

Fulcrum: Integrated Graphical User Interface in SCALE

Capability Overview

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Presentation Outline

- Mission Statement
- Component Overview
- Input Editor
- Data Plotting
- Geometry Visualization

Fulcrum Mission Statement

Provide a cross-platform graphical user interface (GUI) designed to facilitate problem creation, modification, navigation, validation, and visualization, as well as output and data file interaction as needed by new and experienced users.



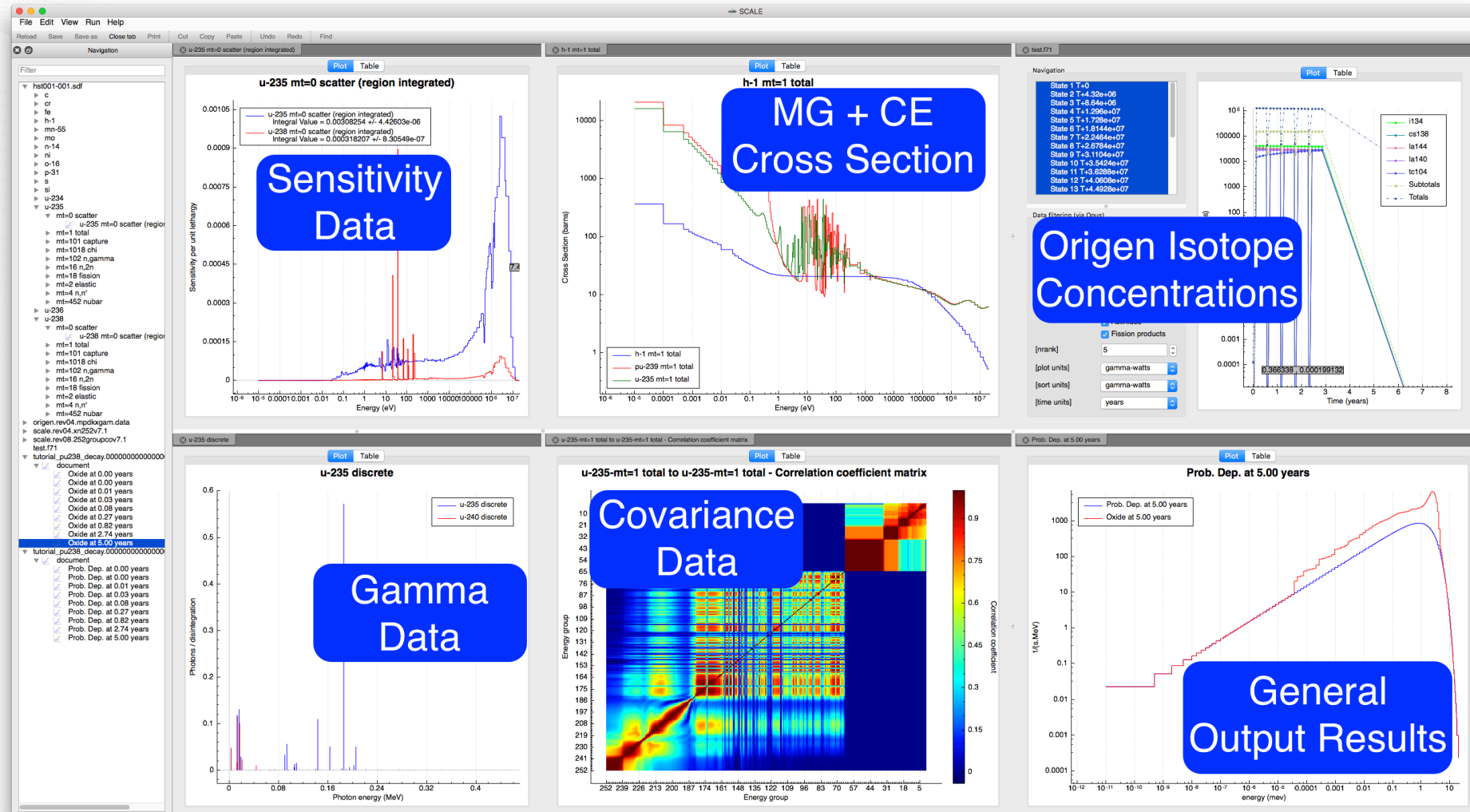
Fulcrum Component Overview

The screenshot displays the TSC-24 software interface, which is used for modeling and simulation. The interface is divided into several main sections:

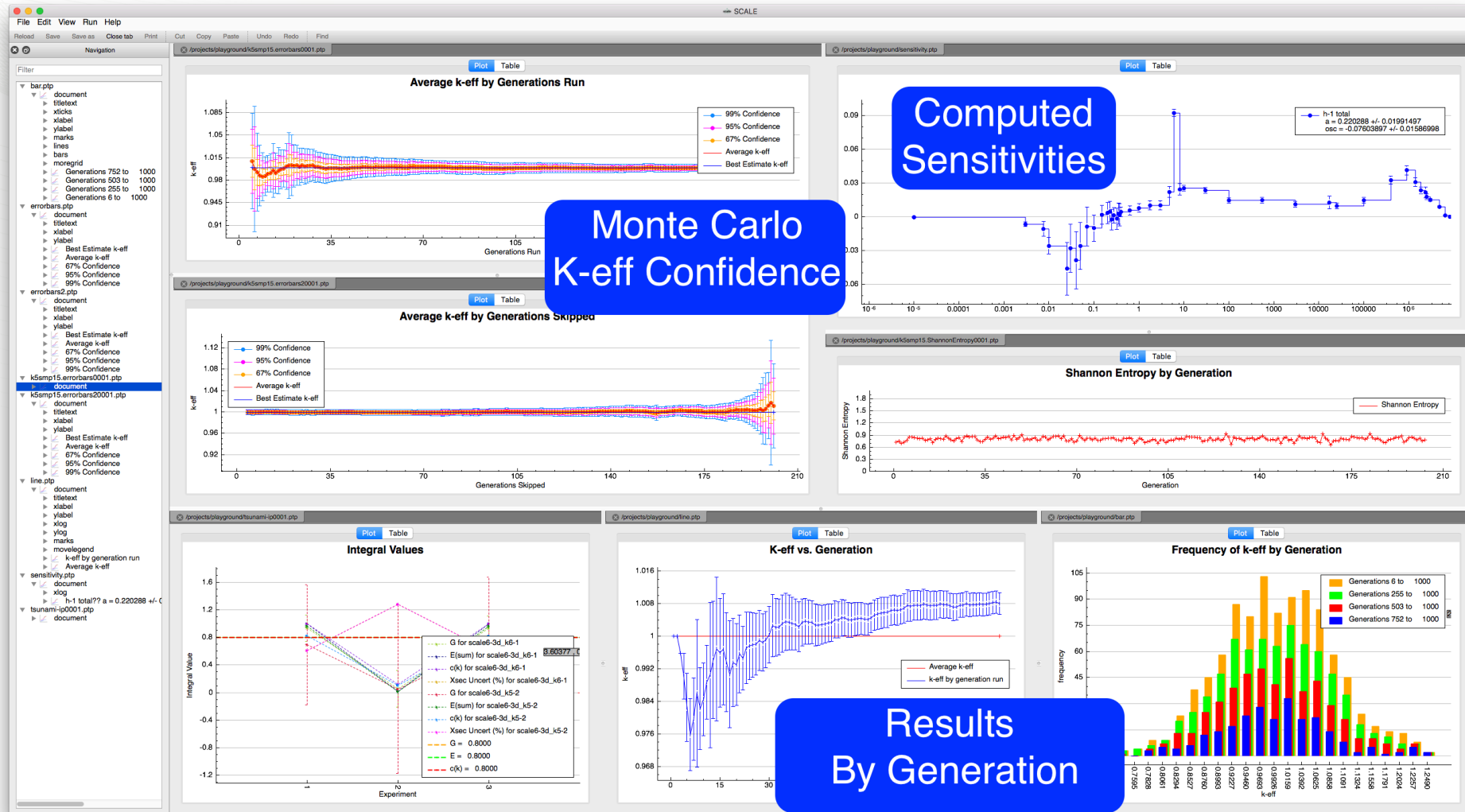
- Document Navigation (Left Panel):** A tree view showing the project structure. The 'geometry' folder is selected, and the 'Response 1' series is highlighted.
- Input Editor (Top Center):** A text editor showing the input file content. The file is named 'TSC-24-TSC-9_bounding_NCTDoseRate_02-02-2004.inp'. The editor shows a list of geometric entities (cylinder, media, boundary, unit) and their associated parameters (x, y, z coordinates, radius, etc.). A blue box labeled 'Input Editor' is overlaid on this section.
- Data Plot (Bottom Center):** A scatter plot titled 'radial axis plot at a=6.1098, b=-1.9435 generated on Thu Jul 28 17:01:33 2016'. The y-axis is labeled 'Responses' and ranges from 0.1 to 100,000. The x-axis is labeled 'radial axis' and ranges from 0 to 320. The plot shows a single data series labeled 'Response 1' with points that decrease in value as the radial axis increases. A blue box labeled 'Data Plot' is overlaid on this section.
- Geometry Viewer (Right Panel):** A 3D visualization of the geometry. The view is titled 'TSC-24-TSC-9_bounding_NCTDoseRate_02-02-2004.inp : geometry (Line 2198)'. The viewer shows a rectangular structure with a central vertical channel. A color scale on the left indicates the response values, ranging from 1.303998724885741e-03 (blue) to 3.282685881252845e+03 (red). A blue box labeled 'Geometry Viewer' is overlaid on this section.

Fulcrum Plot Data

- Supports Most Major SCALE Data Formats
- Export to Image (supports scalar vector graphics)

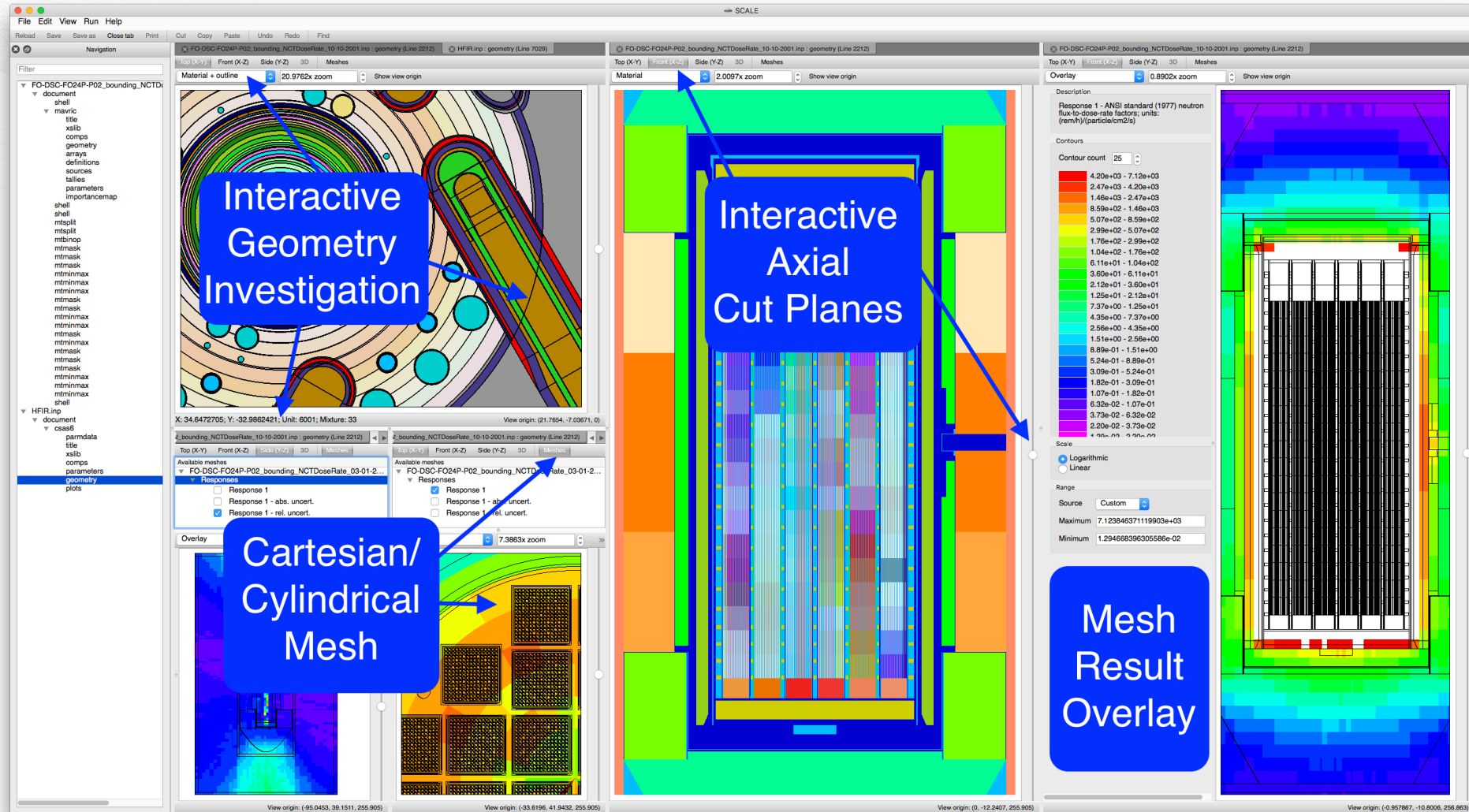


Fulcrum General Output Result Plots



Fulcrum Geometry Visualization

- Interactive Geometry Visualization
- Support for Most Mesh Data*



*Currently Support: 3dmap, Mesh Importance Map, Mesh Source Map, and Denovo Flux File

Component Summary

- Input editor facilitates problem creation, modification, navigation, validation, execution and output file viewing in a consistent, platform independent manner.
- Data plotting facilitates a fast, interactive means of interrogating input and output data.
 - Supports most SCALE data formats.
- Geometry viewer facilitates a fast, interactive means of interrogating SCALE Geometry.
- Fulcrum provides a modular workspace with splitting and drag-and-drop configurable layout.

