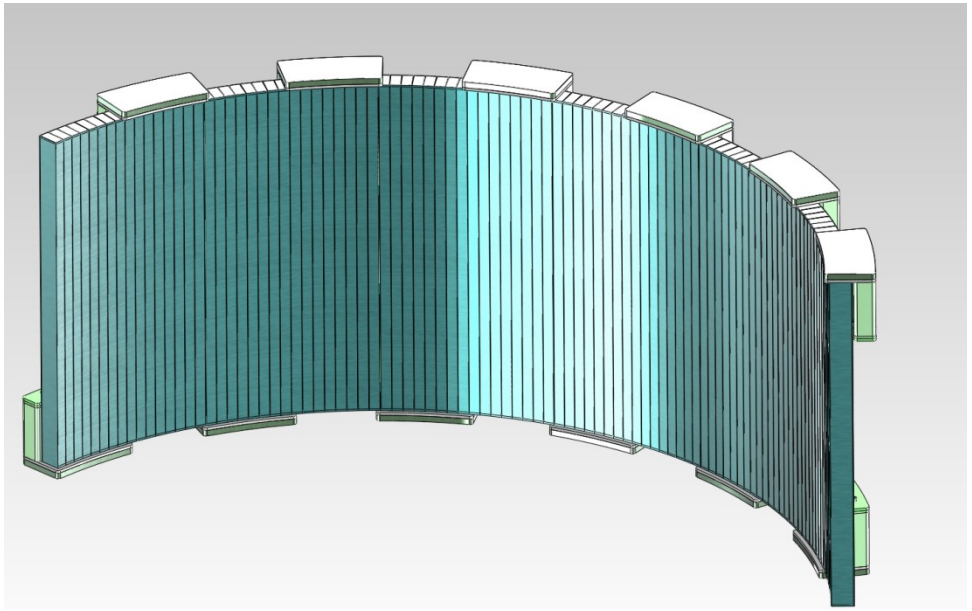
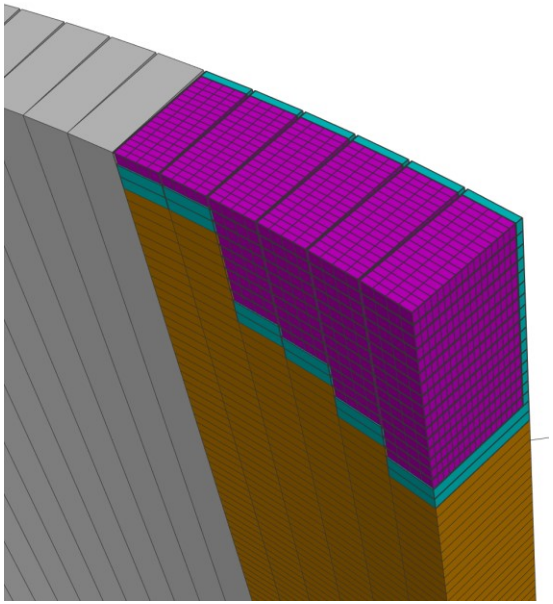
Approaches to Visualizing and Inspecting Voxel Data





Motivation

- Based on some work done previously by Jon Taylor on Multi-grid detector configuration.
- Highlighted some general instrument/data visualization issues which need to be addressed e.g voxel handling.
- We had a reasonable amount of success with work done on the LOKI instrument with the StructuredDetector.
- Using CSPEC geometry as a case study but these ideas will be extended to any instrument which uses voxels.

