Fulcrum User Interface

Capability Introduction

Robert A. Lefebvre

October 2016

OAK RIDGE
National Laboratory
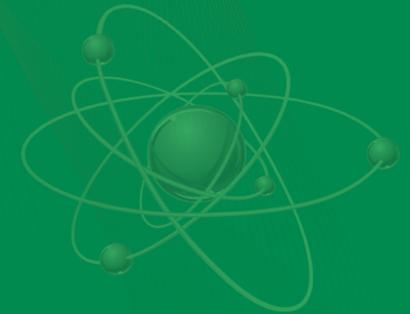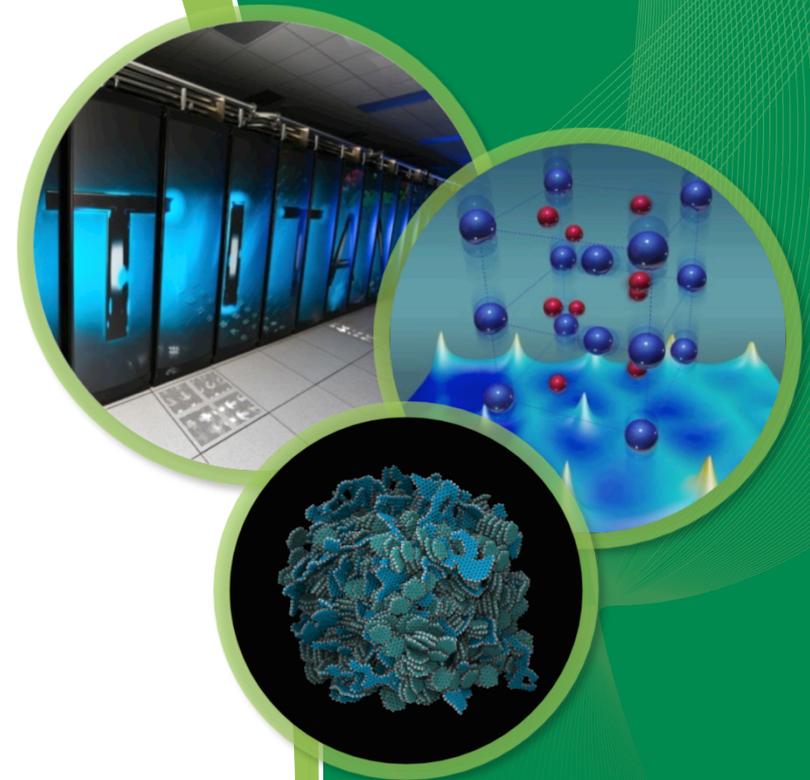
Presentation Outline

- Fulcrum Mission Statement

- Fulcrum Component Overview

- Fulcrum Input Editor

- Fulcrum Data Plotting

- Fulcrum Geometry Visualization

OAK RIDGE
National Laboratory

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.

OAK RIDGE
National Laboratory

Fulcrum Component Overview

Fulcrum Document Navigation

- Hierarchical Listing of Document
  - Quick Navigation to input component
  - Plot creation

- Open Associated Files
  - Lists files with matching extension-less filename
  - streamlines opening associated files

- Filter
  - Regular expression based item filtering

- Dockable
  - Dock to main Fulcrum application
  - Float in separate window
  - Hide completely
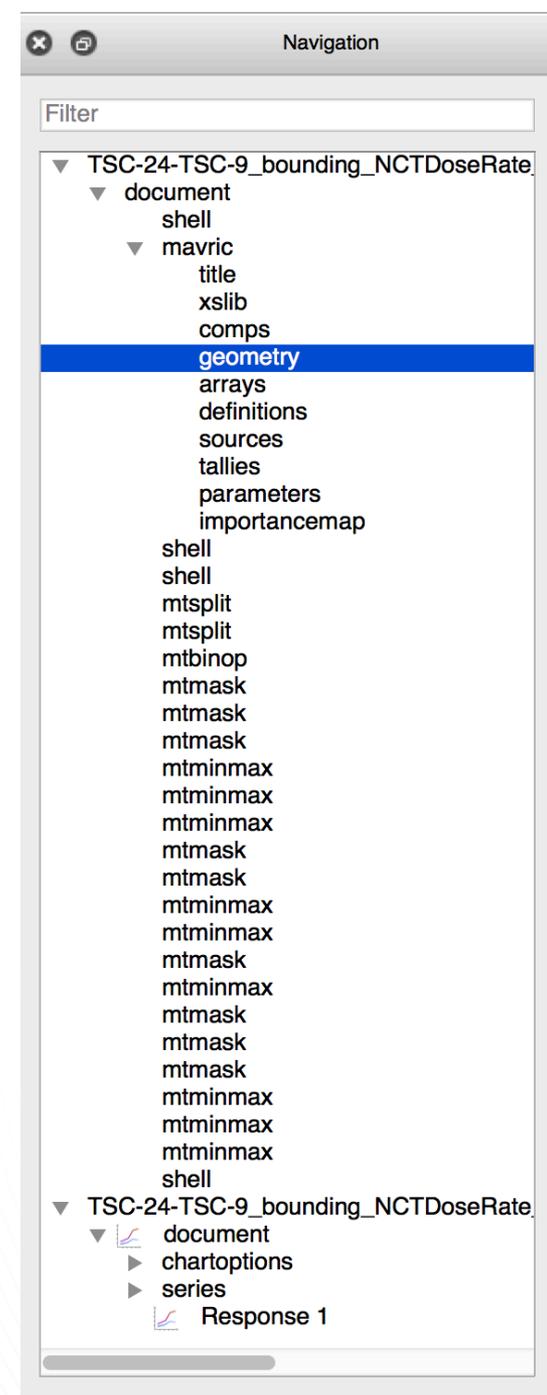
Fulcrum Input Editor

- Syntax Highlighting
- Top Level Quick Navigation
- Cursor Context
- Preserves User Input Format
- Current Input Block Highlight
- Input Autocompletion
- Input Validation
- Customizable Input Execution

Fulcrum Plot Data

- Supports Most Major SCALE Data Formats
- Export to Image (supports svg)

OAK RIDGE
National Laboratory
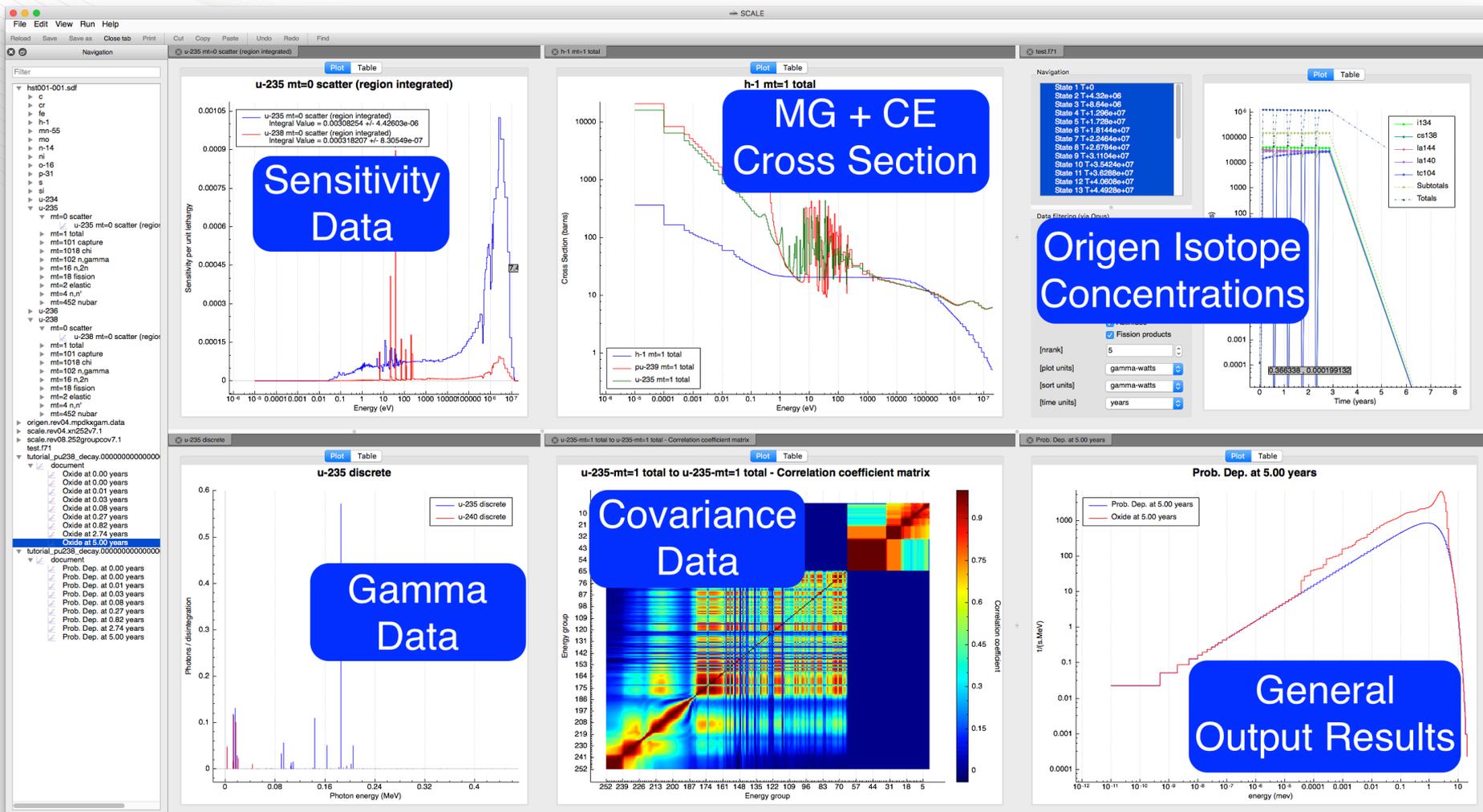
Fulcrum General Output Result Plots
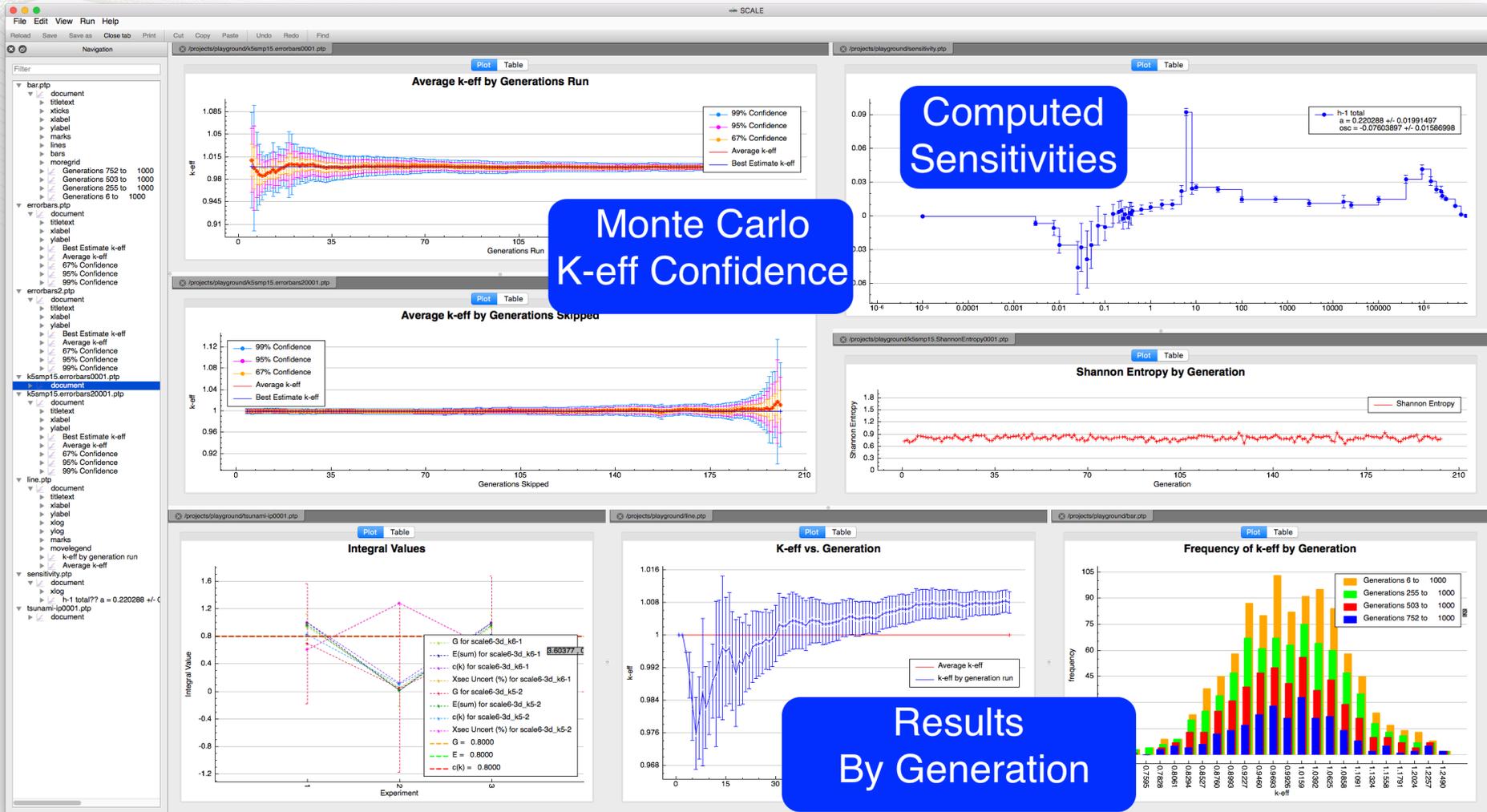
Fulcrum Geometry Visualization

- Interactive Geometry Visualization
- Support for Most Mesh Data*
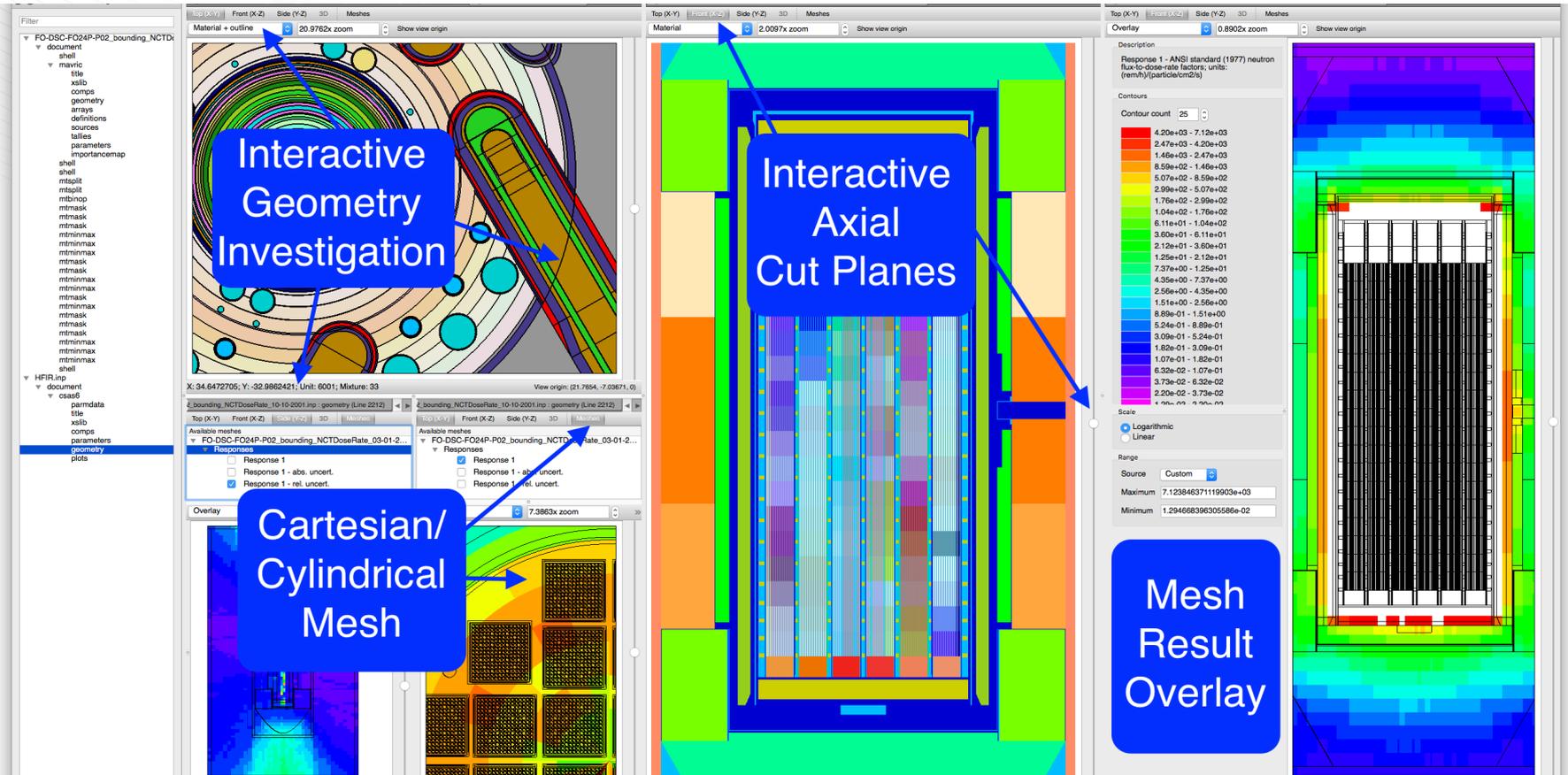
*Currently Support: 3dmap, Mesh Importance Map, Mesh Source Map, and Denovo Flux File

OAK RIDGE
National Laboratory

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.

