Paraview

An Idefix tutorial

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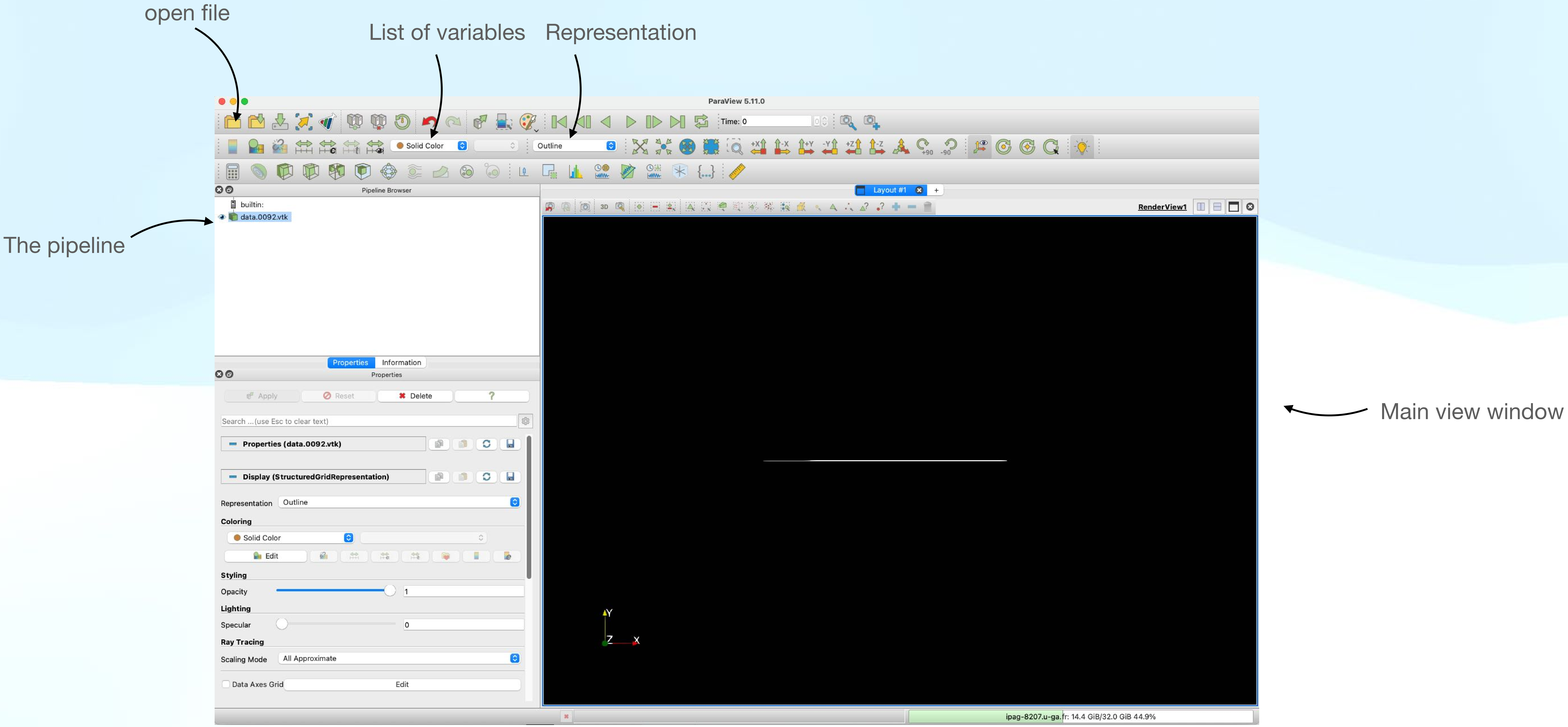
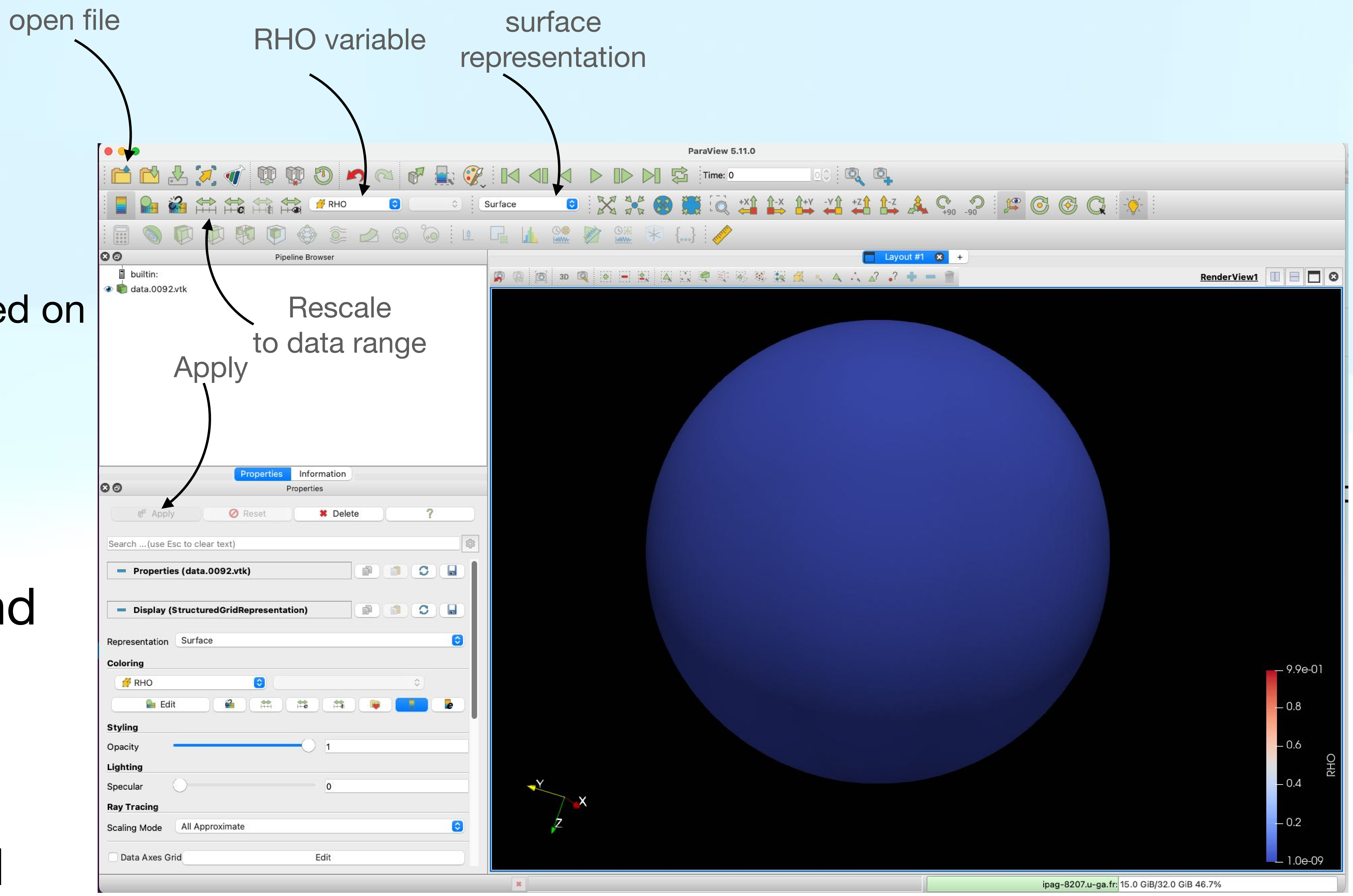
Overview


