

# Blender Workshop Nov. 15, 2023

Jack Draney

# After today you should

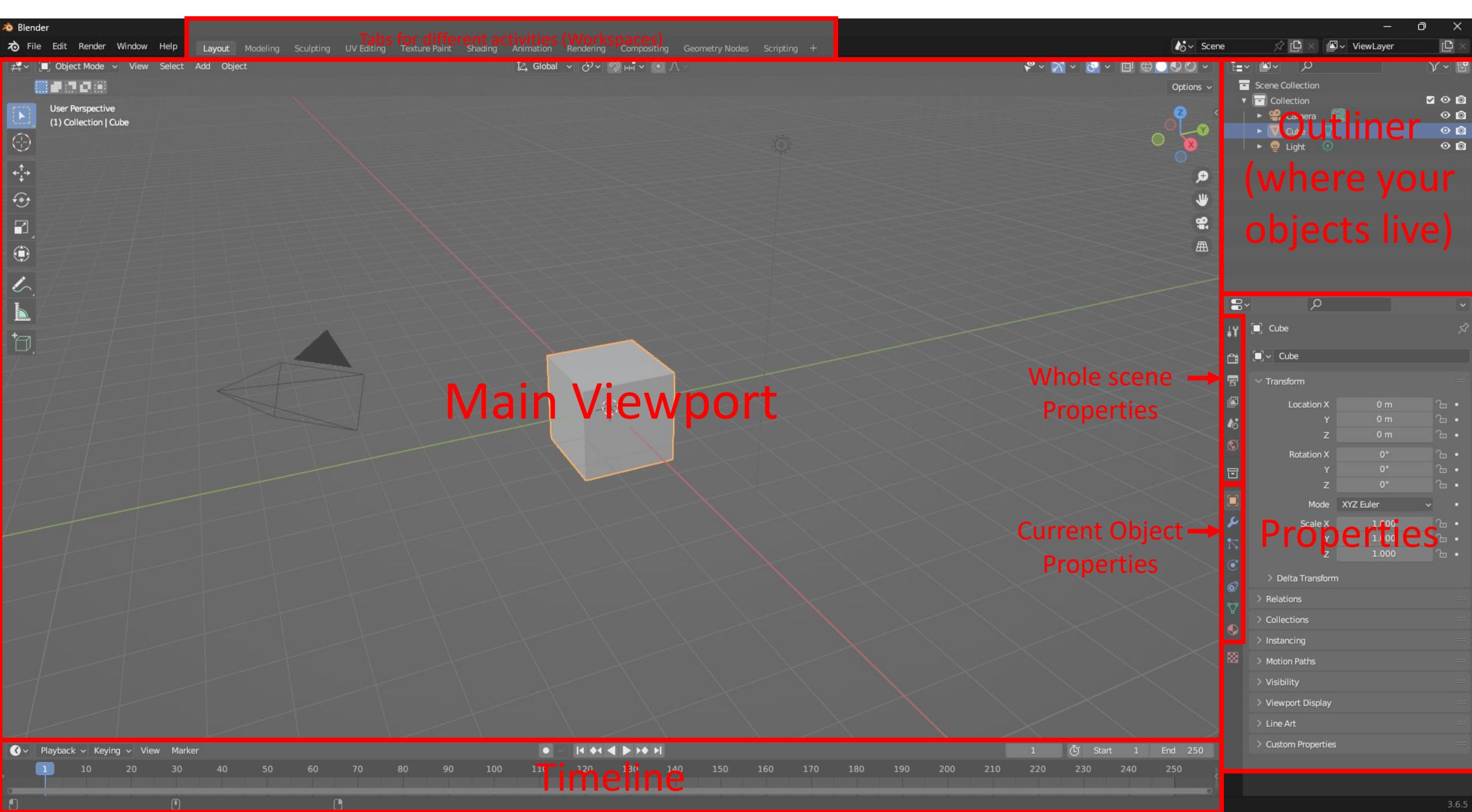
- Know how to:
  - Use my script to import trajectory data into blender (edit, register, console, etc.)
  - Make minor changes to geometry and shader node trees
  - Set up basic camera and lighting
  - Toy with rendering settings
  - Compile your render into a video
- Be aware you can:
  - Change camera to orthographic view
  - Import node trees, etc. from other blender files
  - Use more creative shader settings
  - Add effects, text, etc. to rendered videos
  - Animate camera movements, etc. with keyframes
  - Use Molecular Nodes to render very pretty biomolecules
  - Render from the command line (someone should figure out how to render on the cluster...)
  - Optimize the current setup by removing realize instances

# Agenda

- Very Basic things in Blender
- How to use my scripts
- How to set up camera and lighting
- How to set up rendering
- How to output your renders and sequence them into a video file
- Some notes, more resources , and future work

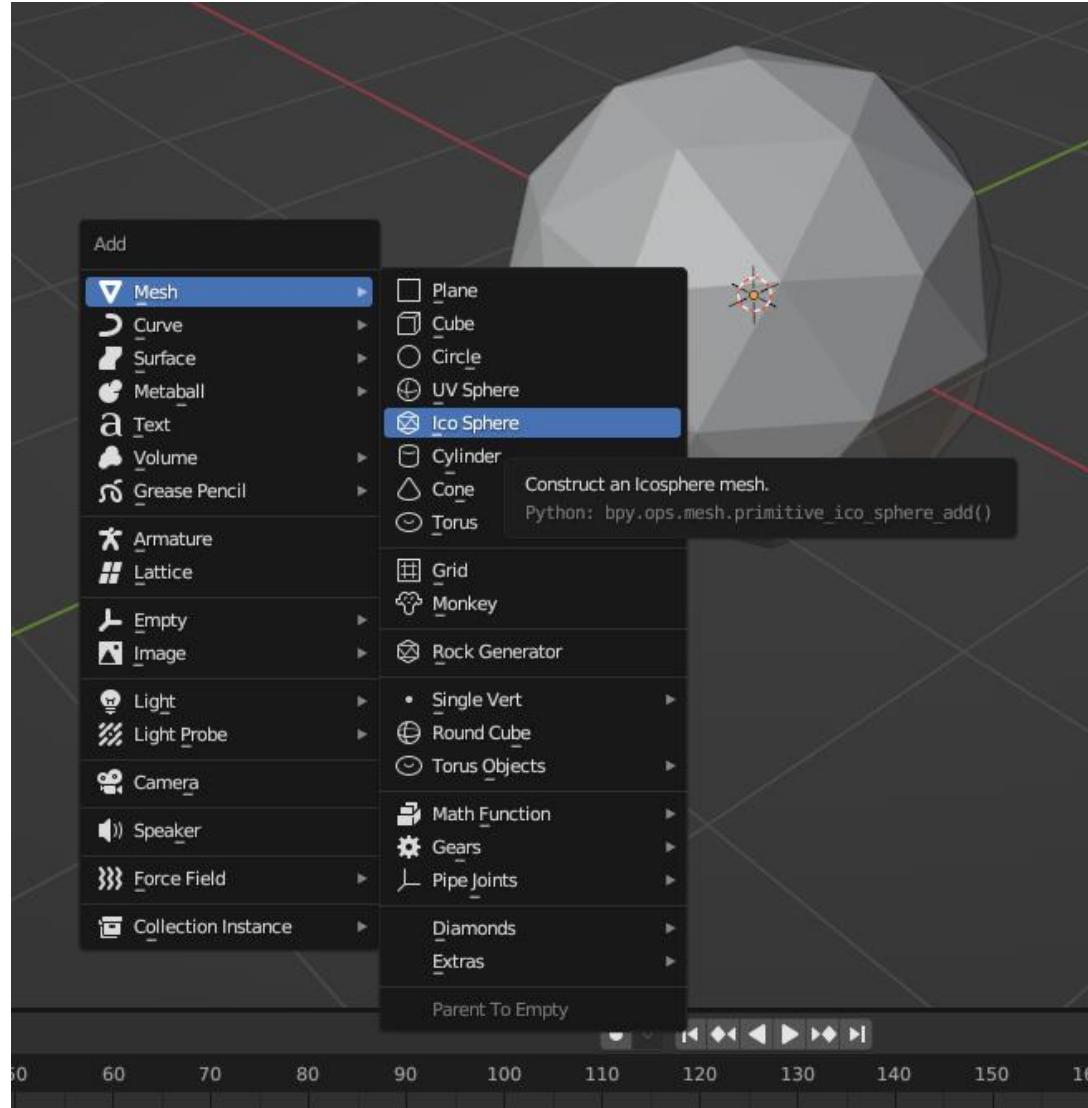
# Molecular Nodes

- Brady Johnston made this wonderful package that might do what you want already.
- VERY nice stuff with Biomolecules especially
- <https://bradyajohnston.github.io/MolecularNodes/>
- His twitter always has good examples too:
  - [1](#)
  - [2](#)
  - [3](#)
  - [4](#)

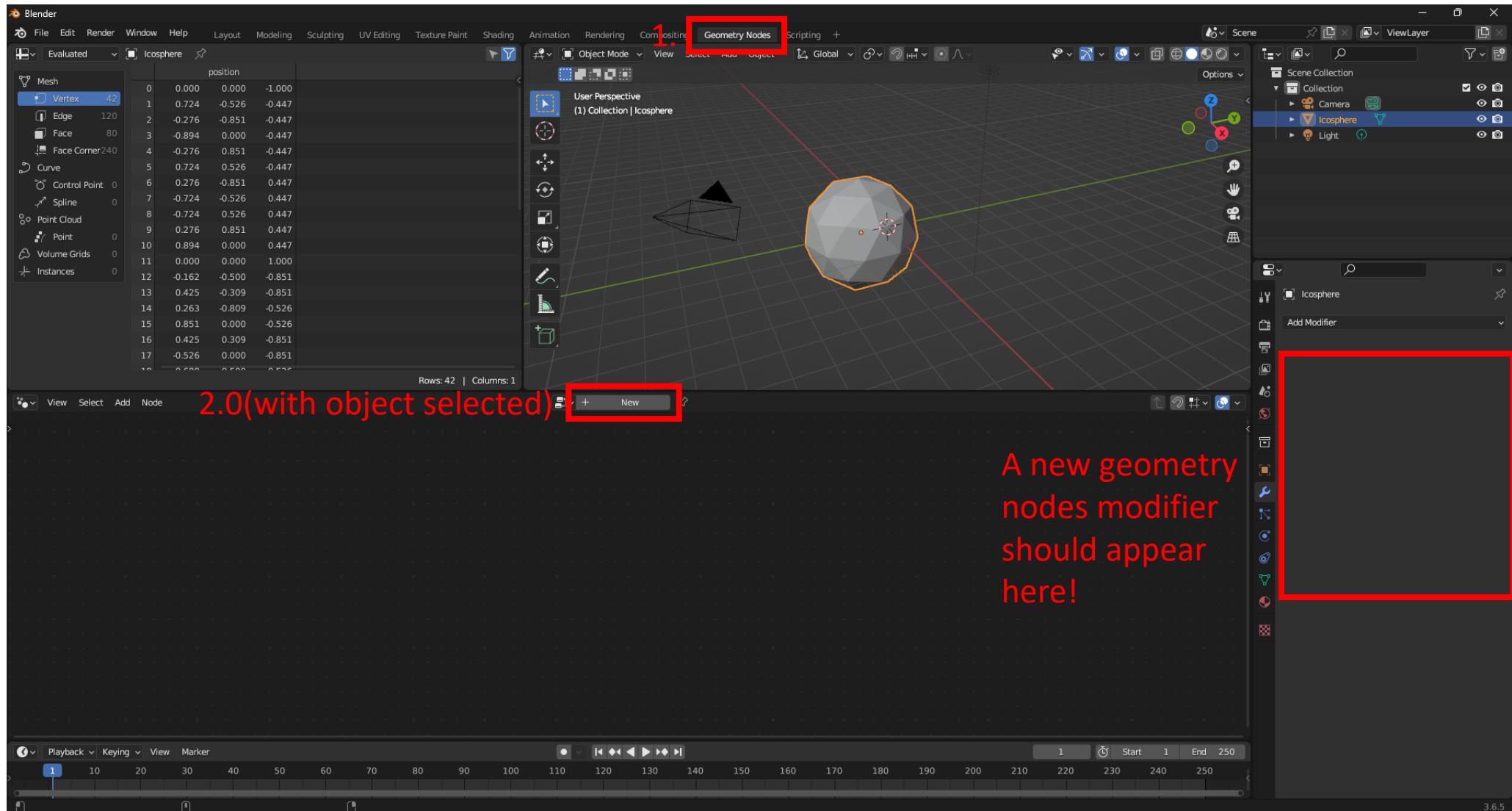


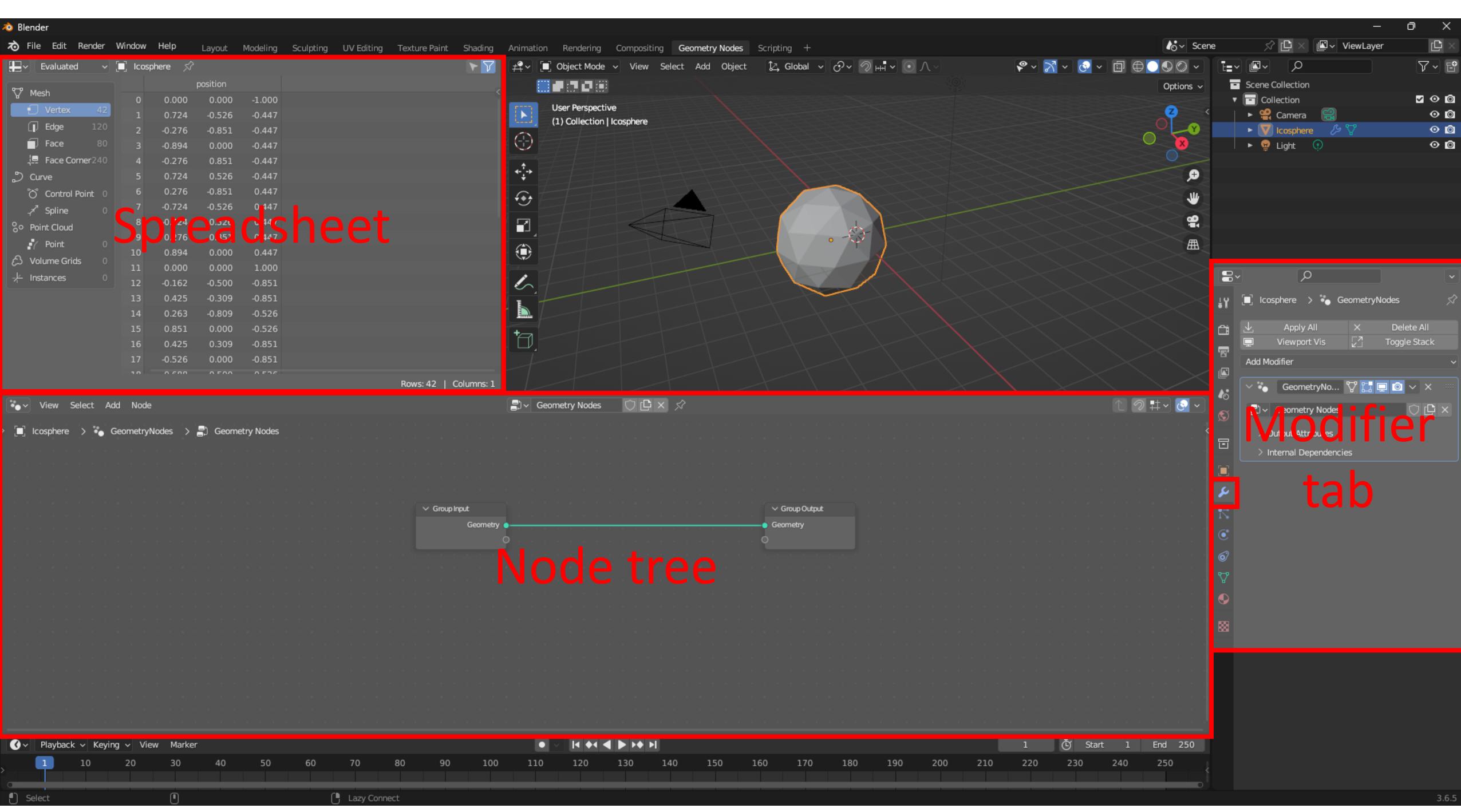
# Basics:

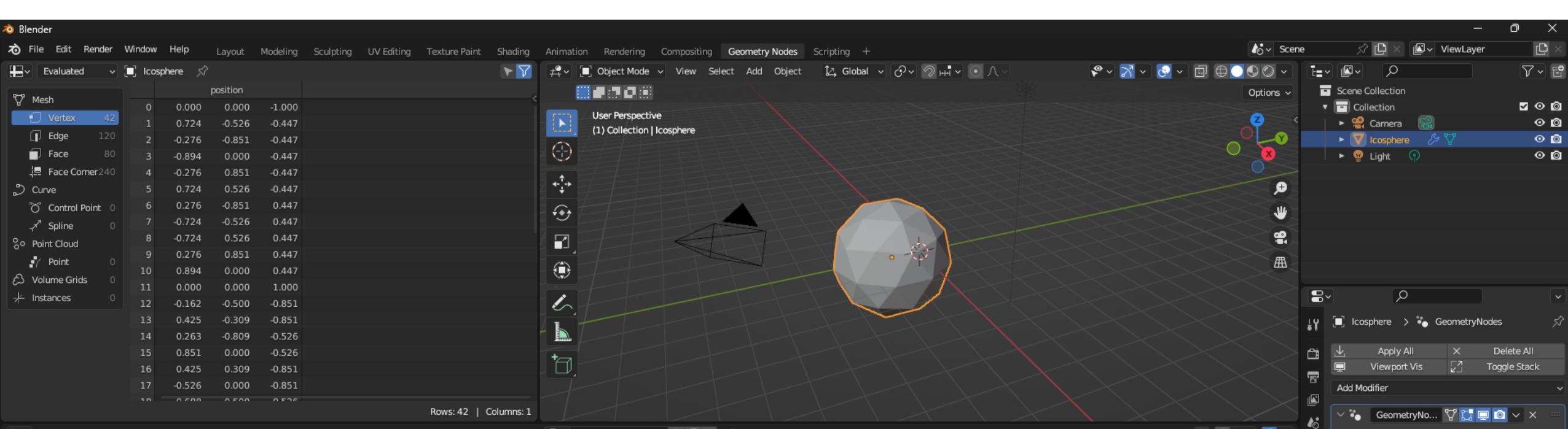
- Start by deleting the default cube by clicking on it and hitting x or delete
- Then add a new mesh
  - **Shift+A** → note what's available here → Mesh → pick one (recommend ico sphere)
- Move the new object in the y direction:
  - With the object selected, press **g**, then **y**, and move your mouse
- Scale the new object by 2
  - With the object selected, press **s**, then **2**, then enter
- Look around by clicking and dragging with middle mouse button, or shift+middle mouse button (on trackpad, same but with 2 fingers)
- Center your object again by using **n** to open the extra menus, clicking the item tab, and setting x,y,z to 0



# Geometry nodes basics



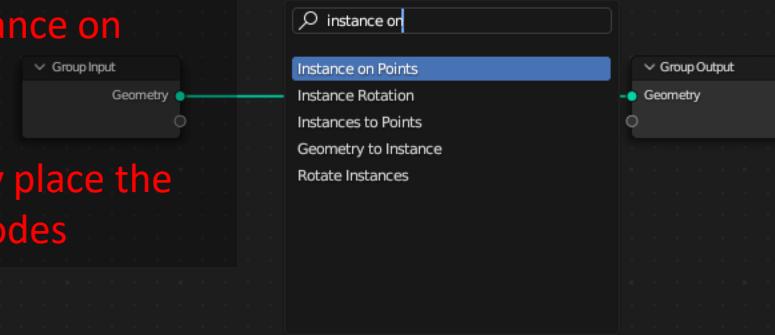




View Select Add Node

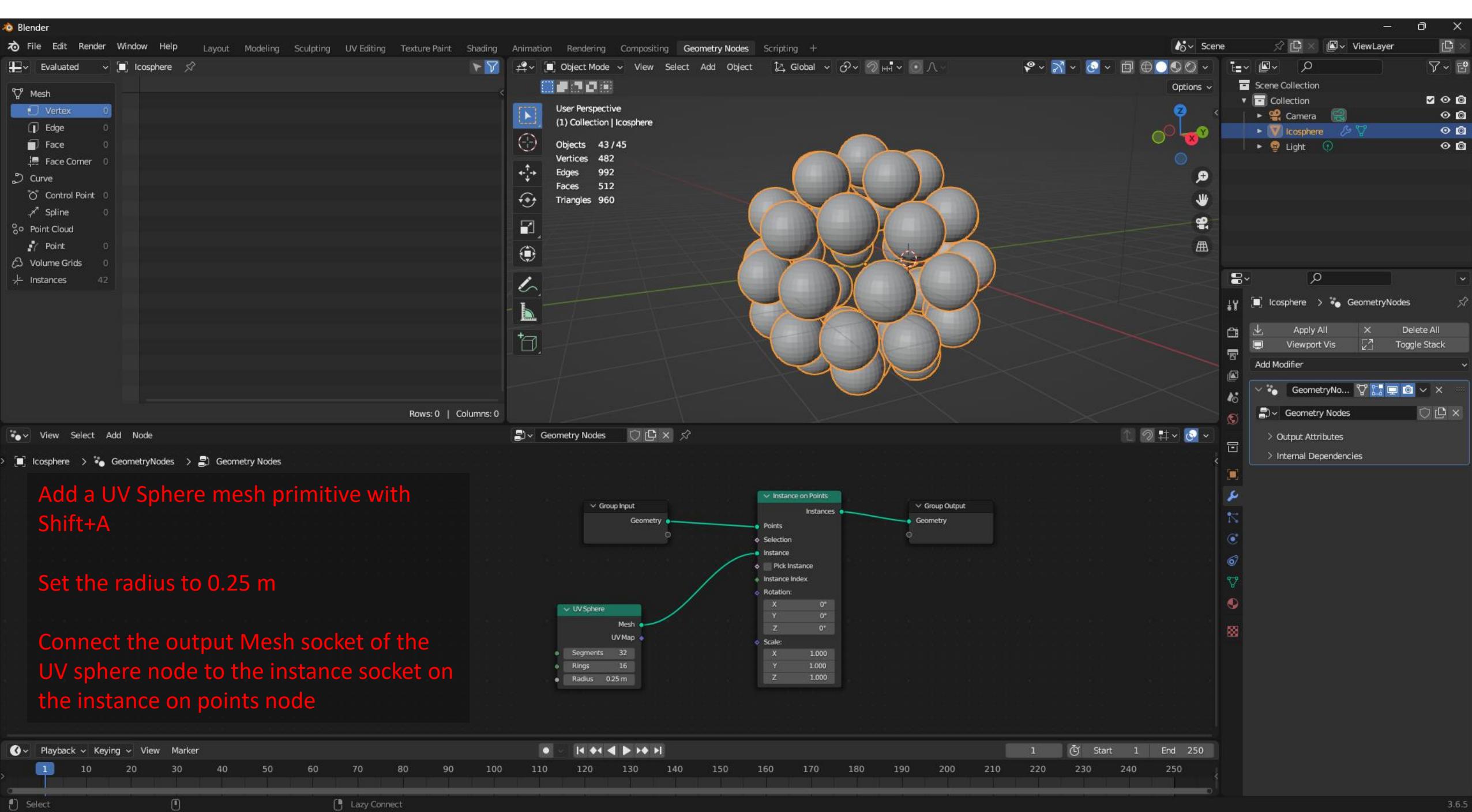
Icosphere > GeometryNodes > Geometry Nodes

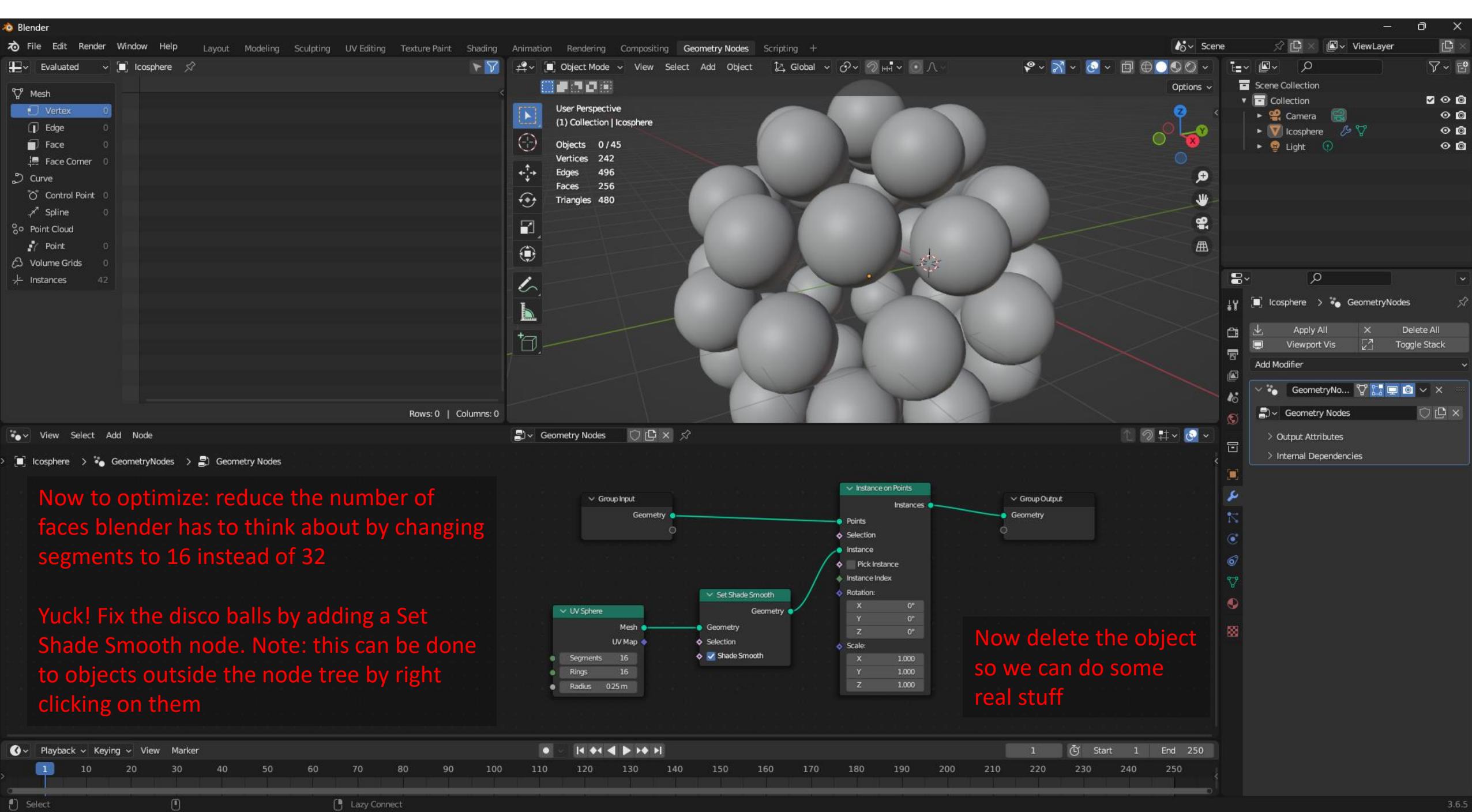
Shift+A, then s to search, and find instance on points node.



Click on the green line to automatically place the node between the input and output nodes

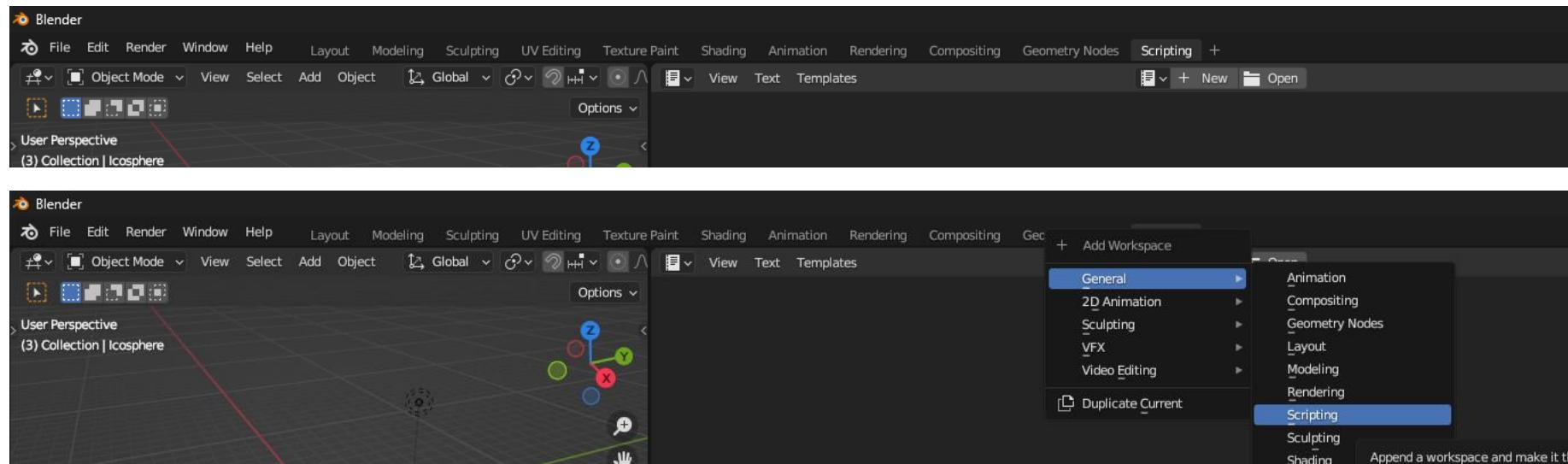
Playback Keying View Marker  
1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250  
1 Start 1 End 250  
Select Lazy Connect





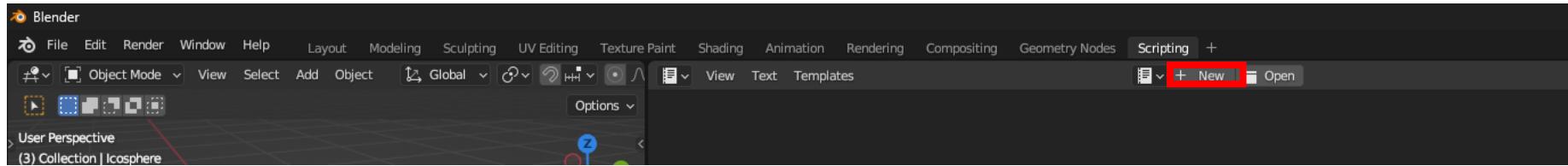
# Setting up for scripting:

- Edit → Preferences
- Interface → Display: Python Tooltips
- Editing → Text Editor: Auto Close Character Pairs (if u want)
- Add the scripting workspace if it isn't there, but I think it should be:



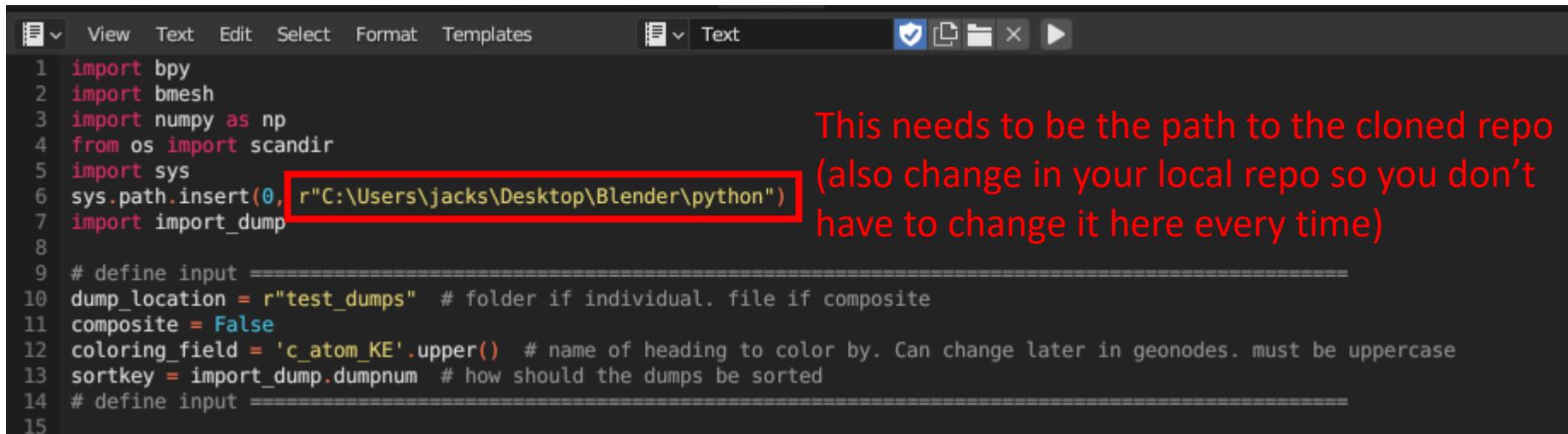
# Setting up for scripting:

- Click New



- Paste the “make\_frames\_atoms.py” script into the text box below (or “make\_frames\_bonds.py” if you have made both atom and bond dumps (you only need make\_frames\_bonds, not both. I just named them in a dumb way).