  – Supports KENO and NEWT (non-polygon rendering).

- Fulcrum provides a modular workspace with splitting and drag-and-drop configurable layout.

- Questions?

OAK RIDGE
National Laboratory

Fulcrum User Interface

Input Editor Overview

Robert A. Lefebvre

October 2016

OAK RIDGE
National Laboratory
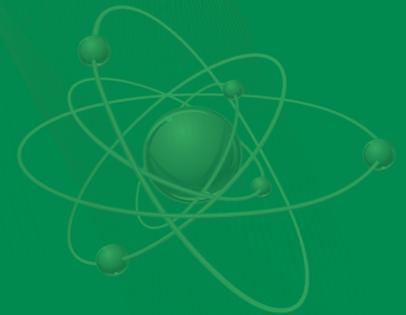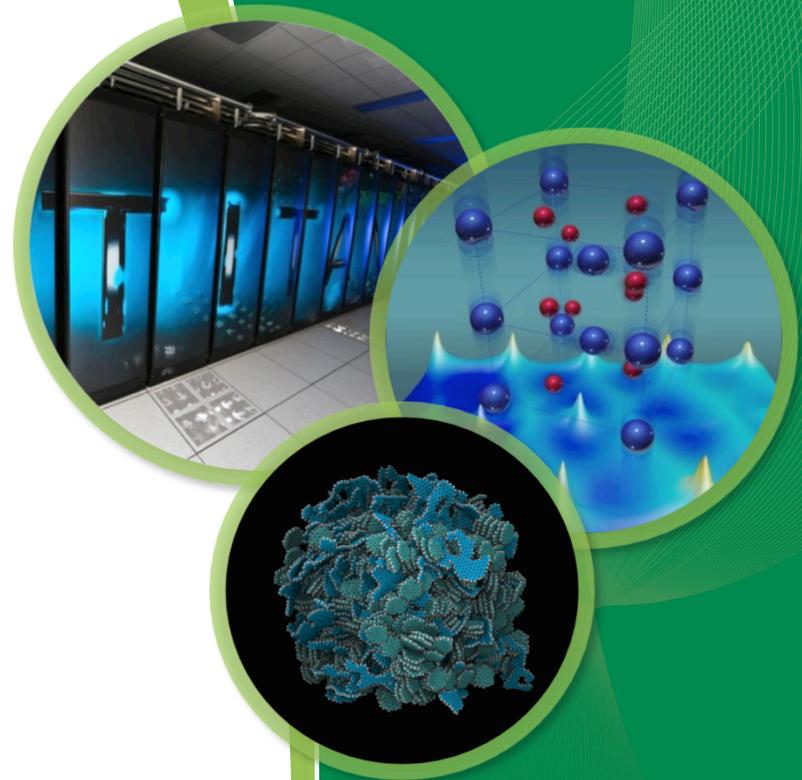
Presentation Outline

- Fulcrum Input Editor Components

- Text Editor Settings

- Syntax Highlighting

- Document Quick Navigation

- Cursor Context

- Input Block Start and End Highlighting

- Input Autocompletion

- Input Validation

- Input Execution

- Output File Viewing

- Miscellaneous Features

- Future Features

OAK RIDGE
National Laboratory

Fulcrum Input Editor Components

Text Editor Settings

- Change font attributes

- Change syntax color by category

- Change current line highlight

- Modify recognized input file extensions
  - Add a '.i' extension

- Update default input editor close behavior
  - When closing a tab, should the document also be closed if the closed tab is the last document tab.

- Accessed via File>Settings

Syntax Highlights

Document Quick Navigation

- Provides document outline.

- Quickly navigate to section from input editor drop-down or navigation tree.

- Places text cursor at start of input block.
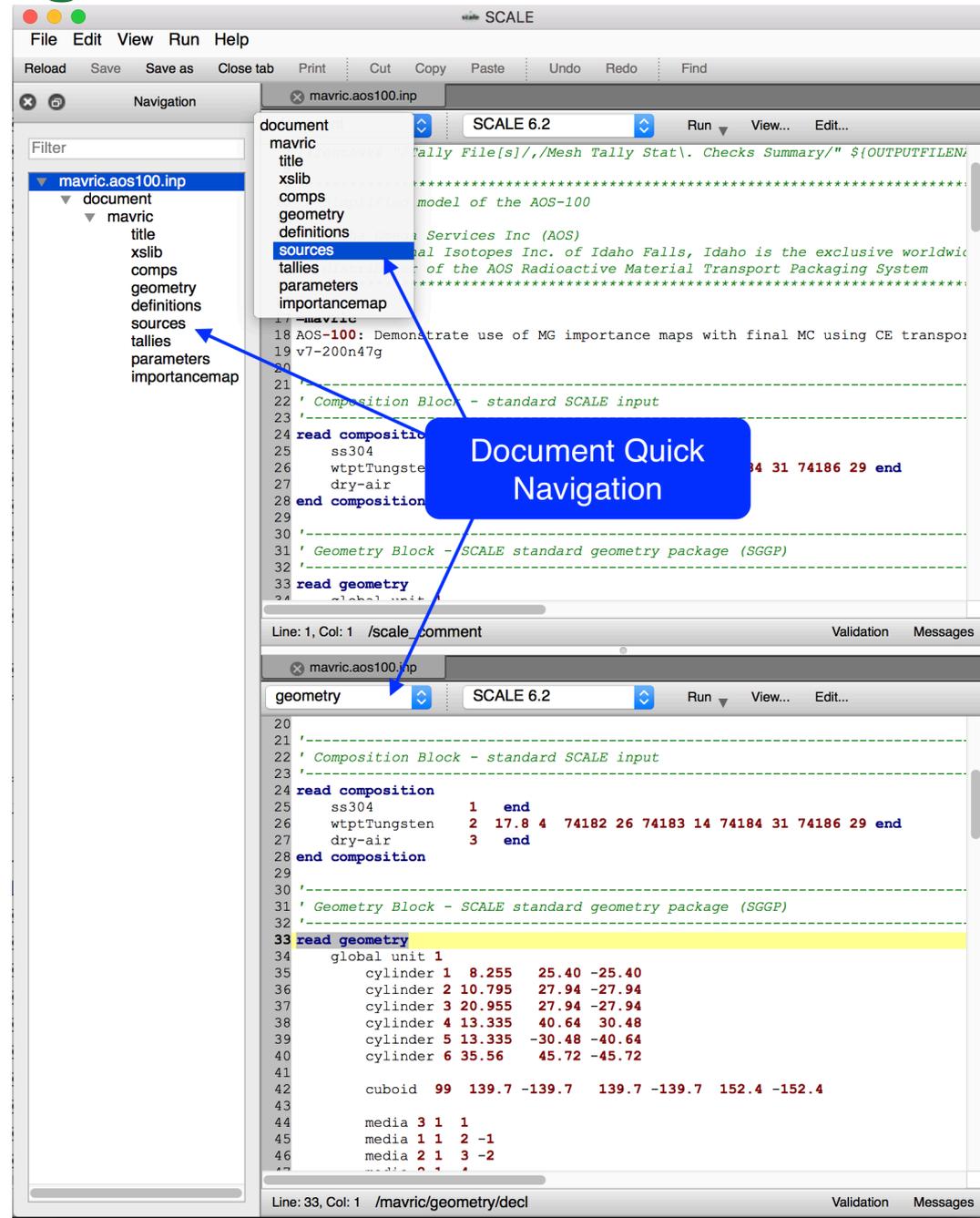
Cursor Context

- Fulcrum uses cursor position to determine cursor context, line, column, and highlighting.

- Cursor context provides a file directory-style listing of the input component at cursor position.
  - Helpful for identifying position-dependent input components.
  - Helpful for advanced SCALE features like Sampler model perturbations.

- Cursor line highlights provide fast cursor acquisition via bold-faced line number and highlighted line visual indicators.

- Cursor line and column entry fields provide quick navigation
  - Useful for entering line and column numbers included in job execution failure messages.
  - Accessible via clicking Line, Col text.
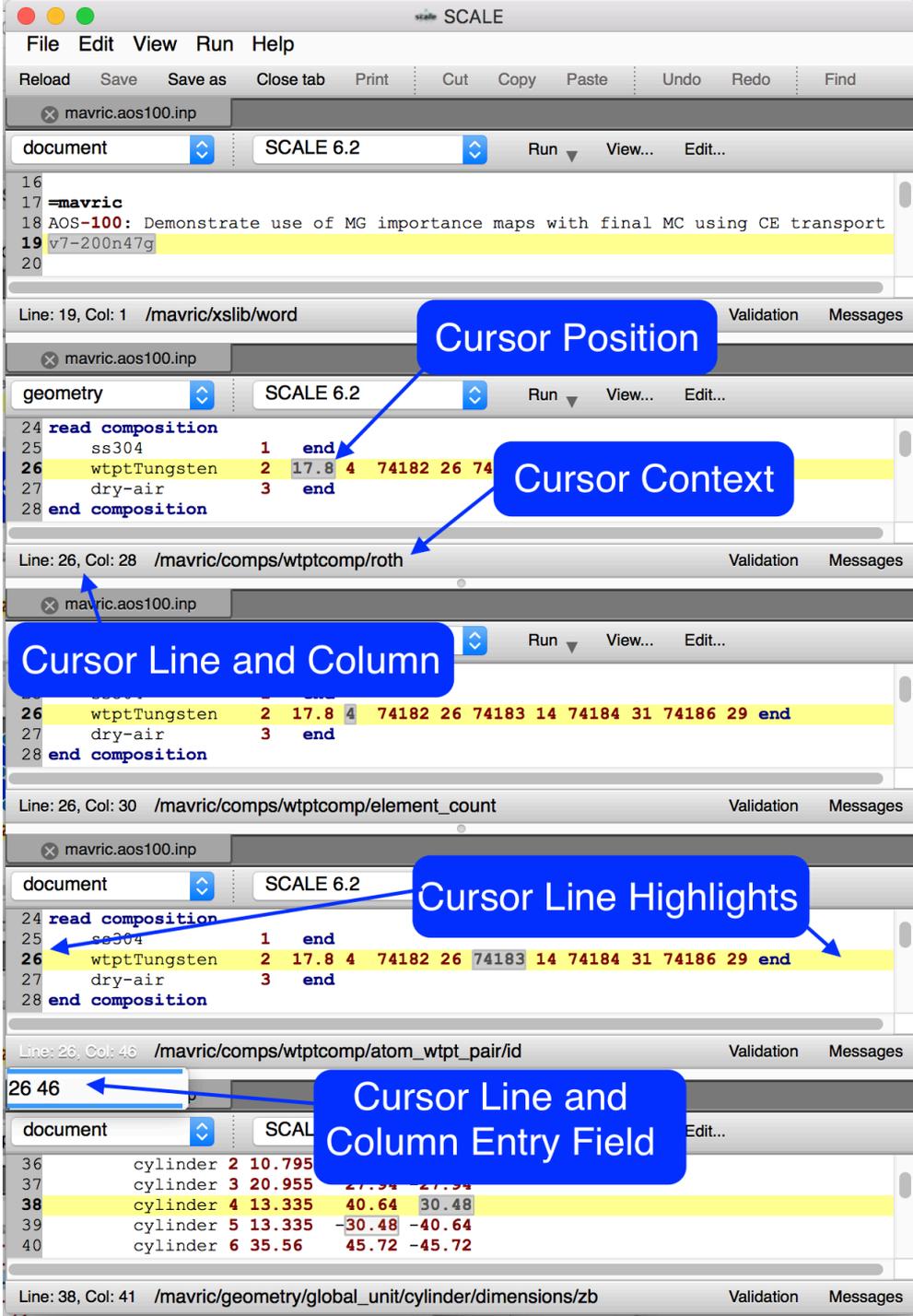
Input Block Start and End Highlighting

- Helps new users identify sections of input.

- Re-enforces SCALE's Read Block construct.

- More effectively communicates Record Blocks which could have user-specified beginning.

- Assists users in identifying new input component sections, such as the Component and Array Blocks used in Origen and Origami input.
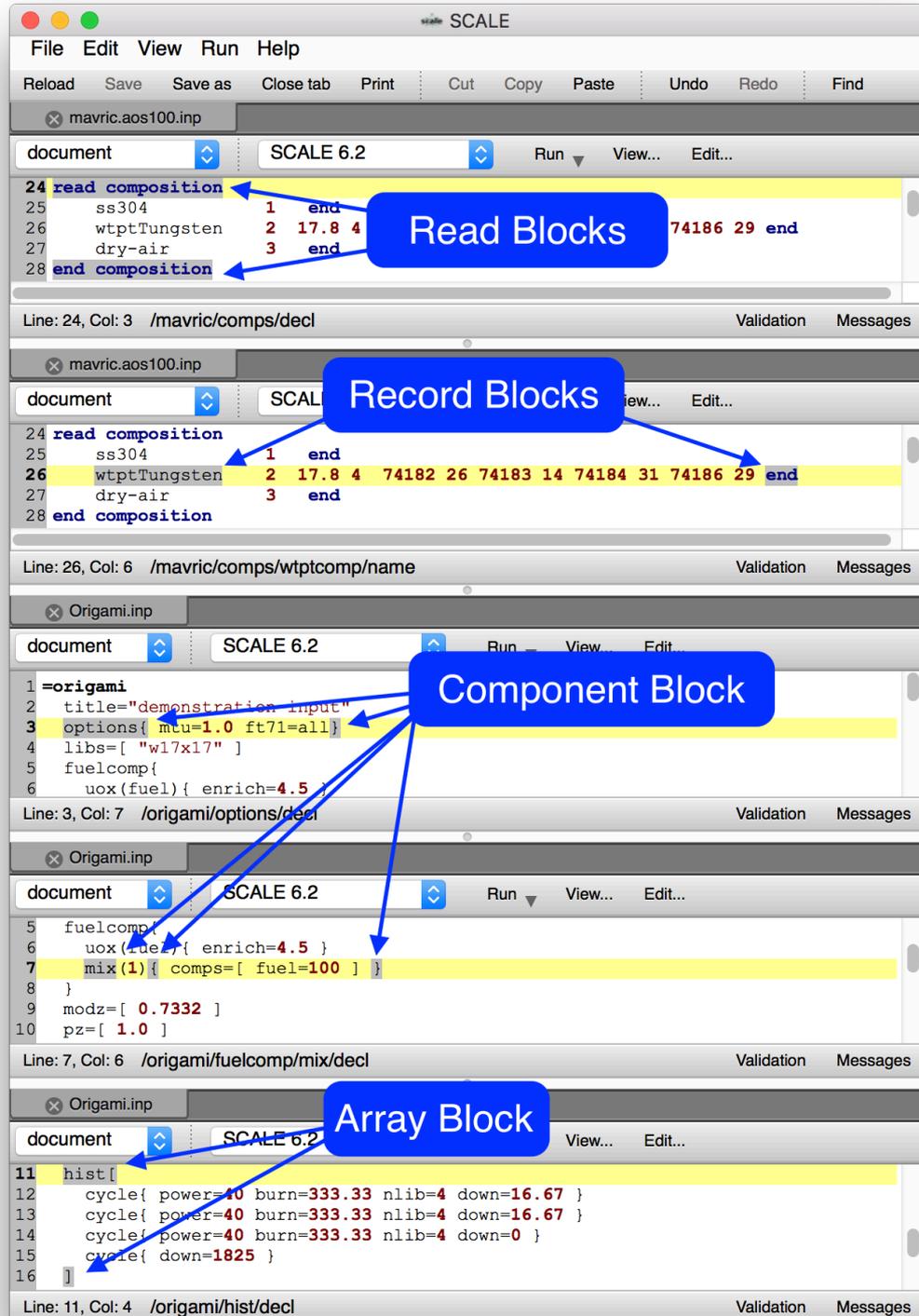
Input Autocompletion Overview

Input Autocompletion provides the user a jump start in input creation and editing. Autocompletion uses the cursor's context within the input to determine what input components are available and can be inserted. The types of autocompletion are as follows:

- Static input component insertion.
  - Inserts a boilerplate piece of input requiring the user to update fields with appropriate values.
  - Provides complete component incorporating component order, etc.