open file
List of variables
Representation
The pipeline
Main view window
ParaView 5.11.0
Time: 0
Solid Color
Outline
Pipeline Browser
builtin:
data.0092.vtk
Layout #1
RenderView1
Properties
Information
Apply
Reset
Delete
Search ...(use Esc to clear text)
Properties (data.0092.vtk)
Display (StructuredGridRepresentation)
Representation
Coloring
Edit
Styling
Opacity
Lighting
Specular
Ray Tracing
Scaling Mode
All Approximate
Data Axes Grid
ipag-8207.u-ga.fr: 14.4 GiB/32.0 GiB 44.9%

Getting started

- Open the vtk file
  (It represents a 3D MRI-turbulent disc computed on AMD Mi250 GPUs)
- Click « apply » to load the vtk file content in memory
- Choose a surface representation, and RHO as the variable
- click on « rescale to data range »
- You now see the whole dataset, and essentially the outer radial boundary, which is quite uninteresting…!



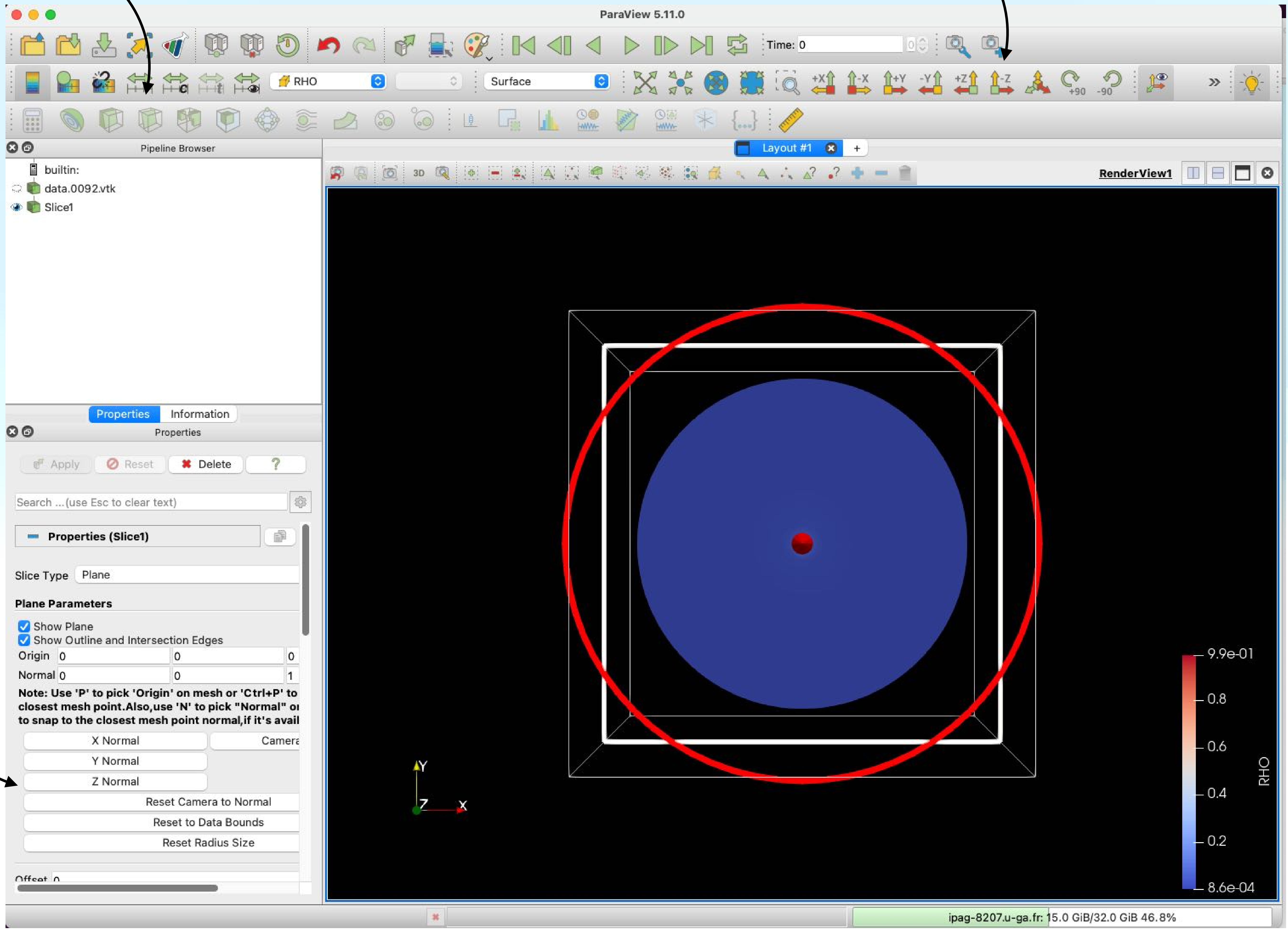
Let’s make a cut

- Use the « slice » tool to slice the spherical domain
- Choose « Z normal » to make the slice in the X-Y plane
- click apply
- Reorient the camera so that we look at the domain from the top
- Check that RHO is still the displayed variable

