

Chapter 32:

In this chapter, we will be creating an animated atom. This will be done by creatively instancing curves circles that will be rotated to simulate electrons around a nucleus. As well as using a Dual Mesh to instance the shape of a neutrons and protons. This tutorial is just for illustrative purposes and not meant to represent any scientific model.

Download the two Chapter 32 files from <https://github.com/rbarbosa51/GeometryNodesByTutorials/tree/main/Chapter32>. Open the Chapter32Start.blend file so you can follow along.

Make sure that you are on the Geometry Nodes Workspace, and then select the Chapter32 object. Select the **Group Input(1)** node, then open the Sidebar. You are going to create two inputs. The first one is going to be: Name: *E.Count*, Type: *Integer*, Default Value: 10, Min: 1, and Max: 20. The second one is going to be: Name: *Speed*, Type: *Float*, Default Value: 10.0, Min: 1.0, and Max: 15.0. On the Modifier Properties Tab, make sure to change the *E.Count* and *Speed* to their default values (10 and 10.0 respectively).

Connect a **Mesh Line(3)** node in between the **Group Input(1)** and **Group Output(2)**. On the viewport, you should see a straight line. Connect the **Group Input(1)**'s *E.Count* socket to the *Count* socket of the **Mesh Line(3)**. On the **Mesh Line(3)**, change the *Start Location* and *Offset* to 0.0,0.0,0.0. You should see on the viewport that you only have a single point. Connect a **Instance on Points(4)** node in between the **Mesh Line(3)** and the **Group Output(2)** nodes. Connect the **Curve Circle(5)** node to the *Instance* socket of the **Instance on Points(4)** node. Change the **Curve Circle(5)**'s *Radius* to 1.25m. Your node tree should resemble Figure 32-1.

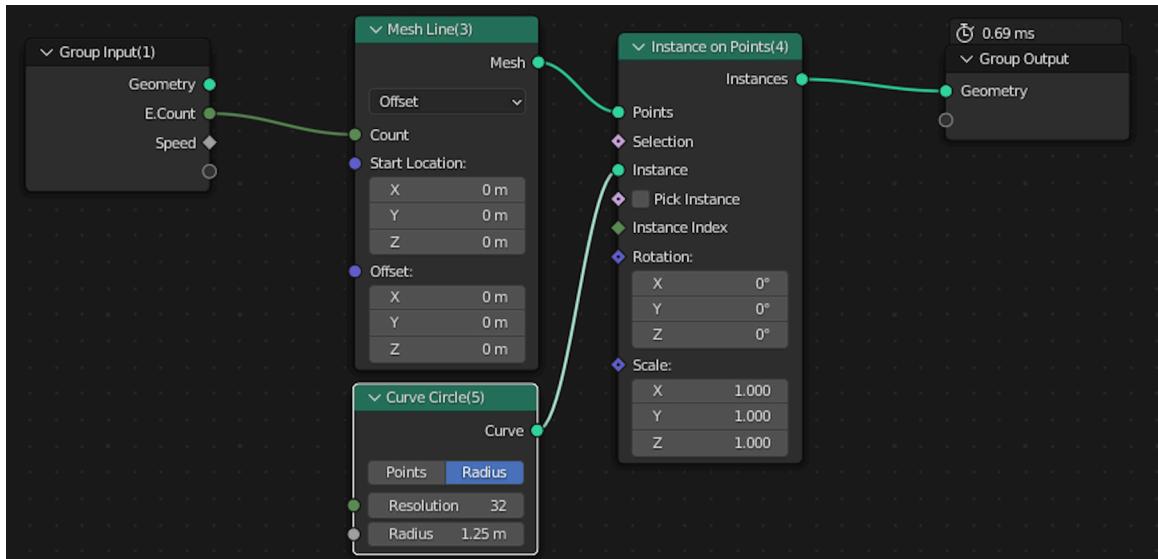


Figure 32-1

Minimize the **Mesh Line(3)** and **Curve Circle(5)** nodes to save visual space. Grab a **Scene Time(6)** and connect its *Frame* socket to the first *Value* socket of the **Math(7)** node. On the **Math(7)** node, change the operation to *Divide*, and write 250.0 on the second *Value*. 250 is the total number of frames in the animation. This will output a value between 0.0 and 1.0 depending on the current keyframe. Grab a **Vector Math(8)** node and change the function to *Multiply Add*. On the Vector Math(8), change the value of the *Multiplier's X axis* to 6.283 ($\pi * 2$ or 360 degrees in radians). Connect the **Math(7)** node to the **Vector Math(8)**'s *Vector* socket. Grab a **Random Value(9)** node and change the mode to *Vector*. Change the **Random Value(9)**'s *Max* values to (6.283, 6.283, 6.283). Connect the **Random Value(9)** node to the *Addend* socket of the **Vector Math(8)** node. Connect the **Vector Math(8)** node to the *Rotation* socket of the **Instance on Points(4)**. Your node tree should resemble Figure 32-2.

