Lightpipe

Requirements

Models: None

Properties: None

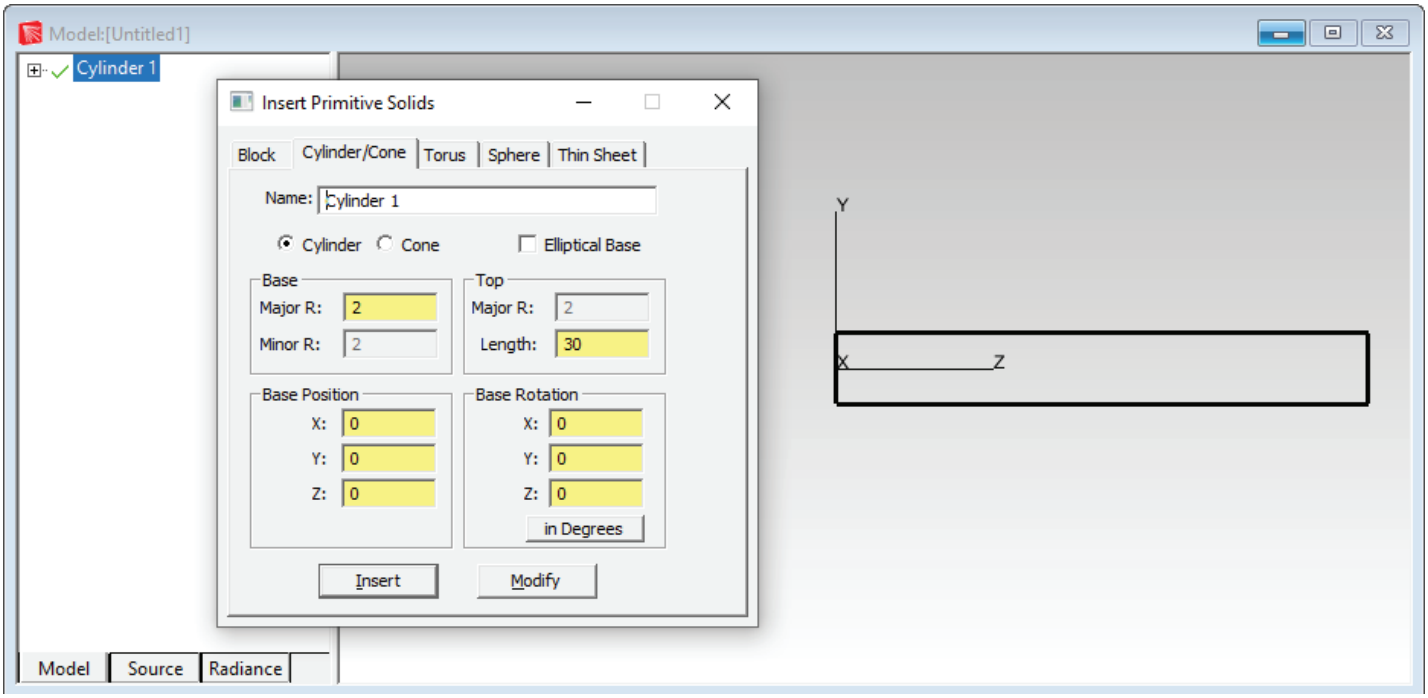
Editions: TracePro LC, Standard and Expert

Introduction

In this tutorial we will create a curved light pipe and analyze its performance.

The first step is to create a cylinder in TracePro.

