

Advanced User Interface Capabilities

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Summary

This tutorial will review the **data plotting** and **geometry visualization** capabilities in the Fulcrum user interface. This tutorial will help you become familiar with Fulcrum's **2D plot**, and **2D and 3D geometry visualization** features.

You will learn how to identify **plottable data items**, **compose** and **export plot** and **plot data** for SCALE plot formats (SDF, Ampx MG/CE, PLT, F71, PTP, SPF, ORIGEN Gamma data, etc.) and **visualize**, **navigate**, **cut**, **hide**, and **export** the **geometry** and **spatial data** (fission-, dose-map, etc.) overlays in 2D and 3D.

No prior experience with SCALE is required. Attendees can follow along using 6.3.0-beta.



User Notice

This tutorial is intended to train users in the advanced functionality of the Fulcrum data and geometry plotting capabilities.

It is not intended to train users in the use of the SCALE code system's cross section processing, criticality safety, depletion, shielding, sensitivity and uncertainty, or source term computational modules.

Schedules and contact information for specific tutorials and training courses can be found at https://www.ornl.gov/scale/scale-training



Outline

- Vision
- Fulcrum Component Overview
- Plotting Overview
- Plot Controls
- 2D Plots
 - AMPX Cross Section Data (MG, CE) plots
 - Covariance data plots
 - ORIGEN Gamma data
 - Sensitivity Data File (SDF) plotsORIGEN F71 Plot

- OPUS PLT
- MAVRIC ChartPlot plots
- Scale Plot Format (SPF) plots
- KENO PTP Results plots
- Plot saving
 PDF, PNG, SPF
- Geometry Visualization
 - Activation and Layout
 - 2D Controls
 - 3D Controls
 - Spatial data plotting



Fulcrum Mission Statement

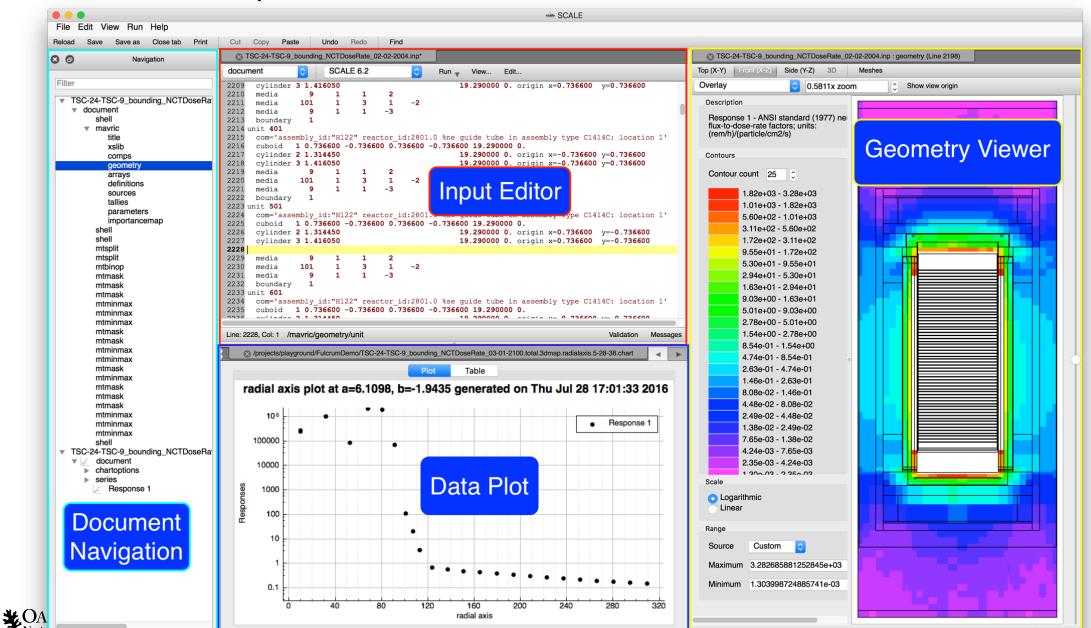
Provide a <u>cross-platform</u> graphical user interface (GUI) designed to facilitate problem creation, modification, navigation, validation, and visualization, as well as output and data file interaction as needed by <u>new</u> and <u>experienced</u> users.



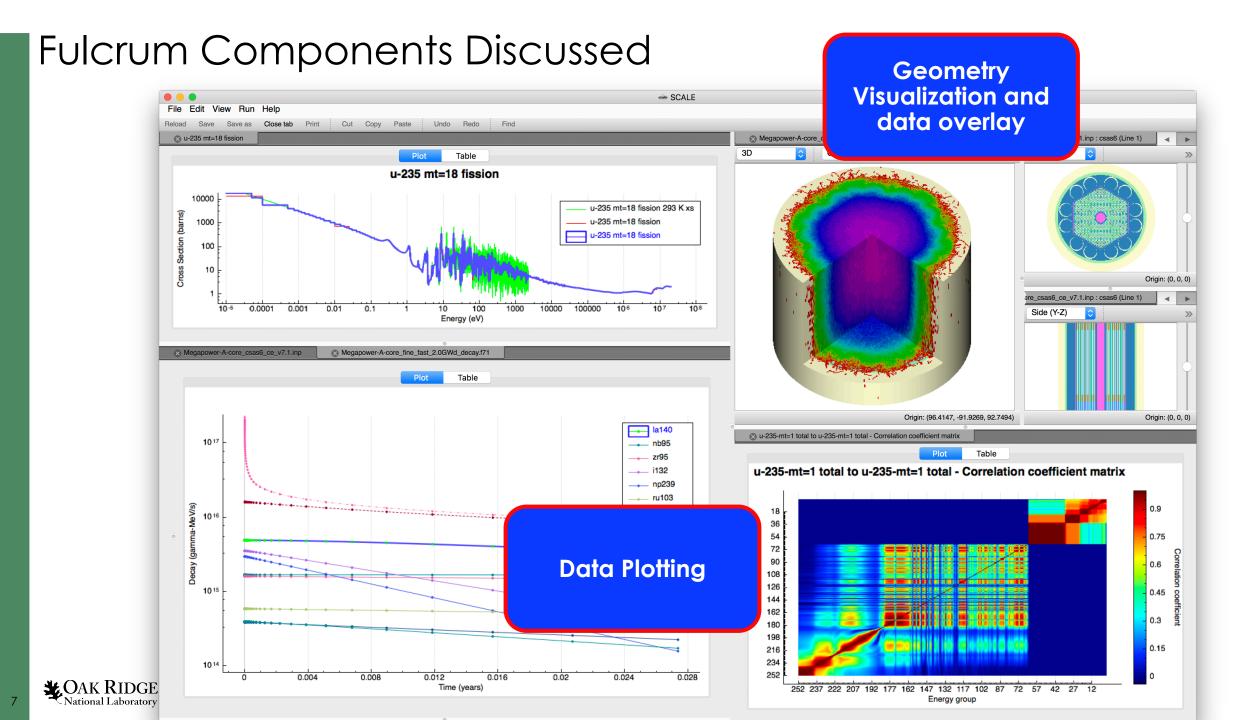


Fulcrum Components Overview

6



View origin: (0, 0, -1.9435)



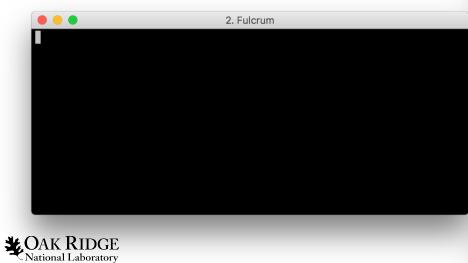
Tutorial Requirements

- Have SCALE 6.3 beta installed
- SCALE Data installed
- Have Advanced_User_Interface training pack downloaded
 - includes input and data files



Fulcrum Startup Screen

- Start Fulcrum
- Little to look at
- Lean and mean
- Always has a terminal/CMD window in the background that contains log messages



			state	SCALE		
File Edit	/iew Run Help					
Reload Save	Save as Close	Print Cut C	opy Paste	Undo Redo	Find	
80	Navigation					
•••	3					





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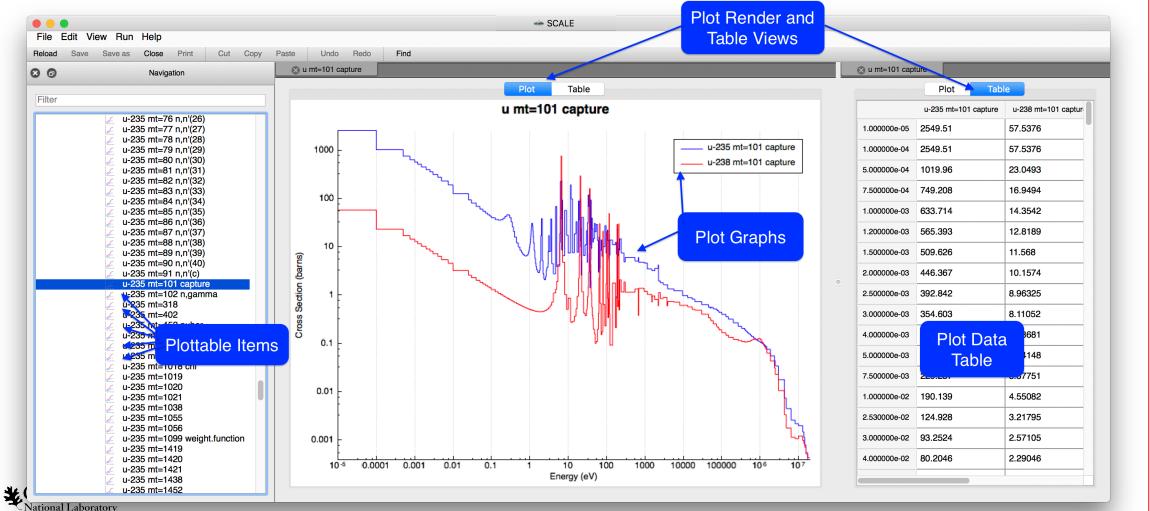
Data Plotting Overview

- Plot Controls
- AMPX Cross Section Data
- Covariance Data
- ORIGEN Gamma Data
- ORIGEN Isotope Concentration Data (F71)
- F71 Special Plot Controls (PlotOpus)
- Sensitivity Data Files (SDF)
- Result Plots (KENO PTP, MAVRIC ChartPlot, Opus PLT, etc.)



General Plot Overview

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

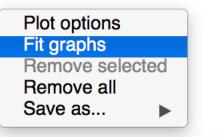


Plot Controls

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/trackpad scroll action
 - Zoom in by scrolling up
 - Zoom out by scrolling down
- Panning is performed via a left-click and drag
 - Pan right by left-click and dragging left
 - Pan up by left clicking and dragging down
- Plot Legend can be dragged to 9 positions via left-click and drag
- Plot attributes (color, style, etc.) can be changed via context menu Plot options
- Reset to original extents via context menu Fit graphs

 Save Plot as PDF (includes scalable vector graphics SVG) PNG and JPG image format Interactive Scale Plot Format (SPF)



	Plot2D Options			
Chart	Property	Value		
Legend	 u-235 mt=101 capture 			
-	Name	u-235 mt=101 capture		
Axes	Line Style	StepRight		
Graphs (2)	Line Color	[0, 0, 255] (255)		
	Red	0		
	Green	0		
	Blue	255		
	Alpha	255		
	Line Weight	0		
	Scatter Style	None		

OK



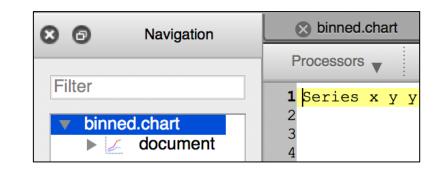
Plot Controls | Hands On

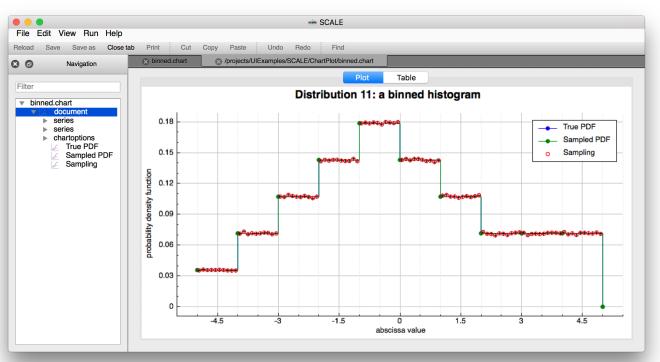
- Click File > Open file... and open Advanced_User_Interface/ChartPlot/ binned.chart
- Observe the binned.chart file become visible in the Navigation panel and a new binned.chart text editor tab
- Note the Navigation panel's Plottable icon

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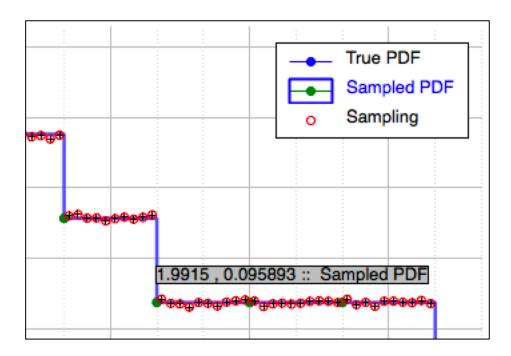
 Double left-click the binned.chart > document plottable item to plot the entire document





Plot Controls | Hands On Graph Selection

- Select the green Sampled PDF graph via a left-click on the green line
- Observe the selected graph turn blue, the Legend graph entry text color become blue with line style emphasized via a blue box, and the cursor location include the graph name Sampled PDF
- Alternatively, a graph selection can be made in the Legend via a left-click of the graph name
- Deselection is accomplished by a left-click in an empty plot location





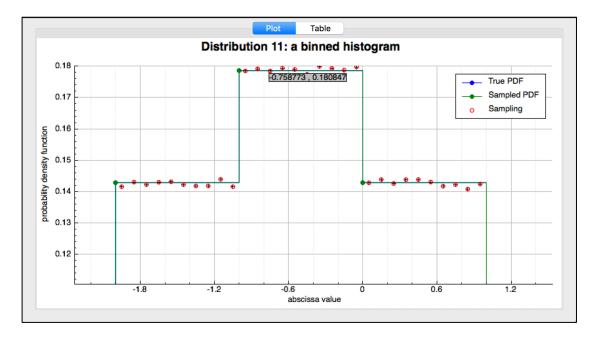
Plot Controls | Hands On Zooming and Panning

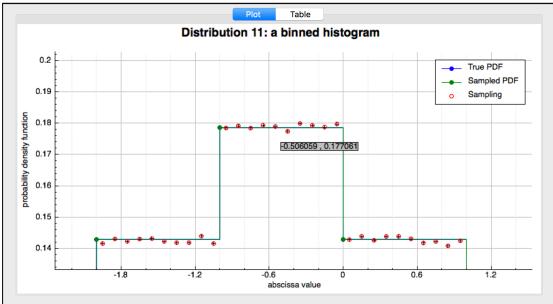
 Zoom in to the graph peak via scrolling up

• Pan down via left-click and drag down

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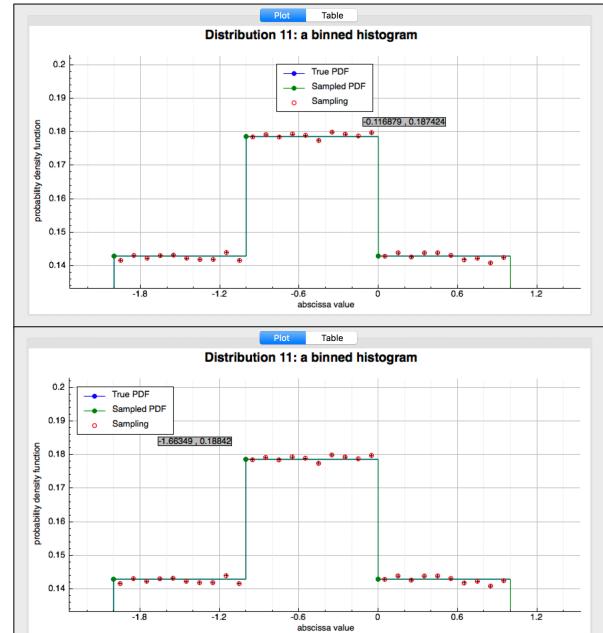
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Plot Controls | Hands On Legend Position

- The **Legend** can be positioned in 9 locations the default is upper-right corner
- Left-click and drag the Legend to the upper-left corner
- Observe the **Legend** snap from the upper-right corner to the upper-center to the upper-left corner





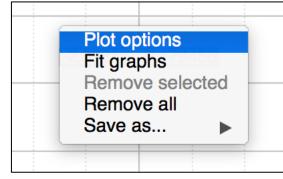
Plot Controls | Hands On Plot Options

- Right-click on the Plot and select Plot options
- Chart allows changing the plot title's
 - text,
 - font,

- color, and
- visibility

-					
	Plot2D Options				
Chart Legend Axes Graphs (3)	Property ▼ Title Visible ▼ Font Family Point Size Bold Italic Underline Strikeout Kerning ▼ Color Red Green Blue Alpha	Value Distribution 11: a binned histogram Image: Distribution 12: binned histogram Image: Distribution 12: binned histogram Image: Distribution 12: binned histogram Image			
1					

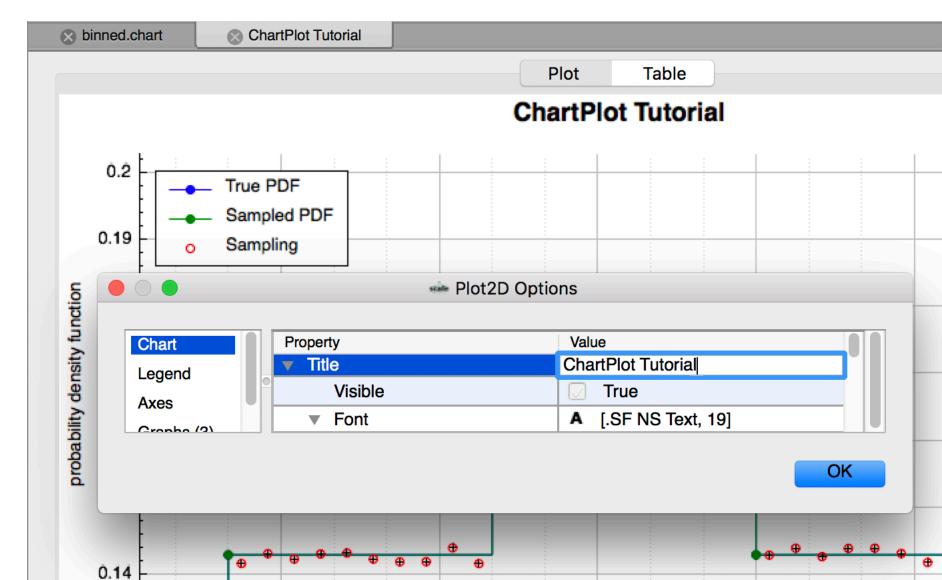




Plot Controls : Plot Options Chart Changes

- In the Title Value column remove the existing title and enter ChartPlot Tutorial
- Observe the Plot Tab title and Plot Title update

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Plot Controls : Plot Options Legend

• Legend allows changing the legend's font and visibility

\bigcirc	Plot2D Options			
Chart	Property	Value		
Legend	Visible	🗸 True		
Axes	 Font 	A [.SF NS Text, 13]		
Graphs (3)	Family	Al Bayan		
Graphs (3)	Point Size	13		
	Bold	False		
	Italic	False		
	Underline	False		
	Strikeout	False		
	Kerning	🕢 True		

OK



Plot Controls : Plot Options Legend Changes

Value Chart Property Click the Font editor ellipsis True Legend A [Helvetica, 14 Font Axes Family Helvetica Note the ellipsis button will appear when the Graphs (3) Point Size 14 Rold Truo Value column field is selected Select font - Platform-specific (Windows, Mac, Linux) Font Collection +Size Family Typeface Cochin All Fonts Regular 14 chooser may appear different than illustrated Comic Sans MS English Oblique 9 Favorites Copperplate Light 10 Light Oblique Courier Recently Used 11 **Fixed Width** Couri Bold 12 Didot **Bold Oblique** 13 Modern Futura Change the Typeface to be Bold 14 PDF Geneva 18 Traditional Georgia 24 Gill Sans Web Click OK to close the Font editor 36 Helvetica ло Cancel OK Observe the Legend items become Bold 0.2 True PDF

0.19

Plot2D Options

Sampled PDF

Sampling



Plot Controls : Plot Options Axes

- Axes allows changing axis
 - visibility,
 - label text,
 - text font and color,
 - Scale (linear or log),
 - range,
 - grid,
 - tick label font and attributes (rotation, precision, etc.)

	🛥 Plot2D Option	ns
Chart	Property	Value
Legend	► X-Axis ▼ Y-Axis	
Axes	Visible	🕢 True
Graphs (3)	Label	probability density function
	► Label Color	[0, 0, 0] (255)
	► Label Font	A [.SF NS Text, 13]
	Scale	Linear
	Range Min	0.133218
	Range Max	0.202769
	Range Reversed	False
	Grid	SubGrid
	► Tick Label Font	A [.SF NS Text, 13]
	Tick Label Rotation	0.00
	Tick Label Type	Number
	Tick Label Precision	6
	Tick Label Number	gb
	Tick Label Date/Ti	hh:mm:ss dd.MM.yy



Plot Controls : Plot Options Graphs

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

* adaptive sampling – conducts intelligent sampling of the data points providing significant speed up when many data points are involved. Default is on.

