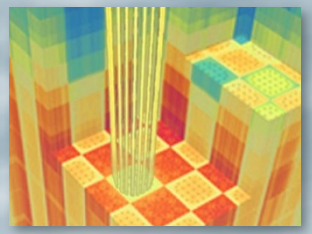
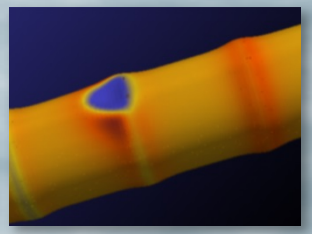
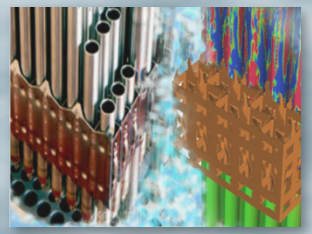
VERAView

Andrew Godfrey, ORNL
Ron Lee, ORNL

11 February 2019


The Consortium for Advanced Simulation of LWRs
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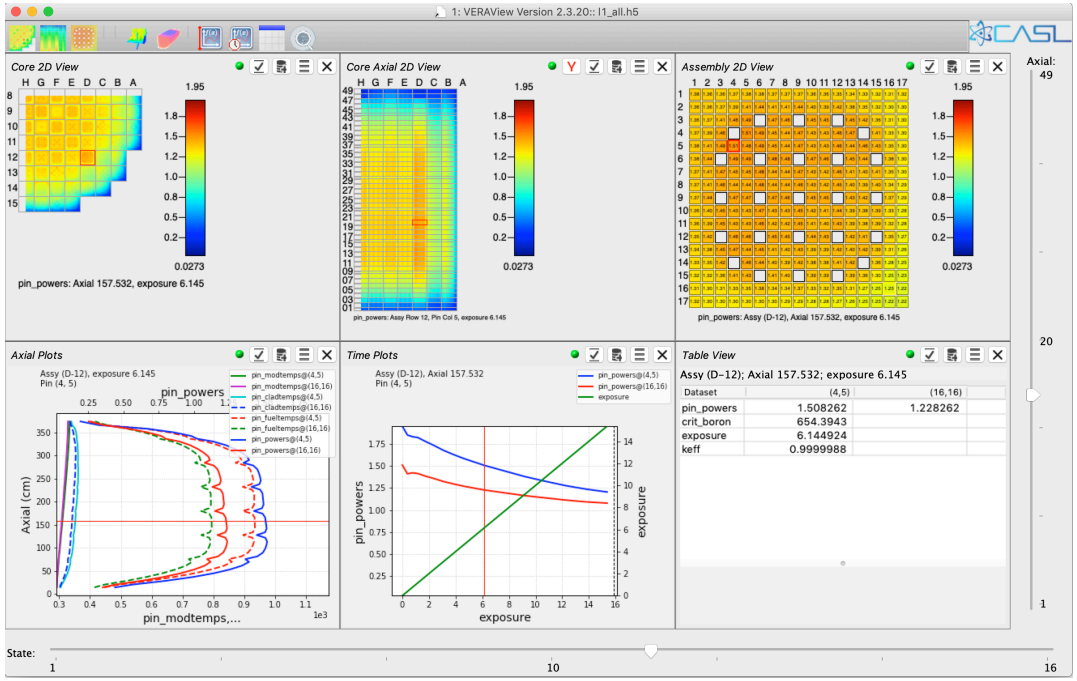
U.S. DEPARTMENT OF ENERGY

VERAView

- Description
- Platforms and Implementation
- Application Basics
- Dataset Types
- Widgets
- Demo

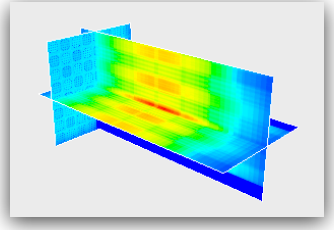


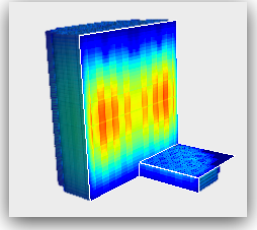
VERAView : Description

- An interactive graphical user interface (GUI) for the visualization and engineering analysis of VERA output
- True multi-physics analysis tool
  - Neutronics, thermal-hydraulics, fuel performance
  - All displayed together
- Displays data at the field rod / coolant channel level
  - Calculates coarser quantities
  - Assembly, axial, core, radial, and radial assembly average and RMS datasets
- Implicitly displays data in a simplified PWR geometry

VERAView : Description

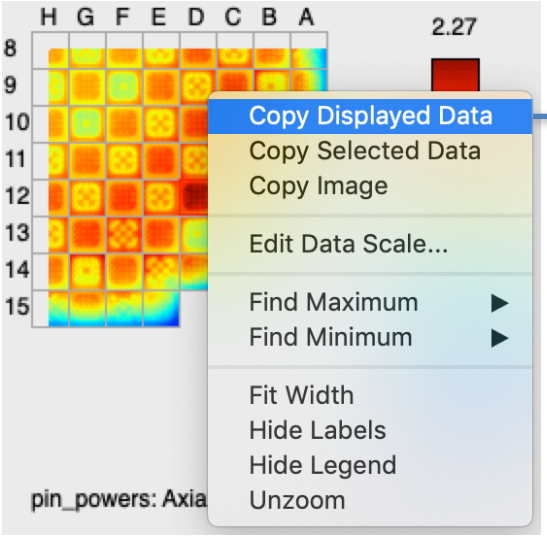
- Reads VERA output files but not connected directly to VERA codes
  - Data from any reactor methods can be displayed
  - Needs only a core_map, axial_mesh, number of pins indicator, and dataset(s) to display
- Designed to be used with no experience or training
  - Not a replacement for *VisIt*, *ParaView*, or other general purpose (i.e, complex) data visualization tools
  - Mostly 2D views with a couple of basic 3D visualizations





VERAView : Description

- Exports data as comma-separated values (CSV) for import to Excel or other spreadsheet apps



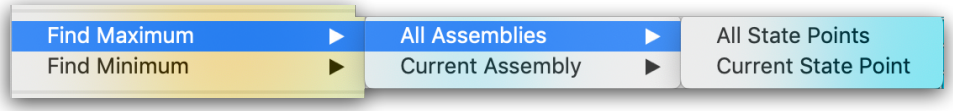
	A	B	C	D	E	F	G	H
1	pin_powers: Axial=193.602; exposure=0							
2	Cols=H:G:F:E:D:C:B:A; Rows=8:9:10:11:12:13:14:15							
3	1.461046	1.461705	1.464555	1.469059	1.473527	1.478106	1.474143	1.47
4	1.461705	1.484783	1.507857	1.53166	1.556733	1.590747	1.562685	1.56
5	1.464556	1.507857	1.561613	1.628809	1.659338	0	1.651808	1.6
6	1.46906	1.53166	1.628809	0	1.700972	1.697518	1.655016	1.65
7	1.473528	1.556733	1.659339	1.700972	1.690563	1.711108	1.672064	1.67
8	1.478107	1.590747	0	1.697518	1.711107	0	1.714979	1.71
9	1.474144	1.562685	1.651807	1.655013	1.672061	1.714977	1.684725	1.68
10	1.472969	1.561941	1.649627	1.651371	1.670133	1.716353	1.68768	1.68
11	1.476133	1.588946	0	1.684915	1.704612	0	1.722216	1.72
12	1.472969	1.561941	1.649627	1.651371	1.670133	1.716353	1.68768	1.68
13	1.474144	1.562685	1.651807	1.655013	1.672061	1.714977	1.684725	1.68
14	1.478107	1.590747	0	1.697518	1.711107	0	1.714979	1.71
15	1.473528	1.556733	1.659339	1.700972	1.690563	1.711108	1.672064	1.67
16	1.46906	1.53166	1.628809	0	1.700972	1.697518	1.655016	1.65
17	1.464556	1.507857	1.561613	1.628809	1.659338	0	1.651808	1.6
18	1.461705	1.484783	1.507857	1.53166	1.556733	1.590747	1.562685	1.56

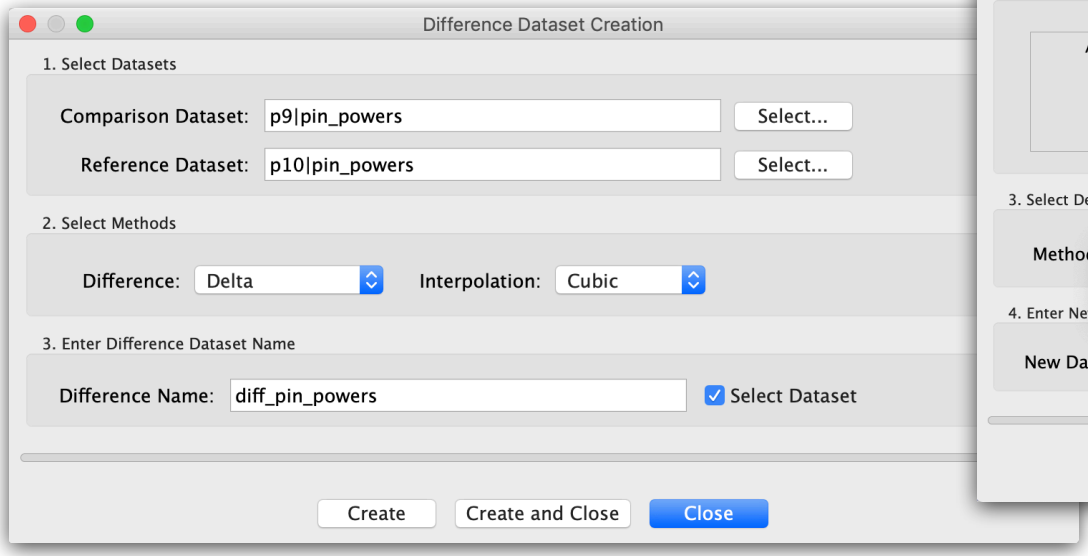
- Creates and exports images and animations