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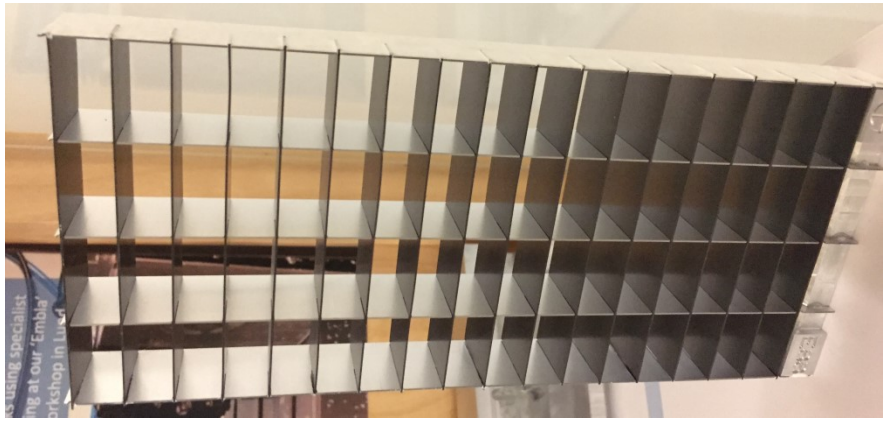
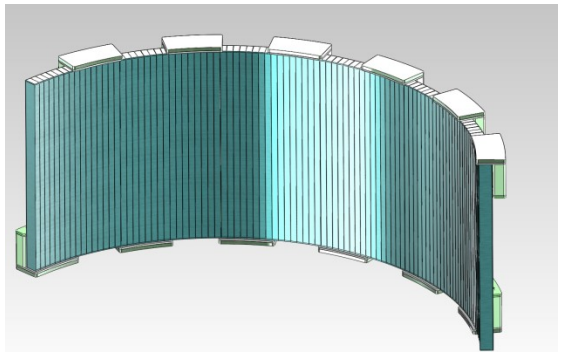
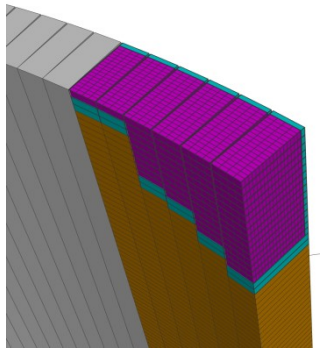
Case Study: CSPEC Preliminary Design

- 4x16 detector grids contain 64 voxels.
- There are 128 Grids per detector bank.
- There are 100 banks in total.
- 819,200 voxels in total!

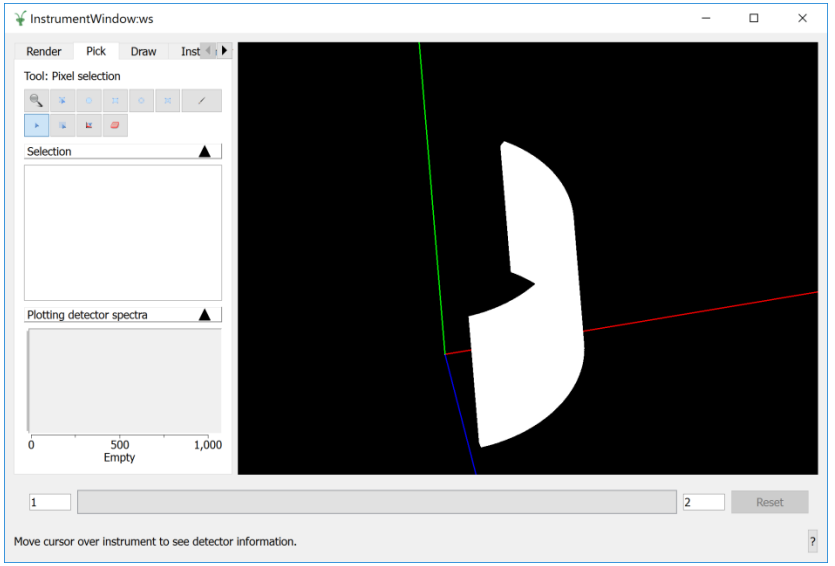






Voxel Handling in Mantid

- Implemented as individual cuboids.
- ~10s file load time.
- ~50s to load Instrument View (Full 3D).
- When displayed Mantid has a memory footprint of ~3GB.
- Very slow navigation in the GUI.