Fulcrum Input Editor Components

The diagram illustrates the Fulcrum Input Editor Components, showing a central 'Synchronized Input Text Editor' connected to various features:

- Customizable Execution**: A callout pointing to the 'Run' button in the top toolbar.
- Document Quick Navigation**: A callout pointing to the 'View...' button in the top toolbar.
- Context Aware Input Autocompletion**: A callout pointing to the autocompletion list on the left side of the editor.
- Cursor Context**: A callout pointing to the 'unit=1 region=7' text in the right editor window.
- Execution Messages**: A callout pointing to the 'Execution Messages' panel at the bottom right.
- Syntax Highlights**: A callout pointing to the highlighted text in the right editor window.
- Input Block Highlights**: A callout pointing to the highlighted text in the right editor window.
- Input Validation**: A callout pointing to the 'Validation' panel at the bottom left.

The central 'Synchronized Input Text Editor' is shown in two windows, 'mavric.aos100.inp' and 'mavric.aos100.inp', displaying code snippets and execution results.

Left Window (mavric.aos100.inp):

```
34 global unit 1
35 cylinder 1 8.255 25.40 -25.40
36 cylinder 2 10.795 27.94 -27.94
37 cylinder 3 20.955 27.94 -27.94
38 cylinder 4 13.335 40.64 30.48
39 cylinder 5 13.335 -30.48 -40.64
40 cylinder 6 35.56 45.72 -45.72
41
42 cone - kenovi (configurable) 2.4 -152.4
43 cone
44 cone
45 cone
46 cone
47 cone
48 cone
49 cone
50 cone
51 cone
52 cone
53 end geom
54 dodecahedron - kenovi (configurable)
55 dodecahedron
56 ellipsoid - kenovi (configurable)
57 ellipsoid
58 hexprism - kenovi (configurable)
59 hexprism
60 hopper - kenovi (configurable)
61 hopper
62 parallelepiped - kenovi (configurable)
63 parallelepiped
64 pentagon - kenovi (configurable)
65 pentagon
66 plane - kenovi (configurable)
67 plane
68 xplane - kenovi (configurable)
69 xplane
70 yplane - kenovi (configurable)
71 yplane
72 quadratic - kenovi (configurable)
73 quadratic
74 rhomboid - kenovi (configurable)
75 rhomboid
76 ring - kenovi (configurable)
77 ring
78 sphere - kenovi (configurable)
79 sphere
80 end geometry
```

Right Window (mavric.aos100.inp):

```
114 meshTally 1
115 photon
116 gridGeometryID=8
117 responseID=5
118 unit=1 region=7
119 energyBoundsID=1
120 end meshTally
121
122 multiplier=1000.0
123 end tallies
124
```

Execution Messages:

```
43
44
45
46 MAVRIC, part 2, writing the forward discrete ordinates input
47 *****
48
49 constructMacroMaterialRAYS (46 x-bins, 46 y-bins)
50
51 Total numMacros: 23
```

Syntax Highlights:

```
89 linear 30 0.00e6 1.50e6
90 bounds 0.510e+6 0.512e+6 1.172e6 1.174e6 1.331e6 1.333e6 end
91 end energyBounds
92 end definitions
93
94 'Sources Block
95 'Sources Block
96 'Sources Block
97 read sources
98 src 1
99 title="One Cl of cobalt-60"
100 useNormConst
101 multiplier=37e9
102 cylinder 8.255 25.40 -25.40
103 photons
104 eDistributionID=1
105 end src
106 end sources
107
108 'Tallies Block
109 'Tallies Block
110 'only collect mesh tally information outside the package (in air region)
111 'multiplier converts responses from rem/hr to mrem/hr
112 'Tallies Block
113 read tallies
114 meshTally 1
115 photon
116 gridGeometryID=8
117 responseID=5
118 unit=1 region=7
119 energyBoundsID=1
```

Input Validation:

```
Line: 49 column: 22 - Validation Error: region value "30" does not exist in set: [ ... ] /cone/id
.../cube/id
.../cylinder/id
.../dodecahedron/id
.../ellipsoid/id
.../hexprism/id
.../hopper/id
.../parallelepiped/id
.../pentagon/id
.../plane/id
.../quadratic/id
.../rhomboid/id
.../ring/id
.../sphere/id
.../wedge/id
.../cylinder/id
```

Input Autocompletion : Static Text

- Static text autocompetition also facilitates abbreviated input to include the component's description allowing users to discover and/or more quickly recall the necessary input components for their analysis.
- Cursor context allows the autocompletion popup to show what is legal and has not already been specified.

Access Autocomplete via
* CTRL+SPACE Keys, or,
* Edit...>Autocomplete

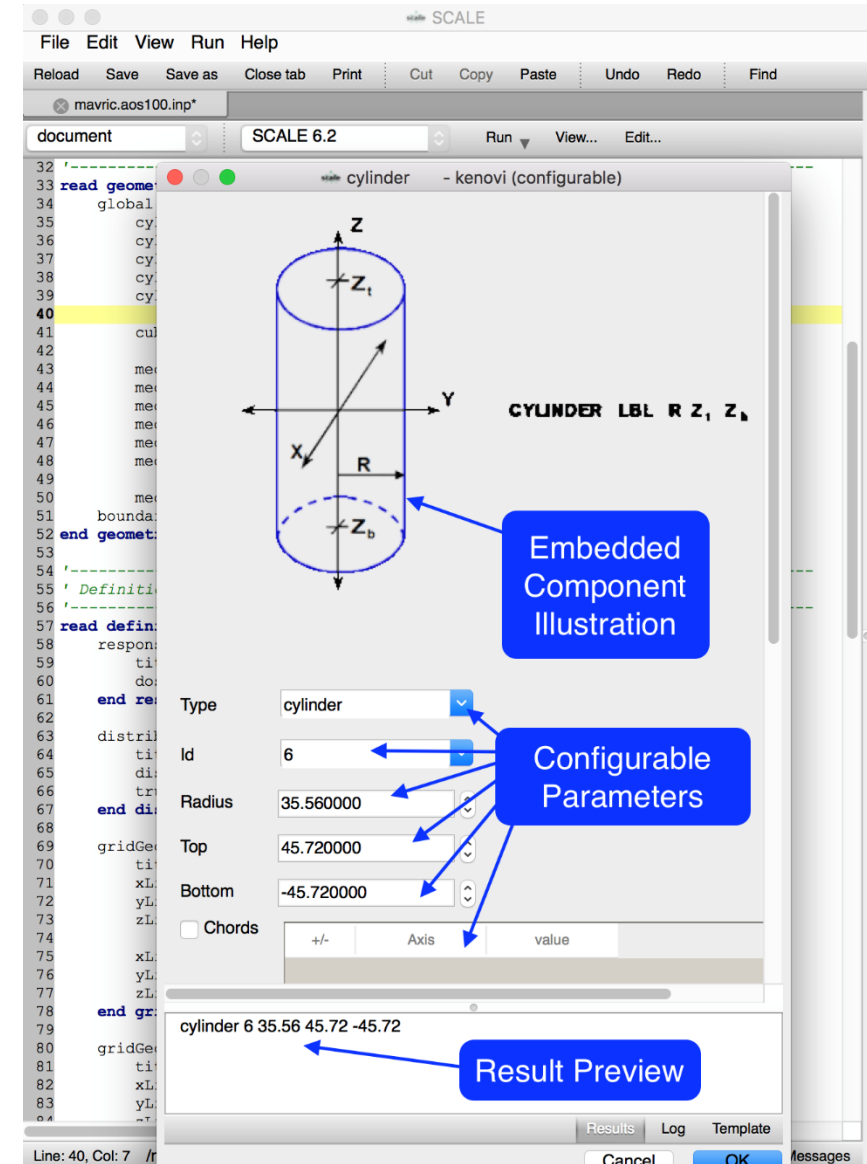
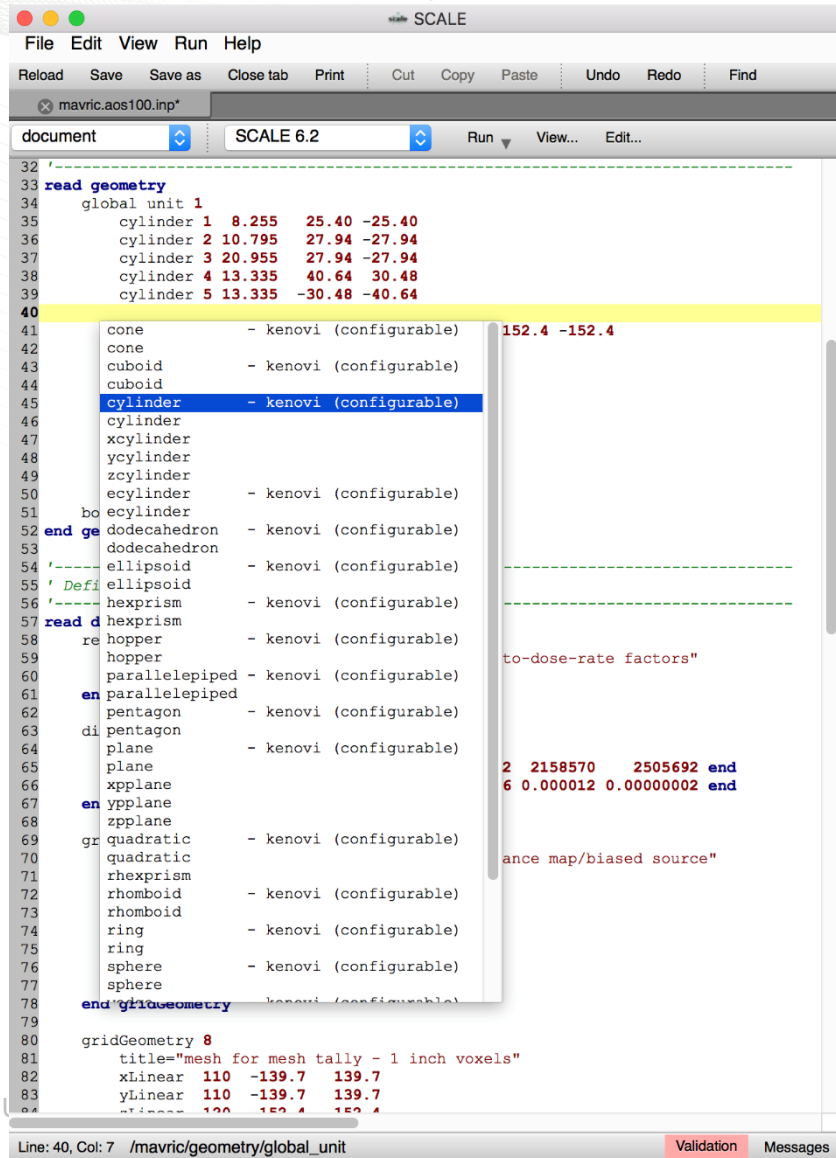
The screenshot shows the SCALE 6.2 software interface. The main window displays a list of parameters and their descriptions. The parameters are listed in a table-like format with columns for the parameter name, its value, and its description. The descriptions are abbreviated and often start with a hyphen. A blue box is overlaid on the bottom right of the screenshot, containing the text "Parameters with descriptions".