	Plot2D Options		
	Drenetti	Value	
Chart	Property True PDF	Value	
Legend	Name	True PDF	
Axes	Line Style	StepLeft	
Graphs (3)			
		[0, 0, 255] (255)	
	Line Weight	1	
	Scatter Style	• Disc	
	Scatter Size	6.00	
	Pen Style	Solid	
	Adaptive Sampling	🔽 True	
	Error Bars	Both	
	 Sampled PDF 		
	Name	Sampled PDF	
	Line Style	StepLeft	
	Line Color	[0, 128, 0] (255)	
	Line Weight	1	
	Scatter Style	Disc	
	Scatter Size	6.00	
	Pen Style	Solid	
	Adaptive Sampling	🔽 True	
	Error Bars	Both	
	 Sampling 		
	Name	Sampling	
	Line Style	None	
	 Line Color 	[255, 0, 0] (255)	
	Red	255	
	Green	0	
	Blue	0	
	Alpha	255	
	Line Weight	1	
	Scatter Style	O Circle	
	Scatter Size	6.00	
	Pen Style	Solid	
	Adaptive Sampling	🛛 True	
	Error Bars	Both	



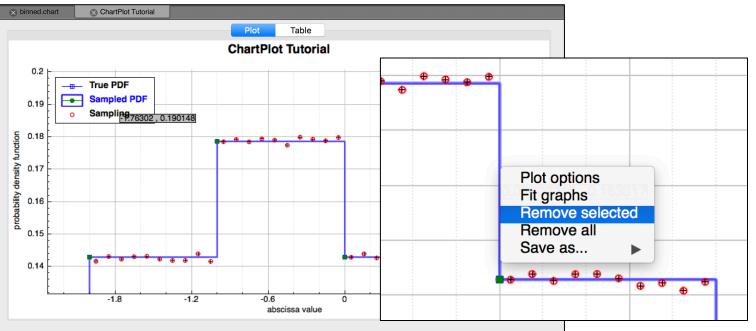
Plot Controls : Plot Options Graph Changes

- Change the True PDF Scatter Style to PlusSquare
- Observe the True PDF Legend entry style update
- Click OK to close the Options dialog

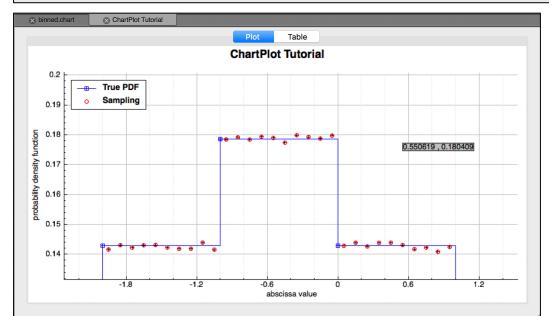
	Plot2D Op	tions	
Chart	Property	Value	
Legend	True PDF		
	Name	True PDF	
Axes	Line Style	StepLeft	True PDF
Graphs (3)	Line Color	[0, 0, 255] (255)	Sampled PDF
	Red	0	o Sampling
	Green	0	
	Blue	255	
	Alpha	255	
	Line Weight	1	
	Scatter Style	🛛 🖽 PlusSquare 😒	
	Scatter Size	6.00	
	Den Ohde		

Plot Controls : Graph Removal

- Select the Sampled PDF graph via left-click the graph in the plot or in the Legend
- Right-Click anywhere in the plot and select **Remove selected**



 Observe the Sampled **PDF** is removed from the plot and Legend



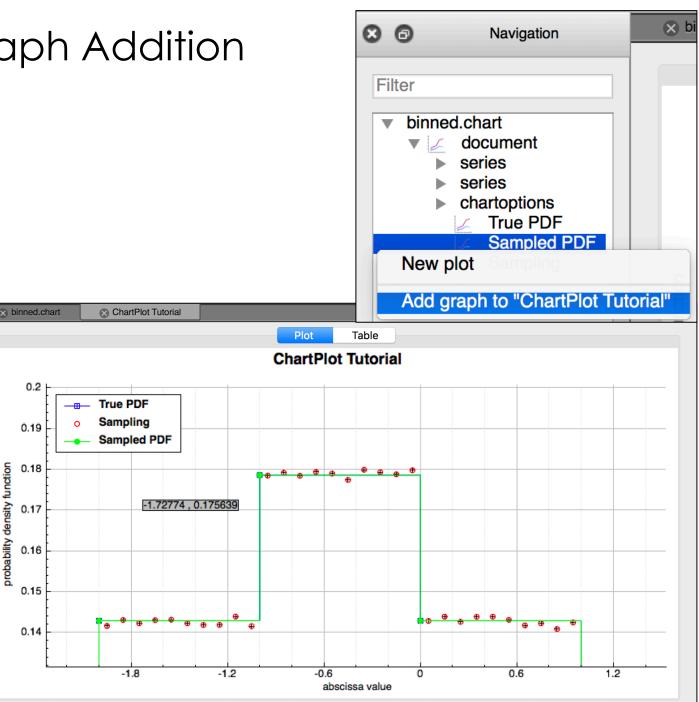


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Plot Controls : Graph Addition

probability density function

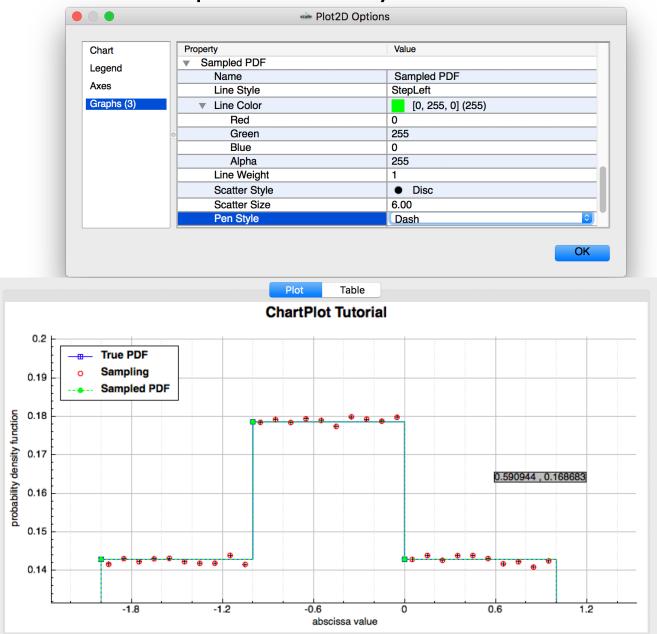
- In the Navigation panel right-click the Sampled PDF
- select Add graph to "ChartPlot Tutorial"
- Observe the Sampled PDF is added to the Plot and Legend
- Plot graphs can be added to any plot that has **matching** axis names





Plot Controls : Plot Options Graph Pen Style

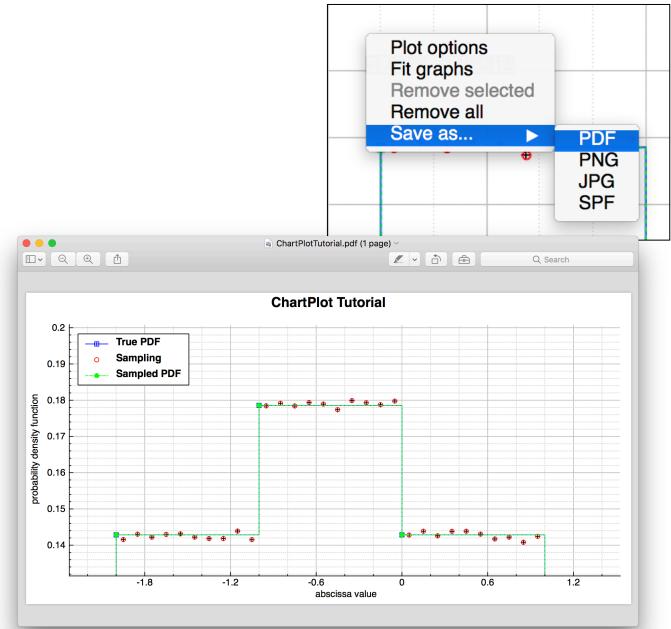
- Right-click the plot and select
 Plot Options
- Update the Sampled PDF Pen Style to be Dashed
- Click OK
- Observe the update in the plot legend and plot, and the improved visibility of **True PDF**





Plot Controls : Save As PDF

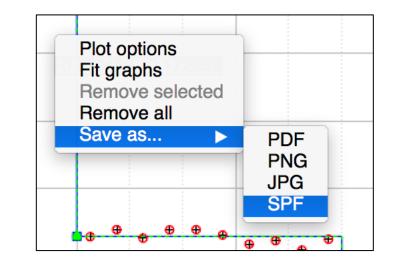
- Save as PDF uses Scalar Vector Graphics (SVG) to improve incorporation into reports
- Right-click the plot and select
 Save as... > PDF
- Save as ChartPlotTutorial.pdf
- Open in your PDF viewer and observe report-ready figure

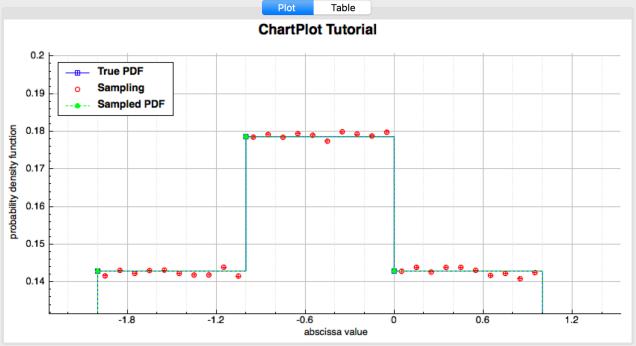




Plot Controls : Save As SPF

- Save as SPF preserves range and all data (outside zoom) for collaboration
- Right-click the plot and select Save as... > SPF
- Save as ChartPlotTutorial.spf
- Open the SPF file via File > Open file... and select ChartPlotTutorial.spf
- Observe the ChartPlotTutorial.spf available in the Navigation panel
- Double left-click the ChartPlotTutorial.spf > document plottable item
- Observe the new plot

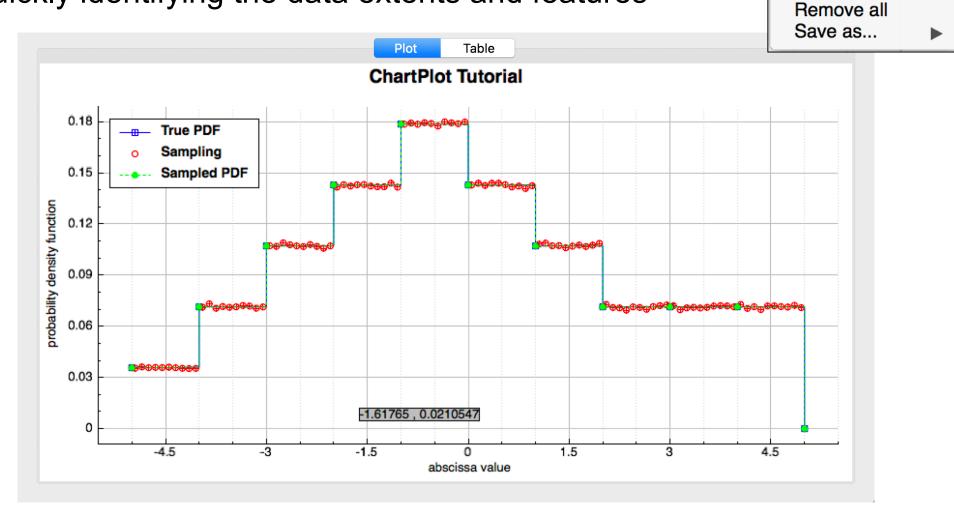






Plot Controls : Fit graphs

- Right-click on the plot and select Fit graphs to zoom out to the extents of the graph data
 Plot options Fit graphs
- Useful for quickly identifying the data extents and features



Remove selected

Plot Controls : Plot Options Mentionables

- When the plot is of bars the **Bars** menu allows changing bar graph name
- When the plot is a color/heat map the Color Map menu allows changing color map graph name and color gradient



Plot Table

- To see graph data select the Table plot tab
- Row, Column, and Table selections allow easy copy-and-paste into Excel, etc.

	Plot	Table	
	True PDF	Sampling	Sampled PDF
5.000000e+00	0.0357143		0.0357143
4.950000e+00		0.03543	
4.850000e+00		0.03617	
4.750000e+00		0.03572	
4.650000e+00		0.03592	
4.550000e+00		0.03579	
4.450000e+00		0.03607	
4.350000e+00		0.03571	
4.250000e+00		0.03538	
4.150000e+00		0.0352	
4.050000e+00		0.03533	
4.000000e+00	0.0714286		0.0714286
3.950000e+00		0.07122	
-3.850000e+00		0.07318	
3.750000e+00		0.07061	
3.650000e+00		0.0716	
		0.07444	

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	True PDF	Sampling	Sampled PDF
5.000000e+00	0.0357143		0.0357143
4.950000e+00		0.03543	
4.850000e+00		0.03617	
4.750000e+00		0.03572	
4.650000e+00		0.03592	
4.550000e+00		0.03579	
4.450000e+00		0.03607	
4.350000e+00		0.03571	
4.250000e+00		0.03538	
4.150000e+00		0.0352	
4.050000e+00		0.03533	
4.000000e+00	0.0714286		0.0714286
3.950000e+00		0.07122	
-3.850000e+00		0.07318	
-3.750000e+00		0.07061	
3.650000e+00		0.0716	

Table

-5.000000e+00 -4.950000e+00 -4.850000e+00 -4.750000e+00 -4.650000e+00 -4.550000e+00 -4.450000e+00 -4.350000e+00 -4.250000e+00 -4.150000e+00 -4.050000e+00 -4.000000e+00 -3.950000e+00 -3.850000e+00 -3.750000e+00 -3.650000e+00 ------

Plot

			Plot	Table	
			True PDF	Sampling	Sampled PDF
		-5.000000e+00	0.0357143		0.0357143
		-4.950000e+00		0.03543	
sy		-4.850000e+00		0.03617	
5		-4.750000e+00		0.03572	
		-4.650000e+00		0.03592	
		-4.550000e+00		0.03579	
Plot True PDF	Tab Sampling			0.03607	
0.0357143	0.03543	0.0357143		0.03571	
	0.03617 0.03572			0.03538	
	0.03592 0.03579			0.0352	
	0.03607 0.03571			0.03533	
	0.03538		0.0714286		0.0714286
0.0714286	0.03533	0.0714286		0.07122	
	0.07122 0.07318			0.07318	
	0.07061 0.0716			0.07061	
	0.07444	-3.650000e+00		0.0716	
	E			0 07444	

Plotting | Review

- You are now practiced in
 - Graph selection, removal, and addition
 - Graph **zooming** via mouse/trackpad scrolling
 - Graph **panning** via left-click and dragging
 - Graph Legend position adjustment via left-click and dragging
 - Graph data table acquisition
 - Plot attributes (color, style, etc.) via context menu Plot options
 - Reset to original extents via context menu Fit graphs
- Questions?
- Close all open documents via File > Close All
- Close all tabs via right-clicking any tab and selecting Close all tabs

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.

New ORIGAMI Automator project	企業N
Open file Open ORIGAMI Automator project Open ORIGEN concentration file Open UNF-ST&DARDS time series	業O ☆業O
Open multigroup library	
Open continuous-energy library Open covariance library Open ORIGEN gamma data	
Recent files Recent ORIGAMI Automator projects	•
Reload	ЖR
Save Save as Save all	<mark></mark> ЖS ଫ̀ЖS
Close Close all	緩W 企緩W
Print	ЖР
Settings Reset settings	Ж,
Exit	ЖQ

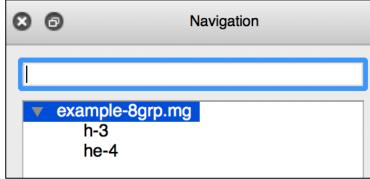
ЖN

New file ...



AMPX XS | Hands On

- Click File > Open multigroup library... and open Advanced_User_Interface/AmpxMG/ example-8grp.mg
- Observe the example-8grp.mg file become visible in the Navigation panel



 Double left-click each (h-3, he-4) to load individual data sets into Fulcrum

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 Because MG libraries can be large Fulcrum in 6.3 (beta 12+) no longer loads all data
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File Edit View	Run Help			
New file	e as Close Print	жN		
New ORIGAMI A	utomator project	☆₩N		
Open file		жо		
•	Automator project	企業O		
· ·	concentration file DARDS time series			
Open UNF-STat	JANDS lime series			
Open multigroup				
Open continuous-energy library				
Open covariance	-			
Open ORIGEN g	jamma data			
Navigation				

Filter

example-8grp.mg
 h-3

Neutron

he-4

- Neutron
 - Reaction XSecs
 - he-4 mt=1 total
 he-4 mt=2 elastic
 he-4 mt=1007 thermal.scat
 - ∠ he-4 mt=1099 weight.function
 - 🌽 he-4 mt=2000
 - he-4 mt=2022 within-grp.scat

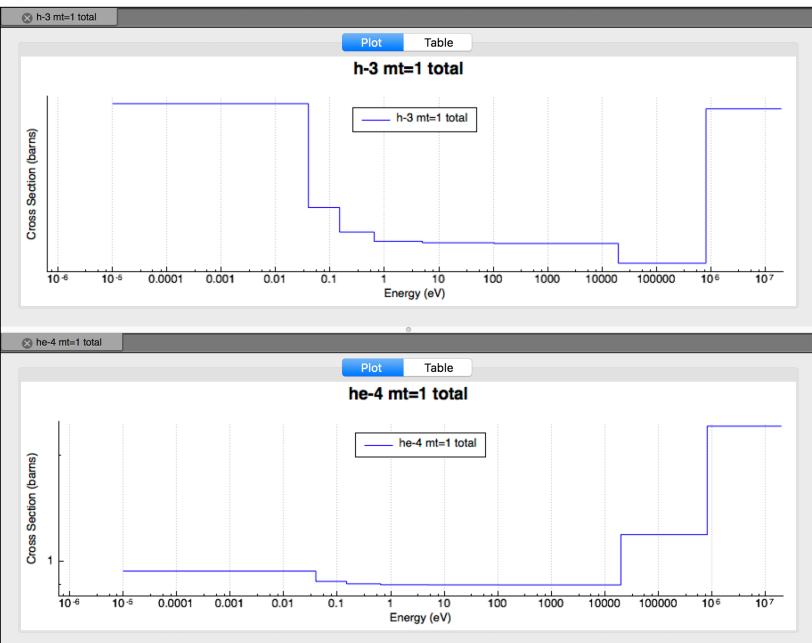
∠ he-4 mt=3002

🌽 he-4 mt=3099

Transfer Arrays

AMPX XS | MG Hands On

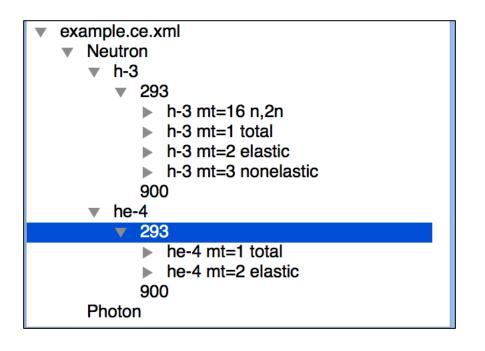
- Plot h-3 mt=1 total and the he-3 mt=1 total on separate plots
- Split the Fulcrum workspace by dragging the he-4 mt=1 total tab and dropping it at the bottom-center (on top of 'Energy (ev)' axis label) of the plot
- Change the Legend position to not overlap the data





AMPX XS | Hands On

- Click File > Open continuous-energy library... and open Advanced_User_Interface/AmpxCE/ example.ce.xml
- Observe the **example-ce.xml** file become visible in the **Navigation panel**
- Expand the Neutron and subsequent h-3 and he-3 Navigation item and observe their available temperatures
- Double left-click each **293** (**h-3**, **he-4**) to load individual temperature data sets into Fulcrum
 - Because CE libraries are large Fulcrum doesn't load all temperature data automatically
- Observe the nuclide reaction listed in the Navigation panel



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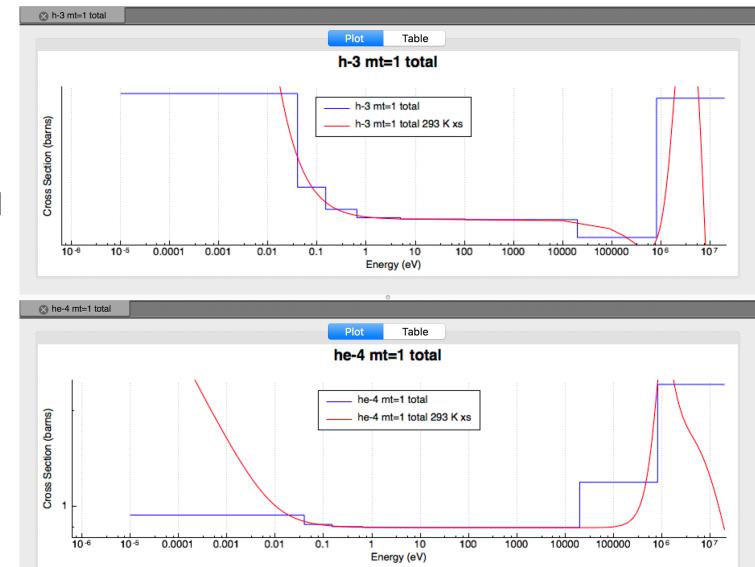
AMPX XS | Hands On

- Expand the h-3 mt=1 total and add the h-3 mt=1 total 293 k xs to the existing h-3 mt=1 total multigroup plot
- Expand the he-4 mt=1 total and add the he-4 mt=1 total 293 k
 xs to the existing he-4 mt=1 total multigroup plot
- Observe the comparison of the MG and CE cross sections
- Questions?

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Close all files and tabs

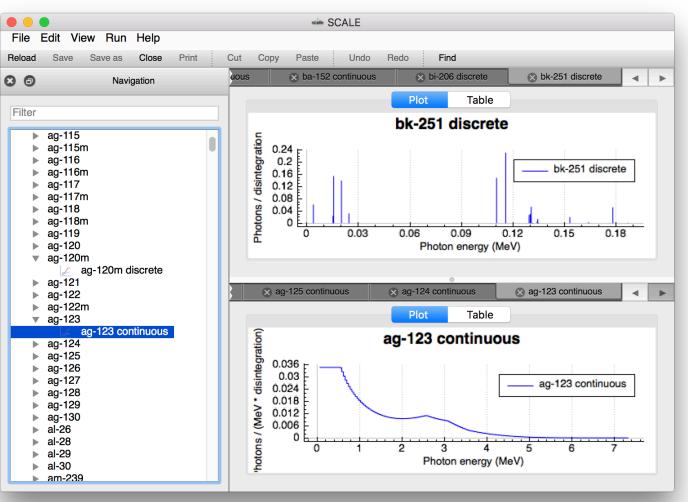


ORIGEN Gamma Data

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...