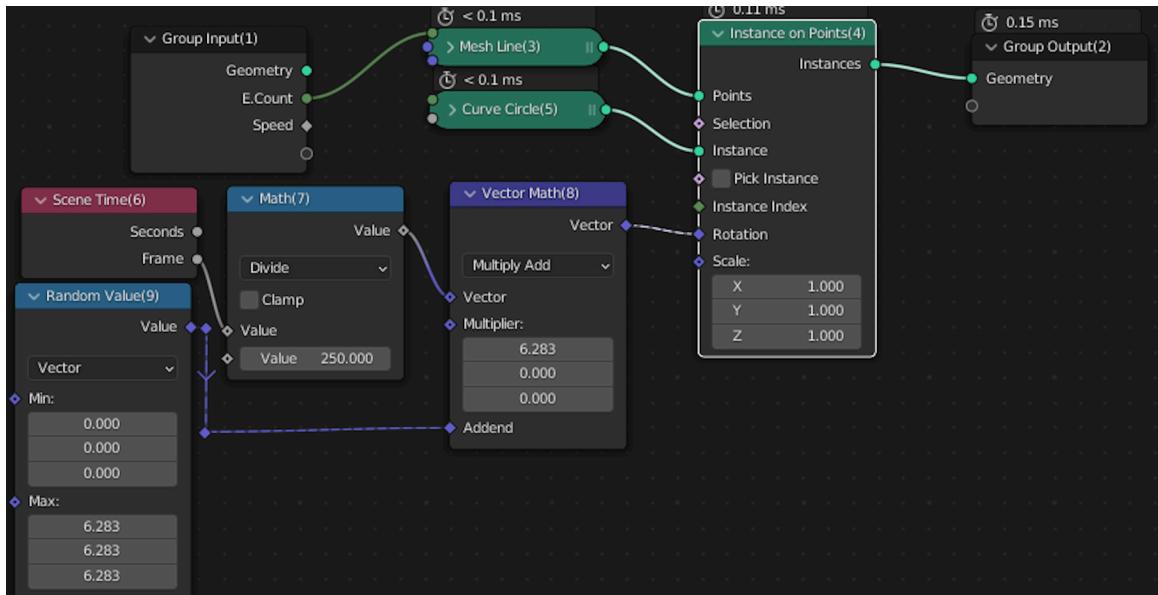


Figure 32-2

Connect the **Realize Instances(10)** node in between the **Instance on Points(4)** and **Group Output(2)** nodes. Connect the **Set Curve Radius(11)** node in between the **Realize Instances(10)** and the **Group Output(2)** nodes. Connect the **Curve to Mesh(12)** node in between the **Set Curve Radius(11)** and the **Group Output(2)** nodes. Connect the **Curve Circle(13)** node to the *Profile Curve* socket of the **Curve to Mesh(12)** node. Your node tree should look like Figure 32-3.

Chapter 32

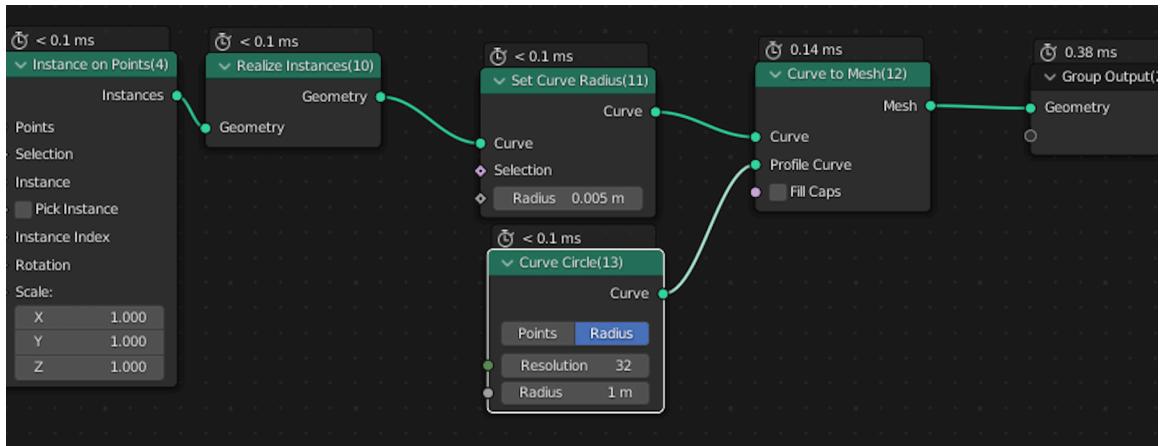


Figure 32-3

We are realizing the instances and subsequently converting them from curves to mesh. Therefore before we do this conversion, we need to capture the individual indices. Grab a **Capture Attribute(14)** node and change the data domain to **Spline**. Connect the **Index(15)** node to the inbound **Value** socket of the **Capture Attribute(14)** node. See Figure 32-4.