slice tool

set view to -z

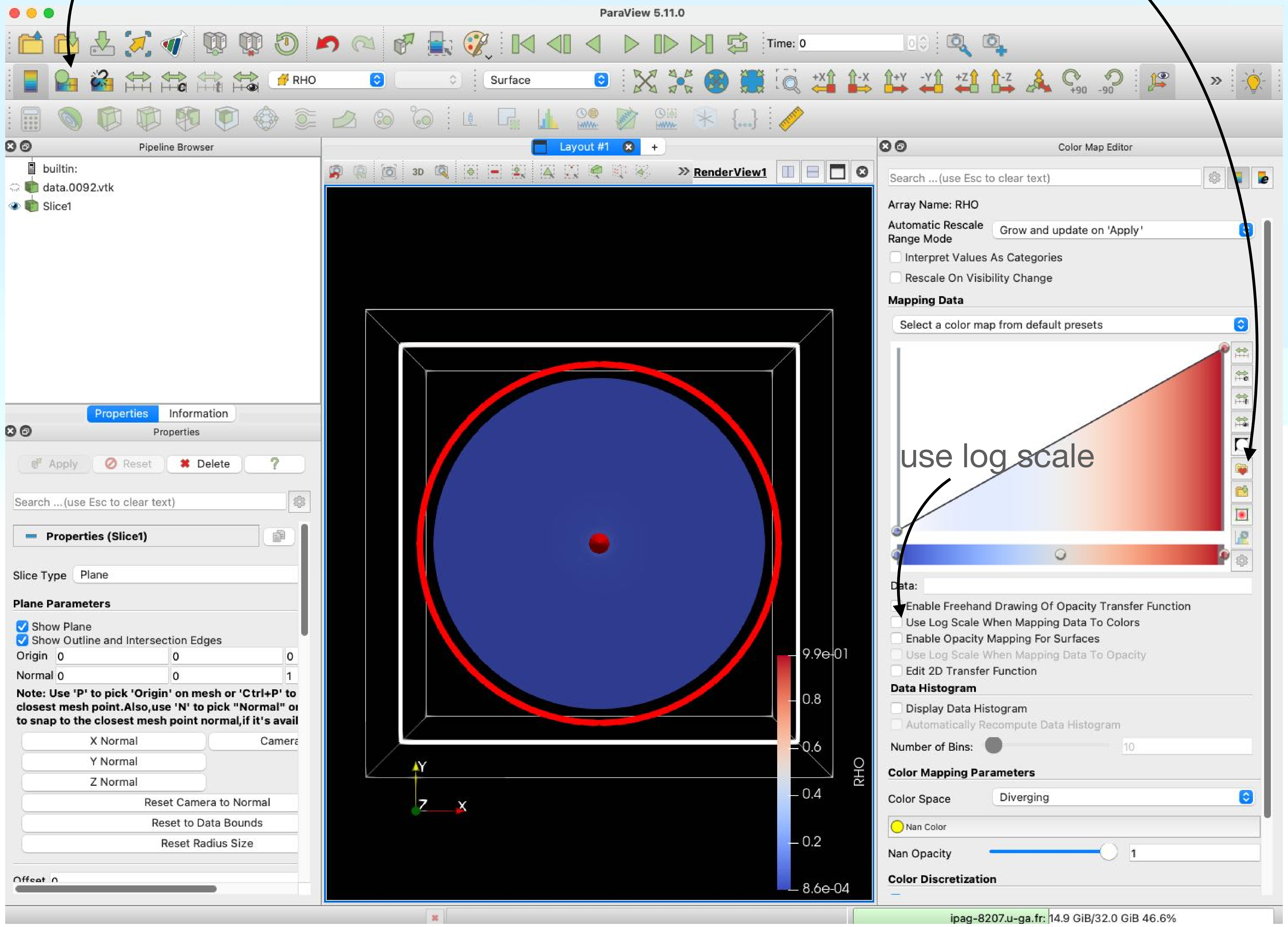
Z normal plane



Change the color bar

edit colormap

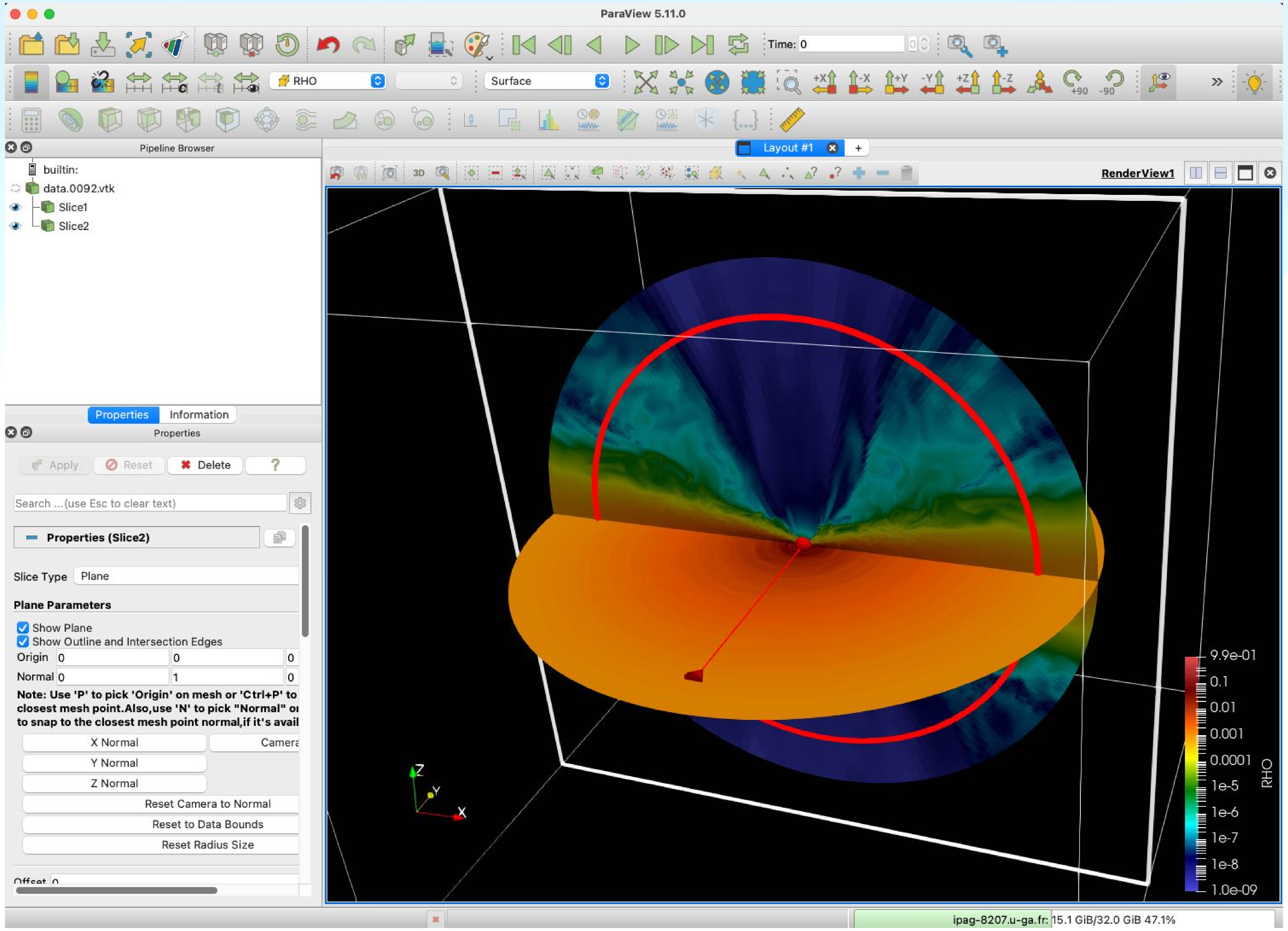
choose a colormap



- Click on « edit colormap »
- Choose « use log scale when mapping data to colors »
- Choose your favorite colormap