Parameter	Value	Description
uranium	10 den=18.76 1 293 92235 93.2 92238 5.6 92234 1.0 92236 0.2 end	
uranium	11 den=18.76 1 293 92235 93.2 92238 5.6 92234 1.0 92236 0.2 end	
uranium	12 den=18.76 1 293 92235 93.2 92238 5.6 92234 1.0 92236 0.2 end	
uranium	13 den=18.76 1 293 92235 93.2 92238 5.6 92234 1.0 92236 0.2 end	
uranium	14 den=18.76 1 293 92235 93.2 92238 5.6 92234 1.0 92236 0.2 end	
end comp		
read param		
pgm=yes plt=yes		
end param		
read geom		
global unit 1		- random number
*** one through t		- execution time (min)
'one top piece		- batch time (min)
cuboid 10 2p6.3 wtl		- average weight
'two middle pie		- wt. for splitting
cuboid 20 2p6.3 msh		- russian roulette wt.
'three bottom pie		- deviation limit
cuboid 30 4p6.3 dbh		- size of flux mesh
*** four is item		- ce temperature tol.
cylinder 40 4.55 gen		- upper dbrc energy cutoff
*** five is item		- lower dbrc energy cutoff
cylinder 50 5.76 nsk		- no. of generations
*** six is item 4		- no. per generation
cylinder 60 4.55 nbk		- generations skipped
*** seven and eig		- gens. between restart
'seven		- neutron bank positions
cuboid 70 2p3. xfb		- extra bank entries
'eight		- fission bank positions
cylinder 80 4.57 beg		- extra bank entries
*** nine is item		- no. of extra l-das
cylinder 90 4.55 nl8		- restart at this gen.
*** ten is item 7		- blocks for d.a. unit
cylinder 100 5.7 ngp		- length of d.a. block
*** eleven is ite		- quadrature order for angular fluxes moments
cylinder 110 4.5 cxm		- number of energy groups for tallying
'*12 through 14 is		- order of flux moments
'twelve		- reaction rate tallying mode
cylinder 120 5.7 fno		- continuous energy directory file
'thirteen		- output restart file identifier
cuboid 130 4p6.3 dbx		- input restart file identifier
'fourteen		- use dbrc for scattering
sphere 140 6. flx		- doppler broadening method
*** fifteen is th		- append restart data
'fifteen		- collect and print
cuboid 150 4p2 ptb		- fission densities
media 1 1 +10		- adjoint calculation
media 2 1 +20 -10		- use probability tables
media 3		
media 4		
media 5		
media 6		
media 7		
media 8		
media 9		
media 10		
media 11		
media 12		
media 13		
media 14		
media 0 1		

Input Autocompletion : Configurable Text

- Allows user to configure values prior to inserting into input.

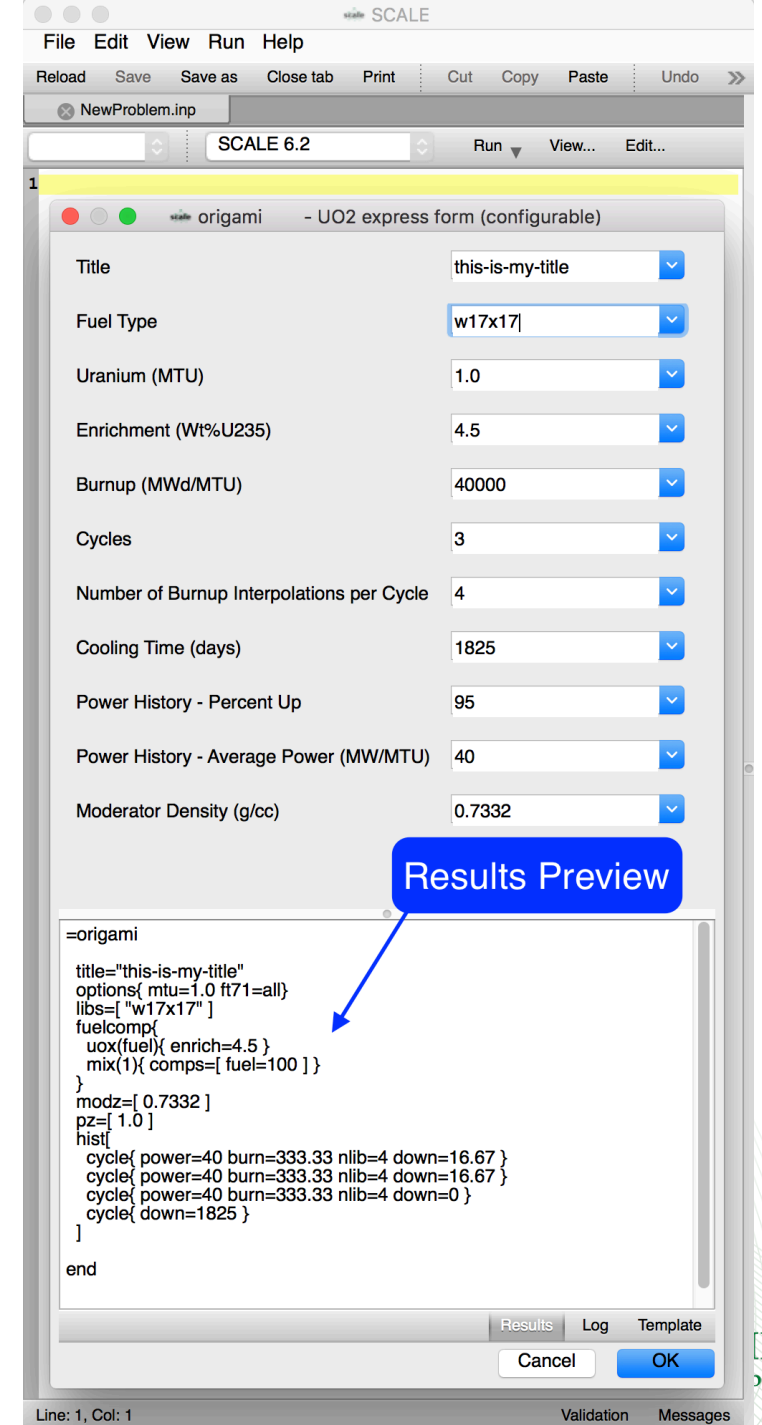
Access Autocomplete via
* CTRL+SPACE Keys, or,
* Edit...>Autocomplete



Input Autocompletion : Configurable Text

- Configurable autocompletion allows entire input creation.
- Results preview facilitates learning input syntax.
- Attributes can be labeled even when the actual input attribute may not have a label.
- Attributes can have a drop-down listing the available or common values to specify.

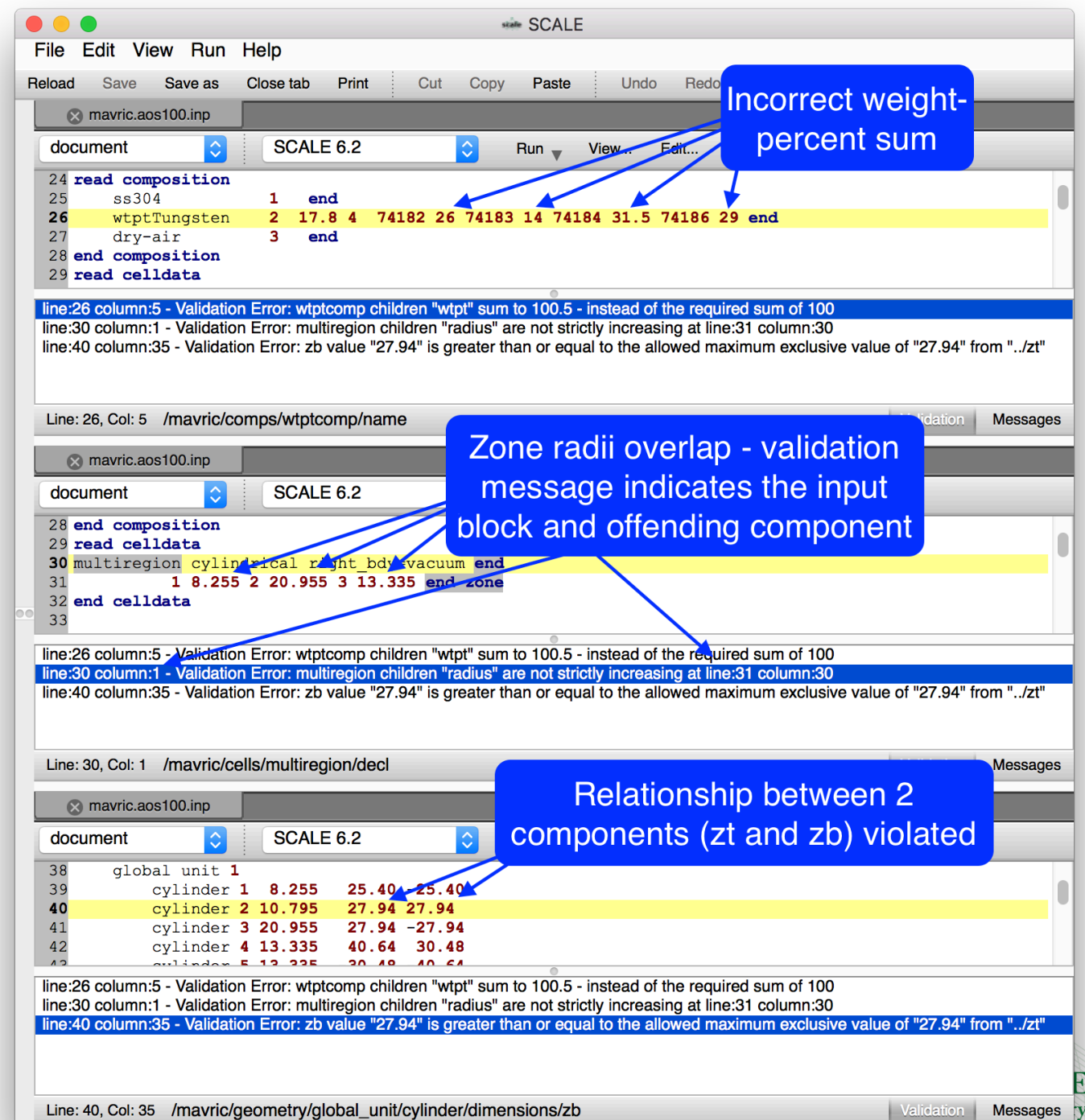
Access Autocomplete via
* CTRL+SPACE Keys, or,
* Edit...>Autocomplete



Input Validation : Value Errors

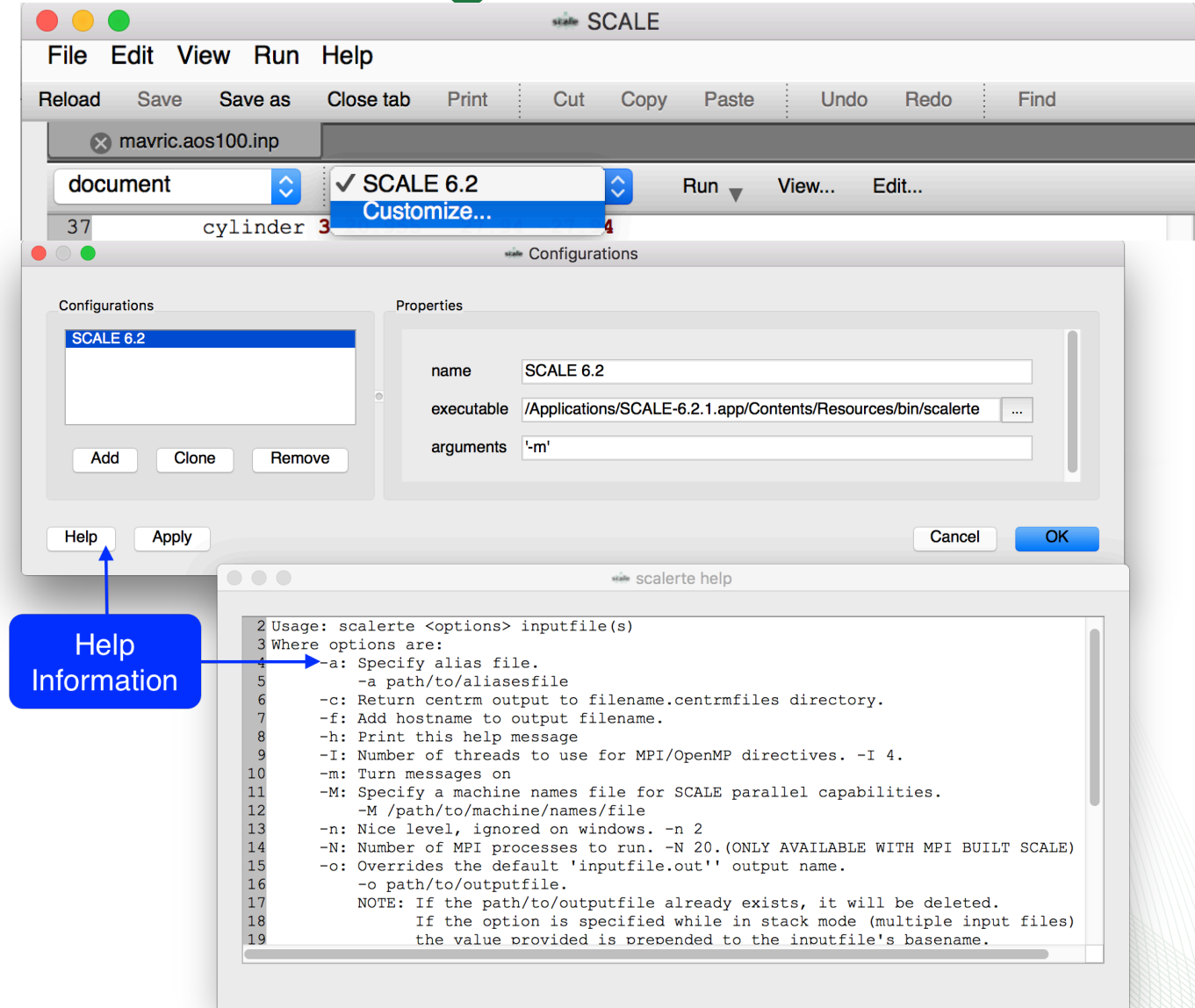
Value constraint errors can be hard to find. Input validation provides immediate feedback on the following.