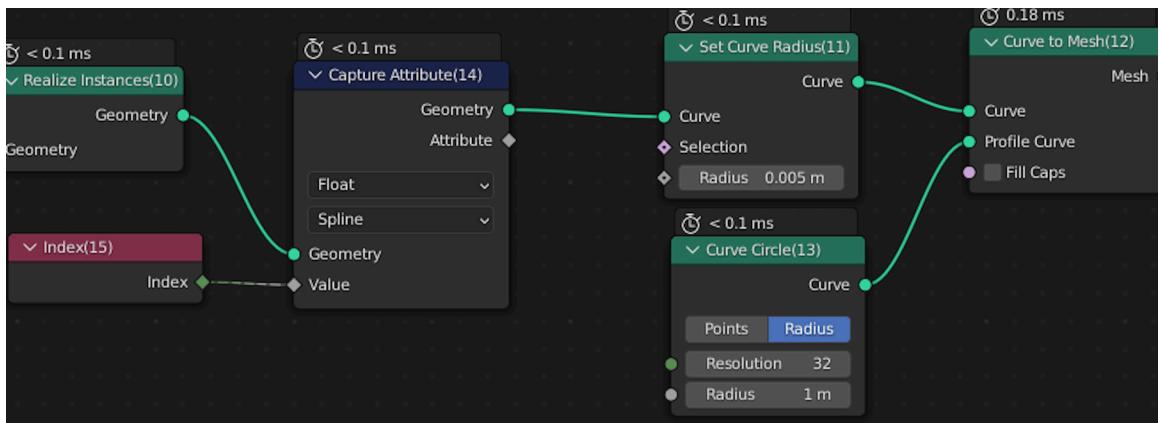


Figure 32-4

Grab the **Scene Time(16)** node and connect its *Frame* socket to the **Math(17)**'s first *Value* socket. Change the function of the **Math(17)** node to *Divide* and set the second *Value* to 250.0. The **Math(17)** node serves the same purpose and values as the **Math(7)** node. Strictly speaking the **Math(17)** was not needed we could have dragged a secondary connection from the **Math(7)** node. However, it is included in this tutorial solely for visual aesthetics.

Grab the **Group Input(18)** and place it under the **Math(17)** node. Connect the **Math(17)** node to the first *Value* socket of the **Math(19)**. Connect the *Speed* socket of the **Group Input(18)** node to the second *Value* socket of the **Math(19)** node. Set the **Math(19)** node to *Multiply*. Grab a **Spline Parameter(20)** node and place it above the **Math(17)** node. Connect the **Spline Parameter(20)**'s *Factor* socket to the first *Value* socket of the **Math(21)** socket. Set the **Math(21)** node function to *Subtract*. Connect the **Math(19)** node to the second *Value* of the **Math(21)**. Grab a **Math(22)** node and change the function to *Fraction*. Connect the **Math(21)** node to the **Math(22)** node. See Figure 32-5.