- Configurable input component insertion.
  - Uses a popup window to capture component values and substitutes these values into a template creating and inserting a complete piece of input (potentially an entire input).

- Input value substitution. Uses cursor context to provide a list of legal attribute values.
  - Convenient for selecting parameter values from a list (htm=yes or no).
  - Helpful for substituting identifiers needed from other input components (available mixtures, region ids etc).

OAK RIDGE
National Laboratory

Input Autocompletion : Static Text

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

• Inserts default values. Requires user to update values as needed.

Input Autocompletion : Static Text

- Static text insertion allows new and experienced users to quickly select and generate input that has order dependent components
  - Standard Composition Records require a sequence of unlabeled components (mixture, volume fraction, temperature, etc).
  - The requirement for the user to recall the correct order of entry is significantly reduced.
- Cursor context facilitates the user in identifying the inserted components needing to be changed.
  - Greatly assists the user in the worst of order-dependent, unlabeled input entry.

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

Order Dependent Static Input Enumerations

Input Autocompletion : Static Text

- Static text autocompetion 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

Parameters with descriptions

Input Autocompletion : Configurable Text

- Allows user to configure values prior to inserting into input.
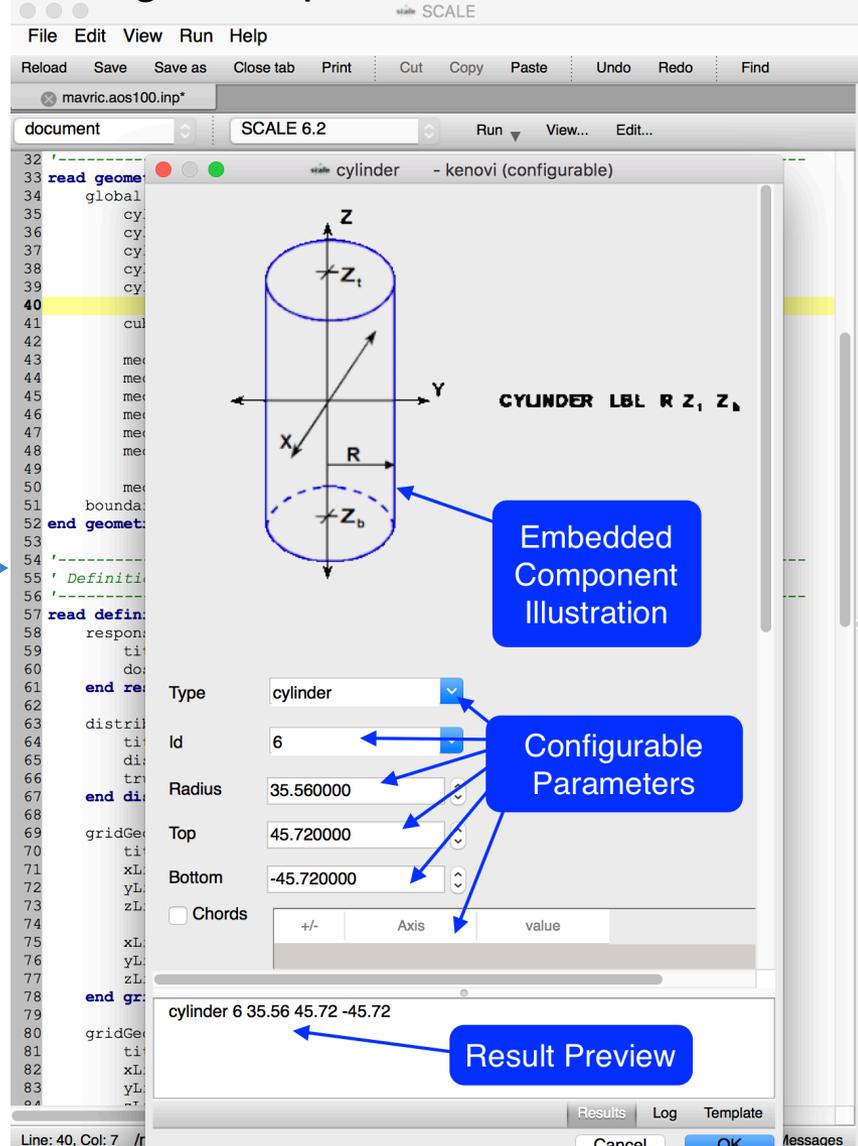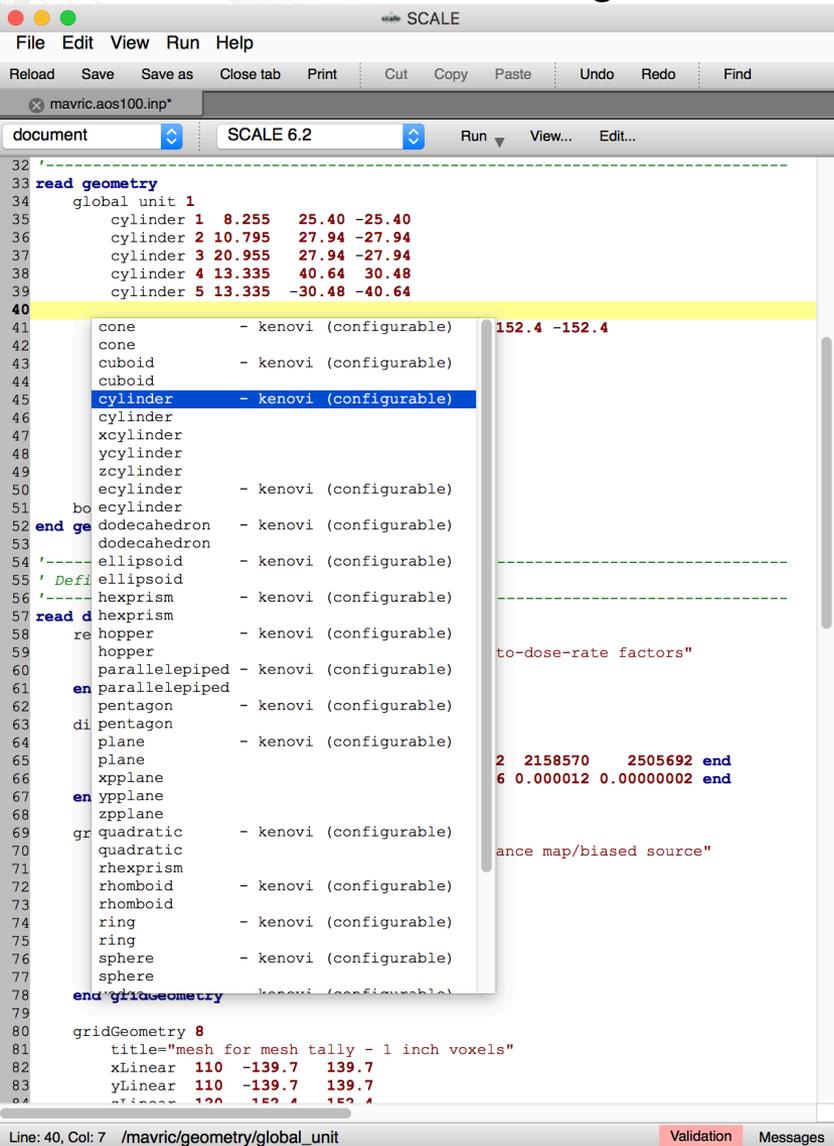
Input Autocompletion : Configurable Text

- 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 Autocompletion : Value Substitution

- When autocompletion is requested on an existing value that is either a member of a set of predefined or existing input component values/identifiers, an autocomplete popup is presented listing the available values to substitute.

- Helps user quickly remember/ learn what is legal/available.

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

List of available values to substitute

List of available values to substitute
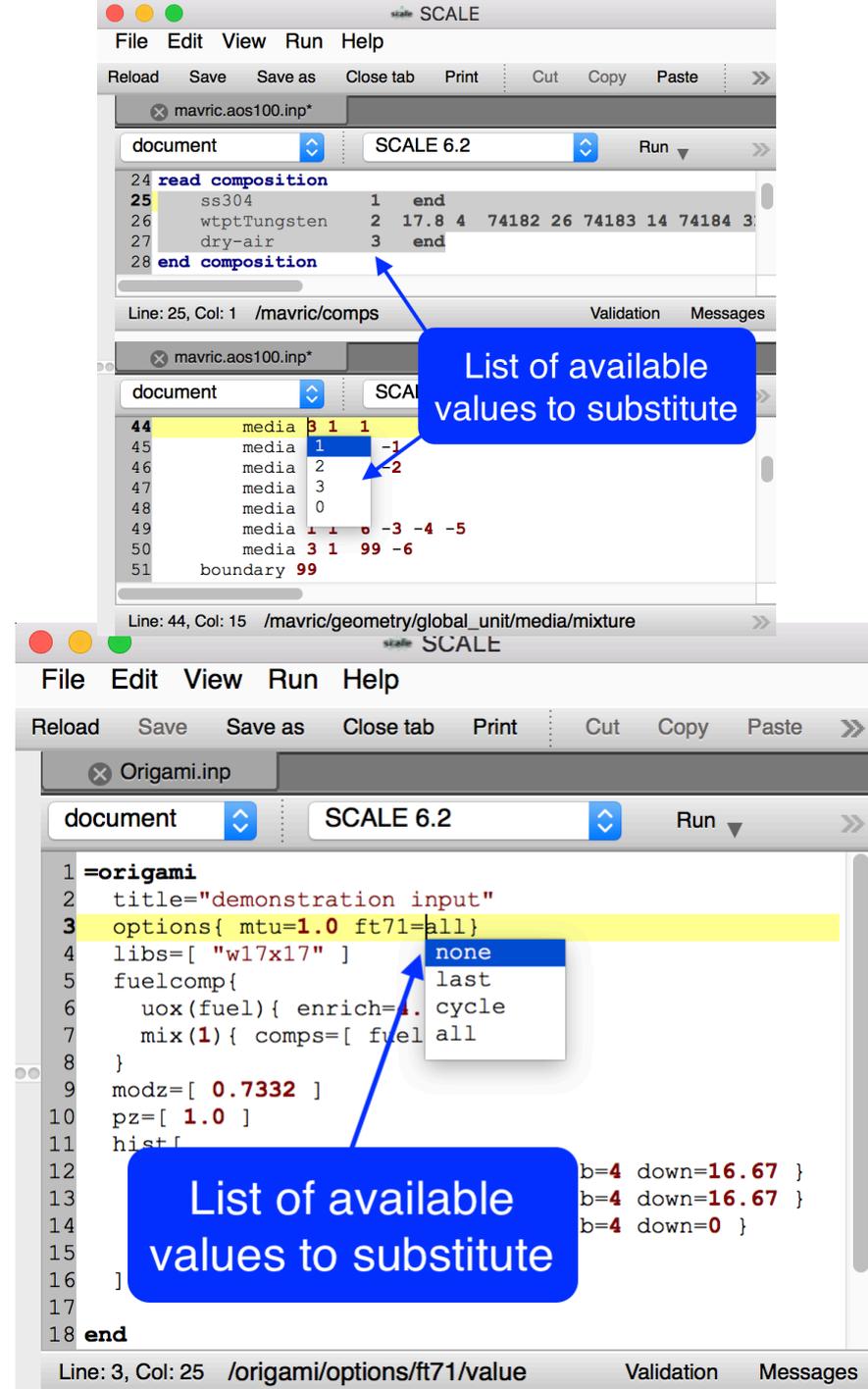
Input Validation Overview

- SCALE validation messages consist of parse and validation errors along with the input line and column.

  - Clicking the message will quick navigate to the location in the input editor

- SCALE parse errors prevent the further processing of input and are hard errors in that the interpretation of the input is incomplete.

  - Parse errors typically involve the input that guides the input parser. E.g., number of element-weight-percent pairs not matching actual number provided in the input.

- SCALE validation uses over 20 rules to provide immediate validation. These include value ranges, value uniqueness – is it unique in an input context, value existence – does the value exist in an input context, value enumeration – is the value a member of a list of values.

OAK RIDGE
National Laboratory

Input Validation Overview

- Parse errors cascade into other parse errors as the input parser attempts to find legitimate input.

- Parse errors often cause the input parser to terminate early preventing the entire input from being validated.

  – Example below has wtpt element count (line 27) specified as 3, but only has 2 (8000,7000) specified causing a parse error and cascade.

Input Validation : Required Input

- Required input should minimally occur once in the input.

- When required input is missing autocompletion can quickly generate the missing blocks.

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 <= 100

- ## More complex
  - Expected value sums
  - Expected value function (increasing, decreasing, etc.)
  - Component relationship
    - E.g., X > Y

Input Validation : Reference Errors

Using component identifiers can lead to duplicate or missing identifiers.

- Checks if the component's identifier is unique in the required input contexts.
  - Ensure all geometry regions have unique identifiers.

- Check if the component identifier references an existing component

Input Execution Overview

- Execution is preconfigured to execute the SCALE included with Fulcrum.

- Execution of other applications (e.g., prior SCALE release) can be setup.

- Only local execution (no cluster or queue support, yet).

- Execution can be in the background.

  – Allows closing Fulcrum without cancelling/terminating the execution.

- Input listing, mixing table, alias expansion, and volume calculation [prototype] are available via quick execution buttons.

- Messages from executions are stored in time stamped tabs.

OAK RIDGE
National Laboratory

Input Execution : Customized Configurations

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

Input Execution : Running Jobs

- Run launches the selected configuration (SCALE 6.2).

- For Run a time-stamped Messages Tab is added with application messages panel.

- Alternatives are conveniently available via the Run drop-down.

  - Run in background launches the job but with a terminal instead of a messages tab.

  - Expand aliases unrolls aliased input (TRITON).

  - Input listing provides directory-like input listing useful for Sampler model perturbation.

  - Mixing table lists the atomic number densities (atoms/b-cm) per nuclide per mixture.

  - Calculate volumes (prototype) runs a user-specified number of rays per geometry axis and accumulates media volumes. The complete input with media 'vol' cards is echoed in the message tab.

Output File Viewing

- Easy to access from the Input file's list of associated files popup context menu.

- No intelligent outline, yet.

- Output file Can be drag-n-dropped onto Fulcrum from a file browser (as can any SCALE file with an extension, *.inp,*.out, etc.).

Associated files available via document navigation item popup menu

Plain Text Output File
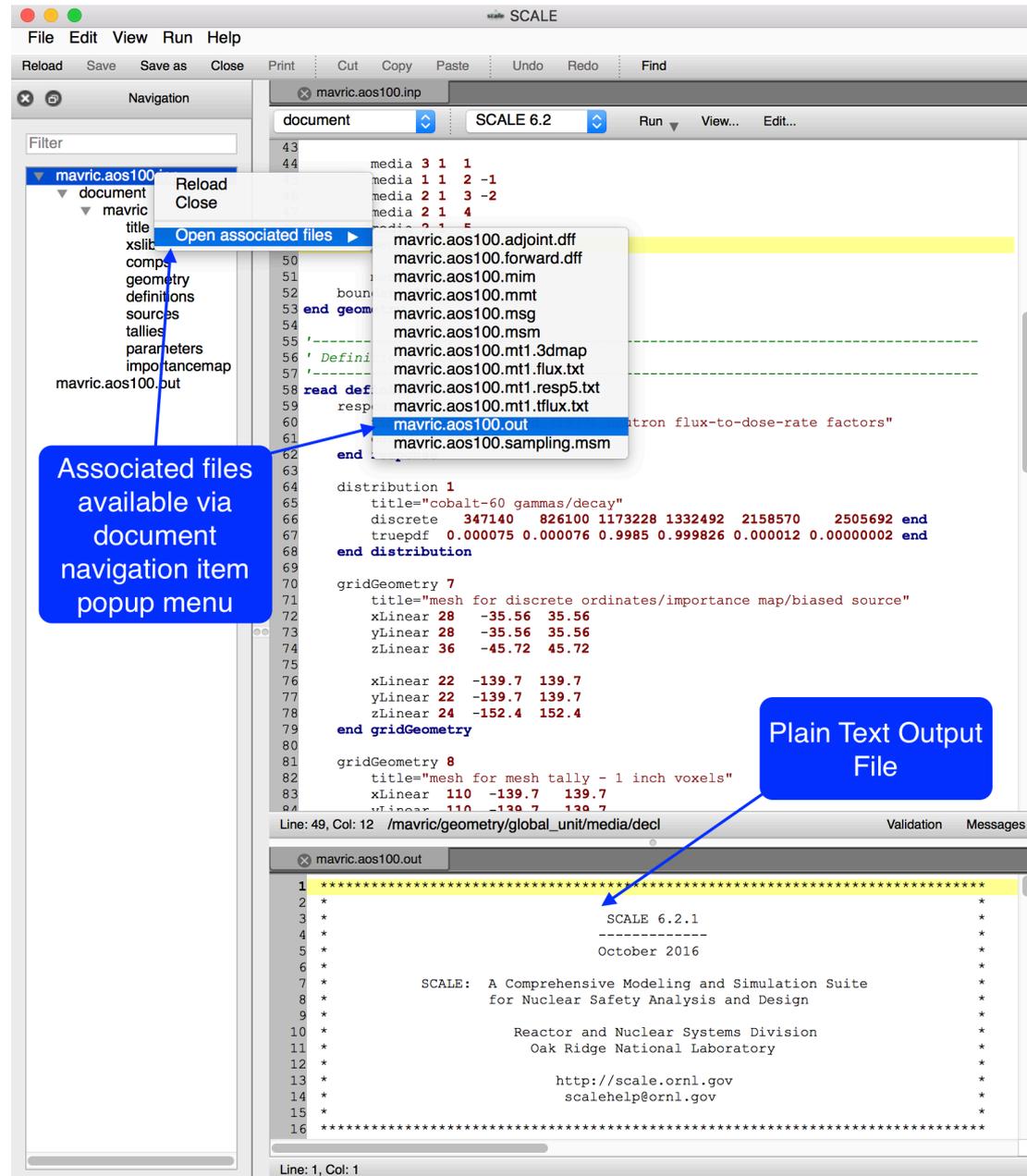
Miscellaneous Features

- 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 back up to *inputname.fulcrum.autosave*.
  - File exists only while there are unsaved document changes
- Features illustrated on following slides

OAK RIDGE
National Laboratory

Miscellaneous : Column Selection/Edit

Formatting related text into aligned columns allows for faster recognition and column-wise text operations.