- Simple value ranges
 - E.g., $0.0 < x \leq 100$
- More complex
 - Expected value sums
 - Expected value function (increasing, decreasing, etc.)
 - Component relationship
 - E.g., $X > Y$



Input Execution : Customized Configurations

- Add new
- Clone existing
- Remove existing
- Modify existing
- Show executable help
- Provide additional arguments



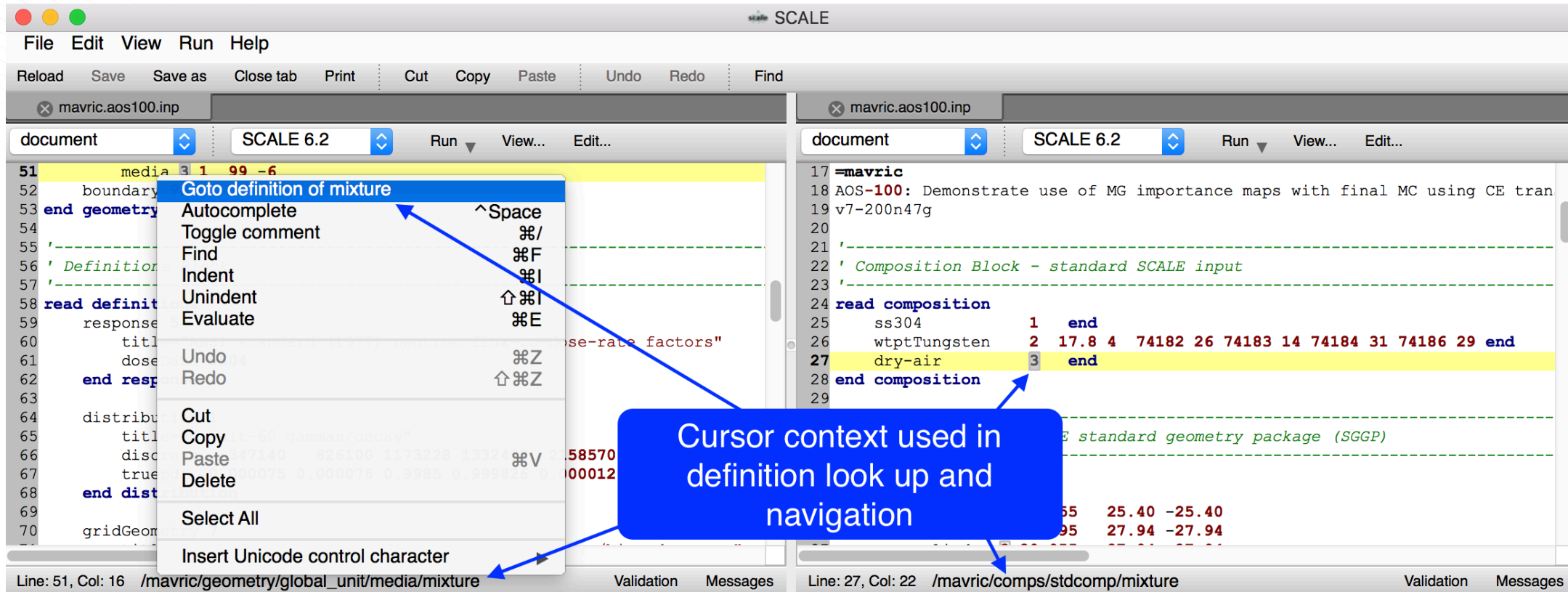
Miscellaneous Features

- Column select/edit
 - via ALT+left click+mouse drag key and mouse combo
- Go to definition – allows quick navigation to input components definition via a right click popup context menu.
 - E.g., anywhere an identifier is used to reference another input component.
- Math evaluator
 - Ability to evaluate selected text as a math expression – replaces selection with expression's result.
- Comment toggle
 - Ability to comment/uncomment selected lines
- Indent/unindent
 - Ability to indent/unindent selected lines
- Auto saves – automatic backup to *inputname.fulcrum.autosave*.
 - File exists only while there are unsaved document changes

Miscellaneous : Go To Definition

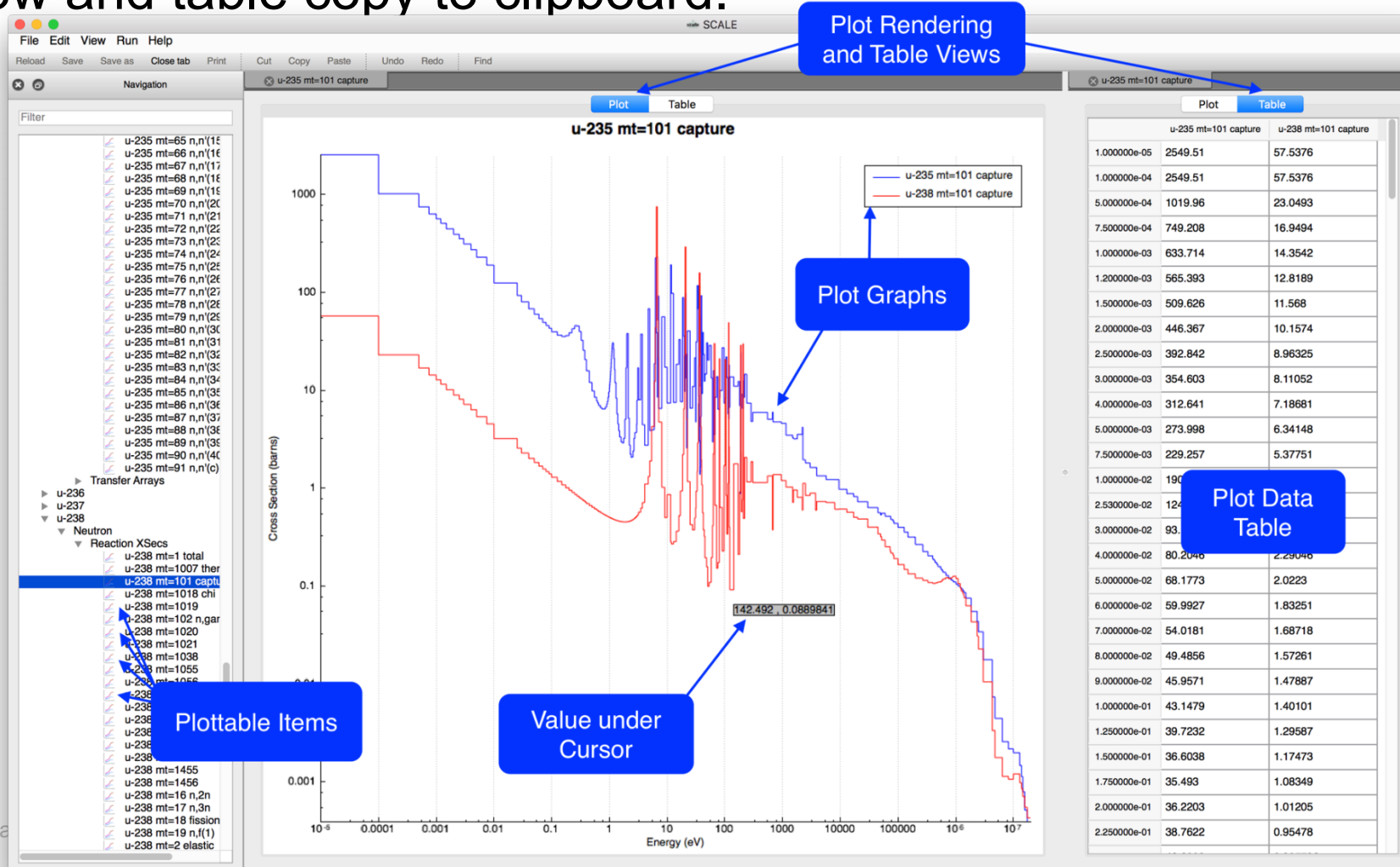
The 'Go To Definition' feature (available via right clicking an input component) is intended to facilitate the user in quickly navigating to the component being referenced. New users can discover input component relationships. Experienced users can have their navigation accelerated, especially in larger inputs.

- Referenced mixture identifier – goes to the mixture's definition.
- Referenced Geometry unit identifiers (holes) – goes to the unit definition.



General Plot Overview

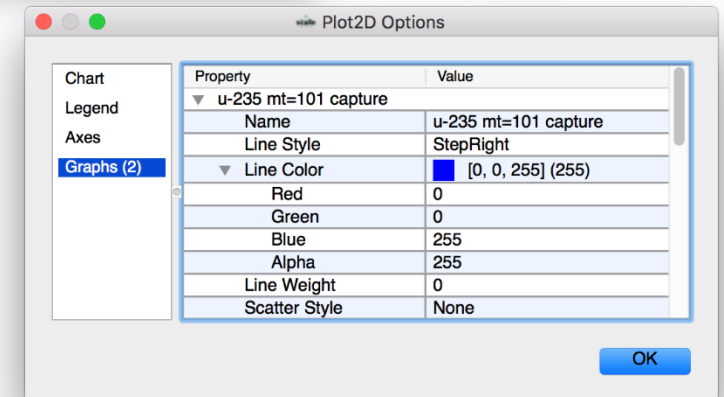
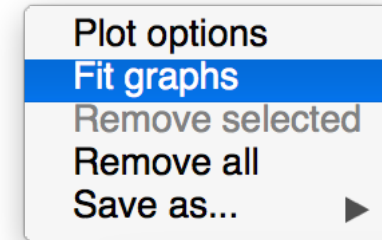
- Interactive and configurable plot rendering
- Plot data table displays graph data.
 - allows row and table copy to clipboard.



Plot Controls

Fulcrum plots consist of graph, bars, or color maps, which can be manipulated as follows.