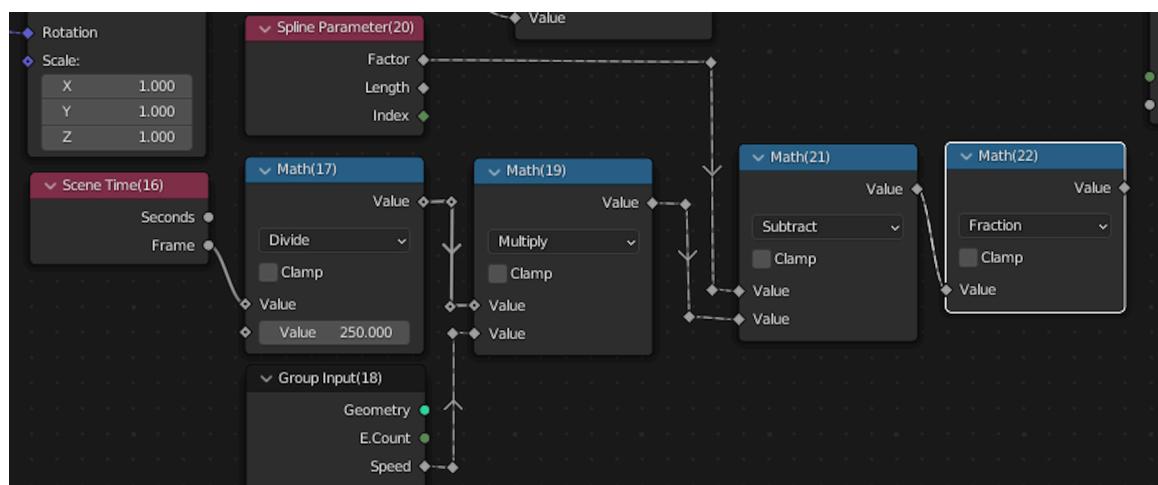


Figure 32-5

Connect the outbound **Attribute** socket of the **Capture Attribute(14)** node to the **Math(23)** node. Change the **Math(23)** node function to *Multiply*. Set the second **Value** to 0.2. We are scaling the value of the indices by 0.2. Connect the **Math(22)** node to the **Map Range(24)** node **Value** socket. Change the **Map Range(24)** node interpolation to *Smooth Step*. Connect the **Math(23)** node to the *To Max* socket of the **Map Range(24)** node. Change the **Map Range(24)**'s *From Min* and *From Max* to: 0.2 and 5.0 respectively. Connect the **Map Range(24)** node to the **Radius** socket of the **Set Curve Radius(11)**. Your node tree should resemble Figure 32-6 and viewport should resemble 32-7.

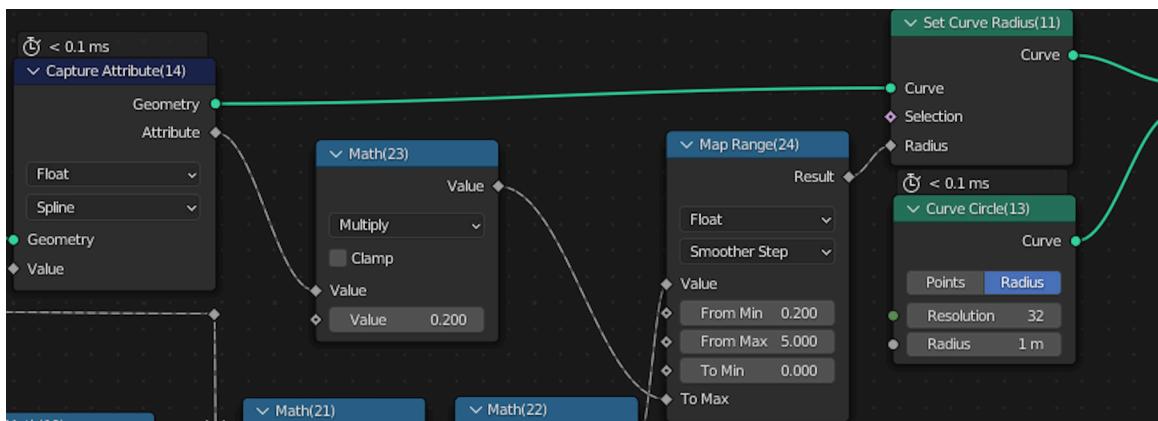


Figure 32-6

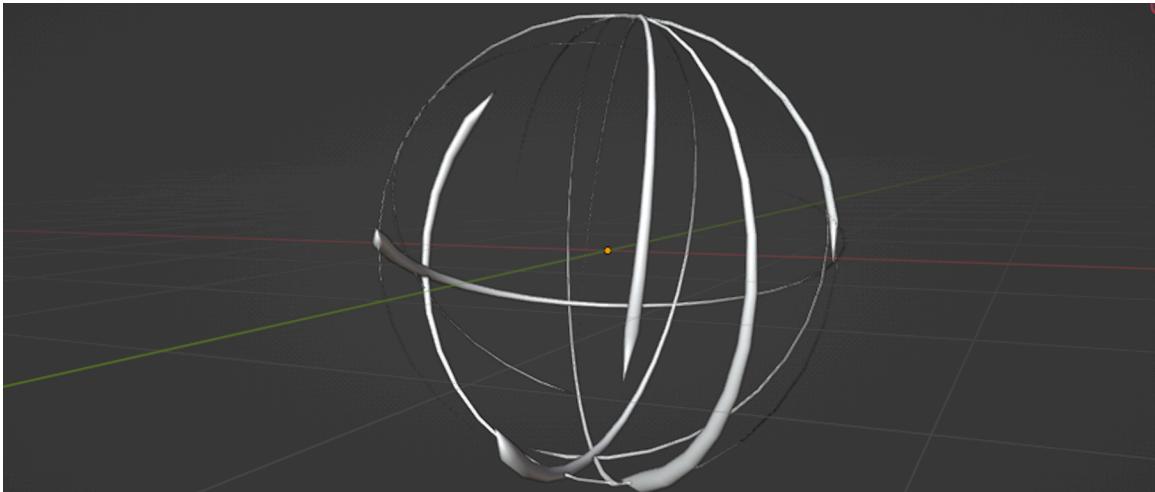


Figure 32-7

Now we are going to create the nucleus. Place the following nodes somewhere underneath your current node tree. Grab the **Ico Sphere(25)** node and change its *Radius* to 0.1m. Connect the **Ico Sphere(25)** to the **Dual Mesh(26)** node. We are going to use the center points of the Ico Sphere to instance UV Spheres along the normal. Therefore we need to capture the normal before we instance the points and change the geometry.