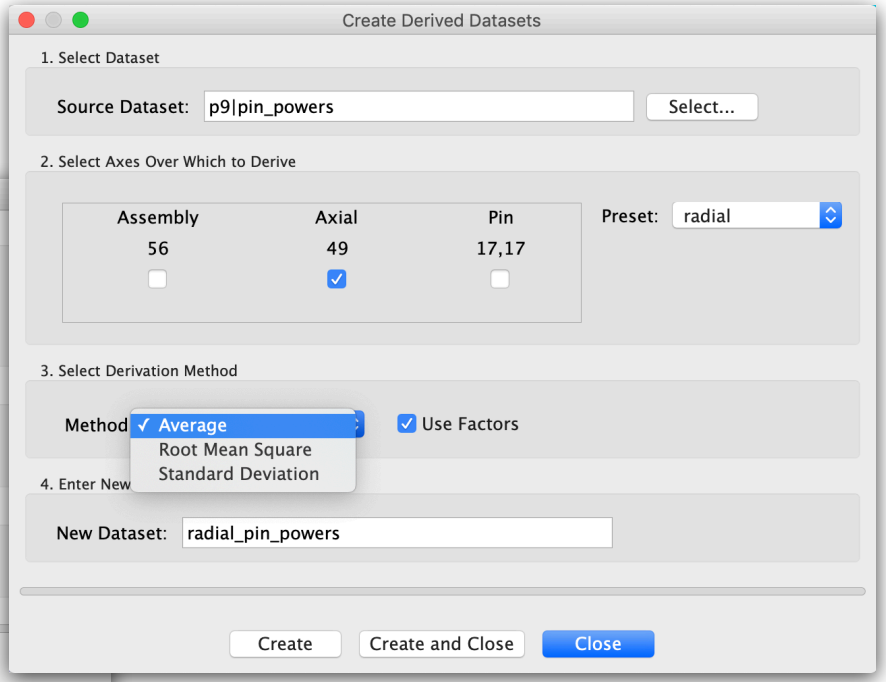
https://newton.ornl.gov/xfer/epm/final-vessel.anim.gif.html

VERAView : Description

- Analysis capabilities
  - Find maximum, minimum values
  - Create derived datasets (average, RMS)
  - Create difference datasets



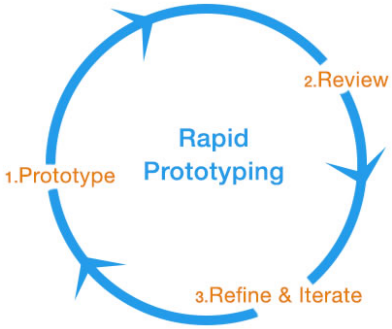




VERAView : Description

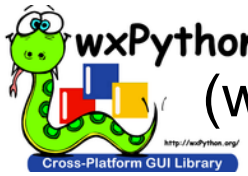
- Developed as a (very) rapid prototype with frequent stakeholder feedback
  - Good for “friendly users”
  - Some fringe features only lightly tested
- Designed to be extensible
  - Framework for adding custom widget implementation
- Open source

  https://github.com/CASL/VERAView



VERAView : Platforms and Implementation

- Python-2 desktop application



(wxWidgets) GUI widget library

plotting

3D rendering

image operations

h5py HDF5 file I/O

array processing and calculations

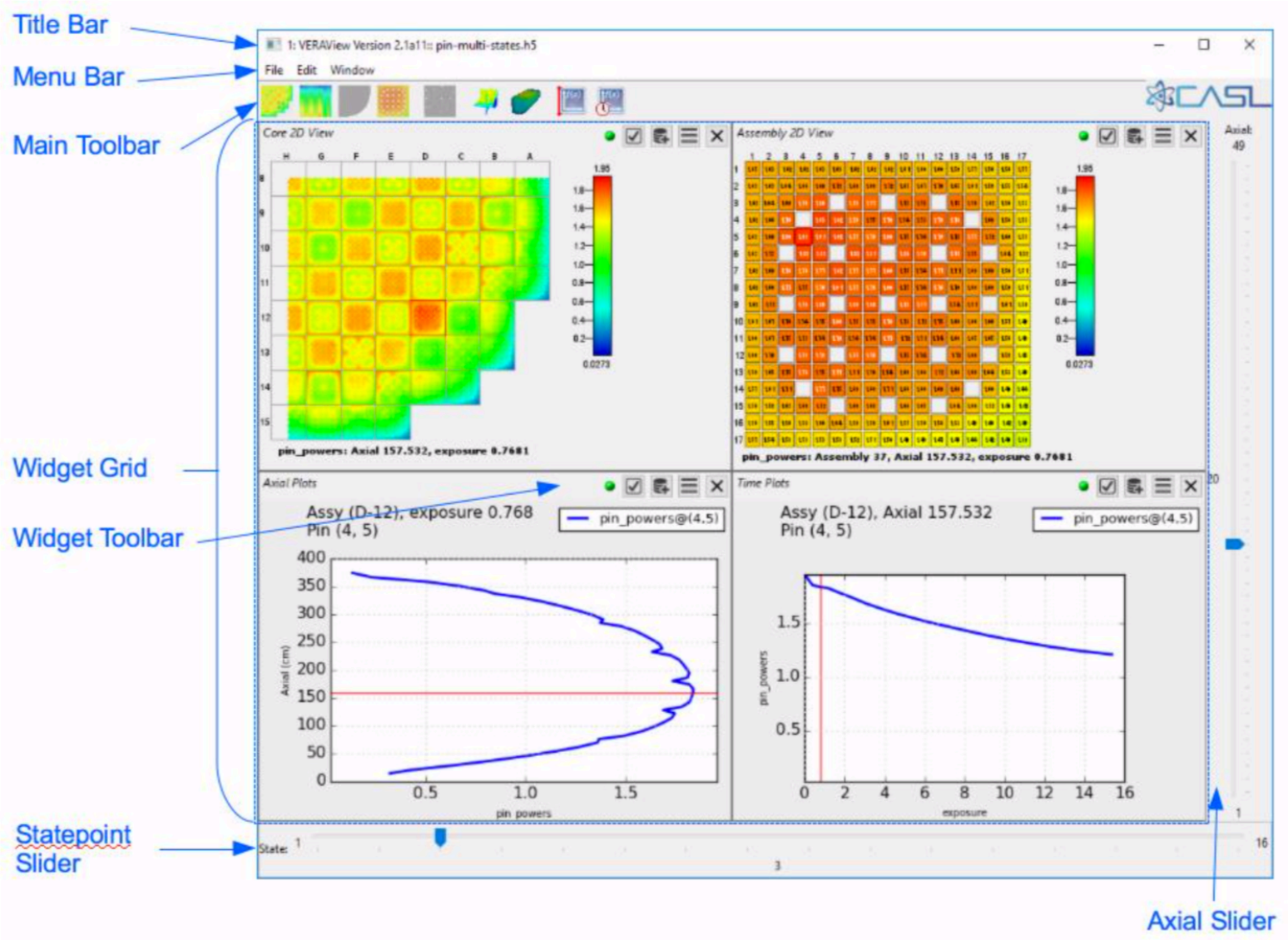
interpolations

VERAView : Platforms and Implementation

- Anaconda Python distribution
  - https://www.anaconda.com/
  - Cross-platform with all required VERAView packages

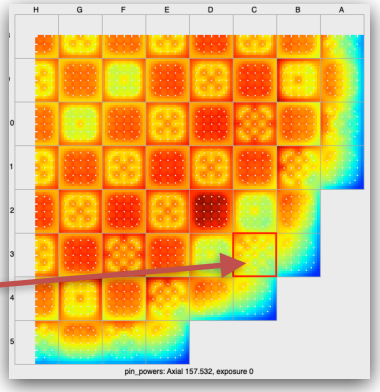

  - VERAView installers include Miniconda2, a lighter version with all required packages

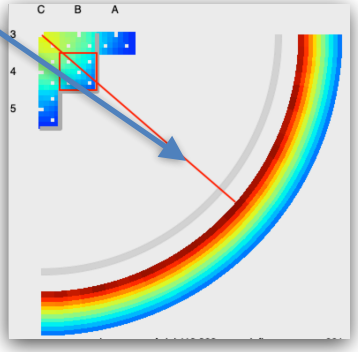
VERAView : Application Basics



VERAView : Application Basics

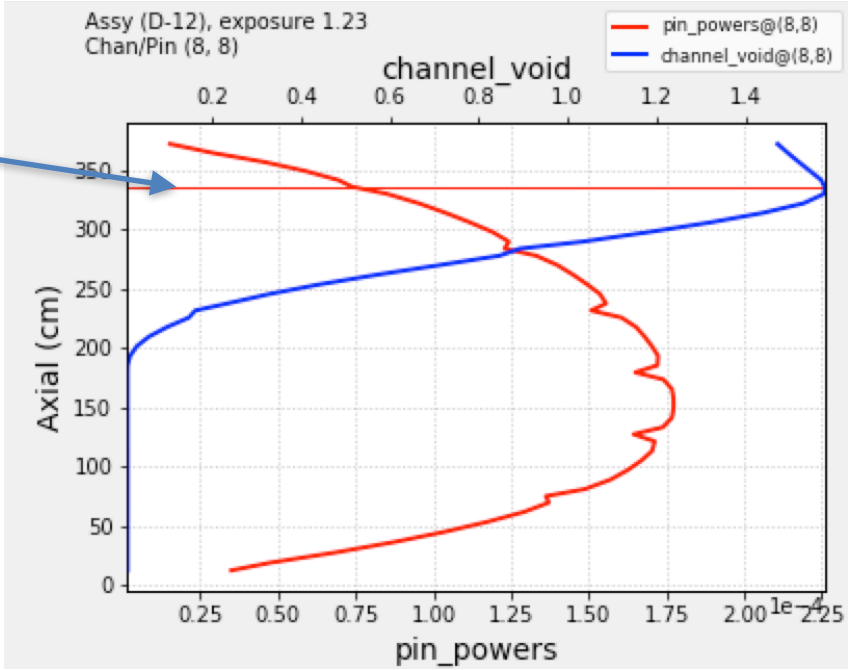
- Current selections
  - Coordinates
    - Assembly/detector (column, row)
    - Pin/channel (column, row)
    - Node
    - Secondary pins and nodes
    - Fluence (theta, r)
  - Dataset(s)