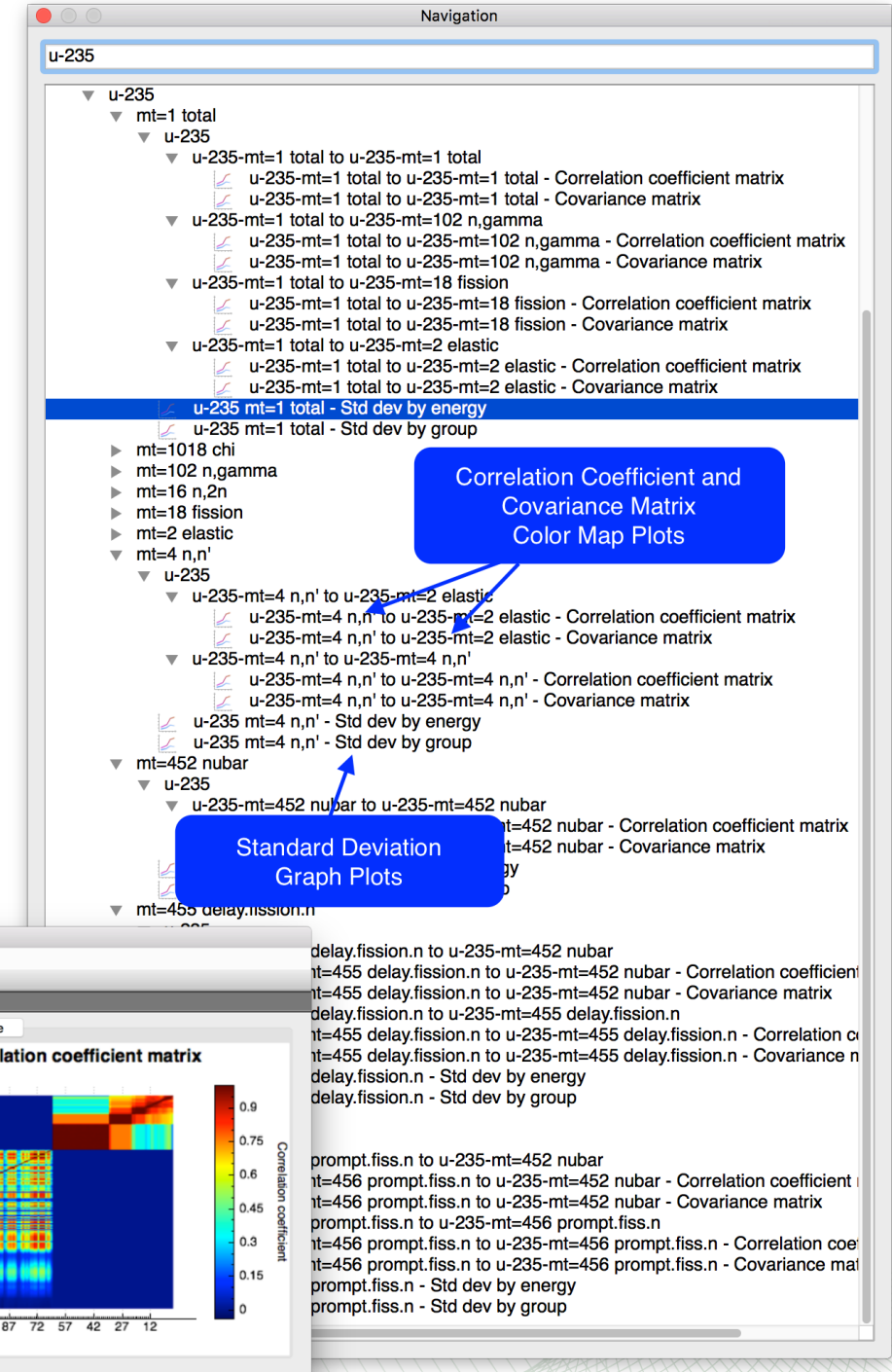
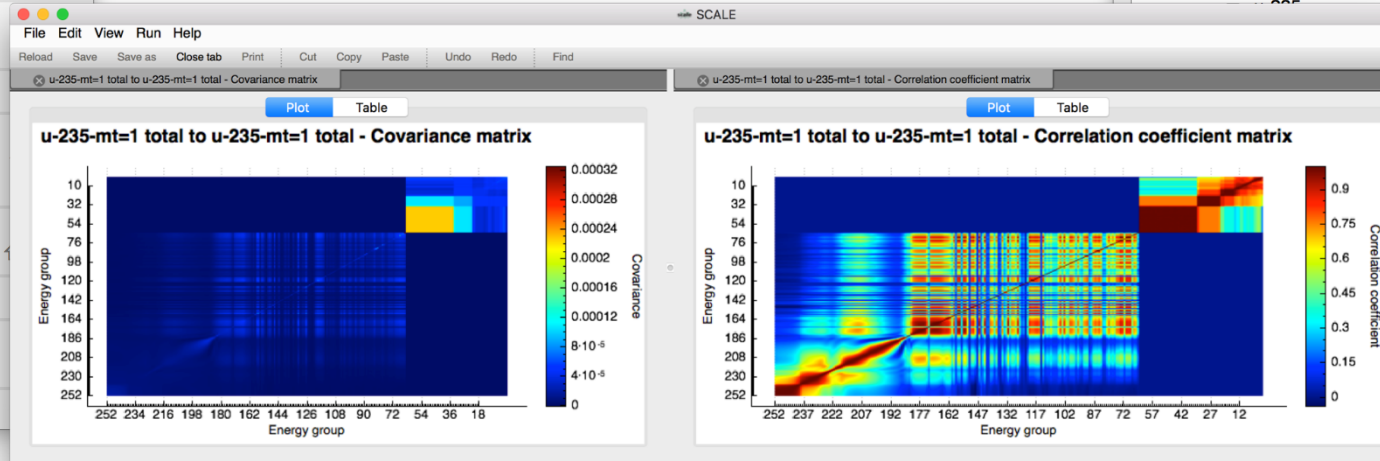
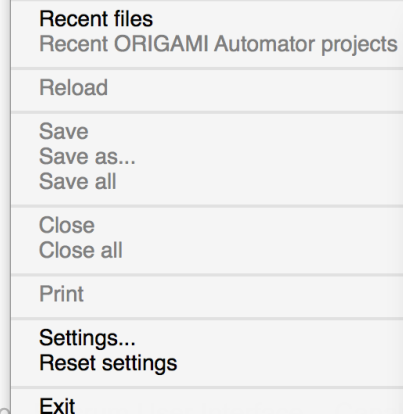
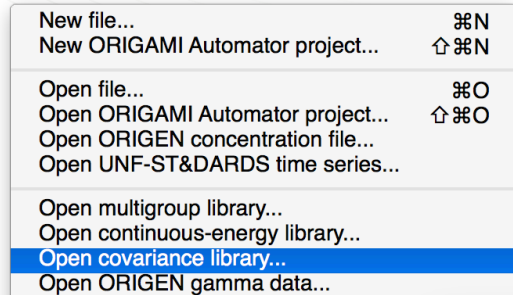
- Select graph via left click in plot or legend.
 - Remove selection via context menu 'Remove selected'
- Zooming is performed via the mouse scroll action.
 - Zoom in by scrolling up.
 - Zoom out by scrolling down.
- Reset to original via context menu Fit graphs.
- Panning is performed via a click and drag.
 - Pan right by left clicking and dragging left.
 - Pan up by left clicking and dragging down.
- Save Plot as
 - **PDF (includes scalable vector graphics - SVG),**
 - PNG and JPG image format
 - **Interactive Scale Plot Format (SPF)**
- Plot attributes (color, style, etc.) can be changed via context menu Plot options.
- Plot Legend can be drug to 9 cardinal positions via left-click and drag.



Covariance Data

Covariance Data is available at SCALE/data. Because the files do not have a unique extension, the user must load them specifically by type.

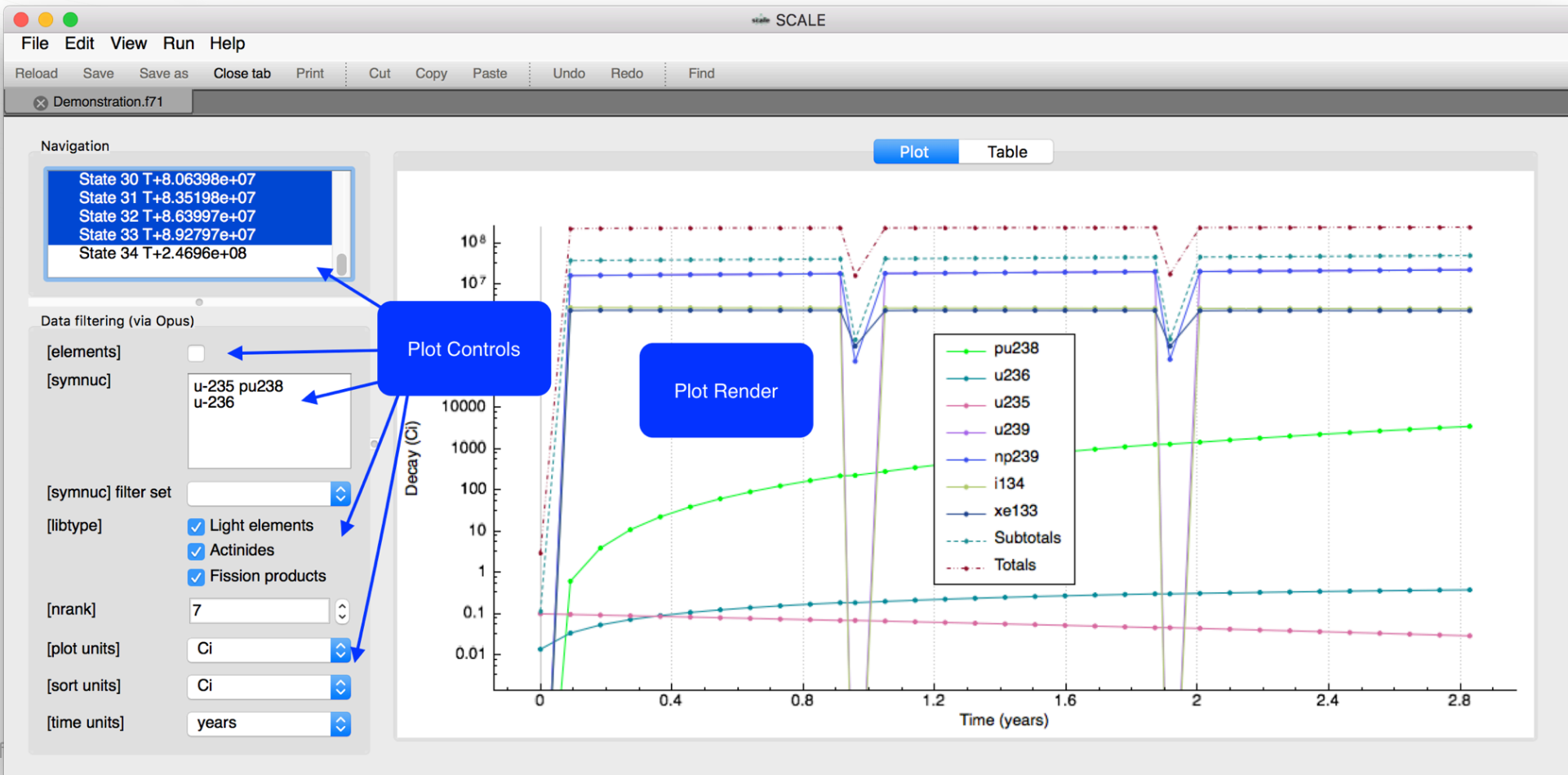
- Correlation coefficient matrix color map plots
- Covariance matrix color map plots
- Isotope Reaction Standard Deviation by energy or group graph plots



ORIGEN Isotope Concentration Data (F71)

Origen concentration data contains results from depletion, decay, and activation calculations. The plot capabilities are centered about the expected Fulcrum interactive plot with the addition of a more familiar PlotOPUS style set of controls.

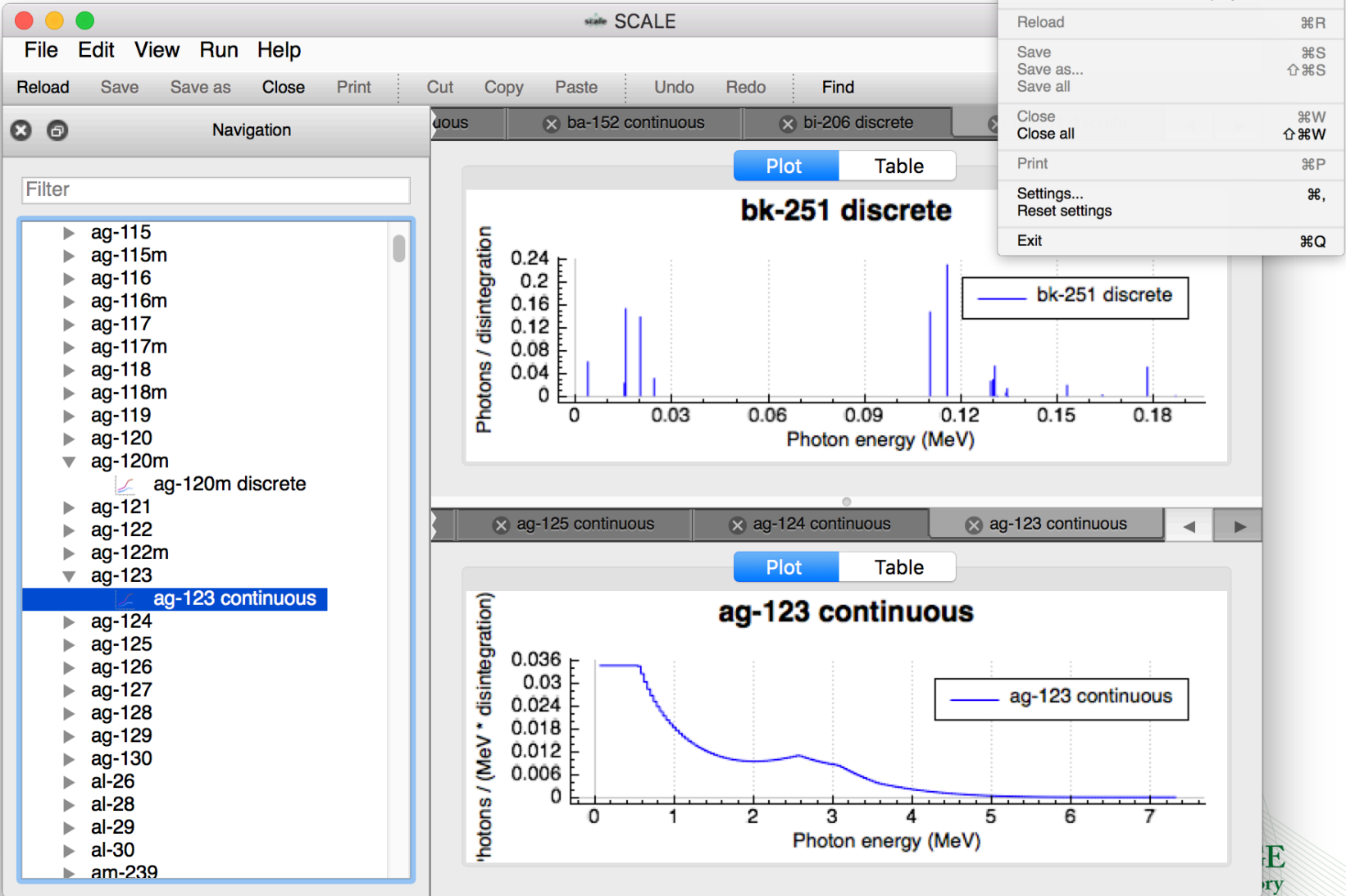
- Easy selection of state information to display.
- Easy display of nuclides or elements by id or category.
- Easily display different units (Decay, Mass, Number).