- Fulcrum provides column selection via ALT+MOUSE SELECTION.

- With column selection made, any edits are made to all columns for each row.

  – E.g., Update all isotope weight percent values to have a decimal digit.

Select and edit columns of text
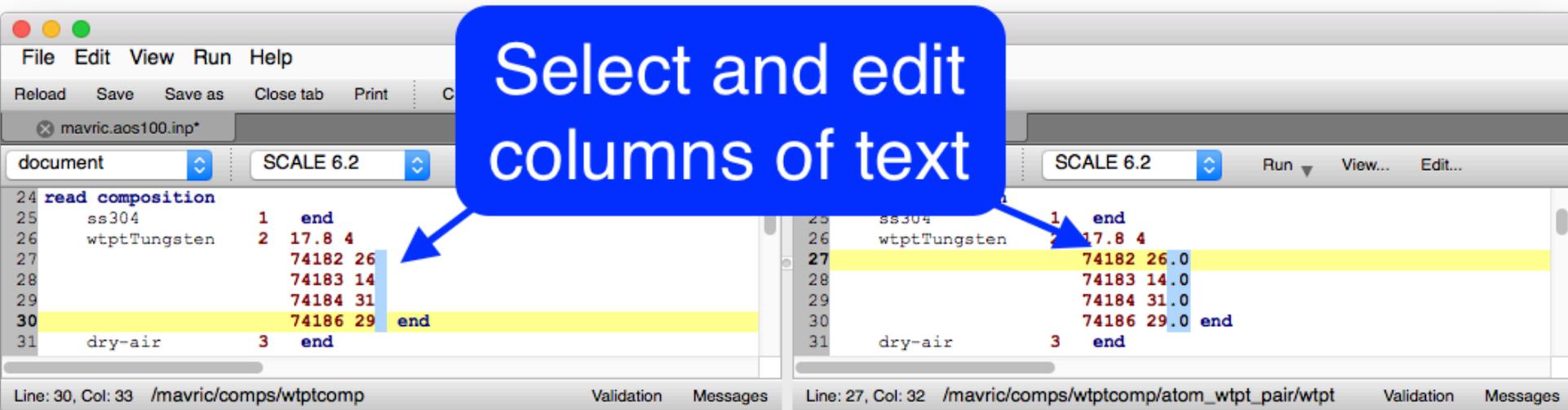
Miscellaneous : Go To Definition

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 referencing. 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.

Miscellaneous : Math Evaluations

Often engineering specifications require conversion to input specifications. Even if a calculator is readily available, a human component is required to enter the converted (e.g, inches to centimeters) value into the input. Fulcrum provides an inline math expression evaluator.

- Removes/mitigates typographical errors related to converted numeric input entry.

- Encourages documentation of engineering specifications that require conversion.

- Full complement of math functions available :
  - +,-,*,/,^,sqrt, cos, sin, root, abs, min, max, avg, sum, mul, floor, ceil, exp, log, logn, log10, hyp, if, clamp, inrange, sign, deg2rad, tan, equal, acos, asin, atan, cosh, tanh, sec, csc, cot, sinh, round, roundn, d2g, g2d, r2d

- Evaluation occurs on highlighted text.

Math expressions and evaluation

OAK RIDGE
National Laboratory

Miscellaneous : Comment Toggle

Comment toggling allows users to quickly comment or uncomment pieces of input.

- Allows comment creation.

- Mitigates user needing to recall what a comment looks like.

- Assists in input development iterations.

- CMD+/ on OS X and CTRL+/ on Windows and Linux.
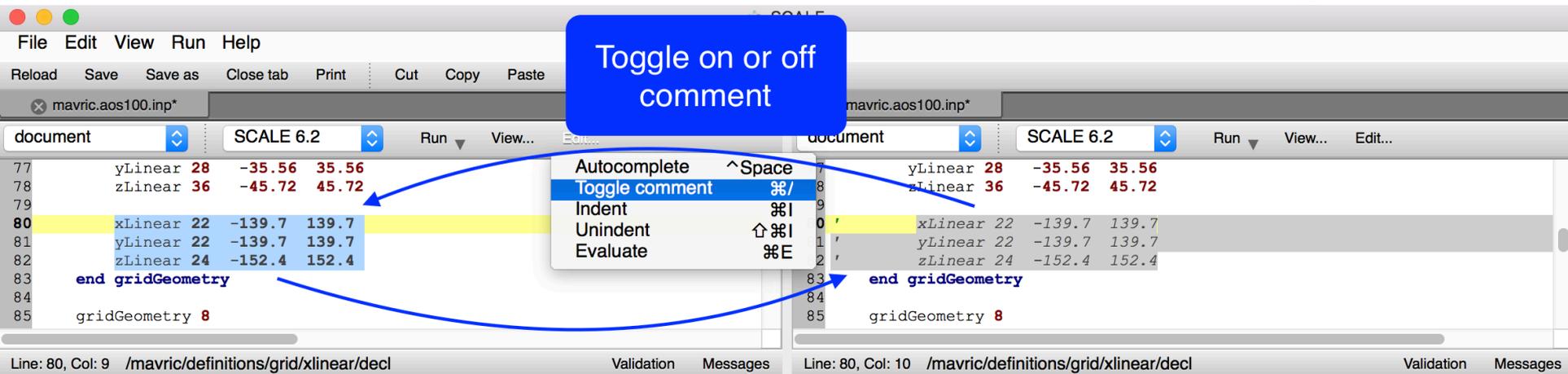
Miscellaneous : Input Indent/Unindent

Hierarchical input (Sequence > Read Block > Component Record) can be depicted using levels of indentation. Input indent and unindent facilitates quick formatting to visually depict hierarchy.

Miscellaneous : File Autosaves

Any file Fulcrum edits - currently only text files - are immediately backed up to a *filename.fulcrum.autosave*. In the scenario that Fulcrum or the application or computer crashes the autosave file will persist.

- Upon Fulcrum restart, when reloading the original file, Fulcrum will check for filename.fulcrum.autosave and load this instead, mitigating any lost progress.

- A save of the file will remove the autosave.

OAK RIDGE
National Laboratory

Input Editor : Future Features

- Enhanced cursor context presentation.

  – Display input record information under cursor with labels.

  – Linked help documentation – press F1 and get help section describing the input record under the cursor.

- Enhanced input component forms.

  – Allows displaying input record/block under cursor in a visual form – allows seamless input text to form round-tripping without loss of input formatting or input [quality assurance] comments.

- Input Differences.

  – Visually difference two inputs.

- Enhanced output review capability.

  – Warning and error quick navigation.

  – Upgraded HTML output.

OAK RIDGE
National Laboratory

Summary

- Fulcrum Input Editor Components

- Text Editor Settings
  - Syntax colors and default editor behaviors

- Syntax Highlighting
  - Input component color

- Document Quick Navigation

- Cursor Context
  - Formal location in the input document

- Input Block Start and End Highlighting

- Input Autocompletion
  - Creation and editing of input

- Input Validation
  - Simple and complex

- Input Execution
  - customizable

- Output File Viewing

- Miscellaneous Features
  - Find/Replace
  - Column select/edit
  - Comment toggle
  - Selection indent/unindent
  - Inline math evaluations

- Future Features coming soon to a Fulcrum on your desktop

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva

Create the Lady Godiva experiment using CSAS6.

Problem definition :

Lady Godiva consists of **17.482** cm diameter sphere.

Run **V7-252 multiregion** cross section with **vacuum right boundary** condition, and **10000 particles per generation** with **200 generations skipped**.

Isotope	Atomic Number Density
U-234	0.000491995
U-235	0.0449996
U-238	0.002498

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva

Purpose :

1) New Input creation.

2) Autocompletion of input.

3) Execution and output viewing.

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva : Task 1

Creation New document named InputEditorExercise1.inp

- File>New File…

- Specify InputEditorExercise1.inp.

You should now have a blank input file.

Exercise 1 : Lady Godiva : Task 2

Autocomplete a **csas6** sequence.

- With cursor in text editor, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination.

- Select the **csas6 – Criticality safety analysis using KENO-VI**.

- Change 'title-goes-here' to 'Lady godiva.'

- Change 'xslib-goes-here' to 'v7-252.'

You should now have an input file with minimum required input blocks. Notice the validation errors indicating what is needed.

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva : Task 3

Autocomplete 3 **stdcomps** with **atomic density** and **temperature** for the listed isotopes.

- With cursor in comps block, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **stdcomp – basic + atomic density + temperature.**

- Update the isotope and atomic density (**aden)**

- Repeat the above 2 steps for each isotope in the table.

You should now have a complete composition block.

Isotope	Atomic Number Density
U-234	0.000491995
U-235	0.0449996
U-238	0.002498

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva : Task 4

Autocomplete the cell block and **17.482 diameter spherical multiregion cell**.

- With cursor below the comps block and above the geometry block, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **cells**.

- With cursor in the cells block, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **multiregion - spherical**.

- Update the multiregion zone input to reflect the proper sphere **radius**.

You should now have an input with complete comp and cell data. The validation messages should indicate error about global unit's missing media,hole, etc.

Exercise 1 : Lady Godiva : Task 5

Autocomplete the sphere.

- With cursor below the global unit and above the unit boundary, select **Edit>Autocomplete**, or press **CTRL +SPACE** key combination and select the **sphere**.

- Update the sphere **radius** to the appropriate value.

You should now have an input with a sphere region specified but no media.

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva : Task 6

Autocomplete the media.

- With cursor below the sphere and above the unit boundary, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **media**.

You should now have an input with a sphere region specified and media. Notice the media material and region definition vector was updated as the default values matched the generated material id from task 3 and 5.

There should be no validation errors.

Exercise 1 : Lady Godiva : Task 7

Execute the first input iteration.

- Click the Run button.

- Click the Messages panel.

- Note the k-eff value of ~1.0007 + or – 0.0016.

At this point you should have a functioning input, that needs a parameter block.

OAK RIDGE
National Laboratory

Exercise 1 : Lady Godiva : Task 8

Autocomplete the parameter block and run again.

- With cursor below the cells block and above the geometry block, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **parameters**.

- With cursor in the parameter block, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **npg** – **no. per generation**. Update to **10000**.

- With cursor in the parameter block, select **Edit>Autocomplete**, or press **CTRL+SPACE** key combination and select the **nsk** – **generations skipped**. Update to **200**.

- Click the Run button.

- Click the Messages panel.

- Note the k-eff value of ~0.9999 + or - 0.0044

Exercise 1 : Lady Godiva : Task 9

Open the output.

- In the document **Navigation** panel right click the InputEditorExercise1.inp file.

- Mouse over Open associated files.

- Select the InputEditorExercise1.out file.

- Conduct a find on 'best estimate.'

- Notice the expected value.

Exercise complete.

OAK RIDGE
National Laboratory

Fulcrum User Interface

Plot Data Overview

Robert A. Lefebvre

October 2016
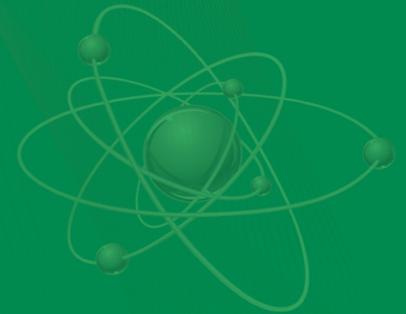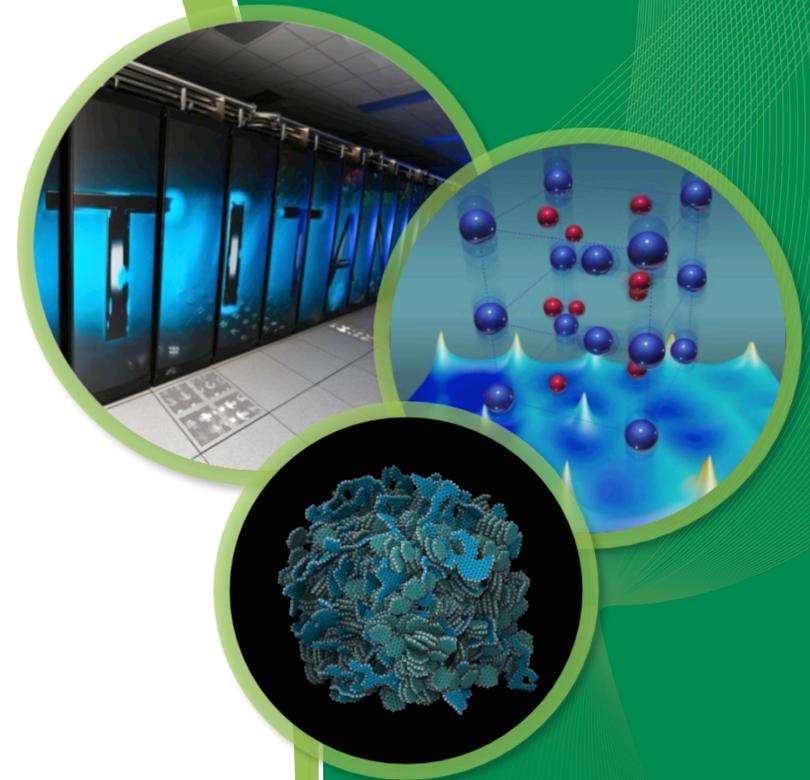
Presentation Outline

- General Plot Overview

- Plot Controls

- AMPX Cross Section Data

- Covariance Data

- ORIGEN Isotope Concentration Data (F71)

- F71 Special Plot Controls (PlotOPUS)

- ORIGEN Gamma Data

- General Output Result Plots

OAK RIDGE
National Laboratory

General Plot Overview

- Interactive and configurable plot rendering

- Plot data table displays graph data.