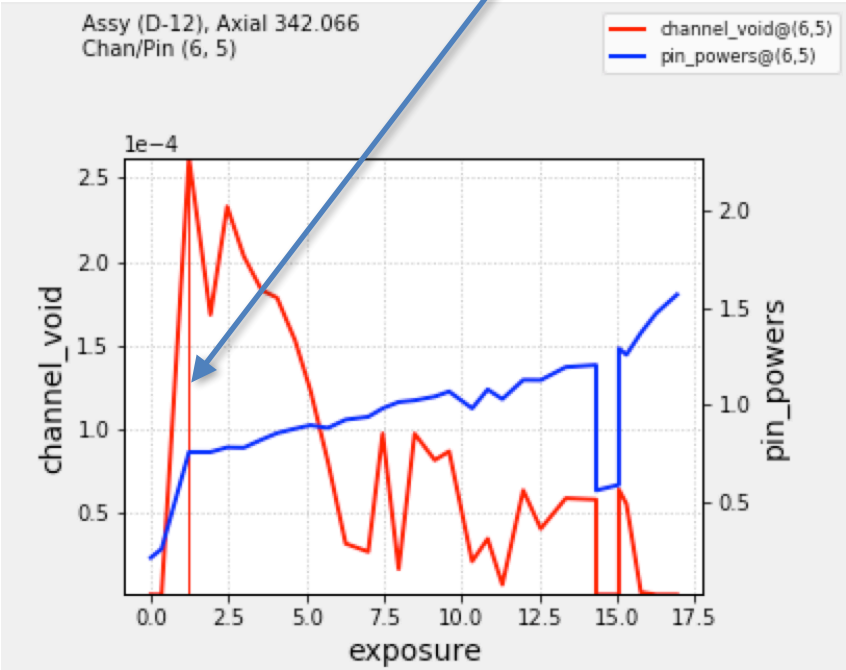




VERAView : Application Basics

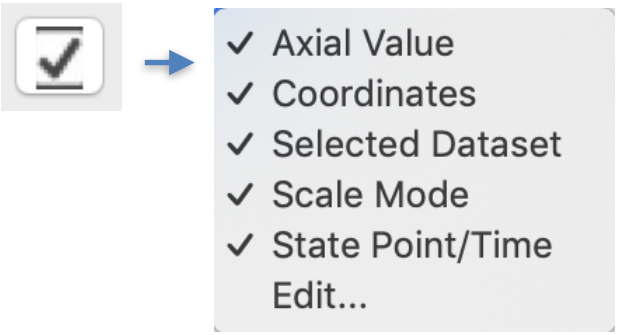
- Current selections (cont'd)
  - Axial level
  - Statepoint (time)





VERAView : Application Basics

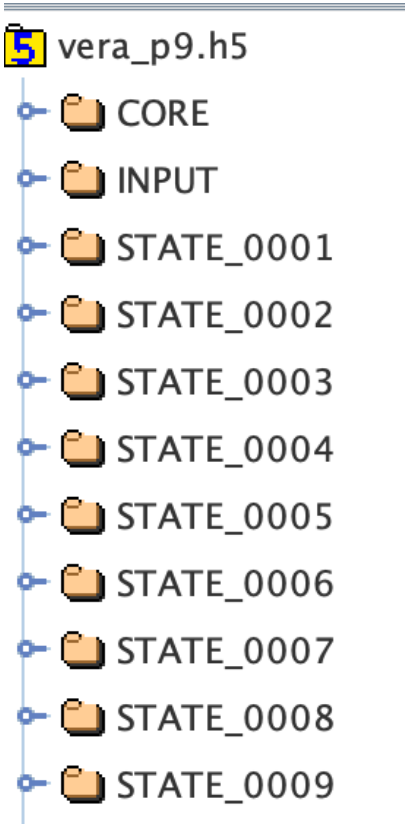
- Selections in one widget are shared with all other widgets
  - Can be toggled for each individual widget

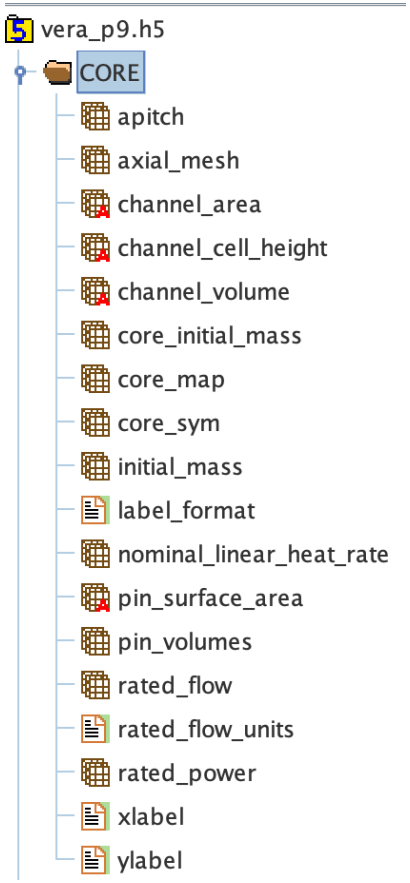


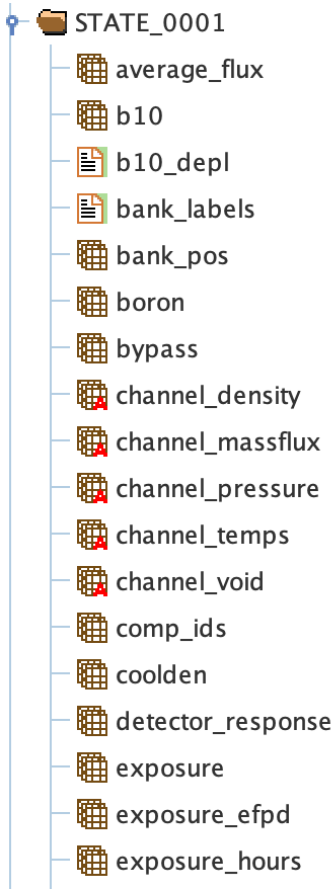
- Sliders added for convenient selection
  - Axial level
  - Statepoint (time)

VERAView : Dataset Types

- VERAOut file is in HDF5 format
  - Hierarchical with groups (directories) and leaf datasets







VERAView : Dataset Types

- Primary types

Type	Shape
channel	(npiny+1, npinx+1, nax, nass)
detector	(ndetax, ndet)
fixed_detector	(nfdetax, ndet)
fluence	(nz, theta, nr)
pin	(npiny, npinx, nax, nass)
radial_detector	(ndet,)
scalar	()
subpin_cc	(nsubtheta, npiny, npinx, nsubax, nass)

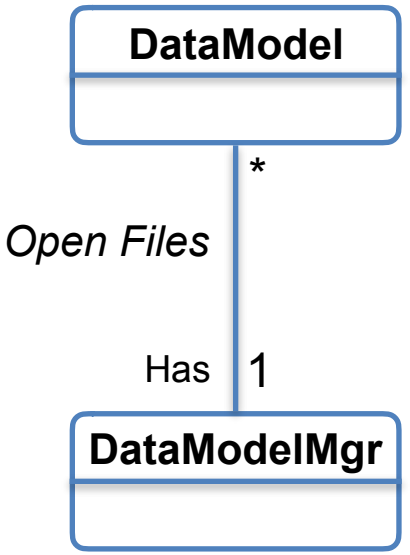
VERAView : Dataset Types

- Derived types

Type	Shape
:assembly	(nax, nass)
:axial	(nax)
:chan_radial	(npiny+1, npinx+1, nass)
:core	()
:node	(4, nax, nass)
:radial	(npiny, npinx, nass)
:radial_assembly	(nass)
:radial_node	(4, nass)