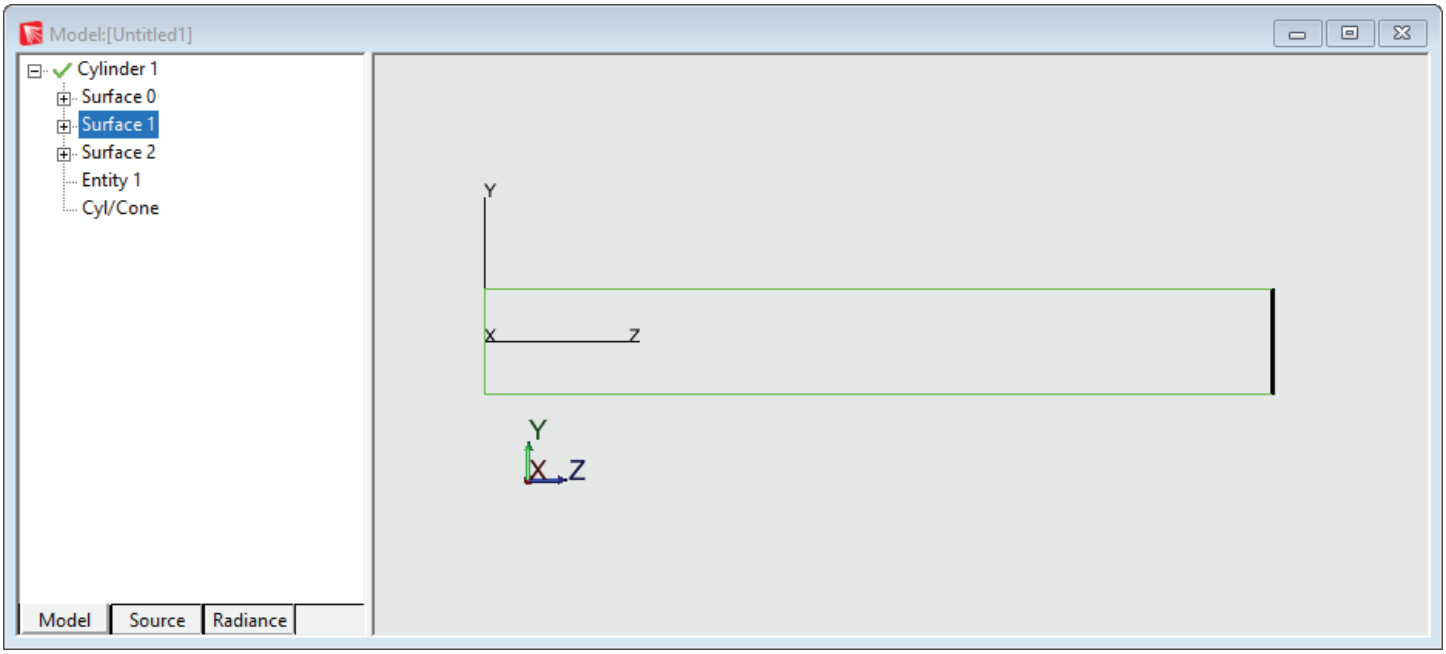
1. Start TracePro and select **Geometry|Primitive Solid**, then select the **Cylinder/Cone** tab.
2. Enter a **Major R of 2**, a **Length of 30** and press the **Insert** Button.
3. Press the **Zoom All** button or select the **View|Zoom|All** menu to see the new object.



Selecting a Surface

TracePro uses surface and object selections for many operations.

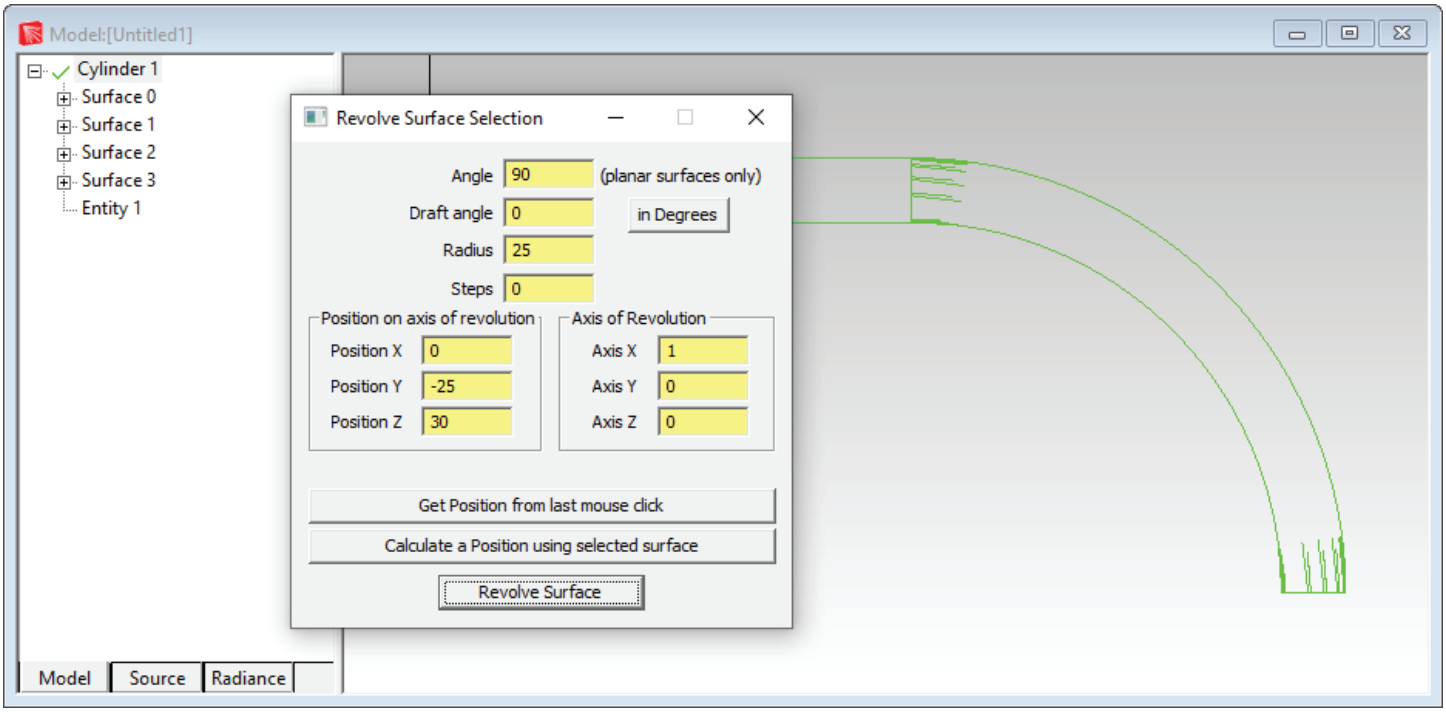
1. Select the right end of the rod using the **Edit|Select>Surface** menu (or **Select Surface** tool), use the mouse to pick the right-hand rod end. This is easier in Silhouette view mode as shown below. Select **View|Silhouettes** to change to Silhouette view.
2. When selecting the surface in the model window, it may be necessary to change the cursor to orbit view mode, rotate the cylinder, then change the cursor back to surface select mode to pick the surface.
3. Objects and surfaces can also be selected in the system tree.