  – allows row and table copy to clipboard.
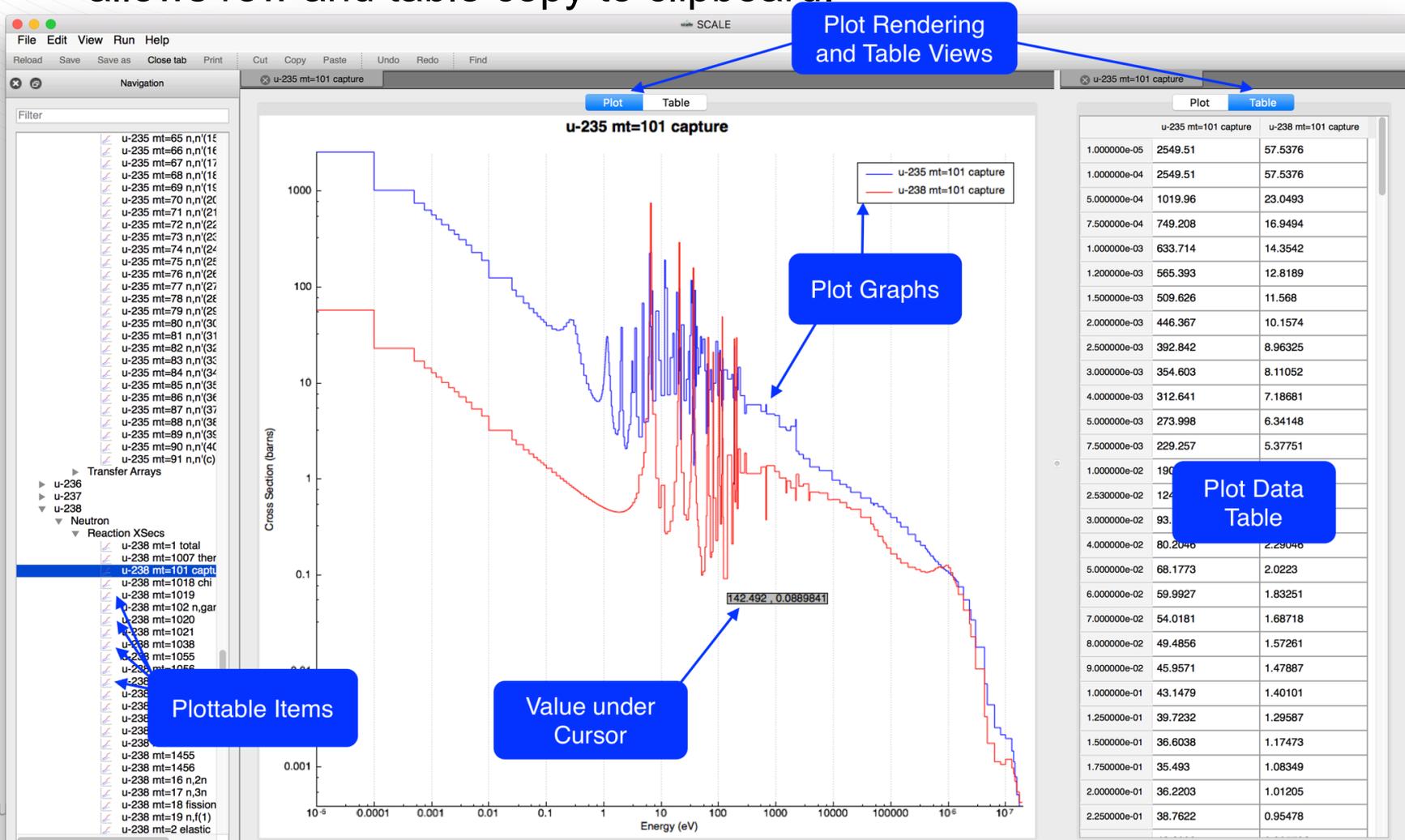
Plot Controls

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.
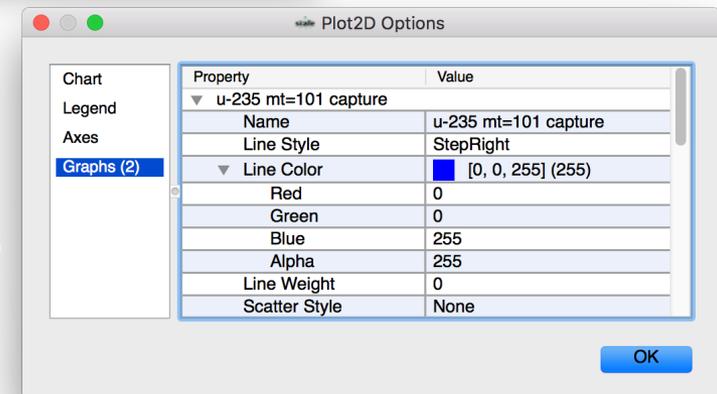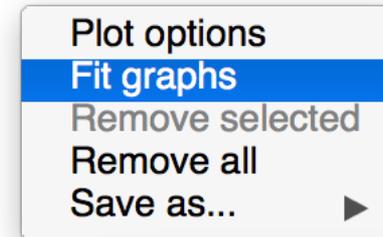
Plot Controls : Plot Options

- Chart – Allows changing the plot title and title visibility.

- Legend – Allows changing the legend's font and visibility.

- Axis – Allows changing axis visibility, label text, label text font, axis scale, axis range, axis grid, tick label font and tick text attributes (rotation, precision, etc.).

- Graphs – Allows changing graph name, line style, line color, line weight, scatter style, scatter size, pen style, adaptive sampling*, errors bars.

- Bars – Allows changing bar graph name.

- Color Map – Allows changing color map graph name and color gradient.

OAK RIDGE
National Laboratory

Plot Controls : Plot Creation

Plots can be created standalone or added to existing.

- Double left-click a plot to create a new plot.

- Alternatively, right click and select New plot.

- Add to preexisting plot via a right click and selecting Add graph to….
  - Add is only available for plots with matching axes.

u-235 mt=1 total
New plot
u-235 mt=... ...rmal.scat
u-2...
Add graph to "u-235 mt=101 capture"
u-2...
u-235 mt=1019
u-235 mt=102 n,gamma
u-235 mt=1020
u-235 mt=1021
u-235 mt=1038
u-235 mt=1055
u-235 mt=1056
u-235 mt=1099 weight.function
u-235 mt=1419
u-235 mt=1420
u-235 mt=1421
u-235 mt=1438
u-235 mt=1452
u-235 mt=1455
u-235 mt=1456
u-235 mt=16 n,2n
u-235 mt=17 n,3n
u-235 mt=18 fission
u-235 mt=19 n,f(1)
u-235 mt=2 elastic
u-235 mt=20 n,nf
u-235 mt=2000
u-235 mt=2022 within-grp.scat
u-235 mt=21 n,2nf
u-235 mt=27 absorption
u-235 mt=3 nonelastic

Default action of New plot, or add to existing graph

OAK RIDGE
National Laboratory

AMPX Cross Section Data

AMPX Cross Section Data is available in multigroup (MG) and continuous-energy form and is located at ${SCALE}/data. Because the files do not have a unique extension, the user must load them specifically by type.

- Load MG XS data via File>Open multigroup library…

- Load CE XS data via File>Open continuous-energy library...

- CE XS data are displayed hierarchically
  – by Neutron or Photon, Isotope, Temperature (K), and Reaction.

- MG XS data are displayed hierarchically
  – By Isotope, Neutron or Gamma, Reaction XS or transfer array.

Continuous Energy :
By type (Neutron, Photon), isotope, temperature (K), and reaction

Multi group :
By isotope, type (Gamma, Neutron), dimension (1d - reaction xs, 2d - transfer array), temperature, and reaction

Plot Exercise 1

Description:

Compare the **252 MG** vs. **CE U-235 Fission** cross section at **293K** and produce a **PDF** of the **108 barn** peak between **0.1-10 eV**.

Intent:

Familiarity with loading CE and MG libraries.

Familiarity with plot controls (zoom and pan).

Familiarity with combining plots.

Familiarity with saving plots.

Plot Exercise 1 : Task 1

1. Load CE V7.1 ENDF library from the SCALE/data directory.

2. Find the U-235 Isotope at 293K.

3. Double click the 293 navigation item to load the reactions at that temperature.

4. Find the U-235 mt=18 fission 293 K xs entry.

5. Double click the entry to create a 2D plot.

6. Done.

OAK RIDGE
National Laboratory

Plot Exercise 1 : Task 2

1. Load 252 group MG library from the SCALE/data directory.

2. Find the U-235 Isotope Neutron Reaction XSecs entry.

3. Find U-235 mt=18 fission entry.

4. Right click the entry to obtain a popup context menu.

5. Click the Add to graph to… menu item.

6. Done.

OAK RIDGE
National Laboratory

Plot Exercise 1 : Task 3

1. Pan the plot to be centered at 1 eV.

   – Left click and drag

2. Zoom the plot to the requested eV range.

   – Scroll up zooms in.

3. Repeat steps 1 and 2 as needed to center plot about the ~108 barn cross section peak near 1 eV.

4. Right click to obtain the plot context menu.

5. Select Save as>PDF and specify PlotExercise1.pdf.

6. Done

Exercise complete.

OAK RIDGE
National Laboratory

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).
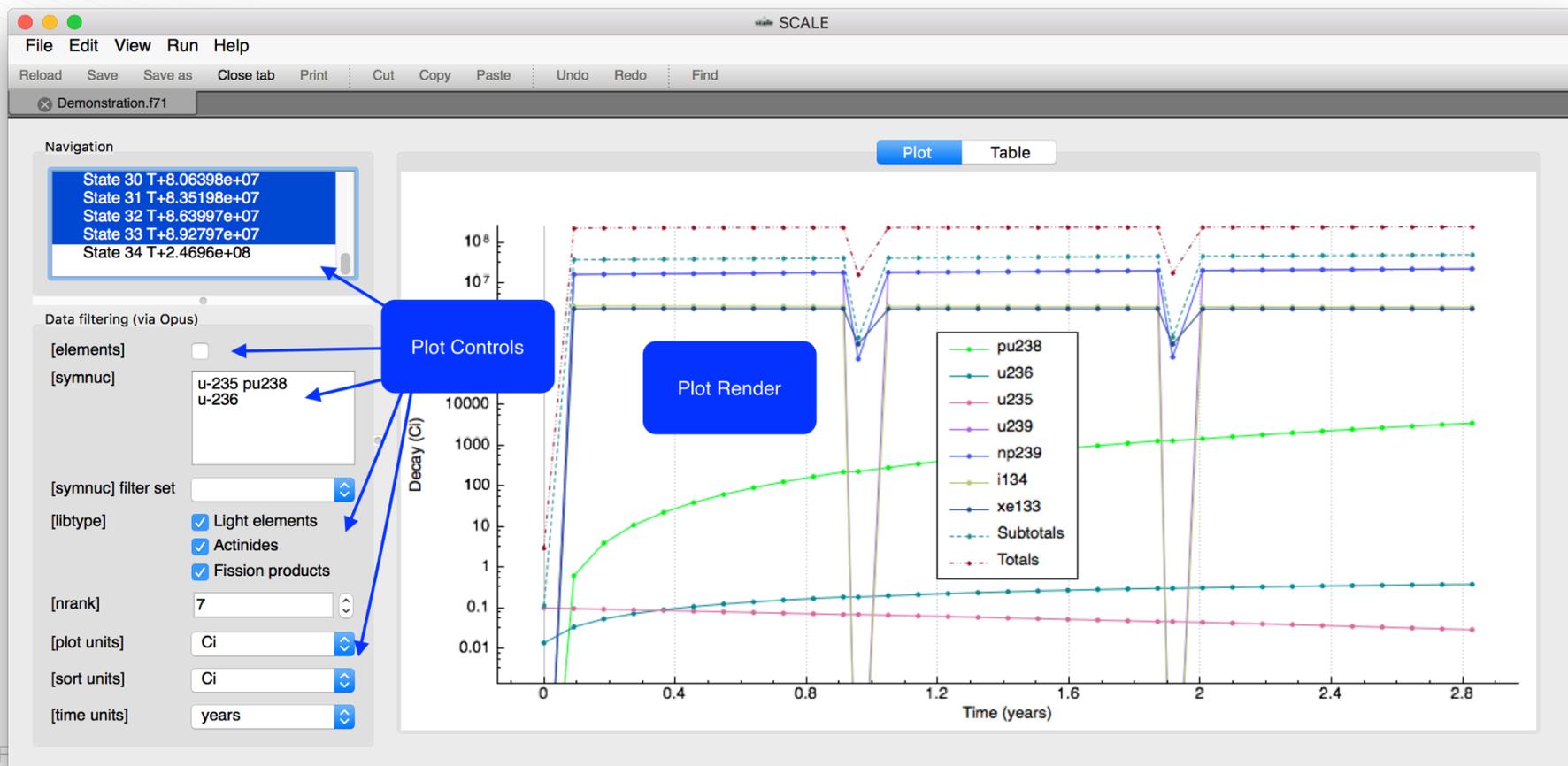
F71 Special Plot Controls (PlotOPUS)

- Navigation allows selection of state information at a given time point.

- Element allows display of results by element instead of nuclide.

- SymNuc allows specifying nuclides or elements to include in the plot.

- Libtype allows display of nuclides or elements contained in the light elements, actinides, and fission product isotope sets.

- Nrank allows limiting the display of the top contributors.

- Time, Plot, and Sort Units allows changing the X and Y axis and the nuclides or elements displayed based on contribution.
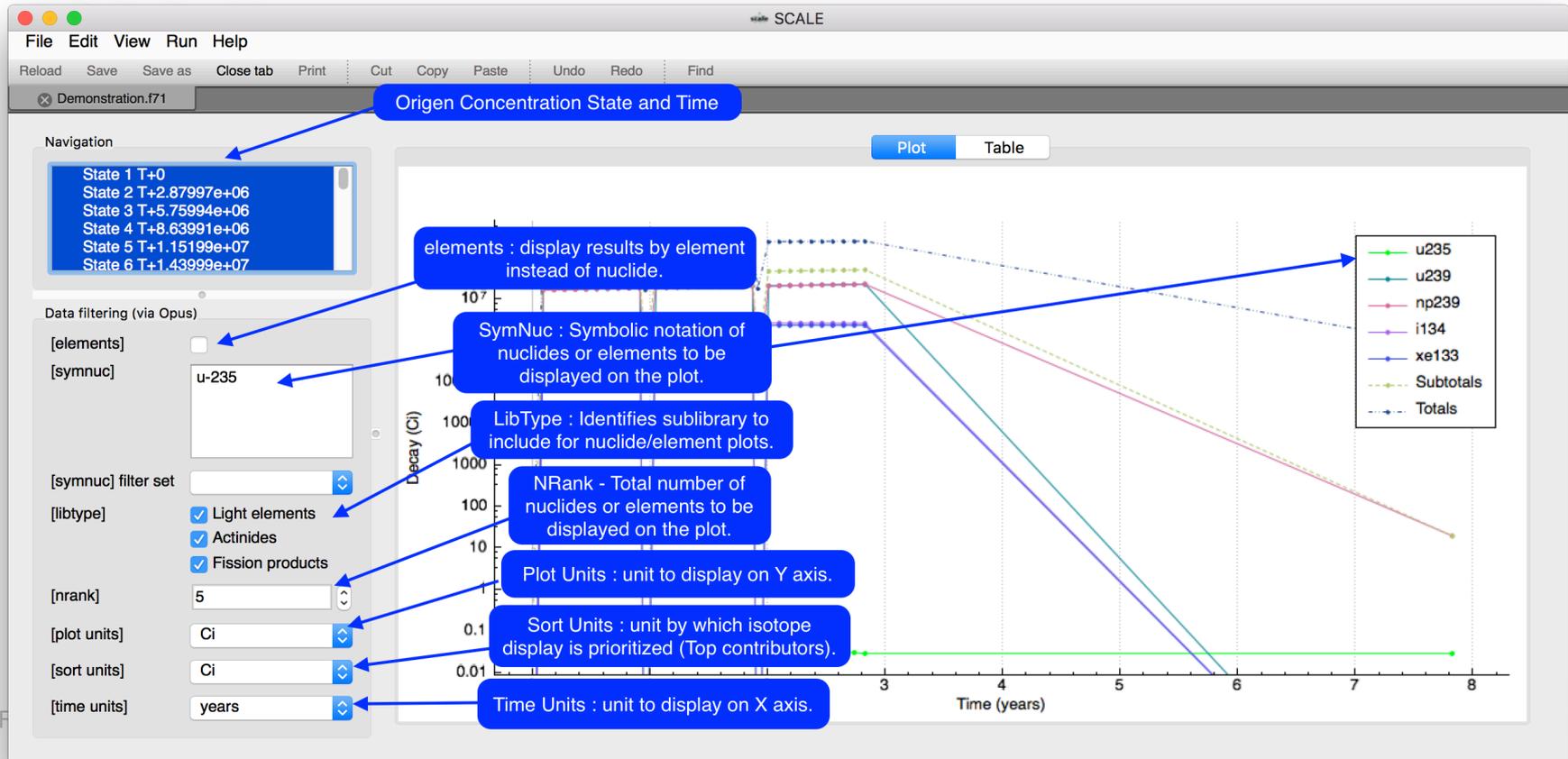
ORIGEN Gamma Data

