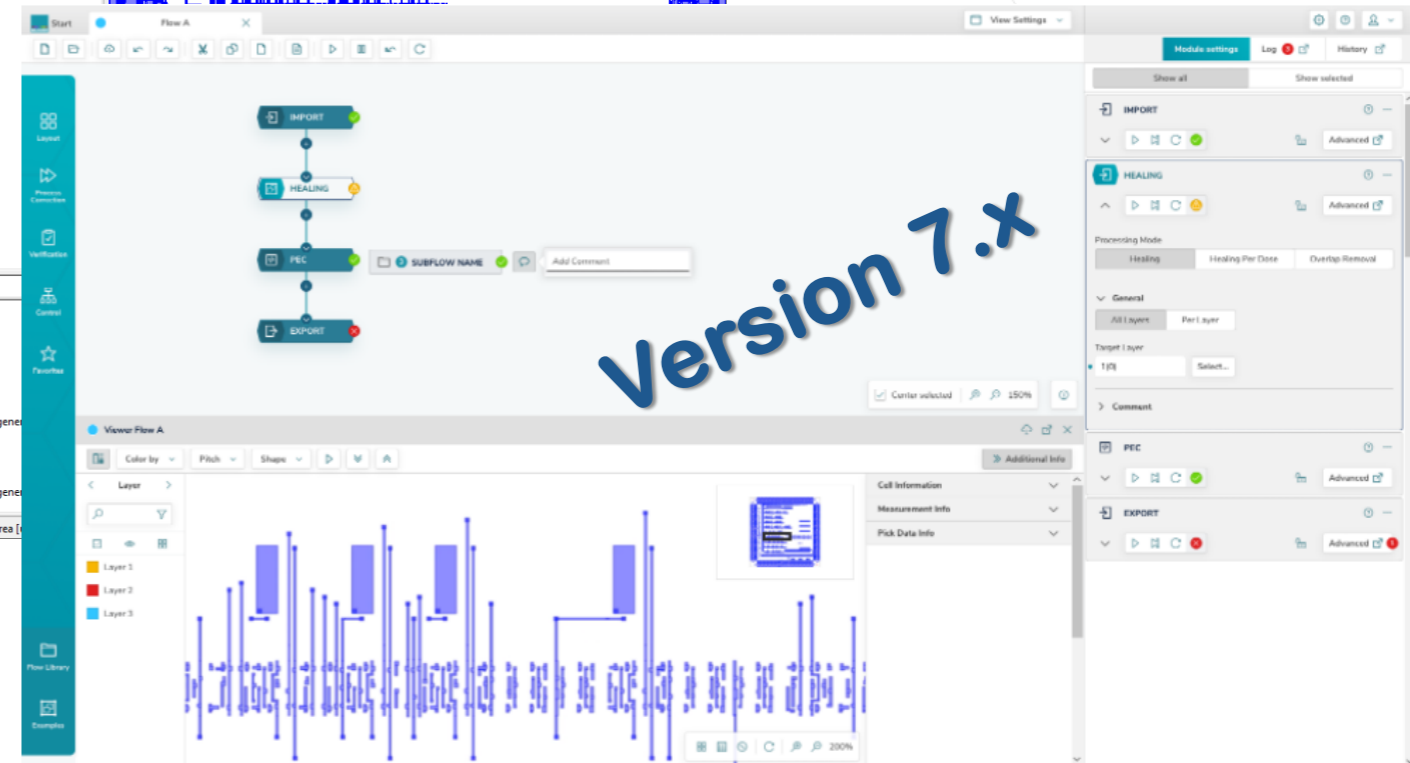
Update – What's new / What's coming up



2006 - 2010

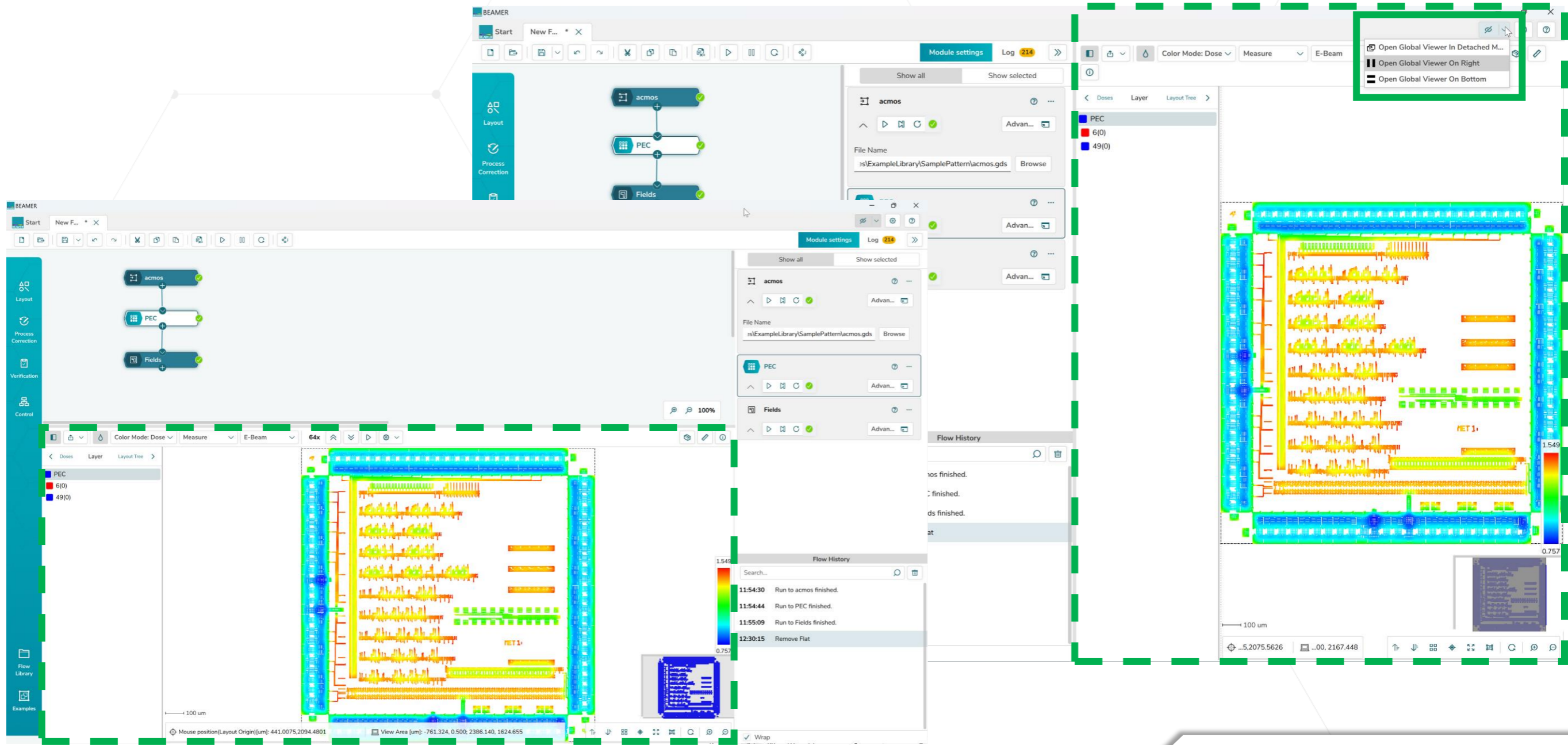


2010 - 2022



2023 ...