Let’s add another cut

- Use the « slice » tool to slice the spherical domain (Warning, you should select the full dataset in the pipeline, otherwise you’ll make a slice of a slice!)
- Choose « Y normal » to make the slice in the X-Z plane
- click apply
- Reorient the camera so that we see both slices
- Check that RHO is still the displayed variable



Compute and plot a custom field

- Let's compute the magnetic pressure
$$P_m = \frac{1}{2}\left(B_r{}^2 + B_\theta^2 + B_\varphi^2\right)$$

- Create a calculator taking our slice 2 as an input

- name the result « Pm », and enter the formula: 0.5*(BX1^2+BX2^2+BX3^2)

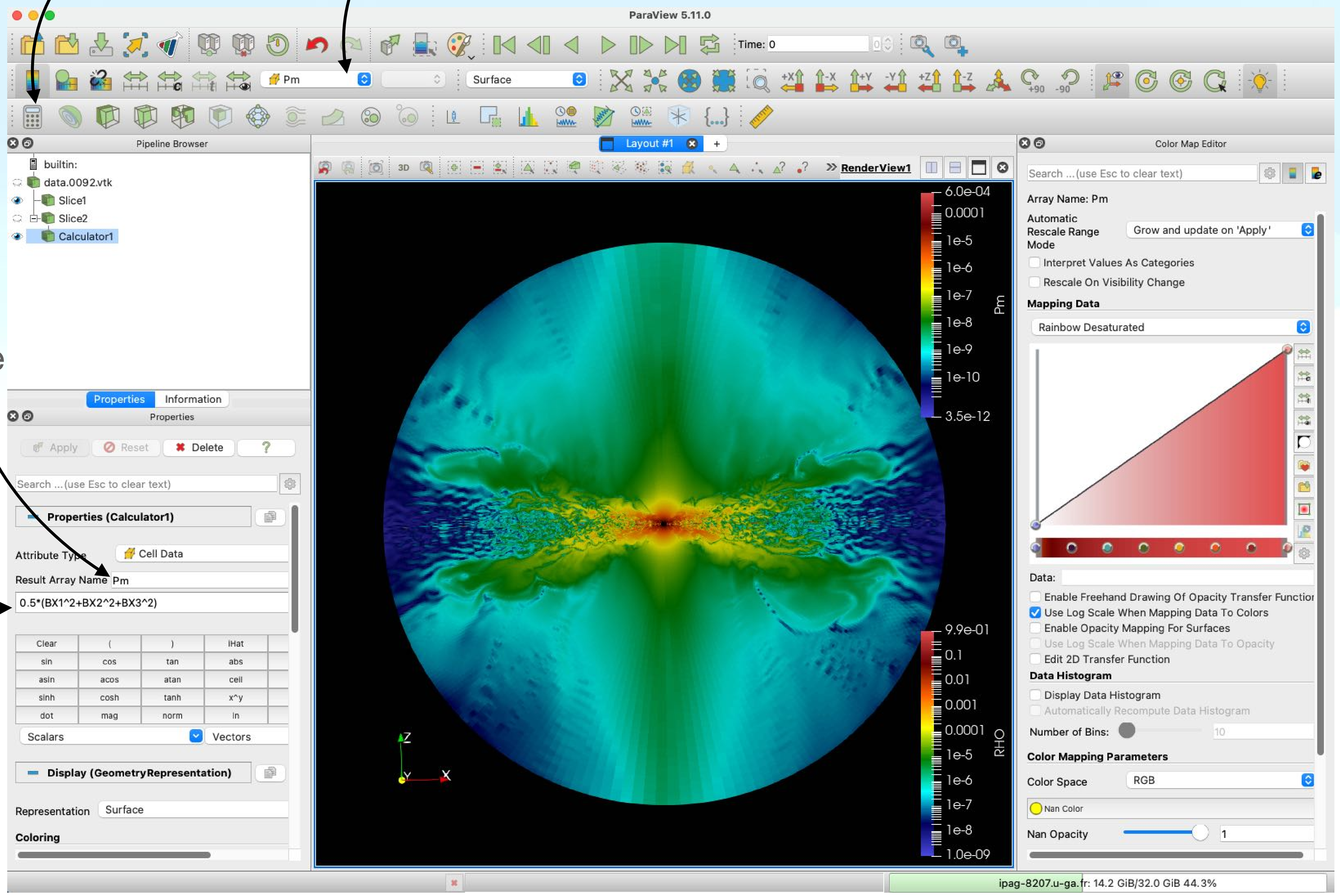
- Now choose the newly created « Pm » in the variable list. Open the colormap editor, and use a log scale representation