Grab a **Capture Attribute(27)** node and change its data type to **Vector**. Connect the **Dual Mesh(26)** to the **Geometry** socket of the **Capture Attribute(27)** node. Connect the **Normal(28)** node to the **Value** socket of the **Capture Attribute(27)** node. Connect the **Capture Attribute(27)**'s **Geometry** socket to the **Instance on Points(29)**'s **Points** socket. Grab the **UV Sphere(30)** and change its *Radius* to 0.15m. Connect the **UV Sphere(30)** node to the **Instance** socket of the **Instance on Points(29)** node. Your node tree should resemble Figure 32-8

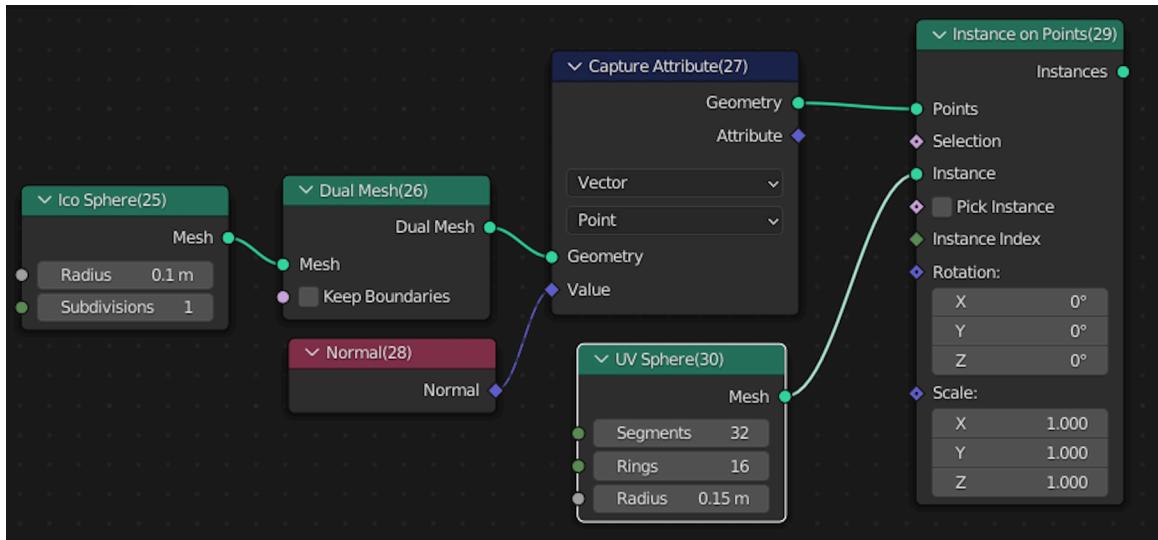


Figure 32-8

Connect the **Instance on Points(29)** to the **Set Position(31)**'s **Geometry** socket. Grab the **Vector Math(32)** node and change its function to **Scale**. Connect the **Capture Attribute(27)**'s **Attribute** socket to the **Vector Math(32)**'s **Vector** socket. Change the **Vector Math(32)**'s **Scale** value to 0.2. Connect the **Vector Math(32)** node to the **Offset** socket of the **Set Position(31)** node. Connect the **Set Position(31)** to a **Set Shade Smooth(33)** node. Connect a **Join Geometry(34)** node in between the **Curve to Mesh(12)** and the **Group Output(2)** node. You may have to move the **Join Geometry(34)** and **Group Output(2)** to the right. Connect the **Set Shade Smooth(33)** node to the **Join Geometry(34)** node. Your node tree should resemble Figure 32-9 and Figure 32-10. Your viewport result should resemble Figure 32-11.