New file New ORIGAMI Automator project	第N 企業N
Open file Open ORIGAMI Automator project Open ORIGEN concentration file Open UNF-ST&DARDS time series	第0 公第0
Open multigroup library Open continuous-energy library Open covariance library Open ORIGEN gamma data	
Recent files Recent ORIGAMI Automator projects	ļ
Reload	ЖR
Save Save as Save all	¥S 企業S
Close Close all	業W 企業W
Print	ЖР
Settings Reset settings	Ж,
Exit	жQ

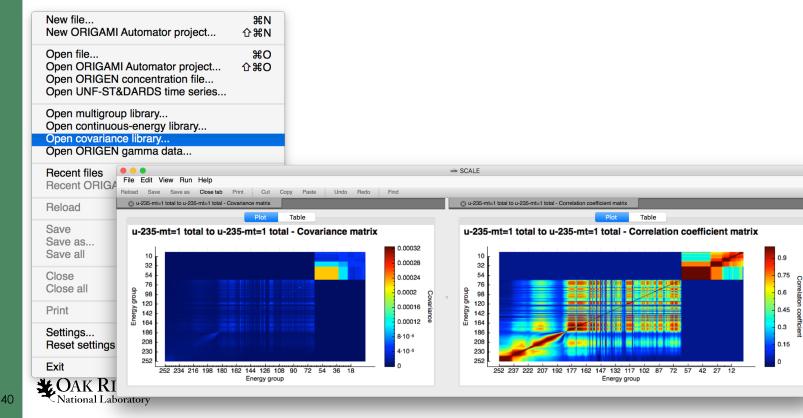


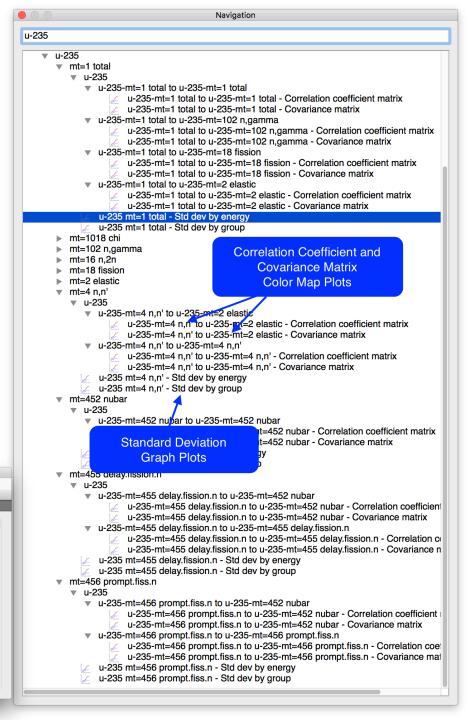
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Covariance Data

Covariance Data is available in SCALE/data. Because the files do not have a unique extension, the user must load them specifically using **File > Open covariance library...**

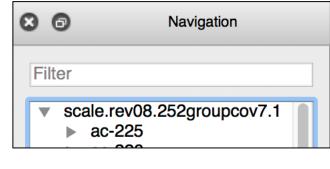
- Correlation coefficient matrix color map plots
- Covariance matrix color map plots
- Isotope Reaction Standard Deviation by energy or group graph plots





Covariance | Hands On

- Use File > Open Covariance Library... to open the SCALE/data/ scale.rev??.252groupcov7.1
- Observe the **252groupcov7.1** display in the **Navigation** panel
- In the Navigation panel's Filter field enter u-235.mt=18
 - Note the period (.) indicates a match of anything and finds item labels with either a space or hyphen

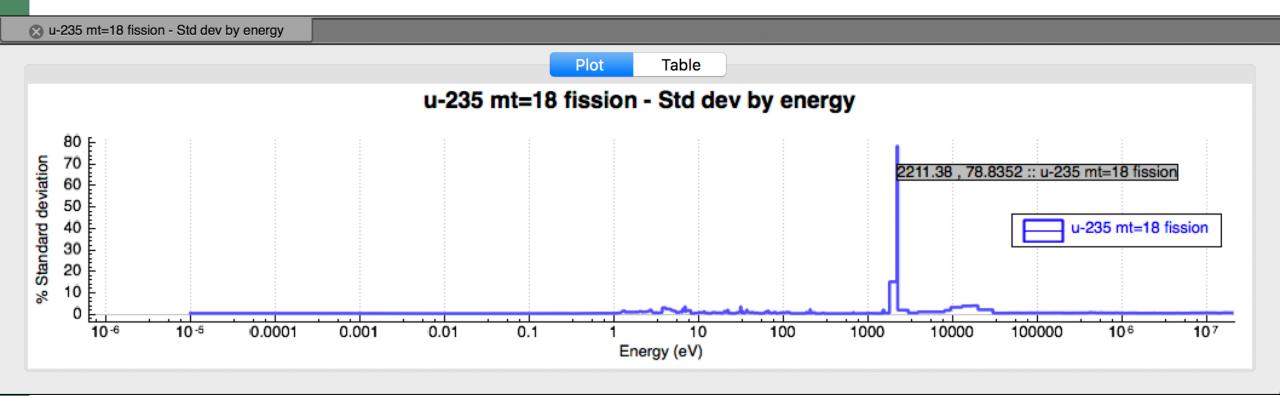


 Observe all matches presented
 OAK RIDGE National Laboratory

-235.mt=	18
	rev08.252groupcov7.1
🔻 au	
\blacksquare	mt=102 n,gamma
	▼ u-235
	▼ au-197-mt=102 n,gamma to u-235-mt=18 fission
	au-197-mt=102 n,gamma to u-235-mt=18 fission - Correlation coefficient matrix
▼ li-6	au-197-mt=102 n,gamma to u-235-mt=18 fission - Covariance matrix
	mt=105 n,t
•	▼ u-235
	▼ li-6-mt=105 n,t to u-235-mt=18 fission
	↓ li-6-mt=105 n,t to u-235-mt=18 fission - Correlation coefficient matrix
	li-6-mt=105 n,t to u-235-mt=18 fission - Covariance matrix
🔻 u-2	here and the second sec
$\mathbf{\nabla}$	mt=1 total
	▼ u-235
	 u-235-mt=1 total to u-235-mt=18 fission
	u-235-mt=1 total to u-235-mt=18 fission - Correlation coefficient matrix
	u-235-mt=1 total to u-235-mt=18 fission - Covariance matrix
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	 pu-239 u-235-mt=18 fission to pu-239-mt=18 fission
	u-235-mt=18 fission to pu-239-mt=18 fission - Correlation coefficient matrix
	u-235-mt=18 fission to pu-239-mt=18 fission - Covariance matrix
	▼ u-235
	 u-235-mt=18 fission to u-235-mt=102 n,gamma
	u-235-mt=18 fission to u-235-mt=102 n,gamma - Correlation coefficient matrix
	u-235-mt=18 fission to u-235-mt=102 n,gamma - Covariance matrix
	 u-235-mt=18 fission to u-235-mt=18 fission
	u-235-mt=18 fission to u-235-mt=18 fission - Correlation coefficient matrix
	u-235-mt=18 fission to u-235-mt=18 fission - Covariance matrix
	u-235 mt=18 fission - Std dev by energy
	 ∠ u-235 mt=18 fission - Std dev by group v-238
	 u-238 u-235-mt=18 fission to u-238-mt=102 n,gamma
	u-235-mt=18 fission to u-238-mt=102 n,gamma - Correlation coefficient matrix
	u-235-mt=18 fission to u-238-mt=102 n,gamma - Covariance matrix
	▼ u-235-mt=18 fission to u-238-mt=18 fission
	u-235-mt=18 fission to u-238-mt=18 fission - Correlation coefficient matrix
	u-235-mt=18 fission to u-238-mt=18 fission - Covariance matrix

Covariance | Hands On Std Dev

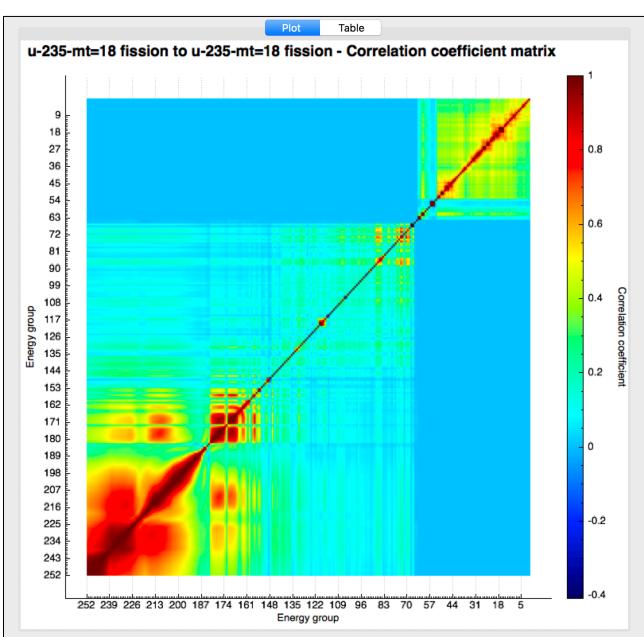
- Plot the u-235 mt=18 fission Std dev by energy
- Observe the ~78% std-dev @ ~2.2 keV



Covariance | Hands On Correlation Coefficient Matrix

 Plot the u-235-mt=18 fission to u-235-mt=18 fission -**Correlation coefficient matrix**

- Close all files and tabs
- Remove the Filter u-235.mt=18 fission
 - If you forget subsequent file content may not be displayed because it doesn't match the filter

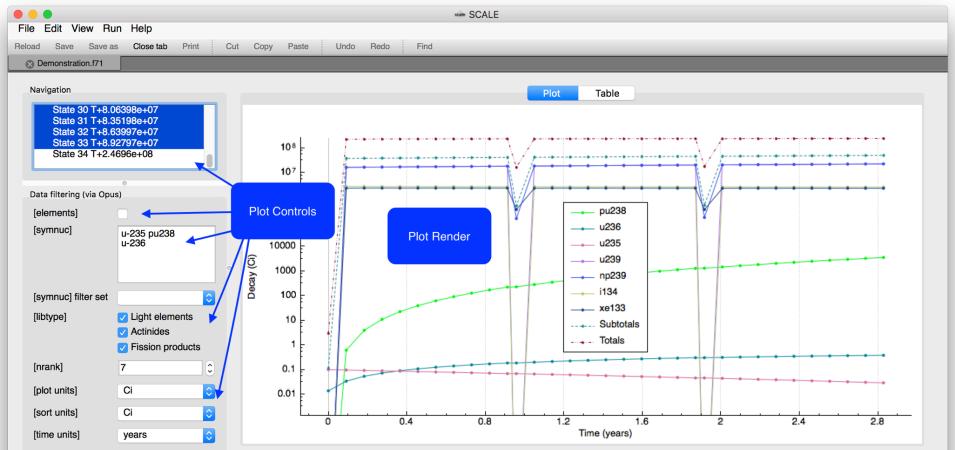




ORIGEN Isotope Concentration Data (F71)

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

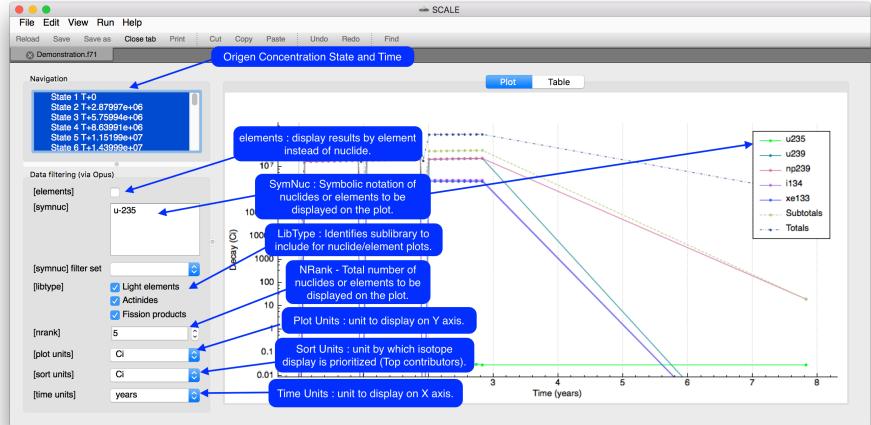
- Easy selection of state information to display.
- Easy display of nuclides or elements by id or category.
- Easy display of different units (Decay, Mass, Number).





ORIGEN F71 Special Plot Controls (PlotOPUS)

- **Navigation** allows selection of state information at a given time point
- [Elements] 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 F71 Plotting | **!! Requirement !!**

Apply

- The F71 plotting requires the ORIGEN decay data which is located in the SCALE DATA directory (data/origen_data/origen.rev??.decay.data)
- When plotting an F71 without the decay data a blank plot is presented
- Fix this via the File > Settings > Environment > Decay Data

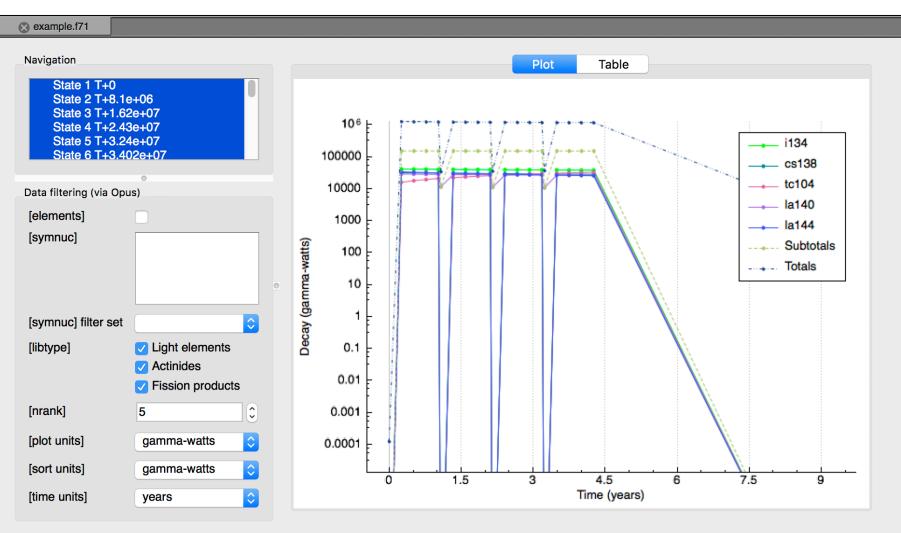
Environment	Decay Data	ont Know Where it is	
Filter Sets	SCALERTE /A	oplications/SCALE-6.3.b11.app/Contents/Resources/bin/scalerte	
	Standard Composition /A	oplications/SCALE-6.3.b11.app/Contents/Resources/data/scale.rev40.sclib	
		settings	
Environment	Decay Data	/Applications/SCALE-6.3.b11.app/Contents/Resources/data/origen_data/origen.rev03.decay.data	
Filter Sets	SCALERTE	/Applications/SCALE-6.3.b11.app/Contents/Resources/bin/scalerte	
<u>_</u>	Standard Compositi	on /Applications/SCALE-6.3.b11.app/Contents/Resources/data/scale.rev40.sclib	
Text Editor	Template Engine	/Applications/SCALE-6.3.b11.app/Contents/Resources/etc/TemplateEngine/dist/TemplateEngine.jar	
	Templates Directory	/Applications/SCALE-6.3.b11.app/Contents/Resources/etc/Templates	
		/Applications/SCALE-6.3.b11.app/Contents/Resources/bin/vulcan	

ORIGEN F71 | Hands On Initial Plot

 Use File > Open file... and open the Advanced_User_Interface/OrigenF71/example.f71

 Observe the Navigation State set are all default selected and plot the multicycle irradiation and decay times

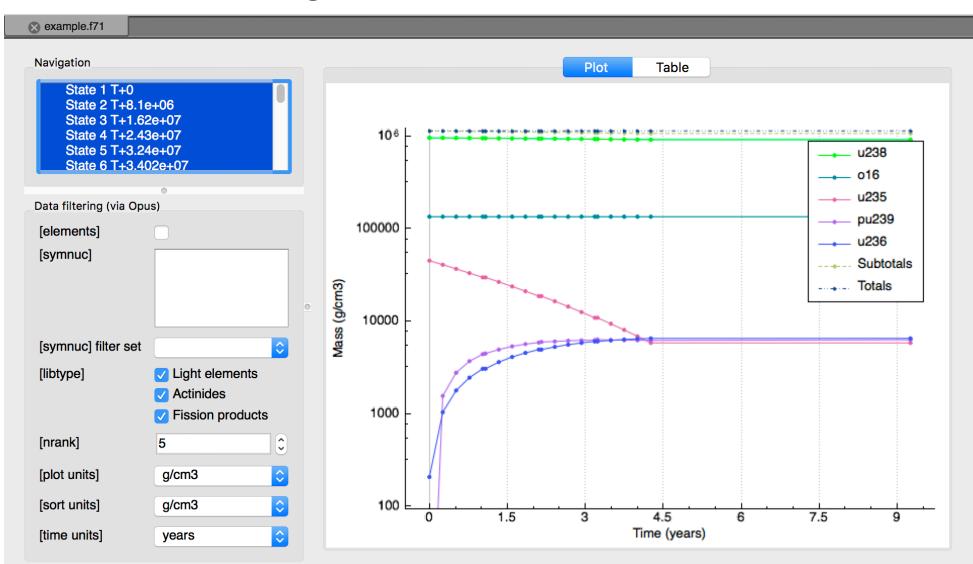
• Observe the default plot **Data filtering**





ORIGEN F71 | Hands On Units

• Update the Plot and Sort Units to be g/cm3





ORIGEN F71 | Hands On NRank

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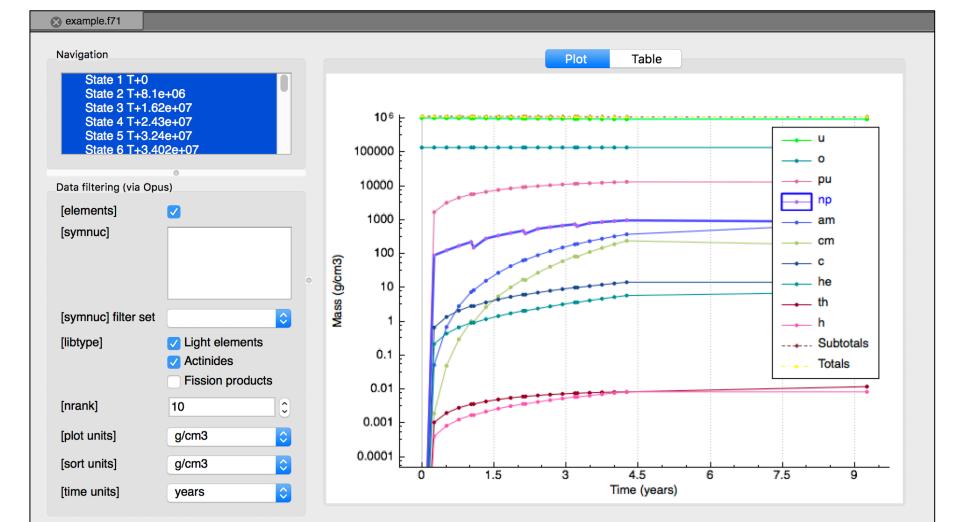
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• Update the Nrank to 10 to illustrate additional Mass (g/cm3) contributors

x example.f71				
State 1 T+0 State 2 T+8.1e+06 State 3 T+1.62e+07 State 4 T+2.43e+07	0	104	Plot Table	
State 5 T+3.24e+07 State 6 T+3.402e+07				u238 o16
• Data filtering (via Opus)		100000	· · · · · · · · · · · · · · · · · · ·	u235
[elements]		100000		pu239 u236
[symnuc]				xe136
	ō	Mass (g/cm3)		pu240 xe134
		(g) ss		ba138
[symnuc] filter set	\bigcirc	Ma	0.586535 , 5604.95	la139
[libtype] Vight elements		1000		Subtotals
Fission product	s			
[nrank] 10	Ĵ			
[plot units] g/cm3	\$	100		
[sort units] g/cm3	\bigcirc		0 1.5 3 4.5 6	7.5 9
[time units] years	\diamond		Time (years)	

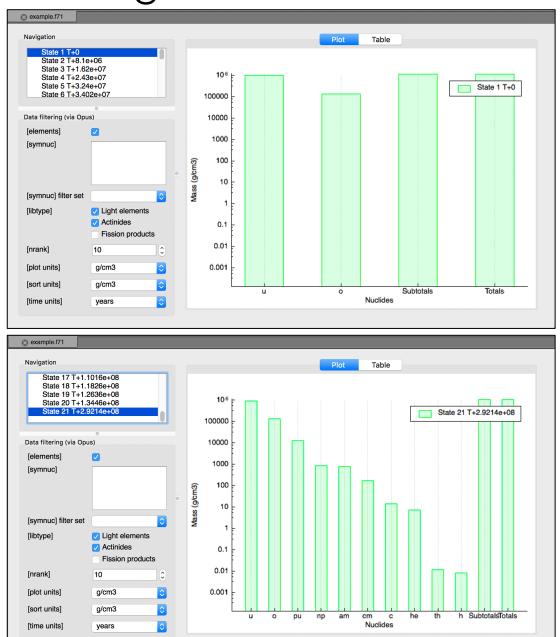
ORIGEN F71 | Hands On Elements and LibType

- Check the **Elements checkbox** to consolidate isotopes
- Uncheck the Fission Products checkbox
- Select neptunium (np)



ORIGEN F71 | Hands On Single State Navigation

- Single **State** selection displays a bar plot of **Filtered** quantity
- Select State 1 T+0
- Note at T=0 it is a uo2 system with only U and O
- Use the Arrow keys to navigate the State history from T+0 to T+2.92e+8
- Observe the evolution of the isotope inventory over time