Add a Bend

Add a bend to the selected surface by revolving the face along an arc.

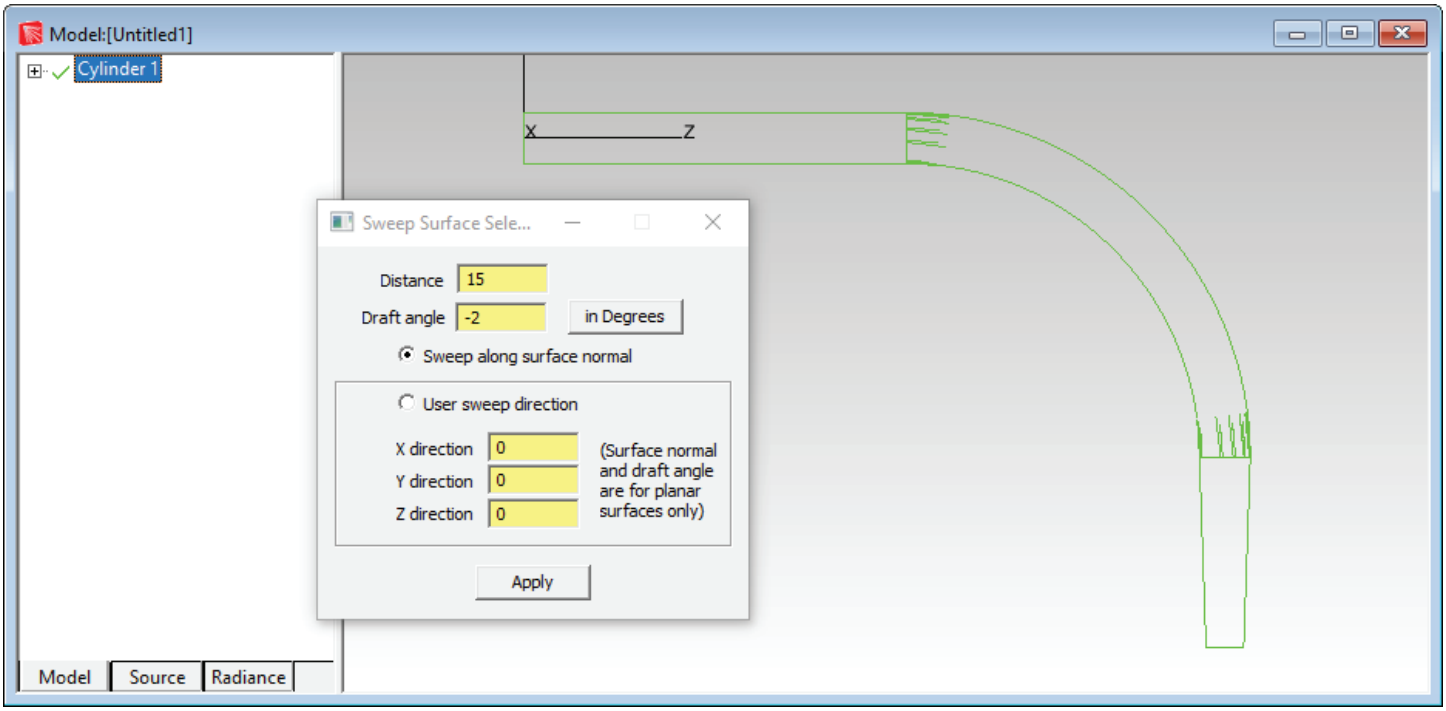
1. With Surface 2 selected, select **Edit|Surface>Revolve** to open the *Revolve Surface Selection*.
2. Enter 90 for the Angle and 25 for the bend Radius.
3. The surface will be swept or revolved about an axis defined by a position in space and a vector. Click the **Calculate a Position using selected surface** button and you will see numbers change in the **Position on axis of revolution** box. This function assumes you want the rotation point to be in the plane of the selected surface, a distance away equal to the **Revolve Radius** (25mm). Define the axis to be pointing along the X axis in the model space (this is the default setting).
4. Click **Revolve Surface** to perform the bend.
5. You might need to zoom the view to see the bend. Select **View|Zoom>All** or use the Zoom All toolbar button.