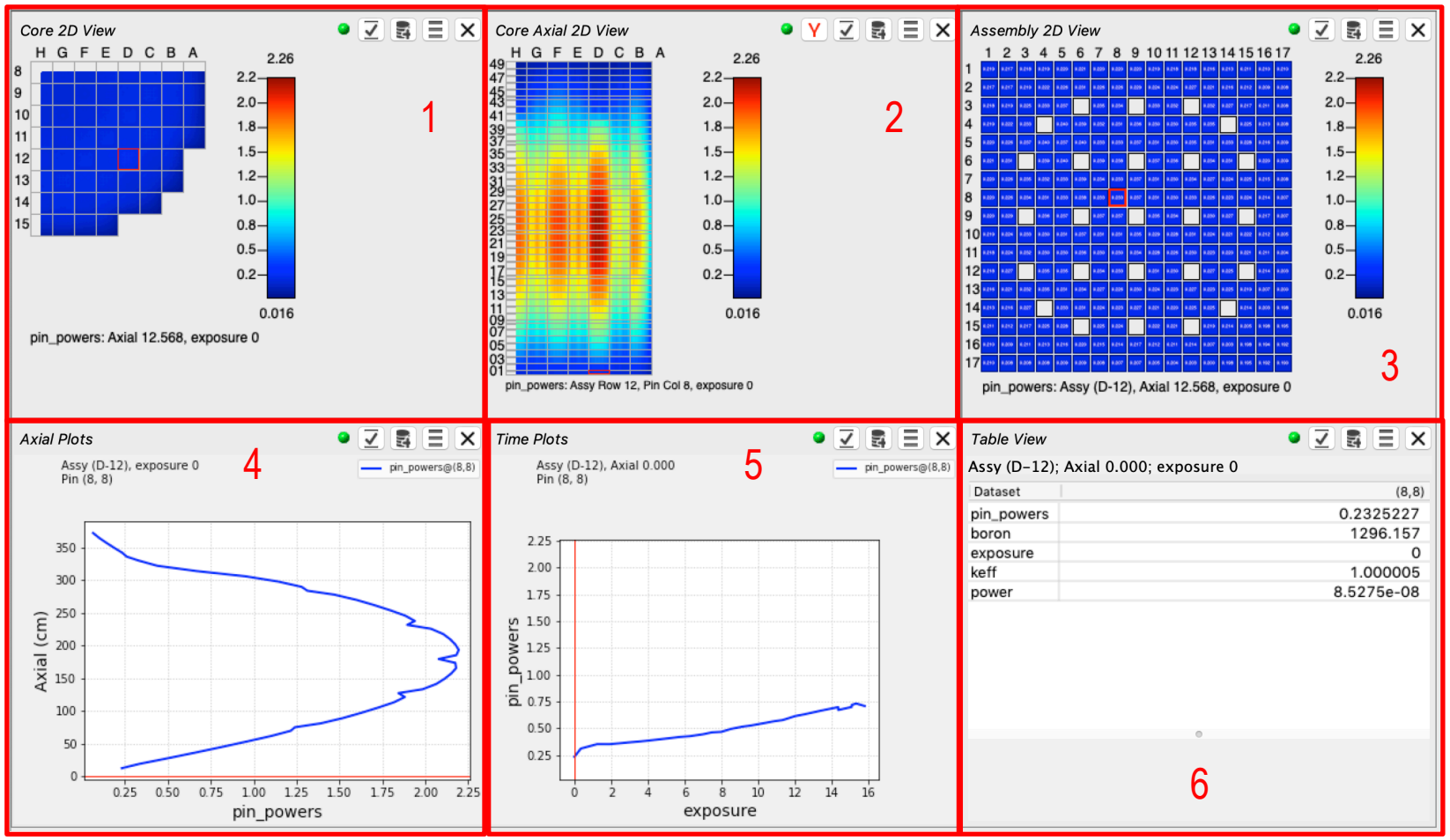
VERAView : Dataset Types

- *DataModel* class
  - Encapsulates all I/O for VERAOut file
  - Finds maximum/minimum values
  - Reads datasets
  - Creates derived datasets
- *DataModelMgr* class
  - Manages multiple open files
  - Reads datasets



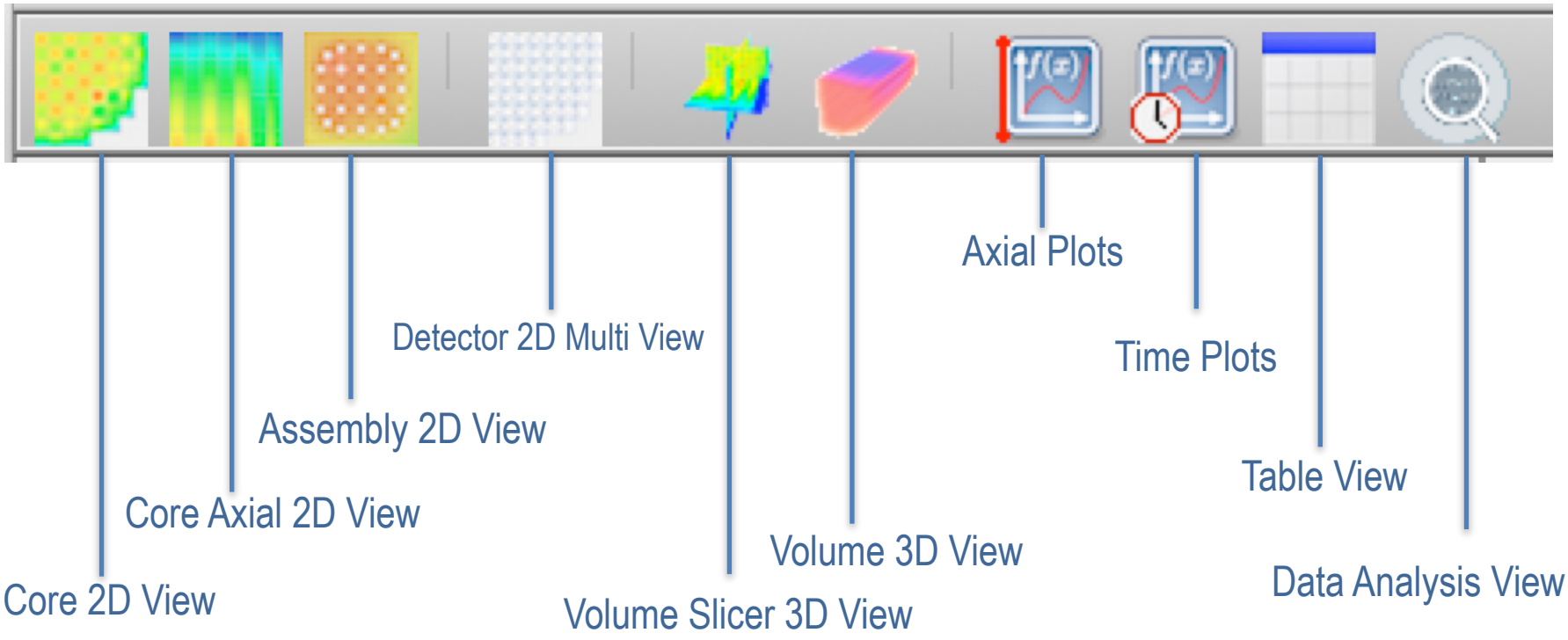
VERAView : Widgets

- Panels in a VERAView frame/window



VERAView : Widgets

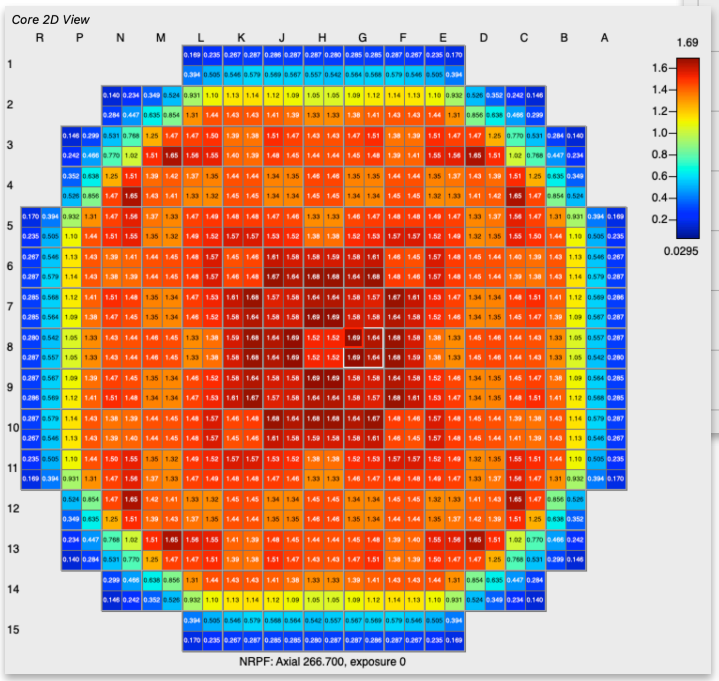
- Available on the toolbar and menubar (*File->New*)
  - Based on dataset types in the open file(s)
  - Tool tip specifies the name

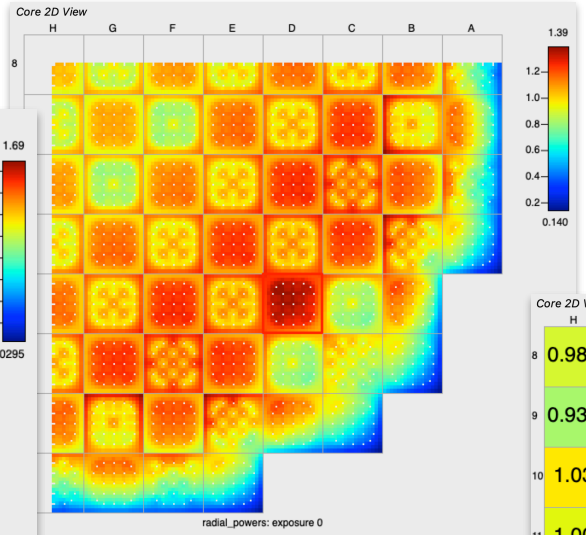


VERAView : Core 2D View

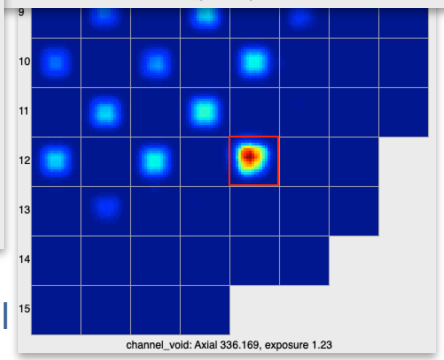
- Displays assemblies in current symmetry
  - Individual fuel rod values displayed
  - Assembly quantities shown as numbers