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…
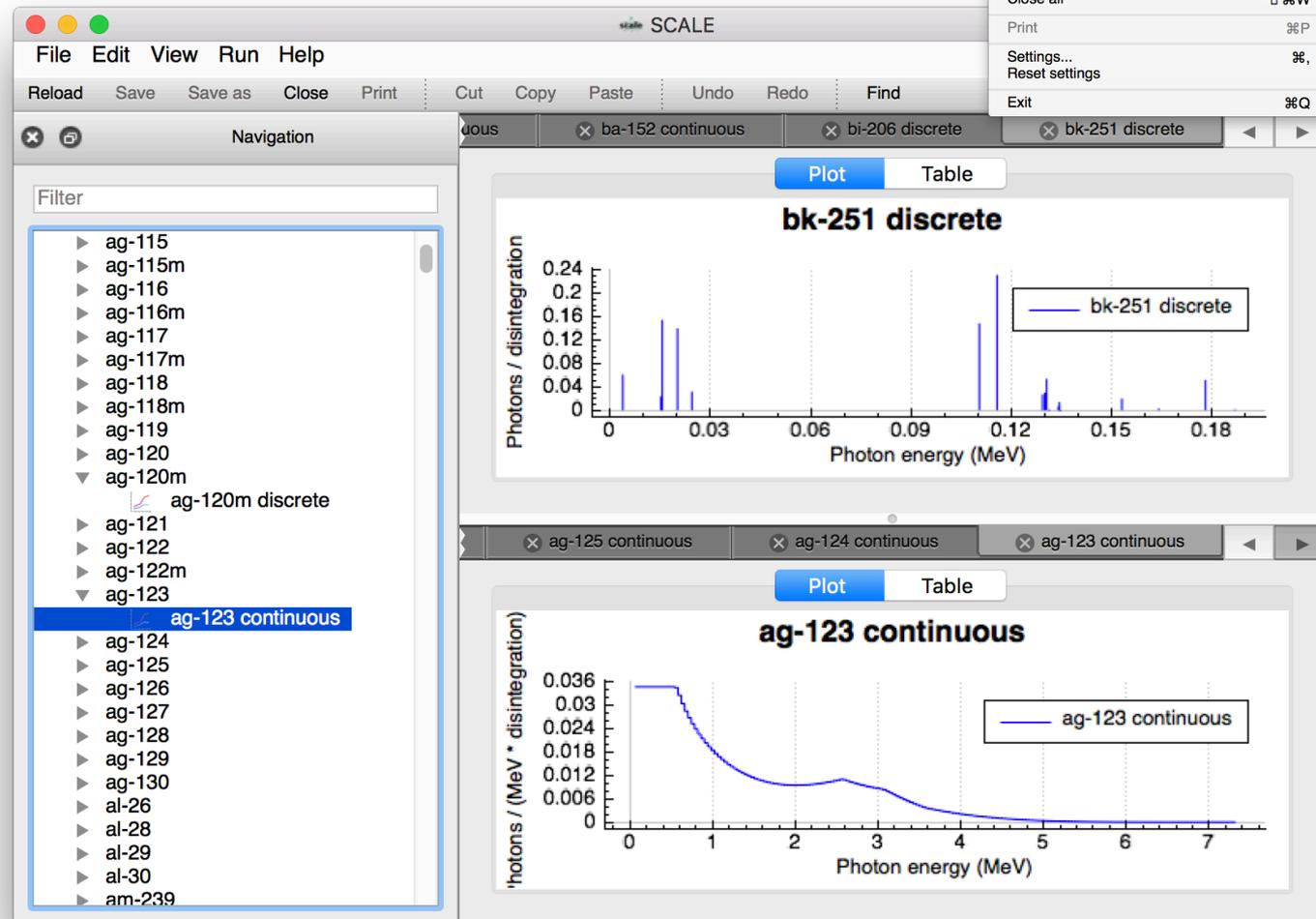
General Output Result Plots

- Keno k-effective By Generation.

- Keno Frequency Distributions.

- Keno Flux.

- Keno Final edit of fissions, absorptions, and leakage.

- MAVRIC batch convergence data for point detector and region tallies.

- MAVRIC response input and multigroup representation.

- Sampler histograms, histories, running averages, and scatter plots.

- Opus Plots (plt)

- And others…

OAK RIDGE
National Laboratory

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
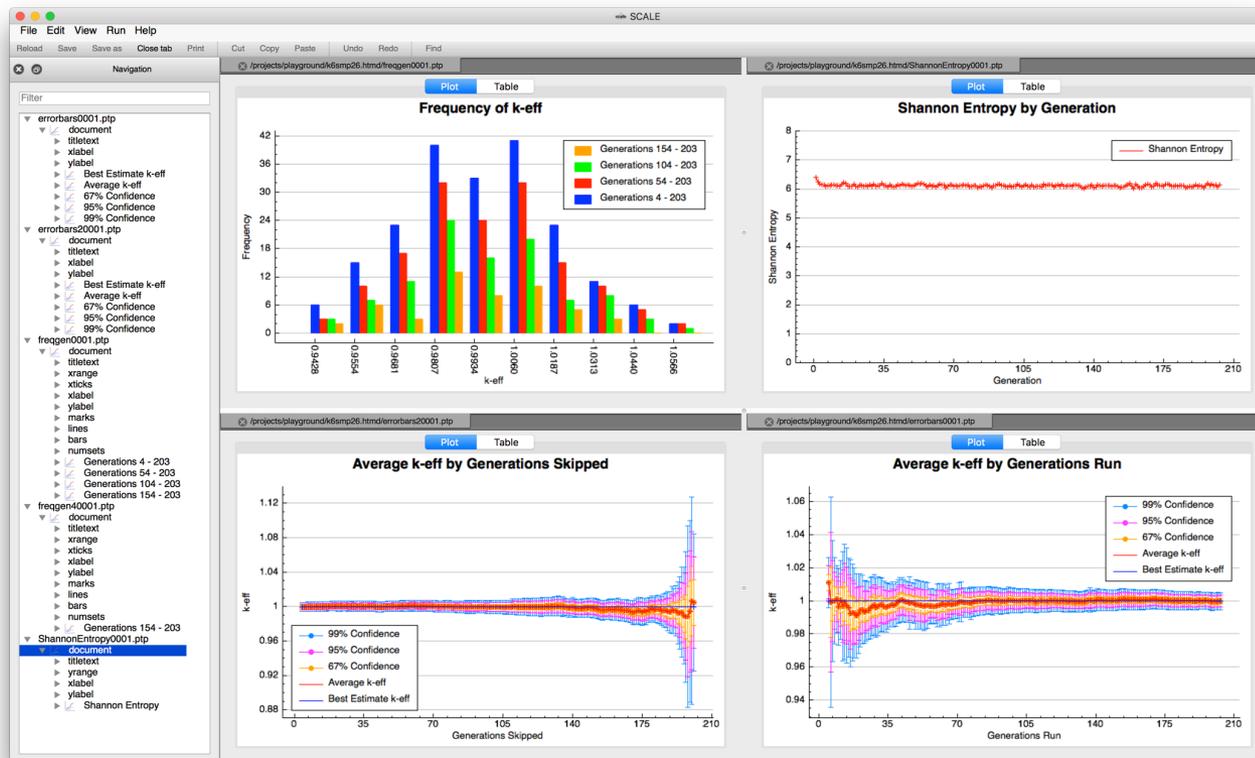
Summary

- Plot Overview

- Interactive plot controls

- AMPX Cross Section Data

- Covariance Data

- ORIGEN Isotope Concentration Data (F71)

- F71 Special Plot Controls (PlotOPUS)

- ORIGEN Gamma Data

- General Output Result Plots

- Questions?

OAK RIDGE
National Laboratory

Fulcrum User Interface

Geometry Viewer Overview

Robert A. Lefebvre

October 2016

OAK RIDGE
National Laboratory
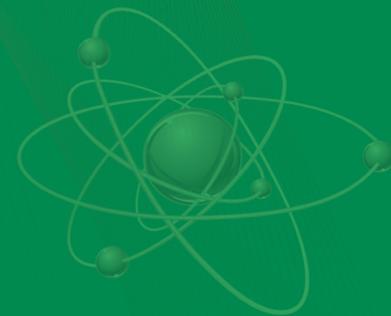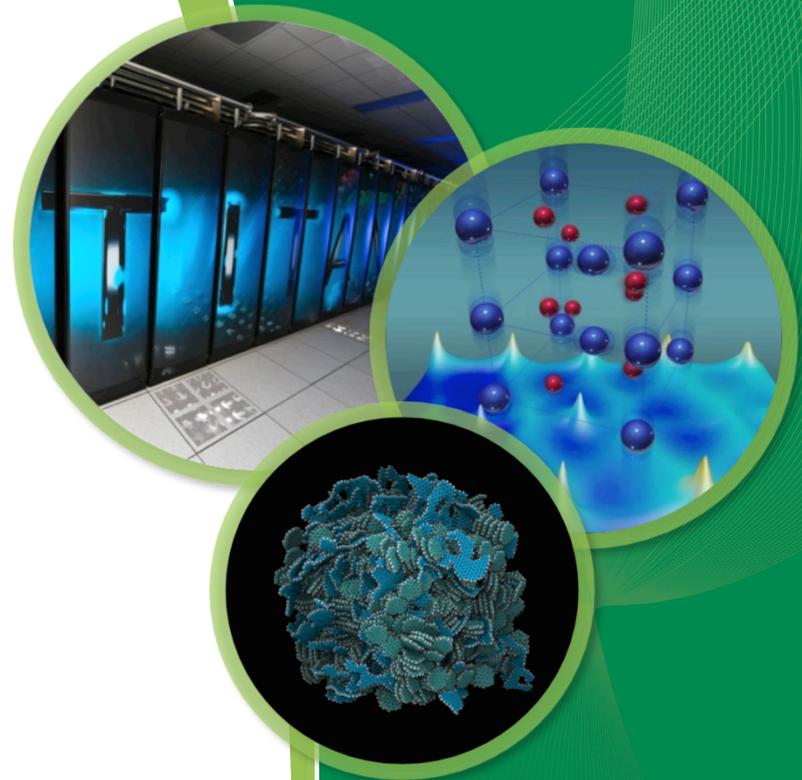
Presentation Outline

- Geometry Viewer Overview

- Activating the Geometry Viewer

- Viewer Controls

- Axis Views

- Render Modes

- Geometry Magnification

- View Origin

- Show View Origin

- View Origin Preserved Across View Plane (Top to Front, etc.)

- Geometry Error Presentation

- Miscellaneous Features

- Mesh Overlay Overview

- Mesh Overlay Supported Formats

- Mesh Overlay Controls

- Future Features

OAK RIDGE
National Laboratory

Geometry Viewer Overview

Geometry viewer uses ray tracing to present a perspective as close to the particle transport as possible to the user.

Geometry Viewer Overview

- Axis Views provide 2D axis-aligned geometry renderings.

- Available Meshes to Overlay allows combining geometry rendering with mesh-based results.

- Render Modes – toggle between different material, outline, and mesh overlay render modes.

- Show view origin – highlights exact point at center of view with crosshair.

- Position, Unit, and Mixture under Cursor – communicates geometry information under mouse cursor.

- View origin – displays and provides control of the origin of the view.

- Axis view plane slide controller – interactively manipulates the elevation of the view plane.

- Context Menu (via right click) – allows changing color and saving images.

OAK RIDGE
National Laboratory

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.

Geometry Viewer Controls

Geometry viewer controls facilitate manipulation of the geometry rendering.

- Axis (X,Y,Z) rendered.
  - Top (X-Y) – view plane intersects Z axis.
  - Front (X-Z) – view plane intersects the Y axis.
  - Side (Y-Z) – view plane intersects the X axis.

- Elevation (axis intersection) of the view plane rendered.

- Type of rendering.
  - material, outline, mesh, etc.

- View origin (point at center of view plane).

- Geometry Magnification.

OAK RIDGE
National Laboratory

Axis Views

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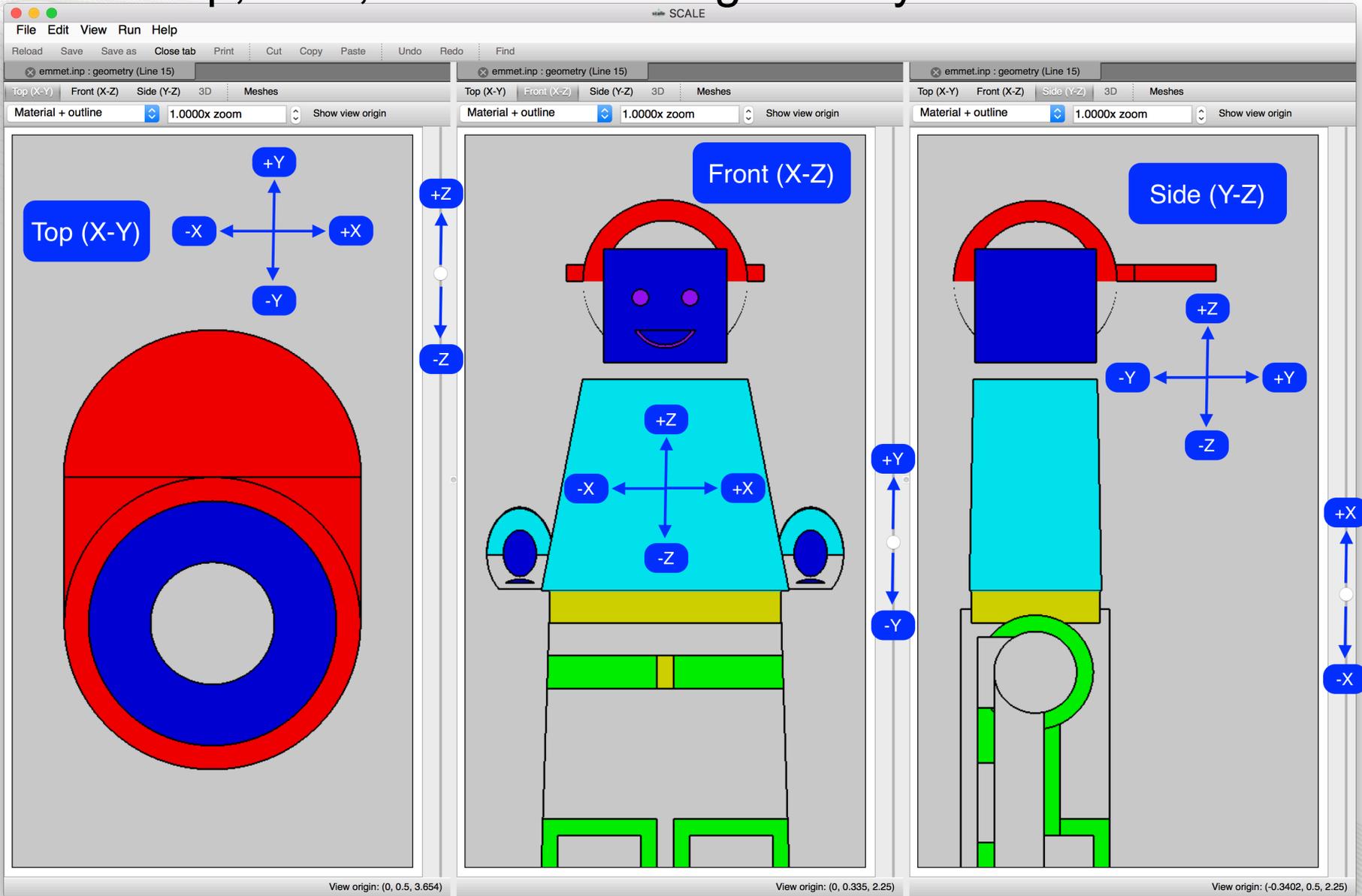
Axis Views : Elevation Control

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.

Render Modes

Render modes control the information displayed.
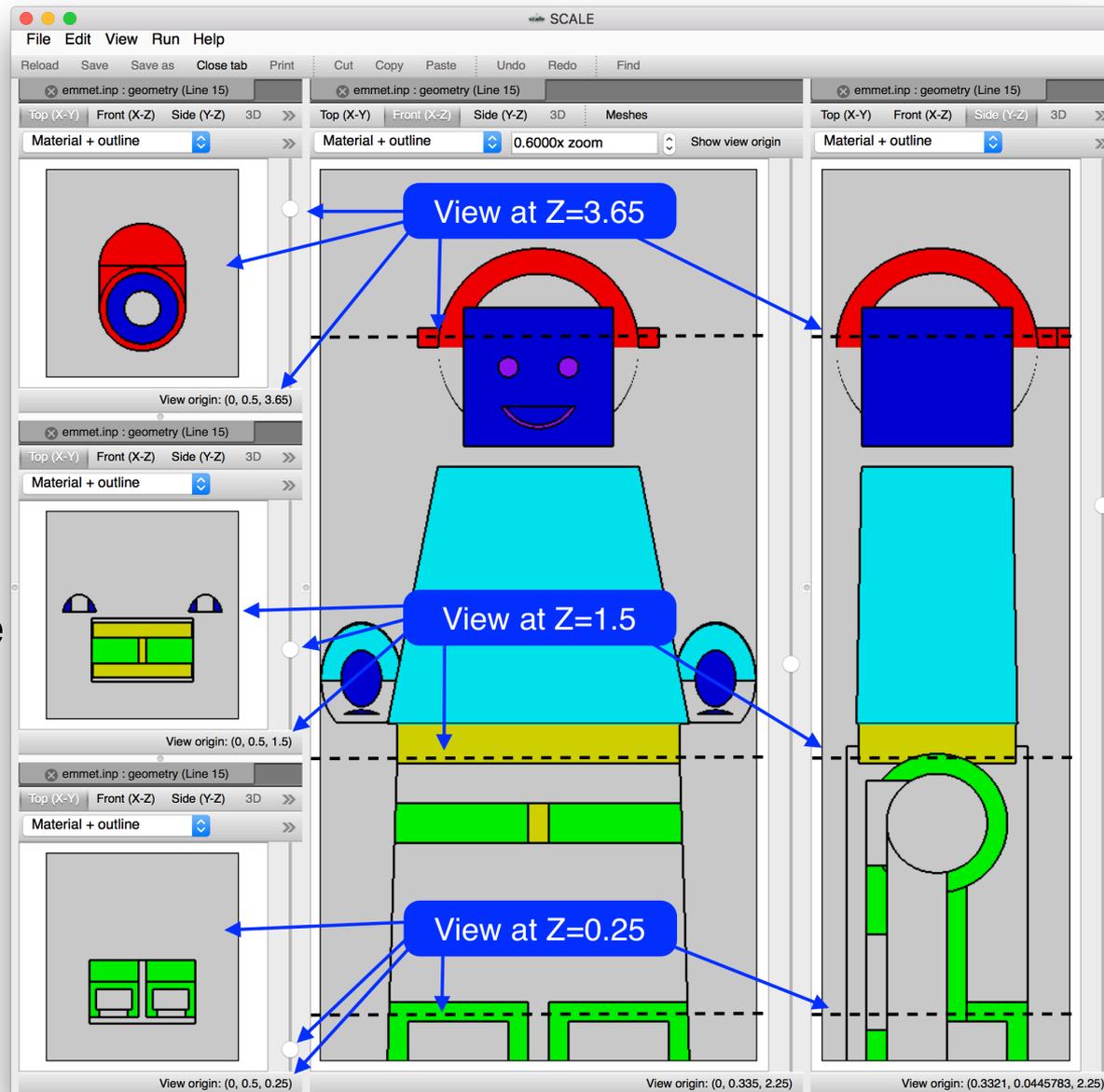
- Material displays only the materials/mixtures.
  - Can hide geometry region outlines that are the same material.