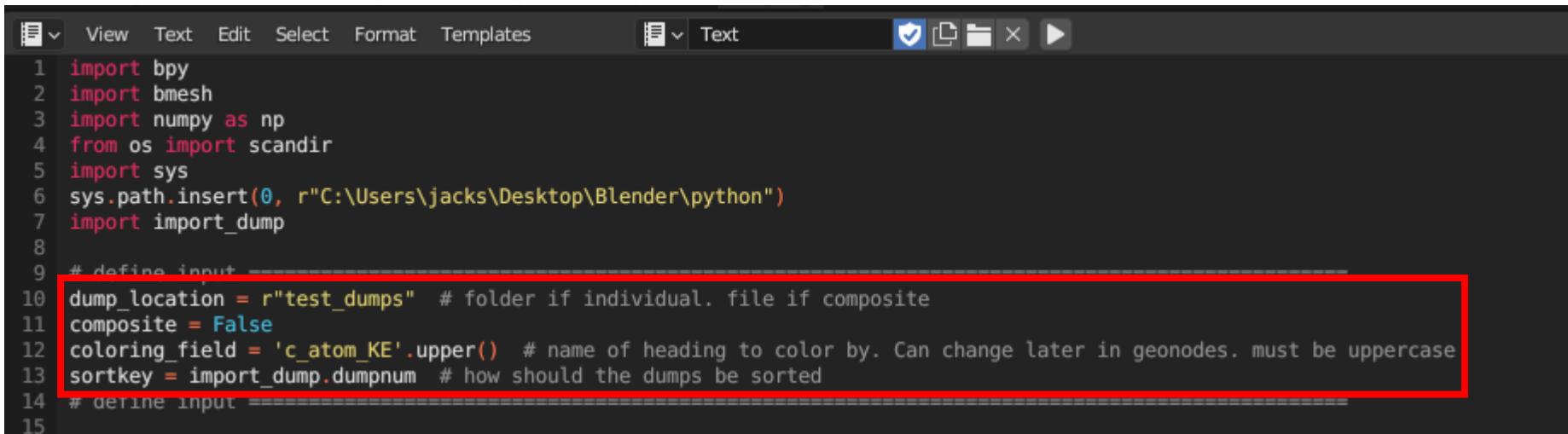
# Setting up the script:



```
1 import bpy
2 import bmesh
3 import numpy as np
4 from os import scandir
5 import sys
6 sys.path.insert(0, r"C:\Users\jacks\Desktop\Blender\python")
7 import import_dump
8
9 # define input =====
10 dump_location = r"test.dumps" # folder if individual. file if composite
11 composite = False
12 coloring_field = 'c_atom_KE'.upper() # name of heading to color by. Can change later in geonodes. must be uppercase
13 sortkey = import_dump.dumpnum # how should the dumps be sorted
14 # define input =====
15
```

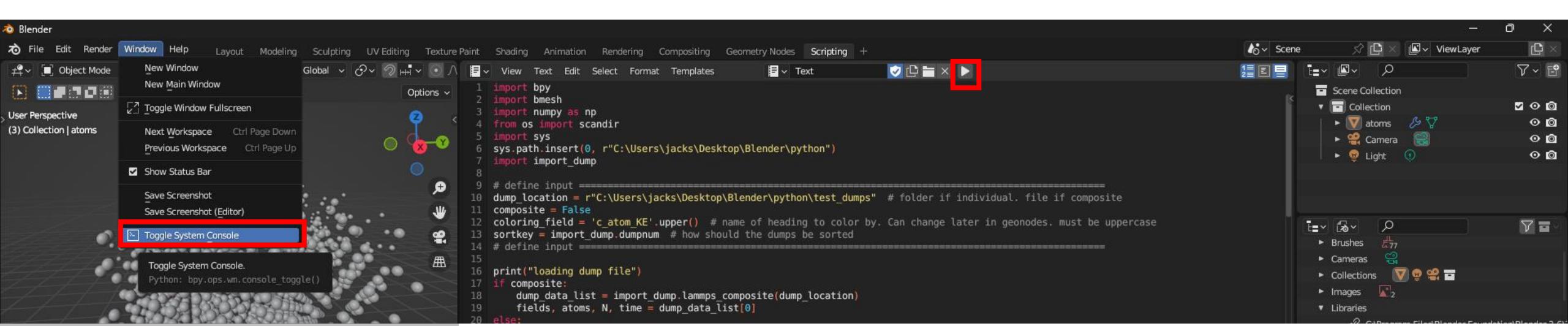
This needs to be the path to the cloned repo  
(also change in your local repo so you don't  
have to change it here every time)

# Setting up the script:



```
1 import bpy
2 import bmesh
3 import numpy as np
4 from os import scandir
5 import sys
6 sys.path.insert(0, r"C:\Users\jacks\Desktop\Blender\python")
7 import import_dump
8
9 # define input -
10 dump_location = r"test.dumps" # folder if individual. file if composite
11 composite = False
12 coloring_field = 'c_atom_KE'.upper() # name of heading to color by. Can change later in geonodes. must be uppercase
13 sortkey = import_dump.dumpnum # how should the dumps be sorted
14 # define input -
15
```

- `dump\_location` is the location of the dump file(s)
- `composite` is whether it's one large dump file or if it's a bunch of little ones
- `coloring\_field` is the name of the column which contains the values you want to color your atoms by. It must be in upper case (hence `upper()`)
- `sortkey` is the function whose return you want to sort the filenames by (if you aren't using a composite dump file)



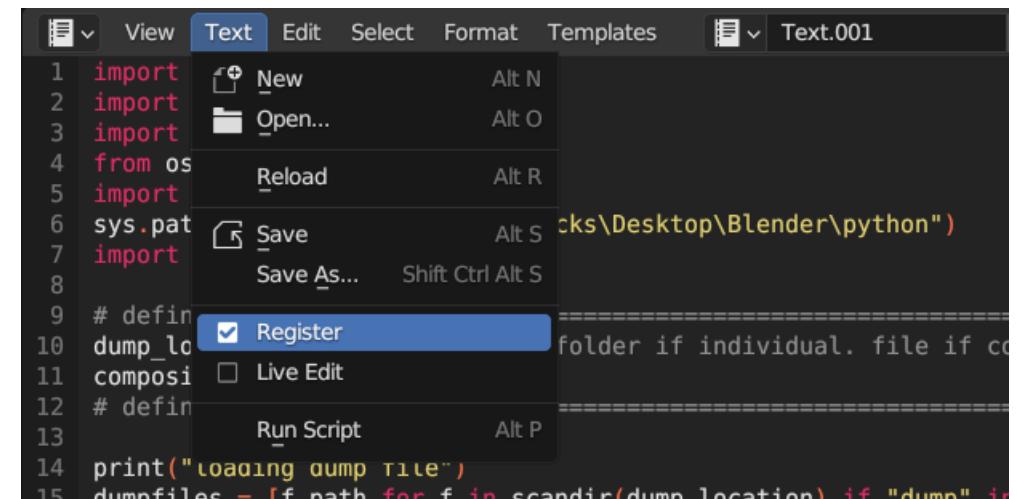
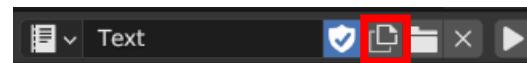
You can turn on the system console from the Window tab to see error messages and other output

## The script:

1. Loads info about your dump files (automatically reads in available fields)
2. Creates atom (and bond) objects
3. Creates geometry node trees and shader node trees and assigns them appropriately
4. Creates a handler function which updates the data every frame

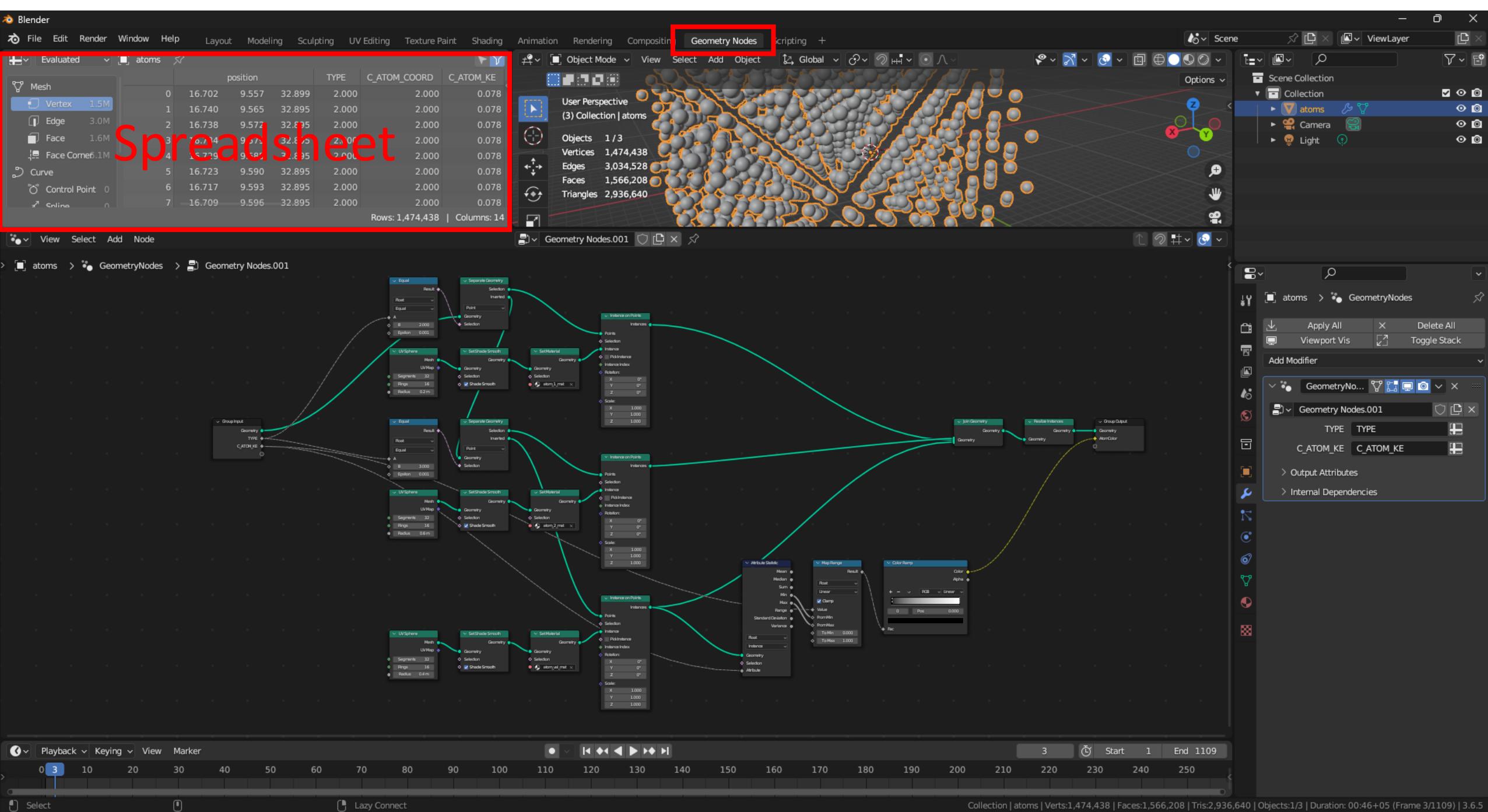
# Aside: Restart.py Scripts

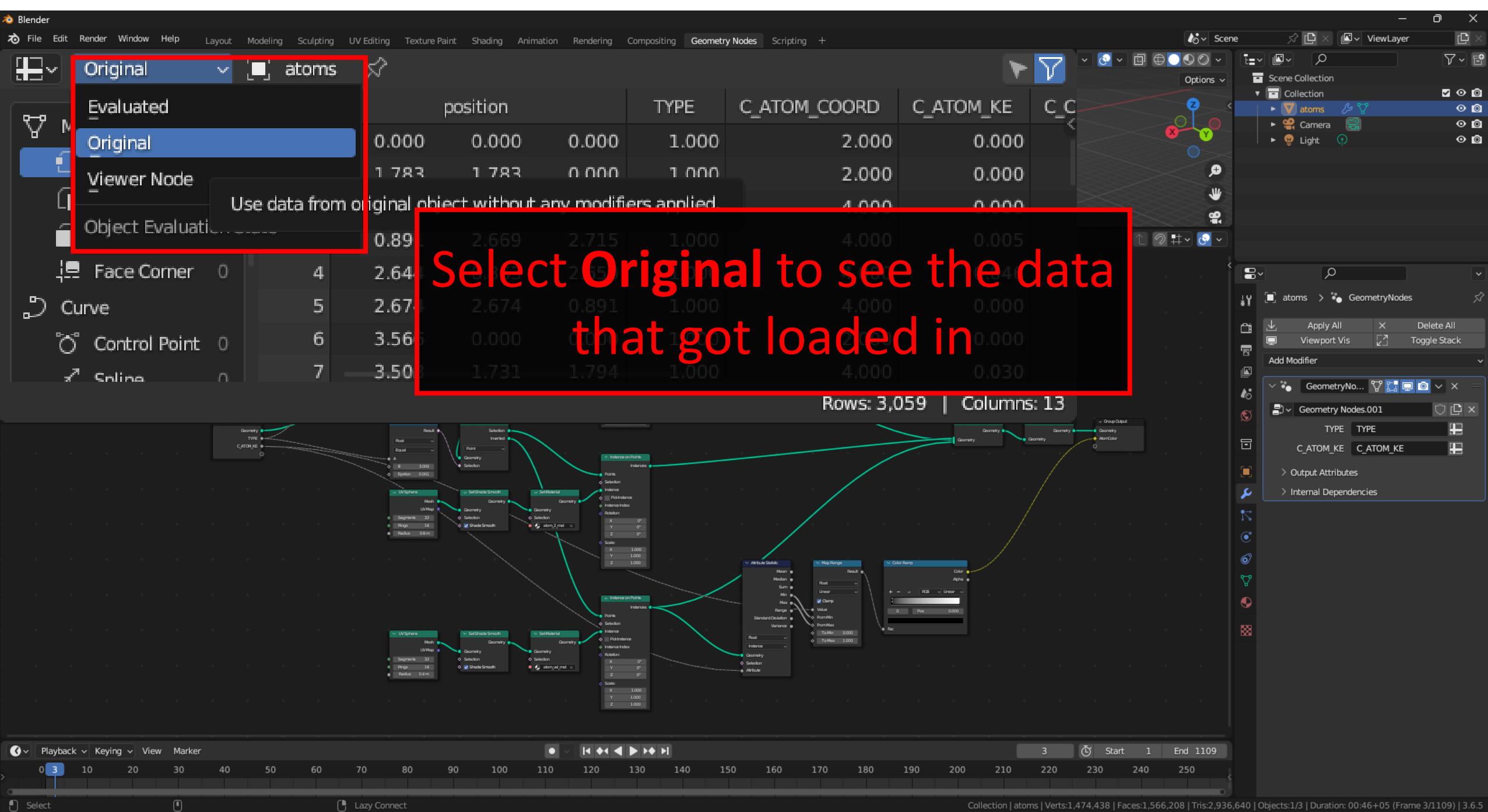
- Create a new text file
- Paste in restart.py (or restart\_bonds.py)
- Make the same edits as above
- Select `Text > Register` to allow this script to run whenever you load this file. The script re-adds the pre-frame handler. Without it, the mesh won't update automatically
- Running this script also re-scans the dump folder and sets the frame range to start at 1 and end on the last frame of the dump automatically