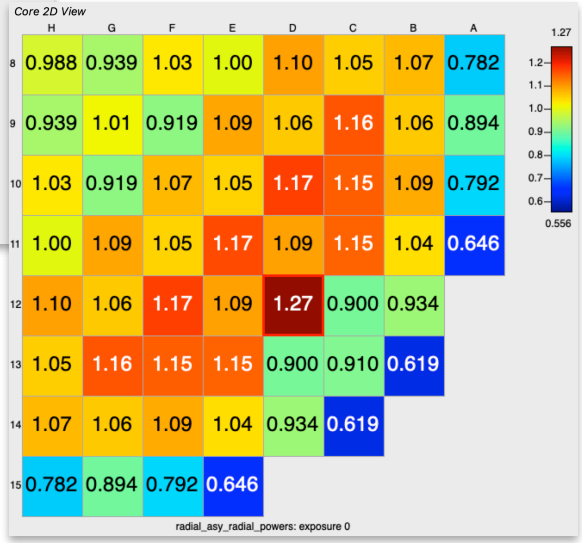
Nodal





Channel



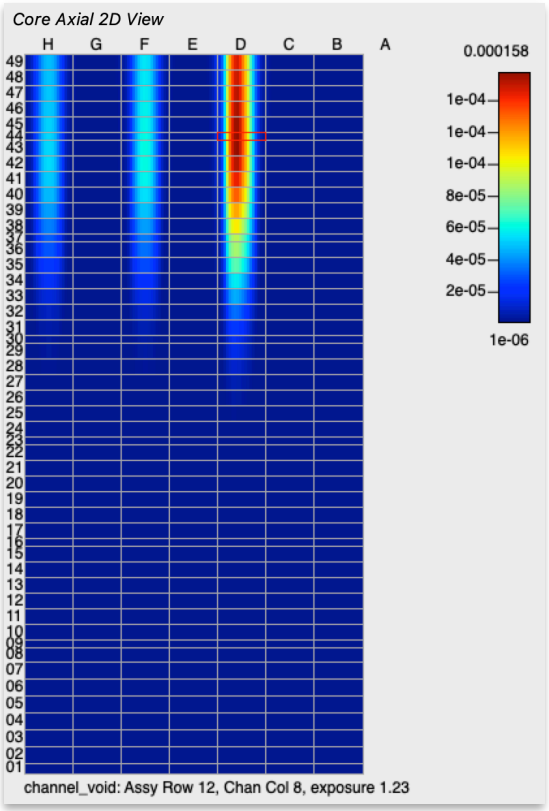


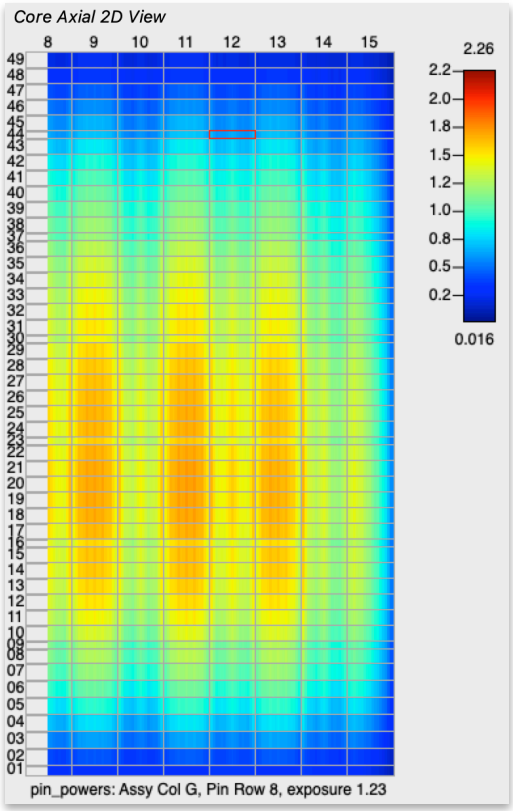
Selects	**Types**
assembly	channel
channel/pin	pin
node	:assembly
	:chan_radial
	:node
	:radial
	:radial_assembly
	:radial_node

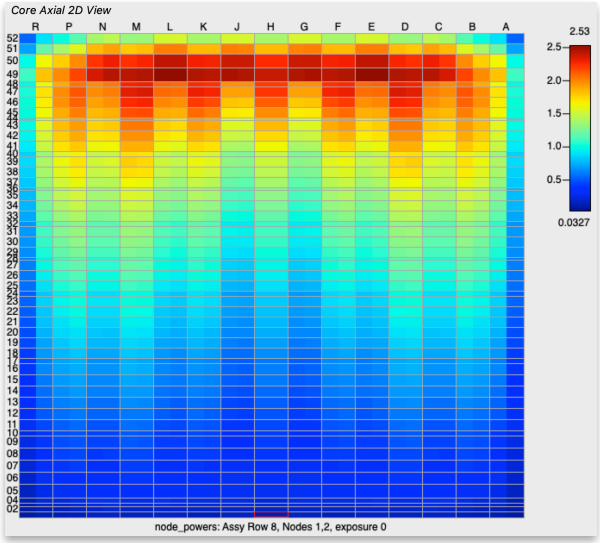
VERAView : Core Axial 2D View

- Displays vertical cut along assembly column or row
  - Individual fuel rod values displayed

Selects	**Types**
assembly axial level	channel pin :assembly :node



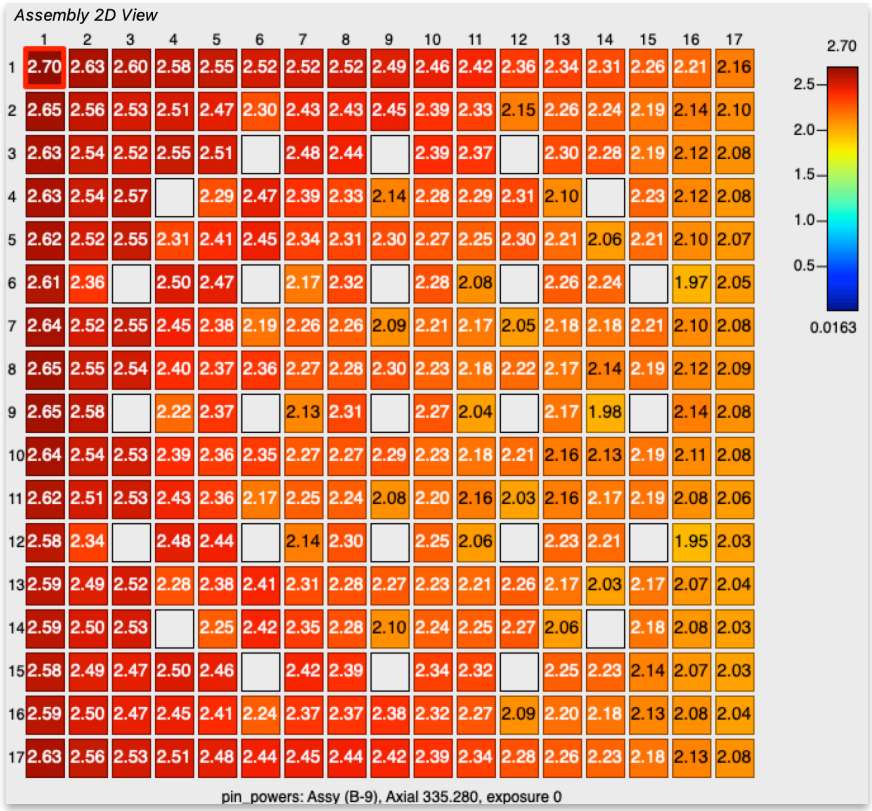


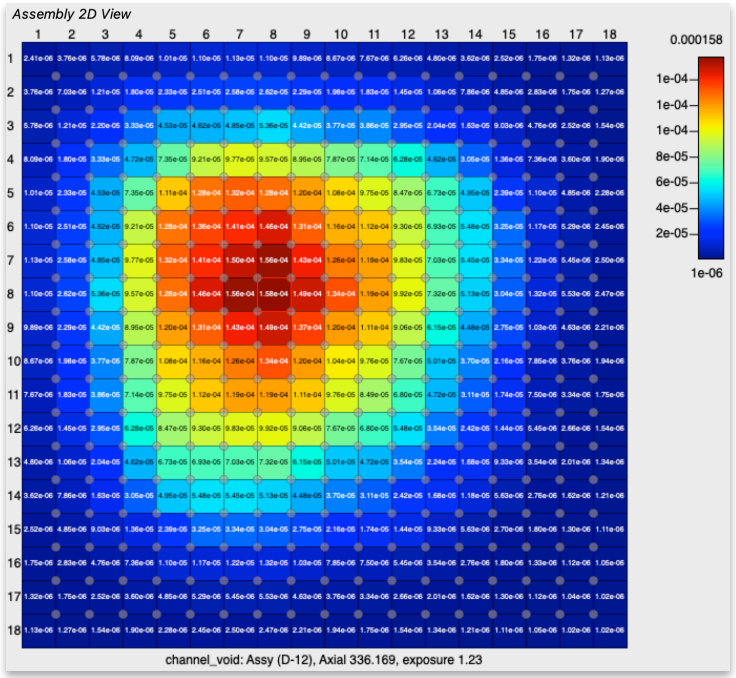


VERAView : Assembly 2D View

- Lattice view of selected assembly
  - Individual fuel rod values displayed, numbers when they fit

Selects	**Types**
channel/pin 2ndary channel/pin	channel pin :chan_radial :radial

