

# MAE 5032 High Performance Computing: Methods and Practices

## Lecture 16: Visualization

Ju Liu

Department of Mechanics and Aerospace Engineering

[liuj36@sustech.edu.cn](mailto:liuj36@sustech.edu.cn)



# Paraview

- Open-source, multi-platform parallel data analysis and visualization application
- Good for general-purpose, rapid visualization
- Built on top of the Visualization ToolKit (VTK) library
- Primary contributors:
  - Kitware, Inc.
  - Sandia National Laboratory
  - LosAlamos National Laboratory
  - Army Research Laboratory
- Supports a wide range of data types
  - Structured grids
  - Unstructured grids
  - Polygonal data
  - DICOM images
  - ...
- Support time series data



# Paraview

- Supports a wide variety of visualization algorithms known as filters
  - Isosurfaces
  - Cutting planes
  - Volume rendering
  - Clipping
- Supports derived variables
  - New scalar/vector data that are functions of existing variables in your data set
- Saves animations
- Can run in parallel / distributed mode for large data visualization

# Data formats

- Dataset: 2 linear tetrahedrons

```
# vtk DataFile Version 4.2
vtk output
ASCII
DATASET UNSTRUCTURED_GRID
POINTS 5 double
0 0 0 1 0 0 0 1 0
0 0 1 1 1 1
CELLS 2 10
4 0 1 2 3
4 1 2 3 4

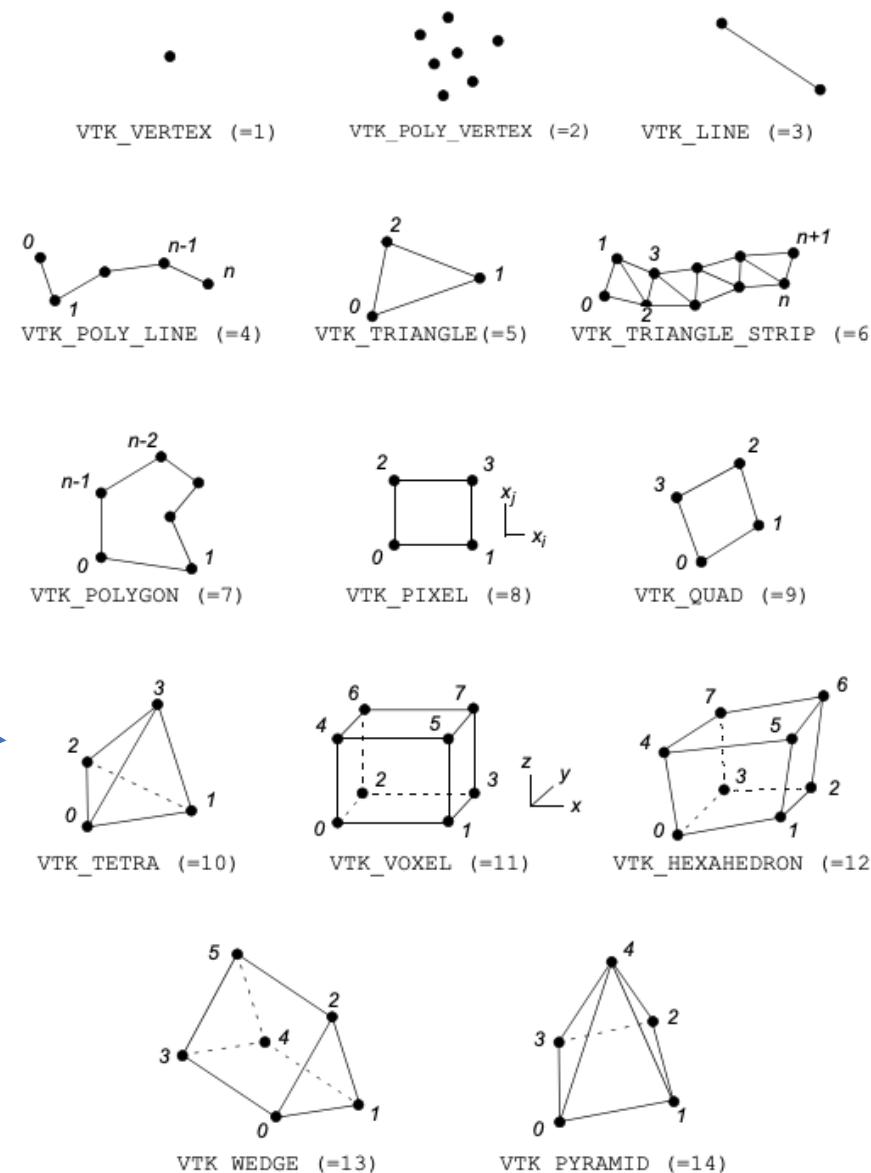
CELL_TYPES 2
10
10
```

CELL\_DATA 2

```
FIELD FieldData 1
GlobalCellID 1 2 int
1 2
```

POINT\_DATA 5

```
FIELD FieldData 1
GlobalNodeID 1 5 int
1 2 3 4 5
```



Refer vtk file formats

# Data formats

- Dataset: 2 linear tetrahedrons

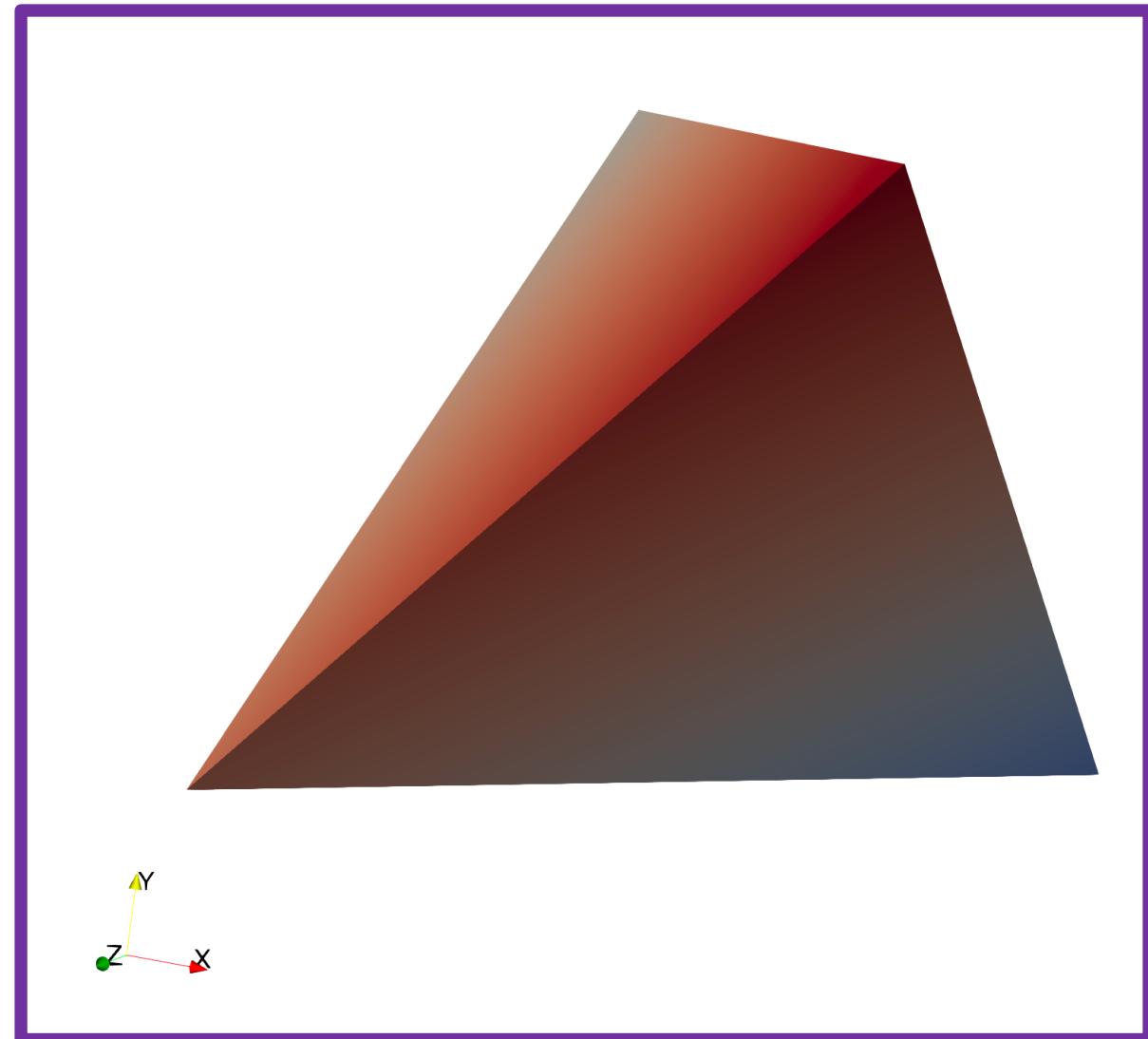
```
# vtk DataFile Version 4.2
vtk output
ASCII
DATASET UNSTRUCTURED_GRID
POINTS 5 double
0 0 0 1 0 0 0 1 0
0 0 1 1 1 1
CELLS 2 10
4 0 1 2 3
4 1 2 3 4

CELL_TYPES 2
10
10

CELL_DATA 2
FIELD FieldData 1
GlobalCellID 1 2 int
1 2
POINT_DATA 5
FIELD FieldData 1
GlobalNodeID 1 5 int
1 2 3 4 5
```