ORIGEN Gamma Data

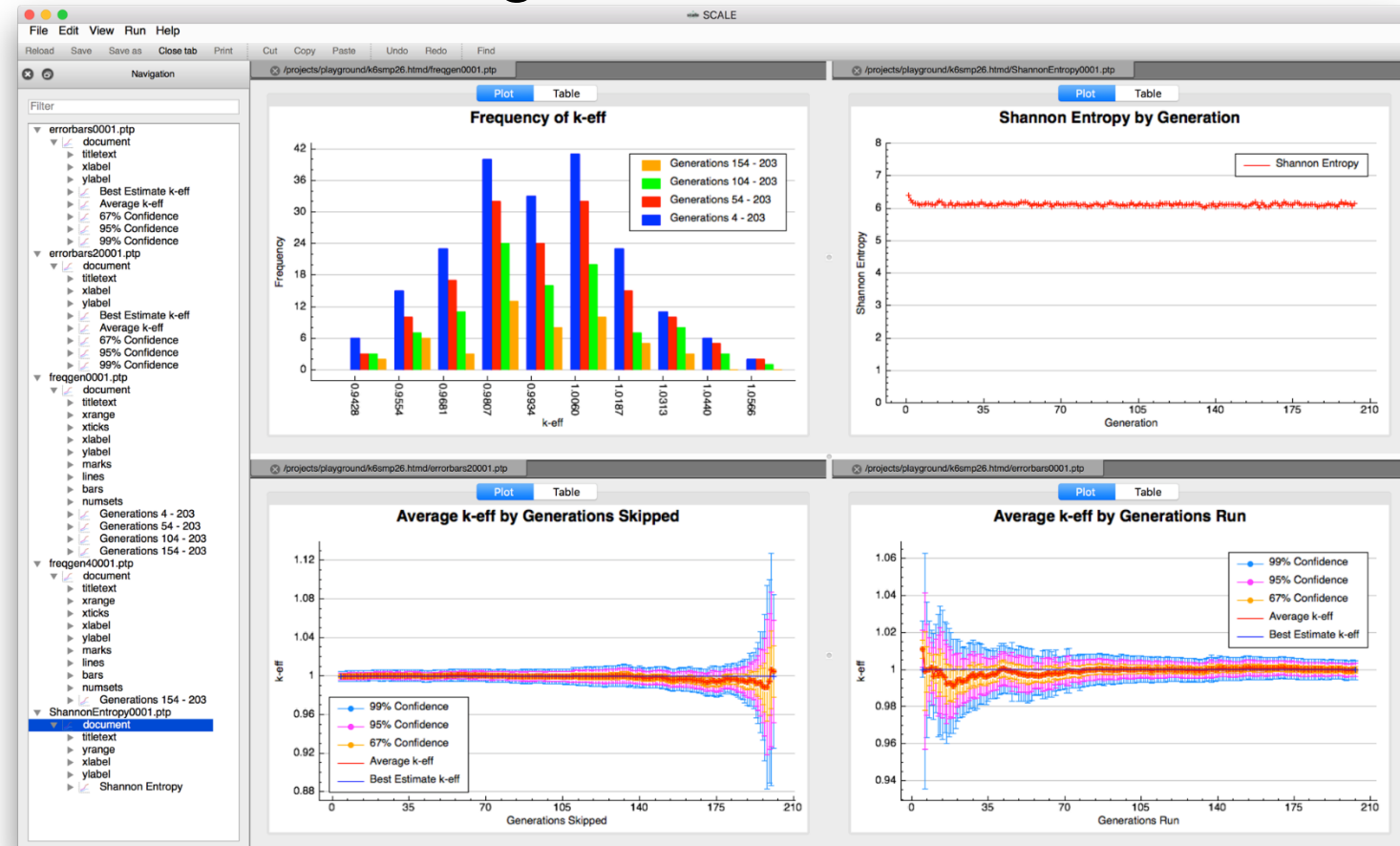
The master photon data library, located at SCALE/data/origen_data/origen.rev##.mpdkxgam.data, provides both discrete and continuous energy gamma lines.

- Opened via File>Open ORIGEN gamma data...



Keno Result Plots

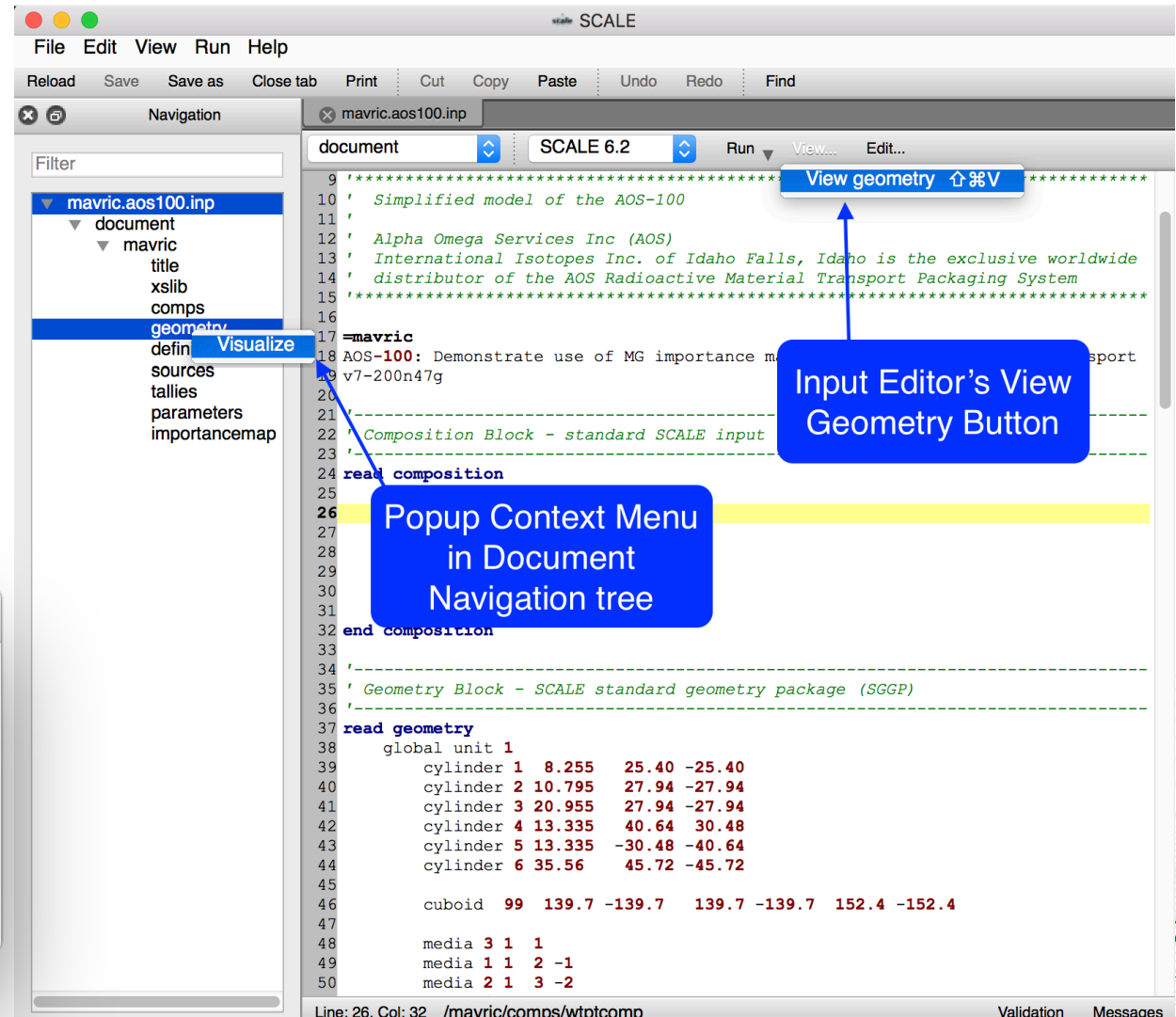
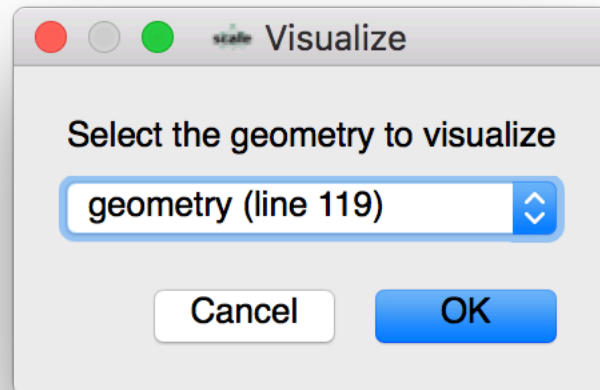
- Plot of average k-effective by generation run
- Plot of average k-effective by generations skipped
- Final edit of fissions, absorptions, and leakage
- Frequency distributions
- Shannon Entropy
- Flux plotting



Activating the Geometry Viewer

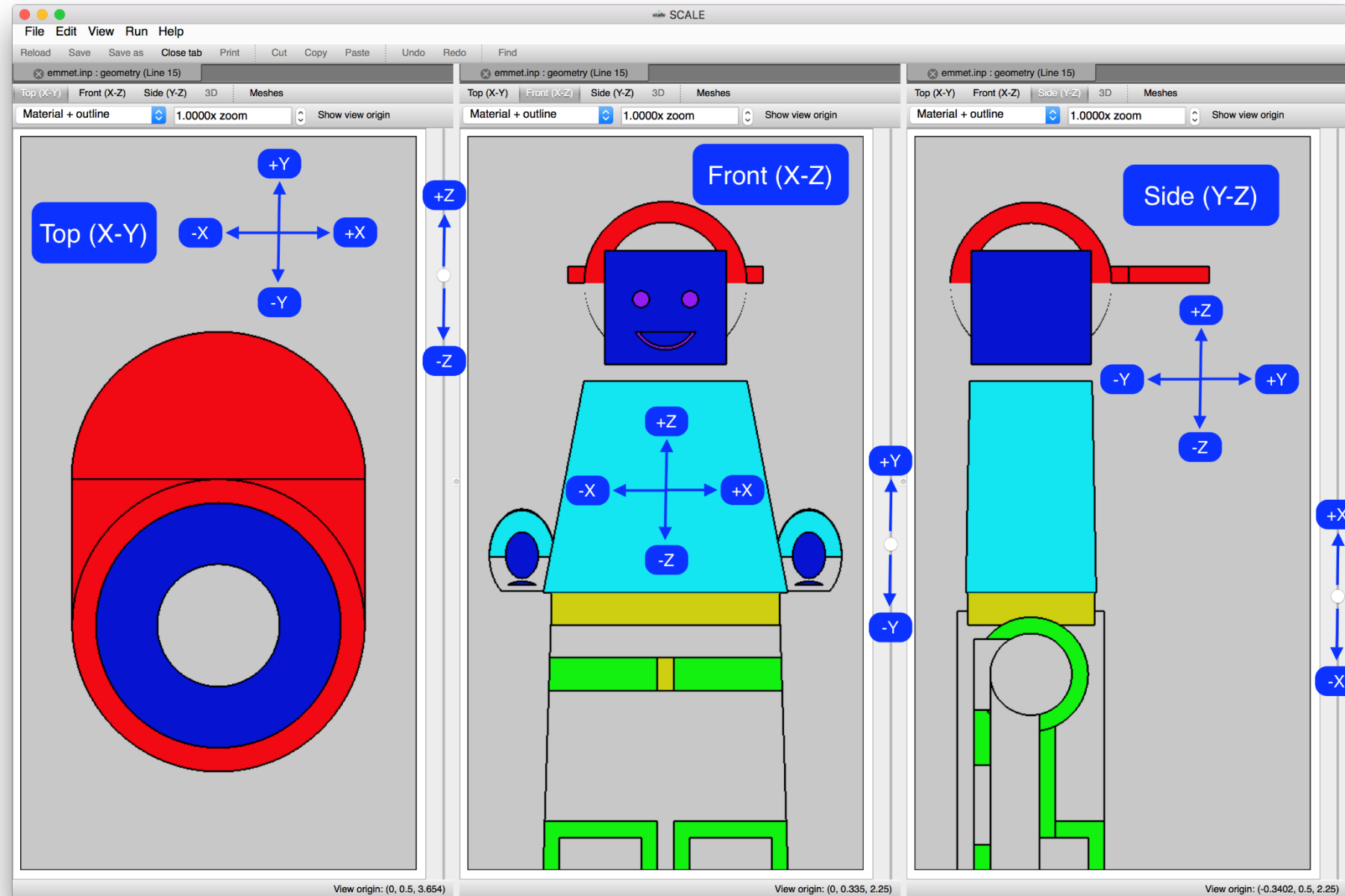
Activating the geometry viewer can be accomplished via the Input Editor's View...>View geometry button or the Document Navigation geometry item's popup context menu.