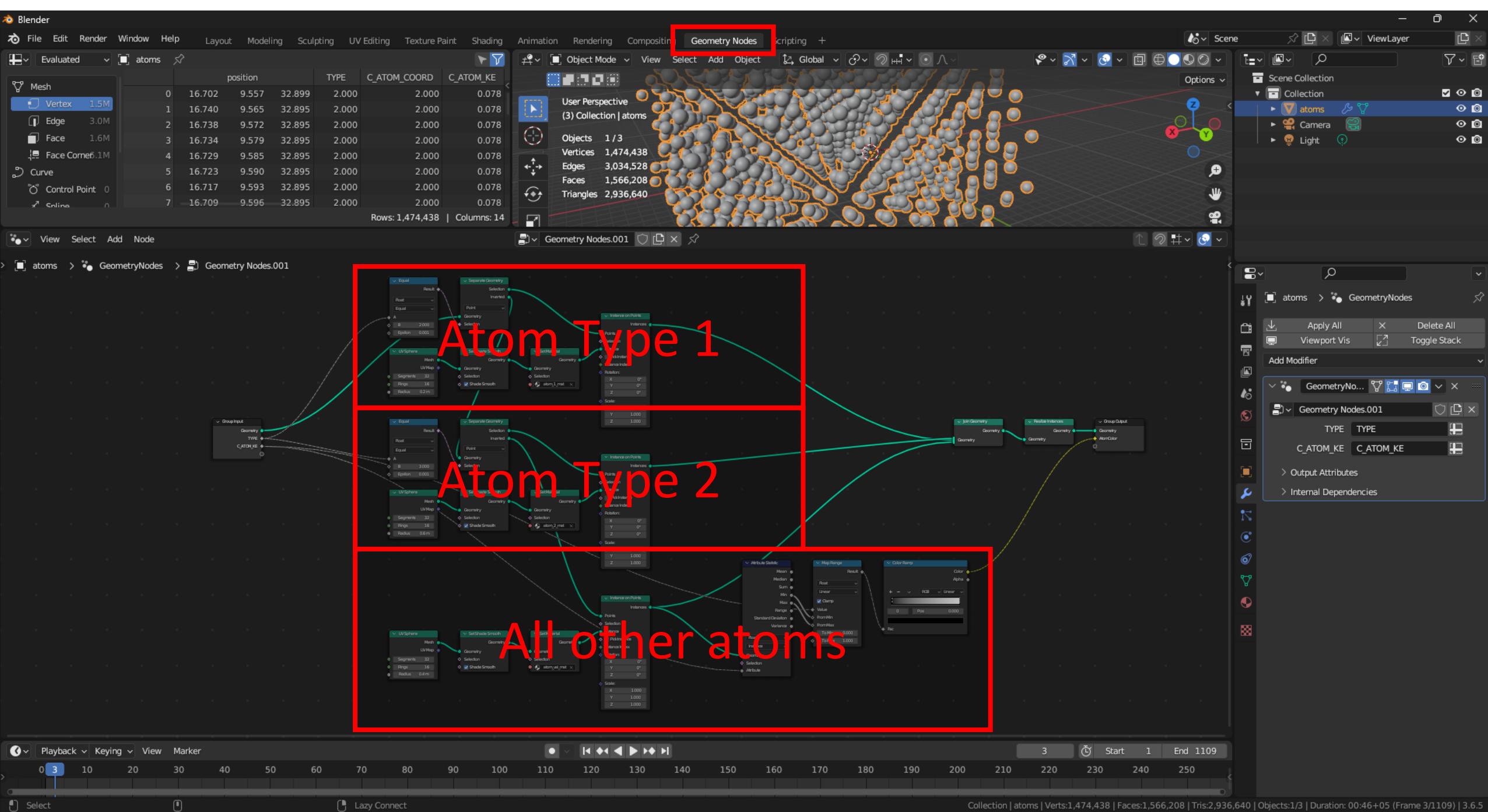


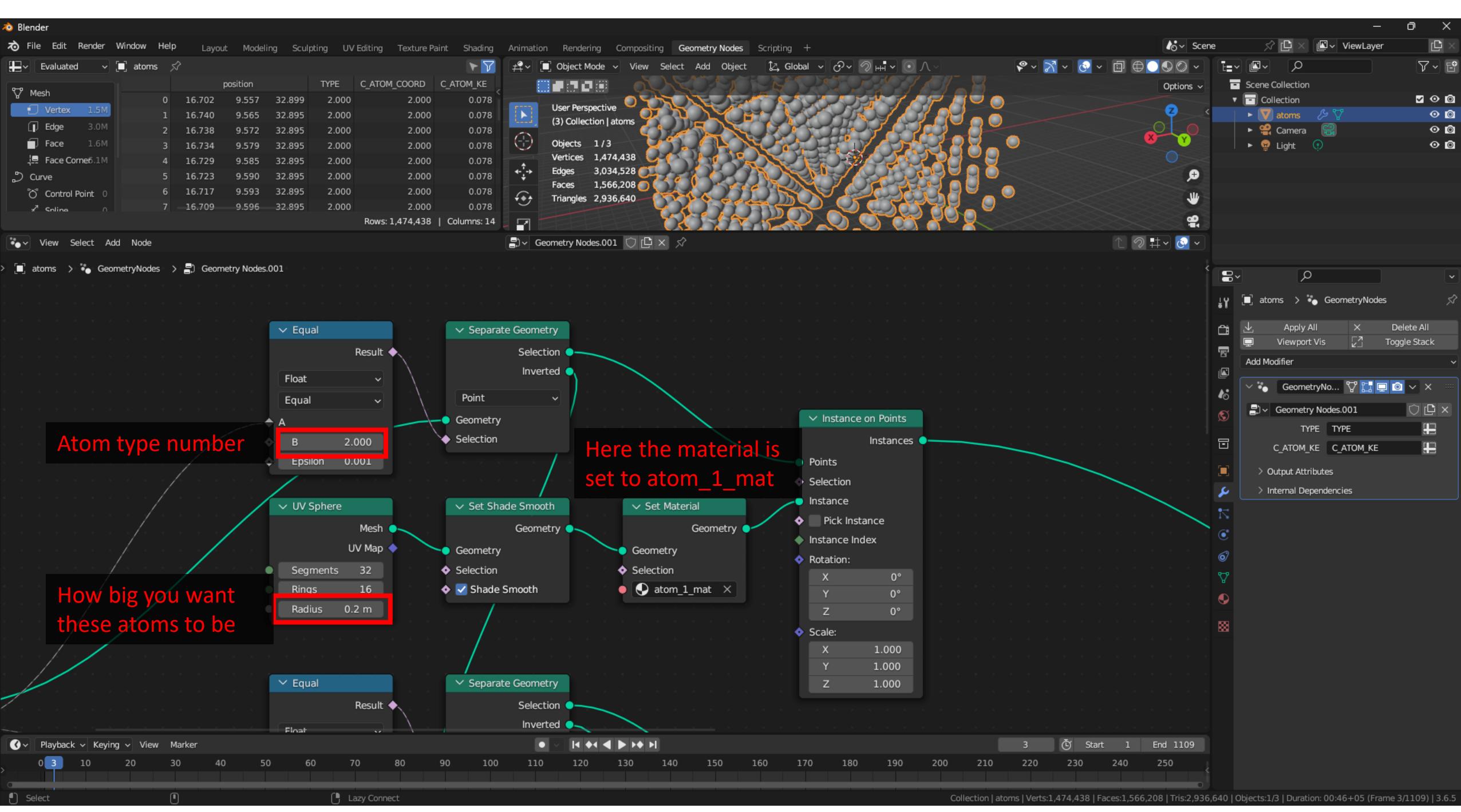
# Aside: Script details and side effects

- Frame handler updates mesh data based on the name of the object (e.g. ‘atoms’) so if you add a second mesh, it won’t work unless you do a little hacking. You can re-use the geometry nodes on multiple objects (if you want them to be the same) so really you just have to create a new object and update the restart.py code to update both objects
- Restart.py clears the existing pre-frame handlers, so it may mess with other add-ons if they have one of those. It’s rare.

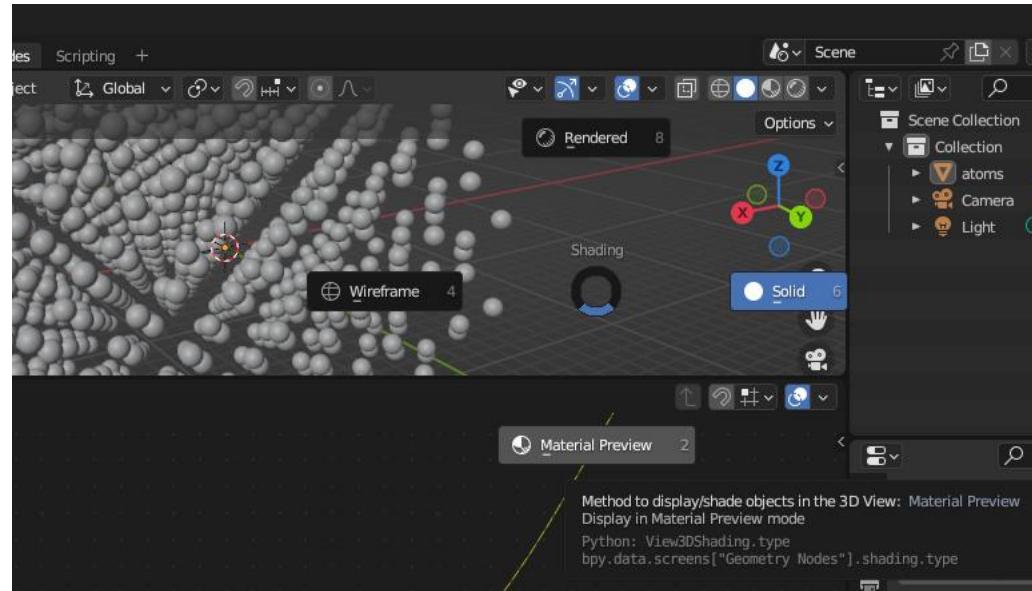








- Up until now we've been using “solid” view
- To change this, click on the viewport and press ‘z’ to open up the shading wheel. For now, move your mouse down or press 2 to select Material Preview
- You'll notice the atoms are (or should be) grayscale based on the field you chose



Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Geometry Nodes Scripting +

Original atoms

Mesh

	position	TYPE	C_ATOM_COORD	C_ATOM_KE	C_C
Vertex	0 0.000 0.000 0.000	1.000	2.000	0.000	
Edge	1 1.783 1.783 0.000	1.000	2.000	0.000	
Face	2 0.891 0.891 0.891	1.000	4.000	0.000	
Face Corner	3 0.891 2.669 2.715	1.000	4.000	0.005	
Curve	4 2.644 0.863 2.650	1.000	4.000	0.046	
Control Point	5 2.674 2.674 0.891	1.000	4.000	0.000	
Outline	6 3.566 0.000 0.000	1.000	2.000	0.000	
	7 3.503 1.731 1.794	1.000	4.000	0.030	

Rows: 3,059 | Columns: 13

User Perspective  
(3) Collection | atoms

Objects 0 / 3  
Vertices 1,474,438  
Edges 3,034,528  
Faces 1,566,208  
Triangles 2,936,640

View Select Add Node

atoms > GeometryNodes > Geometry Nodes.001

Attribute Statistic

- Mean
- Median
- Sum
- Min
- Max
- Range
- Standard Deviation
- Variance

Float Instance

Geometry Selection Attribute

Map Range

Result

- Float
- Linear
- Clamp

Value

From Min

From Max

To Min 0.000

To Max 1.000

Color Ramp

Color Alpha

RGB Linear

+ - Value

0 Pos 0.000

Fac

Make changes to the color ramp node to make the colors different. Add color stops and change their colors to see changes

Attribute Statistic and Map Range work together to map the selected attribute to 0-1 for the color ramp.

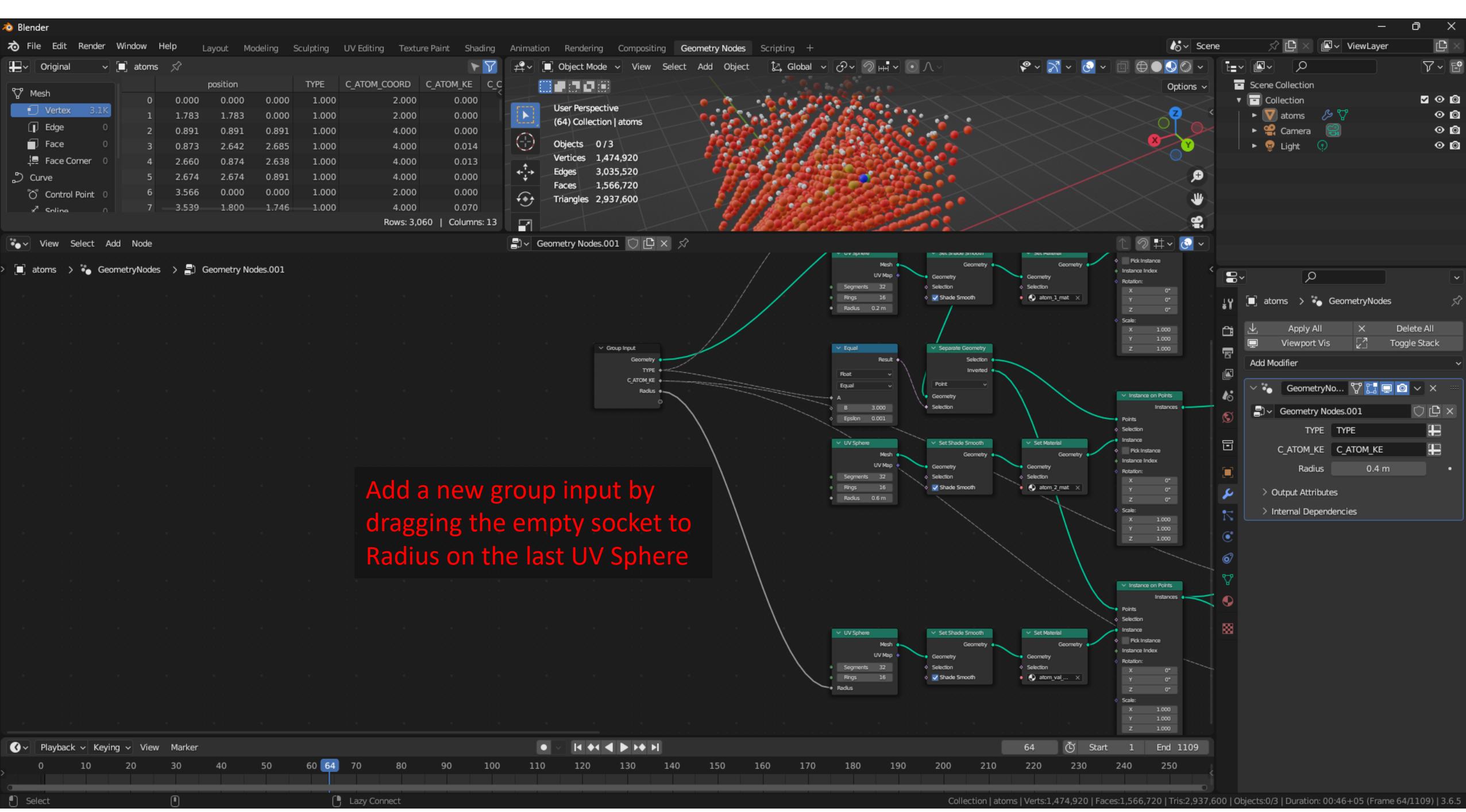
I usually disconnect the attribute statistic node and set the min and max of map range myself so 1) it doesn't change frame to frame and 2) I have more control