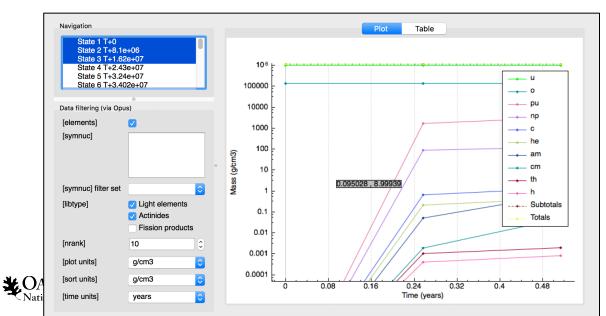


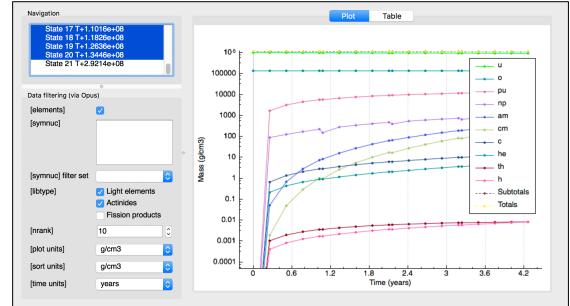


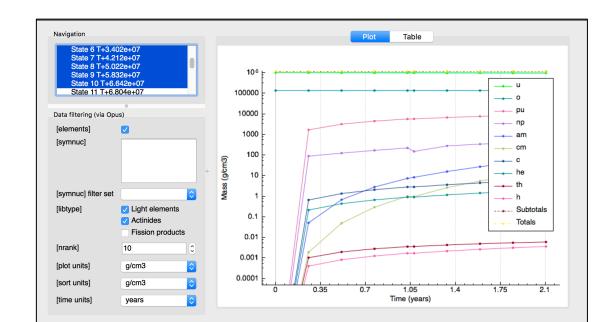
ORIGEN F71 | Hands On Multi State Navigation

- Multi-State selection displays time series plot of Filtered quantity
- Select State 1 T+0

- Press the <u>shift key and arrow down</u> to select multiple State sets
- Observe the data update and assorted elements build in over time

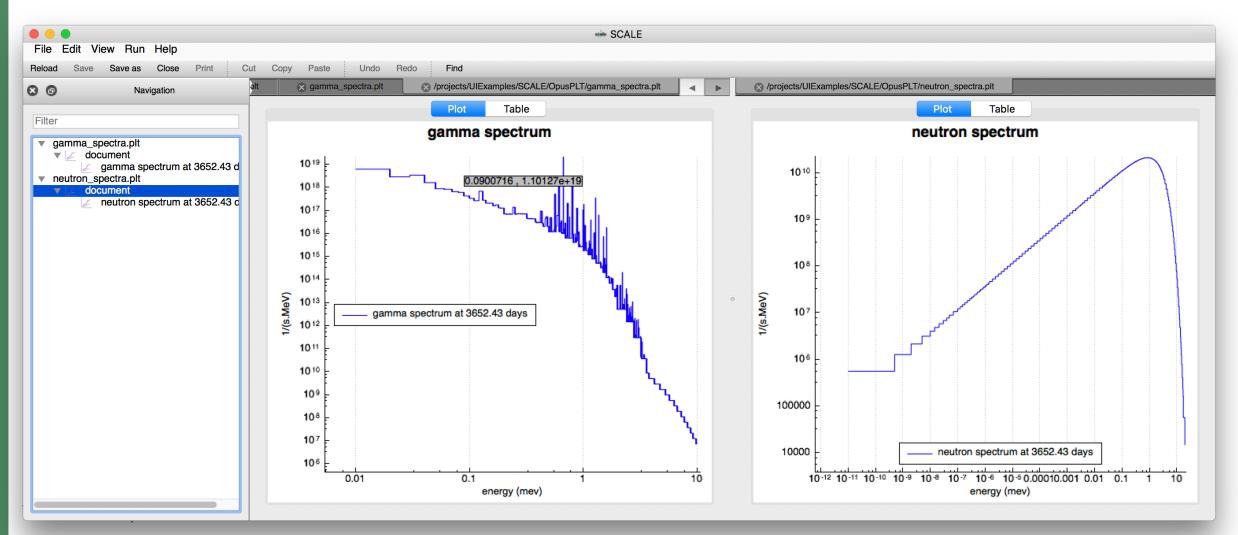






OPUS PLT

The OPUS provides an ORIGEN postprocessing capability that results in PLT files that can illustrate nuclide or element quantities (superseded by ORIGEN F71 capability on prior slides) and **neutron** or **photon spectra (Not yet available in the F71 Viewer)**

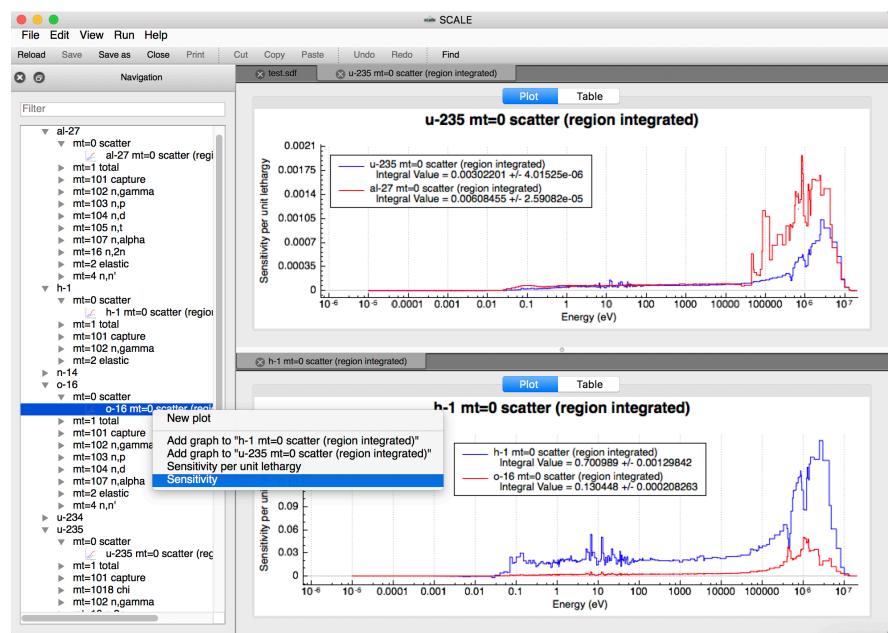


Sensitivity Data File (SDF)

- Sensitivity of k-eff to cross section data
- Sensitivity per unit lethargy
- Sensitivity of k-eff and reaction rates to energydependent cross section data for each reaction of each nuclide in a system model

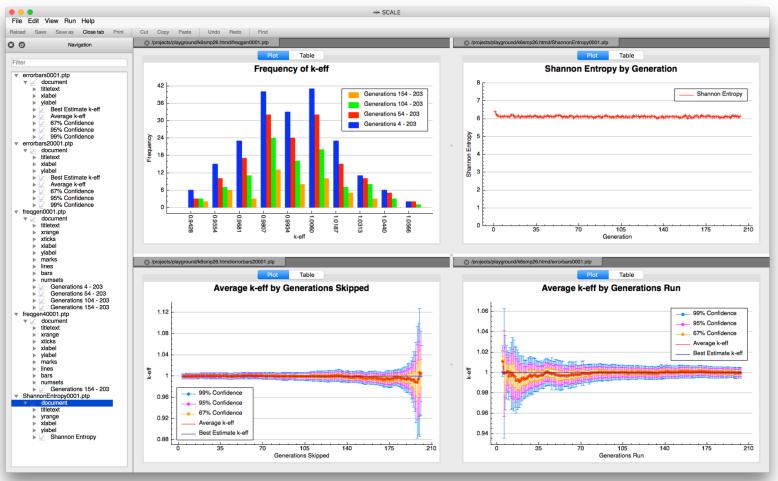
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Result Plots

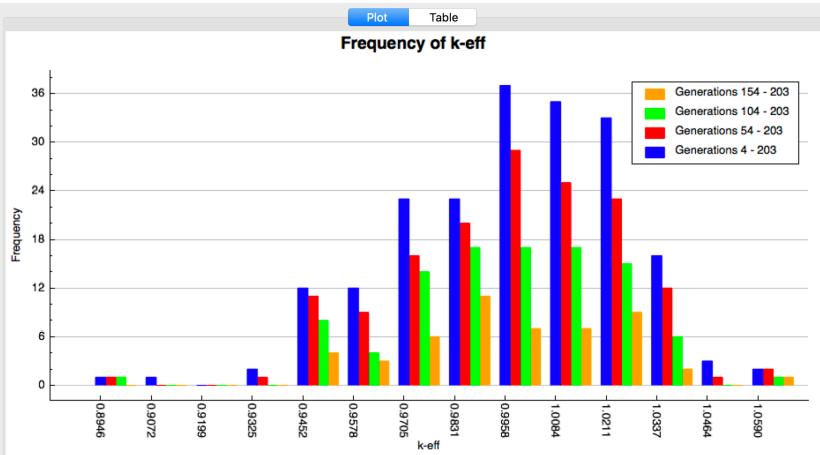
- Plot of average k-effective by generation run
- Plot of average k-effective by generations skipped
- Final edit of fissions, absorptions, and leakage
- Frequency distributions
- Shannon Entropy
- Flux plotting
- Etc.





Result Plots | Hands On K-eff Frequency by Generation

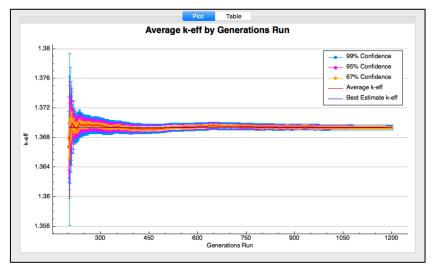
- Use File > Open... and open Advanced_User_Interface/PTP/ frequency_by_generations.ptp
- Double left-click the document
 plottable item
- Observe the frequency of k-eff by generation plotted





Result Plots | Hands On Average K-eff by Generation

- Use File > Open... and open Advanced_User_Interface/PTP/average_keff_by_generation_run.ptp
- Double left-click the **document** plottable item •
- Observe the frequency of k-eff by generation plotted



 Zoom into last 200 generations and observe the Average and Best Estimate



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Plot Review

- You are now practiced in
 - ChartPlot data
 - AMPX XS data
 - Covariance data
 - ORIGEN F71 data and the F71Viewer (PlotOpus) controls
 - KENO Result data (PTP)
- You are aware of
 - Sensitivity Data Files
 - OPUS PLT
 - ORIGEN Gamma Data
- Questions?
- Close all open documents via File > Close All
- Close all tabs via right-clicking any tab and selecting Close all tabs for each tab group





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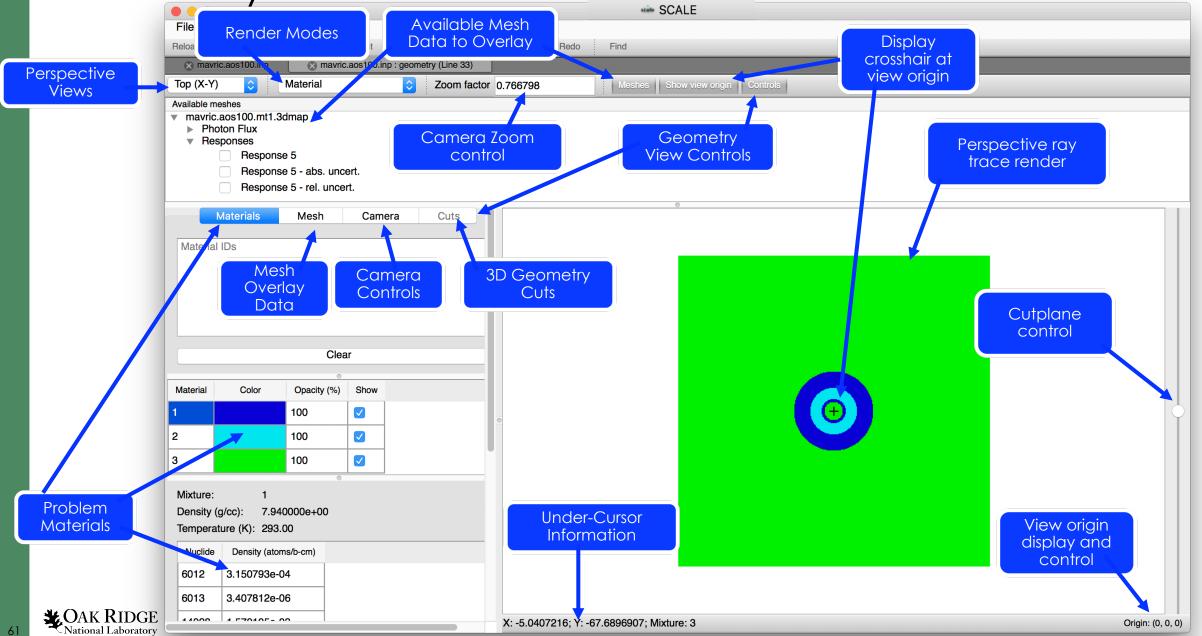


Geometry Visualization Overview

- Geometry Viewer Layout
- 2D Viewer Controls
- Perspective Views
- Render Modes
- Mesh Overlay
- 3D Viewer Controls



Geometry View Overview continued



Geometry Viewer Overview

- **Perspective Views** provide 2D axis-aligned and 3D 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 the view with a crosshair
- Under-Cursor Information shows position, and Mixture under cursor
- View origin displays and provides control of the origin of the view
- Cutplane controller interactively manipulates the elevation of the 2D view plane
- Context Menu (via right click) allows changing color and saving images

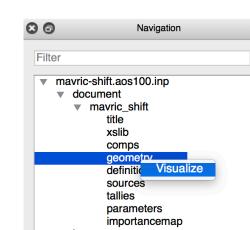


Geometry Visualization Activation

- From within the text editor, click View or click View > View geometry
- Alternatively, from within the Navigation panel left click document>sequence and right click geometry and select Visualize

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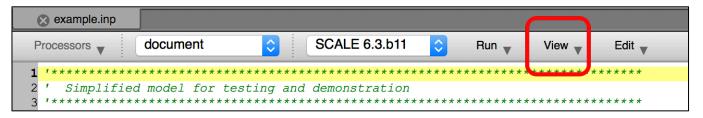


🗙 mavric.aos100.inp*						
Processors V docur	ment ᅌ	SCALE 6.3.b11	ᅌ Run 🔻	View 🔻	Edit 🔻	
1 /**********	****	****	****	View geo	ometry 企業V	
2 ' Simplified mode	l of the AOS-100					

		sile SCALE			
File Edit View Run Help					
Reload Save Save as Close tab Print		Undo Redo Find	- (l in - 0)		
3 🗇 Navigation	x mavric.aos100.inp*	Material			
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 mavric.aos100.inp* document 					
 mavric 					
title xslib					
comps					
mavric definitions					
sources					
tallies					
parameters importancemap					
					Origina (O. (
					Origin: (0, 0

Geometry Visualization | Get Started!

Using File > Open... open
 Advanced_User_Interface/
 Input/example.inp and
 click View

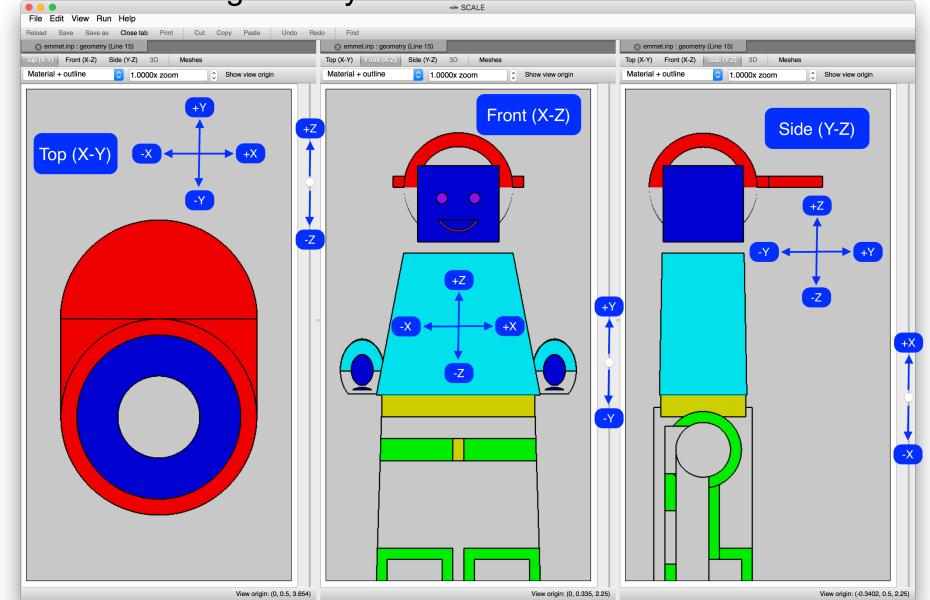


		SCALE		
File Edit View Run Help	Cut Conv Posta Unda	Pode : Find		
Reload Save Save as Close tab Print		Redo Find		
O Navigation		.inp : mavric (Line 5)		
Filter	Top (X-Y)	Coom factor 1	Meshes Show view origin	Controls
 example.inp document 		O		
	X: -194.4843137; Y: 31.6966387			Origin: (0, 0, 0)



2D Perspective Views

• 2D Perspective views provide standard orthographic model projections of the **top**, **front**, and **side** of the geometry.



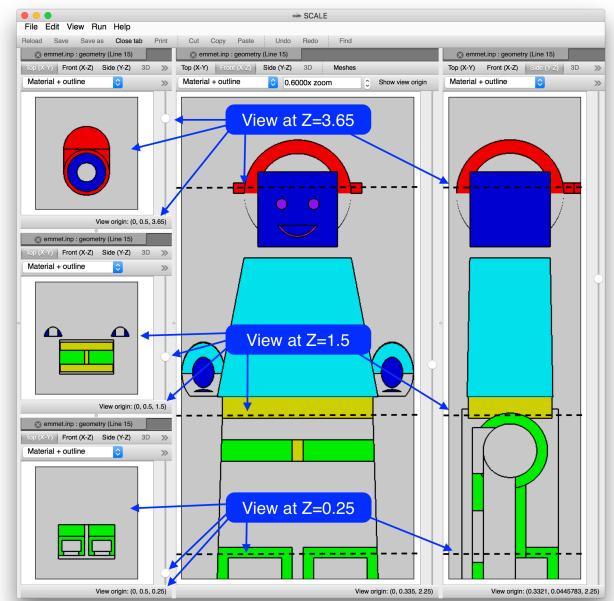
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2D Perspective Views : Elevation Control View plane elevation is controlled via a slide control on the right side of each geometry view.

- 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.

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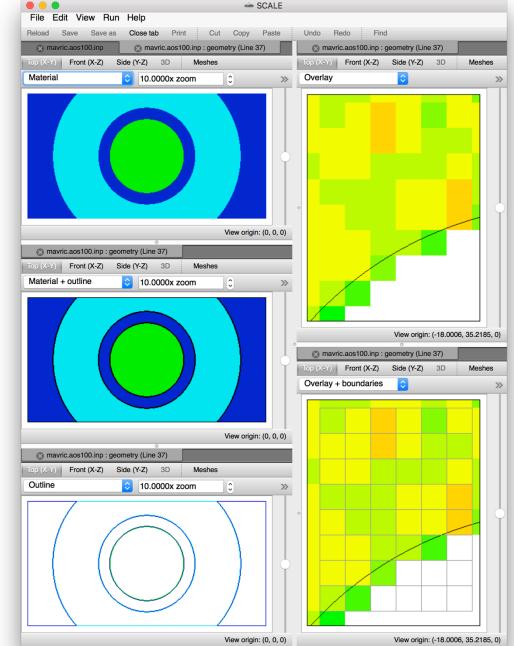


Render Modes

✓ Material
Material + outline
Outline
Overlay
Overlay + boundaries

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.

• Specify a zoom value.

File Edit View Run Help Reload Save Save as Close

Top (X-Y) Front (X-Z) Material + outline

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mavric.aos100.inp : geometry (Line 37)

Side (Y-Z)

1.0000x zoom

• Visually specified via a user-drawn zoom reticle.