Calculator tool

Choose the new field in the list of variables

result name

formula to compute the new variable



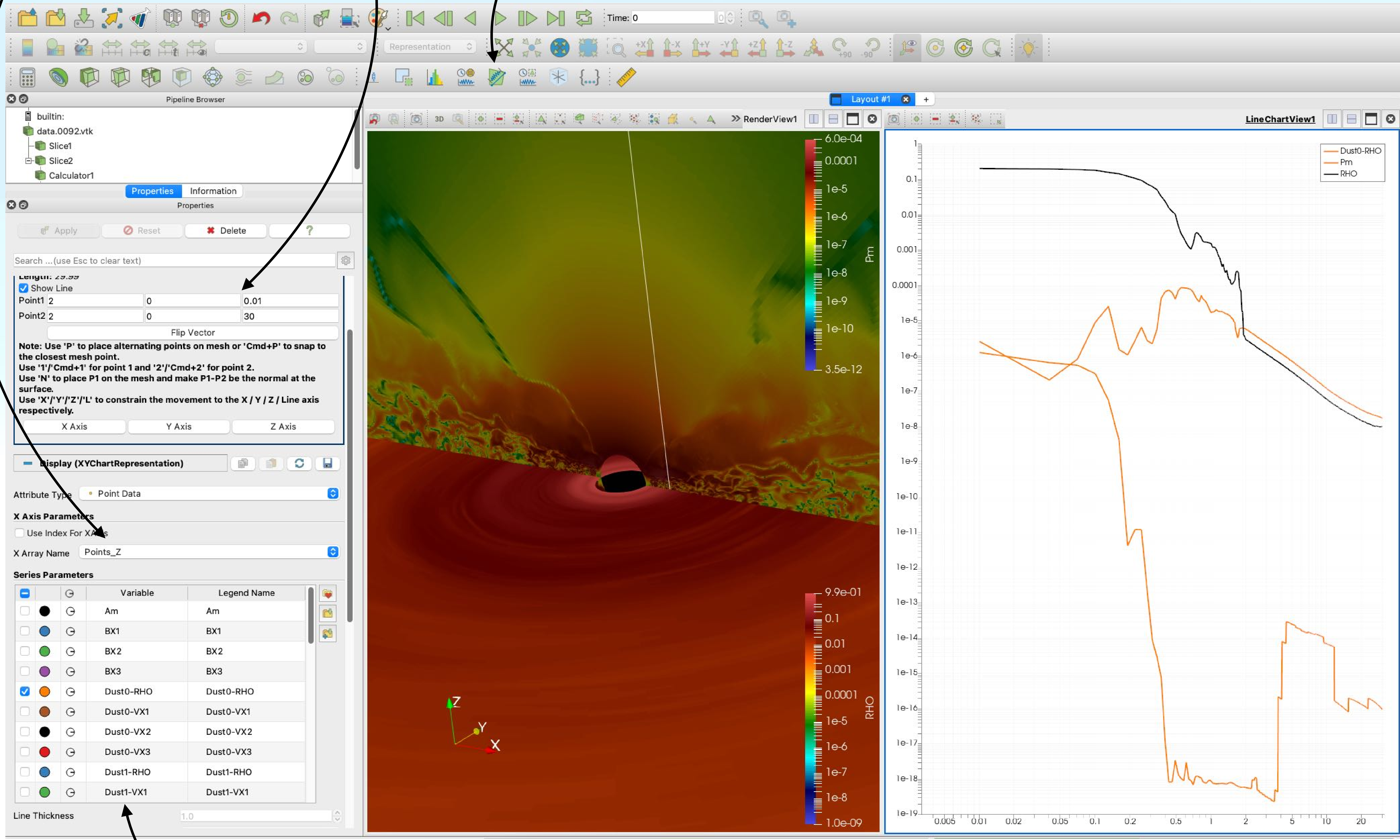
1D plot

- Let’s make a 1D plot of the density and magnetic pressure along z at R=2
- Take the calculator in the pipeline, so that our next filter will have access to « Pm »
- Choose « plot over line »
- Make a line that goes from 2, 0, 0.01 to 2,0, 30 in the « line parameters »
- Apply
- Only plot RHO, Dust0-RHO and Pm (pick up the variables in the « series parameters » of the PlotOverLine properties)
- Specify that we want to use the Z Coordinate as the X axis of the 1D plot
- To plot this in log log, go down the « properties » panel and click « left axis log scale » and « bottom axis log scale »

X axis for the 1D plot

line parameters

plot over line



1D plot variables

Streamlines/fieldlines

- Field lines and streamlines can only be computed from point wise vector, while Idefix produces cell-wise scalars
- We must first convert cell data to point data: select the original 3D dataset, then go to « Filters->Alphabetical->cell data to point data »
- From this point, the data is sampled on points. We can therefore use the calculator to construct the magnetic field vector from its spherical components (note that paraview always uses a cartesian coordinate system)

$$B_r\frac{x\boldsymbol{e}_x+y\boldsymbol{e}_y+z\boldsymbol{e}_z}{\sqrt{x^2+y^2+z^2}}+$$

$$B_\theta\frac{xz\boldsymbol{e}_x+yz\boldsymbol{e}_y-(x^2+y^2)\boldsymbol{e}_z}{\sqrt{(x^2+y^2+z^2)(x^2+y^2)}}$$