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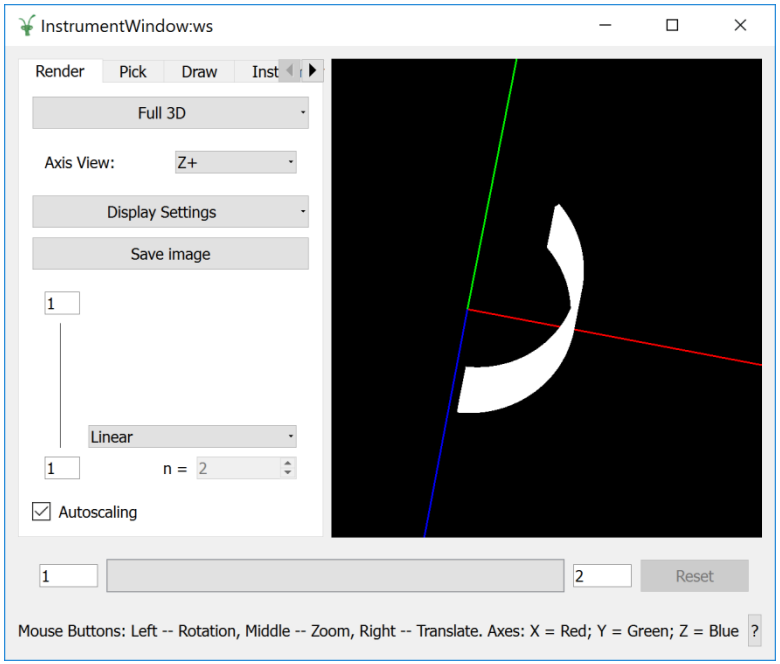
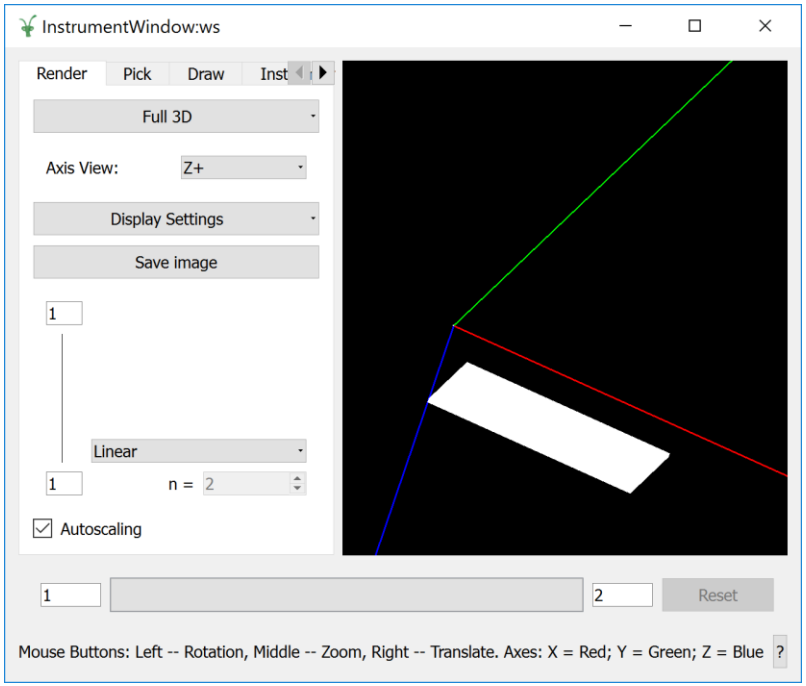
Voxel Handling in Mantid

- Implemented each bank as a stack of 16 RectangularDetector.
- ~2s file load time.
- ~2s to load Instrument View (Full 3D).
- When displayed Mantid has a memory footprint of ~500 MB.
- Slow navigation in the GUI.



Voxel Handling in Mantid

- A test of 16 planes with dimensions 400x128.
- ~4s file load time.
- ~2s to load Instrument View (Full 3D).
- When displayed Mantid has a memory footprint of ~1 GB.
- GUI navigation smooth.



Voxel Handling in Mantid

- Rectangular plane test significantly better performance.
- May need a new type of Rectangular detector with ability to define curvature.

What's Missing?

- No useful method of visualizing the entire instrument.
- No ability to do simple slicing and thresholding.
- No ability to query and display subsets of interesting detectors.
- No volumetric rendering.

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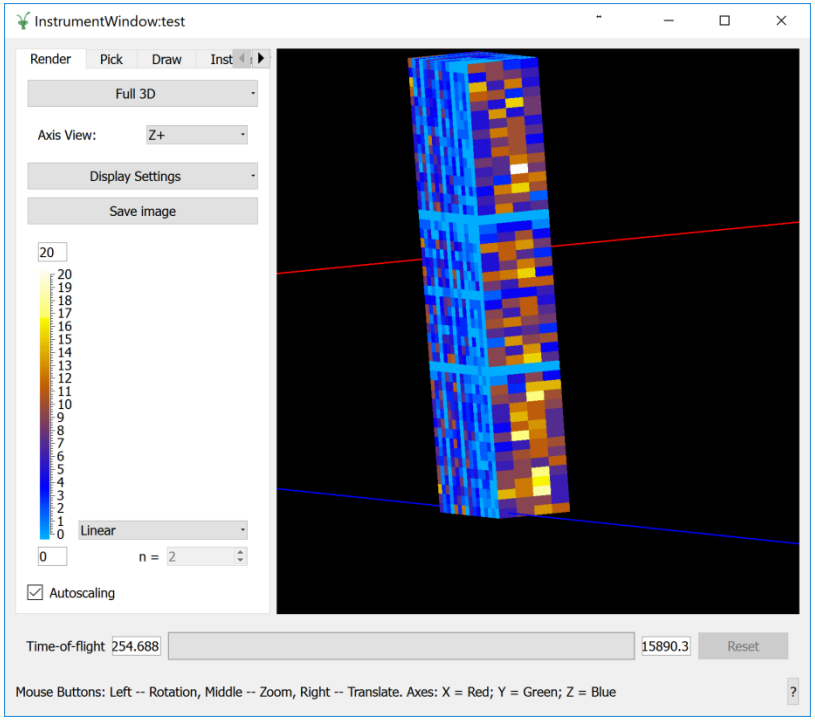
Voxel Handling in Other Packages