Add a taper

You can sweep the surface with a taper to finish the lightpipe.

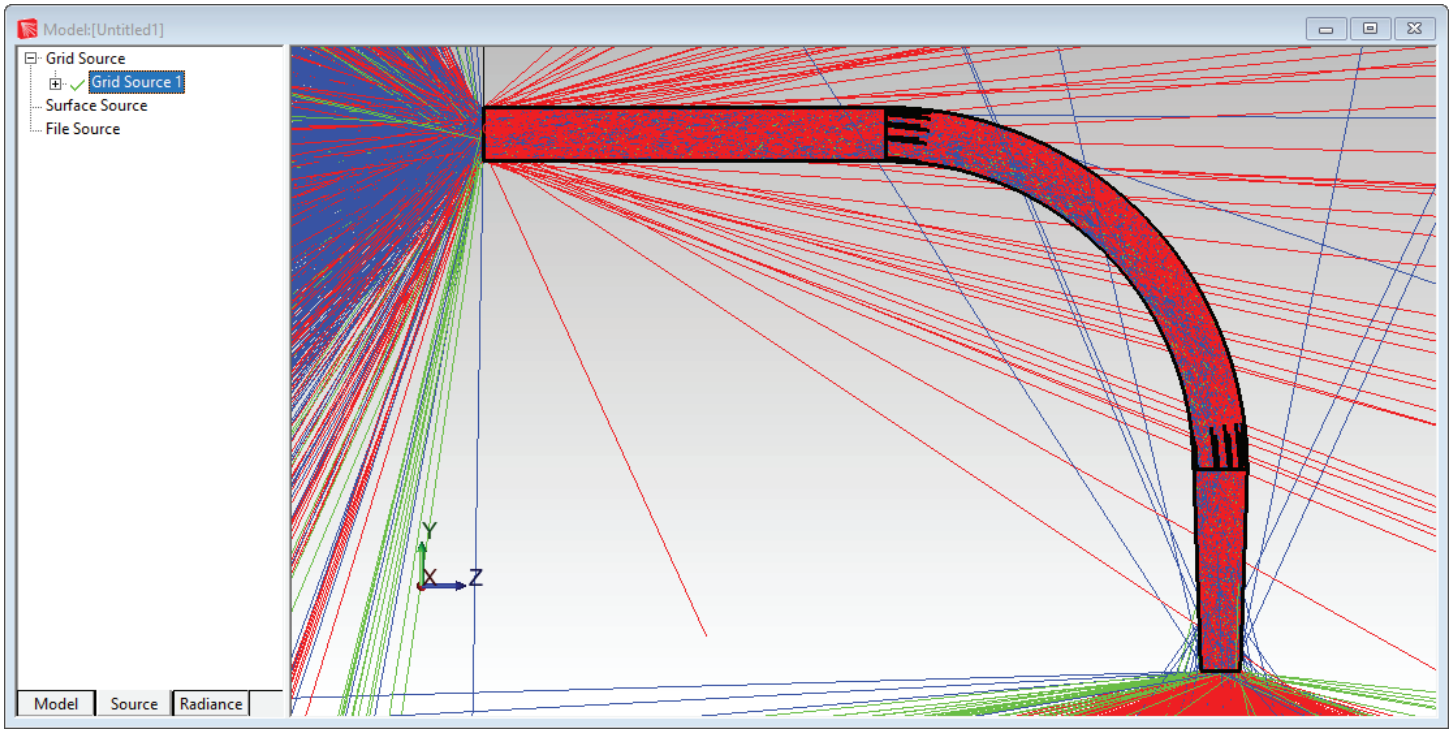
1. Select the bottom end of the pipe, then select **Edit|Surface>Sweep**.
2. Enter a sweep length of 15 in the Distance box and a Draft angle of -2 degrees. The surface will taper in by 2 degrees as it is swept along its distance.