Close tab Print Cut Copy Paste

Meshes

View origin: (0, 0, 0)

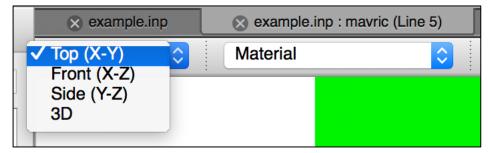
- Left click and drag down and to the right.

own and to the right.	
X: -20.1951344; Z: 35.5199420; Unit: 1; Mixture: 1)
** SCALE	
Undo Redo Find	
😒 mavric.aos100.inp : geometry (Line 37) 😒 mavric.aos100.inp : geometry (Line 37)	
Op (X-Y) Front (X-Z) Side (Y-Z) 3D Meshes Top (X-Y) Front (X-Z) Side (Y-Z) 3D Meshes	
Atterial + outline 😧 5,0000x zoom 🗘 >> Material + outline 😂 50x zoom 🗘 >> Material + outline 😂 500000.0000x zoom 🗘 >>	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
View origin: (-12.5443, 0, 30.2137) View origin: (-13.1363, 0, 30.3996) View origin: (-13.335, 0, 30.48	

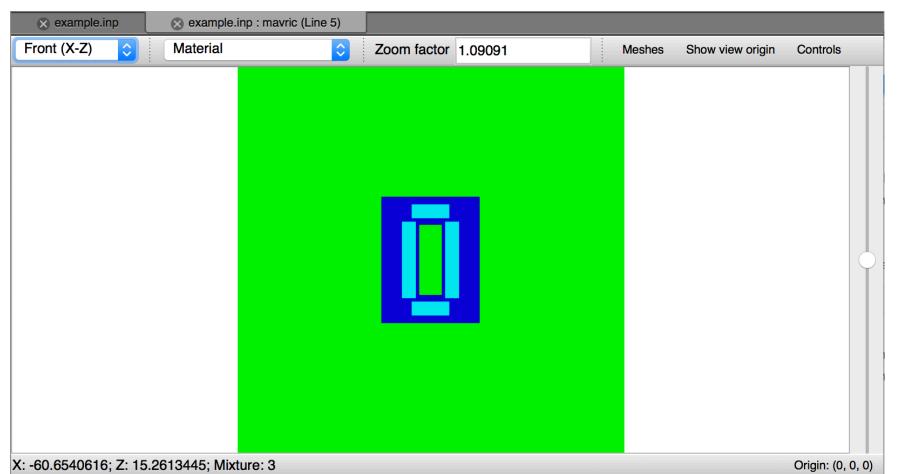
SCALE

Geometry Visualization | Hands On with 2D Views

 Click the perspective dropdown and select Front (X-Z)



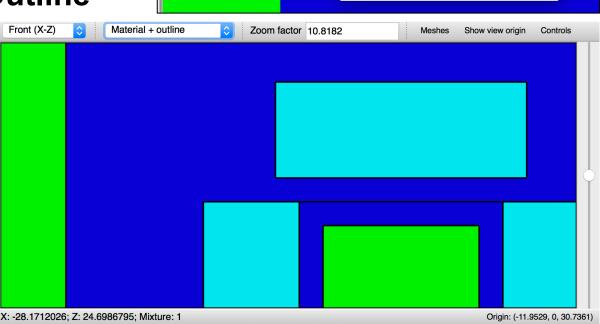
 Observe the new rendering of the X-Z cut at Origin: (0,0,0)





Geometry Visualization | Hands On with 2D Views

- Mouse over the model rendering and observe information under the cursor displayed in the lower-left of the rendering
- Perform a zoom by left-click and drag as depicted
- Update the Render mode to Material + Outline
- Observe the new view Origin, Zoom factor, and geometry region outline



X: -31.6966387; Z: 59.0887955; Mixture: 3

 \Diamond

Material

Outline Overlav

Material + outline

Overlay + boundaries

Front (X-Z)



Geometry View | Origin Display and Control

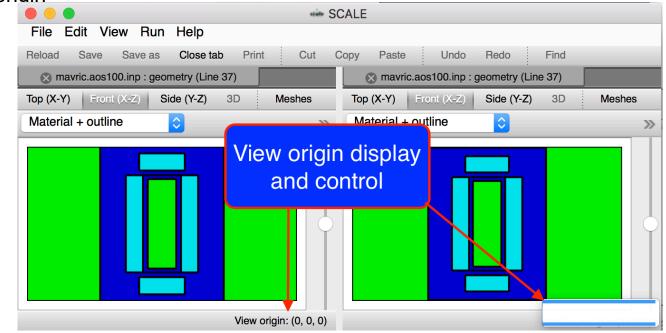
Often when geometry errors are encountered, an X, Y, Z position is included in the error message. The ability to quickly navigate to this location and inspect the geometry is facilitated by the view origin control

- Left-click the View origin display will activate X, Y, Z entry
- 3 Modes of Origin input
 - Single value : Updates the view plane elevation (axis intersect same as slider control but more precise)
 - 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
- Shift and left-click pans

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Geometry View | Hands On 2D Controls

Click Show View Origin

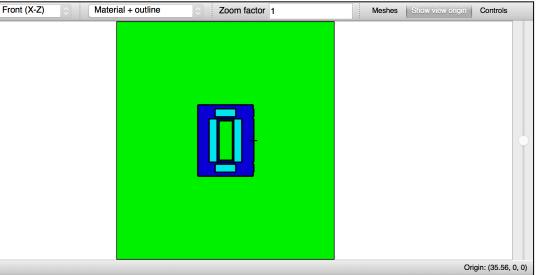
Front (X-Z) 🔇 Material + outline 🗘 Zoom facto	10.8182	Meshes	Show view origin Controls	
-----------------------------------------------	---------	--------	---------------------------	--

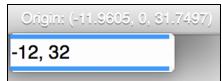
- Perform a view pan by clicking the Origin label (lower-right corner) and entering 2 values (-12, 32) and pressing the return/enter key
- Perform a X-Z elevation change (change in Y-intersect) by entering a single value (-8)
- Play with the elevation slider
 - Sliding up increases **Y-intersect**, down decreases **Y-intersect**
- Perform an elevation and origin change by entering 3 values (35.56, 0, 0)
 - Places the view origin at the edge of the outermost cylinder for this example problem
- Zoom out by

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- Enter 1.0 in the Zoom Factor field or
- Left-click and dragging up and to the left and releasing





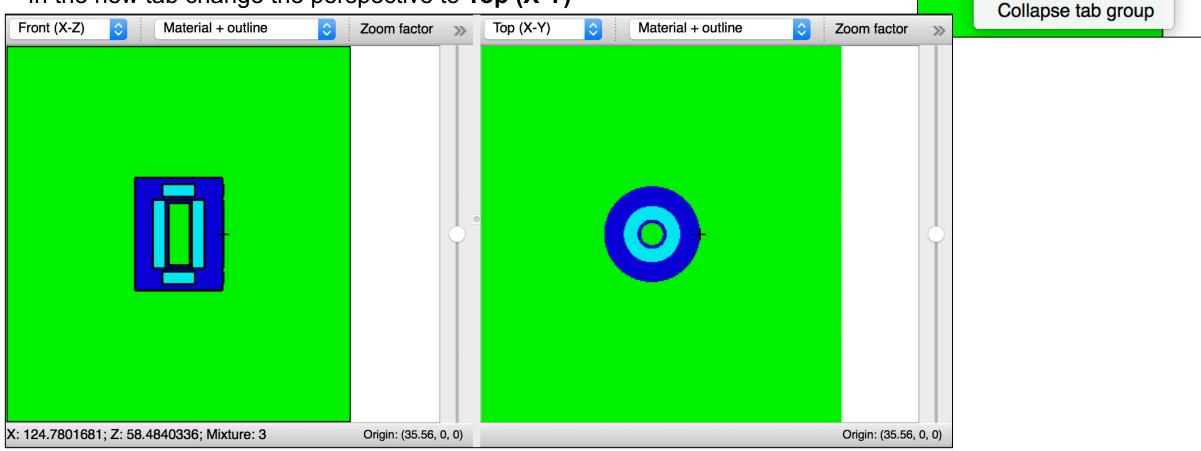
Geometry View Origin Preserved Across View Plane The geometry viewer is often used for geometry verification and debugging. Both typically involve known locations – X, Y, Z of lost particle, etc.

- 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

	stâte	SCALE		
File Edit View Run Help				
Reload Save Save as Close tab	Print Cut Copy Paste Undo	Redo Find		
S mavric.aos100.inp : geometry (Line 37)	Close tab	🗴 mavric.aos100.inp : g	geometry (Line 37)	
Top (X-Y) Front (X-Z) Side (Y-Z) 3D	Close other tabs	Top (X-Y) Front (X-Z)	Side (Y-Z) 3D Mesi	hes
Material + outline	Close all tabs	Material + outline		Show view origin
	Clone tab New tab group Collapse tab group		-	
OAK Nation	View origin: (29.8695, 19.911, 0)			View origin: (29.8695, 19.911, 0)

Geometry View | Hands On 2D Clone

- Right-click the example.inp : mavric (Line 5) geometry tab and select Clone tab
- In the new tab change the perspective to Top (X-Y)



example.inp : mavric (Line 5)

Close other tabs Close all tabs

New tab group

Close tab

Clone tab

 \otimes

Ma

• Close the Top (X-Y) tab

Mesh Overlay Overview

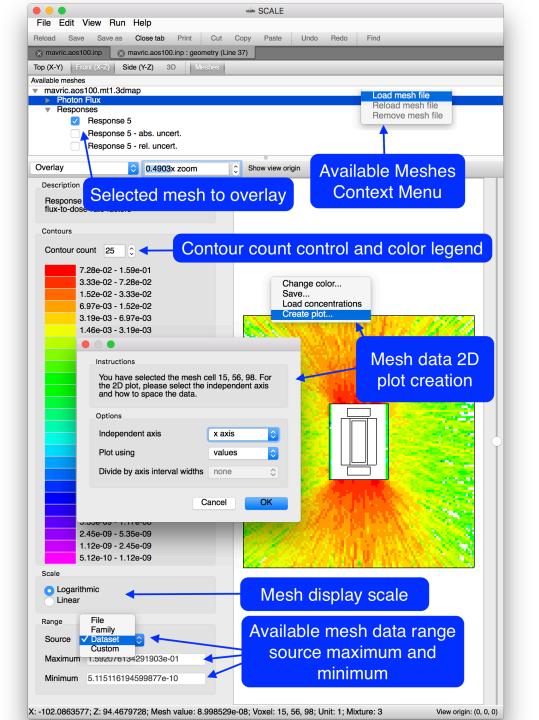
- Loading Mesh Data
- Render Modes
- Contours and color legend
- Scale Log and Linear
- Range File, Family, Dataset, or Custom
- Position, Mesh value, Mesh Voxel, Unit, and Mixture under Cursor
- Context Menu

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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 the Load mesh file dialog.
 Select the mesh to load
- Most of SCALE's major mesh formats are supported

Mesh files (*.3dmap)

Mesh importance files (*.mim)

Mesh source files (*.msm)

Denovo flux files (*.dff)

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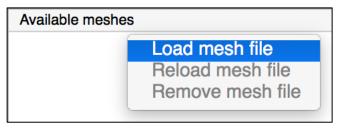
	see SCALE
File Edit View Run He	•
	se tab Print Cut Copy Paste Undo Redo Find
🛿 🗇 Navigation	x mavric.aos100.inp x mavric.aos100.inp : geometry (Line 37)
Filter	Top (X-Y) Front (X-Z) Side (Y-Z) 3D Meshes
 mavric.aos100.inp document mavric title xslib comps geometry definitions sources tallies parameters importancemap 	Available meshes Load mesh file Reload mesh file Remove mesh file Material 2.0036x zoom Show view origin () () () () () () () () () (

Mesh Overlay | Hands On Loading Mesh Data

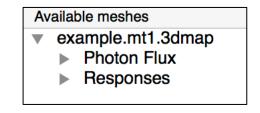
Click the Geometry View's Meshes panel button and observe the Available meshes

Front (X-Z) Image: Material + outline Image: Complexity of the second seco	Meshes	
Available meshes	Meshes	

Right-click inside the Available meshes panel and select Load mesh file



- Open the Advanced_User_Interface/Input/example.mt1.3dmap
- Observe the available data sets for plotting

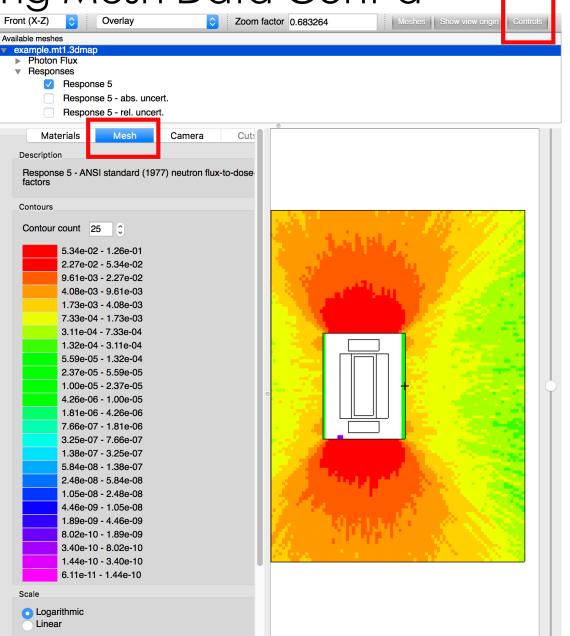




Mesh Overlay : Hands On Loading Mesh Data Cont'd

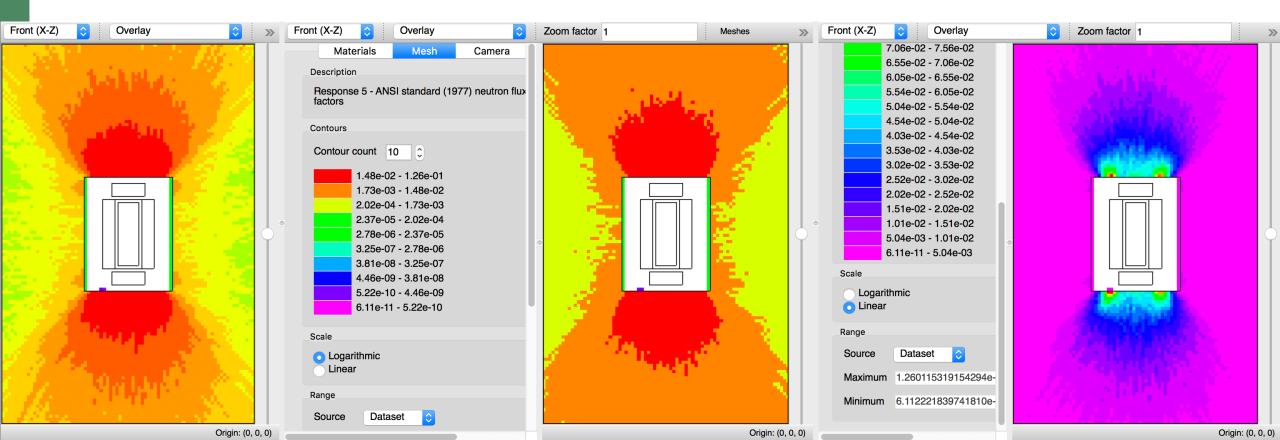
Range

- Expand **Responses** and select **Response 5**
- Change the render mode to Overlay
- Click the Controls panel button
- select the Mesh tab
- Mouse over the data rendering and observe the display of the cursor position (X-Z), mesh voxel, and mesh value



Mesh Overlay | Contours, Color Legend, and Scale

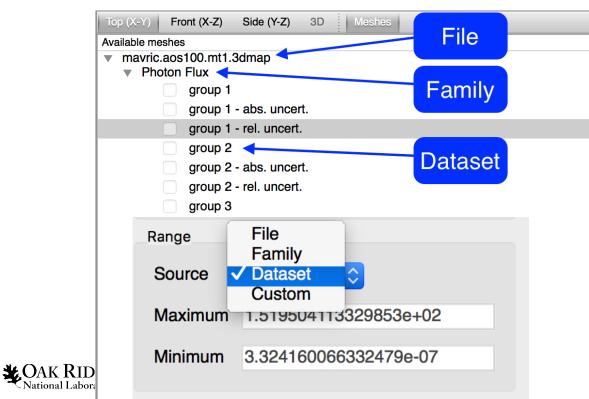
- Controls influenced by MAVRIC's MeshView plot program
- Allows changing contour count from 25 to 2 enhancing data contrast
- Can improve print quality for printouts
- Linear and logarithmic scale data display

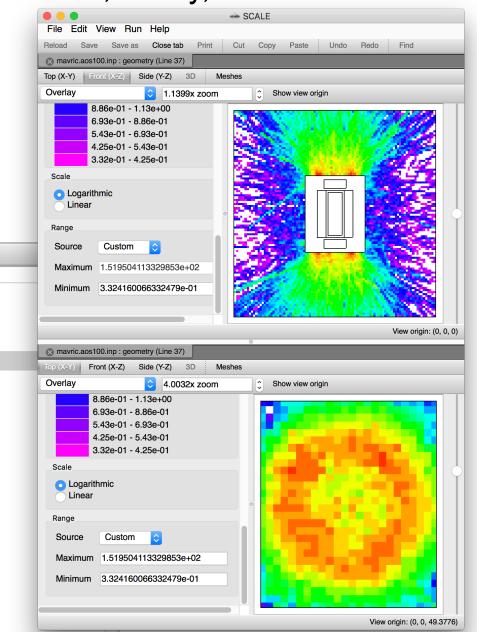


Mesh Overlay | Data Ranges

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

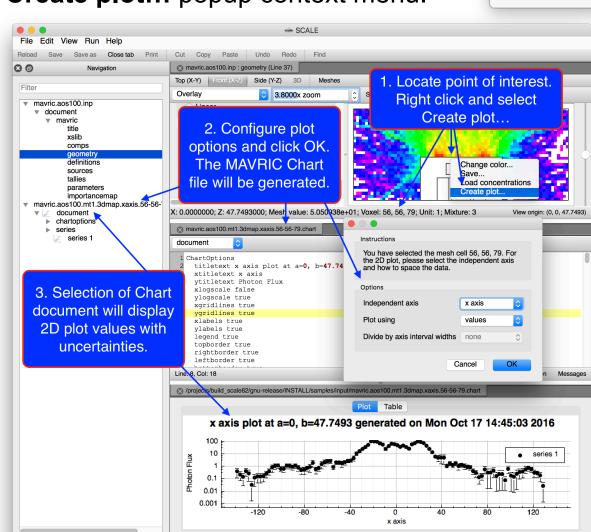
- 2D Plot creation is available via the **Create plot...** popup context menu.
- Plot options include
 - Independent axis
 - Cartesian X,Y, and Z
 - Cylindrical Radial, Theta, and Z
 - Group when group-wise data is available
 - Plot using values or indices

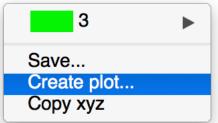
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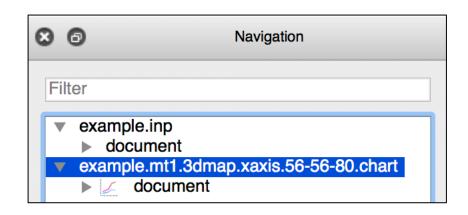
 When data is group-wise axis interval widths can optionally be divided linearly or logarithmically

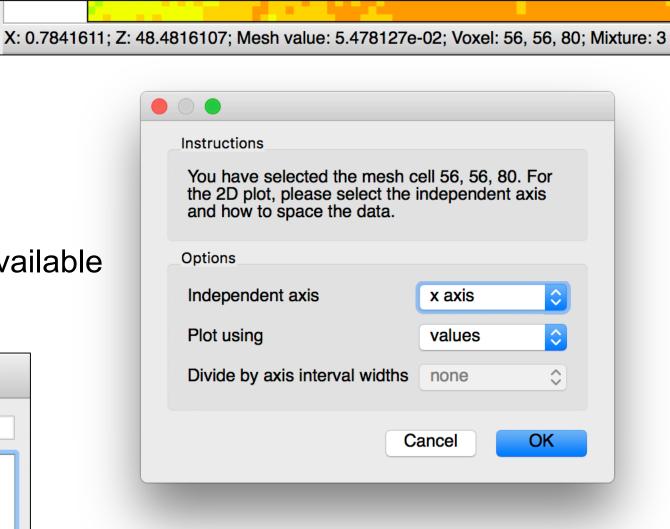




Mesh Overlay | Hands On Interactive 2D Plots

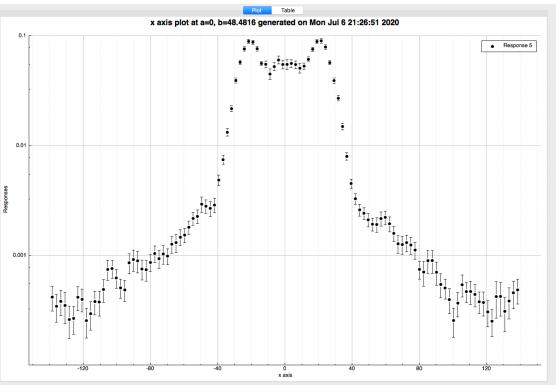
- Using the cursor find Voxel 56, 56, 80
- Right-click and select
 Create Plot ...
- Select defaults
 - Plot mesh values along the x axis
- Click OK
- Observe chart file generated and available in the Navigation panel





Mesh Overlay | Hands On Interactive 2D Plots

• Double left-click the **example*****chart** > **document** to plot the data



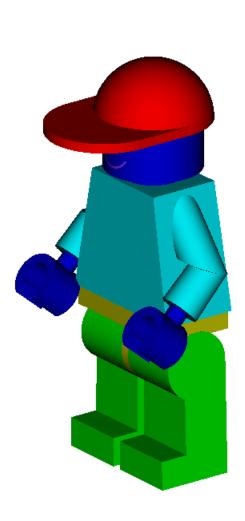
- Observe the data and the high and low uncertainties
 - Remember the <u>Table</u> view allows copy-and-paste of the data
- Close the Chart tab and file and select the previously opened Geometry tab



3D Overview

- Camera
 - Presets
 - Panning
 - Zooming
 - Rotation
- Rendering modes
- Display metadata
- Material controls
 - Filter material table
- Geometry Cuts

3D		Material		Zoom factor	127.135
	Materials	Mesh		Cuts	
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Misc	ellaneous				
Ort	hographic				
Zo	om factor	127.135			
Ou	tline threshold	0.50 🗘			



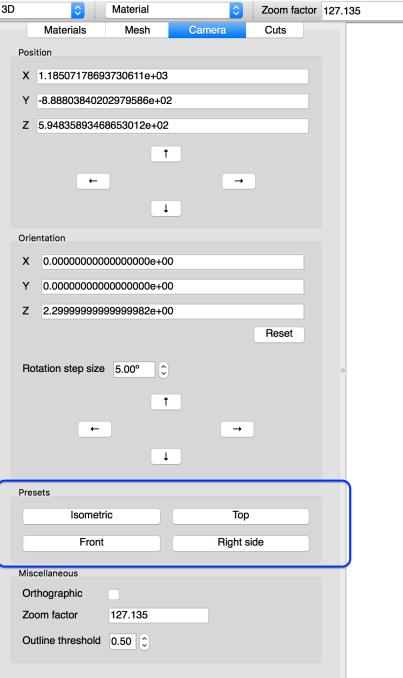
Meshes

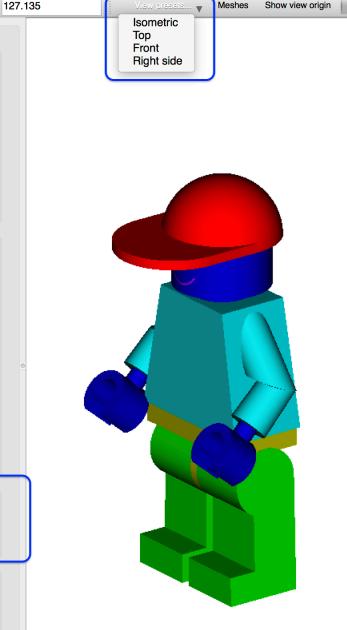
View presets... 🚽

Show view origin



- **Top**: camera is in +Z looking into –Z
- Front: camera is in –Y looking into +Y
- **Right side**: camera is in +X looking into -X
- **Isometric**: camera is above and in front +X,-Y,+Z