Graphical user interface

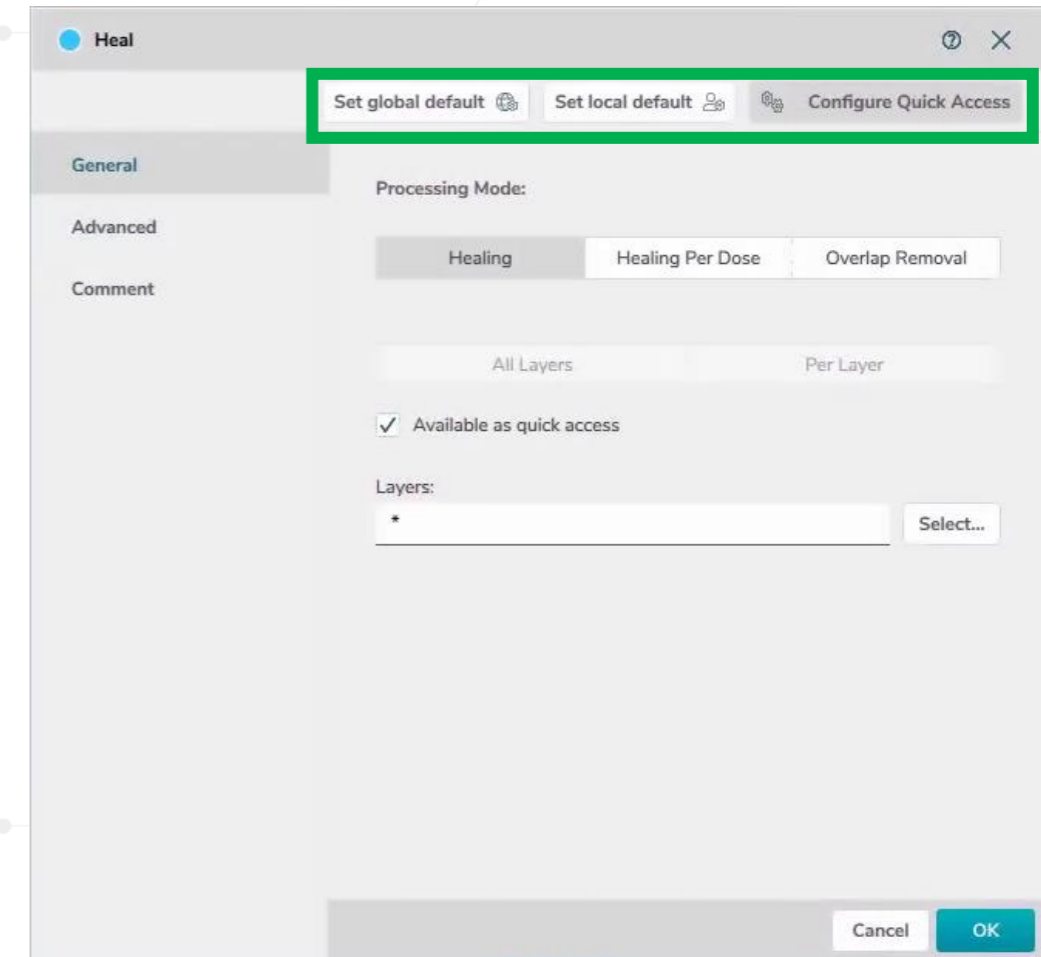
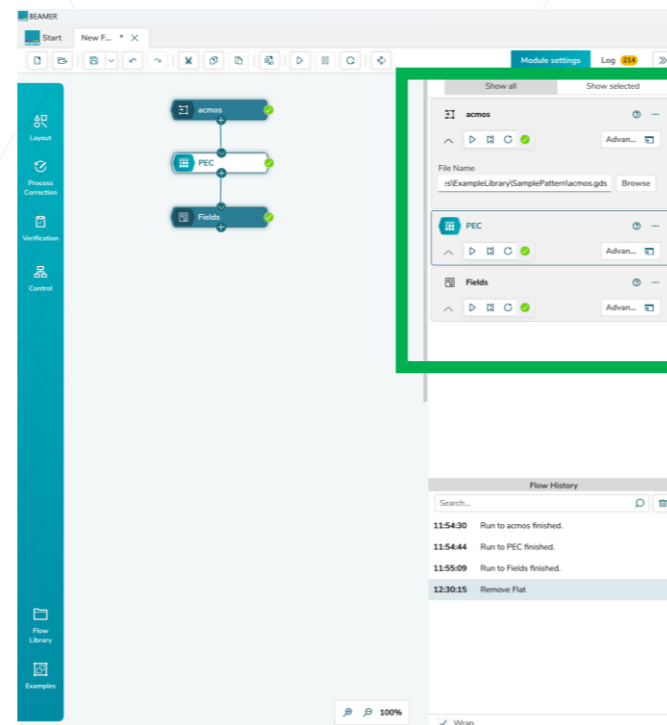


The screenshot displays the BEAMER software interface, which is divided into several functional areas:

- Workflow Diagram:** Located at the top center, it shows a sequence of three modules: 'acmos', 'PEC', and 'Fields', each with a green checkmark indicating successful completion.
- 3D Layout View:** On the left side, a 3D perspective view of the particle accelerator layout is shown, with various components color-coded.
- 2D Dose Distribution Plot:** The main central area displays a 2D dose distribution plot. The plot uses a color scale from blue (low dose) to red (high dose) to show the intensity of the beam across the target area. A scale bar at the bottom indicates 100 μm.
- Control Panel:** On the far left, a vertical sidebar contains icons for 'Layout', 'Process Correction', 'Verification', and 'Control'.
- Settings and Data:** On the right side, there are panels for 'Module settings' (showing 'acmos', 'PEC', and 'Fields' with their respective file names), 'Color Mode' (set to 'Dose'), 'Measure', and 'E-Beam' parameters.
- Flow History:** A window at the bottom right provides a log of system events, including:
 - 11:54:30 Run to acmos finished.
 - 11:54:44 Run to PEC finished.
 - 11:55:09 Run to Fields finished.
 - 12:30:15 Remove Flat.
- Global Viewer Options:** A green dashed box highlights a menu in the top right corner with the following options:
 - Open Global Viewer In Detached M...
 - Open Global Viewer On Right
 - Open Global Viewer On Bottom

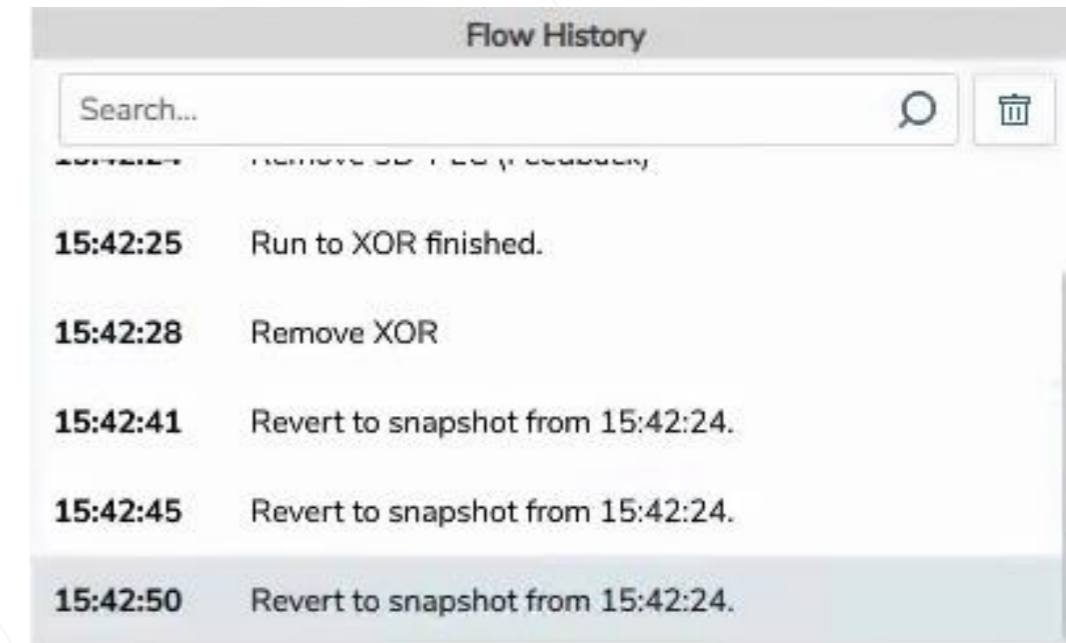
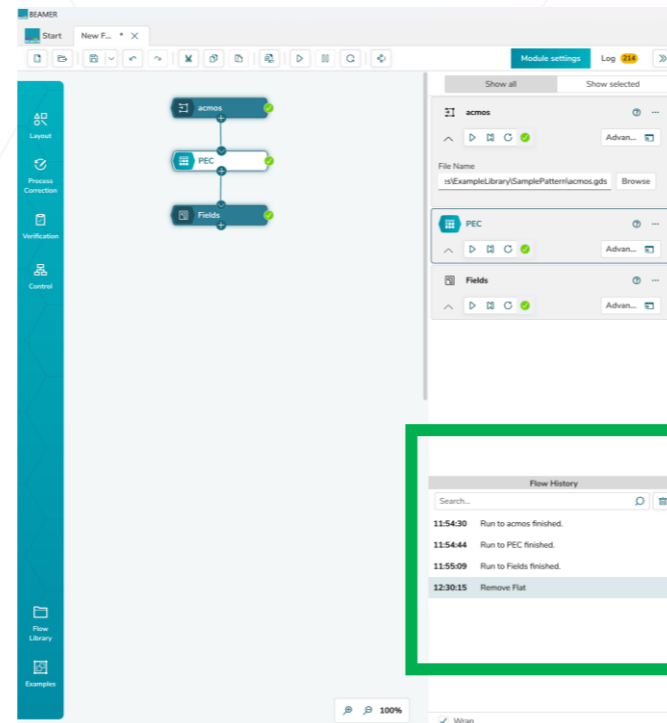
Quick Access Configuration

Quick Access can now be configured for the current user either as a *local default*, or as a *global default* in which case for all **BEAMER** users Quick Access applies for the selected values. The local default overrides the global setting.