Chapter 32

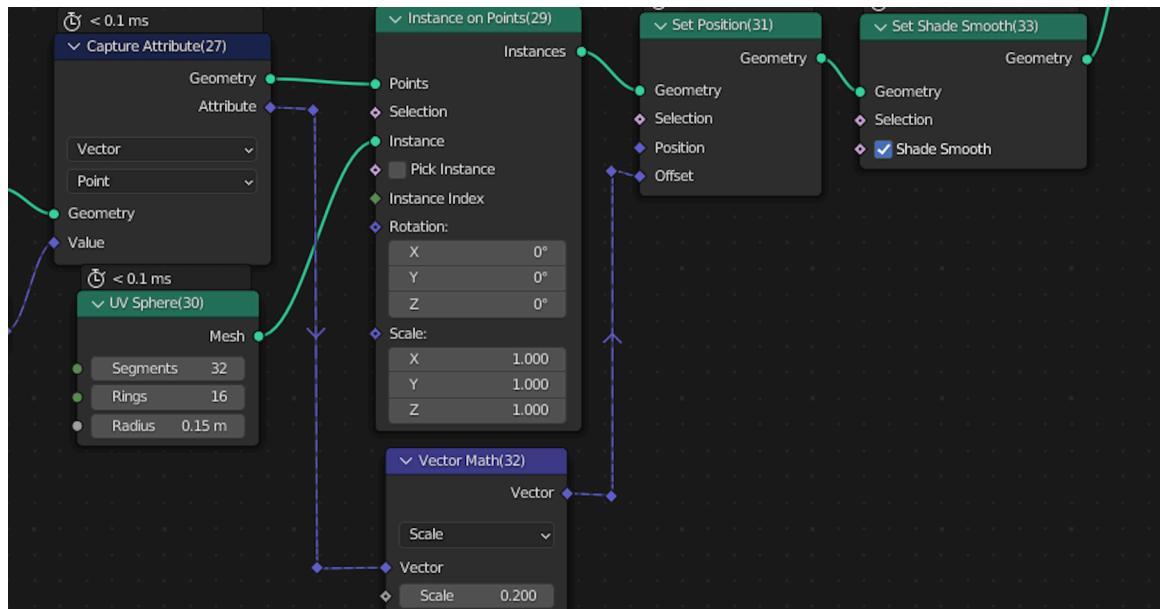


Figure 32-9

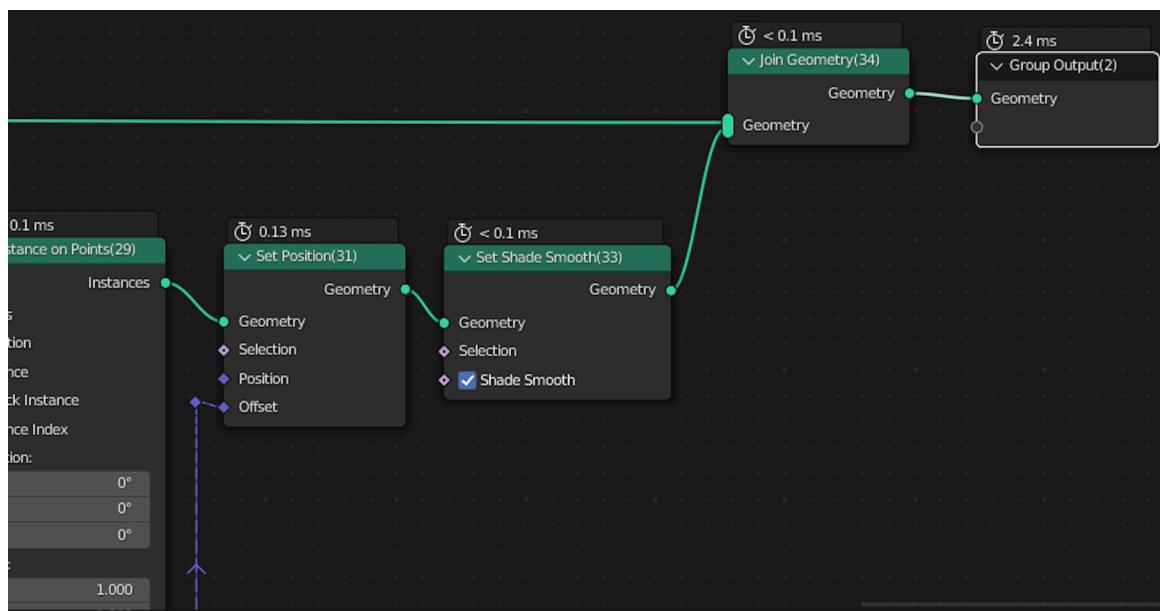


Figure 32-10

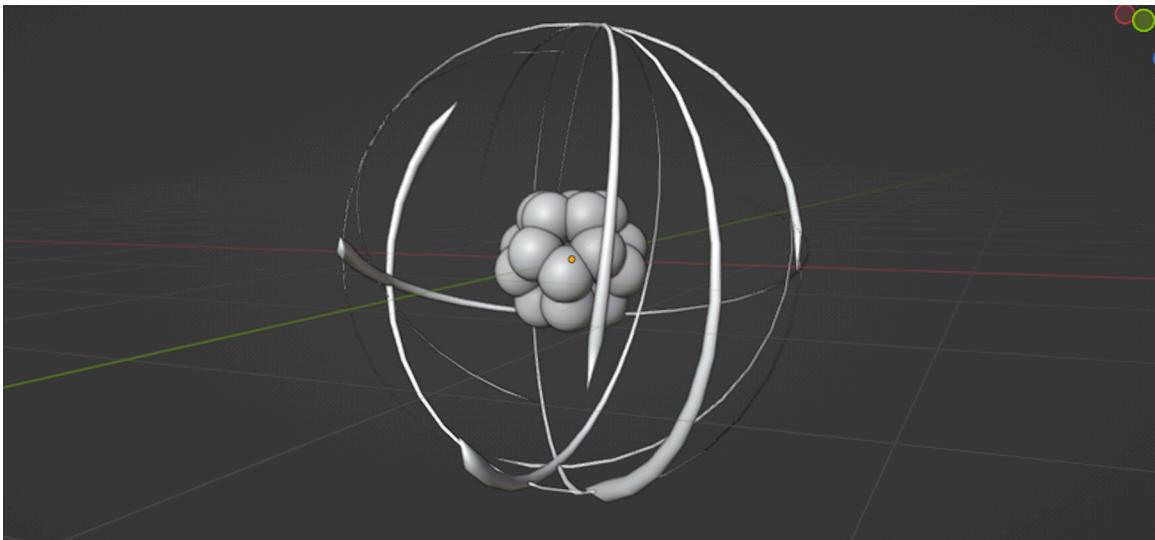


Figure 32-11

Connect the **Set Material(25)** in between the **Set Shade Smooth(33)** and the **Join Geometry(34)** nodes. Set the *Material* of the **Set Material(25)** node to the pre-made *Nucleus* material. Connect the **Set Material(26)** node in between the **Curve to Mesh(12)** and the **Join Geometry(34)** nodes. Set the **Set Material(26)**'s *Material* to the pre-made *Electron* material. Change the Viewport shading to *Material Preview*. Your node tree should resemble Figure 32-12, and the viewport should look like Figure 32-13 and Figure 32-14.