ParaView



Refer vtk file formats

# Paraview tutorial

- Download the example data file: `disk_out_ref.ex2`
- Open Paraview

# Paraview

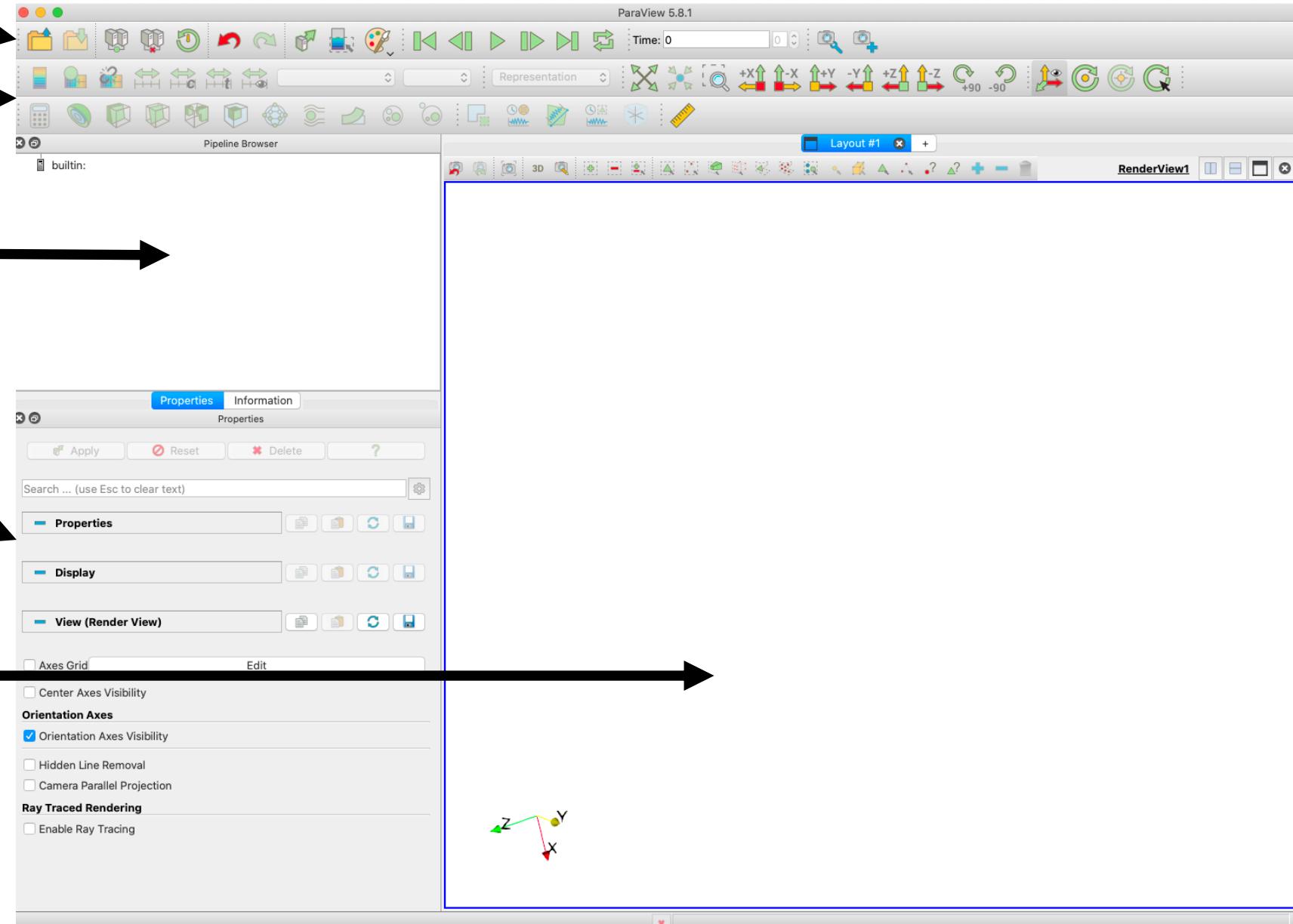
Menu bar

Toolbars

Pipeline browser

Object Inspector

3D View

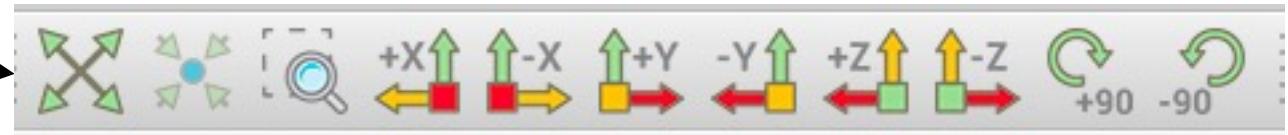


# Paraview

Undo/Redo



Camera controls



View controls



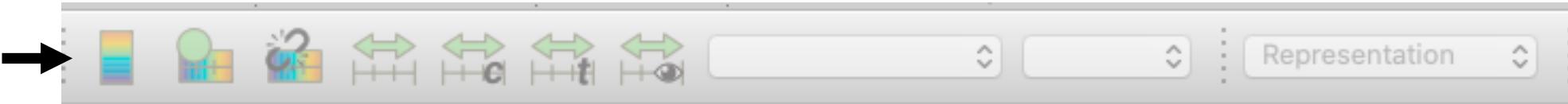
VCR controls



Common controls



Active Variable  
Controls

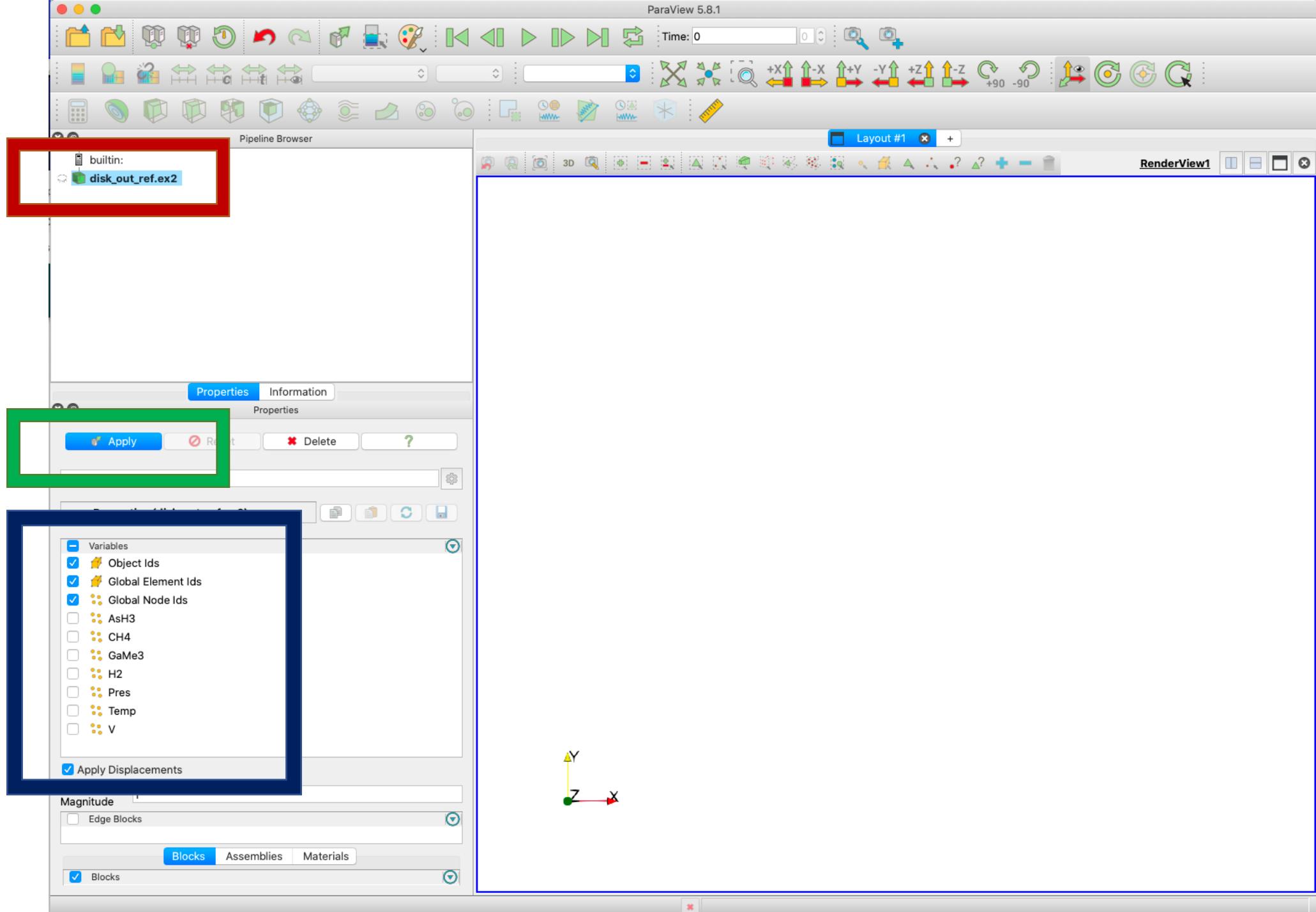


# Visualize data

3. You should  
be able to see  
the eyes is  
turned on

2. Then click  
Apply

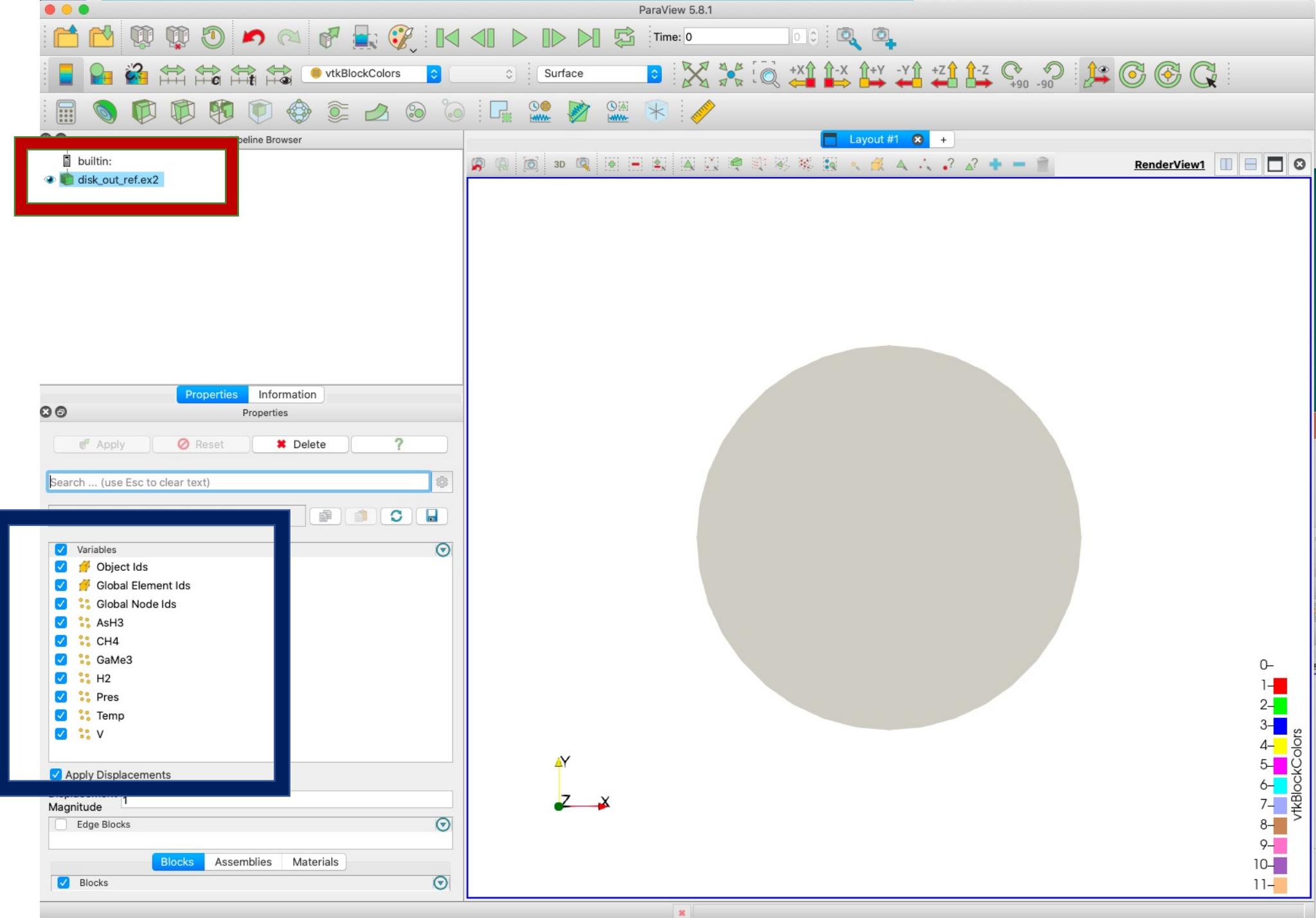
1. Select the  
data you want  
to visualize