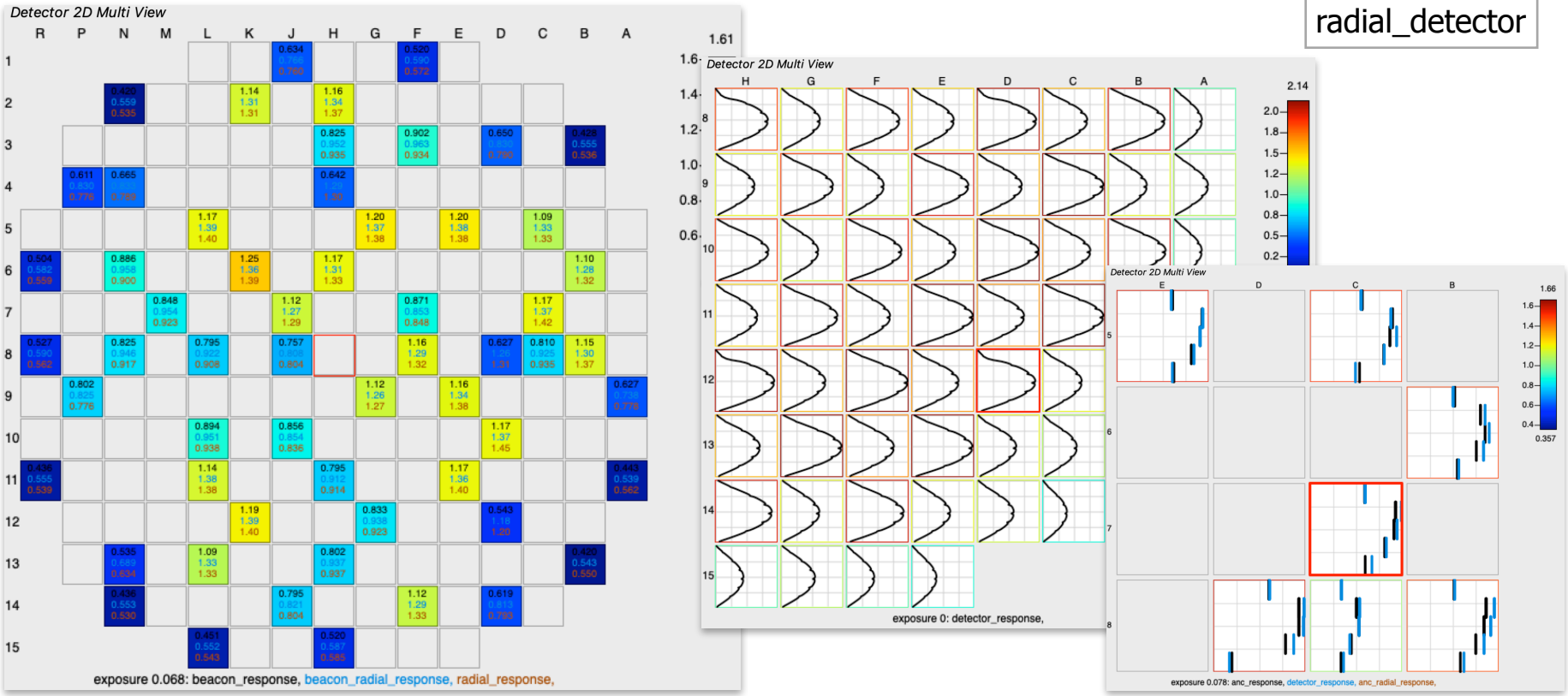




VERAView : Detector Multi View

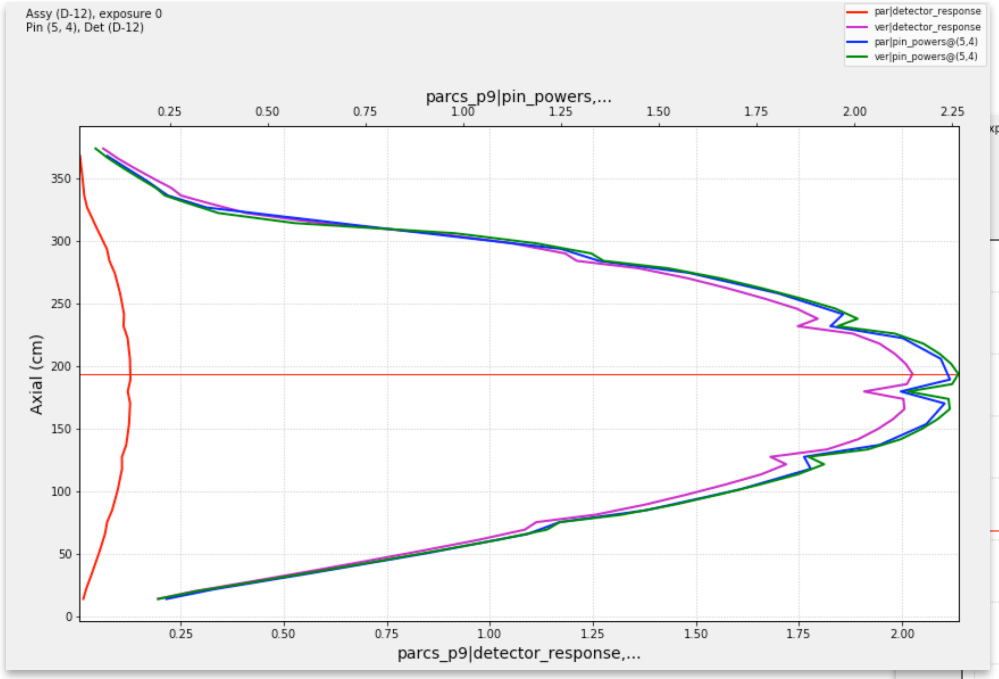
- Plots of detector, fixed_detector, and radial_detector values at detector locations
  - Plots or numbers

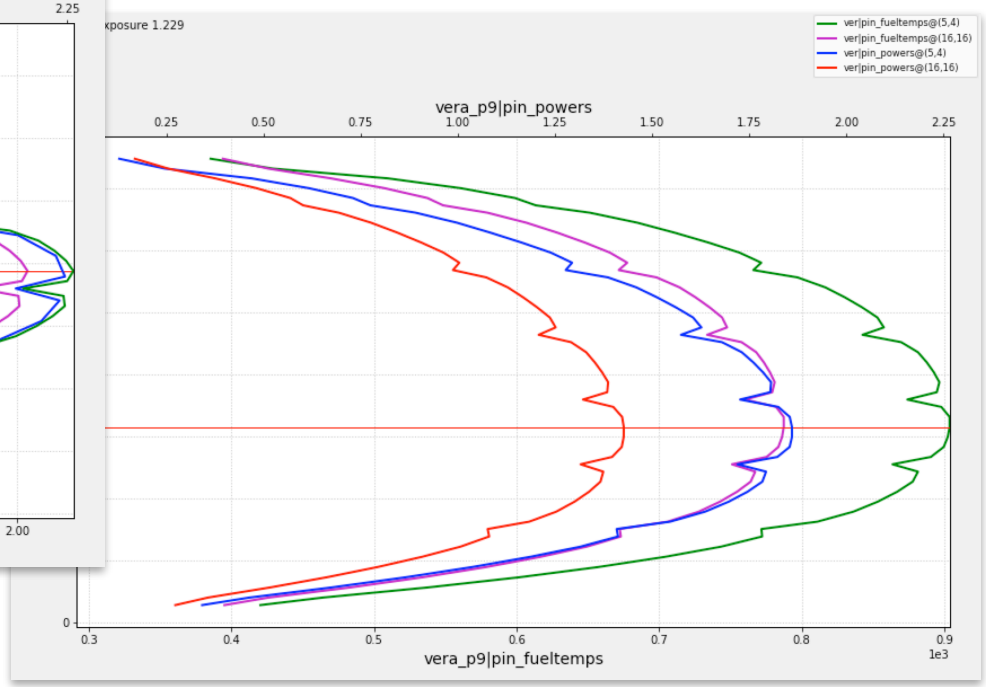
Selects	**Types**
assembly/detector	detector fixed_detector radial_detector



VERAView : Axial Plots

- Plots with axial level as the Y-axis
  - Multiple datasets, two scales
  - Shows plots for current and secondary selections