- <u>Top</u>: camera is in +Z looking into –Z
- Front: camera is in –Y looking into +Y
- Right side: camera is in +X looking into –X
- Isometric: camera is above and in front

		Material	 Zoom factor 127 	.359	View presets 🔻	Meshes	Show view origin	Controls	
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- Top: camera is in +Z looking into –Z
- <u>Front</u>: camera is in –Y looking into +Y
- Right side: camera is in +X looking into –X
- Isometric: camera is above and in front

Material	Coom factor 12	27.354 View presets	Meshes Show view origin	Controls
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Front	Right side			
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Miscellaneous Orthographic				
Zoom factor 127.354				•
Outline threshold 0.50 🗘			→ + X	

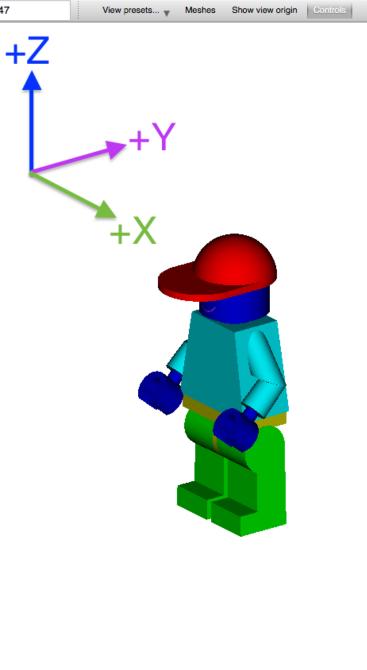
- Top: camera is in +Z looking into –Z
- Front: camera is in –Y looking into +Y
- <u>Right side</u>: camera is in +X looking into –X
- Isometric: camera is above and in front

♦ Material	Zoom factor 127.354	View presets 🔻 Me	eshes Show view origin	Controls
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Ļ		•		
Presets Isometric Top Front Right si	de → +Z			
Miscellaneous Orthographic				
Zoom factor 127.354				
Outline threshold 0.50 C			+Y	



- Top: camera is in +Z looking into –Z
- Front: camera is in –Y looking into +Y
- Right side: camera is in +X looking into –X
- <u>Isometric</u>: camera is above and in front

3D	\$	Material	\$	Zoom factor	89.5147
	Materials	Mesh	Camera	Cuts	
Posi	ition				
x	1.1850717869	3730611e+03			
Y	-8.8880384020	2979586e+02			
z	5.9483589346	8653012e+02			
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		4			
Orie	ntation				
x	0.000000000	0000000e+00			
Y	0.000000000	0000000e+00			
z	2.2999999999	99999982e+00			
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	Isometr	ic	Тор)	
	Front		Right	side	
Mier	cellaneous				
	thographic				
	om factor	89.5147			
Qu	tline threshold	0.50 🗘			





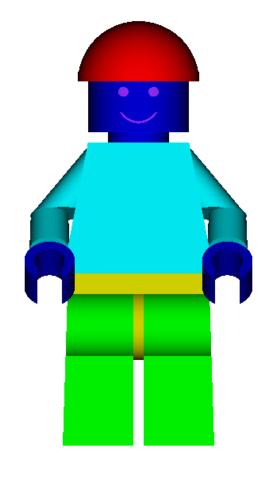
Camera Panning

- **Position** fields allow absolute camera positioning
- **Up** arrow moves model up by moving camera down
- **Down** arrow moves model down by moving camera up
- Left arrow moves model left by moving camera right
- Right arrow moves model right by moving camera left
- Double-click at a point pans to re-center at click point
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3D	\$	Material	\	Zoom factor	127.3
	Materials	Mesh	Camera	Cuts	
Posi X Y Z		0000000e+00 23569512e+03]
x		0000000e+00)		
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Pres	ets Isometr Front	ic	Top Right si	de	
Ort	ellaneous hographic om factor tline threshold	127.354 0.50 🗘			

Shift+Mouse Drag to new location



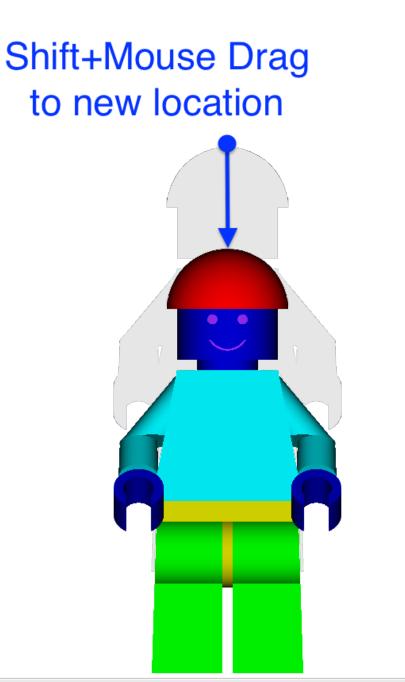
- <u>Up</u> arrow moves model up by moving camera down
- Down arrow moves model down by moving camera up
- Left arrow moves model left by moving camera right
- Right arrow moves model right by moving camera left
- Double-click at a point pans to recenter at click point

3D	\$	Material		۵	Zoom factor	127.354
	Materials	Mesh	Came	era.	Cuts	
Posi	tion					
x	0.0000000000	000000e+0	0			
Y	-1.5954517202	3569512e+0	03			
Z	2.29999999999	9999982e+0	0			
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z	2.2999999999	99999982e+(00			
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Pres	ets					
	Isometr	c		Тор		
	Front			Right sid	e	
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	hographic					
Zoo	om factor	127.354				
Ou	tline threshold	0.50 🗘				



- Up arrow moves model up by moving camera down
- <u>Down</u> arrow moves model down by moving camera up
- Left arrow moves model left by moving camera right
- Right arrow moves model right by moving camera left
- Double-click at a point pans to recenter at click point

3D	\$	Material		\diamond	Zoom factor	127.354
	Materials	Mesh	Camer	1	Cuts	
Posit	ion					
x	0.000000000	0000000e+00				
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Misce	ellaneous					
Orth	nographic					
Zoo	m factor	127.354				
Out	line threshold	0.50 🗘				



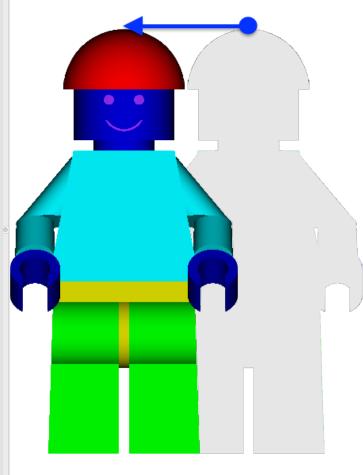
Meshes Show view origin

View presets... 🚽

- Up arrow moves model up by moving camera down
- Down arrow moves model down by moving camera up
- <u>Left</u> arrow moves model left by moving camera right
- Right arrow moves model right by moving camera left
- Double-click at a point pans to recenter at click point

D	\$	Material	\$	Zoom factor	127.354
	Materials	Mesh	Camera	Cuts	
Pos	ition				
x	0.000000000	0000000e+00			
Y	-1.5954517202	23569512e+03			
z	2.2999999999	9999982e+00			
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Y	0.000000000	0000000e+00			
z	2.2999999999	99999982e+00			
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Pres	sets				
	Isometri	ic	Тор		
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	thographic				
	om factor	127.354			
Ou	tline threshold	0.50 🗘			

Shift+Mouse Drag to new location



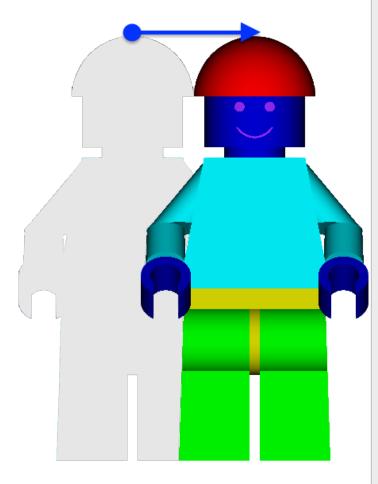
- Up arrow moves model up by moving camera down
- Down arrow moves model down by moving camera up
- Left arrow moves model left by moving camera right
- <u>Right</u> arrow moves model right by moving camera left
- Double-click at a point pans to recenter at click point

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D	\$	Material	\$	Zoom factor	127.354
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Shift+Mouse Drag to new location



Display metadata

3D

Material

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Y -1.59545 Z 2.299999

Orientation

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Rotation ster

Presets

Miscellaneous

Orthographic

Zoom factor Outline three

Position

Materia

Zoom factor 127 354

- Mousing-over pixels reports the material under the cursor
- The user can also right-click on a pixel with material information and control
 - visibility,
 - opacity,

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- and $\ensuremath{\textbf{color}}$
- for one or more materials under the given pixel.

		127.001				
Mesh Cam 000000000000000000000000000000000000			:			
↑	→			5 Save	Change Change Hide	e color e opacity
00000000000000000000000000000000000000	Reset				Hide	
size 5.00° ≎ ↑ ←	→	C			R	
Front	Top Right side					
127.354 hold 0.50 🗘						
		Mixture: 5				Origin: (0, -1595.45, 2

View presets

Show view origin

Meshes

Materials Controls

- A table containing the full listing of known materials in the model.
- Table allows controlling
 - visibility,
 - opacity,

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- and **color**
- for **all** material in the model.
- Mixture information changes as a function of selected material

3D	\$	Material		 Zoom facto 	r 127.354	View presets 🔻	Meshes	Show view origin	Controls	
	Maierials	Mesh	Came	ra Cuts						
Materia	l IDs									
		Clea	r							
Material	Color	Opacity (%)	Show							
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1		100					•	<u> </u>		
2		100								
3		100								
4		100								
5		100								
6		100			0					
Mixture: Density Tempera Nuclide 1001 1002 6012 6013 7014 7015	(g/cc): 1.04 ature (K): 293	ms/b-cm) 02 06 02 02 04 03								
										Origin: (0, -1595.45, 2.3)

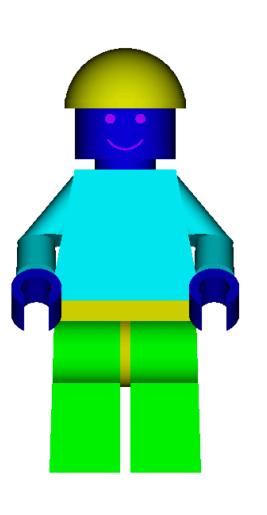
Materials Controls: Color

Se Se	elect Color	
	•	
C	ancel OK]

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3D	\bigcirc	Material		\$ Zoom fac	ctor 127.354
	Materials	Mesh	Camera	Cuts	
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		Clea	ar		
Madavial	Oslar		Ohann	 	
Material void	Color	Opacity (%)	Show		
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3		100			
4		100			
5		100			
6		100			•
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Mixture					
	rature (K): 293.	0000e+00 .00			
Nuclid	e Density (ator	ns/b-cm)			
1001	5.038231e-0	02			
1002	5.794743e-0	06			
6012	4.398437e-0	02			
6013	4.757230e-0	04			
7014	2.953217e-0	03			
7015	1.078897e-0	05			



View presets... Meshes Show view origin Controls

Origin: (0, -1595.45, 2.3)

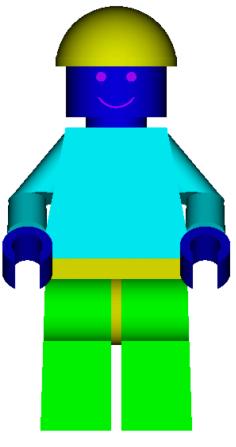
Materials Controls: Visibility

3D	\$	Material	\$	Zoom factor	127.354	View presets	Meshes	Show view origin	Controls
	Materials	Mesh	Camera	Cuts					
Material	l IDs								
		Clea	ır						
		0	-						
Material	Color	Opacity (%)	Show						
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Nuclide	Density (ator	ns/b-cm)							
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1002	5.794743e-0	06							
6012	4.398437e-0)2							
6013	4.757230e-0)4							
7014	2.953217e-0	03							
7015	1.078897e-0	05							

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Materials Controls: Visibility

	•	Material	\$	Zoom factor	127.354	View presets 🔻
	Materials	Mesh	Camera	Cuts		
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Material	Color	Opacity (%)	Show			
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Density Tempera Nuclide	(g/cc): 1.04 ature (K): 293 Density (ator 5.038231e-0	40000e+00 .00 ms/b-cm) 02 06				
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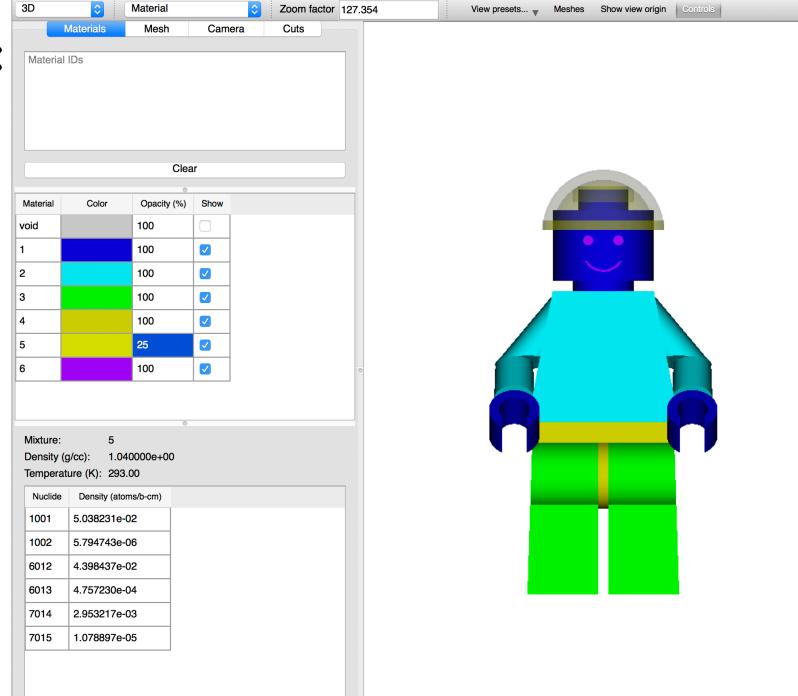


Show view origin

Controls

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Materials Controls: Opacity

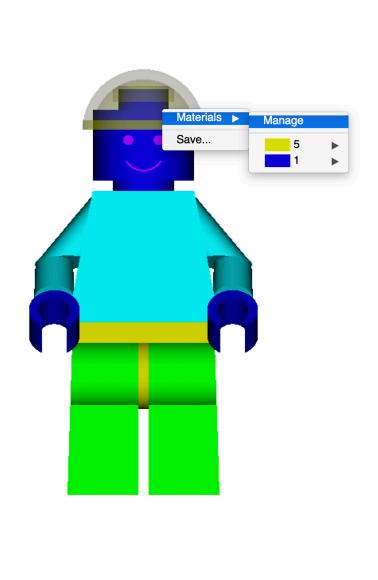


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Material Filter

- Users can type material identifiers (numbers) to filter material table rows.
- Same filtering capability conducted by right-clicking a pixel with multiple materials and selecting 'Manage'

3D	\diamond	Material		\$	Zoom f	actor	127.354		
Materials Mesh Camera Cuts 15 Filter Table									
		Clea	ır						
		•							
Material	Color	Opacity (%)	Show						
1		100							
5		25							
Mixture: Density Tempera		0000e+00 00							
Nuclide									
1001	5.038231e-0								
1002	5.794743e-0	6							
6012	4.398437e-0	2							
6013	4.757230e-0	4							
7014	2.953217e-0	3							
7015	1.078897e-0	5							



Show view origin

Meshes

View presets...



Zooming

- Rectangle (or lasso) zoom is implemented just as it is in the 2D view
 - Click upper-left and drag to lower-right
- Quick zoom is implemented via a Zoom factor text field, allowing the user to enter a zoom (multiplication) factor.
 - Show view origin can assist in zoom factor focus

BD ᅌ Material ᅌ 🤇 Zoom factor 127.3	354 View presets View presets Meshes Show view origin Controls
Materials Mesh Camera Cuts	
Position	
X 0.000000000000000000e+00	
Y -1.59545172023569512e+03	
Z 2.299999999999999982e+00	
Ť	
← →	
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Orientation	
X 0.000000000000000e+00	
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Z 2.299999999999999982e+00	
Reset	
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Presets	
Isometric Top	
Front Right side	
Miscellaneous	
Orthographic	
Zoom factor 127.354	
Outline threshold 0.50 🗘	

Zooming

• Rectangle (or lasso) zoom is implemented just as it is in the 2D view

3D

Position

Orientation

Presets

Miscellaneous

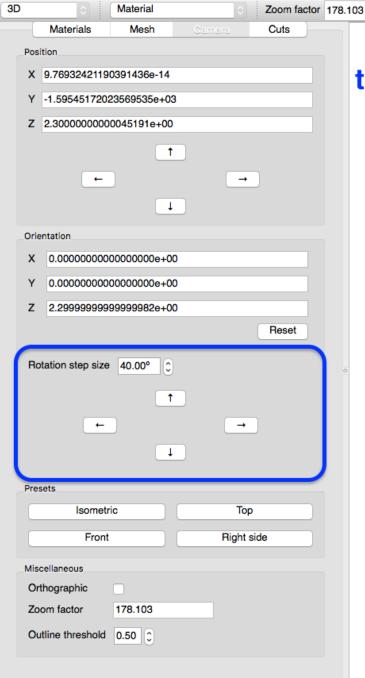
- Click upper-left and drag to lower-right
- Quick zoom is implemented via a **Zoom factor** text field, allowing the user to enter a zoom (multiplication) factor.
 - Show view origin can assist in zoom factor focus

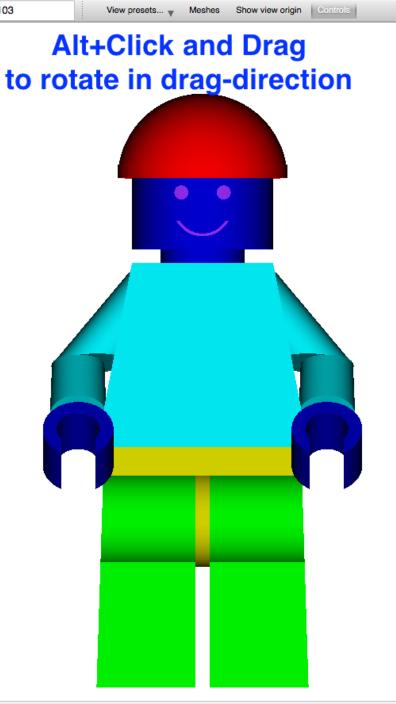
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	Material	 Zoom factor 482. 	182 View presets view presets	Meshes Show view origin Controls	
Materials	Mesh Came	ara Cuts			
Position					
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Y -1.5954517202	23569512e+03				
Z 3.5249348532	2335287e+00				
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Miscellaneous					
Zoom factor	482.182				
Outline threshold	0.50 🗘				
					Origin: (0, -1595.45, 3.52493)

Camera Rotation

- Rotation step size input field allows specifying explicit rotation.
- Up arrow rotates model up by rotating camera down
- Down arrow rotates model down by rotating camera up
- Left arrow rotates model left by rotating camera right
- Right arrow rotates model right by rotating camera left
- Arbitrary rotation is achieved by Alt+click-anddrag
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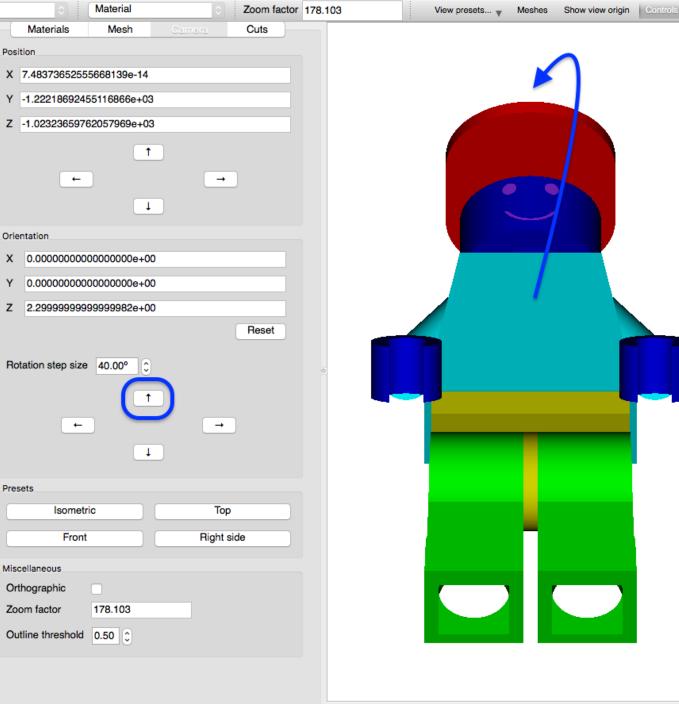




Camera Rotation: Up

- Rotation step size input field allows specifying explicit rotation.
- Up arrow rotates model up by rotating camera down
- Down arrow rotates model down by rotating camera up
- Left arrow rotates model left by rotating camera right
- Right arrow rotates model right by rotating camera left
- Arbitrary rotation is achieved by <u>Alt+click-and-</u> <u>drag</u>