$$B_\varphi\frac{x\boldsymbol{e}_y-y\boldsymbol{e}_x}{\sqrt{x^2+y^2}}$$

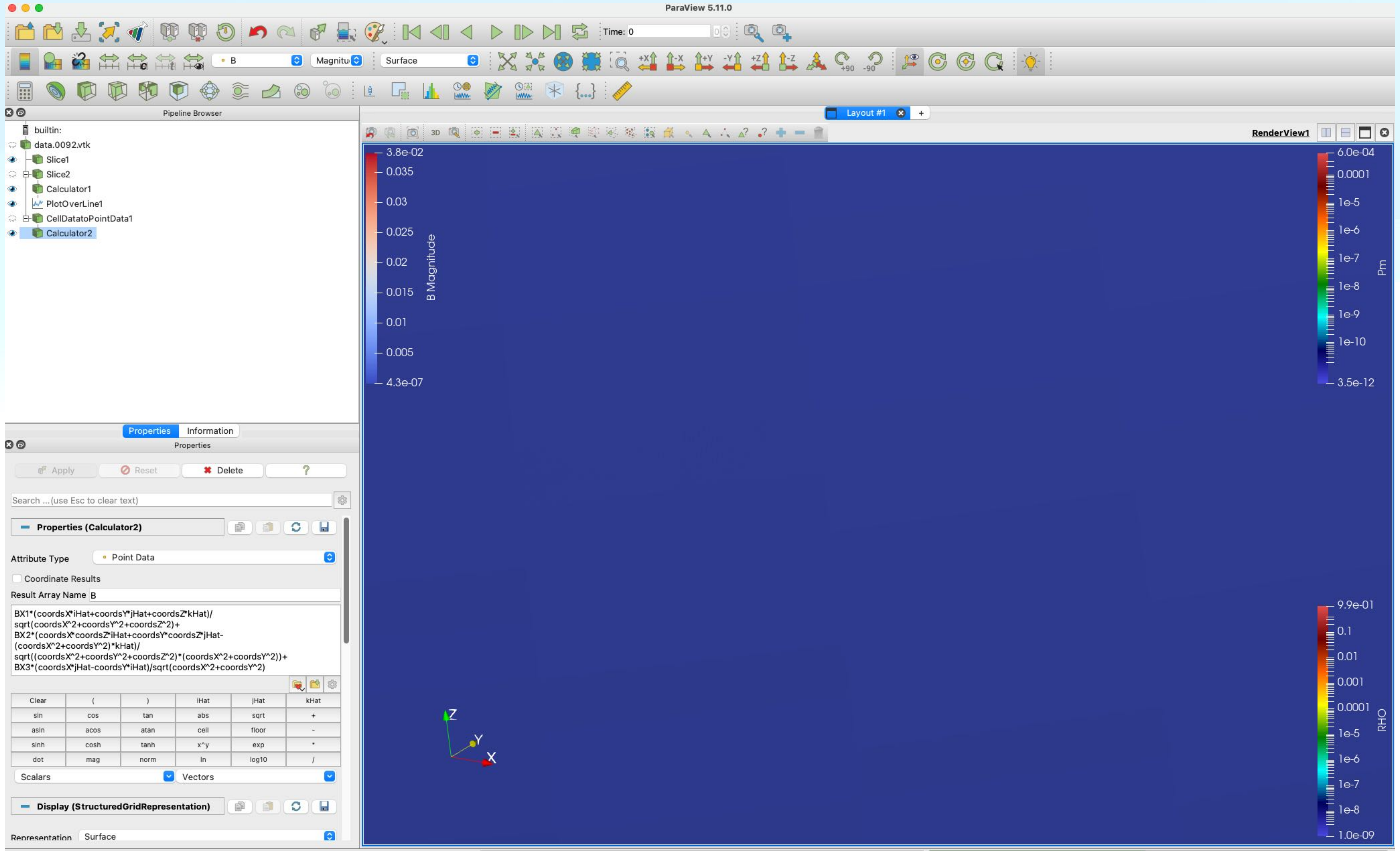
- Which gives in paraview calculator (note that iHat, jHat and kHat are the unit vector e_x, e_y and e_z):

```
BX1*(coordsX*iHat+coordsY*jHat+coordsZ*kHat)/
sqrt(coordsX^2+coordsY^2+coordsZ^2)+

BX2*(coordsX*coordsZ*iHat+coordsY*coordsZ*jHat-
(coordsX^2+coordsY^2)*kHat)/
sqrt((coordsX^2+coordsY^2+coordsZ^2)*(coordsX^2+co
ordsY^2))+

BX3*(coordsX*jHat-coordsY*iHat)/
sqrt(coordsX^2+coordsY^2)
```

- Let's name « B » the name of the result of the calculator and apply
- From this point, we have a vector « B », for which we can plot the magnitude and components (check the variable list)



Streamlines/fieldlines (cont'd)