Chapter 32

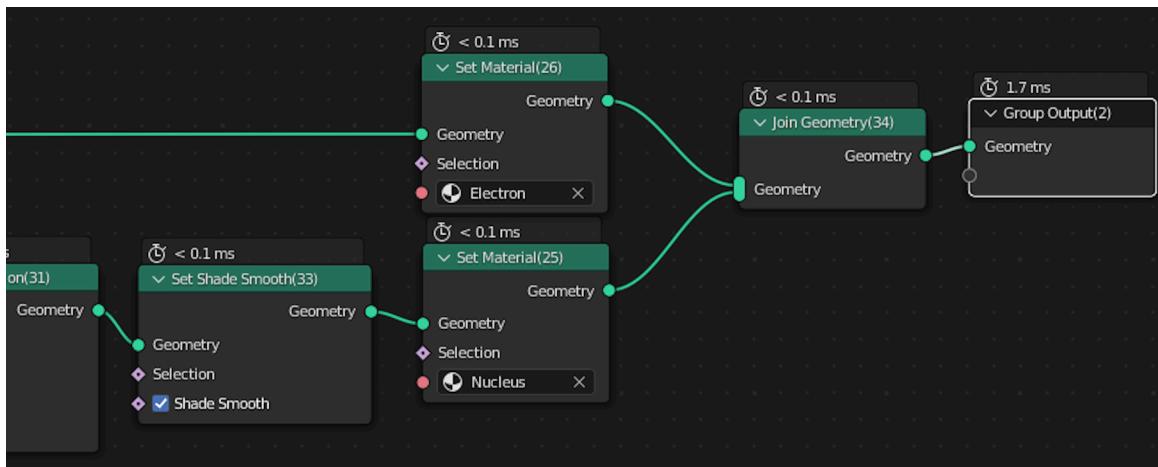


Figure 32-12

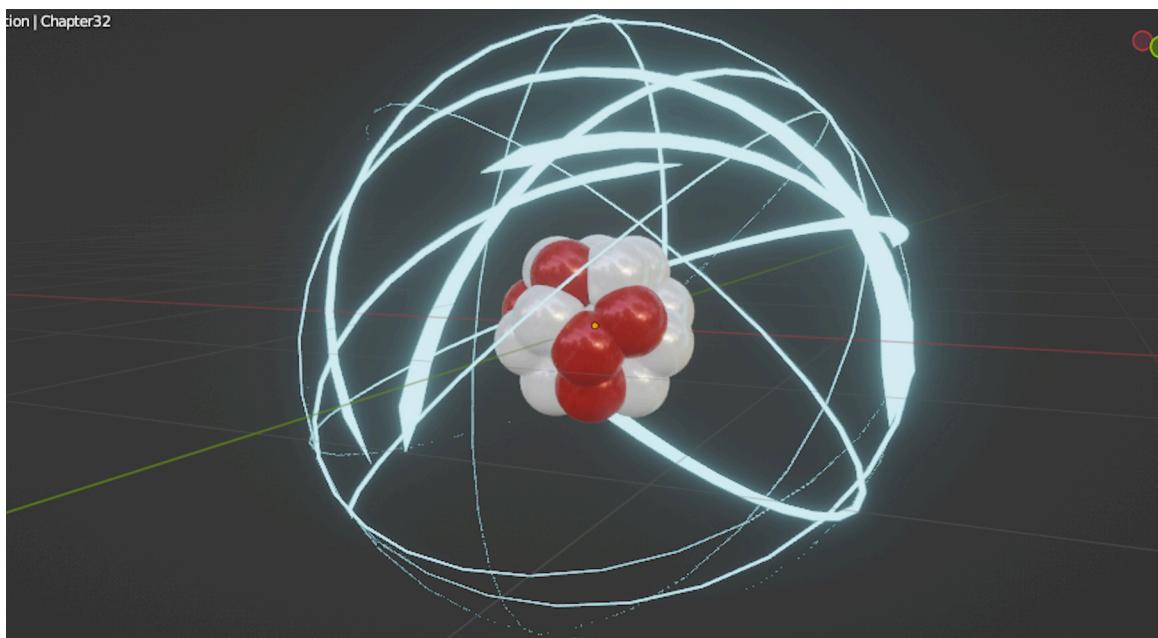


Figure 32-13

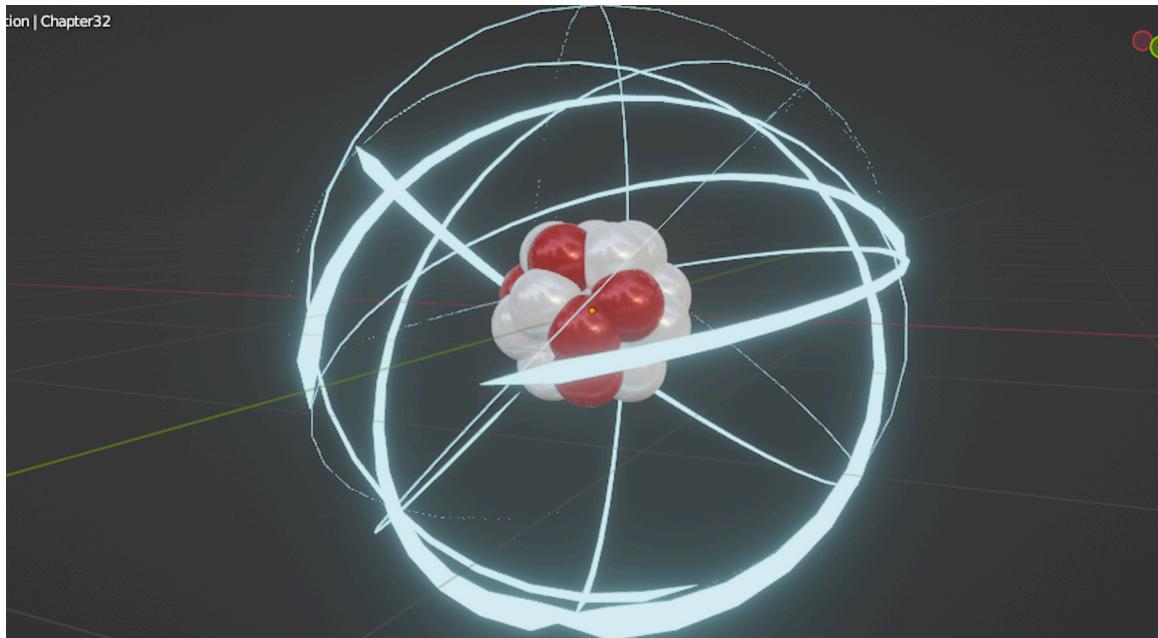


Figure 32-14

Go to the Layout Workspace, and turn on the animation. Play with the E.Count and the Speed in the Modifier Interface. Observe the results.

Compare your results and node tree with those of the downloaded Chapter32Final.blend file.
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<https://www.amazon.com/Blender-3-3-Geometry-Nodes-Tutorials-ebook/dp/B0BFG6GYVN>