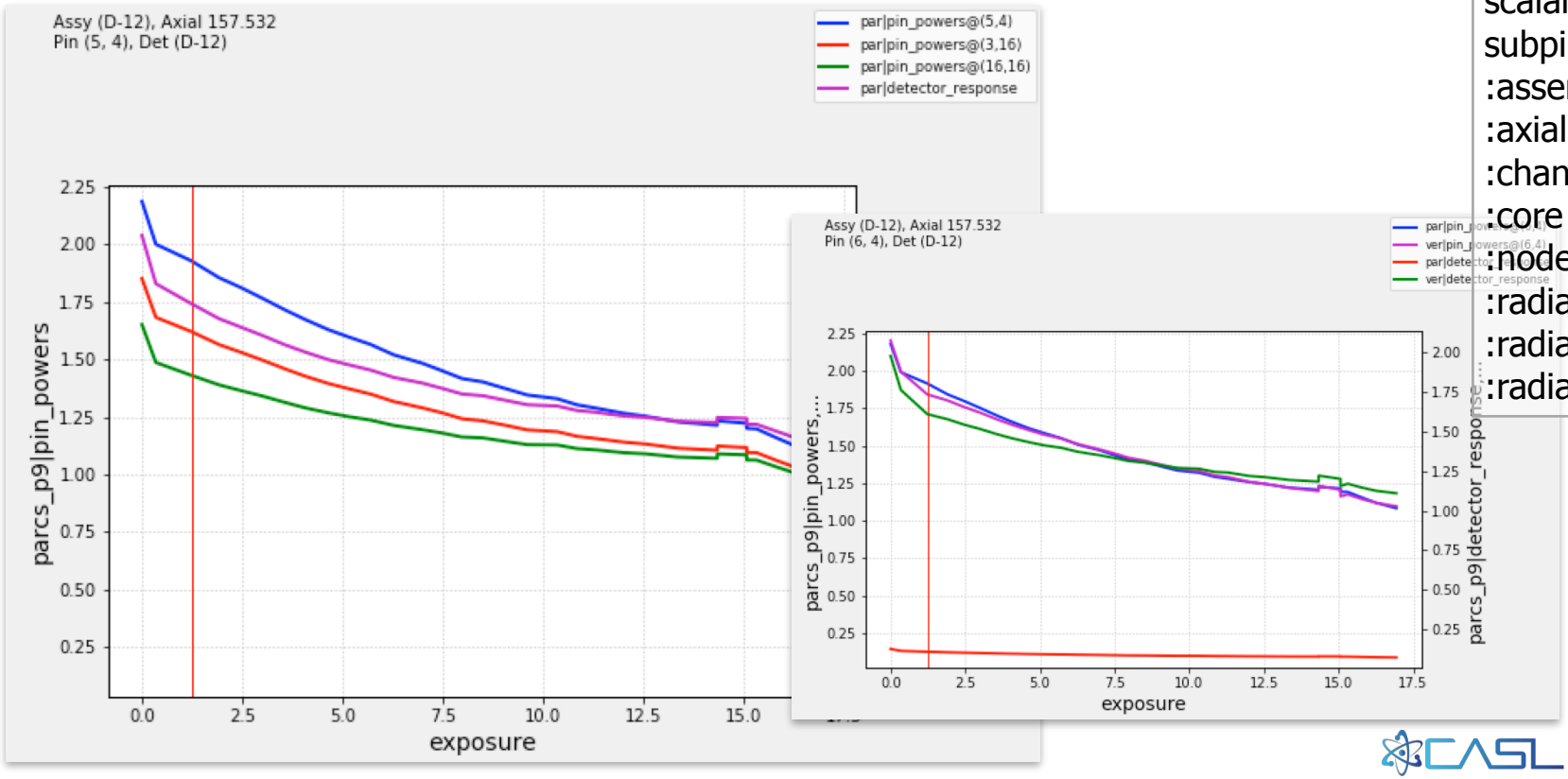


Selects	**Types**
axial level	anything with an axial dimension

VERAView : Time Plots

- Plots with time as the X-axis
  - Multiple datasets, two scales
  - Shows plots for current and secondary selections

Selects	Types
time	channel detector fixed_detector fluence pin radial_detector scalar subpin_cc :assembly :axial :chan_radial :core :node :radial :radial_assembly :radial_node



VERAView : Table View

- Shows dataset values at current coordinates and time
  - Additional columns for secondary selections

Table View

Assy (D-12); Axial 157.532; exposure 1.229

Dataset	(6,4)	(16,7)	(4,15)
par|boron	848.4		
par|detector_response	0.0128985		
par|exposure	1.229		
par|keff	1		
par|nodal_powers	0.2134		
ver|boron	840.3723		
ver|channel_pressure	155.577		
ver|channel_void	0.002040424	5.56	
ver|detector_response	1.388785		
ver|exposure	1.229048		
ver|keff	0.9999997		
ver|pin_powers	1.611144		
ver|power	99.7		

Table View

Assy (B-4); Axial 124.868; exposure 1.549; Fluence r=35.5

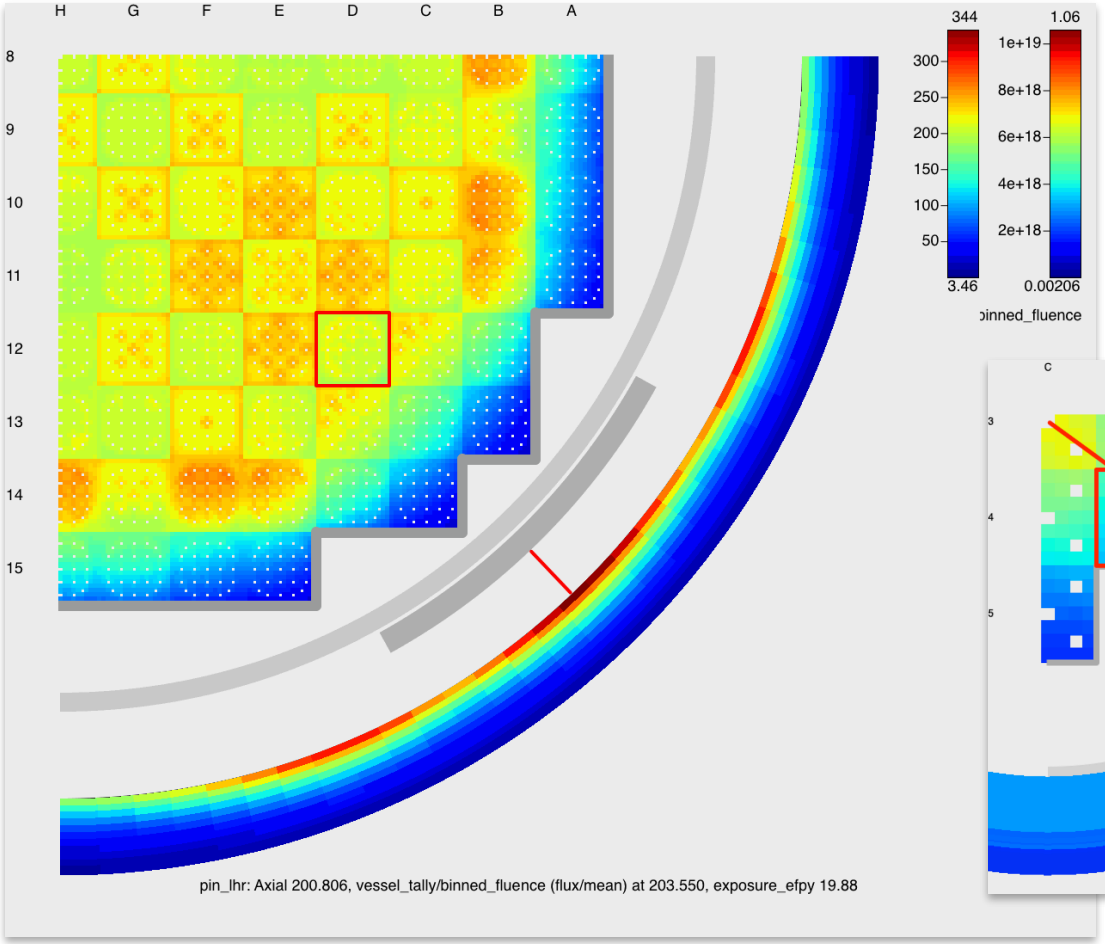
Dataset	(3,3)
boron	
exposure	1.549247
keff	0.7342351
power	100
vessel_fluence_group001	4.776968e+18
vessel_fluence_group002	8.362626e+18
vessel_fluence_variance_group001	7.024052e+34
vessel_fluence_variance_group002	1.569659e+35
vessel_flux_group001	4.931349e+12
vessel_flux_group002	8.844322e+12
vessel_flux_variance_group001	3.977706e+23
vessel_flux_variance_group002	6.880595e+23

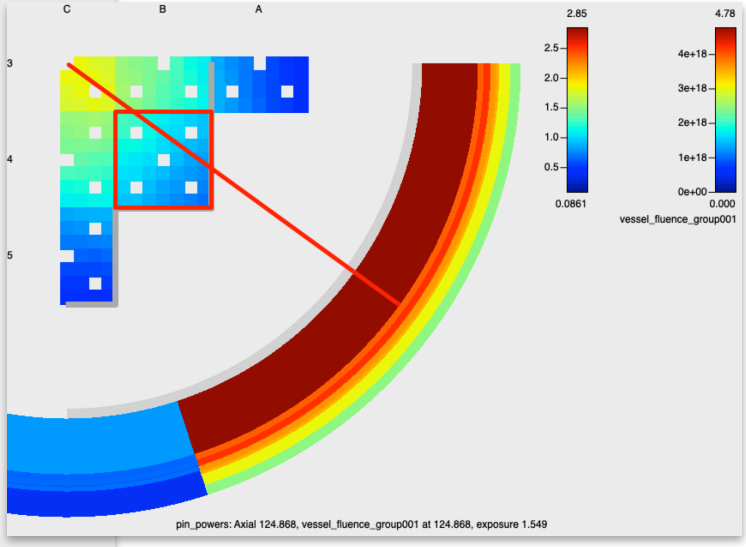
Types
channel
detector
fixed_detector
fluence
pin
radial_detector
scalar
:assembly
:axial
:chan_radial
:core
:node
:radial
:radial_assembly

VERAView : Vessel Core 2D View

- Shows vessel fluence datasets
  - Currently only quarter symmetry

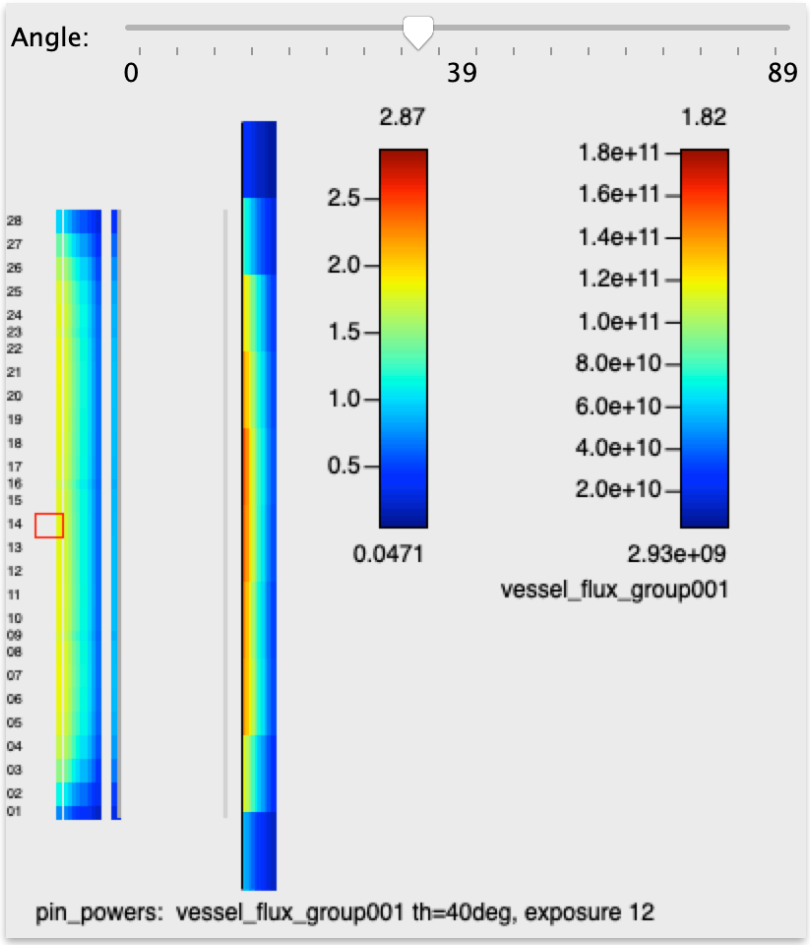
Types
fluence
Selects
fluence r fluence theta