- Example dataset 4x48x16 based on CNCS instrument.
- Created by Jon Taylor using python.



Voxel Data in Paraview

- Paraview is a visualization and analysis toolkit.
- Paraview contains many tools for inspecting 3D volumes.
- Paraview built for large datasets.
- Exploratory requirements gathering.
- May want to use third-party software instead of expending effort embedding this funcitonality into Mantid.

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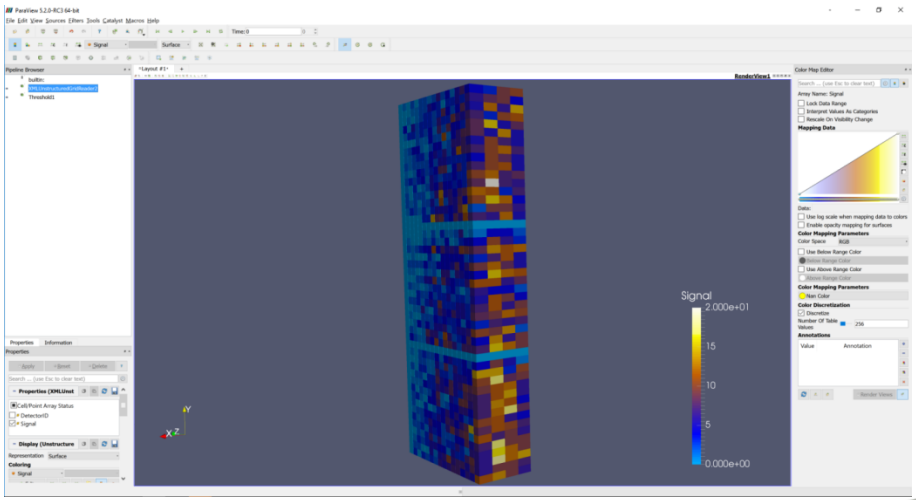
Voxel Data in Paraview

- Test data-set exported as vtk unstructured grid.
- Data contains scalar properties (Neutron Signal and DetectorID).
- Beam direction z+.