Apply a Material Property

TracePro uses properties to make the model optical. Material properties define the bulk or volume data for an object, in this case the index of refraction.

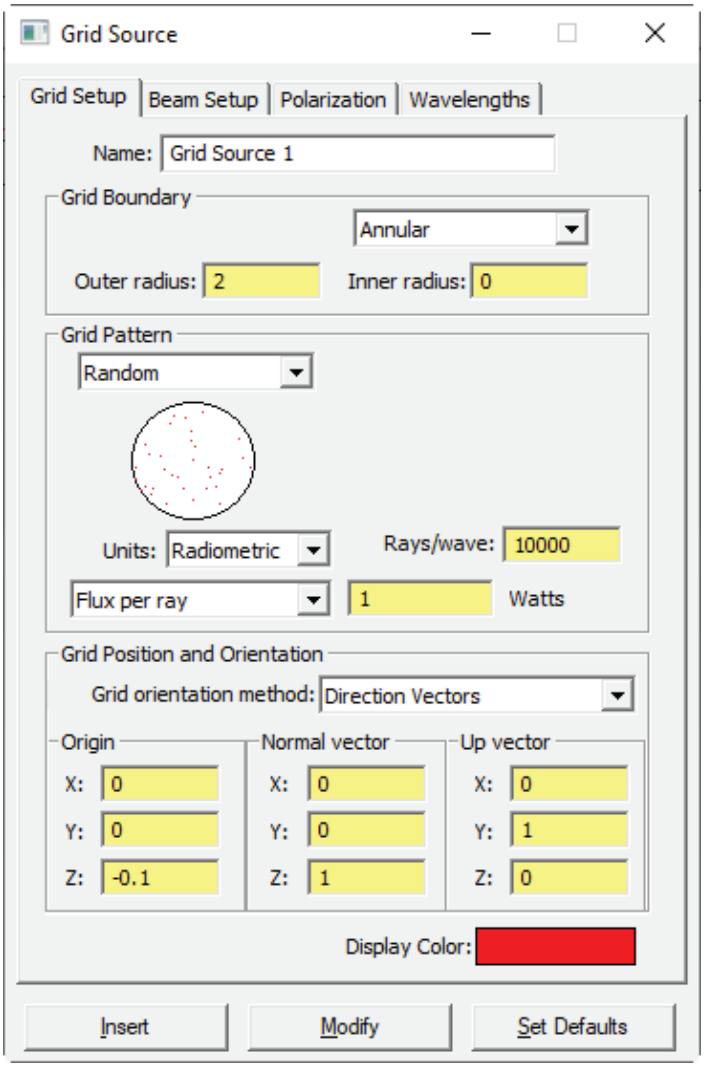
1. Select the lightpipe (Cylinder 1) and select **Define|Apply Properties**.
2. Select the Plastic catalog, select Acrylic and press the Apply button. You can see the Material property name by expanding the Cylinder 1 object in the system tree.