- If multiple geometry input blocks exist in the document, a selection will be provided.



Axis Views

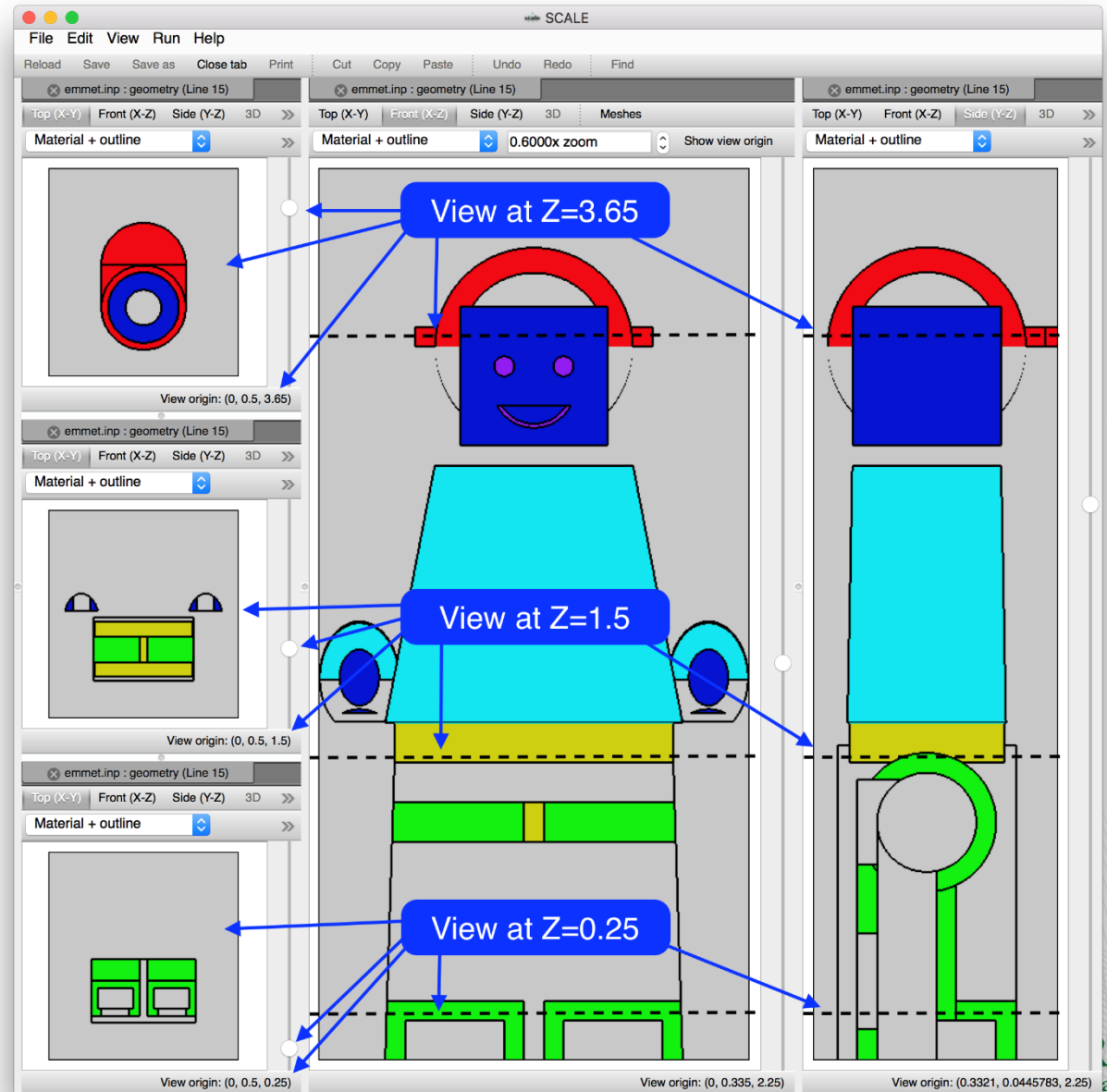
- Axis views provide standard orthographic model projections of the top, front, and side of the geometry.



Axis Views : Elevation Control

View plane elevation is controlled via a slide control on the right side of each geometry view.

- View plane elevation corresponds to view plane control – the higher the slider control, the higher the view plane.
 - Top (X-Y) - raising the slider increases the Z intersect.
 - Front (X-Z) – raising the slider increases the Y intersect.
 - Side (Y-Z) – raising the slider increases the Z intersect.

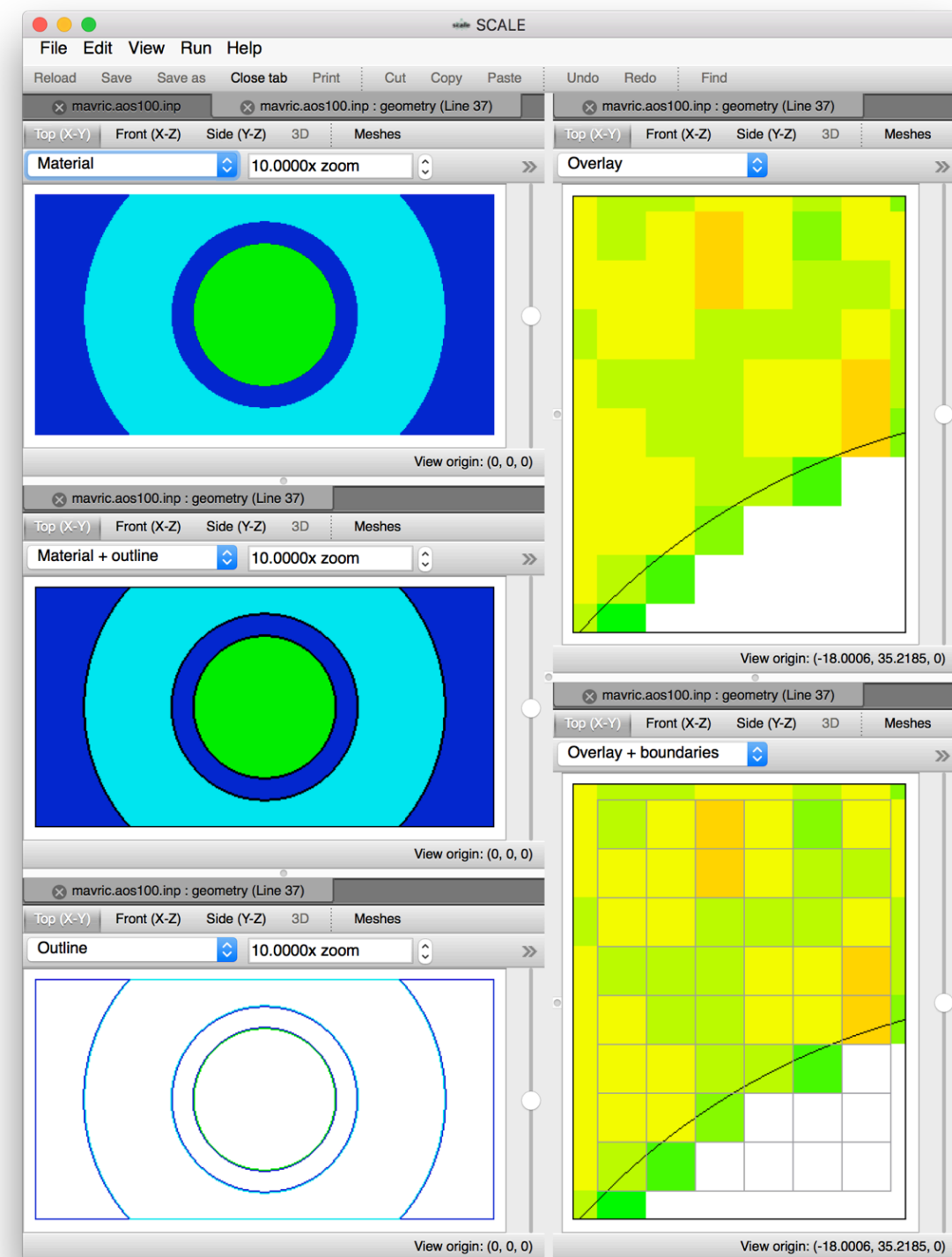


- ✓ Material
- Material + outline
- Outline
- Overlay
- Overlay + boundaries

Render Modes

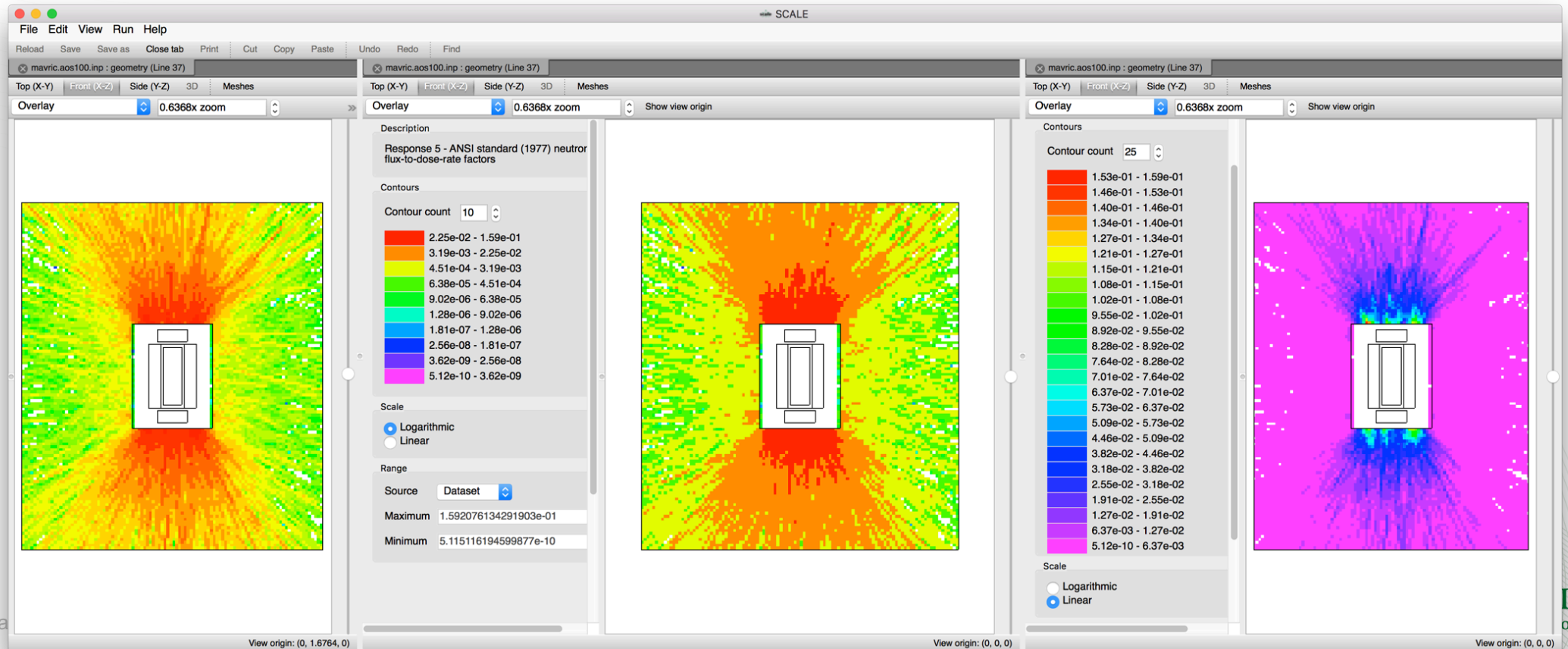
Render modes control the information displayed.