- 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
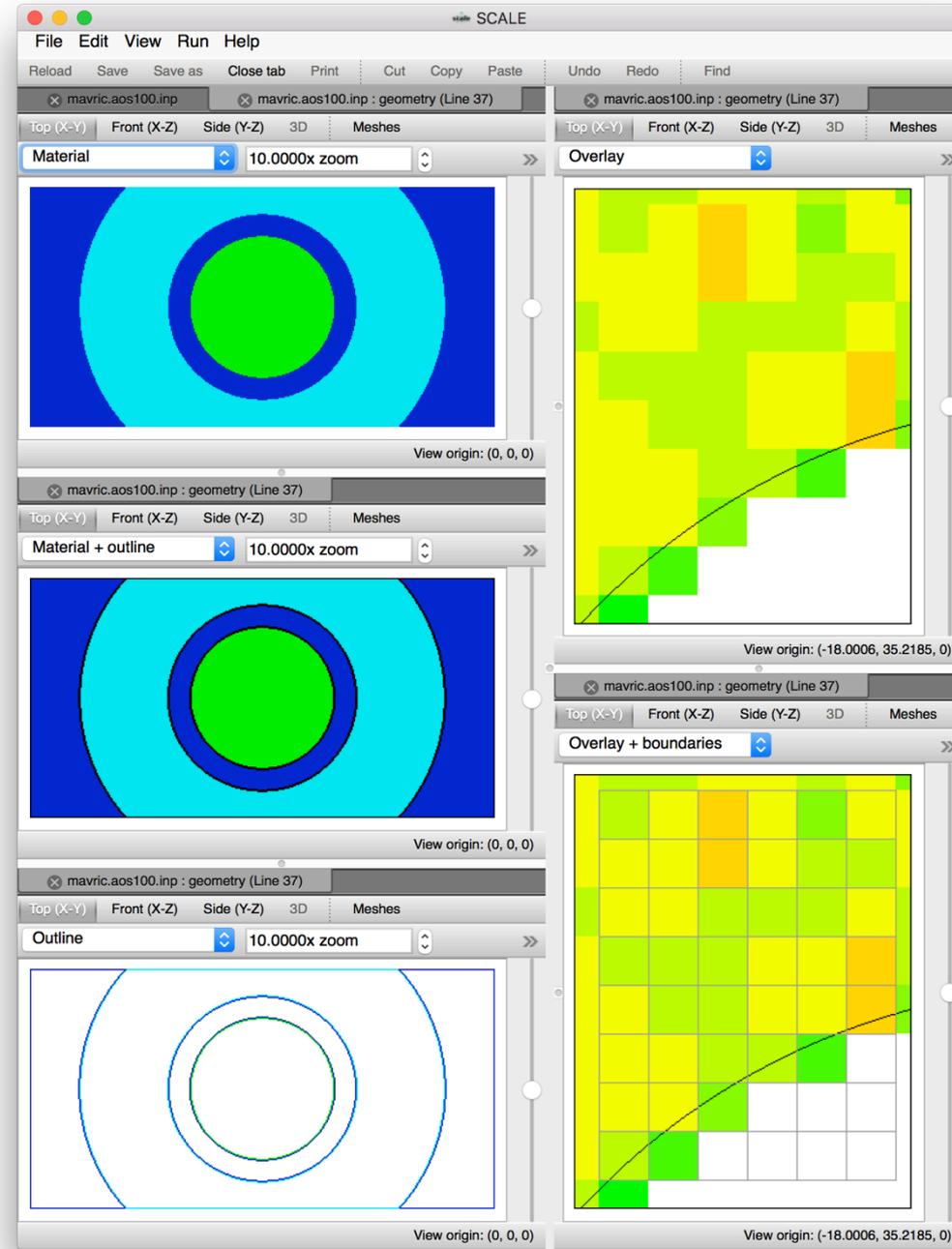
Geometry Magnification (Zoom)

Ray traced geometry rendering allows for significant magnification.

- Specific value typed by user.

- Incremented or decremented via zoom editor spinner controls.

- Visually specified via a user-drawn zoom reticle.
  – Left click and drag down and to the right.
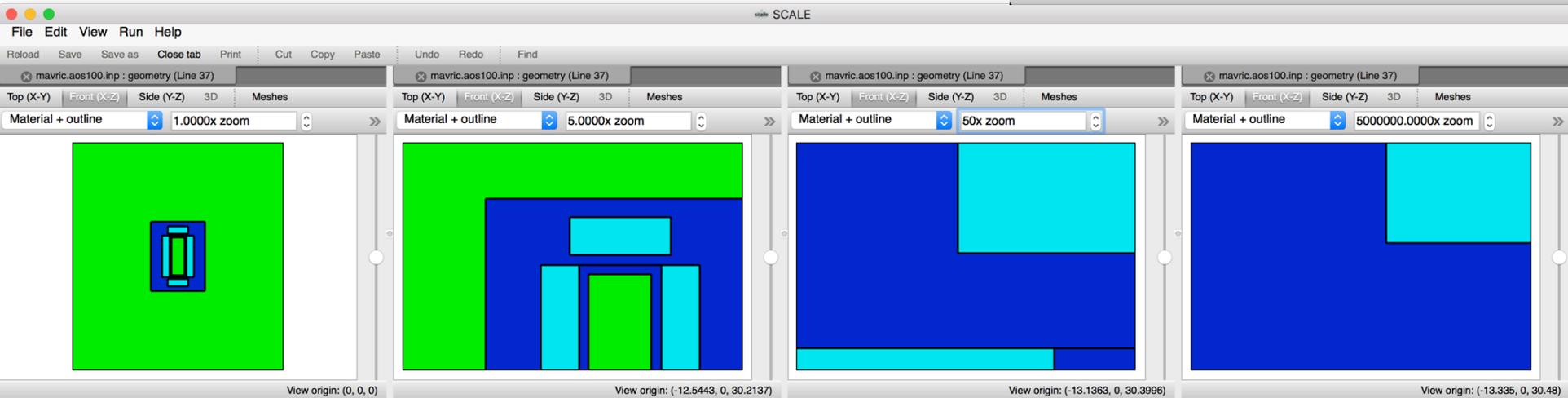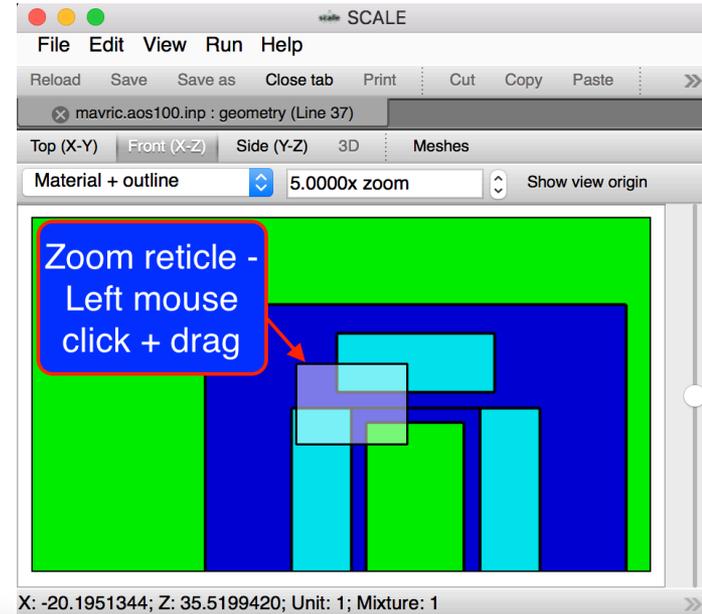
Geometry View Origin Display and Control

Often when geometry errors are encountered, an X,Y,Z position is included in the error message. The ability to quickly navigate to this location and inspect the geometry is facilitated by the view origin control.

- Left click the View origin display to activate X,Y,Z entry.

- 3 Modes of Origin input

    - Single value : Updates the view plane elevation (axis intersect – same as slider control).

    - Two values : Updates the view plane 2D origin (pans the image).

        - Top (X-Y) – sets the X and Y coordinates of the origin.

        - Front (X-Z) – sets the X and Z coordinates of the origin.

        - Side (Y-Z) – sets the Y and Z coordinates of the origin.

    - Three values :
      Updates the view plane elevation and the view plane 2D origin.

- Double Left click centers the view origin at the point clicked.

- Useful when combined with the Show View Origin.
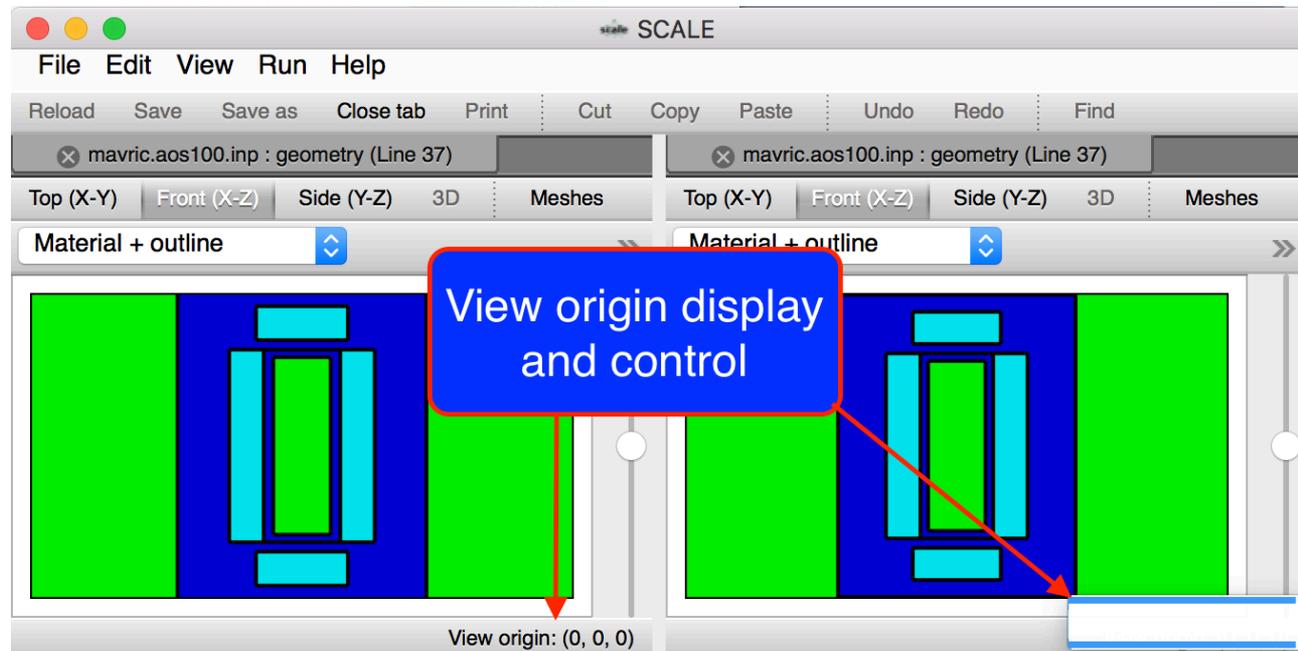
Show View Origin

With ray traced geometry rendering allowing significant magnification, it can be difficult to focus on a specific location. The Show view origin button was added to unambiguously display the location of the view's origin.

- Very useful when debugging geometry at a given location.
  - Enter the location via the view origin control.
  - Show the view origin.
  - Magnify as needed.
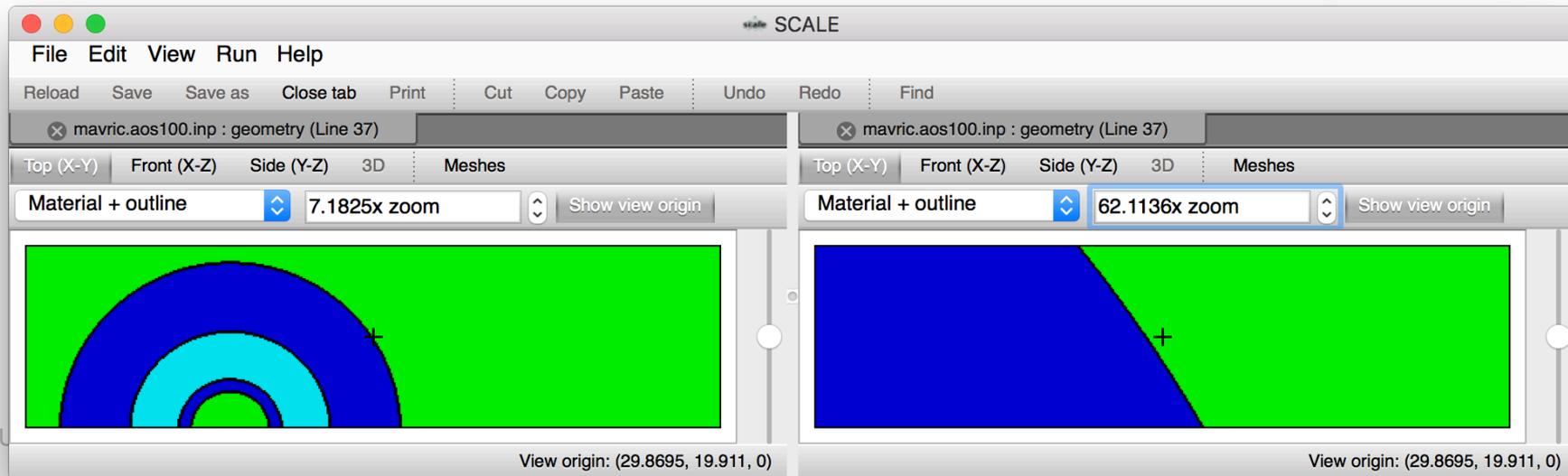
View Origin Preserved Across View Plane

The geometry viewer is often used for geometry verification and debugging. Both typically involve known locations – X,Y,Z of lost particle, etc.

- View origin is preserved during view plane changes (Top to Front, etc.)
  - Facilitates quickly identifying locations where initial view plane is epsilon (1e-15) off a tangent surface.

- Cloneable geometry viewer with subsequent view plane change allows quick visual comparison of location.
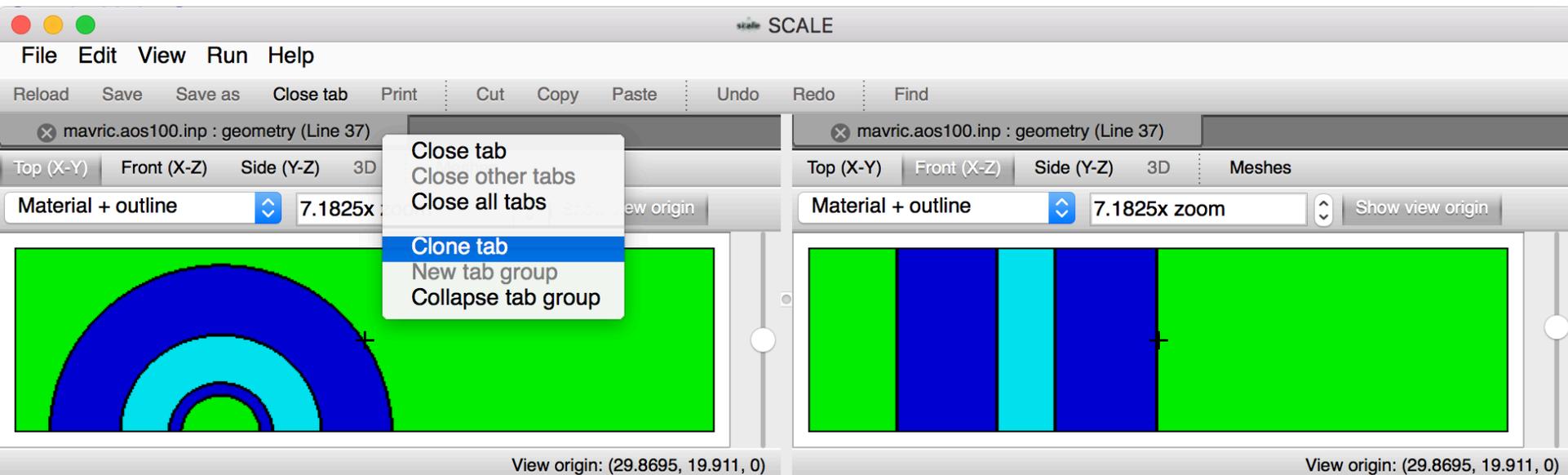
Geometry Errors : Undefined Space

Undefined space lacks any geometry specification. This typically happens when a space is not accounted for with a material statement.