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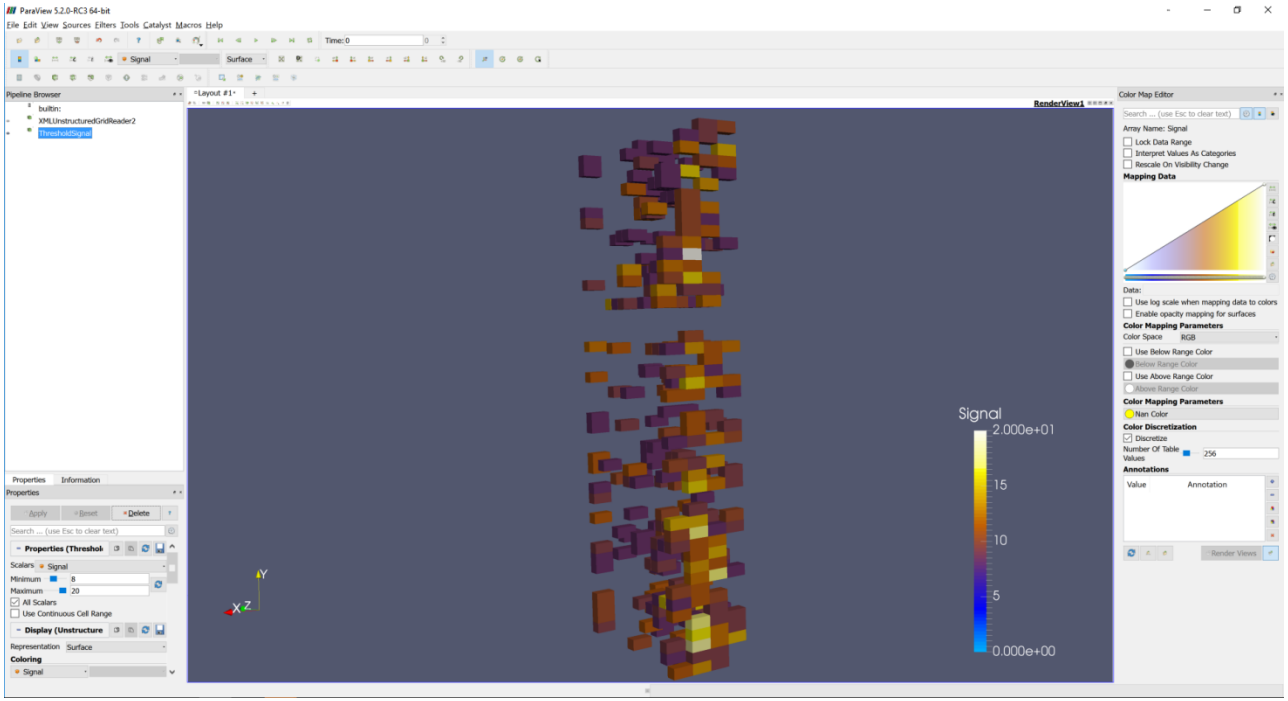
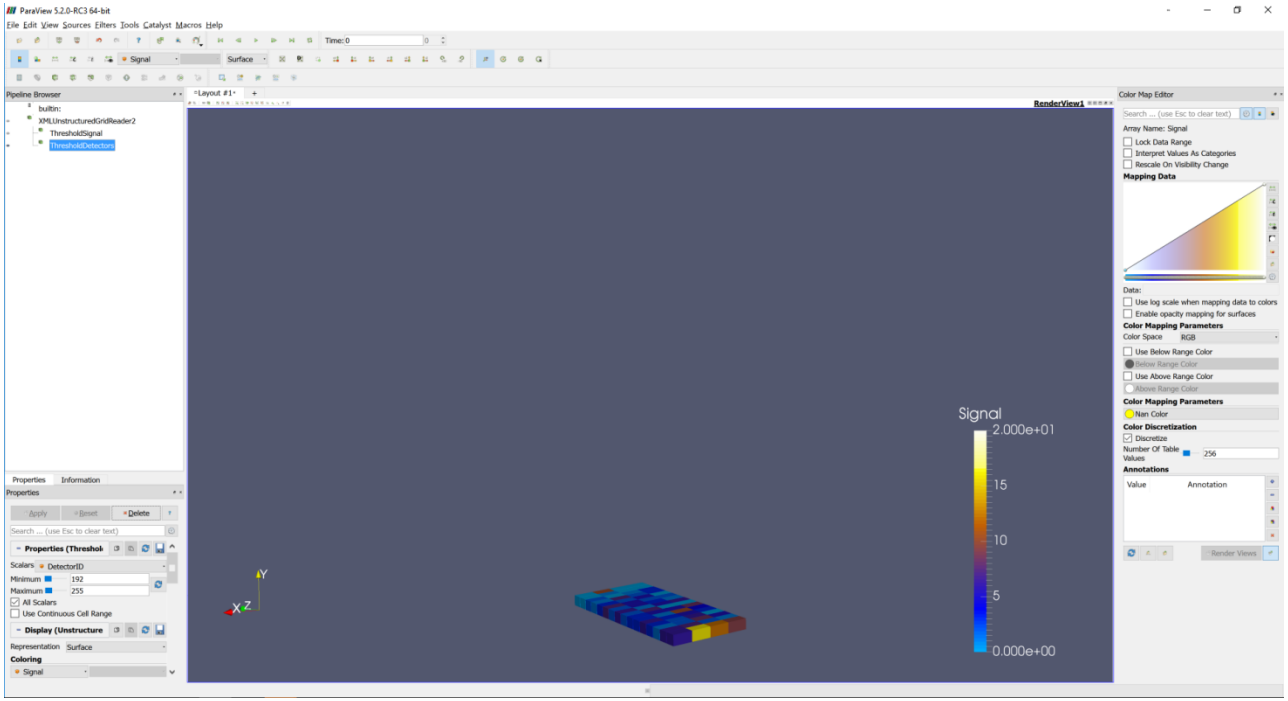
Data Inspection (Basic Thresholding)

- Thresholding based on neutron counts.