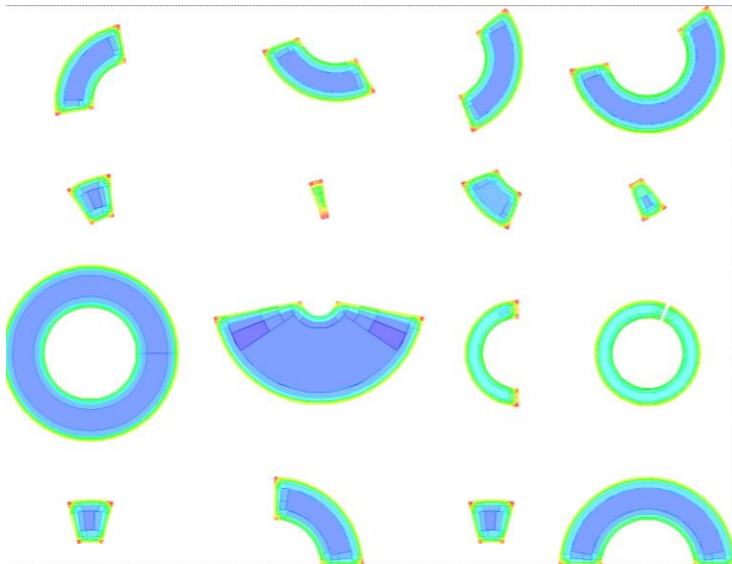
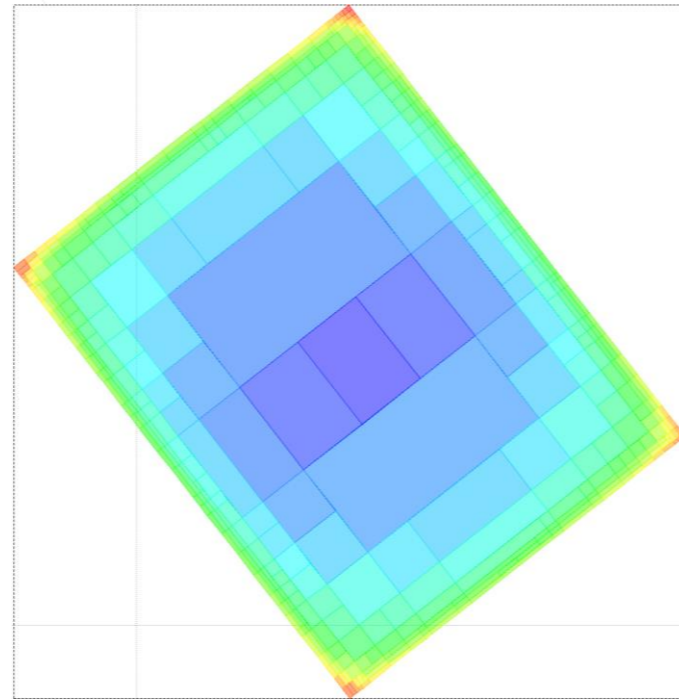
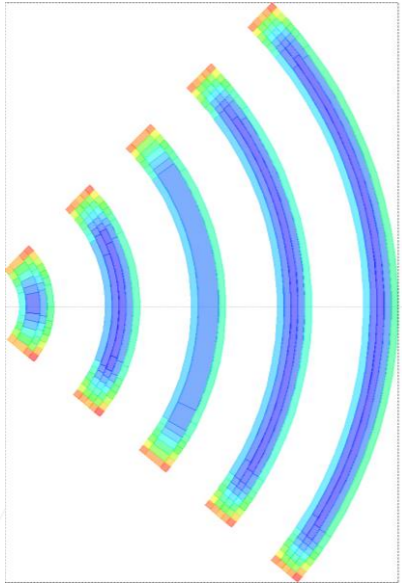
The Flow history feature allows to revert to a previous status of a module whose parameters have been since updated.

Also accidental deletes can be restored including results.



PEC

Improved PEC fracturing

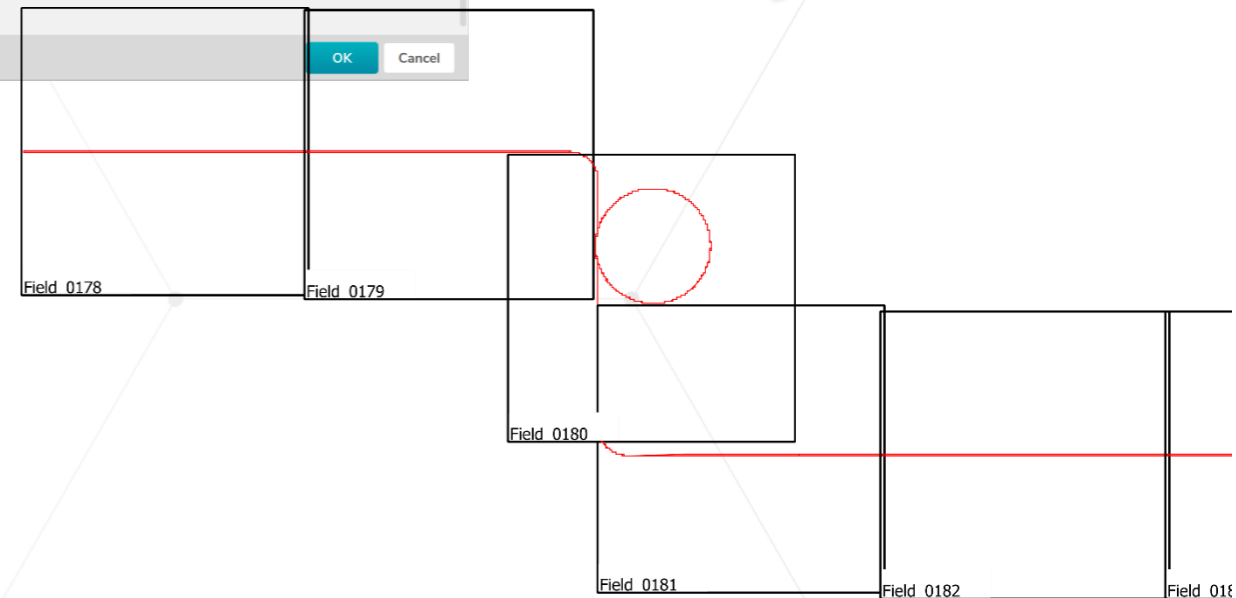
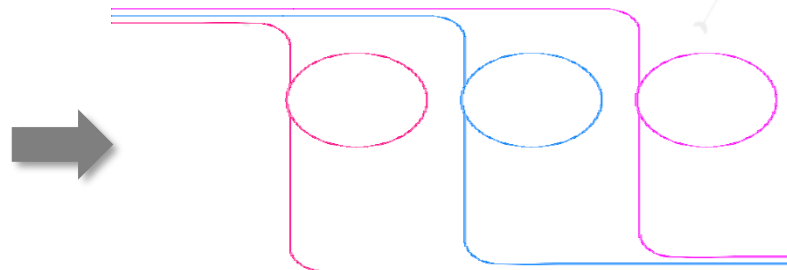
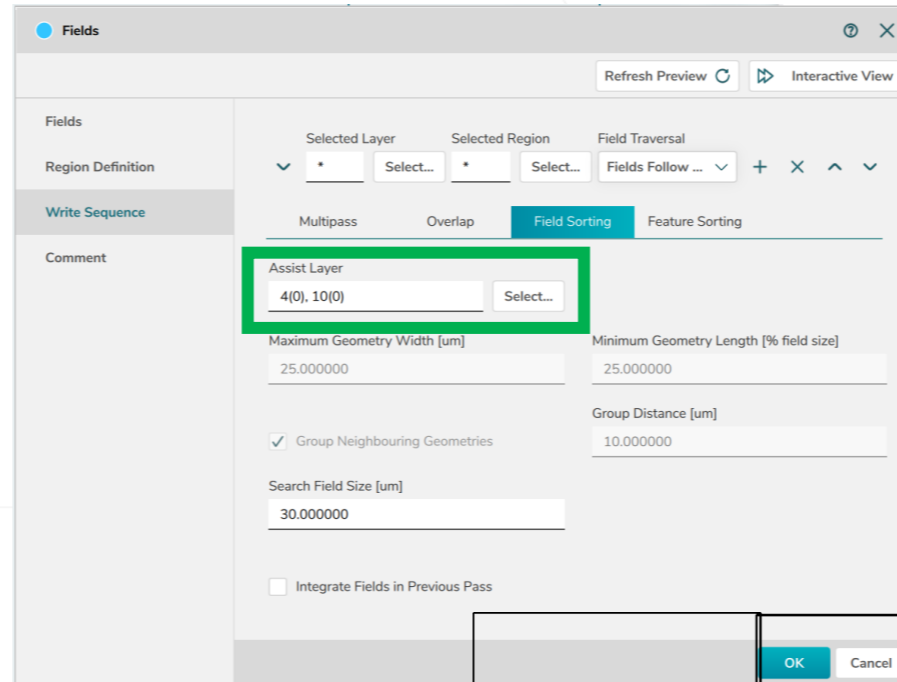
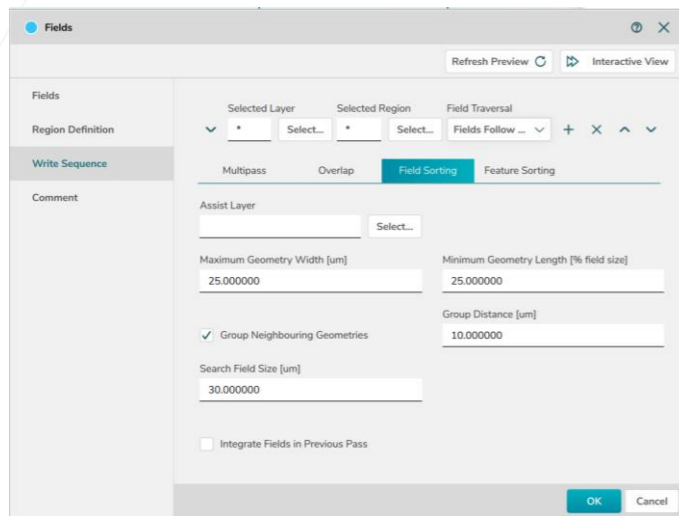


Generic element types like Circles / Arcs / Rotated Rectangles are maintained during fracturing. Dose fracturing of PEC will fracture e.g. ARC elements only into smaller ARC elements to improve the fracture quality.