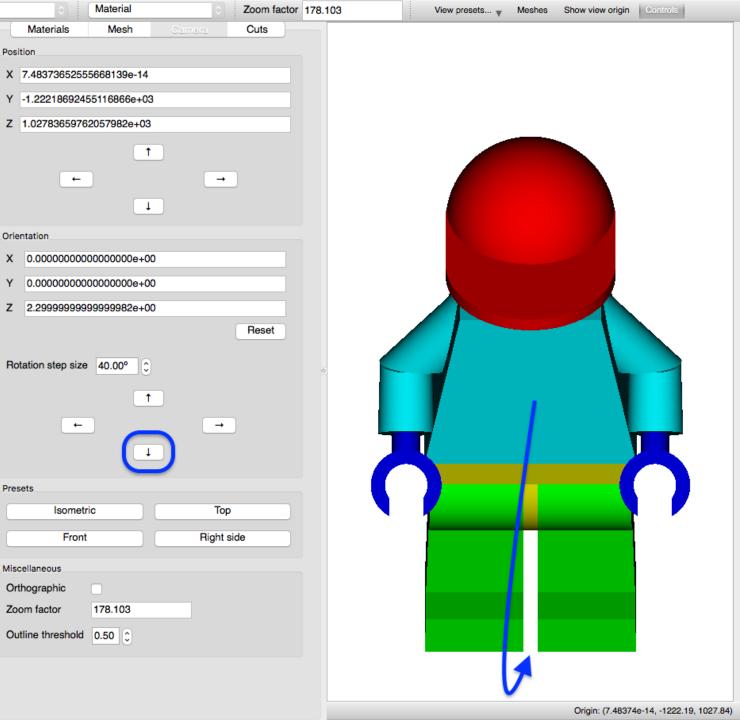
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Camera Rotation: Down

- Rotation step size input field allows specifying explicit rotation.
- Up arrow rotates model up by rotating camera down
- <u>Down arrow rotates model</u> <u>down</u> by rotating camera up
- Left arrow rotates model left by rotating camera right
- Right arrow rotates model right by rotating camera left
- Arbitrary rotation is achieved by <u>Alt+click-and-</u> <u>drag</u>

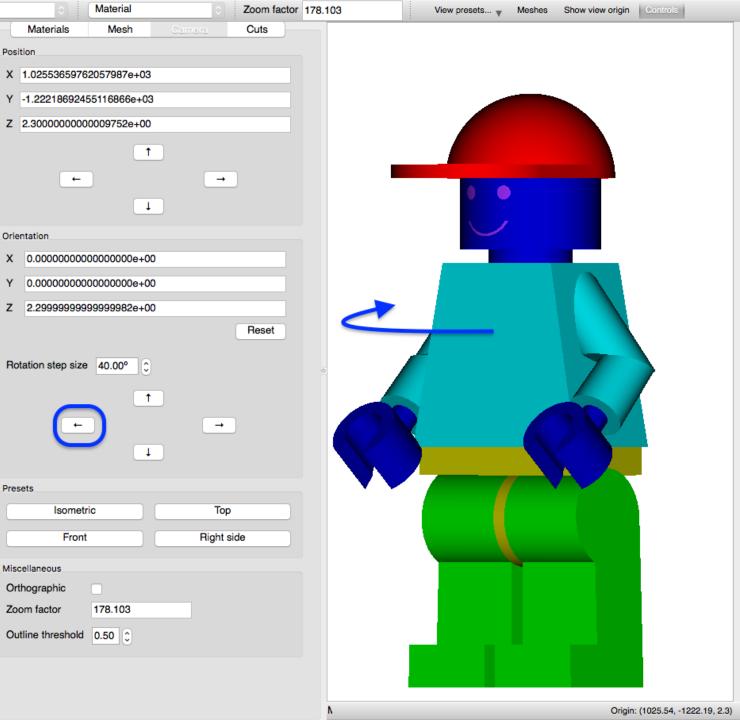
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Camera Rotation: Left

- Rotation step size input field allows specifying explicit rotation.
- Up arrow rotates model up by rotating camera down
- Down arrow rotates model down by rotating camera up
- <u>Left arrow rotates model left</u> by rotating camera right
- Right arrow rotates model right by rotating camera left
- Arbitrary rotation is achieved by <u>Alt+click-and-</u> <u>drag</u>

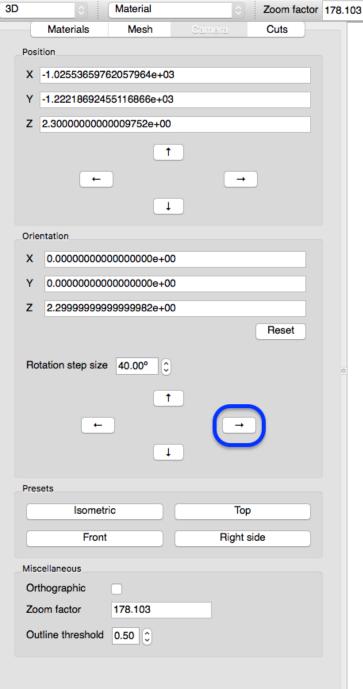
CAK RIDGE National Laboratory

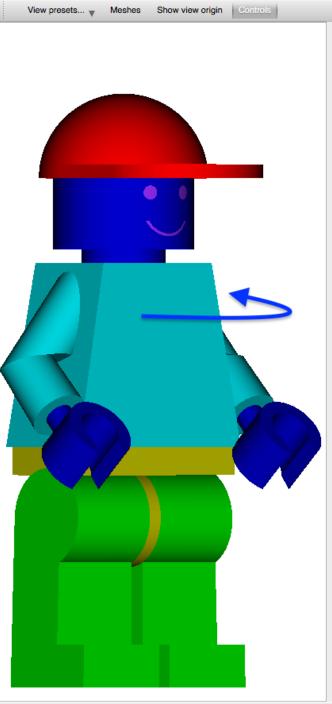


Camera Rotation: Right

- Rotation step size input field allows specifying explicit rotation.
- Up arrow rotates model up by rotating camera down
- Down arrow rotates model down by rotating camera up
- Left arrow rotates model left by rotating camera right
- <u>Right arrow rotates model</u> <u>right</u> by rotating camera left
- Arbitrary rotation is achieved by <u>Alt+click-and-</u> <u>drag</u>

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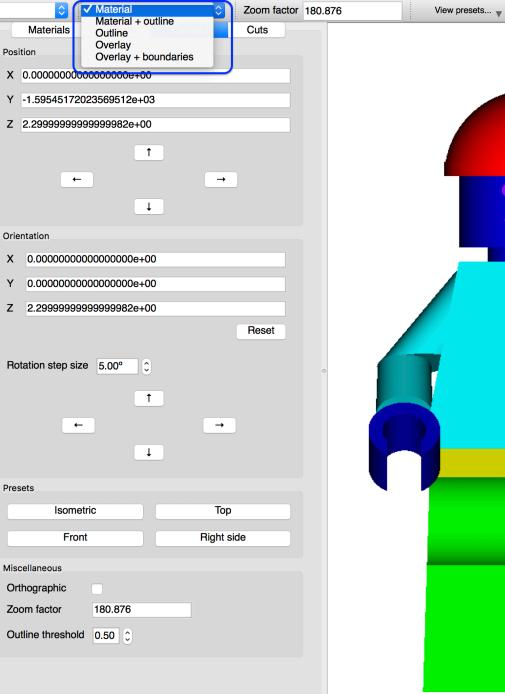
Rendering modes

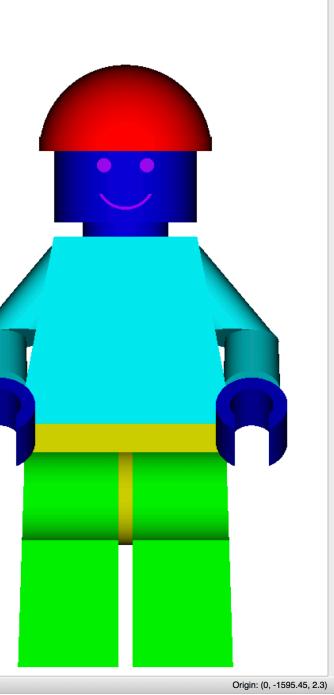
3D

- Material renders only material colors, shaded according to surface normal
- Material+Outline renders same as Material with the addition of black outlines at boundaries
- Outline renders only material boundaries using Material colors
- Mesh data **Overlay** and **Overlay+boundaries** capabilities do data point sampling on first interacted geometry surfaces

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Meshes Show view origin

Controls

Rendering modes: Material + outline

3D

Position

Orientat

Presets

Miscella Orthog Zoom Outline

• renders same as Material with the addition of black outlines at boundaries

		Material + outline	Zoom factor	180.876	View presets w	Meshes	Show view origin	Controls
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Rendering modes: Outline

3D

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X

R

Mis Or Zo

 renders only material boundaries using Material colors

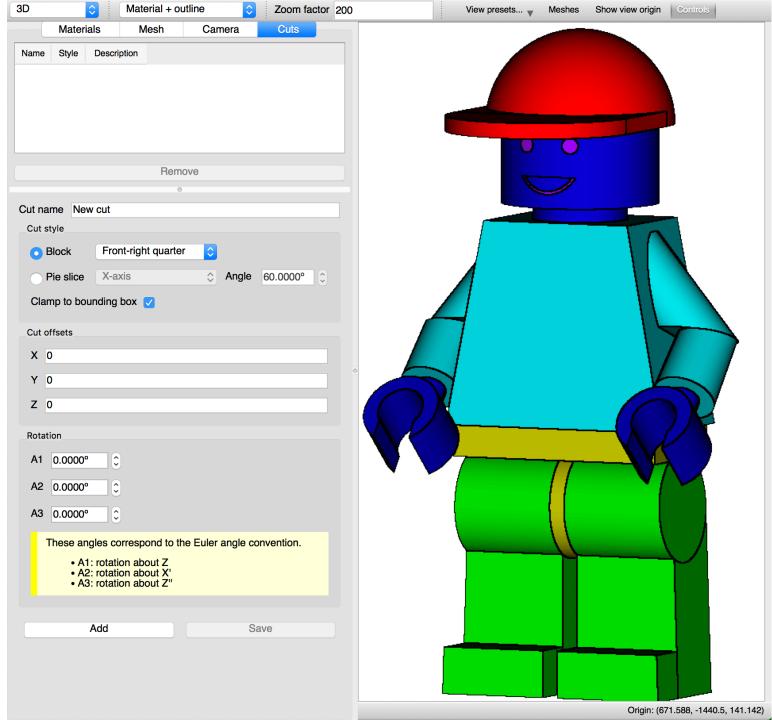
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-1.595451720	23569512e+03							
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om factor	180.876							
utline threshold								
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Model Cutting

- Named Block and Pie slice model cut styles
- Boundary box cut clamping
- Cut offsets allow for moving the origin of the cut
- **Rotation** uses Euler-X convention to rotate cuts to desired angles
- Ability to remove and edit/save existing cuts

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- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)

3D

Name

Cut nai Cut s

Cut of

Rotati

• Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)

)	\diamond	Material + out	line ᅌ	Zoom facto	or 200		View presets	Meshes	Show view origin	Controls
Mate	erials	Mesh	Camera	Cuts						
ut name N Cut style Block Pie slic Clamp to b Cut offsets X 0 Y 0 Z 0	Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Description Descri	ption pp half ottom half eft half ight half ront half ack half ront-right quart		60.0000°						
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	Add		S	ave						

- Block
 - <u>Top half (+Z)</u>
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)

• Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)

3D		Material + outli	ne 🗘	Zoom factor	200	View presets 🔻	Meshes	Show view origin	Controls
	Materia	ls Mesh	Camera	Cuts					
Name	Style	Description							
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) Bl	ock	Top half	0						
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Cut off	sets							_ /	
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Y 0.	0000000	00000000000e+00							
Ζ 0.	0000000	00000000000e+00						K	
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Rotatio									
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A2 (0.0000°	0							
A3 (0.0000°	0							$\overline{\mathcal{I}}$
Th	iese and	les correspond to the	Euler angle co	nvention.					
	• A1:	rotation about Z	^o						
	• A2: • A3:	rotation about X' rotation about Z"					N		
	ŀ	Add	Sa	ive					

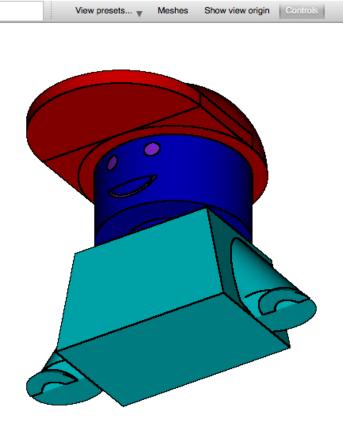
- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)

• Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)

3D	<		Material + o	utlin	е		Zoom fact	or 200
	Materia	ls	Mesh		Camera		Ouis	
Name	Style		Description					
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			c)				
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Cut st	yle							
() E	lock	Bot	tom half		٢			
OF	ie slice	X-a	xis		Ang	le	60.000°	0
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			000000e+00					
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zo	.0000000	00000	000000e+00					
Rotat	on							
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A2	0.0000°							
A3	0.0000°	0	J					
г	hese ang	les co	prrespond to t	he E	uler angle	e co	onvention.	
			on about Z on about X'					
			on about Z"					
	1	Add				Sa	ave	



```
Origin: (730.088, -1113.7, -846.161)
```

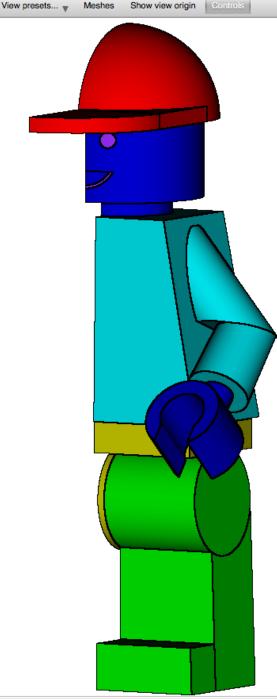
- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)
- Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)

3D	0		Material + o	utline	\$		Zoom factor	200
	Materia	s	Mesh	Ca	mera		Cuts	
Name	Style		Description					
New cut	Block	Left-	half, clamped					
			Rem	ove				
			0			_		
Cut nam	e New	cut						
Cut styl	e							
) Blo	ock	Left	half	0				
O Pie	slice	X-a	xis	0	Angle	6	0.0000°	
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Cut offs	sets							
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Y 0.0	000000	0000	000000e+00					
Z 0.0	000000	0000	000000e+00					
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A2 0	.0000°	0	J					
A3 0	°0000.	0)					
Th	ese ang	les co	orrespond to th	he Euler	angle co	on	vention.	
			on about Z on about X'					
			on about Z"					
	A	٨dd			S	av	e	



Origin: (794.859, -1356.35, 147.954)

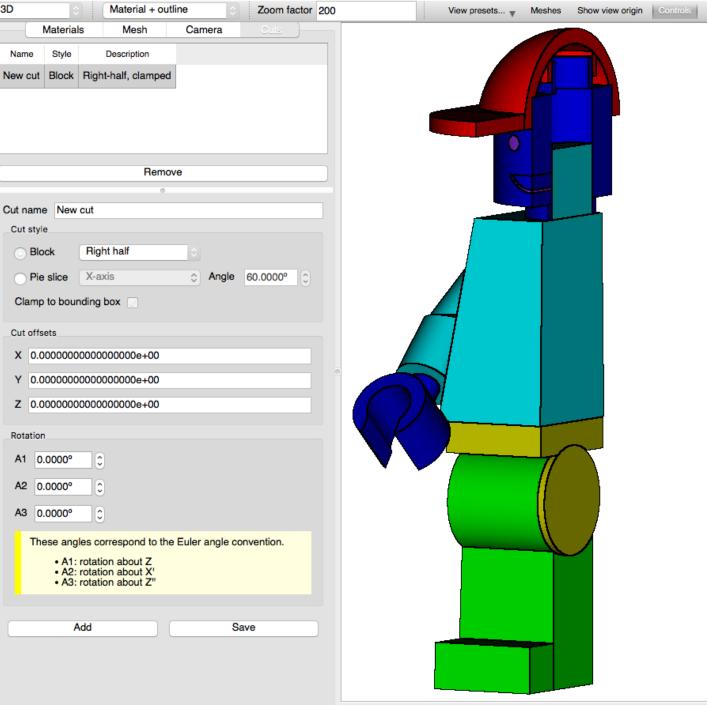
- Block lacksquare
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - <u>Right half (+X)</u> —
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)

3D

• Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)



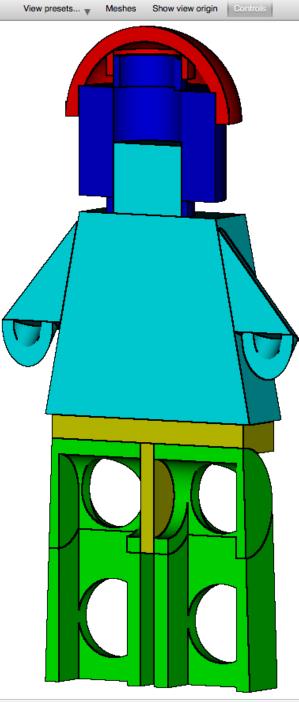
- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)
- Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)

3D	0	Material + or	utline 🔅	Zoom factor	200
	Materia	s Mesh	Camera	Outs	
Name	Style	Description			
New cut	Block	Front-half, clampe	d		
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Cut name	e New	cut			
Cut styl	e				_
	ck	Front half	\$		
O Pie	slice	X-axis	Angle	60.000° 🗘	
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Cut offs	ets				
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Z 0.0	000000	0000000000e+00			
Rotation	ı				_
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A2 0	.0000°	٢			
A3 0	.0000°	0			
			5 (
	-	les correspond to th rotation about Z	ie Euler angle co	nvenuon.	
	• A2:	rotation about X' rotation about Z"			
	A	dd	S	ave	
	-				

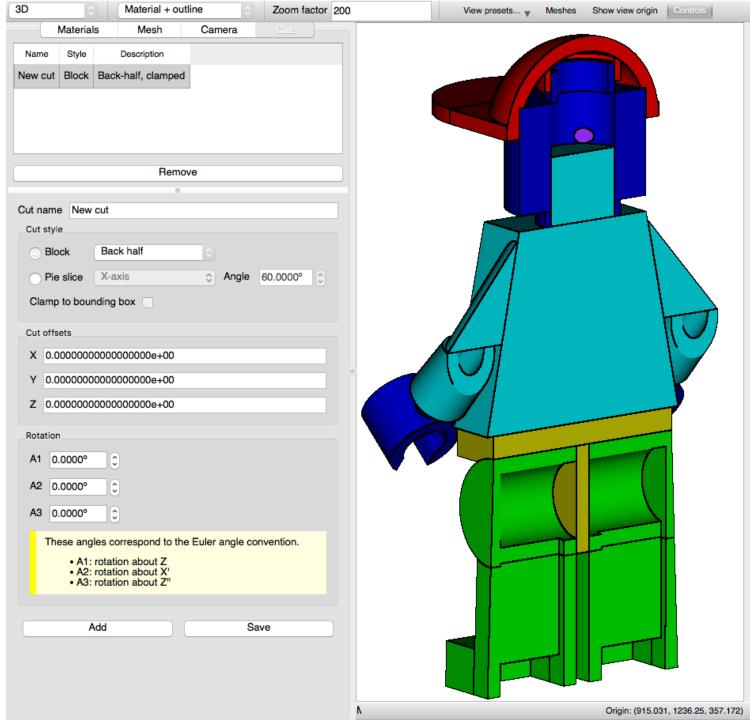


Origin: (794.859, -1356.35, 147.954)

- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)
- Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)



- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)

3D

Name New cu

Cut nan Cut st

Cut of X 0.