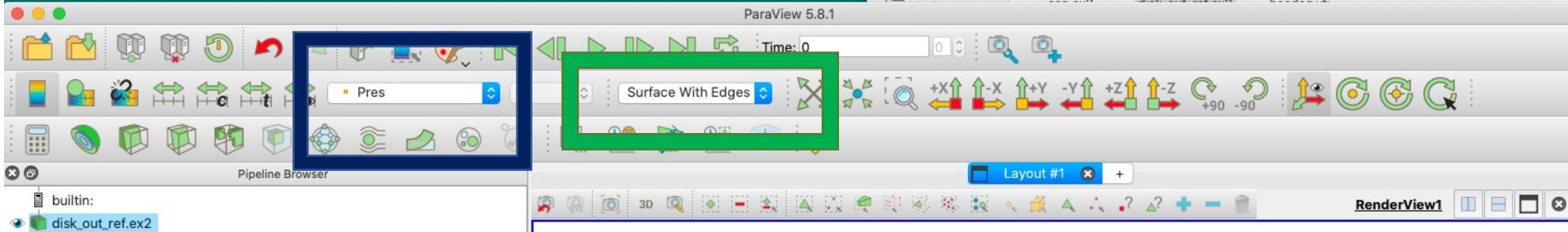
3. You should  
be able to see  
the eyes is  
turned on

2. Then click  
Apply

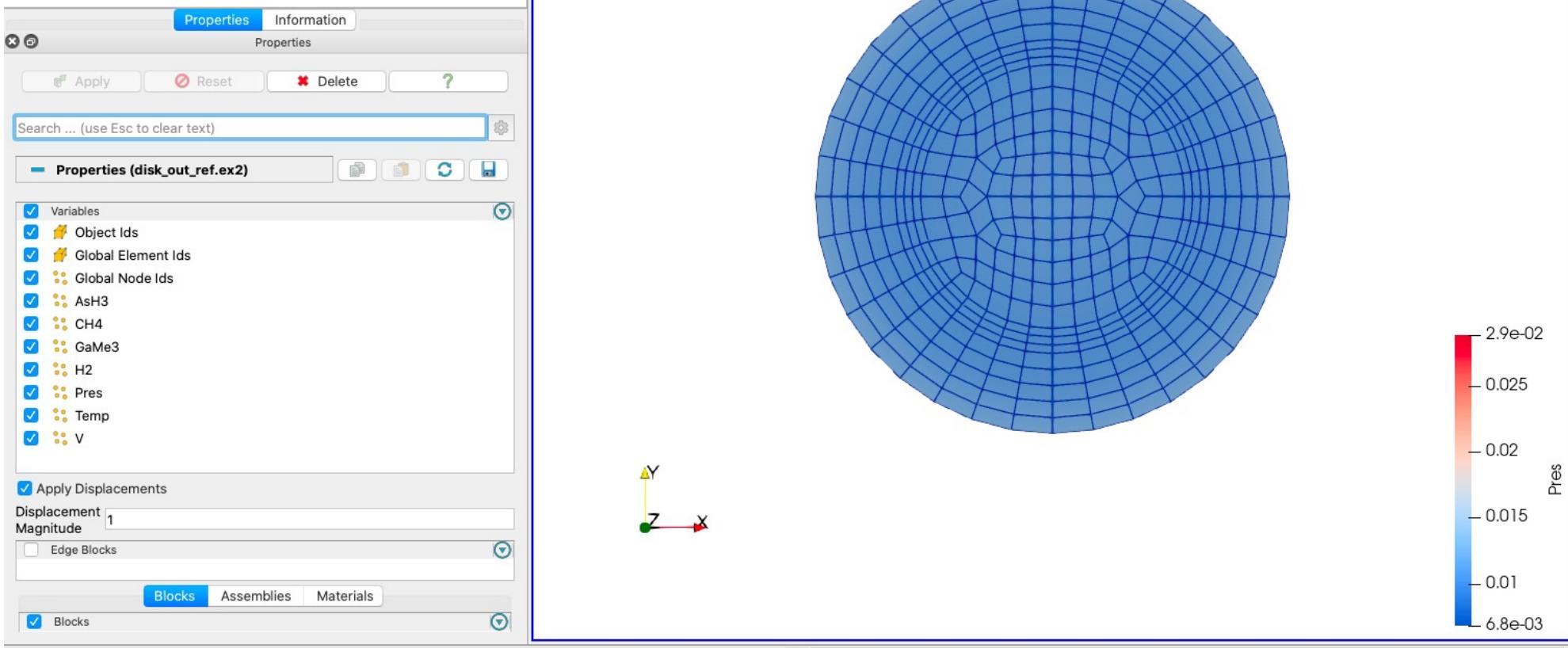
1. Select the  
data you want  
to visualize



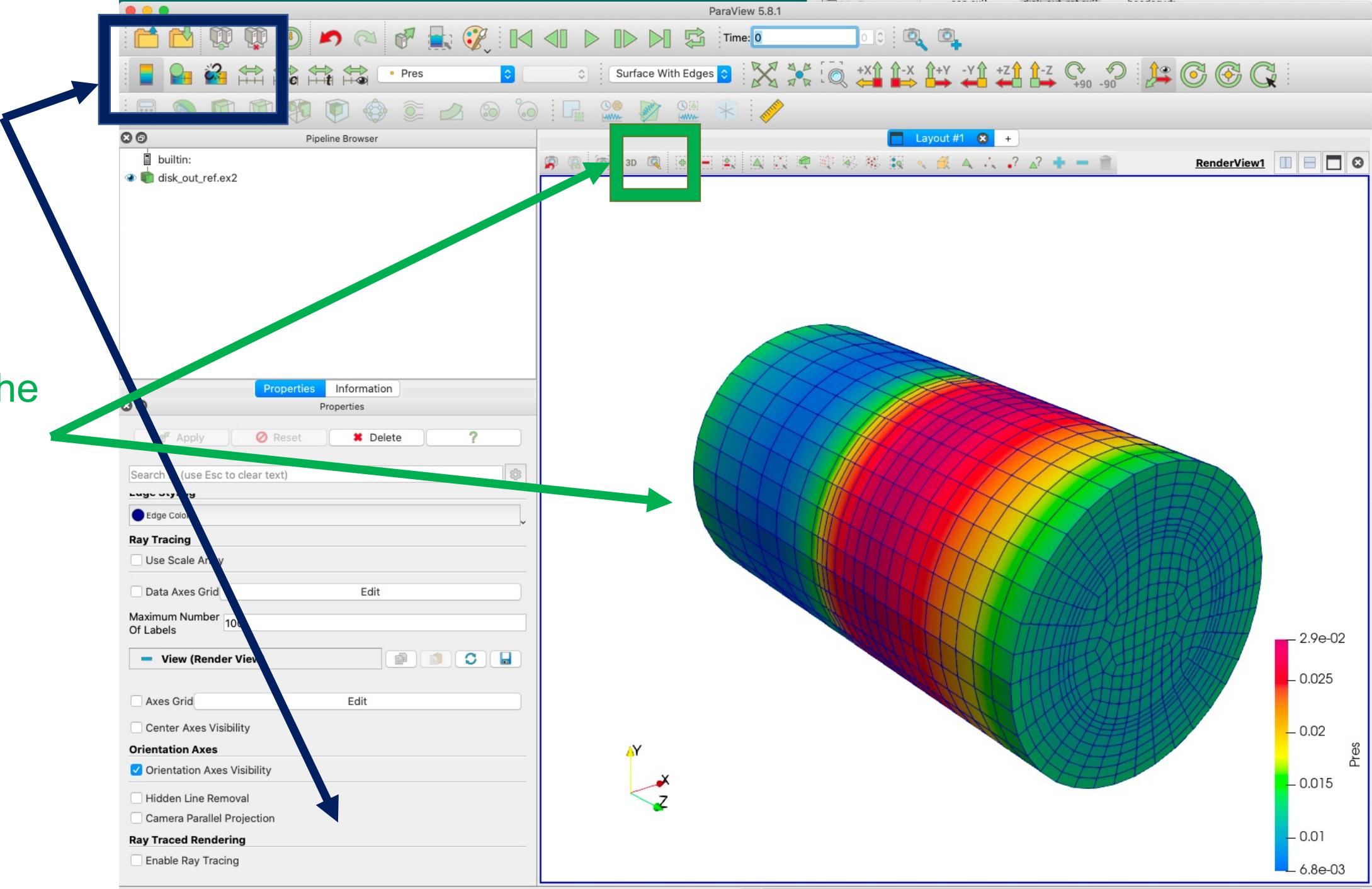
4. Select “pres”