Field control

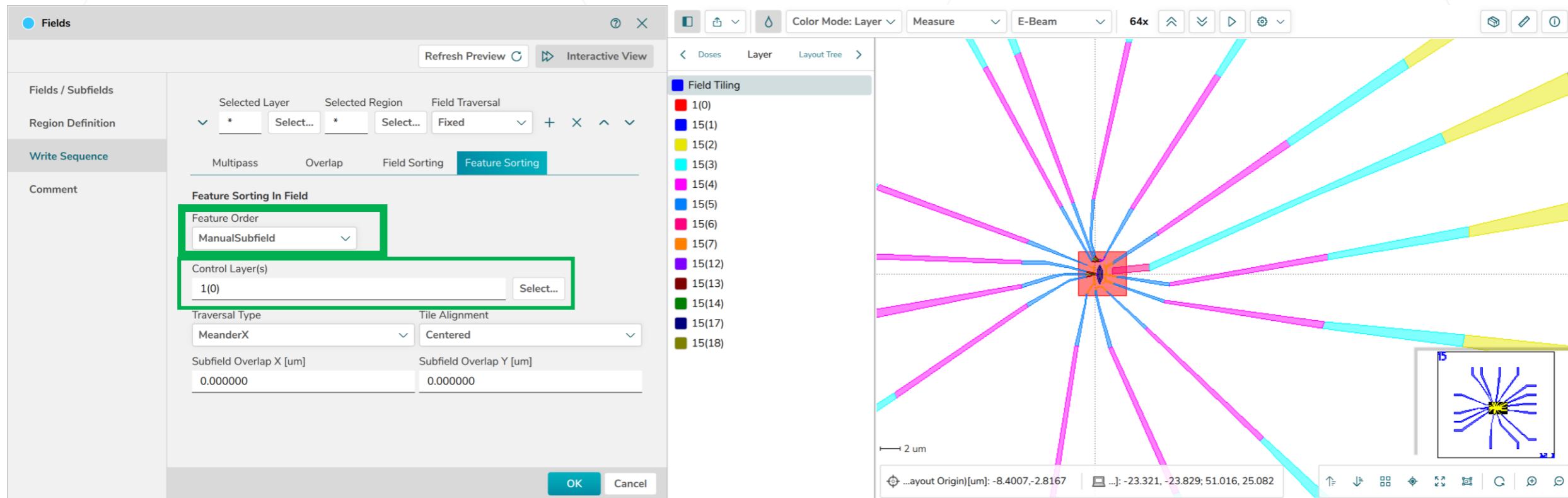
Fields Follow Geometry includes a new feature that helps to improve the quality of the results.

An *Assist Layer* can be included in the design narrowing down the geometry data that will be processed by the writing algorithm.



Fields module – ManualSubfield mode

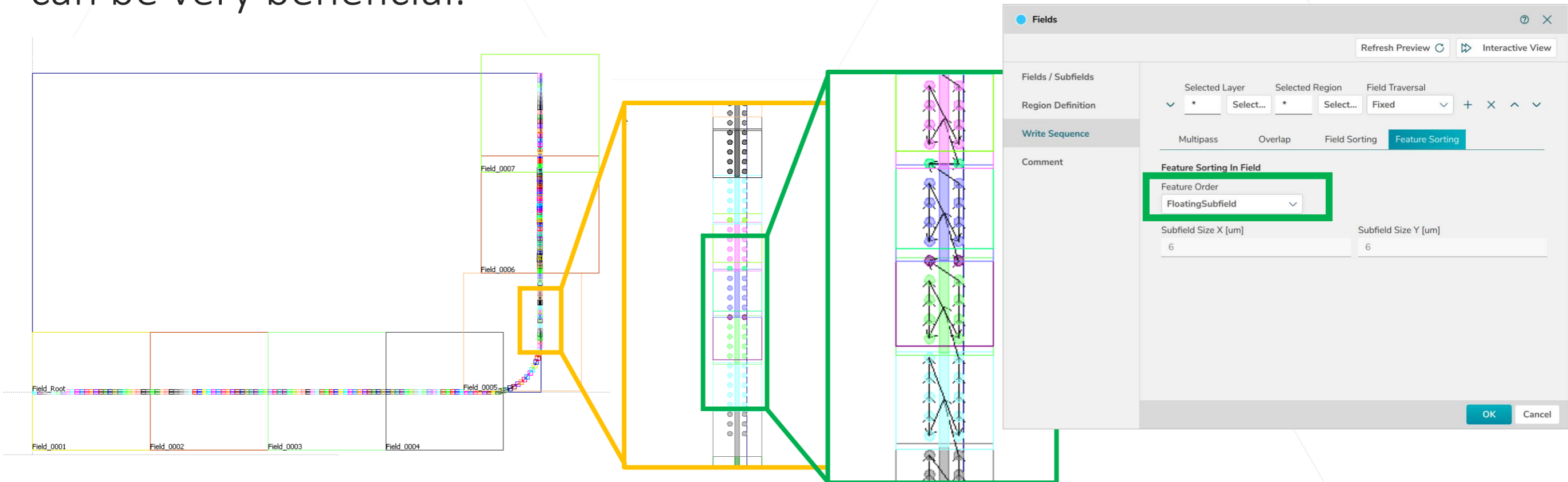
- The exposure order of critical regions within a Field are optimized using ManualSubfield
- The Control layer can be used to identify critical layout parts



The screenshot displays the GenISys Fields module interface. On the left, the 'Fields' panel is open, showing the 'Feature Sorting' tab. The 'Feature Order' dropdown is set to 'ManualSubfield', and the 'Control Layer(s)' field contains '1(0)'. The 'Traversal Type' is set to 'MeanderX' and 'Tile Alignment' is 'Centered'. The 'Subfield Overlap X [um]' and 'Subfield Overlap Y [um]' are both set to '0.000000'. The main window shows a field layout visualization with a central red square and multiple colored lines radiating outwards. A 'Field Tiling' legend on the left lists various subfields (1(0) to 15(18)) with corresponding colors. The interface includes a 'Refresh Preview' button, 'Interactive View' toggle, and various toolbars for navigation and zooming.

Fields module – FloatingSubfield mode

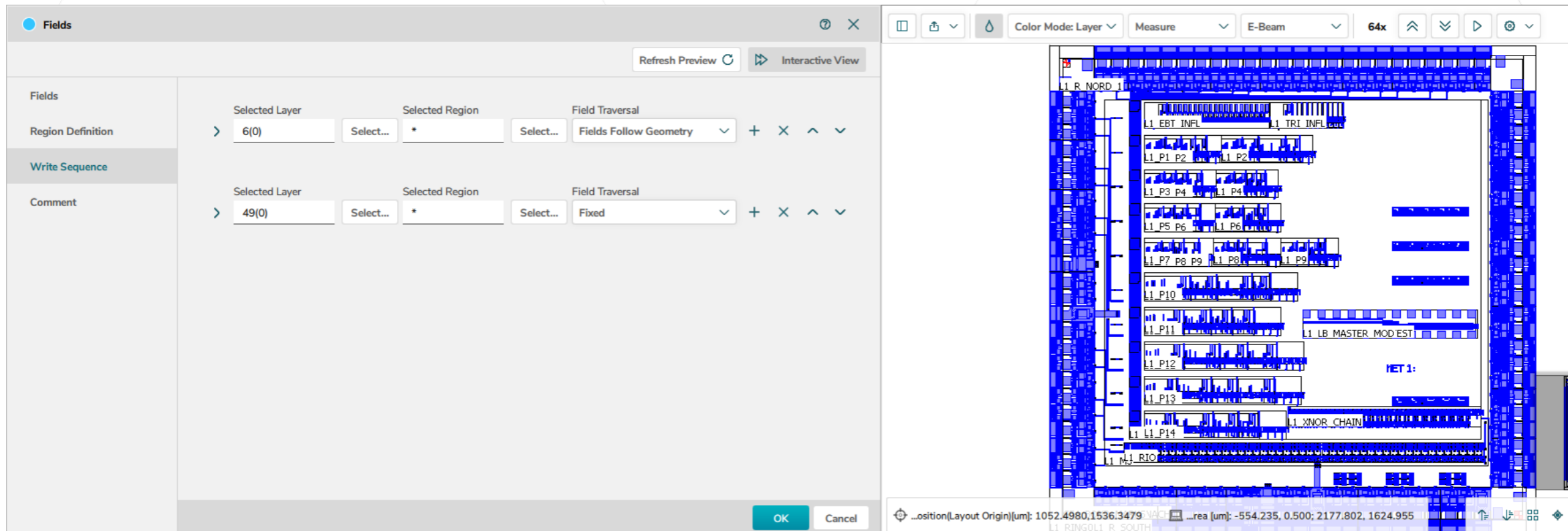
A floating subfield algorithm has been implemented that analyses the pattern and follows the path of the layout based on the feature distribution. This works very similar to the floating algorithm in the main field sorting. For sparse patterns, to follow a path, this method can be very beneficial.



The image displays a screenshot of the GenISys software interface, specifically the 'Fields' module. The main window shows a layout with several fields labeled 'Field_0001' through 'Field_0007'. A detailed view of a subfield path is shown, illustrating the 'FloatingSubfield' mode. The path is defined by a series of colored dots (blue, green, purple) connected by lines, following the layout's features. A green box highlights the 'Feature Order' dropdown menu in the 'Feature Sorting In Field' section, which is set to 'FloatingSubfield'. Other settings include 'Subfield Size X [um]' and 'Subfield Size Y [um]' both set to 6. The interface also includes a 'Write Sequence' section and a 'Comment' field.