- Material displays only the materials/mixtures.
 - Can hide geometry region outlines that are the same material.
- Material + outline displays the material and the region outlines.
 - Displays region outline in black.
 - Useful for contrasting geometry regions.
- Outline displays only geometry region outlines.
 - Displays region outline in material color.
- Overlay displays geometry region outline and mesh data results.
- Overlay + boundaries displays geometry region outline, mesh boundaries*, and mesh data results



Mesh Contours, Color Legend, and Scale

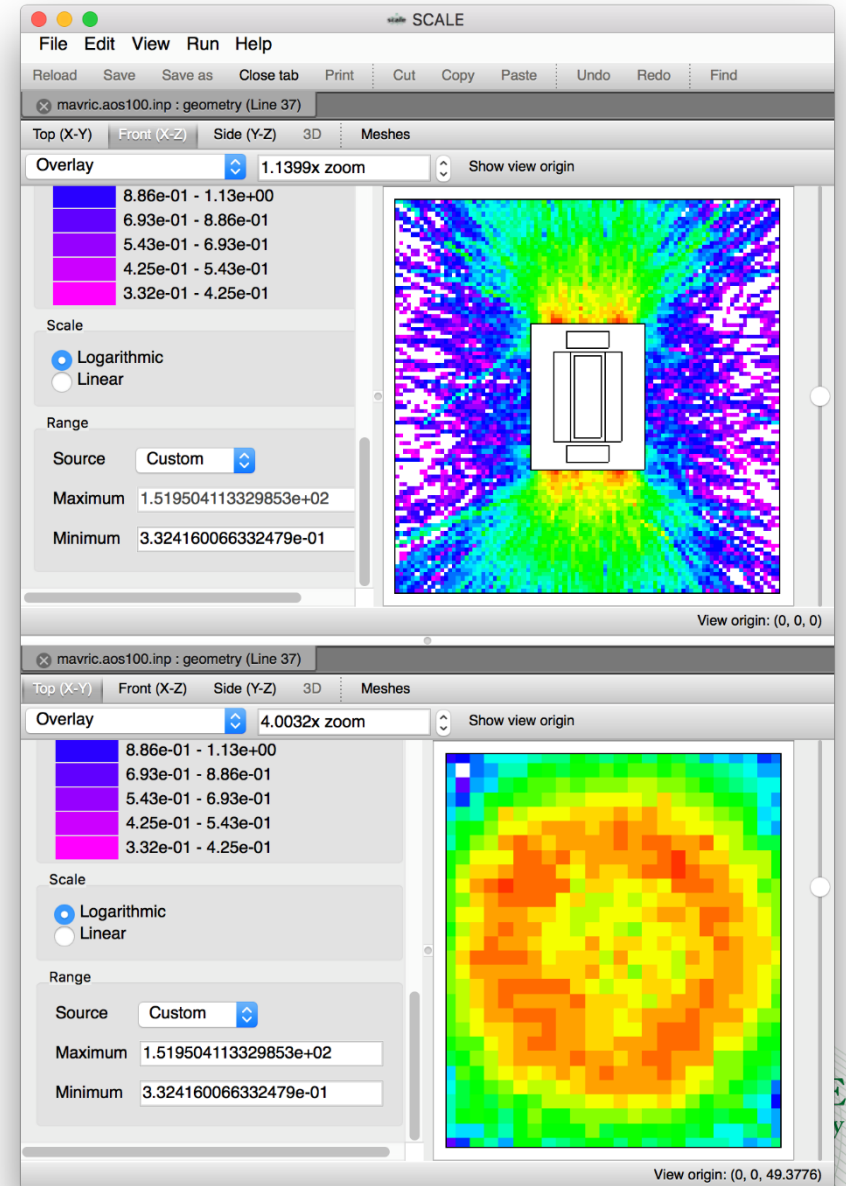
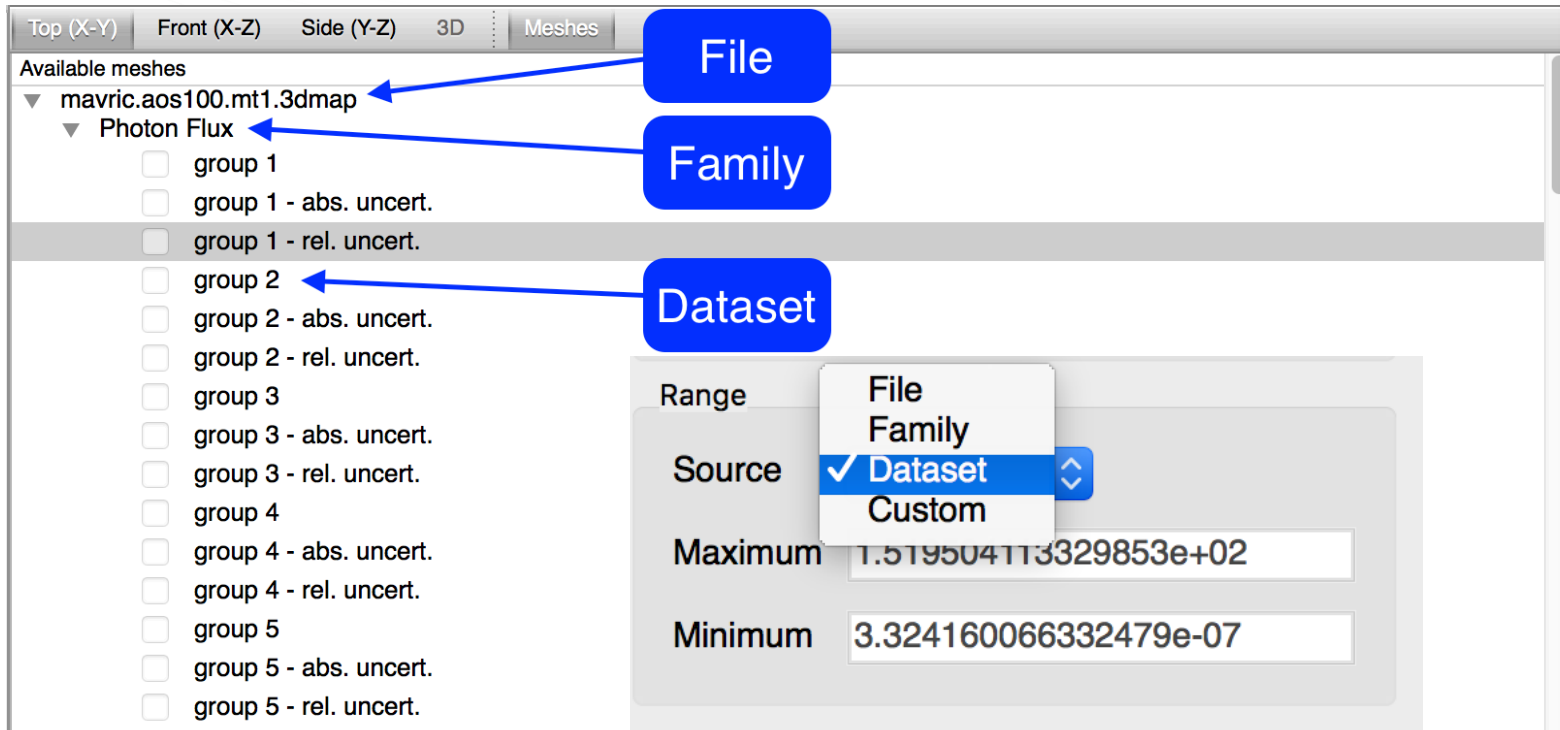
- Controls influenced by MAVRIC's MeshView plot program.
- Allows changing contour count from 25 to 2 enhancing data contrast.
- Can improve print quality for black and white printouts.
- Linear and logarithmic scale data display.



Mesh Overlay : Data Ranges

The overlaid dataset's data range can be selected as the file, family, dataset or as custom user-specified.

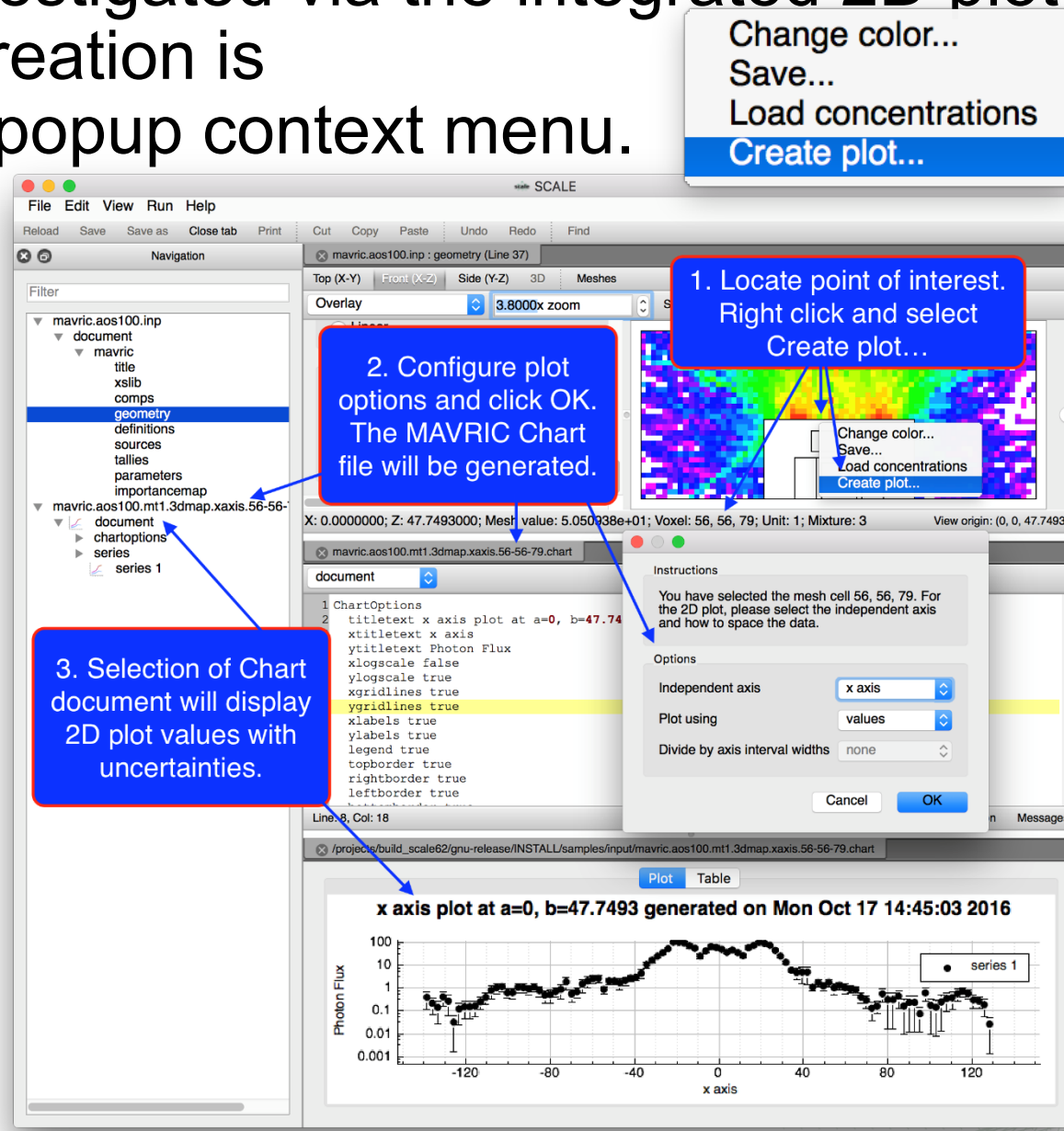
- The file indicates the entire mesh file context.
- The family range provides context to a selected dataset.
- Custom allows down-selection.



Mesh Overlay : Integrated 2D Plot Creation

Mesh data can be further investigated via the integrated 2D plot creation capability. 2D Plot creation is available via the Create plot popup context menu.

- Plot options include
 - Independent axis
 - Cartesian X,Y, and Z.
 - Cylindrical Radial, Theta, and Z.
 - Group when group-wise data is available.
 - Plot using values or indices.
 - When data is group-wise axis interval widths can optionally be divided linearly or logarithmically.



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- Fulcrum Mission Statement
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- Fulcrum Data Plotting
- Fulcrum Geometry Visualization
- Questions?