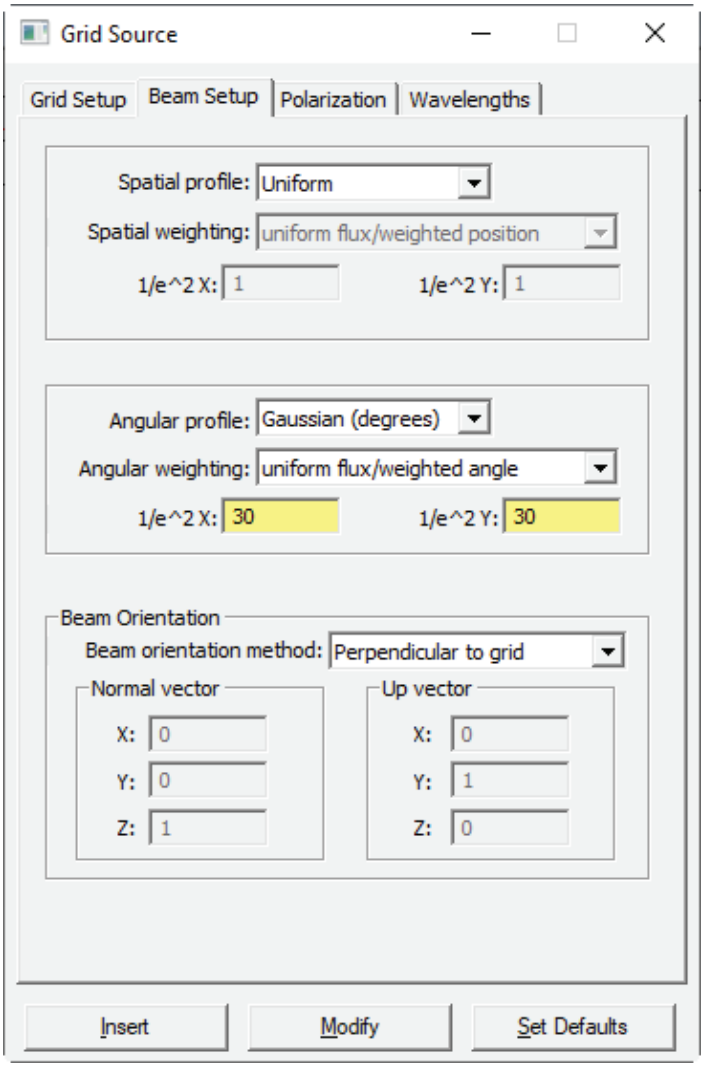


Set Up a Grid of Rays

Now set up a Gaussian beam using a Grid Source.

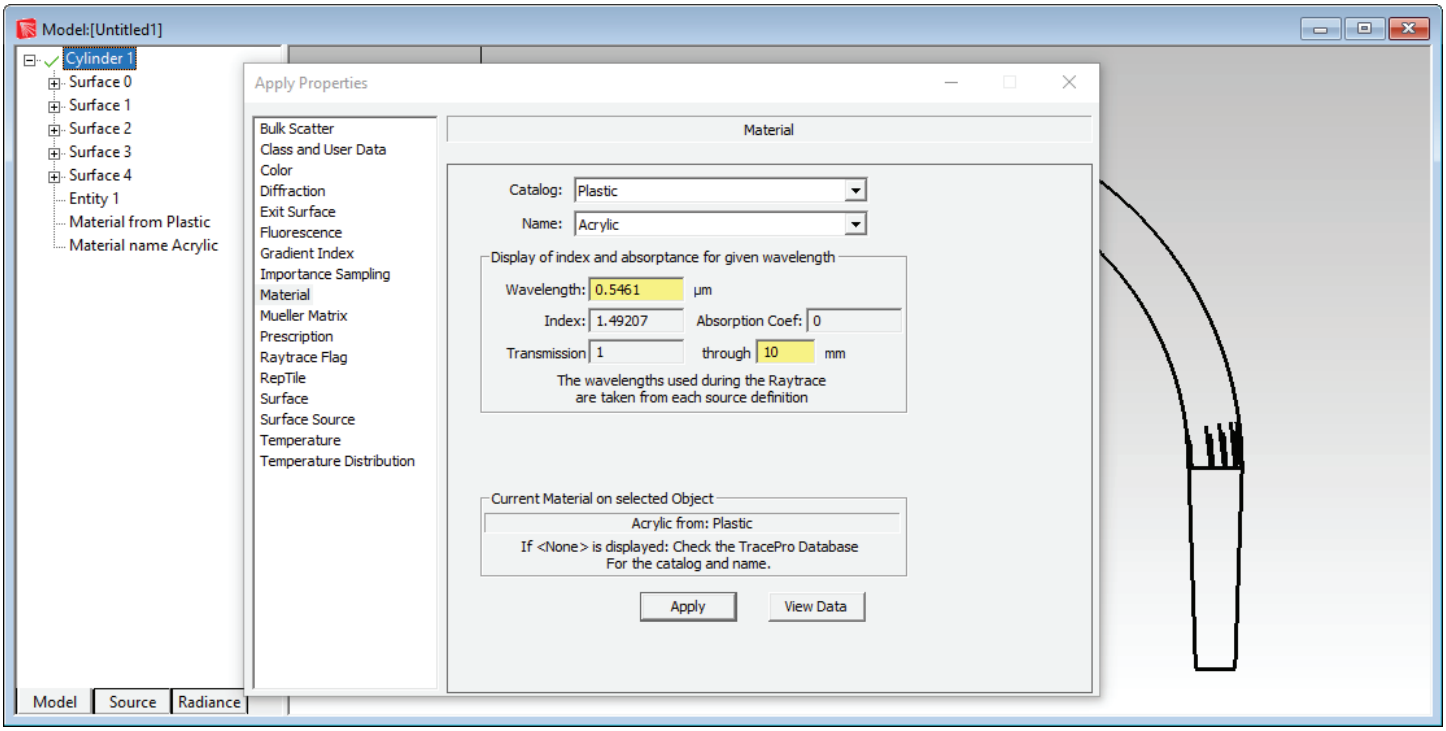
1. First, select the Source tab which is on the bottom of the system tree. This will open up the Source section of the system tree.
2. Expand the Grid Source group and make Grid Source 1 active by clicking on the red X in front of it. This will change the red X to a green check mark signifying that this source is now active. Double-click on the Grid Source 1 name to bring up the Grid Source dialog box, or select **Define|Grid Source**.
3. Update the *Grid Setup* tab so the Outer radius is 2, the Grid Pattern is Random and the Rays/wave is set to 10000. Define the Origin location of the grid at (0,0,-0.1) as shown in the left figure below.
4. Modify the *Beam Setup* tab to have an Angular profile of Gaussian (degrees) with 30° half angles as shown on the right.