Data Inspection (Basic Thresholding)

- Thresholding based on detector ID.



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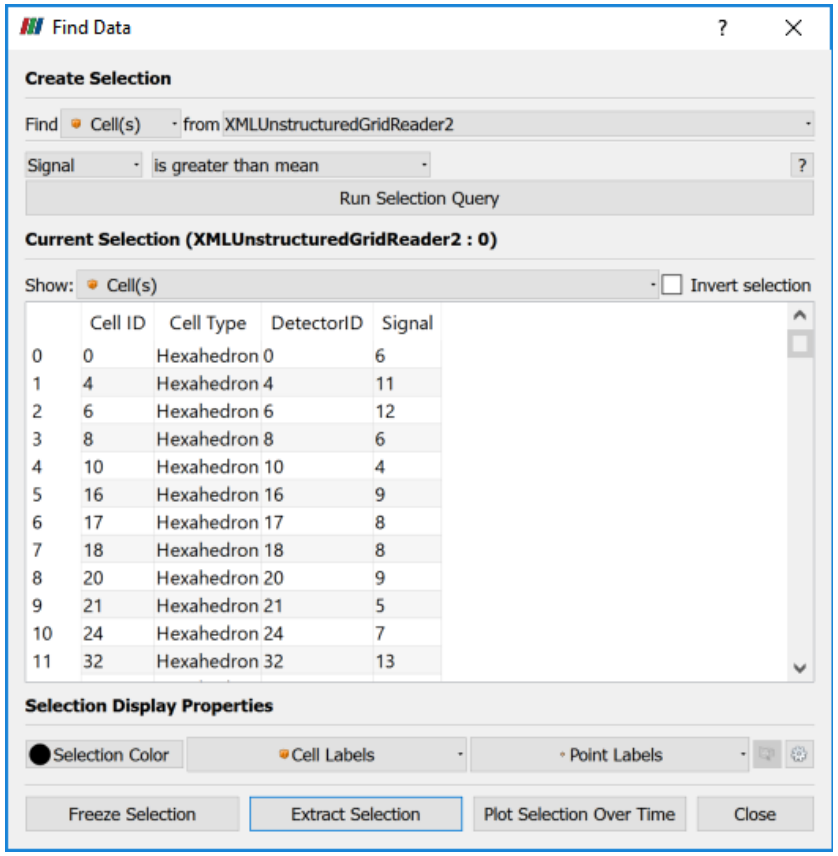
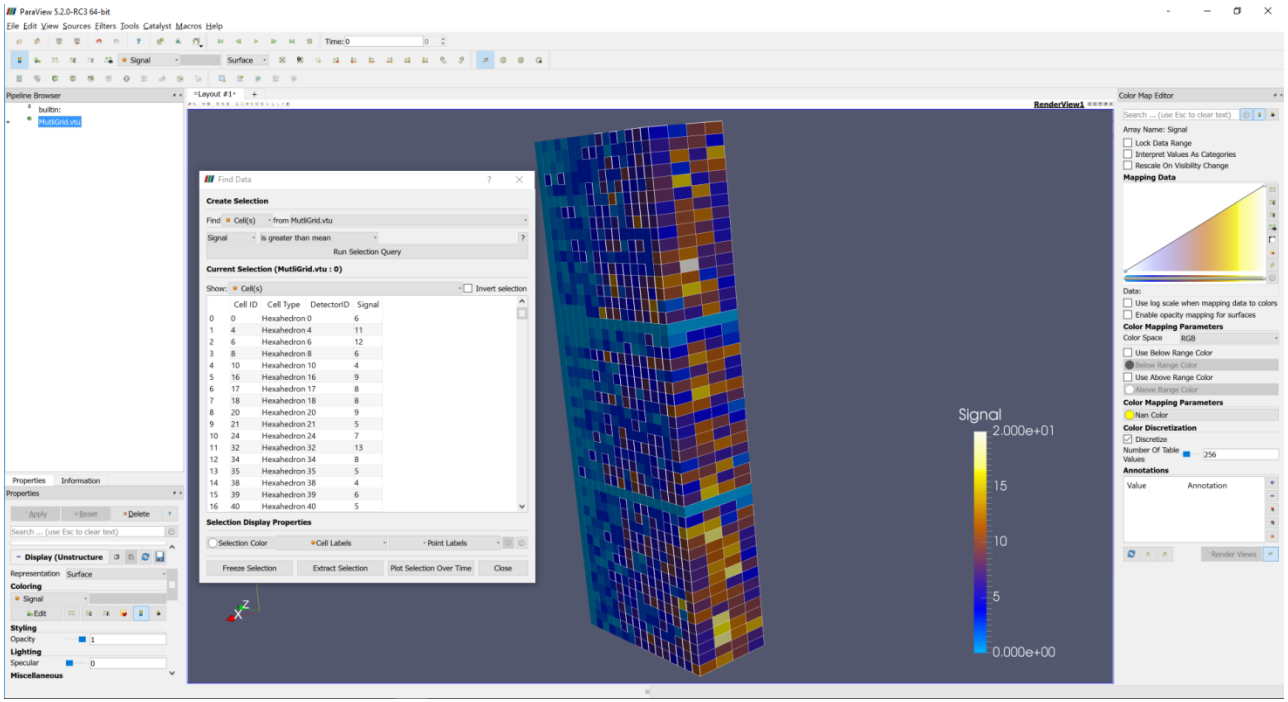
Data Inspection (Using Data Queries)