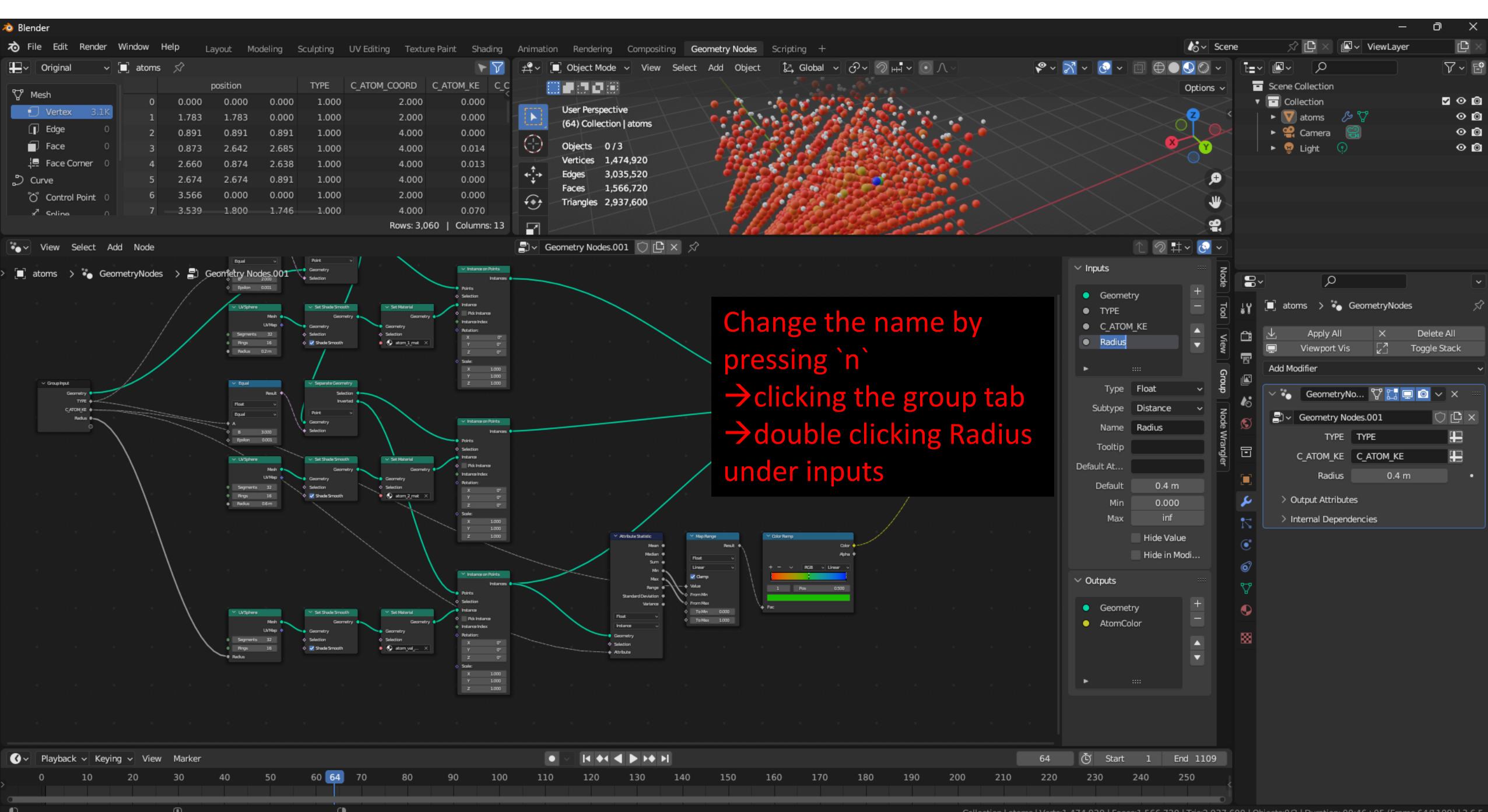
Playback Keying View Marker

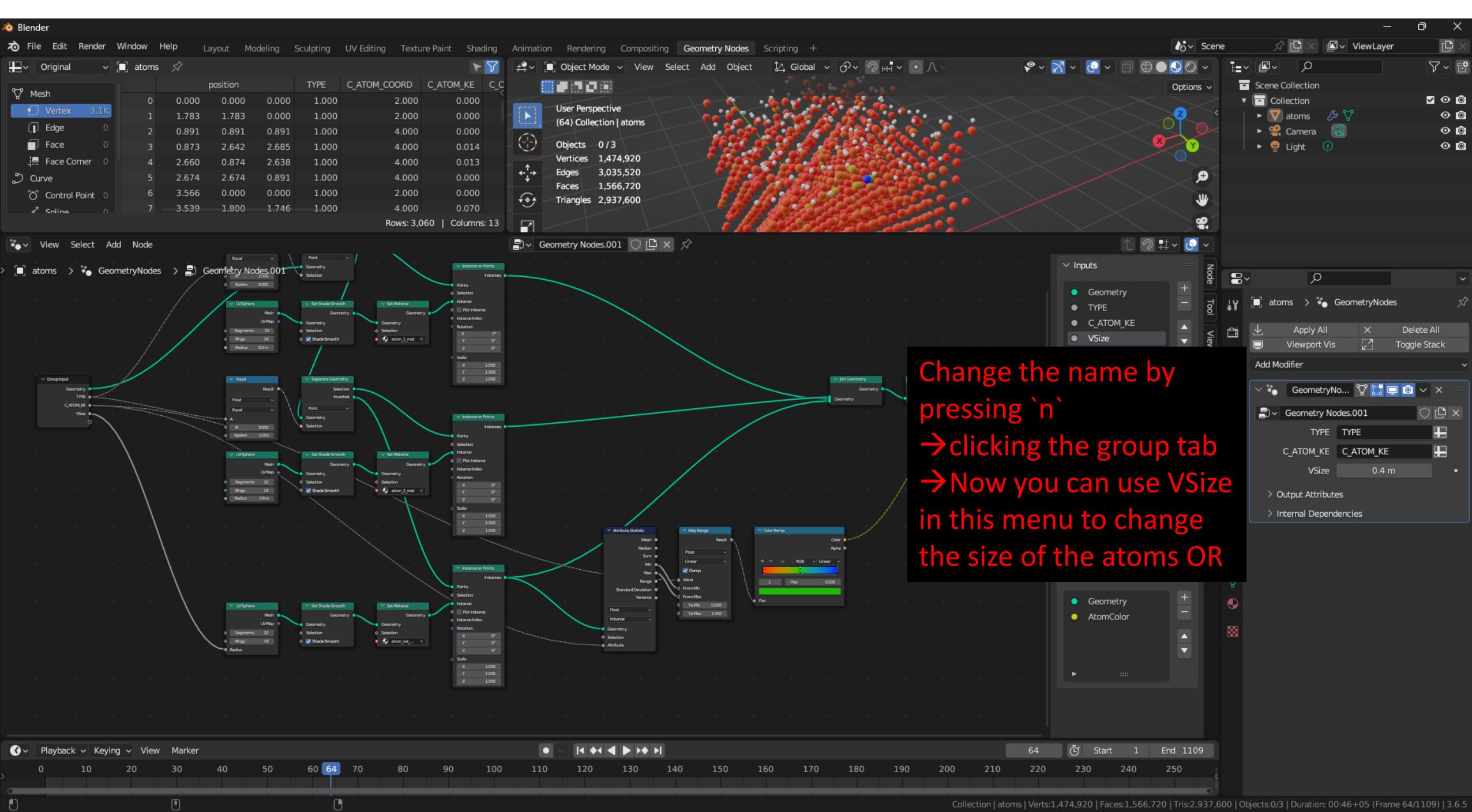
0 3 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Start 1 End 1109

Collection | atoms | Verts:1,474,438 | Faces:1,566,208 | Tris:2,936,640 | Objects:0/3 | Duration: 00:46+05 (Frame 3/1109) | 3.6.5







Change the name by  
pressing `n`  
→ clicking the group tab  
→ Now you can use VSize  
in this menu to change  
the size of the atoms OR

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Geometry Nodes Scripting +

Scene ViewLayer

Original atoms

	position	TYPE	C_ATOM_COORD	C_ATOM_KE	C_C
Vertex	0 0.000 0.000 0.000	1.000	2.000	0.000	
Edge	1 1.783 1.783 0.000 1.000	1.000	2.000	0.000	
Face	2 0.891 0.891 0.891 1.000	1.000	4.000	0.000	
Face Corner	3 0.873 2.642 2.685 1.000	1.000	4.000	0.014	
Curve	4 2.660 0.874 2.638 1.000	1.000	4.000	0.013	
Control Point	5 2.674 2.674 0.891 1.000	1.000	4.000	0.000	
Curve	6 3.566 0.000 0.000 1.000	1.000	2.000	0.000	
Curve	7 3.539 1.800 1.746 1.000	1.000	4.000	0.070	

Rows: 3,060 | Columns: 13

User Perspective  
(64) Collection | atoms  
Objects 0 / 3  
Vertices 1,474,920  
Edges 3,035,520  
Faces 1,566,720  
Triangles 2,937,600

View Select Add Node

atoms > GeometryNodes > Geometry Nodes.001

Group Input  
Geometry  
TYPE  
C\_ATOM\_KE  
VSize

Equal  
Result: Float Equal A: 3.000 B: 3.000 Epsilon: 0.001

Separate Geometry  
Selection: Inverted Point: Geometry Selection

UV Sphere  
Segments: 32 Rings: 16 Radius: 0.6 m

Set Shade Smooth  
Geometry Selection Shade Smooth

Set Material  
Geometry Selection atom\_2\_mat

Instance on Points  
Instances: Points Selection Instance Pick Instance Instance Index Rotation: X: 1.000 Y: 1.000 Z: 1.000 Scale: X: 1.000 Y: 1.000 Z: 1.000

UV Sphere  
Segments: 32 Rings: 16 Radius: 0.4 m

Set Shade Smooth  
Geometry Selection Shade Smooth

Set Material  
Geometry Selection atom\_val\_mat

Combine XYZ  
Vector: X: 0 Y: 0 Z: 0

Instance on Points  
Instances: Points Selection Instance Pick Instance Instance Index Rotation: X: 0 Y: 0 Z: 0 Scale: X: 0 Y: 0 Z: 0

Inputs  
Geometry  
TYPE  
C\_ATOM\_KE  
VSize

Type: Float Subtype: Distance Name: VSize Tooltip: Default At... Default: 0.4 m Min: 0.000 Max: inf Hide Value Hide in Mod... Outputs  
Geometry  
AtomColor

Apply All Viewport Vis Toggle Stack

Add Modifier

GeometryNodes.001  
TYPE  
C\_ATOM\_KE  
VSize 0.4 m

Output Attributes Internal Dependencies

Click the Melee symbol to allow this to be an Attribute input

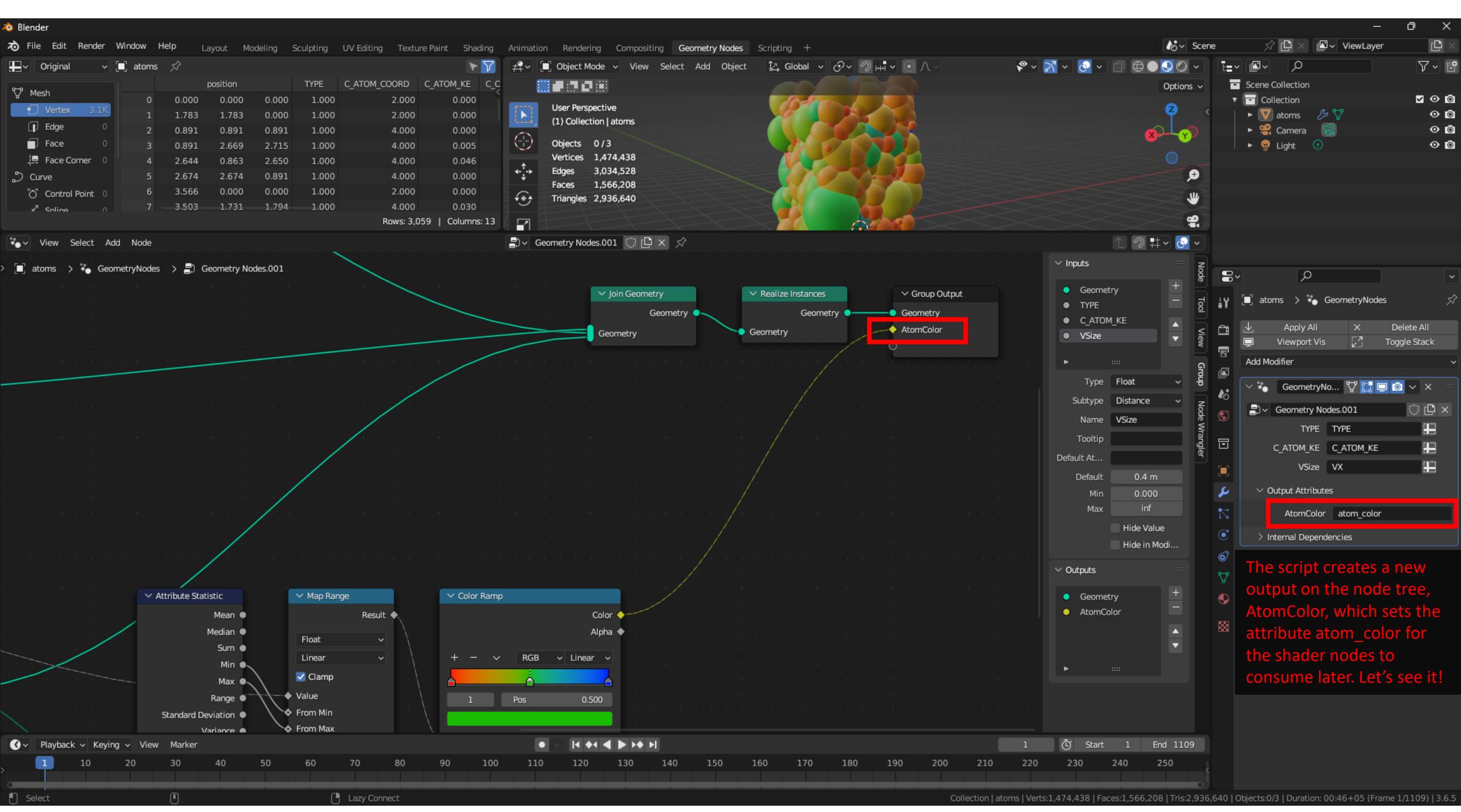
Choose an attribute by clicking the name. VX is fun I think.

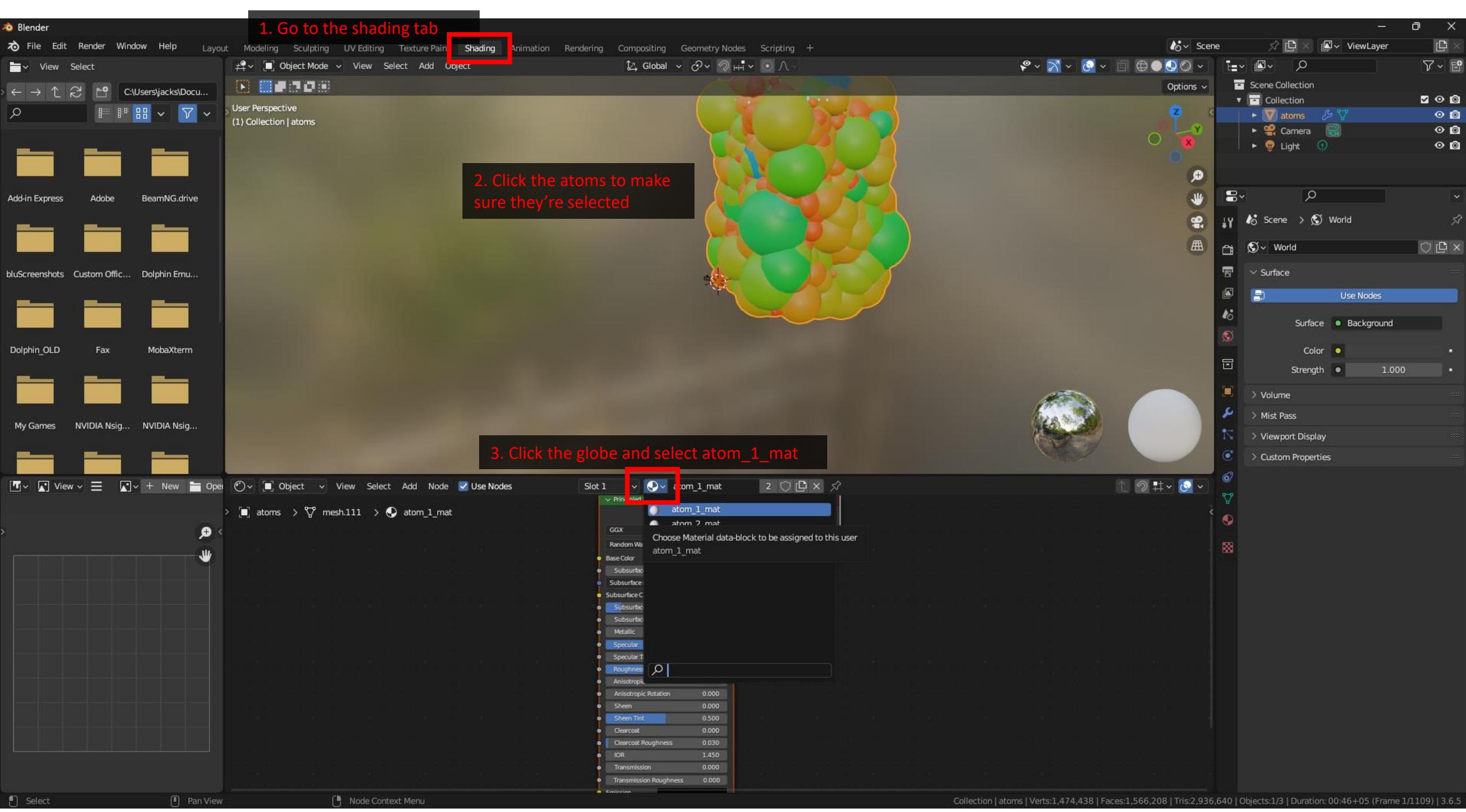
Playback Keying View Marker

64 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Start 1 End 1109

Collection | atoms | Verts:1,474,920 | Faces:1,566,720 | Tris:2,937,600 | Objects:0/3 | Duration: 00:46+05 (Frame 64/1109) | 3.65





Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Geometry Nodes Scripting +

View Select C:\Users\jacks\Docu... Options

User Perspective (1) Collection | atoms

Add-in Express Adobe BeamNG.drive bluScreenshots Custom Office... Dolphin Emu... Dolphin\_OLD Fax MobaXterm My Games NVIDIA Nsig... NVIDIA Nsig... View New Open Object View Select Add Node Use Nodes atoms > mesh.111 > atom\_1\_mat

Make the Base Color a nice pink or something!

Lots of settings you could change, like alpha (transparency), among other things. This shader was invented by disney to do incredibly complex things. Most values aren't useful to us, but you can play around!