New field sorting module – for advanced Region and field sorting applications

- The fields module can create field and region/ sub fields within a layout
- During the system specific export, the user makes use of this structure via cell to field / cell to SF



The screenshot displays the 'Fields' module interface. On the left, there are two sections for configuration:

- Region Definition:** Selected Layer: 6(0), Selected Region: *, Field Traversal: Fields Follow Geometry.
- Write Sequence:** Selected Layer: 49(0), Selected Region: *, Field Traversal: Fixed.

The main area shows a detailed layout of a circuit board with various components labeled, including:

- L1 R_NORD 1
- L1 EB1 INFL
- L1 TRI INFL
- L1 P1 P2
- L1 P3 P4
- L1 P5 P6
- L1 P7 P8 P9
- L1 P10
- L1 P11
- L1 P12
- L1 P13
- L1 P14
- L1 RIO
- L1 LB MASTER MODEST
- L1 XNOR_CHAIN

The interface includes a toolbar with options like 'Color Mode: Layer', 'Measure', 'E-Beam', and a zoom level of '64x'. The status bar at the bottom shows coordinates: ...osition[Layout Origin][um]: 1052.4980,1536.3479 and ...rea [um]: -554.235, 0.500; 2177.802, 1624.955.

Shape Sleeving

New Fracture Feature

The *Fracture* module includes a fast and easy way to *Generate Sleeves* on target layers using zero width path exposure characteristics increasing pattern quality without affecting throughput.

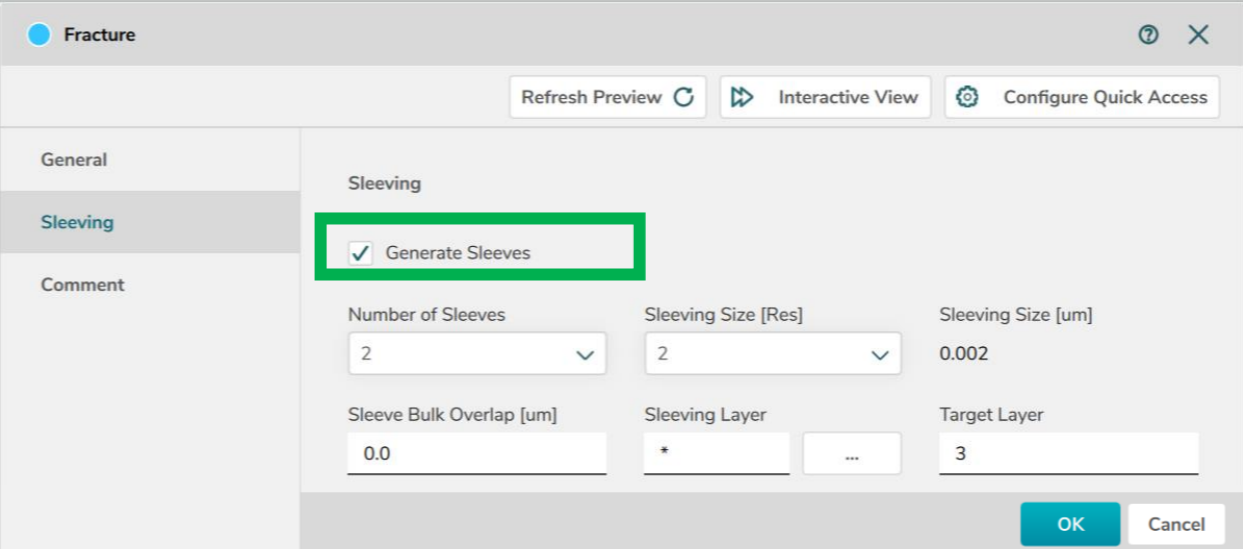
Parameters to control:

Number of Sleeves

Sleeving Size

Overlap between Sleeve and Bulk

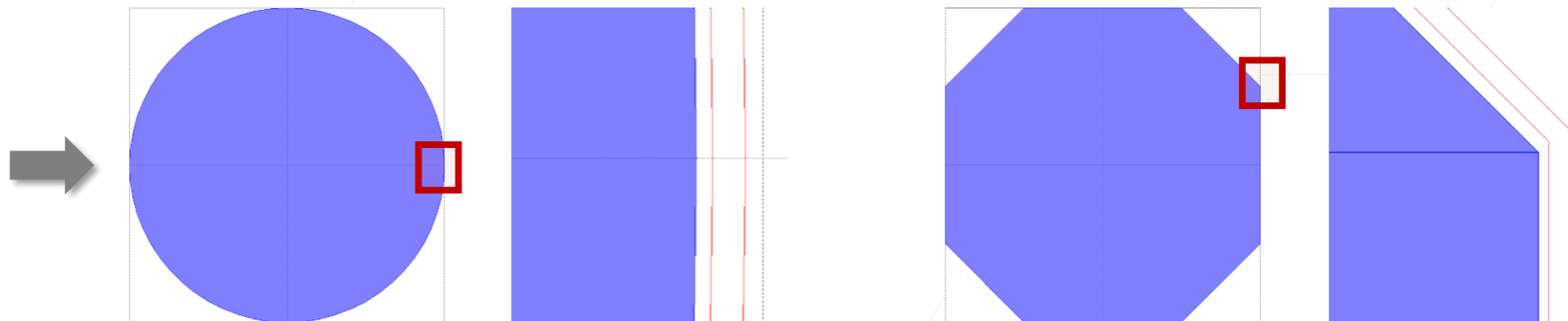
Sleeving Layer



The screenshot shows the 'Fracture' software interface with the 'Sleeving' configuration panel. The 'Generate Sleeves' checkbox is checked and highlighted with a green box. The configuration includes:

- Number of Sleeves:** 2
- Sleeving Size [Res]:** 2
- Sleeving Size [um]:** 0.002
- Sleeve Bulk Overlap [um]:** 0.0
- Sleeving Layer:** *
- Target Layer:** 3

Buttons for 'Refresh Preview', 'Interactive View', and 'Configure Quick Access' are visible at the top. 'OK' and 'Cancel' buttons are at the bottom right.



Sleeves generated by this method can find use in the capability of several tool exports:

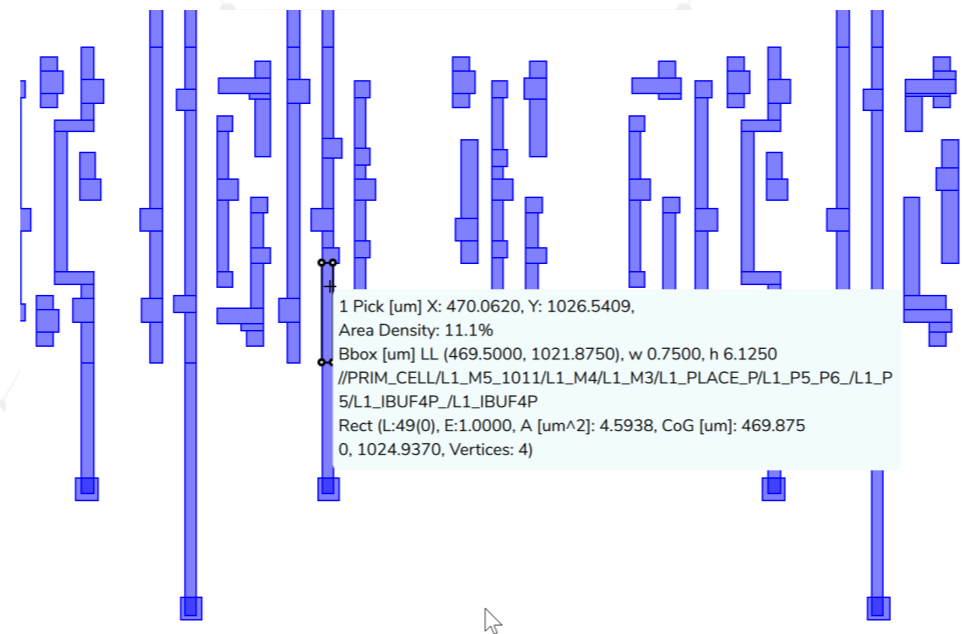
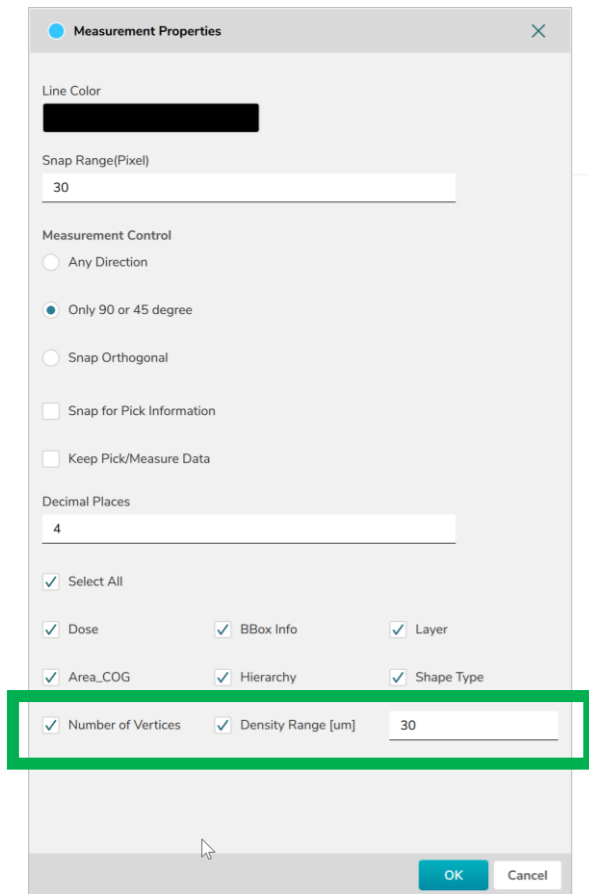
- taking benefit of the unique treatment during the exposure
- utilizing FDA to assign a compensational dose factor for example to benefit from a improved contrast at the edge of the shape
- utilizing Extract & Transform to duplicate the sleeves and create an intentional pattern smoothing (shift by half a beam step size and halving the dose)