5. Select  
“surface with  
edges”



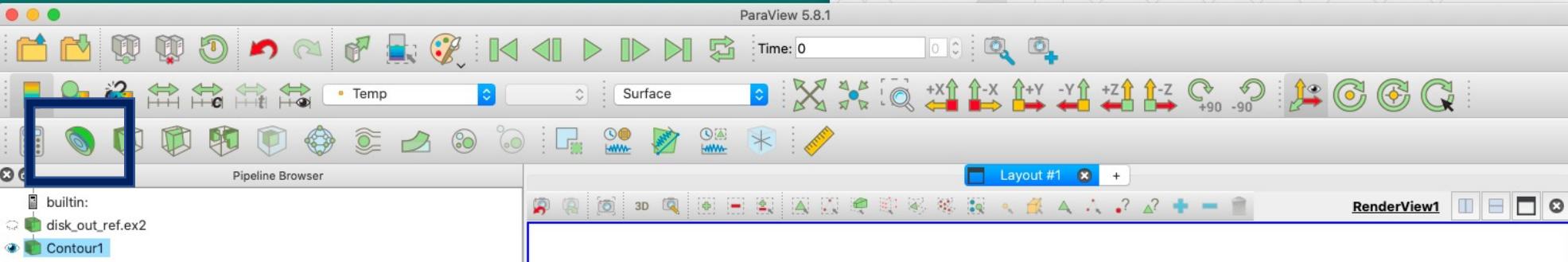
## 6. Edit the color map



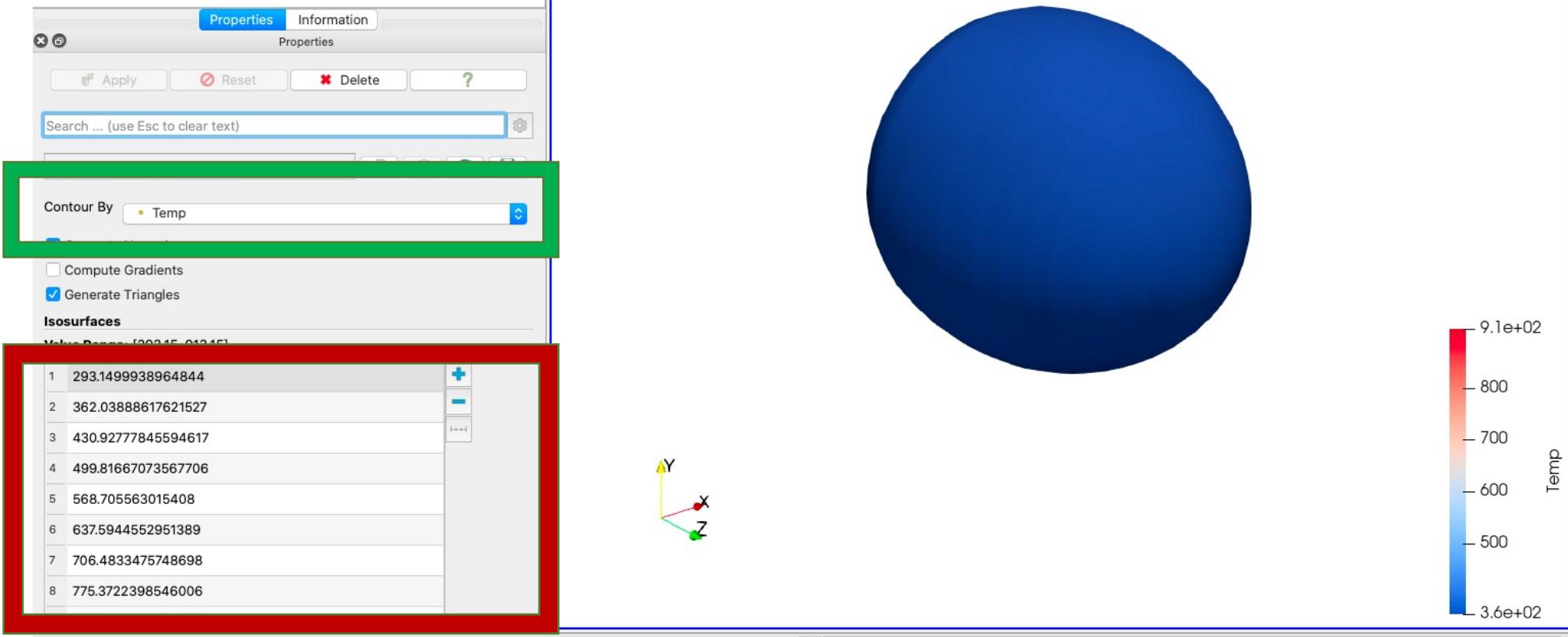
## 7. Change the camera location

# Contour filter

1. Select contour filter



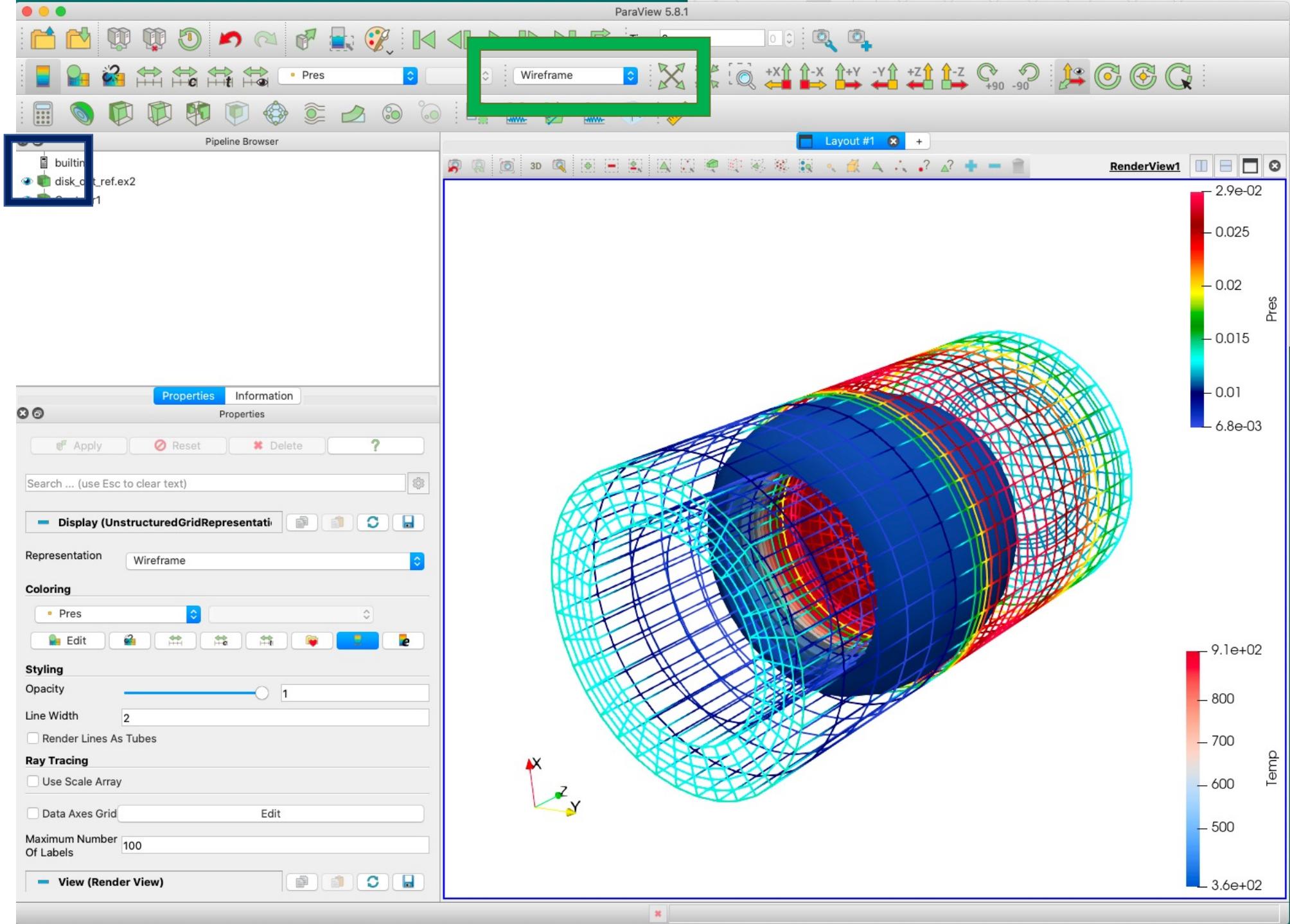
2. Select contour by temp



3. Generate the values for isosurfaces

4. Hit apply

1. Turn on the pressure visualization by hitting the eye



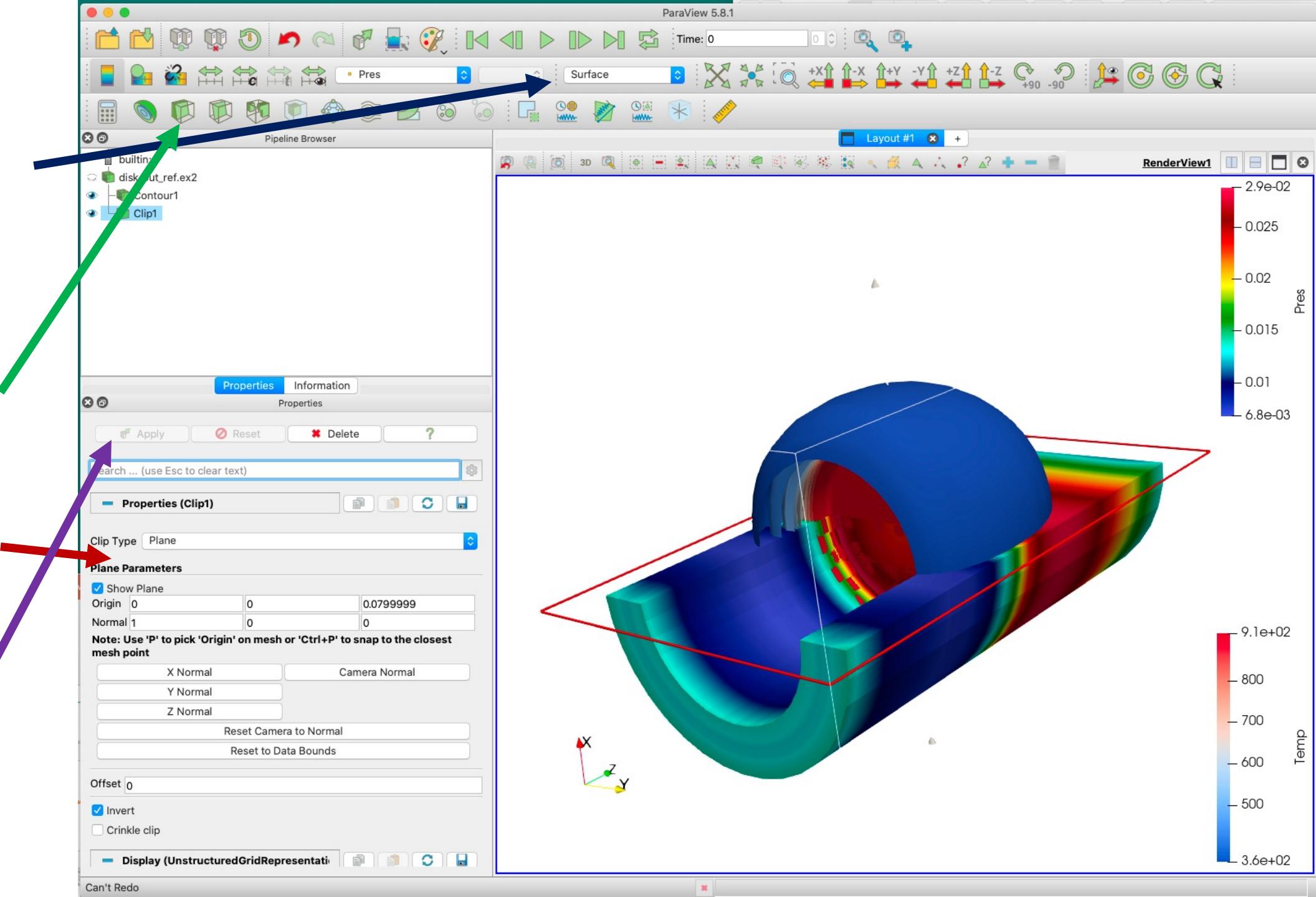