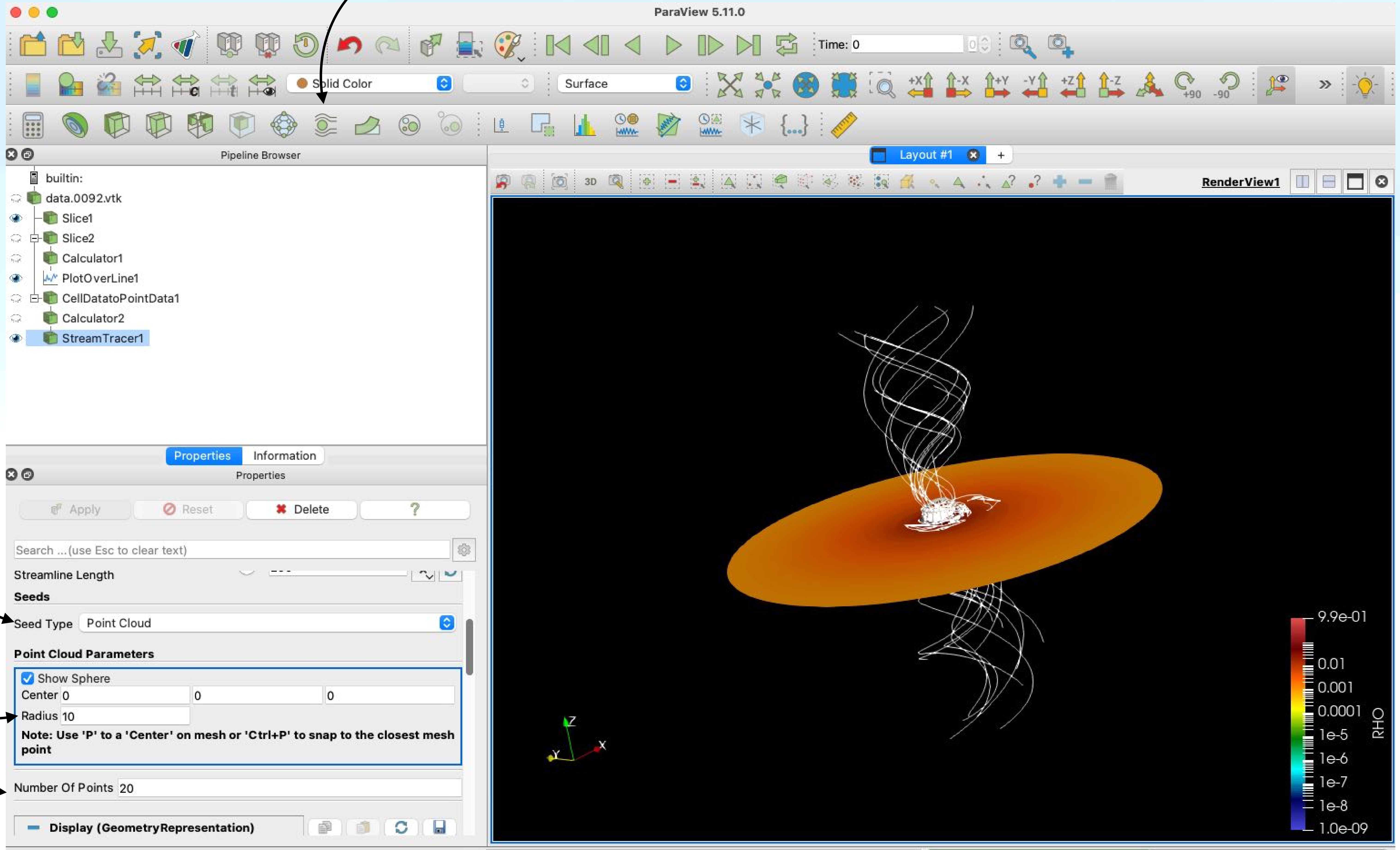
- With the vector B properly defined, we can plot the field lines, click on « streamtracer »
- The streamtracer uses a numerical integration to represents the streamlines, hence one need to give it a set of starting points: the « seeds »
- Let's choose a "point cloud » of radius 10, and only 20 seed points. Paraview will pick up random points at the sphere surface as starting points.
- Hide the second slice (click on the « eye » in the pipeline) to view your field line
- Extra: to give it a little more perspective, make the field line like tubes: go to « filters->alphabetical->tube »
  Feel free to color the field lines by whatever variable you want

streamtracer

seed type

seed radius

# of point seed



Volume rendering

- Volume rendering is very time-consuming on an unstructured grid (checkout the information tab). Hence, it is recommend to re-mesh onto a regular cartesian grid before attempting any volume rendering.
- First pick the « celldatatopointdata » object in your pipeline: this will be our starting point. We are going to remesh its output.
- Go to filters->alphabetical->Resample to image.
- We want to represent the disc with a volume rendering of the density. So we are going to re-mesh only the disc:
    - uncheck « use input bound »
    - use a sampling dimension of 200x200x50 (that's the resolution of the new mesh in x,y,z)
    - for the sampling bound, let's zoom on a box centered in +/-20 in x and y and +/- 2 in z
    - Don't forget to apply!
- Now that we have a uniform rectilinear grid, let's use the volume representation
- Most of the time with volume rendering is spent on finding the right opacity table and colormap range. Here, it is recommended to set the colormap range to [0.01,0.05]
- It is recommended to switch off the field lines (« tube »), or reduce the number of seeds to make a cleaner representation