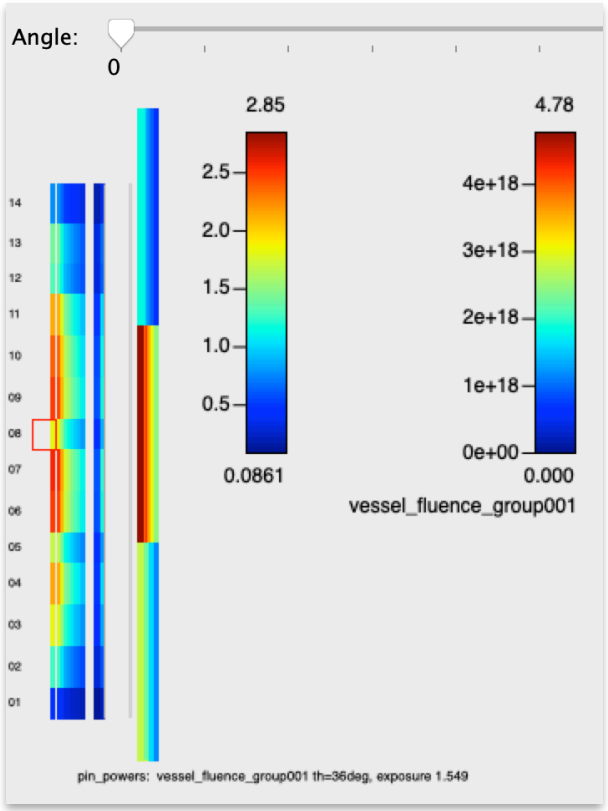




VERAView : Vessel Core Axial 2D View

- Shows vessel fluence vertical slice





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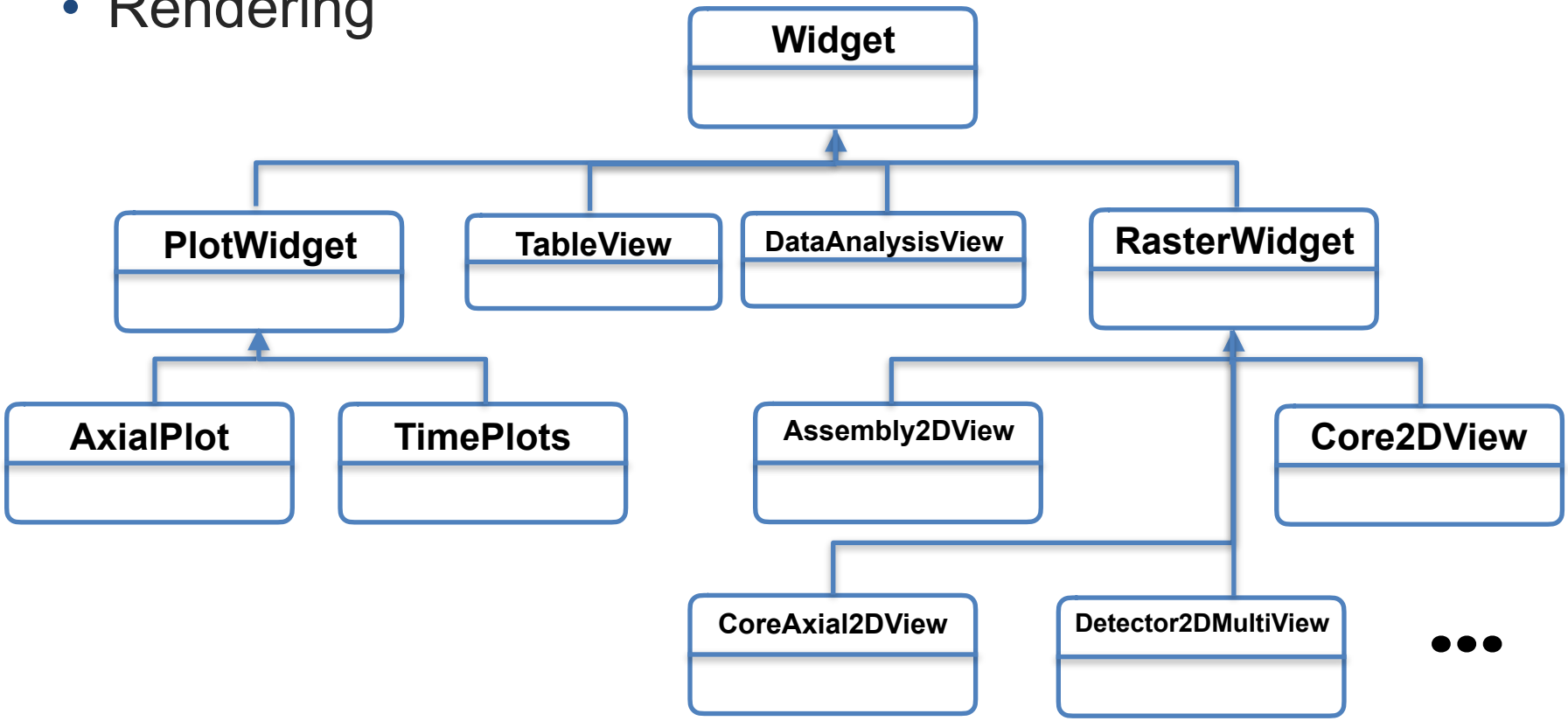
VERAView : Widgets

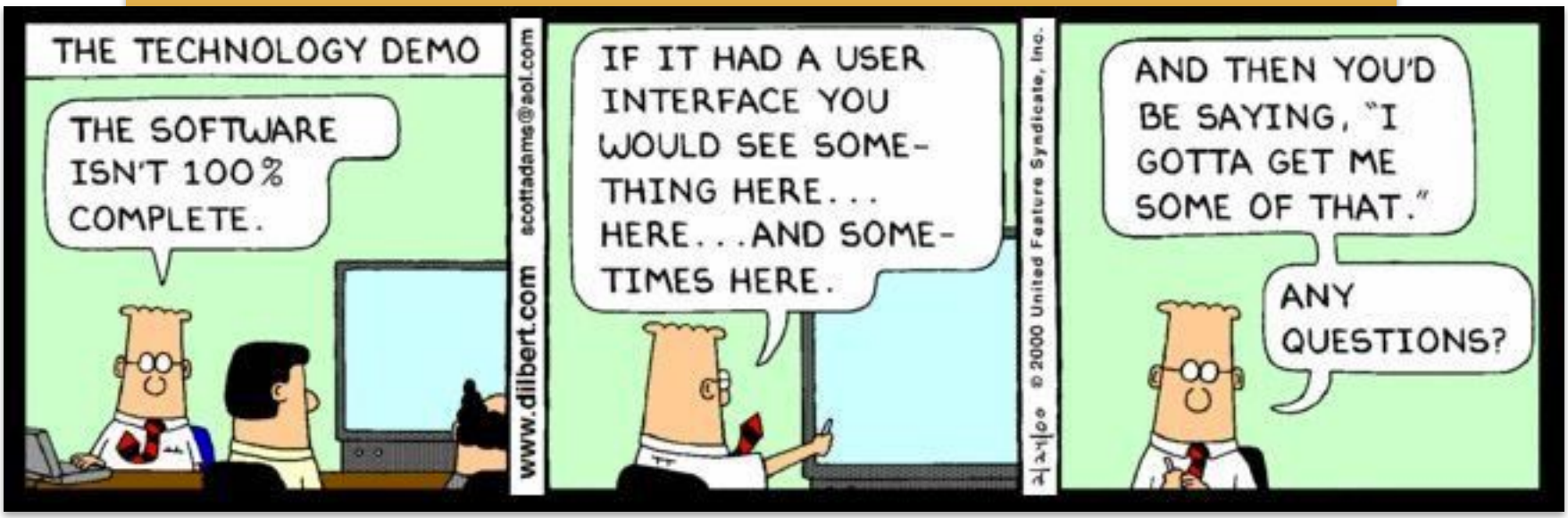
- Widget framework
  - Event handlers and propagation
  - Rendering



VERAView : Demo

Live Demo!

What could possibly go wrong?



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Additional Slides

VERAView : Dataset Types

- Dataset types determined by shape
  - Can be overridden by an attribute
  - Dimensions

nass	Number of assemblies
nax	Number of axial mesh points
npin	Number of pin rows and columns
ndet	Number of detectors
ndetax, nfdetax	Number of detector/fixed detector axial mesh points

VERAView : Dataset Types

- Dimensions determined
  - Explicitly from CORE datasets
    - CORE/npin, CORE/nass
  - Implicitly from CORE datasets
    - CORE/axial_mesh
    - CORE/core_map
    - CORE/detector_map
    - CORE/detector_mesh
    - CORE/pin_volumes
  - Implicitly from STATE_0001/pin_powers