# **Clip and slice filter**

1. Choose pressure representation on surface

2. Select the clip filter

3. Select the plane for clip cut

4 Hit apply

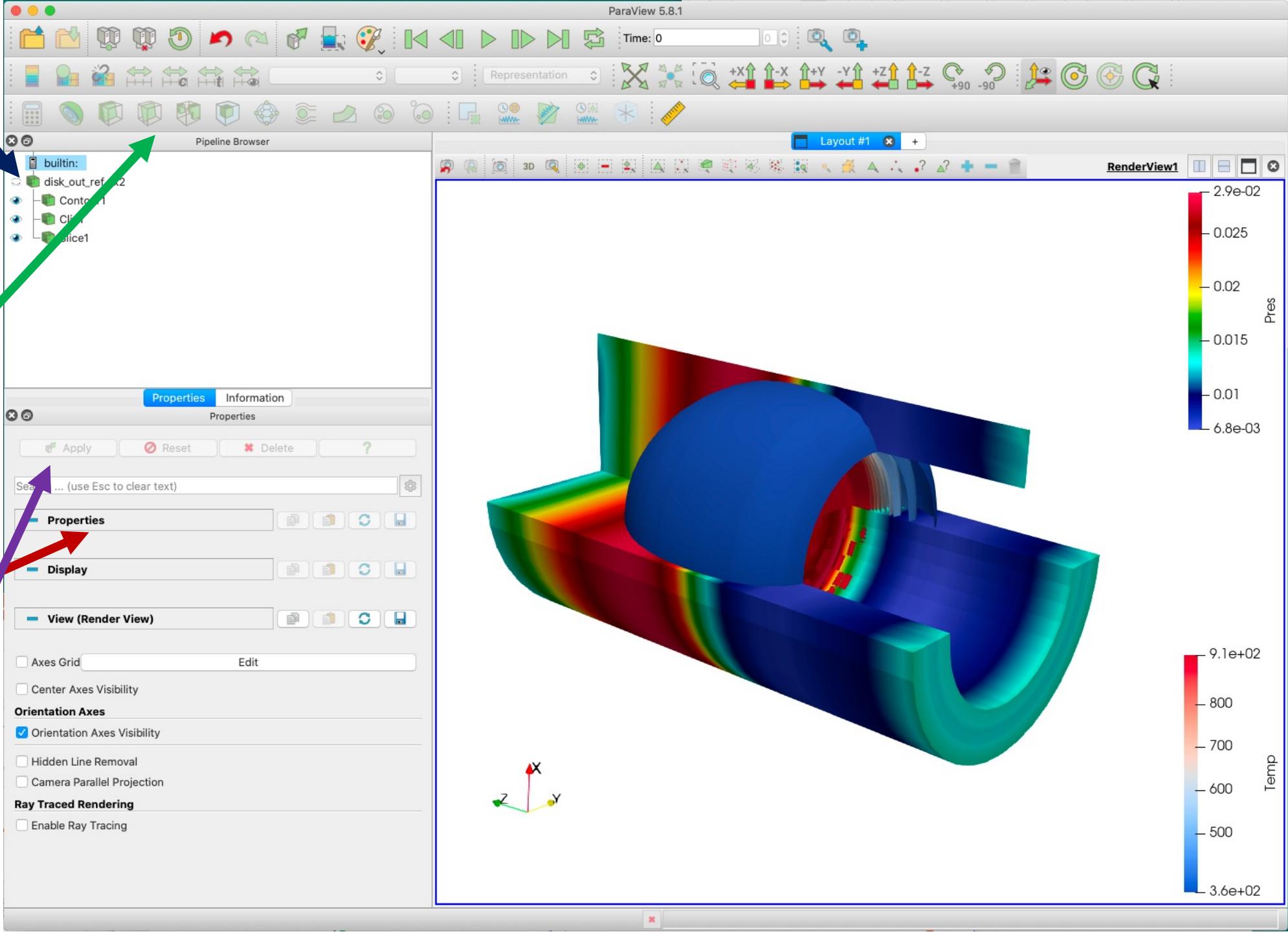


**1. Choose  
disk out ref.ex2**

2. Select the  
slice filter

3. Select the  
plane for clip  
cut (y nomral)

4 Hit apply



# **Streamline, Tube, and Glyph filter**

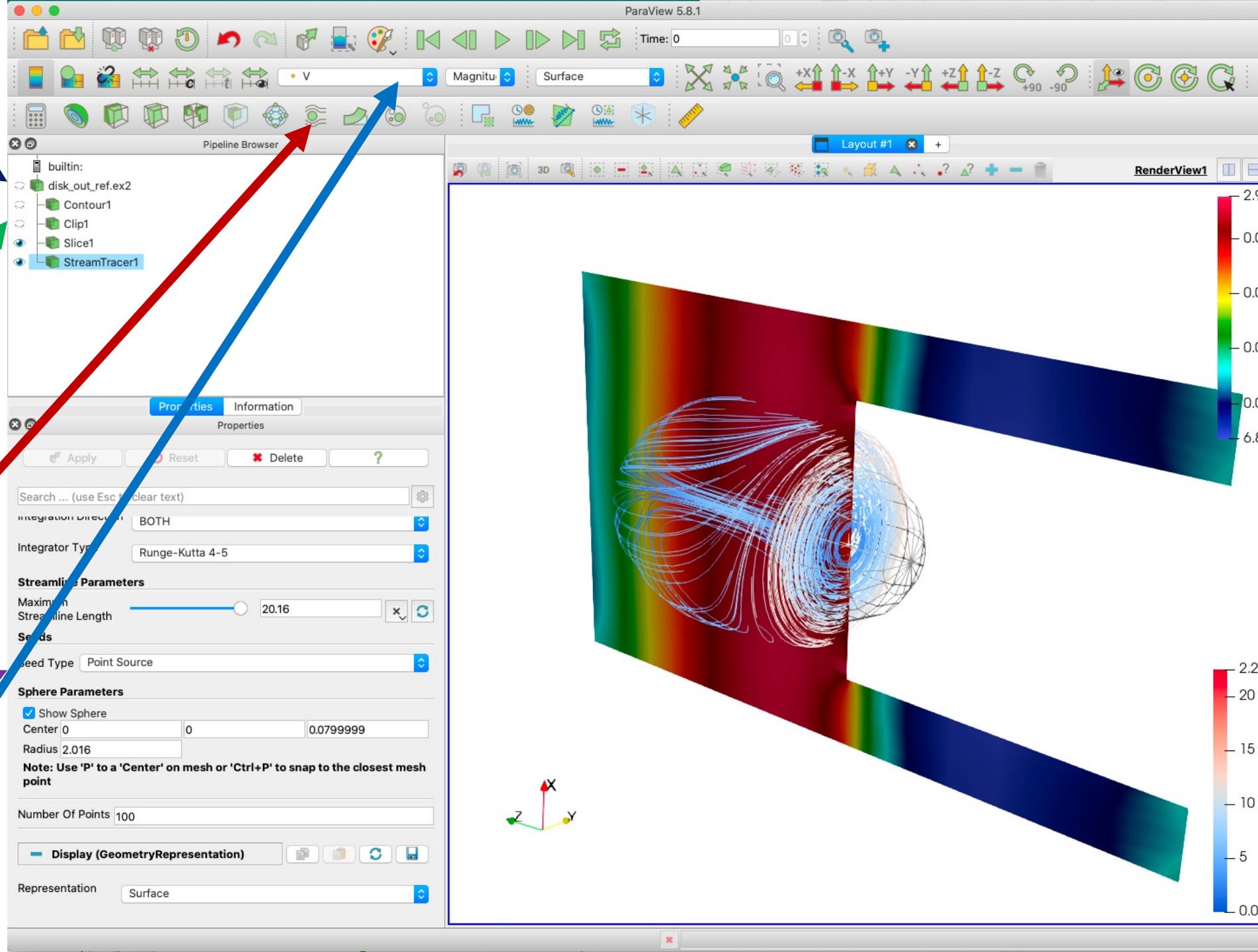