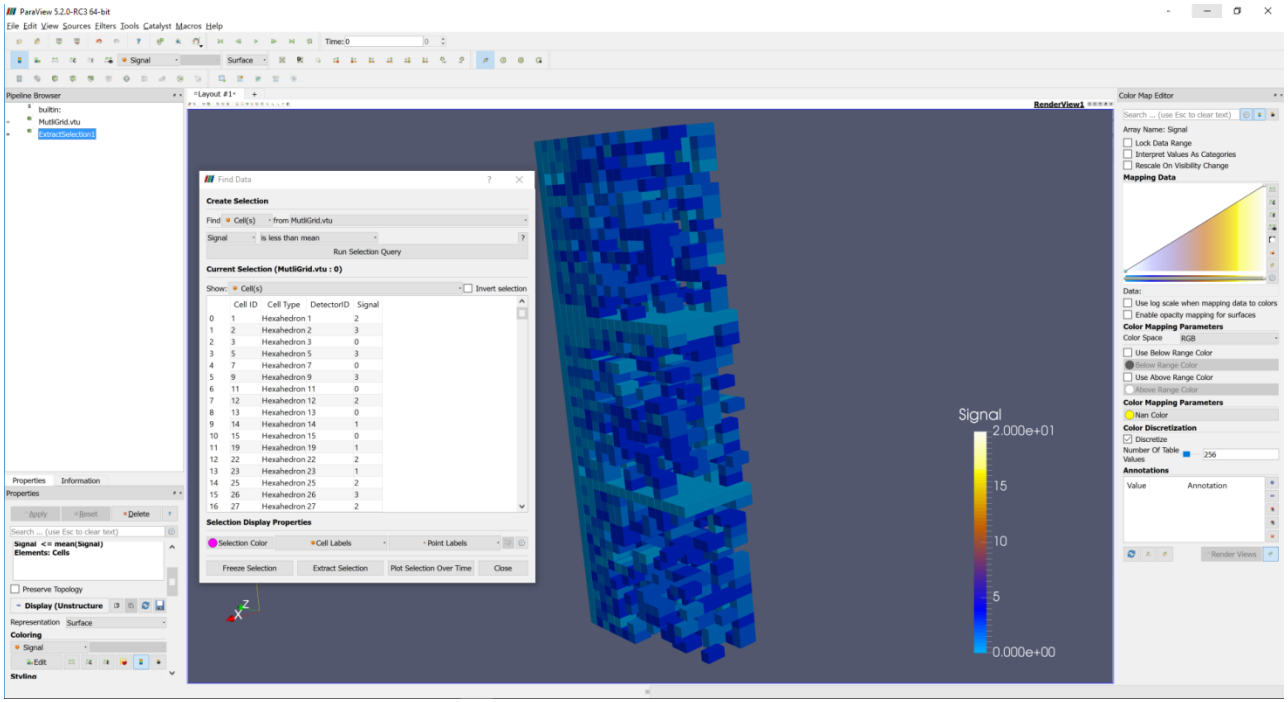


	Cell ID	Cell Type	DetectorID	Signal
0	0	Hexahedron	0	6
1	4	Hexahedron	4	11
2	6	Hexahedron	6	12
3	8	Hexahedron	8	6
4	10	Hexahedron	10	4
5	16	Hexahedron	16	9
6	17	Hexahedron	17	8
7	18	Hexahedron	18	8
8	20	Hexahedron	20	9
9	21	Hexahedron	21	5
10	24	Hexahedron	24	7
11	32	Hexahedron	32	13