(note, if you change alpha with eevee you'll probably have to change blend mode, which is in the options tab of the n menu here)

RGB HSV Hex  
Hue 0.927  
Saturation 0.733  
Value 0.800  
Alpha 1.000

Slot 1  
GGX  
Random Walk  
Base Color  
Subsurface 0.000  
Subsurface Radius  
Subsurface C...  
Subsurface IOR 1.400  
Subsurface Anisotropy 0.000  
Metallic 0.000  
Specular 0.500  
Specular Tint 0.000  
Roughness 0.500  
Anisotropic 0.000  
Anisotropic Rotation 0.000  
Sheen 0.000  
Sheen Tint 0.500  
Clearcoat 0.000  
Clearcoat Roughness 0.030  
IOR 1.400

Surface Volume Displacement

Do beware!

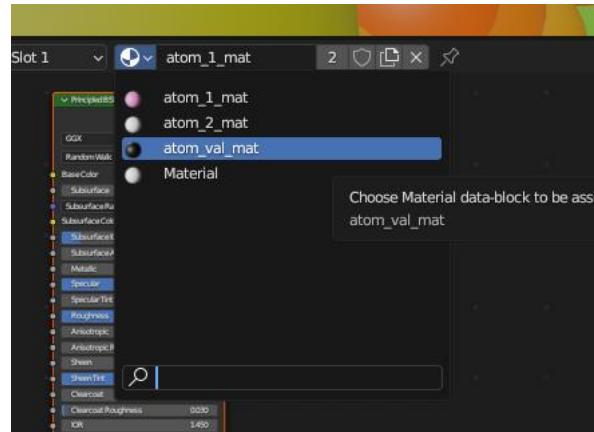
- 1) Transparency and translucence will make your renders take significantly longer
- 2) It's easy to waste time on these things. Glass atoms are cool, but they look a little over-the-top when you're just trying to convey info about your simulations. Clarity is more important!

That being said, this whole blender thing is an exercise of vanity, so have fun. I make my ions glow (proportional to their kinetic energy)

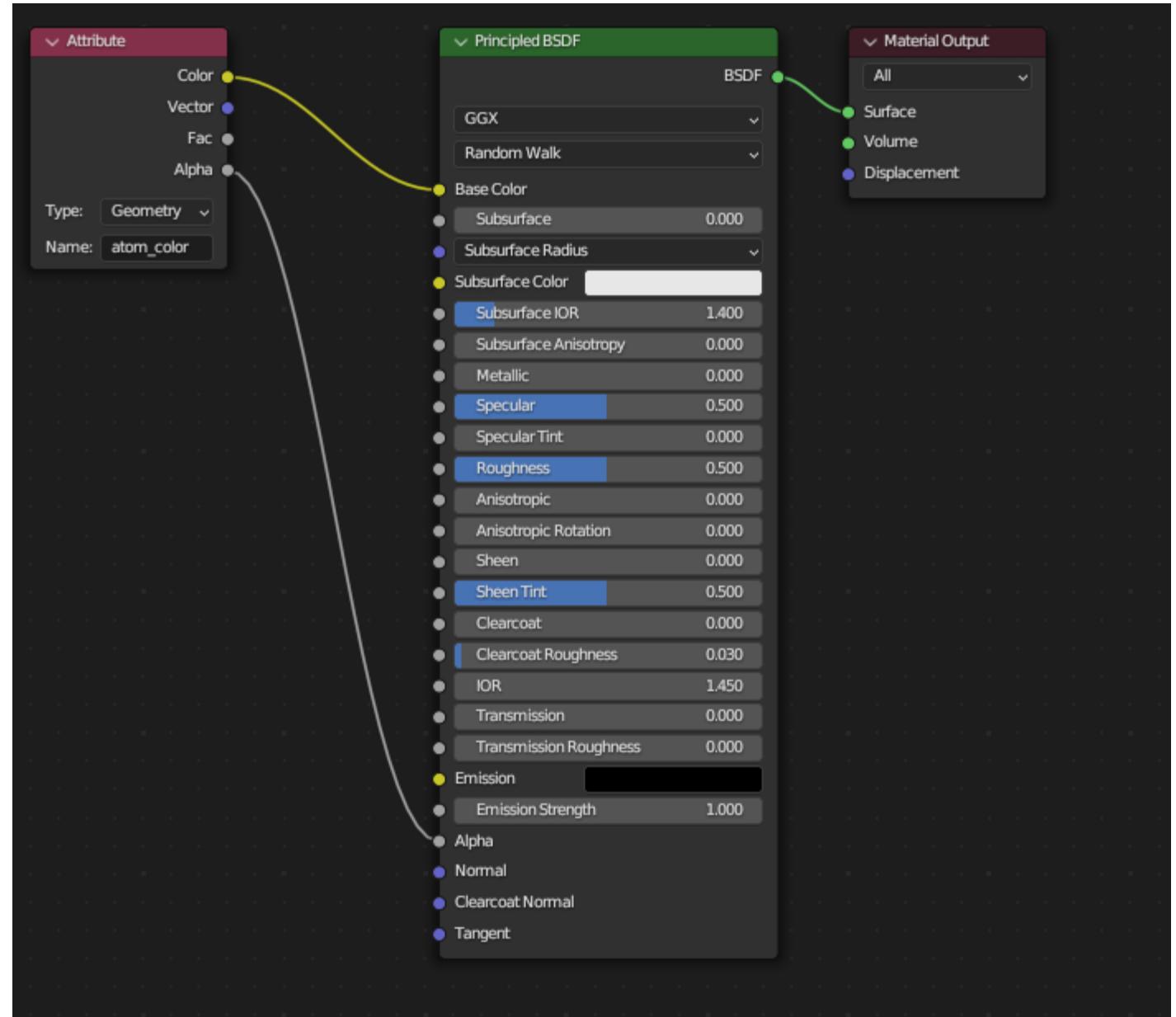
Scene Collection Collection atoms Camera Light

Scene World Surface Use Nodes Surface Background Color Strength 1.000 Volume Mist Pass Viewport Display Custom Properties

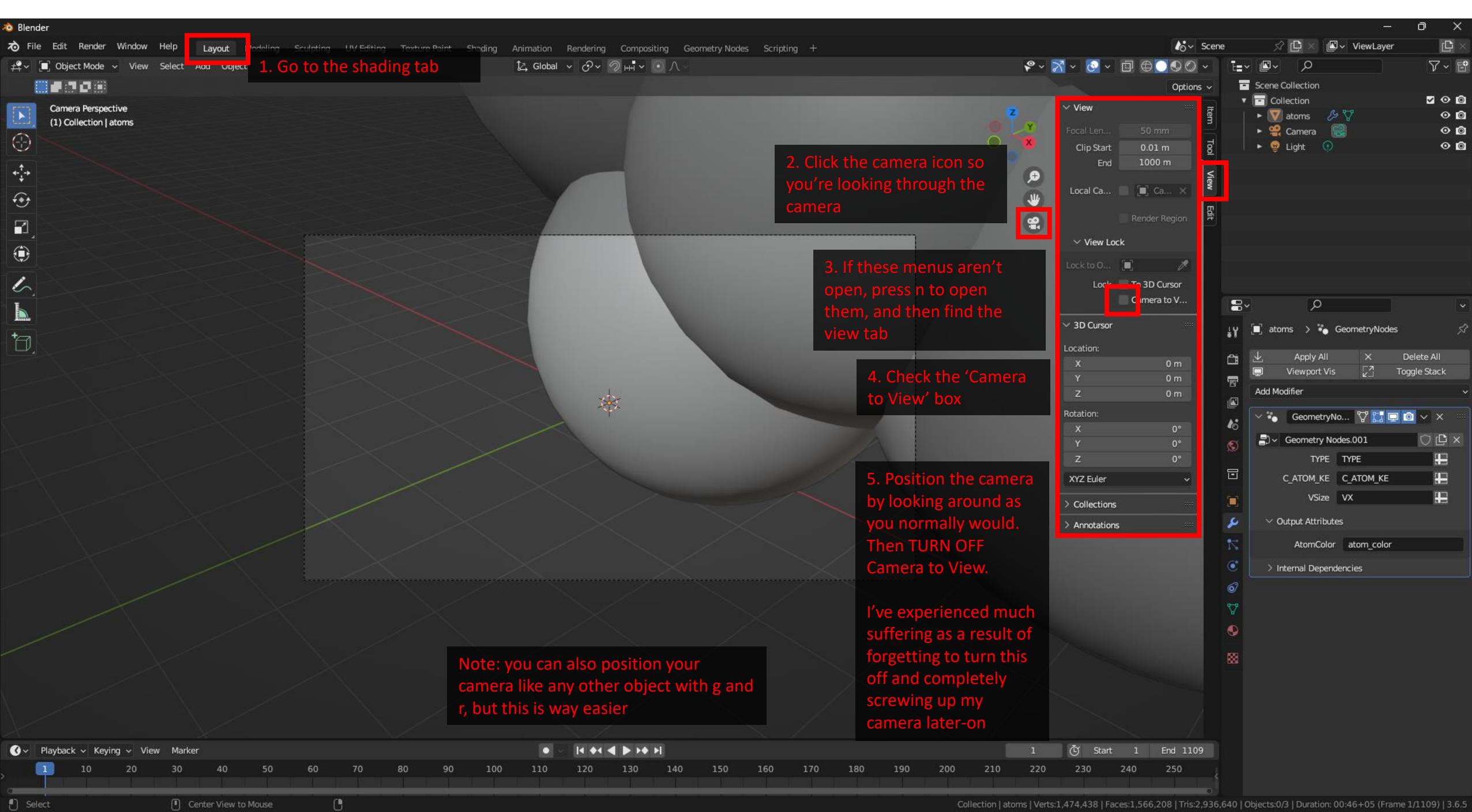
Collection | atoms | Verts:1,474,438 | Faces:1,566,208 | Tris:2,936,640 | Objects:1/3 | Duration: 00:46+05 (Frame 1/1109) | 3.65

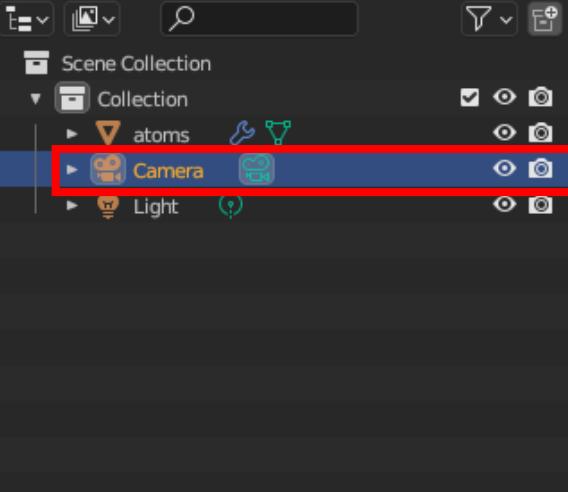


In atom\_val\_mat, you'll see the atom\_color attribute drives the base color and alpha nodes



# Setting the Camera





If you select your camera, you can change some settings. To set the 'active' camera when you have multiple cameras, click the green camera icon up here

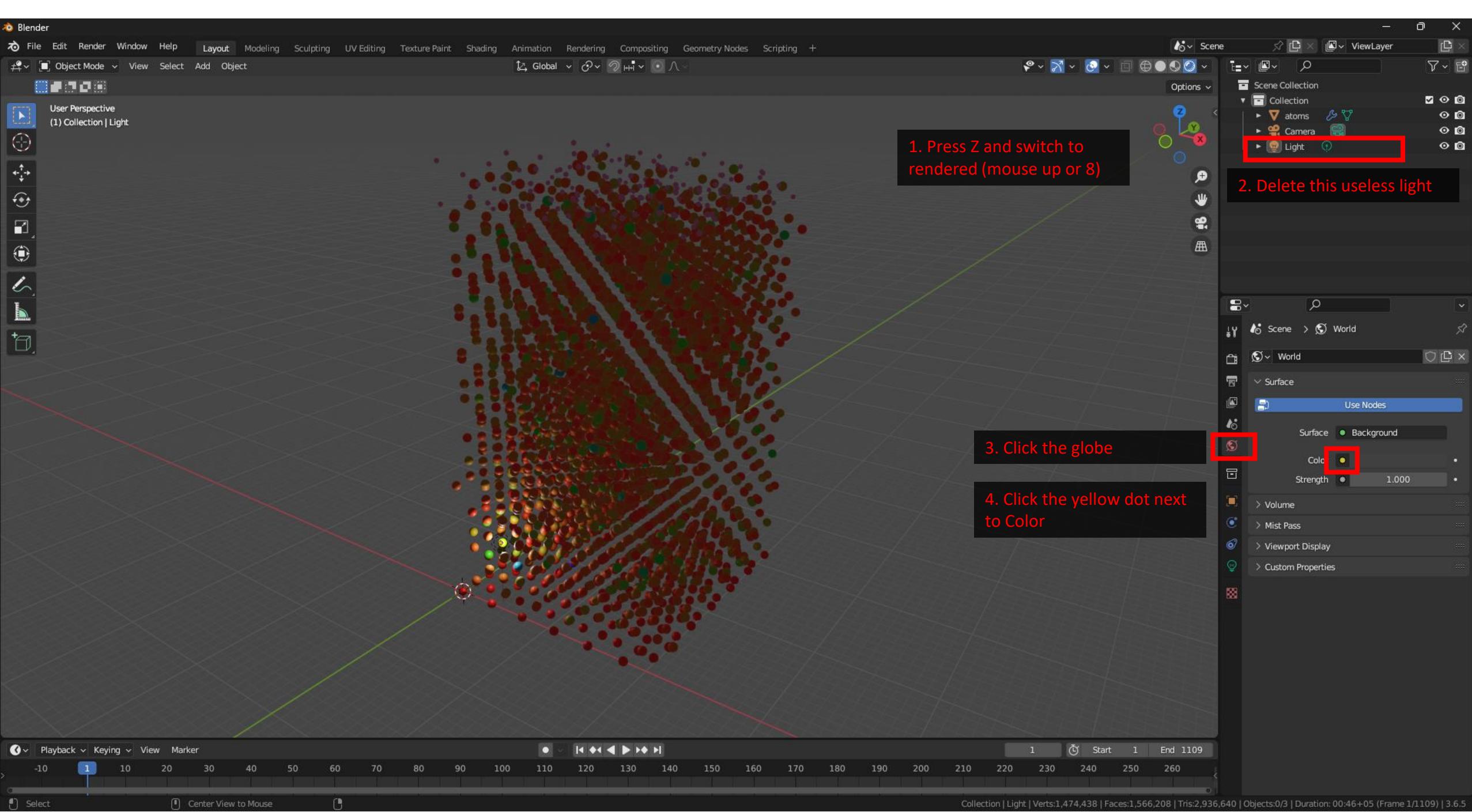
Click this camera to get to its settings

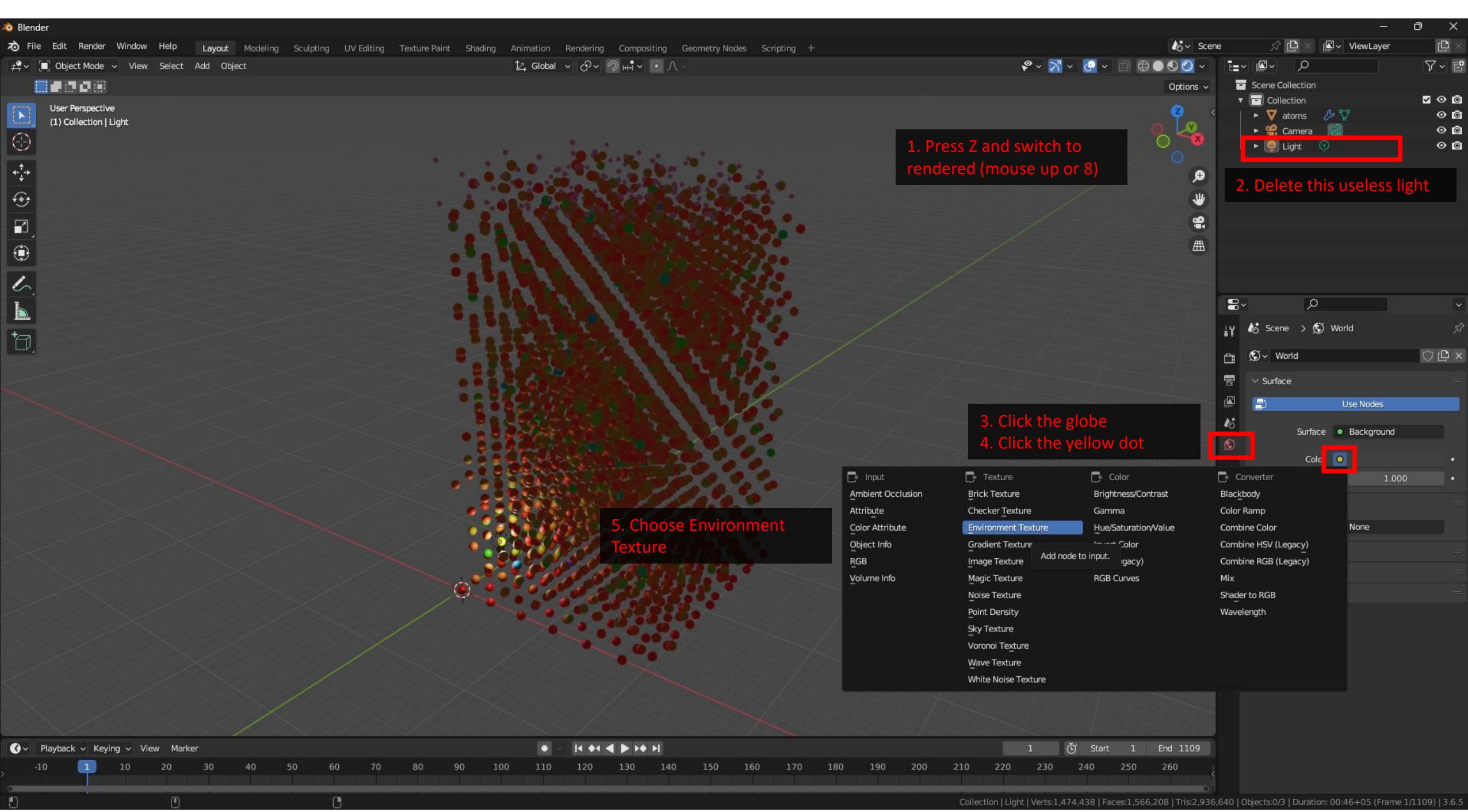
Camera Type allows you to pick orthographic view!!!