Rotatio

• Pie slice

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- X axis (opening in –Y)
- Y axis (opening in –Z)
- Z axis (opening in -Y)

)	 Material + outli 	ine 🗘	Zoom factor	200	View presets w	Meshes	Show view origin	Controls
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Name Style	Description					1E		
ew cut Block	Front-right quarter, c	lamped				$ A_{-} $		
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	0	•						
ut name Nev	v cut							
Cut style								
Block	Front-right quarter	0						
O Pie slice	X-axis	Angle	60.0000° 🗘					
Clamp to bo	unding box		0					
					A			
Cut offsets								
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Y 0.000000	00000000000e+00							
Z 0.000000	0000000000e+00							
Rotation						_		
							h	
A1 0.0000°				•				
A2 0.0000°	 ©							
A3 0.0000°	٢							
These an	gles correspond to the	Euler angle co	nvention.					
• A1	: rotation about Z : rotation about X' : rotation about Z"							4
• A3	: rotation about Z"							
	Add	Sa	ive					

Origin: (794.859, -1356.35, 147.954)

- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)
- Pie slice

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- <u>X axis (opening in -Y)</u>
- Y axis (opening in –Z)
- Z axis (opening in -Y)

D	0	Material + outline	e 🗘	Zoom factor	200		View presets.	🔻 Meshe	s Show view origin	Co
	Materials	Mesh	Camera	Cuts						
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		op half	0							
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Clamp	to boundir	ng box 💟							X	
Cut offs							\square			77
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A2 0	.0000°	٥								\sim
_	.0000°	0					l l			
In		correspond to the E	uler angle co	nvention.					·	4
	 A2: rot A3: rot 	ation about Z ation about X' ation about Z"								
	Add		Sa	ave						
										-

Origin: (726.899, -1396.76, 119.088)

- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)
- Pie slice

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- X axis (opening in –Y)
- Y axis (opening in -Z)
- Z axis (opening in -Y)

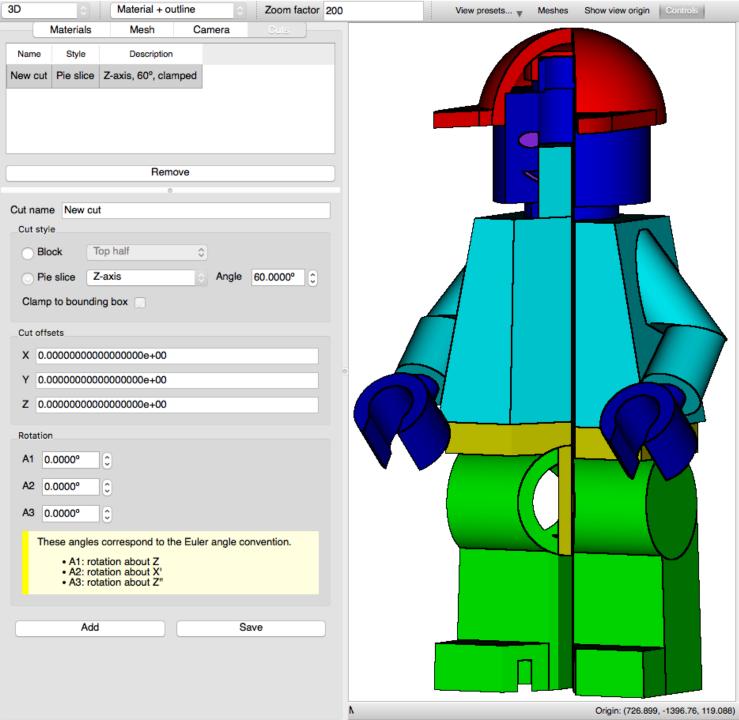
Q	Material + outline		Zoom facto	r 200		View presets 🔻	Meshes	Show view origin	Controls
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	Remove								
	0								
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ut style								Λ	
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Clamp to bounding	box 📝								
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A2 0.0000° 🗘									
A3 0.0000° 🗘									
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	ion about Z	er angle con	venuori.						
 A2: rotati 	on about X' on about Z"								
Add		Sav	e						
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					N			Origin: (706.900	1206 76 110 099

- Block
 - Top half (+Z)
 - Bottom half (-Z)
 - Left half (-X)
 - Right half (+X)
 - Front half (-Y)
 - Back half (+Y)
 - Front-right quarter (-Y,+X)

• Pie slice

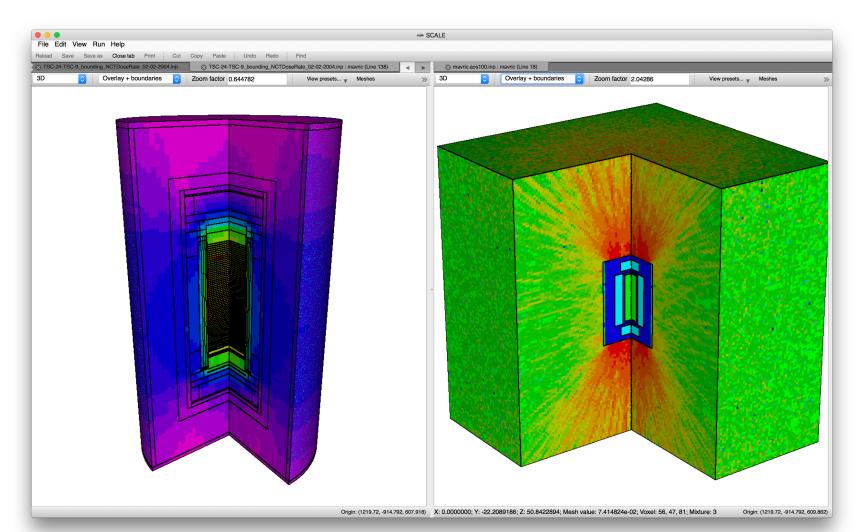
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- X axis (opening in –Y)
- Y axis (opening in –Z)
- <u>Z axis (opening in -Y)</u>



3D Model visualization with mesh overlay

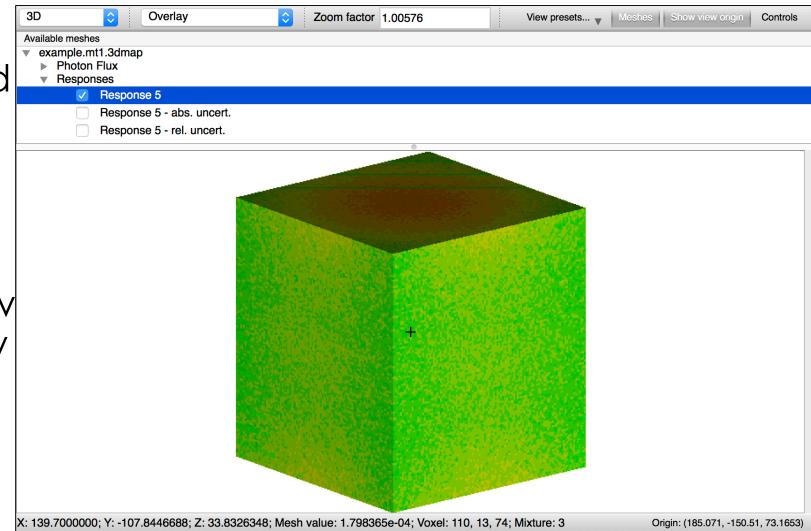
 Available when mesh data is loaded and selected, and the render mode is Overlay or Overlay + Boundaries





3D Controls | Hands On

- Change the perspective from Front (X-Z) to **3D**
- Depending on your CPU clock speed and core count you may observe a pause while the model is raytraced
- Note the Origin is now the Camera not View Plane origin
- Observe mouse-over surface information



3D Controls | Hands On Model Cut

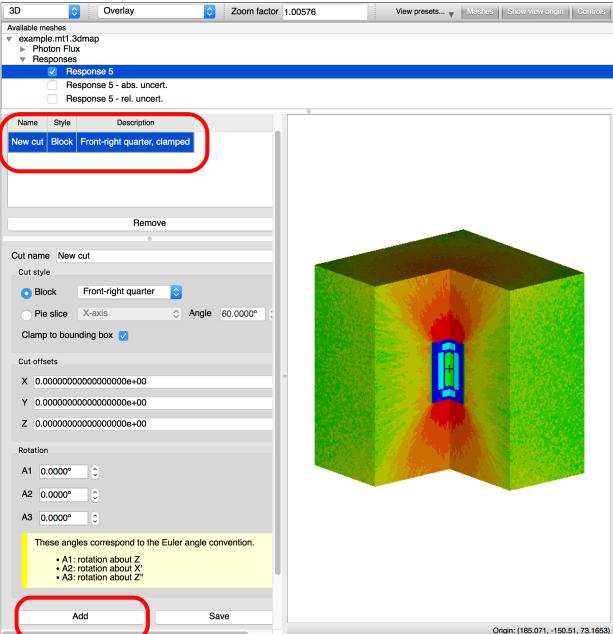
- Click the **Controls** panel button to display sidebar controls
- Click the Cuts tab

3D 📀 Overlay ᅌ Zoor	m factor 1.00576	View presets View original Meshes Show view original	in Controls
Available meshes ■ example.mt1.3dmap ▶ Photon Flux ■ Responses			
Response 5			
Response 5 - abs. uncert.			
Response 5 - rel. uncert.			
Materials Mesh Camera Cut			
Remove		+	
Cut name New cut			
Cut style Block Front-right quarter Pie slice X-axis Angle 60.000 Clamp to bounding box Cut offsets X 0.00000000000000000000000000000000000	0° (
		Origin: (185.071, -1	50.51, 73.1653)



3D Controls | Hands On New Model Cut

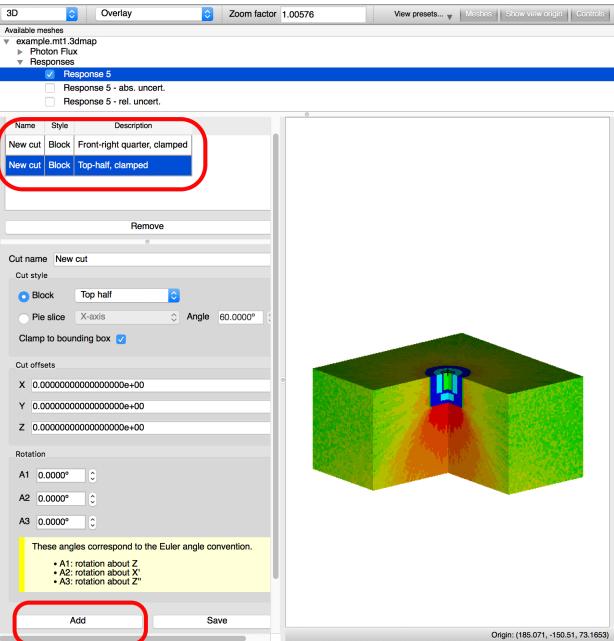
- Conduct a default
 Front-right quarter Block
 cut by clicking the Add
 button
- Observe the **New cut** entry in the cuts table
- Observe the section removed and rendered with new overlay data





3D Controls | Hands On New Model Cut Cont'd

- Conduct a default
 Top half Block cut by selecting the Top half Cut style and clicking the Add button
- Observe the **New cut** entry in the cuts table
- Observe the section removed and rendered with new overlay data

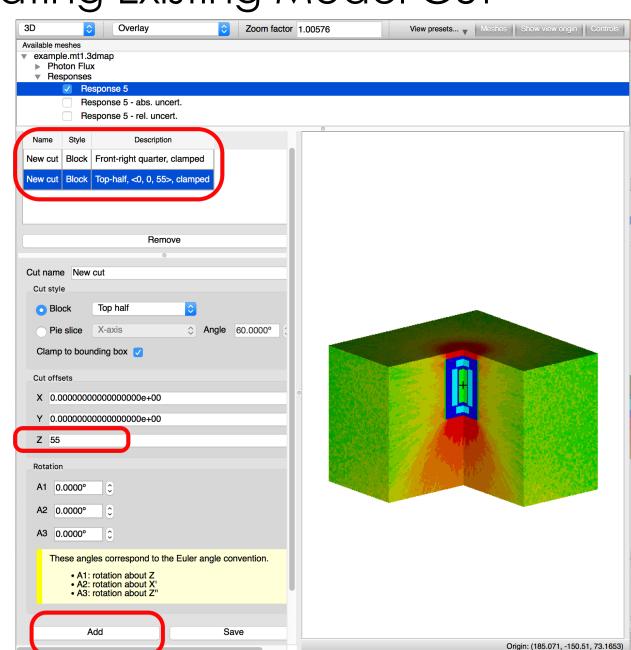




3D Controls | Hands On Updating Existing Model Cut

- Let's edit the Top-half cut to remove less model via a Cut offset in Z of 55
- Update Cut offset Z to be 55
- Click Save
- Observe the cuts table entry **Description** update as well as the additional model and data visible





3D Controls | Hands On Camera Controls

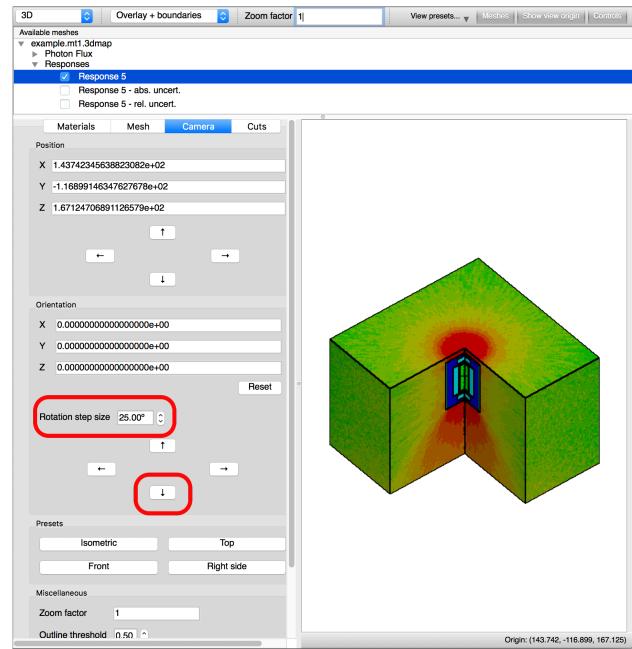
- Select the Camera controls
- Update Rotation step size to be 25
- Rotate down by clicking the Orientation down arrow button
- Observe the camera Position
 change

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- Good to remember the camera is moving, not the model



3D Controls | Hands On Camera Controls

- Update the **Zoom** to be **5**
- Update the **Render mode** to be **Overlay + boundaries**
 - In 3D this mode includes rendering boundaries as a function of surface normal

3D	Overlay + boundaries	Zoom factor 5	View presets View origin Controls
Available me			
 example 	e.mt1.3dmap		
	on Flux ponses		
	Response 5		
(Response 5 - abs. uncert.		
	Response 5 - rel. uncert.		
N	laterials Mesh Camera	Cuts	
Position			
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Y -1.	16899146347627678e+02		
Z 1.6	67124706891126579e+02		
	Ť		
	Ļ		
Orienta	tion		
X 0.	.0000000000000000000000000000000000000		
Y 0.	.0000000000000000000000000000000000000		
Z 0.	.0000000000000000000000000000000000000		
		Reset	
Rotati	on step size 25.00° 🗘		
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	1		
	←	→	
	Ļ	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Presets			
	Isometric	Гор	
	Front Righ	nt side	
MISCEII	aneous		
Zoom			
	e threshold		
			Origin: (143.742, -116.899, 167.125)



3D Controls | Hands On Material Controls

- Click the Materials panel button to display materials controls
- In the Show column of the Material table deselect material 1
 - Alternatively, right-click the

region and select **Hide**

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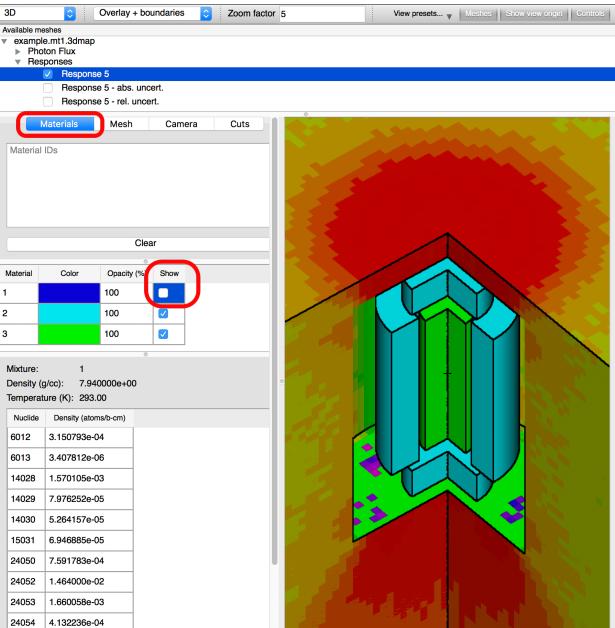
National Laboratory

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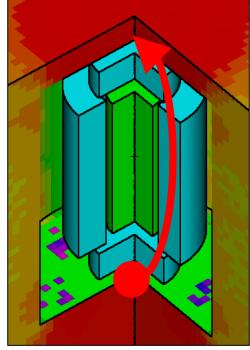
2

 Observe Material 1 is hidden in the rendering



3D Controls | Hands On Arbitrary Rotation

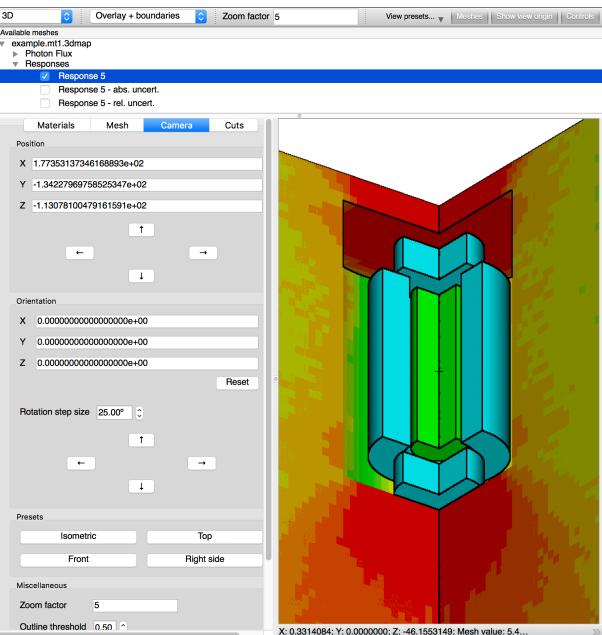
 With the Alt (option on Mac) key pressed click and drag up as depicted



• Perform various rotations to become familiar with control

CAK RIDGE

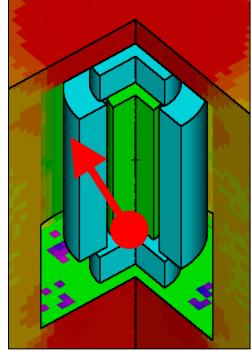
National Laboratory

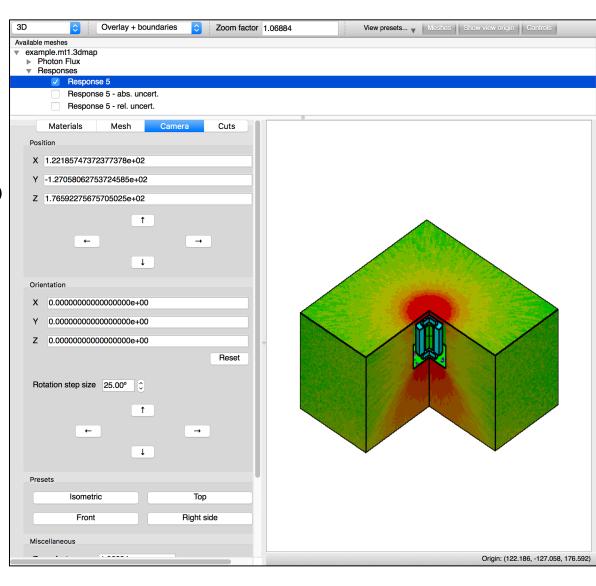


3D Controls | Hands On Fit to Screen

- Too close or far or simply lost in the geometry?
- A Left mouse button press and drag **up and to the left** and release fits the model's extents to the render window

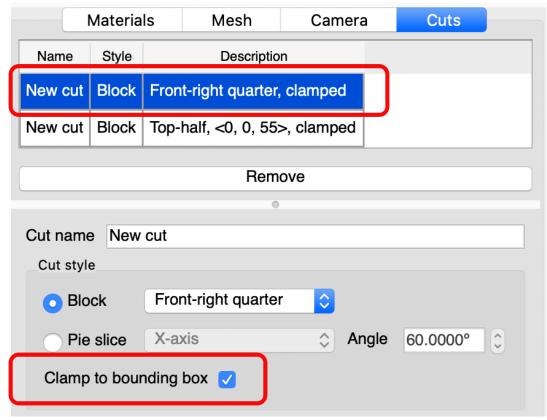
- Zooms out if too close to model
- Zooms in if too far away from the model





3D Controls | Hands On Cut Clamp to Bounding Box

- Select the Cuts tab
- Select the Front-right quarter cut
- The **Clamp to bounding box** option updates the 'infinite' cutting surface into a cutting volume
 - E.g., Front-right quarter is defined via 2 planes, clamp to bounding box updates the cutting surface to be a cutting box
- Volume is defined prior to application of translation and rotation

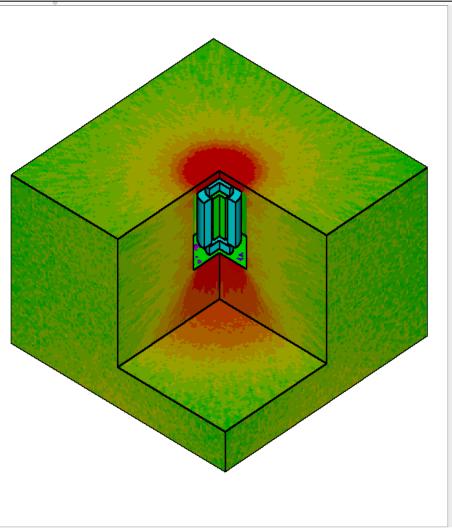




3D Controls | Hands On Cut Clamp to Bounding Box

- Update Cut Offsets to be 50
- Click Save
- Observe the Clamped cut is offset +50 from the lower z extent of -152.4 creating a 'shelf' at z=-102.4
 - Mouse over model to see X,Y,Z values

Materials		ls Mes	h	Camera	Cuts
Name	Style	Description			
New cut	Block	Front-right quarter, <0, 0, 50>, clamped			
New cut	Block	Top-half, <0, 0, 55>, clamped			
Remove					
0					
Cut name New cut					
Cut style					
O Blo	ck	Front-right q	uarter	\$	
Pie	slice	X-axis		Angle	60.0000° 🗘
Clamp to bounding box 🗸					
Cut offsets					
X 0.000000000000000000e+00					
Y 0.00000000000000000000000000000000000					
Z 50					
2 30					
Rotation					
A1 0.0000° 🗘					
A2 0.0000° 🗘					
A3 0.0000° C					
These angles correspond to the Euler angle convention. • A1: rotation about Z • A2: rotation about X' • A3: rotation about Z''					
Add				ę	Save



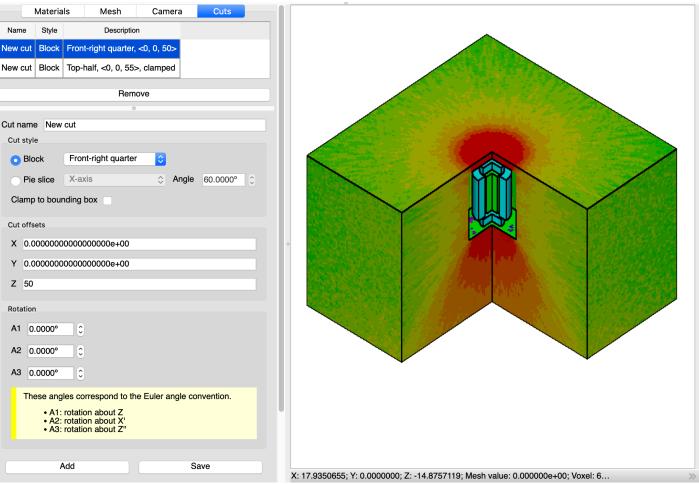
X: 58.1605316; Y: -64.6214986; Z: -102.4000000; Mesh value: 1.950537e-03; Voxe..

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>

3D Controls | Hands On Cut Clamp to Bounding Box

- Uncheck the Clamp to Bounding
 Box
- Click Save
- Observe the cut offset of +50 is ignored as the front-right corner cut is no longer clamped to the bounding box





Geometry Review

- You are now aware and practiced with 2D and 3D Camera controls
- You are aware and practiced with 3D Cut and Material controls
- You are aware and practiced with 2D and 3D mesh data overlay information, controls, and data plotting

• Questions?



Advanced User Interface Capabilities Review

- You are now aware and practiced with data plotting
 - Various data formats, options, and controls
- You are now aware and practiced with 2D and 3D geometry visualization
 - Controls, cuts, and data overlay

• Thank you!



Questions?