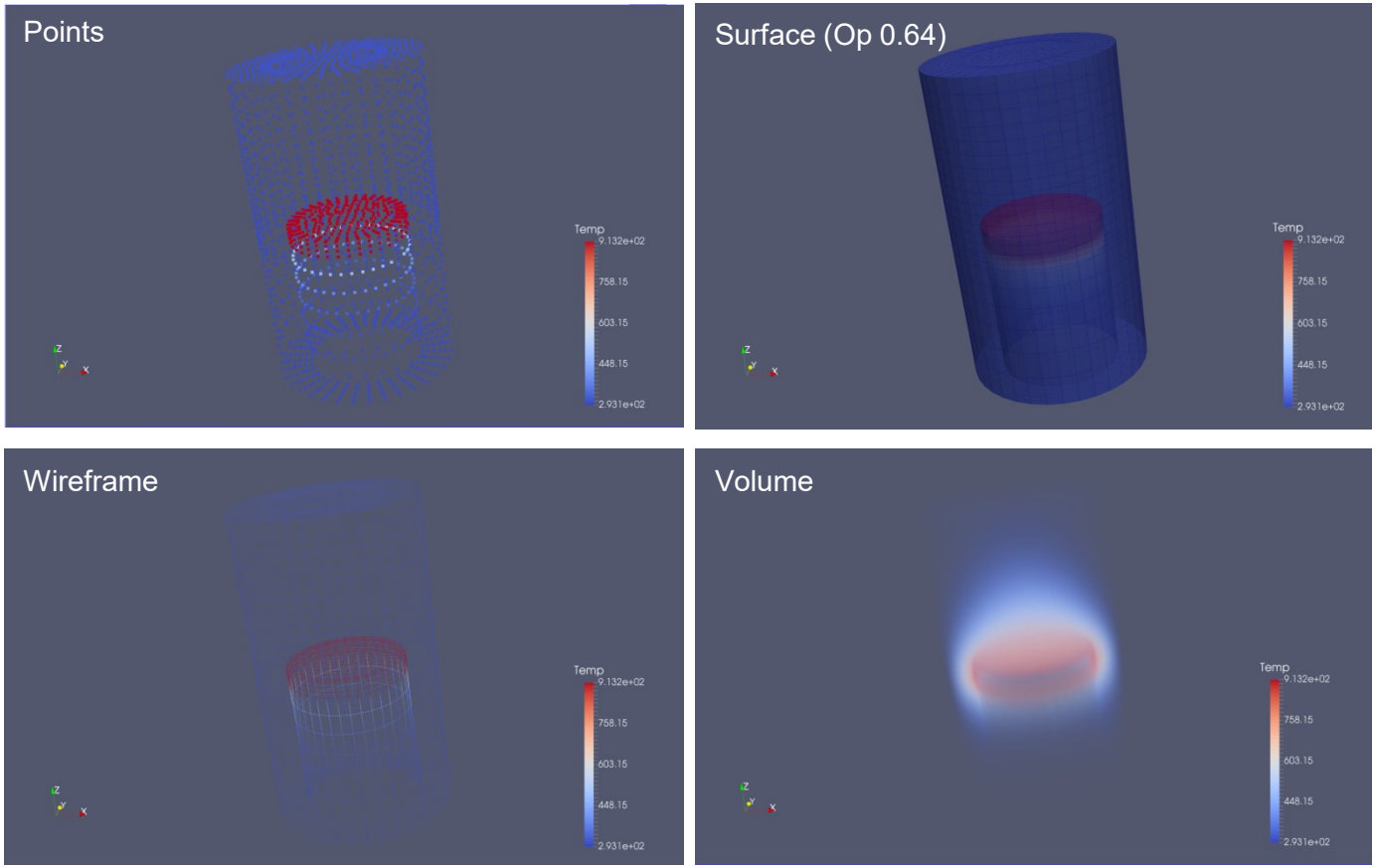
Data Inspection (Using Data Queries)



Data Inspection (Using Data Queries)



Visualizing 3D Volumes



Conclusion

- What levels of visualization will be required by users?
- How are users expecting to see volume data?
- If the detector group uses Mantid for commissioning the instrument. What would they expect to see?
- Should the tools presented in Paraview remain stand-alone or should it be built into Mantid?
- Is Paraview too complex an interface?

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The End

Thanks For Listening!

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