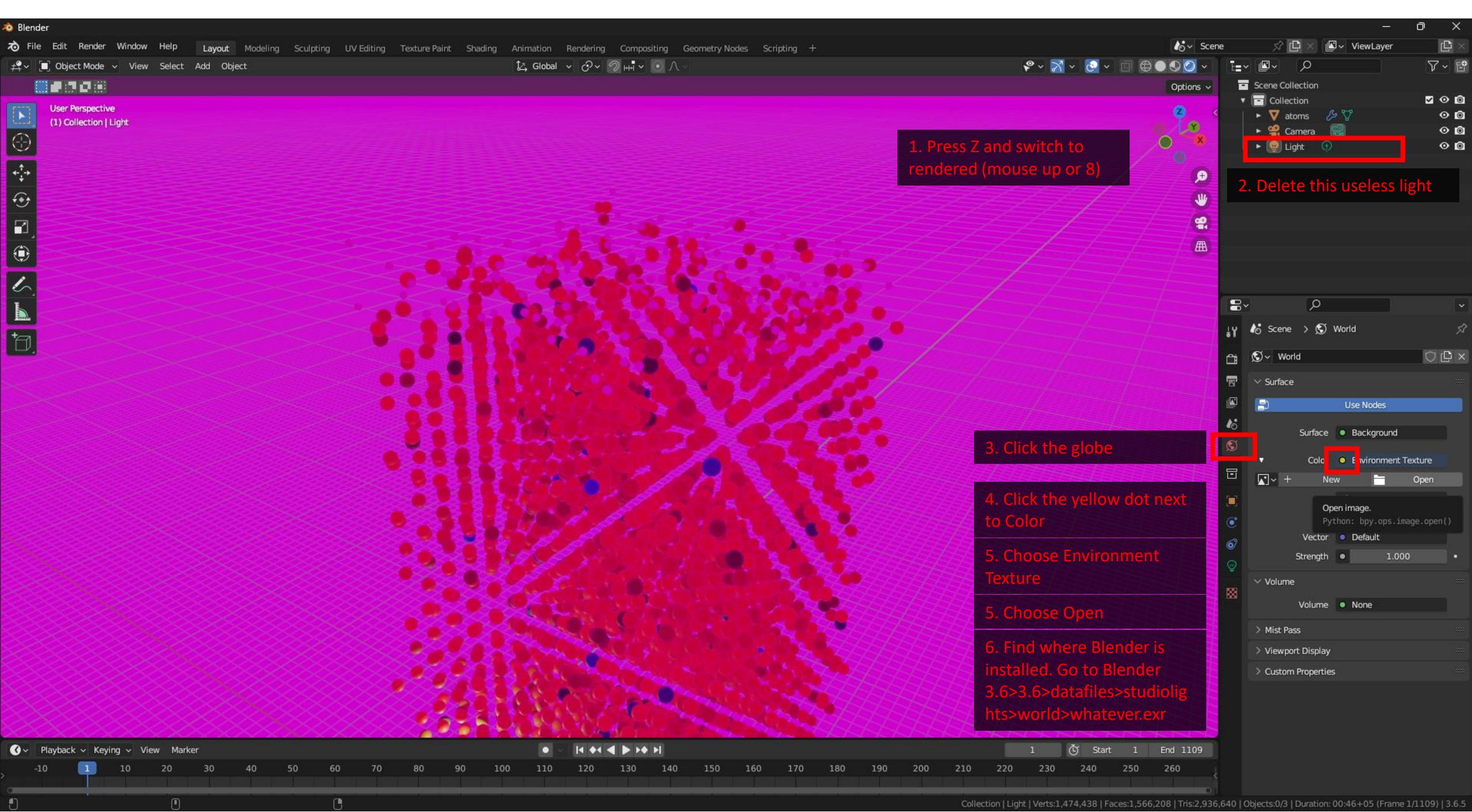
Type	Perspective
Focal Length	50 mm
Lens Unit	Millimeters
Shift X	0.000
Y	0.000
Clip Start	0.1 m
End	100 m

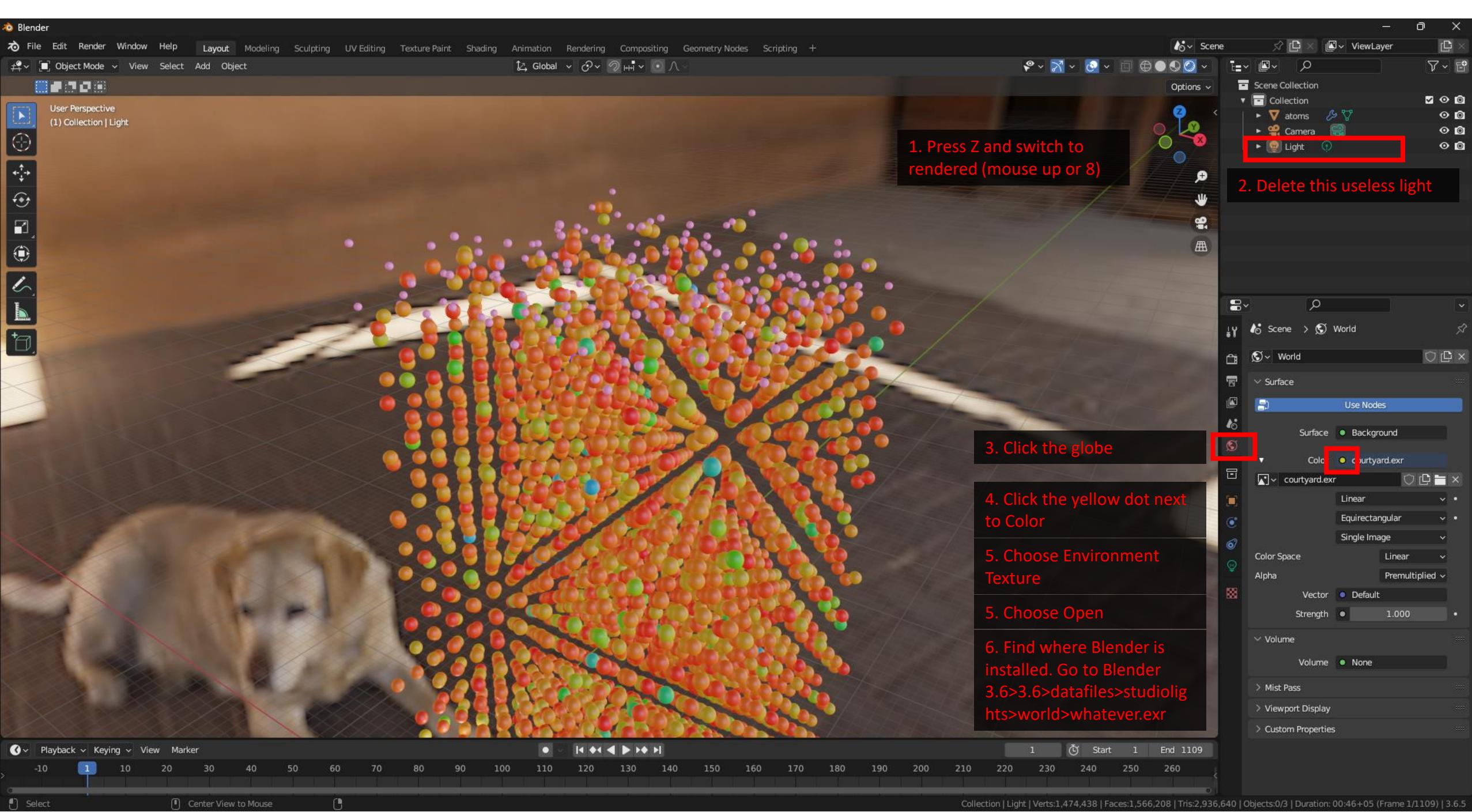
The other common option is Clip End. When positioning your camera you probably saw some of the atoms in the back go away. Change this to like 2000 m to avoid that

# Lighting









File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Geometry Nodes Scripting + Scene ViewLayer

User Perspective (2 Collection | Light)

Switch to the rendering tab

Scene Collection  
Collection  
atoms  
Camera  
Light

Bloom  
Depth of Field  
Subsurface Scattering  
Screen Space Reflections  
Motion Blur  
Volumetrics  
Performance  
Curves  
Shadows  
Indirect Lighting  
Film  
Filter Size 1.50 px  
Transparent  
Overscan 3.00%  
Simplify  
Grease Pencil  
Freestyle  
Color Management

Playback Keying View Marker

20 40 60 80 100 120 140 160 180 200 220 240 260

Start 1 End 1109

Collection | Light | Verts:1,474,920 | Faces:1,566,720 | Tris:2,937,600 | Objects:0/3 | Duration: 00:46+05 (Frame 2/1109) | 3.6.5

# Rendering

- There are two render engines built into blender: Eevee and Cycles
- Eevee is a “real-time” renderer. It is ugly and bad. Everything we have seen so far has been with Eevee
- Cycles does light transport simulations.
- If you have a gpu, set it up in edit>preferences>system

Eevee



Cycles



# Rendering

- Instead of screenshots I'm just gonna write out all the non-default settings I use:
- Render Engine: Cycles
- Device: GPU Compute
- Sampling (under Render. Viewport is the preview, so do whatever u want there)
  - Max Samples: 256 or 512 or some other power of 2
  - Under denoise, I change the denoiser to Optix, which is the fast GPU denoiser
- Light Paths
  - Max Bounces
    - Total: 8
    - Diffuse: 4
    - Spectral: 4
    - Others: 0 unless I have transparency, then max = 12 and I add like 4 or 8 to the others. Increase these numbers until you stop seeing artifacts (most common is too many transparent atoms lined up lead to black areas)

# Rendering

- Film
  - Check Transparent so your world goes away
- Performance
  - If on a good GPU, don't use tiling. It always makes stuff slower.
  - Experiment with use tiling (powers of 2) if:
    - You're using CPU to render
    - You're using a bad GPU (with low memory)
    - You've made too many atoms and you're running out of memory
      - For this you can also: reduce the complexity of the spheres in geometry nodes
      - Remove 'realize instances' at the end of the geometry nodes tree. This removes the ability to color instances with a variable, but by making more materials and assigning them based on logic in geonodes you can get similar results. This will GREATLY speed things up.

# Rendering

- Color Management
  - I usually use View Transform: Filmic. If you need pure whites, switch to standard.
  - For pubs I use Look: medium high contrast
- With these settings I can get to ~ 8 seconds / frame with my laptop

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Geometry Nodes Scripting Scene ViewLayer

User Perspective  
(1) Collection | atoms  
Rendering Done

Switch to the Output tab

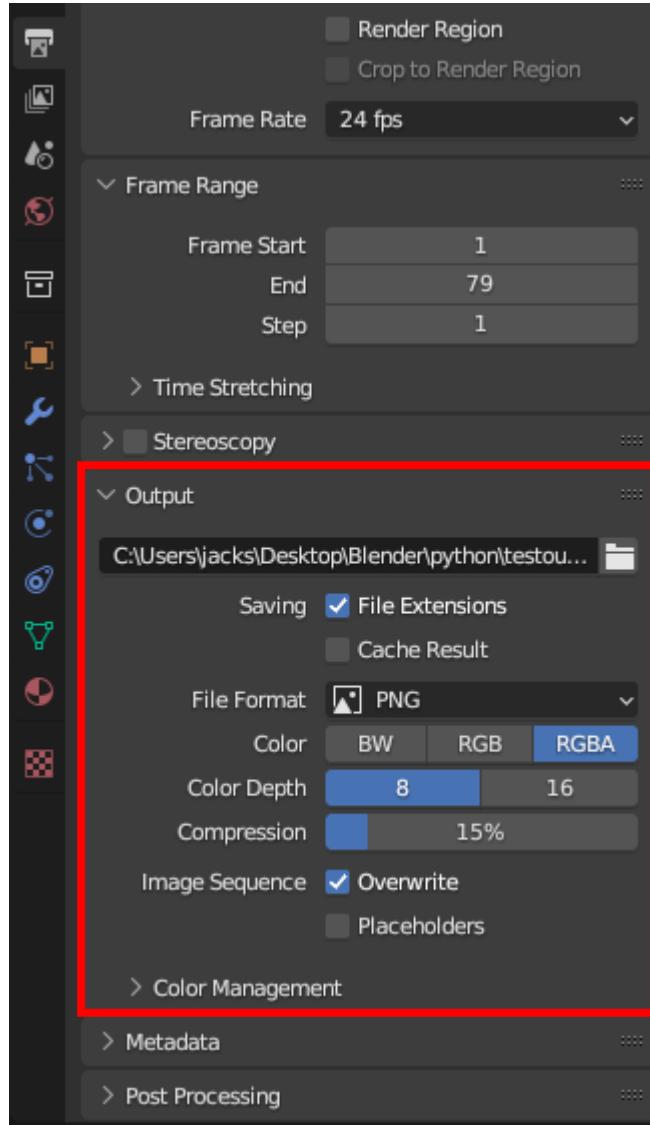
Scene Collection  
Collection  
atoms  
Camera  
Light

Scene  
Format  
Resolution X 1920 px  
Y 1080 px  
% 100%  
Aspect X 1.000  
Y 1.000  
Render Region  
Crop to Render ...  
Frame Rate 24 fps  
Frame Range  
Frame Start 1  
End 1109  
Step 1  
Time Stretching  
Stereoscopy  
Output  
/tmp/  
Saving  File Extensions

Playback Keying View Marker  
1 20 40 60 80 100 120 140 160 180 200 220 240 260  
Start 1 End 1109

Select Center View to Mouse

Collection | atoms | Verts:1,474,438 | Faces:1,566,208 | Tris:2,936,640 | Objects:0/3 | Duration: 00:46+05 (Frame 1/1109) | 3.65



Choose a file location and a prefix here (e.g. “outfolder\\test\_”) (renders will append the frame to the name, e.g. test\_0001.png)

Press F12 to do a test render (**look up render slots, a way to easily compare test renders**)

Press Ctrl+F12 to render the entire frame range. It's best to always render to png frames. We will combine them in a moment.

Default settings are fine here. Note if you switch off PNG and then return it'll be RGB instead of RGBA, you need the A channel for transparency.

To continue a crashed / stopped render, uncheck ‘Overwrite’ and it’ll only render frames that aren’t already in the output folder.

Why are we outputting to png? Because 1) renders take a long time, and 2) renders crash. If you go straight to video you can't stop and restart renders, plus it limits what you can change later on. Trust me, you don't want to render to video!