Trace the Rays

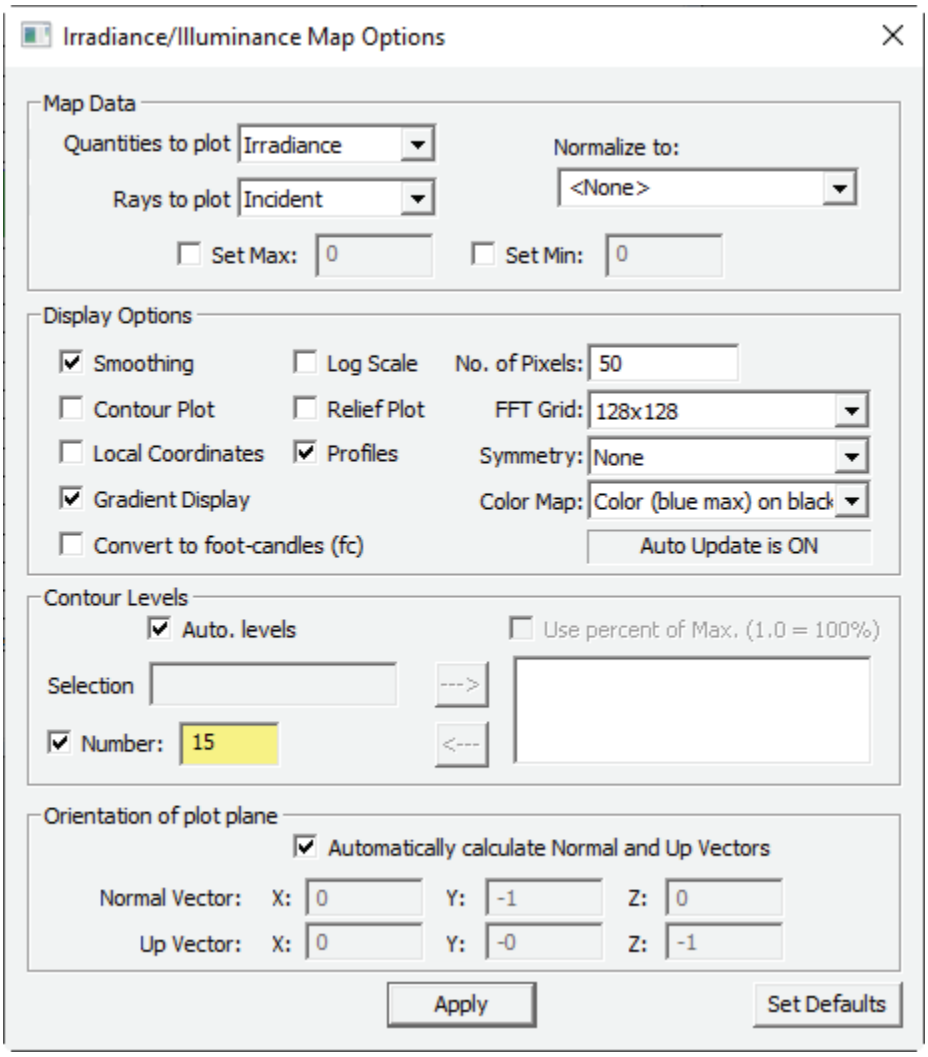
Select **Raytrace|Trace Rays** to perform the raytrace. A dialog box will ask you to choose Analysis Mode or Simulation Mode Raytrace. Choose Analysis Mode. Next the Audit will update the model with property information from the database and finally the raytrace will begin. The output is shown below. You can turn off the rays using the **Analysis|Display Rays** menu or try **Analysis|Ray Sorting** to reduce the percentage of rays drawn.