- Cursor information lacks mixture information.

- Undefined space is rendered with grey stripes.

Geometry Errors : Double-Defined Space

Double-defined space has more than a single geometry specification for a give space. This typically happens when a space is not excluded appropriately.

- Cursor information lists multiple mixtures.

- Double-defined space is rendered using alternating striped mixture colors.

- NOTE : the tangent planes of adjacent regions can appear as double-defined space but are infinitely thin.

Mesh Overlay Overview

- Loading Mesh Data.
  - Supported formats (see slide 89).

- Render Modes.

- Contours and color legend.

- Scale – Log and Linear.

- Range – File, Family, Dataset, or Custom.

- Position, Mesh value, Mesh Voxel, Unit, and Mixture under Cursor.

- Context Menu.

- 2D Plot creation.
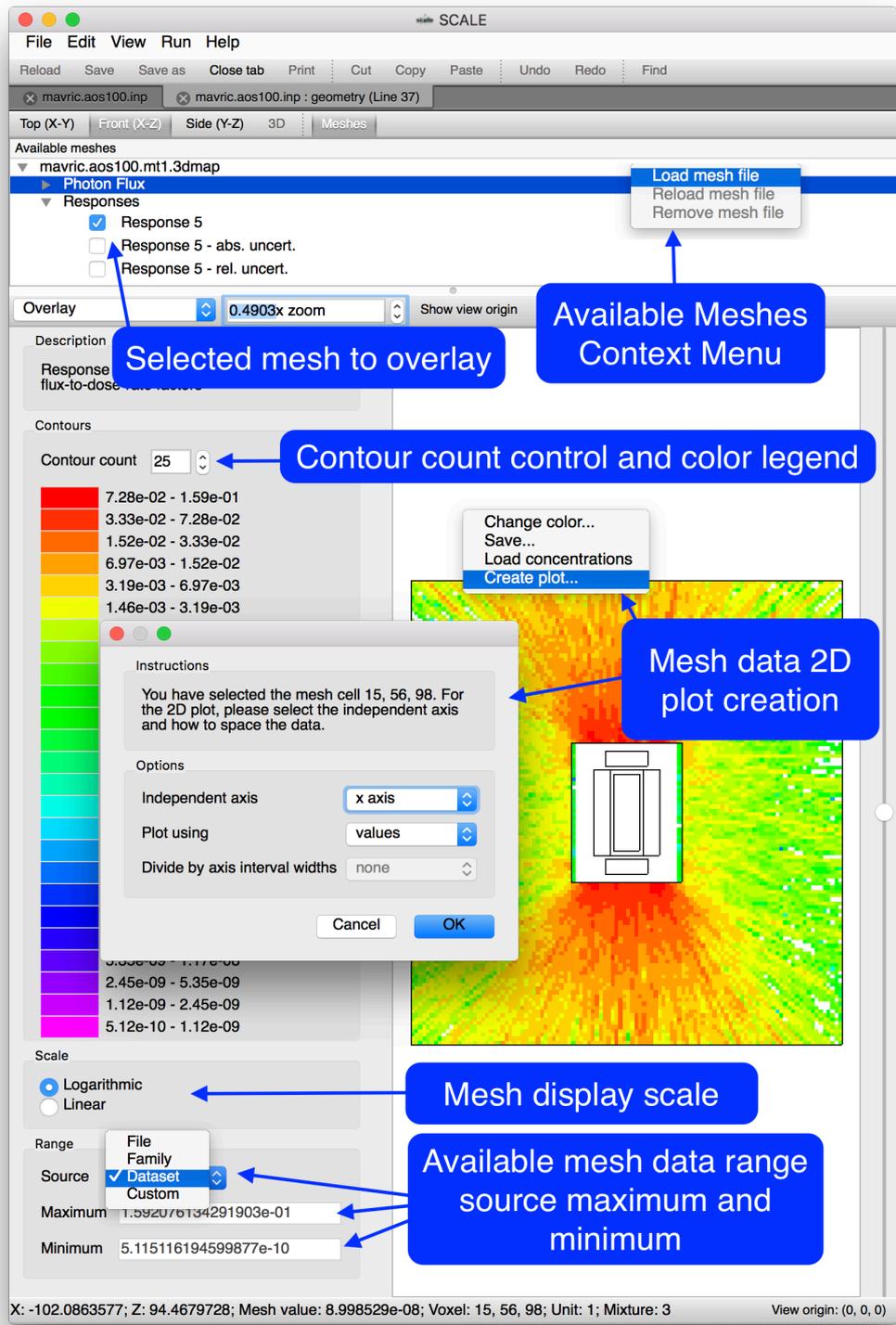
Mesh Overlay : Loading Mesh Data

With the available Meshes window open, a context menu is available via right click. This context menu will allow loading new, and removing or reloading existing mesh files.

- Right click in Available meshes to access Load mesh file dialog. Select the mesh to load.

- Most of SCALE's major mesh formats are supported
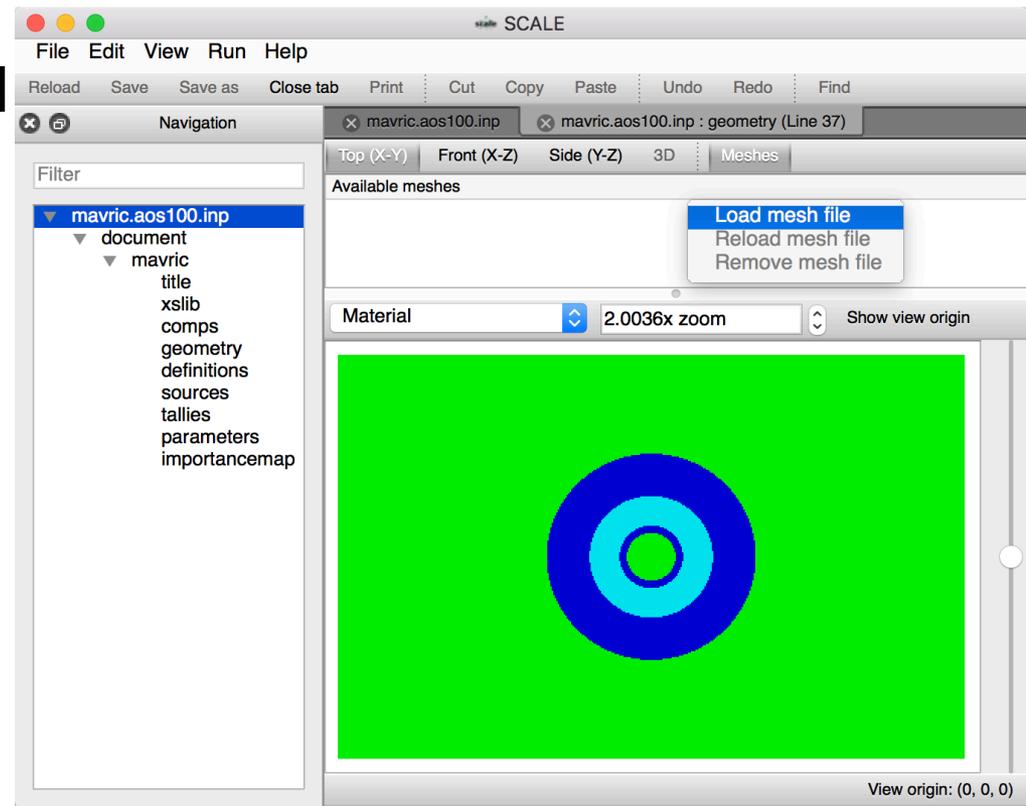
Mesh Contours, Color Legend, and Scale

- 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.

OAK RIDGE
National Laboratory
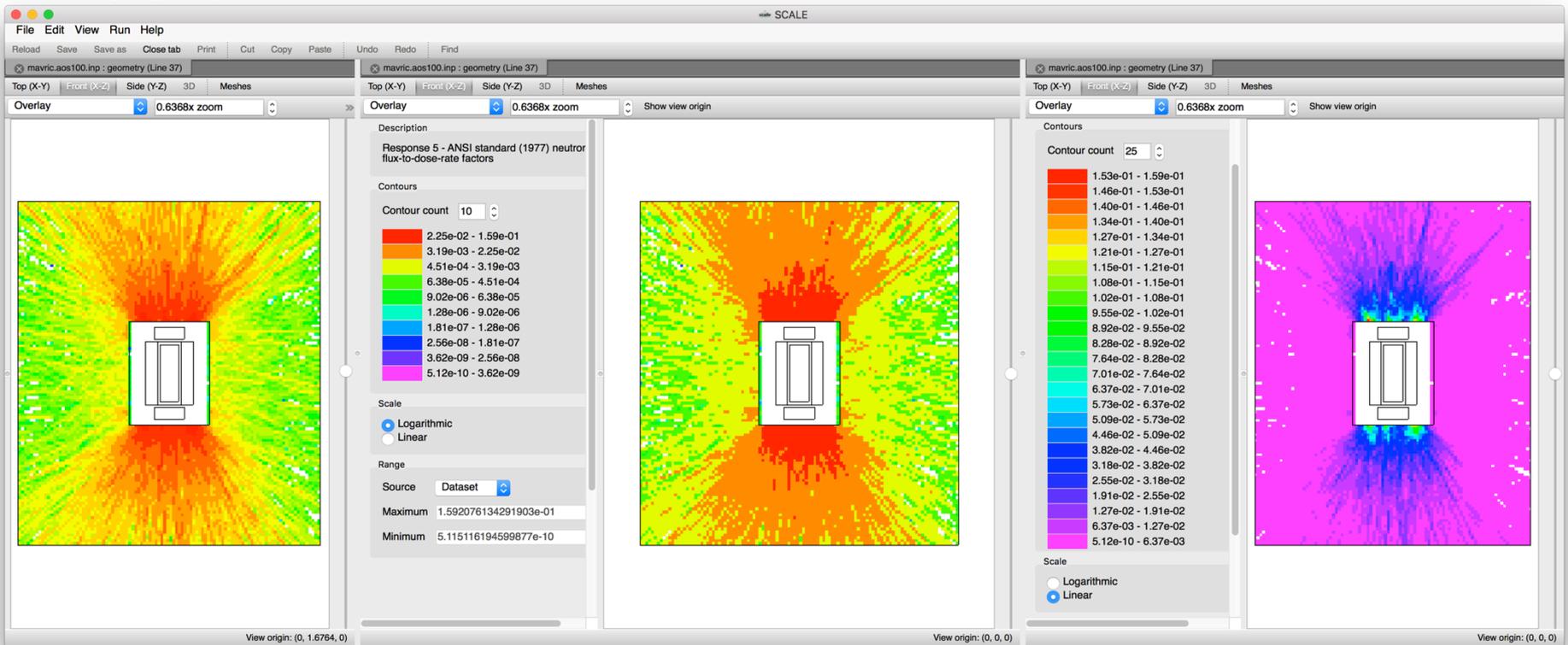
Mesh Overlay : Data Ranges

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.
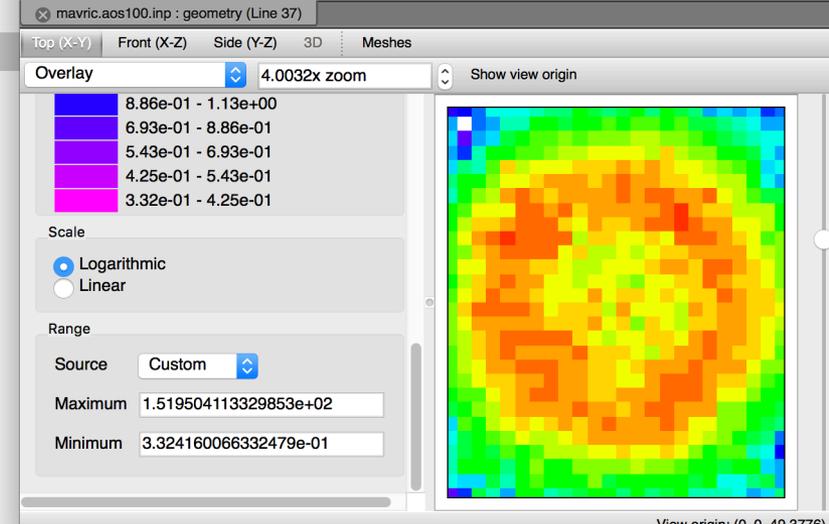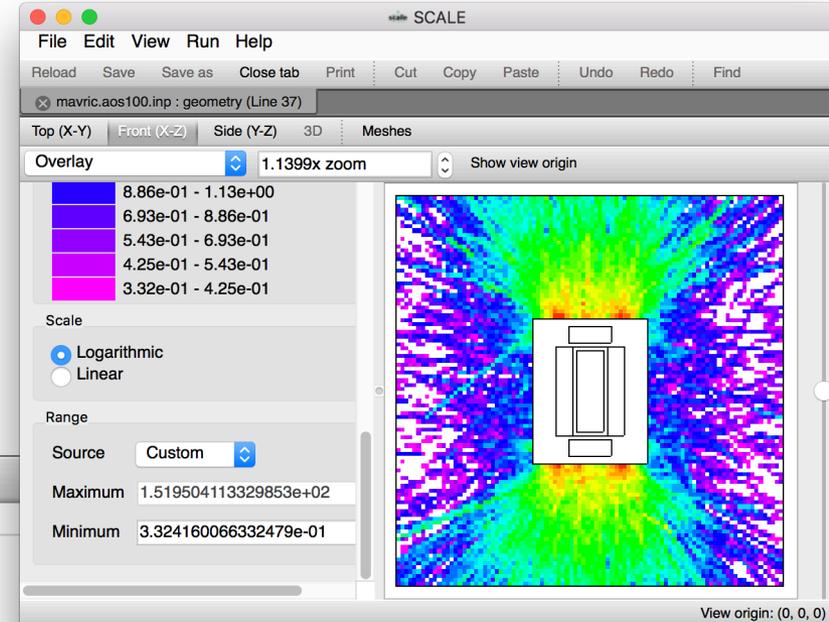
Mesh Overlay : Integrated 2D Plot Creation

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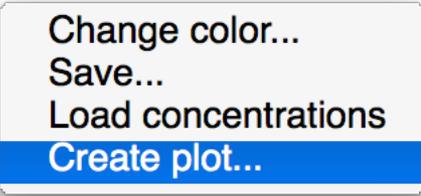
- Plot options include
  - Independent axis
    - Cartesian X,Y, and Z.
    - Cylindrical Radial, Theta, and Z.
    - Group when group-wise data is available.
  - Plot using values or indices.
  - When data is group-wise axis interval widths can optionally be divided linearly or logarithmically.

Geometry Viewer : Future Features

- 3D Ray traced visualization.
  - Material Transparency.
  - Geometry Culling Surfaces (similar to Keno3D cutaways).
  - Mesh Overlays.

- Geometry view to Input material definition quick view.
  - Allows display of input that creates the material under the cursor.
  - Allows display of isotopic number densities that compose the material under the cursor.

- Geometry view to Input region definition quick view.
  - Allows display of input region/media statement that creates geometry under cursor.

- Visualize any unit on-demand with an optional nesting level.
  - Allows investigating single geometry units with limited depth/ complexity.

- Enhanced input and geometry coupling.
  - Display grid/cylinder geometry prior to job execution.
  - Display detector/source locations prior to job execution.

OAK RIDGE
National Laboratory

Summary

- Geometry Viewer Overview

- Activating the Geometry Viewer

- Viewer Controls

- Axis Views

- Render Modes

- Geometry Magnification

- View Origin

- Show View Origin

- View Origin Preserved Across View Plane (Top to Front, etc.)

- Geometry Error Presentation

- Miscellaneous Features

- Mesh Overlay Overview

- Mesh Overlay Supported Formats

- Mesh Overlay Controls

- Future Features

- Questions?

OAK RIDGE
National Laboratory