Usability

VIEWER – pick information

The VIEWER pick information has been extended to cover:

- Number of vertices
- Pattern density in a certain range



RuleOPC – Import/Export

Rule Based Process Correction

Configure Quick Access

General

Layer(s): *

Min Free Edge Size [um]: 0.050000

Min Segment Size [um]: 0.100000

Min Corner Size [um]: 0.150000

Max Segment Size [um]: 1000000.000000

Bias Limit [um]: 0.000000

Insert Delete Up Down

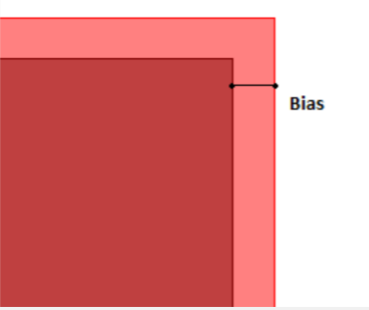
<input checked="" type="checkbox"/>	Action	Dependence Param	Scenario	Condition
<input checked="" type="checkbox"/>	Bias	CD	AnySegment	true
<input checked="" type="checkbox"/>		-	-	

Condition

CD [um]	Bias [um]
0.000000	0.000000

Segment Assignment Preview

OK Cancel



For easier rule setup an import/export option has been added for the CD dependend bias correction

Python module - Formatting improvements

BEAMER 7.0

```
BEAMER.bias(**gobject**, {'SoftFrame': 0.300000, 'Bias': 0.000000, 'CornerExtension': 1.000000, 'SuppressExtensionOfTinyCorners': False, 'Mode': 'X-Y', 'HierarchicalProcessing': True, 'LayerAssignment': 'AllLayer', 'TargetLayer': '0(0)', 'ExtentType': 'Automatic'})
```

```
BEAMER.fracture(**gobject**, {'FractureLayer': '*', 'KeepResolution': True, 'Resolution': 0.001000, 'BeamStepSize': 1, 'CurveApproxTolerance': 0.100000, 'CurveTolerance': 1.000000, 'FractureAxis': 'X_AND_Y', 'FractureMode': 'LRFT', 'BssFracturing': False, 'Symmetric Fracturing': False, 'FractureAngle': 'AnyAngle', 'FractureTolerance': 1.000000, 'FractureType': 'Flat'})
```

BEAMER 7.1

```
1 BEAMER.bias( **gobject**,
2     {'SoftFrame' : 0.300000,
3     'Bias' : 0.000000,
4     'CornerExtension' : 1.000000,
5     'SuppressExtensionOfTinyCorners' : False,
6     'Mode' : 'X-Y',
7     'HierarchicalProcessing' : True,
8     'LayerAssignment' : 'AllLayer',
9     'TargetLayer' : '0(0)',
10    'ExtentType' : 'Automatic'} )
11 |
```

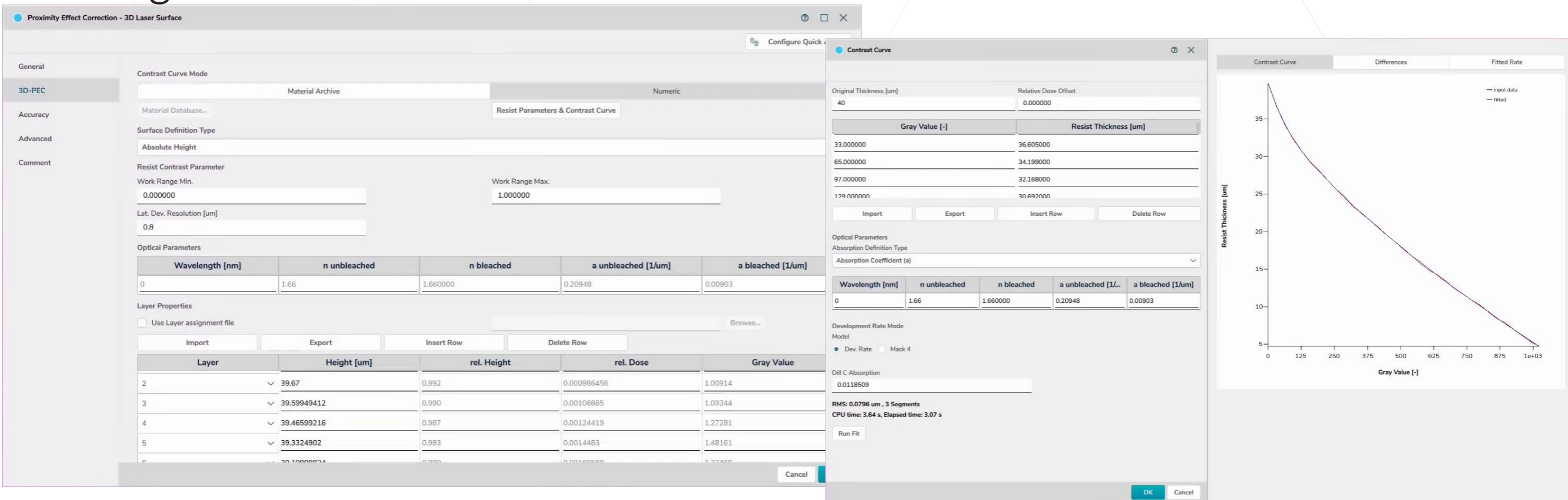
The formatting of Python code has been improved for better readability.

```
1 BEAMER.fracture( **gobject**,
2     {'FractureLayer' : '*',
3     'KeepResolution' : True,
4     'Resolution' : 0.001000,
5     'BeamStepSize' : 1,
6     'NumberSleeves' : 1,
7     'SleevingSize' : 1,
8     'SleeveBulkOverlap' : 0.0,
9     'SleevingLayer' : '*',
10    'SleevingTargetLayer' : '',
11    'CurveApproxTolerance' : 0.100000,
12    'CurveTolerance' : 1.000000,
13    'FractureAxis' : 'X_AND_Y',
14    'FractureMode' : 'LRFT',
15    'BssFracturing' : False,
16    'SleeveGeneration' : False,
17    'Symmetric Fracturing' : False,
18    'FractureAngle' : 'AnyAngle',
19    'FractureTolerance' : 1.000000,
20    'FractureType' : 'Flat'} )
21
```


3D Laser Surface

Optimized user interface to follow a top-to-bottom approach setting up the correction.

Moved optical parameters to the *Resist Parameters & Contrast Curve* dialog.

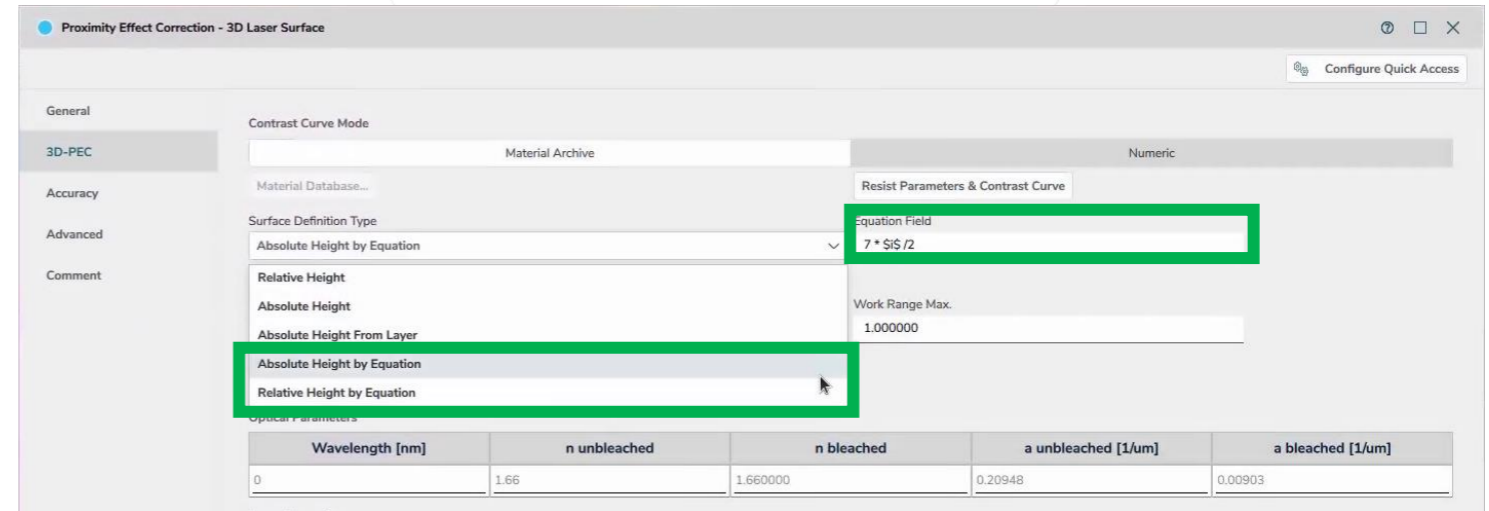


The screenshot displays the 'Proximity Effect Correction - 3D Laser Surface' software interface. The main window is titled 'Contrast Curve' and is divided into several sections:

- General:** Includes 'Contrast Curve Mode' (Material Archive, Numeric), 'Material Database...', 'Surface Definition Type' (Absolute Height), and 'Resist Contrast Parameter' (Work Range Min. 0.000000, Work Range Max. 1.000000).
- Optical Parameters:** A table with columns: Wavelength [nm], n unbleached, n bleached, a unbleached [1/um], and a bleached [1/um].
- Layer Properties:** Includes 'Use Layer assignment file' and a 'Browse...' button.
- Layer Table:** A table with columns: Layer, Height [um], rel. Height, rel. Dose, and Gray Value.
- Contrast Curve Dialog:** A separate window showing 'Original Thickness [um]' (40), 'Relative Dose Offset' (0.000000), and a table of Gray Value [-] vs Resist Thickness [um].
- Graph:** A plot of Resist Thickness [um] vs Gray Value [-]. The y-axis ranges from 5 to 35, and the x-axis ranges from 0 to 1e+03. The graph shows 'input data' (red dots) and a 'fitted' curve (blue line).