**1. Choose  
disk\_out\_ref.ex2**

2. Select off  
contour and  
clip

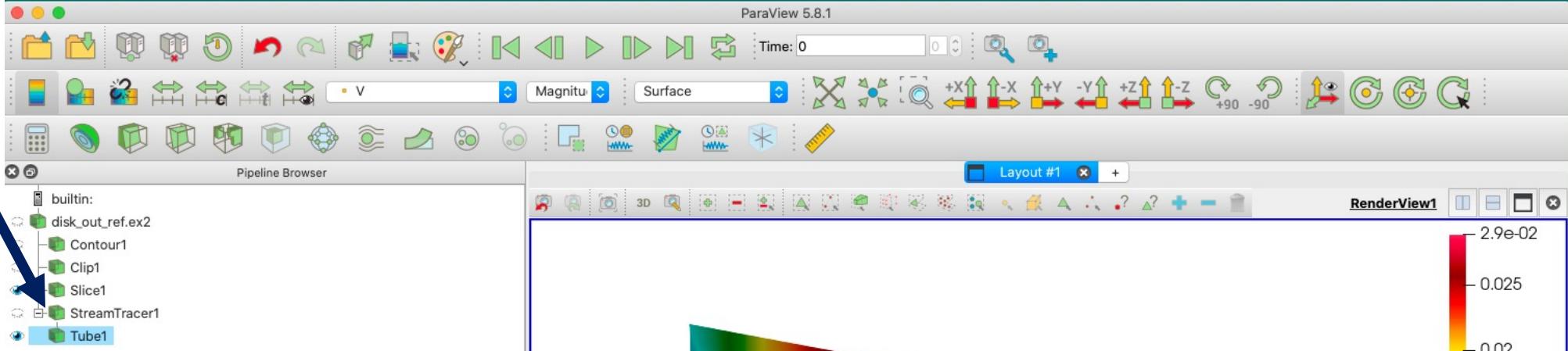
3. Select the  
streamline filter

4 Select Seed  
Type: Point  
source

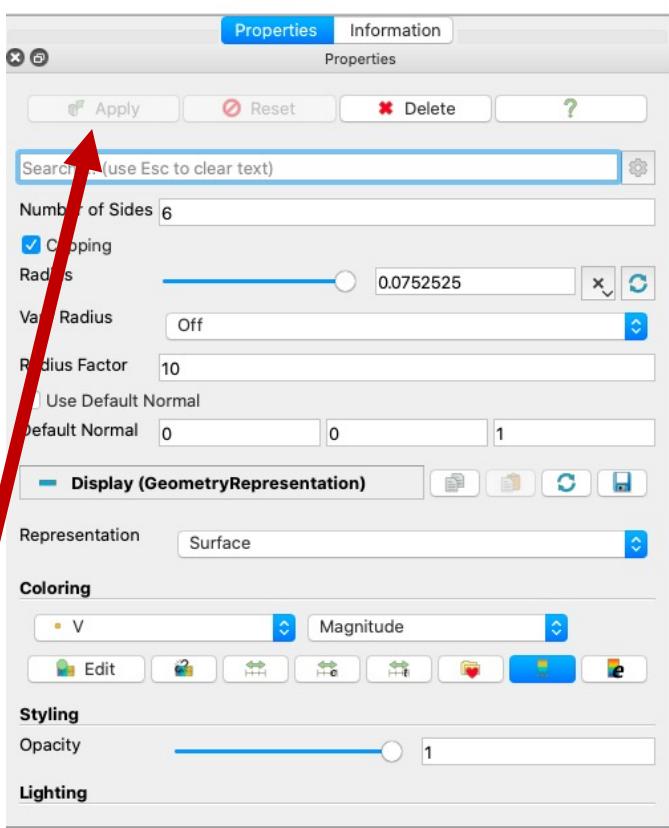
5. Select V for  
coloring



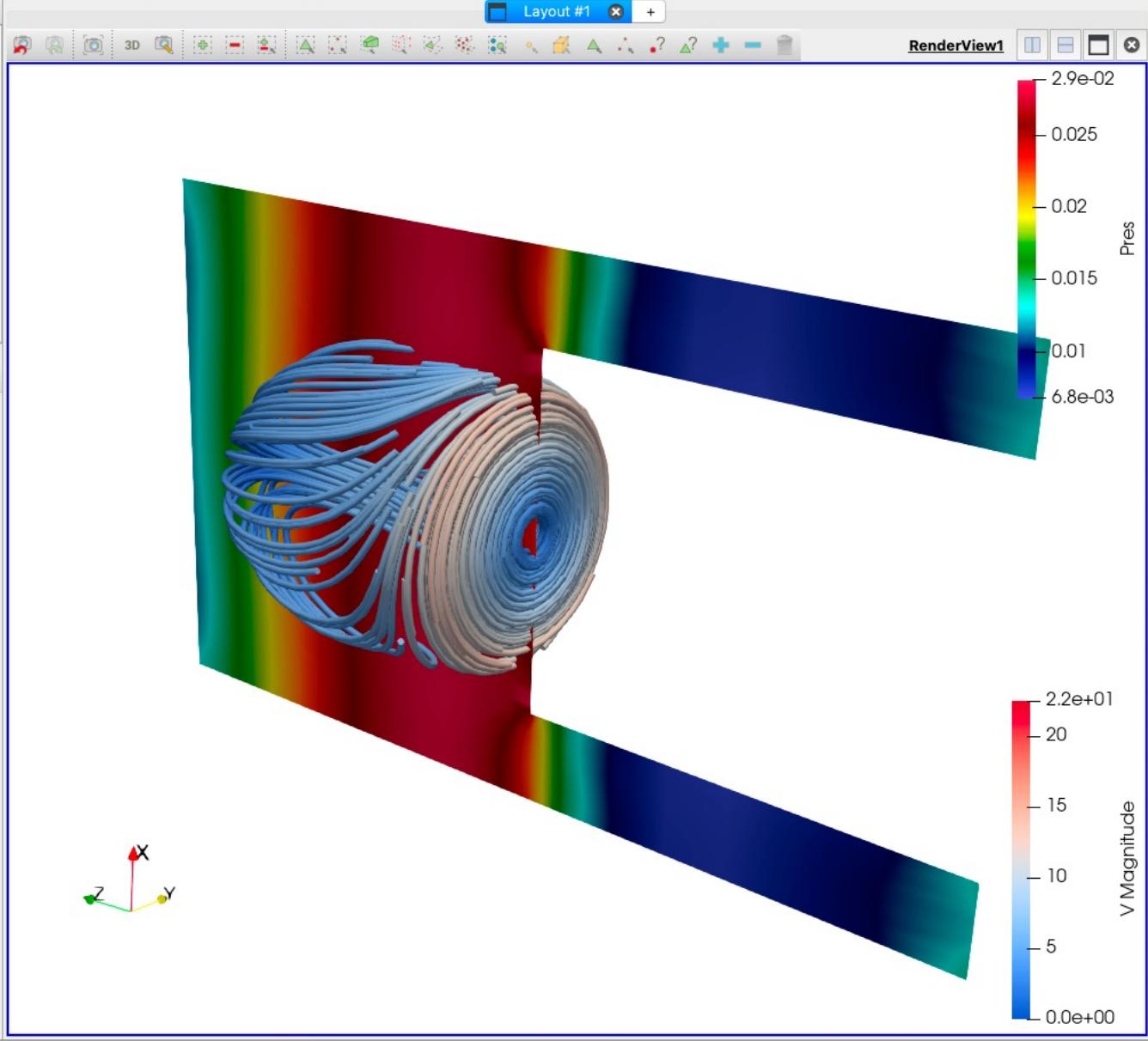
# 1. Choose StreamTracer1



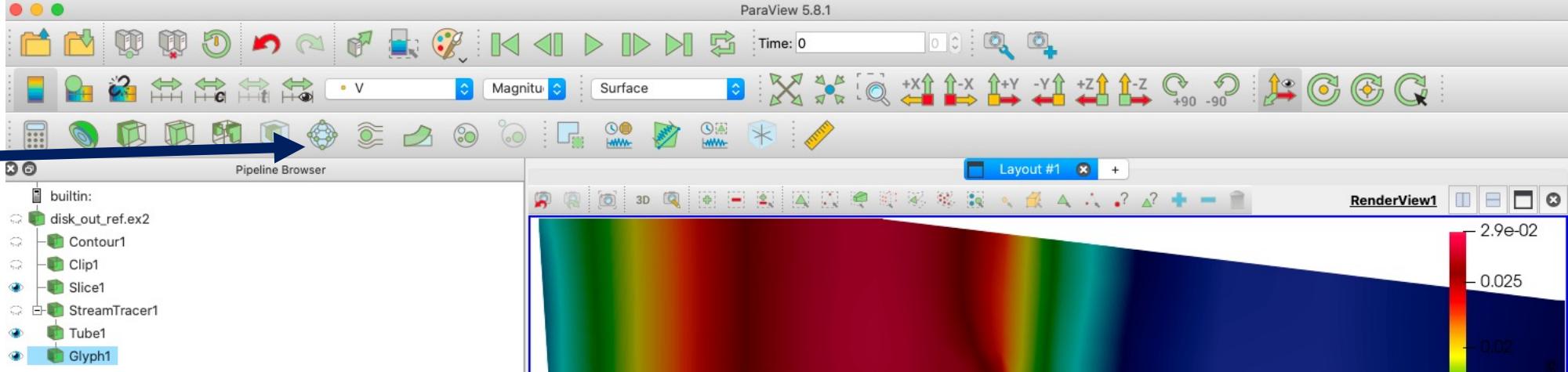
**2. Select the tube filter from  
Filters ->  
Alphebatically -  
> Tube**