For a quick render so you can do the next part, just do like 12 frames with Eevee

# Sequencing

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Geometry Nodes Scripting + Scene ViewLayer

New Ctrl N  
Open... Ctrl O  
Open Recent Shift Ctrl O  
Revert  
Recover  
Save Ctrl S  
Save As... Shift Ctrl S  
Save Copy...  
Link...  
Append...  
Data Previews  
Import  
Export  
External Data  
Clean Up  
Defaults  
Quit Ctrl Q

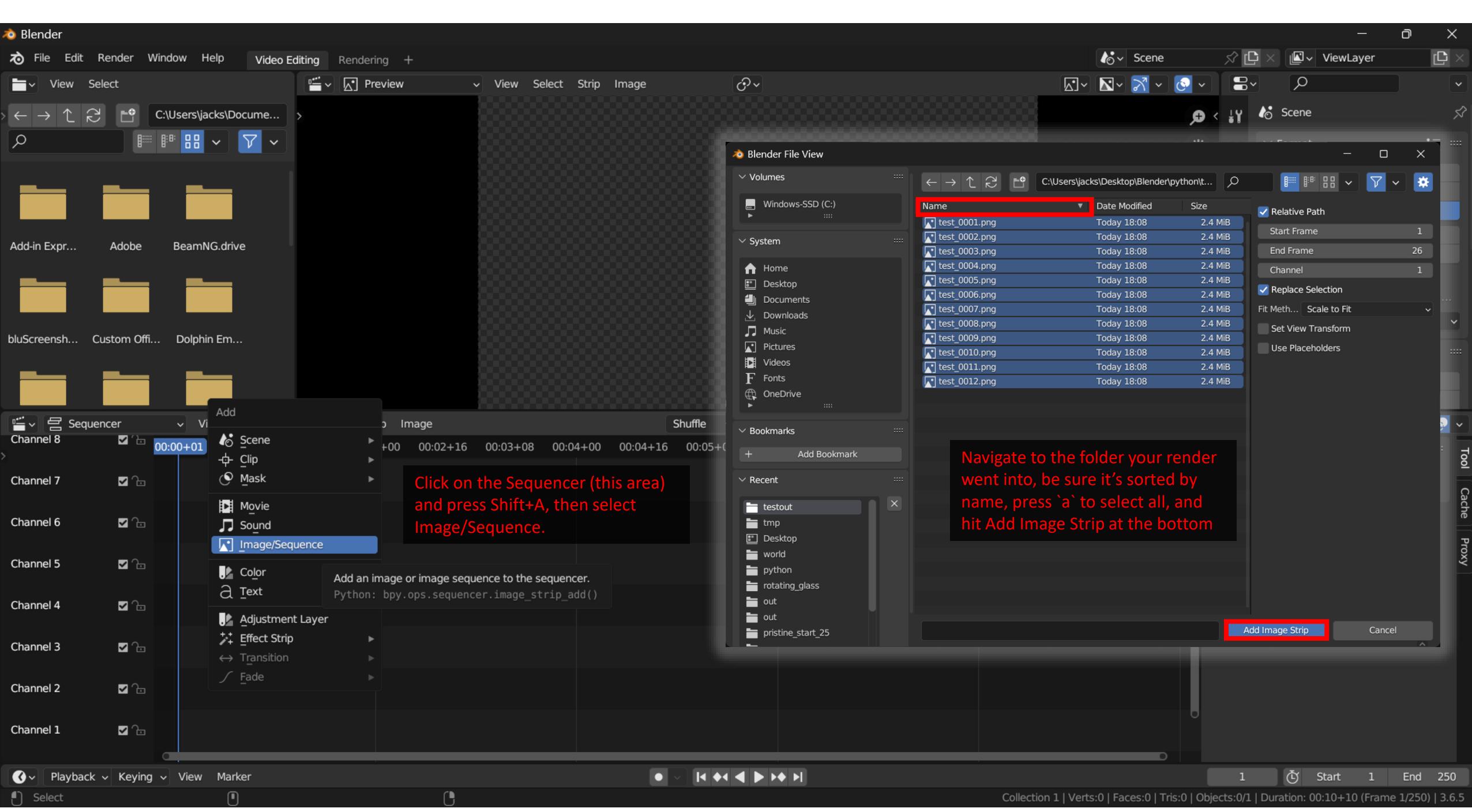
General  
2D Animation  
Sculpting  
VFX  
Video Editing

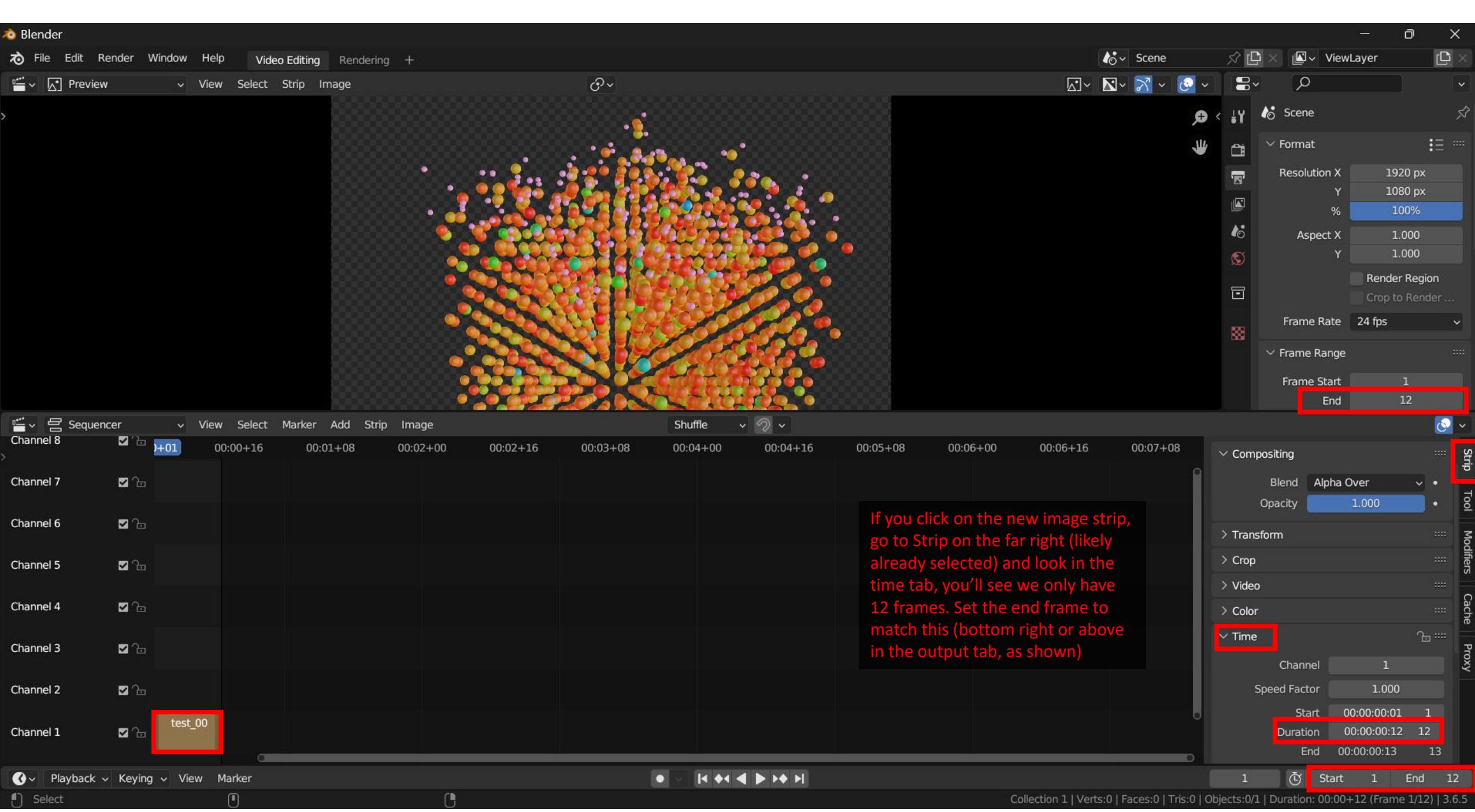
Save your work and open a new file, selecting **Video Editing** as the type. This opens a slightly different workspace. You can get to the video editing tools from the general workspace, but this is much easier. Plus, we want a separate file for this part anyway.

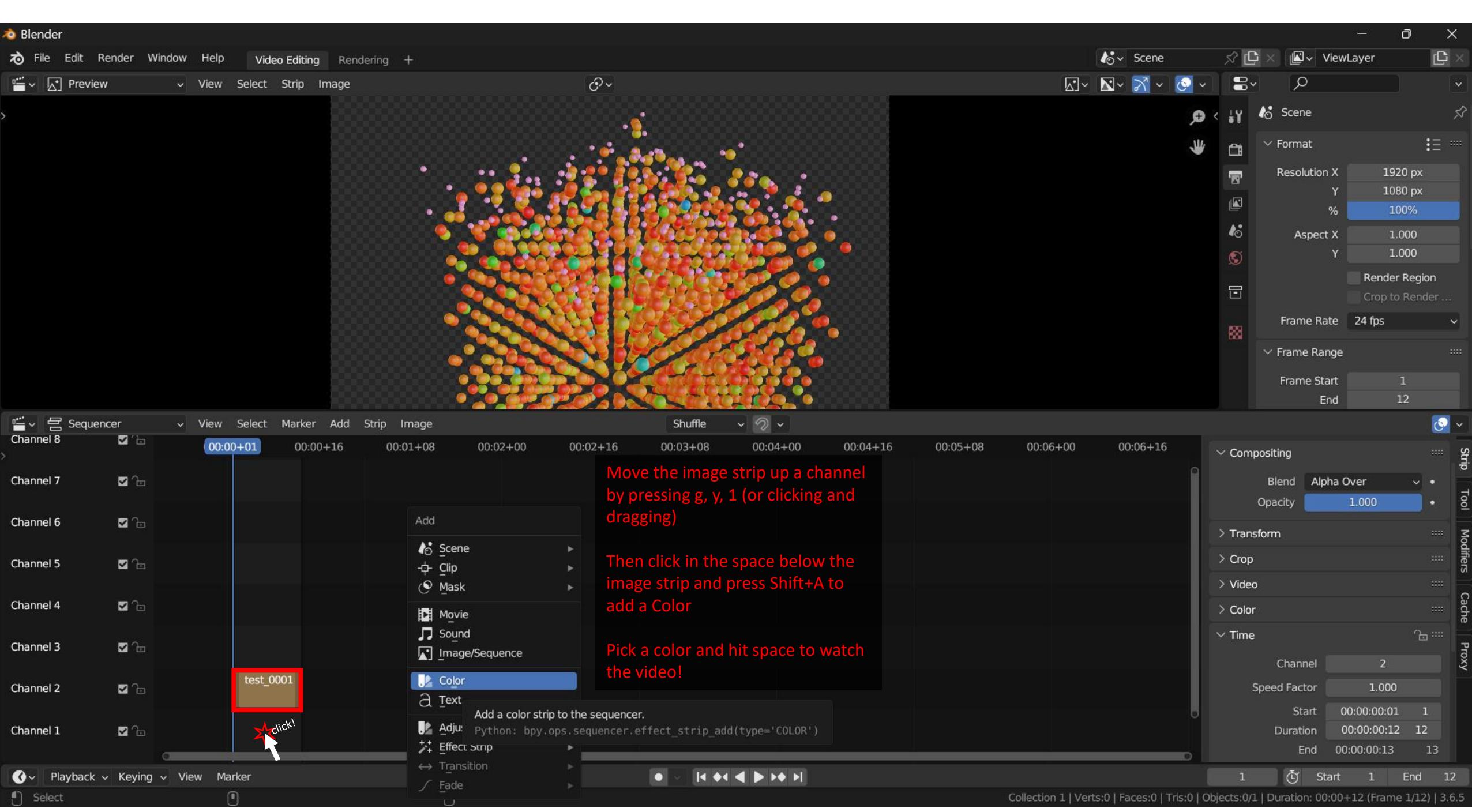
Collection atoms Camera Light

Scene  
Render Engine Eevee  
Sampling  
Ambient Occlusion  
Bloom  
Depth of Field  
Subsurface Scattering  
Screen Space Reflections  
Motion Blur  
Volumetrics  
Performance  
Curves  
Shadows  
Indirect Lighting

Collection | atoms | Verts:1,474,438 | Faces:1,566,208 | Tris:2,936,640 | Objects:0/3 | Duration: 00:00+12 (Frame 1/12) | 3.6.5







Blender

File Edit Render Window Help Video Editing Rendering +

Preview View Select Strip Image

fps: 12

Scene ViewLayer

Format

Resolution X: 1920 px  
Y: 1080 px  
%: 100%

Aspect X: 1.000  
Y: 1.000

Render Region  
Crop to Render ...

Frame Rate: Custom (12 fps)  
FPS: 12  
Base: 1.000

Frame Range

Sequencer

Channel 8: 00:00+01

Channel 7

Channel 6

Channel 5

Channel 4

Channel 3

Channel 2: test\_0001

Channel 1: Color | 25

Shuffle

Effect Strip

Compositing

Blend: Alpha Over  
Opacity: 1.000

Transform  
Crop  
Video

Playback Keying View Marker

Anim Player

Collection 1 | Verts:0 | Faces:0 | Tris:0 | Objects:0/1 | Duration: 00:01+00 (Frame 3/12) | 3.6.5

This is the same screen, I've just made the top panel bigger and scrolled down to show everything.

Change the output file to where you want the video

Most everything else should be default (File format should probably be FFmpeg Video, Container should be MPEG-4, Codec should be H.264. These are the defaults if you selected "Video Editing" when you made a new file. Otherwise...they aren't)

The only thing I'd change is **Output Quality**, which should be High Quality. You can also change Encoding Speed to be slowest if you want better compression efficiency.

Press F12 to render your movie. You're done! Congrats, you've made a very bad, very short animation.

The image shows the Blender interface with a particle simulation in the main 3D Viewport. The particles are colored spheres arranged in several parallel, curved lines, resembling a molecular or crystal lattice structure. The interface includes various toolbars and panels for editing, rendering, and output settings. A large red box highlights the 'Output' panel on the right, specifically the 'File Path' field which contains the path 'C:\Users\jacks...on\testout\test\_'. Another red box highlights the 'Output Quality' dropdown menu, which is set to 'Medium Quality'. The bottom status bar displays the frame information: 'Collection 1 | Verts:0 | Faces:0 | Tris:0 | Objects:0/1 | Duration: 00:01+00 (Frame 5/12) | 3.6.5'.

# Notes

- If you want to edit the default geometry nodes or shader setup, don't try to edit this portion of the script! Just make the atoms object in a new file (rename the default cube "atoms"), copy the restart file over, and "append" the asset (geometry node tree, or whatever) you like from another file (google this). Or, just like, make a copy of the blend file and change the input and output folders in the restart script... This is actually what I do, since I've added so much stuff for pbc etc.
- If you don't have a GPU, or even if you do, be aware you can render from the command line, and so should be able to use the cluster...
  - Ex: blender.exe -b example.blend -y -a
    - (-b = background, -y = yes run python scripts on startup, -a = render animation)
  - The della-vis1 node features 80 CPU-cores, 1 TB of memory and an **A100 GPU with 40 GB of memory**.
  - The della-vis2 node features 28 CPU-cores, 256 GB of memory and **four P100 GPUs with 16 GB of memory per GPU**.

# Notes

- For animations (with bonds), here is how I do the output for lammps:
  - `compute pns all property/local patom1 patom2`
  - `compute pld all pair/local dx dy dz dist eng p1`
  - `write_dump all custom dumps/atoms*.dump id type x y z vx vy vz modify sort id`
  - `write_dump all local dumps/bonds*.dump c_pns[*] c_pld[*]`
  - (use the thermo output hack to get the computes to run before the dump)
- For bonds, I generally make all bonds a grayish color, and map the bond energy to the transparency, so they're transparent around 0 energy, and get more solid below that. Then maybe a red or something for those with positive energy.

# Further Resources

- [CG Figures](#) on youtube is how I learned a lot of this. He also has an incredible asset library for lots of scientific things
- [Ryo Mizuta Graphics](#) is also very good
- [Classic Donut Tutorial](#) for learning about blender VERY generally
- Me: Jack Draney, [jd6157@princeton.edu](mailto:jd6157@princeton.edu)
  - Maybe I make a channel in slack where I can give updates on development, ideas, and people can ask questions?
  - I'm a huge dork about this stuff so please please please reach out. I'd love nothing more than to help build whatever it is you want / debug your stuff / talk about Blender

# Future of Blender

- Blender 4.0 is in alpha!
  - Loops in geometry nodes
  - New simulation nodes
  - HUGE Eevee improvements: real time ray-tracing! Might switch to this for faster renders!
  - Agx Color Management View Transform
  - New syntax which breaks my scripts

# Future Work: Please help!

- Squishy atoms
- Adding UVs to the atoms so they have labels
- Jiggling and turning of geometric atoms (actually I've done this already)
- Lammmps module in python: doesn't work on windows
- Making these tools into a module
- Rendering on the cluster
- Better shader setups for sci-viz (gooch?) ([toon](#)?)
- Caching trajectories
- Pickling trajectories
- Using align to euler node instead of calculating rotations manually for bonds