2 new *Surface Definition Types*:

- Absolute Height by Equation
- Relative Height by Equation



Layer properties table is filled using an equation defined by the user and the *Laser Contrast Curve*.

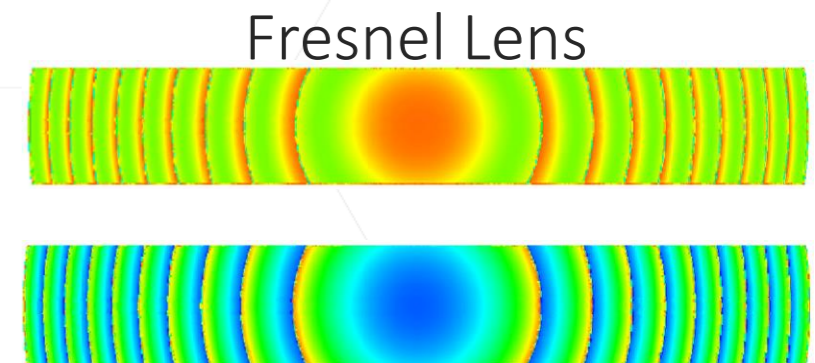
Layer	Height [um]	rel. Height	rel. Dose	Gray Value
30 (\$i\$: 1)	0.032110	0.003	0.983141	250.701
31 (\$i\$: 2)	0.064220	0.006	0.977	249.135
32 (\$i\$: 3)	0.096330	0.010	0.9709	247.58
33 (\$i\$: 4)	0.128440	0.013	0.964839	246.034
34 (\$i\$: 5)	0.160550	0.016	0.958815	244.498

Only **\$i\$** is predefined, but any type of equation can be used under the Contrast Curve limits.

Example of Equations:

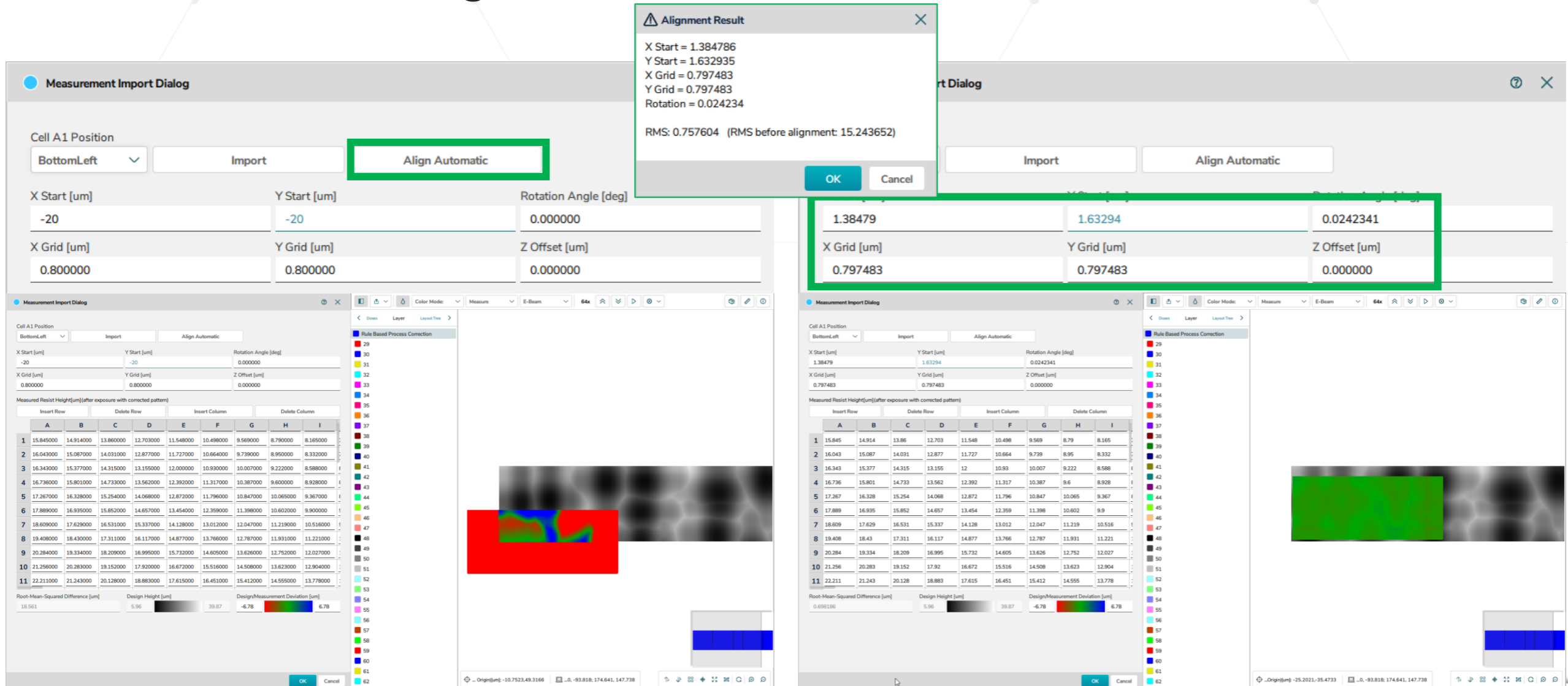
$$\sin \left(\$i\$ * \frac{3.1416}{180} \right)$$

$$7 * \frac{\$i\$}{218}$$



Feedback Loop – automatic alignment

- Imported measurement data can be automatically aligned now to the correction target.



The screenshot displays the GenISys software interface, specifically the Measurement Import Dialog and the Alignment Result dialog.

Measurement Import Dialog (Left):

- Cell A1 Position: BottomLeft
- Buttons: Import, **Align Automatic** (highlighted in green)
- X Start [um]: -20, Y Start [um]: -20, Rotation Angle [deg]: 0.000000
- X Grid [um]: 0.800000, Y Grid [um]: 0.800000, Z Offset [um]: 0.000000

Alignment Result Dialog (Top Center):

- X Start = 1.384786
- Y Start = 1.632935
- X Grid = 0.797483
- Y Grid = 0.797483
- Rotation = 0.024234
- RMS: 0.757604 (RMS before alignment: 15.243652)
- Buttons: OK, Cancel

Measurement Import Dialog (Right):

- Buttons: Import, **Align Automatic** (highlighted in green)
- X Start [um]: 1.38479, Y Start [um]: 1.63294, Rotation Angle [deg]: 0.0242341
- X Grid [um]: 0.797483, Y Grid [um]: 0.797483, Z Offset [um]: 0.000000