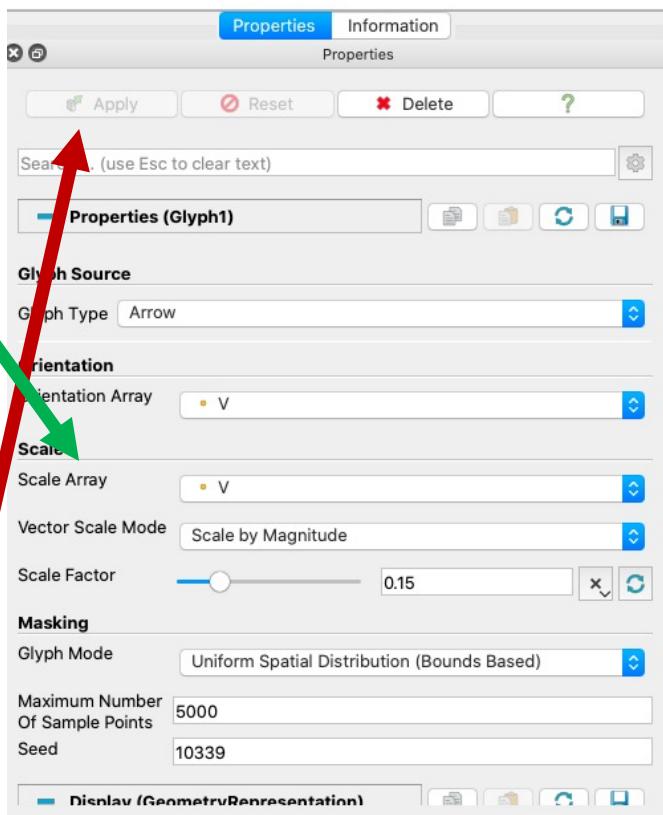
**3. Hit apply**



# 1. Choose Glyph under Tube1

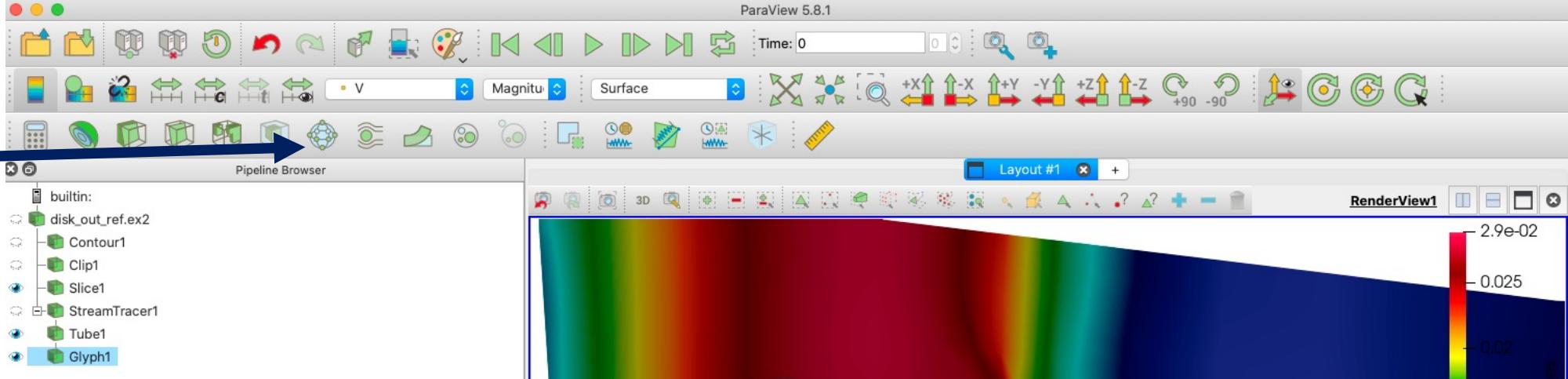


2. Select the Orientation Array and Scale Array both by V

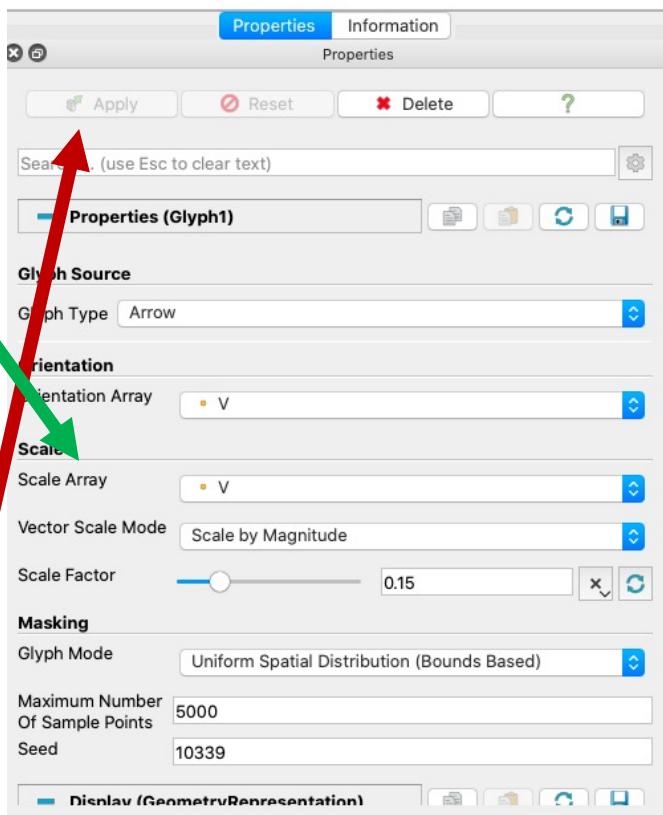


3. Hit blue apply

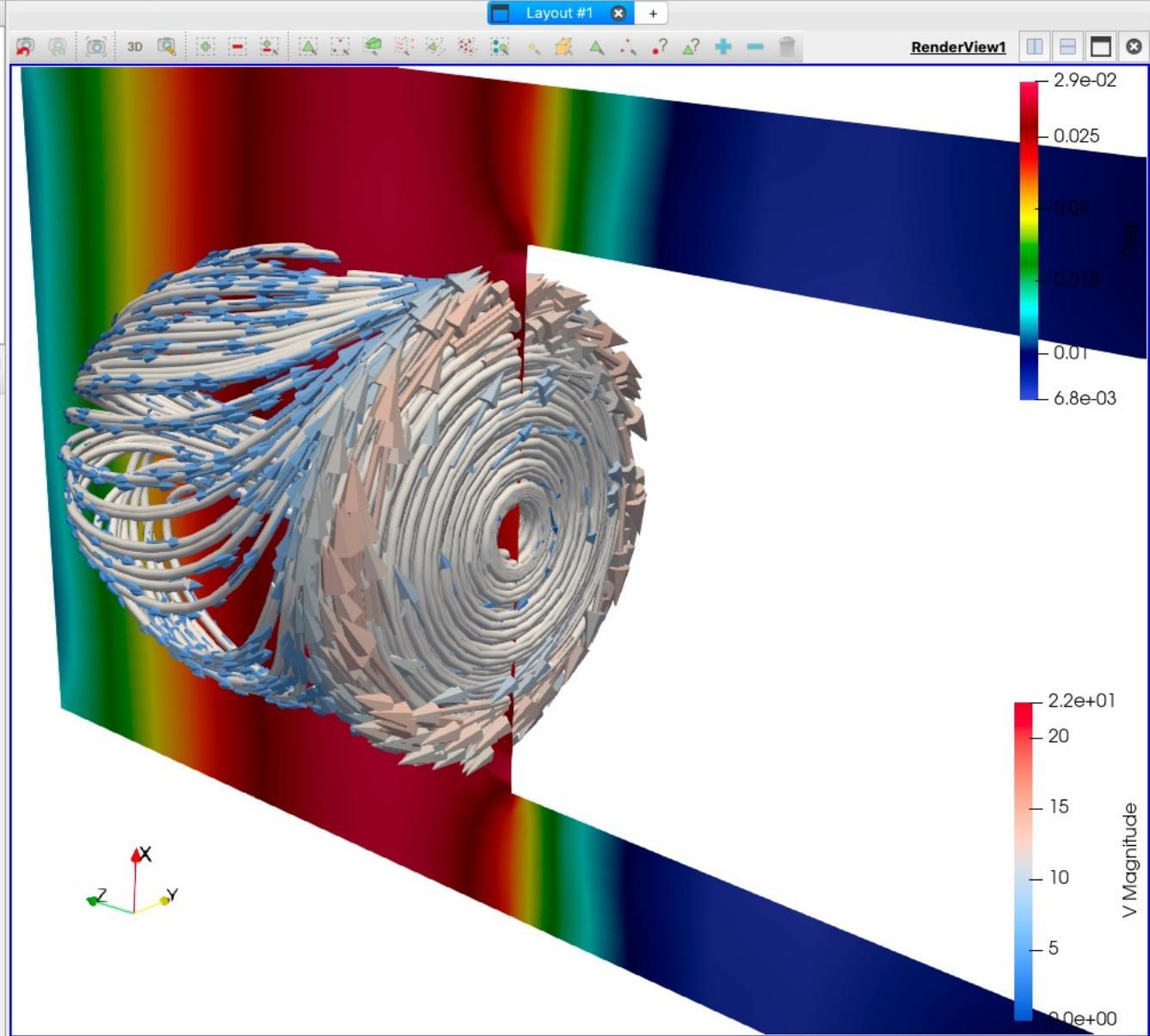
# 1. Choose Glyph under Tube1



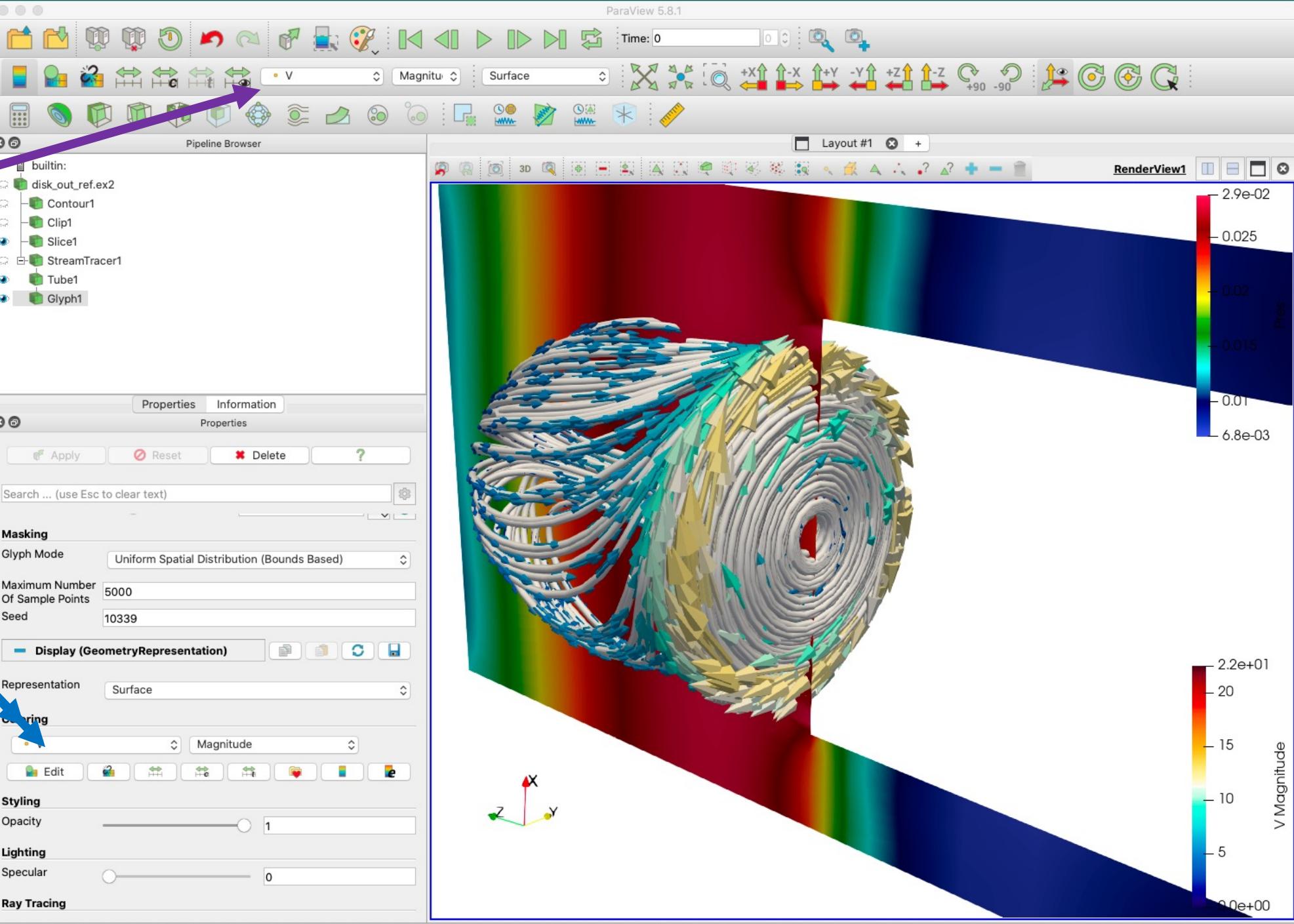
**2. Select the Orientation Array and Scale Array both by V**

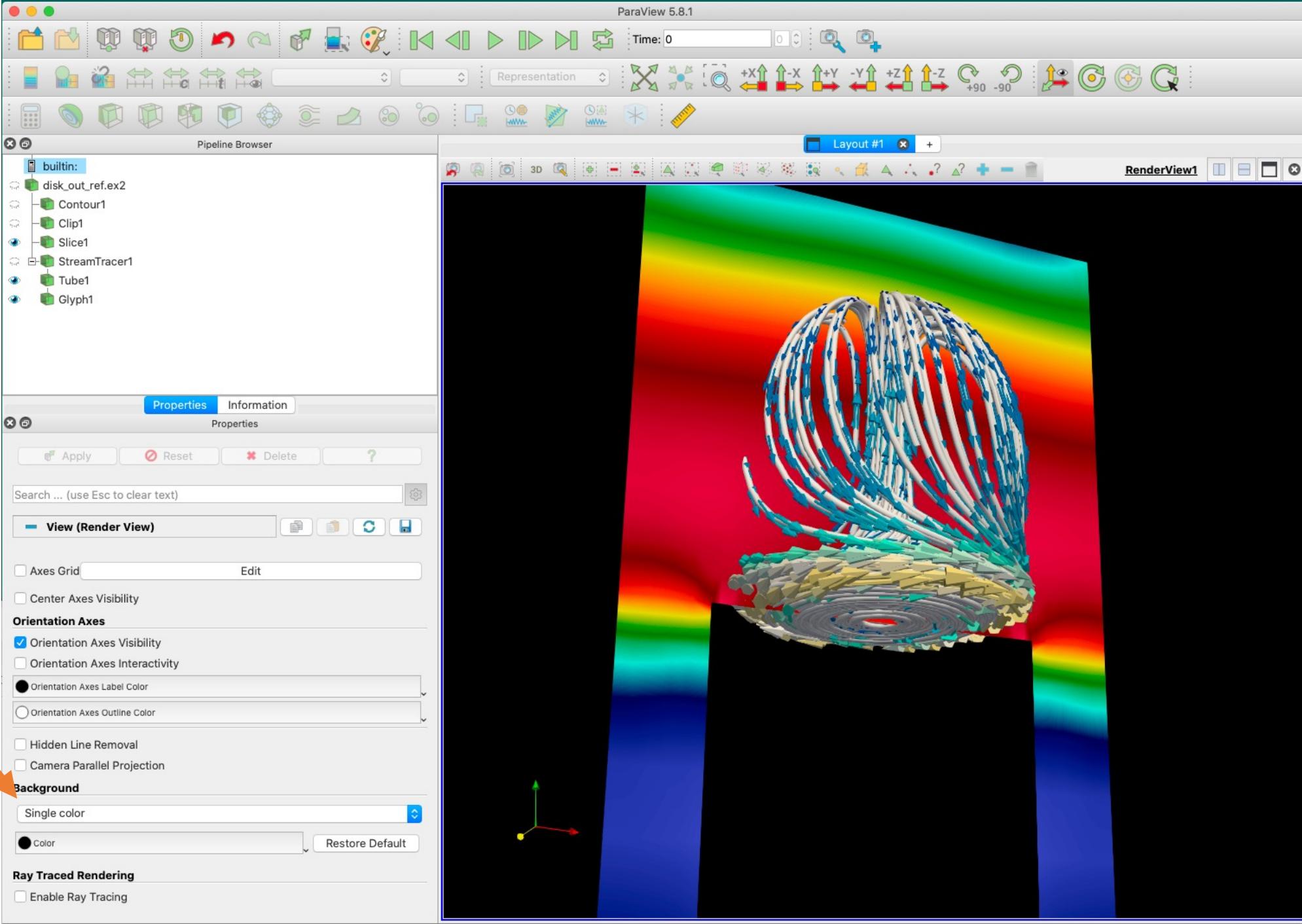


**3. Hit blue apply**

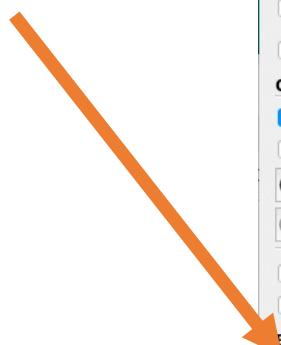


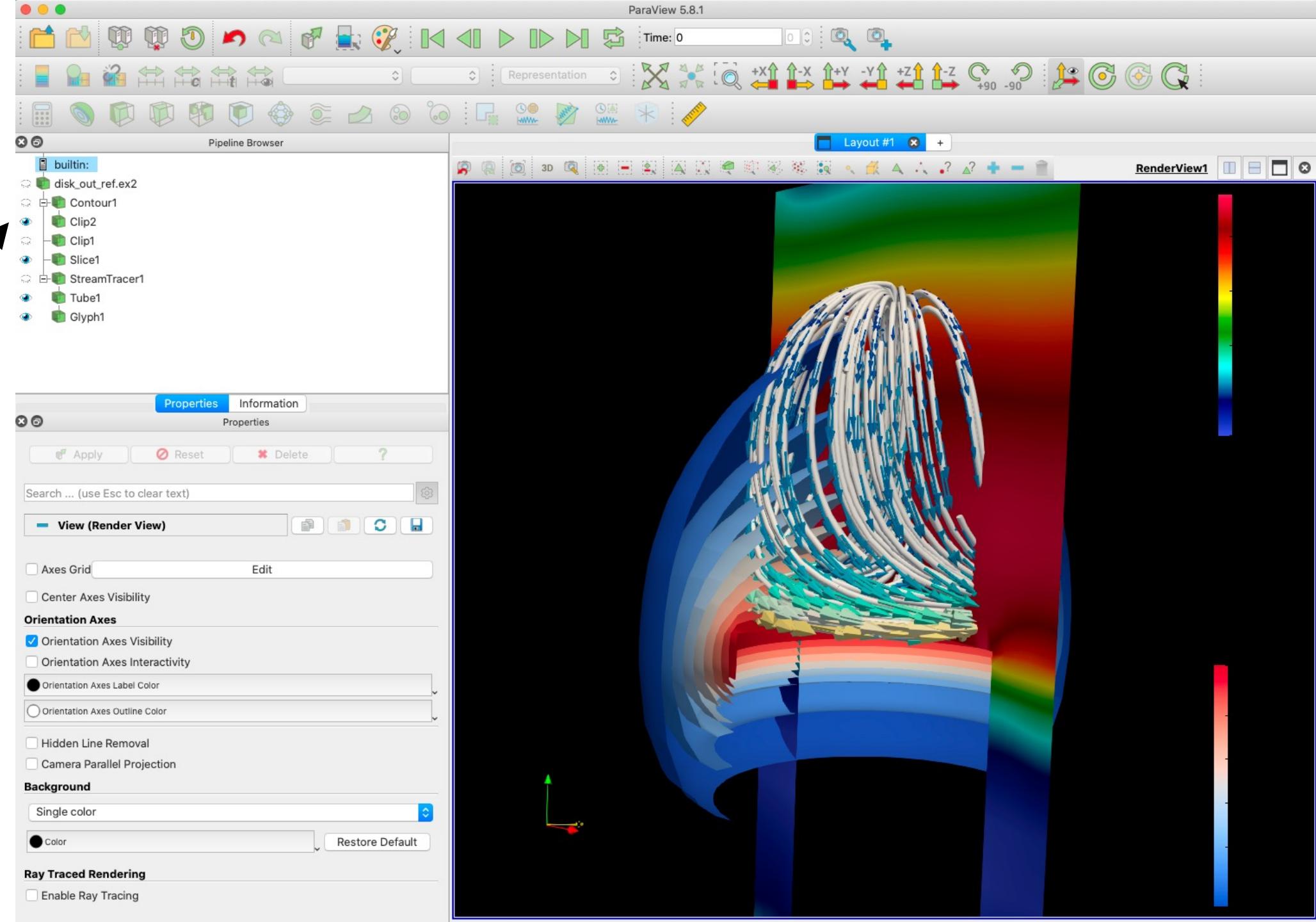
4. Select tube  
and select solid  
color





7. Select the background color to black





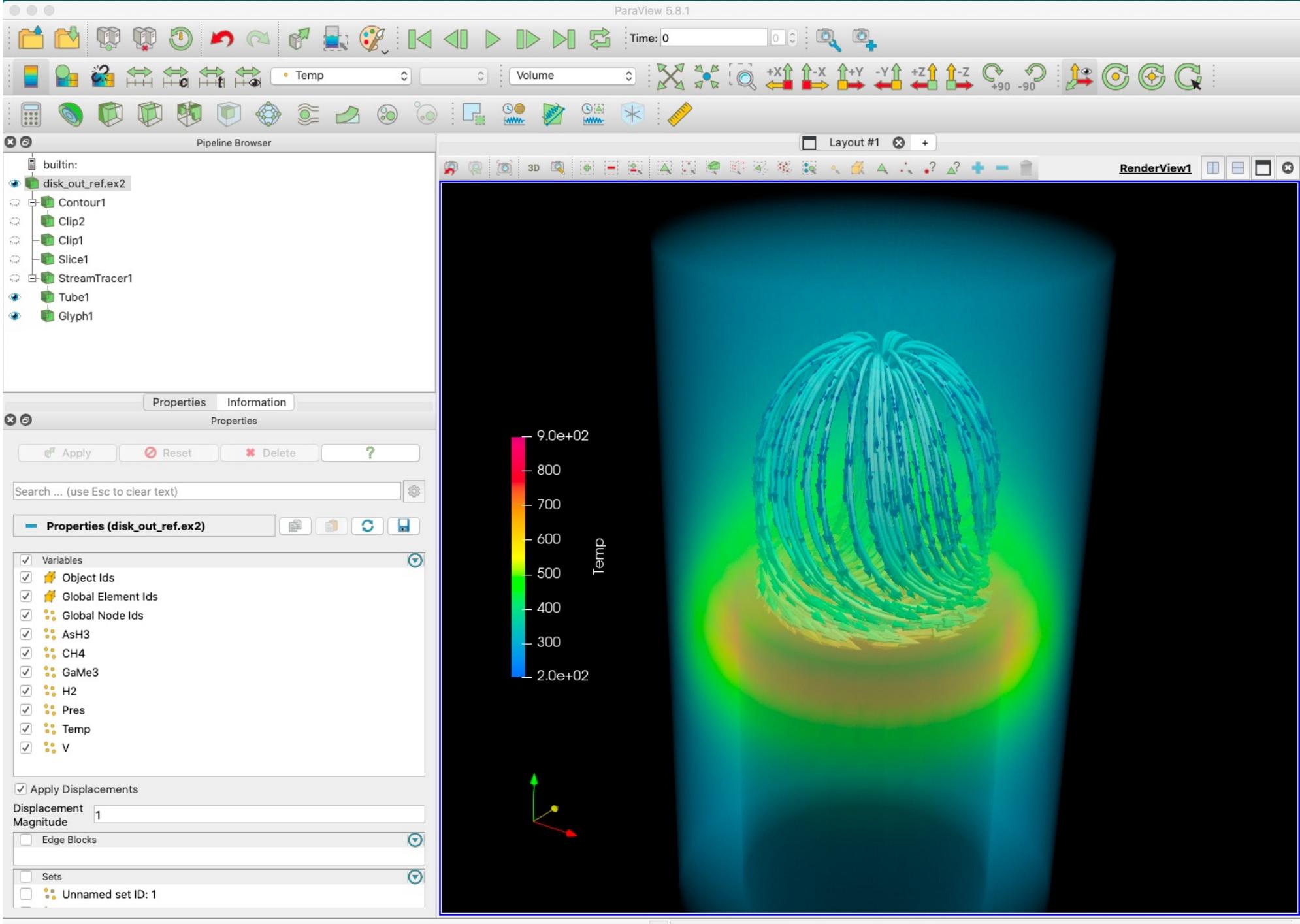
Select  
disk\_out\_ref.ex2

Select Volume  
representation

Edit color map

Edit color  
legend font

Select the data  
range



# Summary

- Paraview is a powerful tool for postprocessing and visualizing scientific/engineering data
- You may combine filters to get the best visualization effect
- You can create movies
- You can run it on clusters
- You can do data analysis on it
- More tutorials:
  - <https://docs.paraview.org/en/latest/Tutorials/index.html>
  - [https://www.paraview.org/Wiki/ParaView Classroom Tutorials](https://www.paraview.org/Wiki/ParaView_Classroom_Tutorials)
  - <https://www.paraview.org/Wiki/images/b/bc/ParaViewTutorial56.pdf>