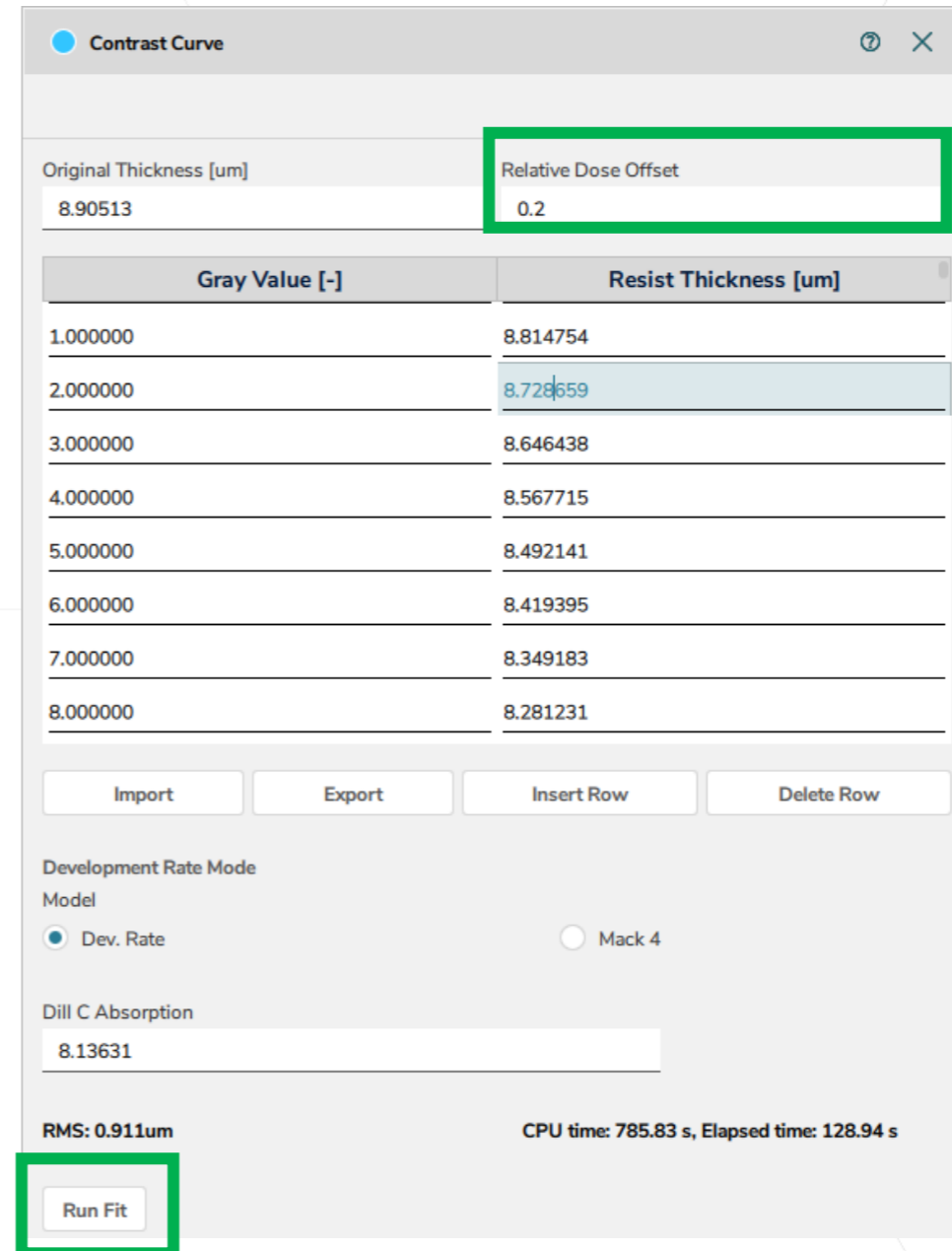
The background shows a measurement grid with a color-coded deviation map and a table of measured resist heights.

Insert Row	Delete Row	Insert Column	Delete Column						
A	B	C	D	E	F	G	H	I	
1	15.845000	14.914000	13.860000	12.703000	11.548000	10.498000	9.569000	8.790000	8.165000
2	16.043000	15.087000	14.031000	12.877000	11.727000	10.664000	9.739000	8.950000	8.332000
3	16.343000	15.377000	14.315000	13.155000	12.000000	10.930000	10.007000	9.222000	8.588000
4	16.736000	15.801000	14.733000	13.562000	12.392000	11.317000	10.387000	9.600000	8.928000
5	17.267000	16.328000	15.254000	14.068000	12.872000	11.796000	10.847000	10.065000	9.367000
6	17.889000	16.935000	15.852000	14.657000	13.454000	12.359000	11.398000	10.602000	9.900000
7	18.609000	17.629000	16.531000	15.337000	14.128000	13.012000	12.047000	11.219000	10.516000
8	19.408000	18.430000	17.311000	16.117000	14.877000	13.766000	12.787000	11.931000	11.221000
9	20.284000	19.334000	18.209000	16.995000	15.732000	14.605000	13.626000	12.752000	12.027000
10	21.256000	20.283000	19.152000	17.920000	16.672000	15.516000	14.508000	13.623000	12.904000
11	22.211000	21.243000	20.128000	18.883000	17.615000	16.451000	15.412000	14.555000	13.778000

Dose Offset in Contrast Curve

The Relative Dose Offset is introduced to consider non-zero exposure dose for Gray value 0.

- The whole gray value range covers the relative exposure dose between relative dose offset and 1.
- The change of relative dose offset affects the contrast curve fitting result. User needs to rerun the fit.
- It offers the full number of gray values in a relevant dose range for finer granularity.



The screenshot shows the 'Contrast Curve' window with the following data and controls:

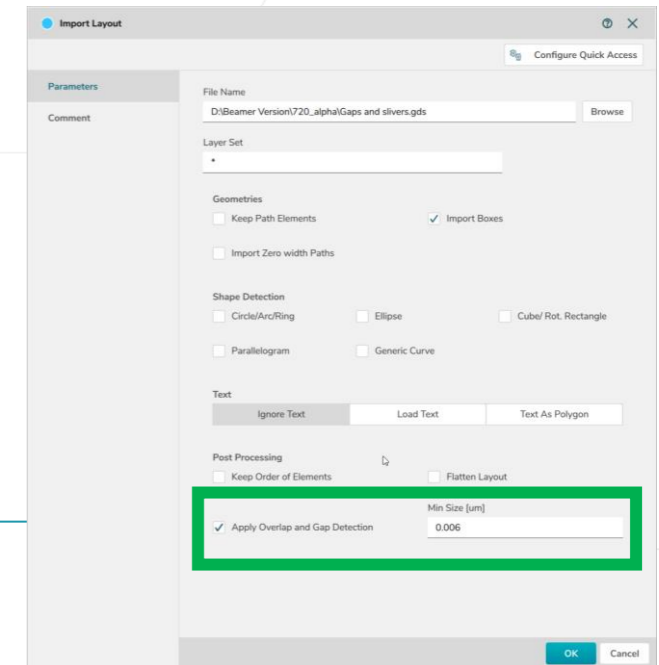
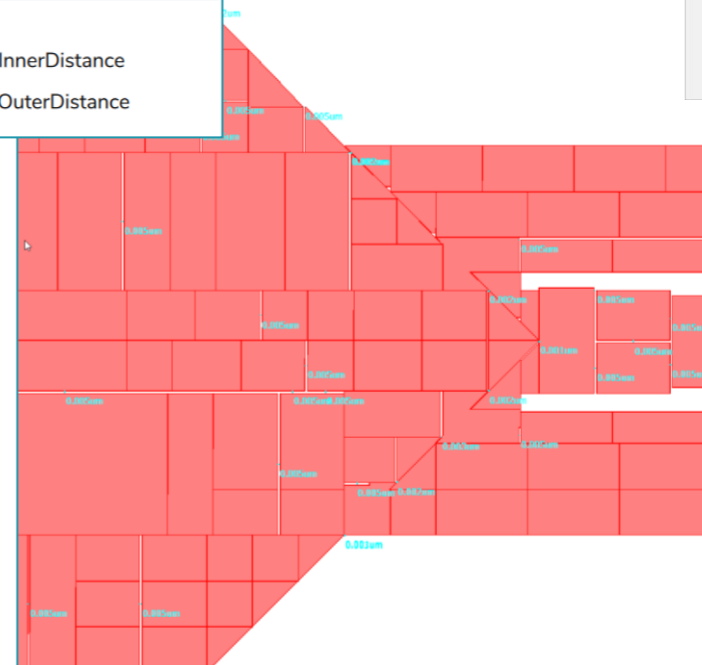
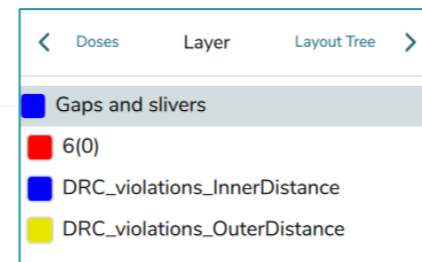
Gray Value [-]	Resist Thickness [um]
1.000000	8.814754
2.000000	8.728659
3.000000	8.646438
4.000000	8.567715
5.000000	8.492141
6.000000	8.419395
7.000000	8.349183
8.000000	8.281231

Other fields and controls:

- Original Thickness [um]: 8.90513
- Relative Dose Offset: 0.2
- Buttons: Import, Export, Insert Row, Delete Row
- Development Rate Mode: Model
- Model: Dev. Rate, Mack 4
- Dill C Absorption: 8.13631
- RMS: 0.911um
- CPU time: 785.83 s, Elapsed time: 128.94 s
- Run Fit button

BEAMER 7.2

“Overlap and Gap Detection” will analyze *GDS and DXF* layouts for small gaps or overlaps. The gaps or overlaps are shown in the Layout VIEWER. This allows the user to detect layout issues at the start of the data preparation, which might negatively influence correction applied to the layout.



- Infrastructure – remove wx libraries completely
- Shape detection in DXF import
- Import: Layout check to identify small gaps / overlaps
- Fields module: Shape sorting within subfield
- Performance improvements: Floating fields / RuleOPC

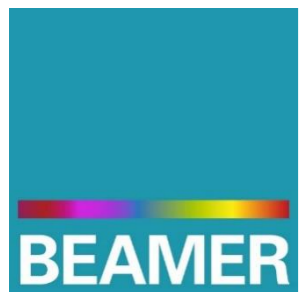


BEAMER 7.2 release June 2024

The image displays two screenshots of the GenISys website. The left screenshot shows the 'Applications' page with a grid of featured topics including 'Advanced exposure technique', 'Fracture Optimization', 'Flexibility', and 'SUSS-MicroOptics Source Mask Optimisation'. The right screenshot shows a 'Webinar Series: Proximity Effect in E-Beam Lithography' page, which includes a 'Webinar Series Summary' and a list of seven parts covering topics like Electron Scattering, Dose PEC, and 3D T-Gate.

Thank You!

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