Setting Irradiance Map Options

The next step is to set the **Irradiance Map Options**. The options may be set at any time to modify the display of the Irradiance Plot.

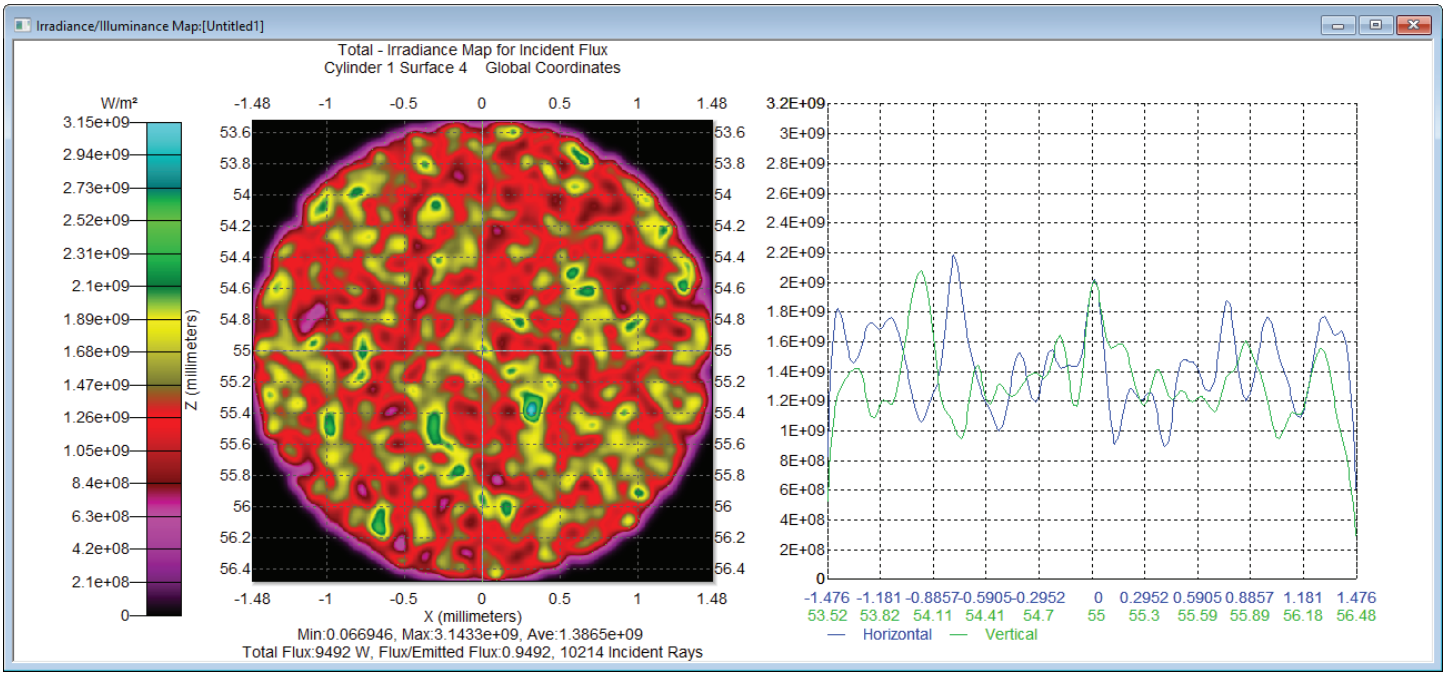
1. Select the Model tab in the system tree, and select the end of the lightpipe, Surface 4 in this example.
2. Select **Analysis|Irradiance/Illuminance Options**, update the options as shown, and click **Apply**



Display the Irradiance Map

With the end of the lightpipe selected you can display raytrace results. An irradiance map displays the flux per unit area over a surface.

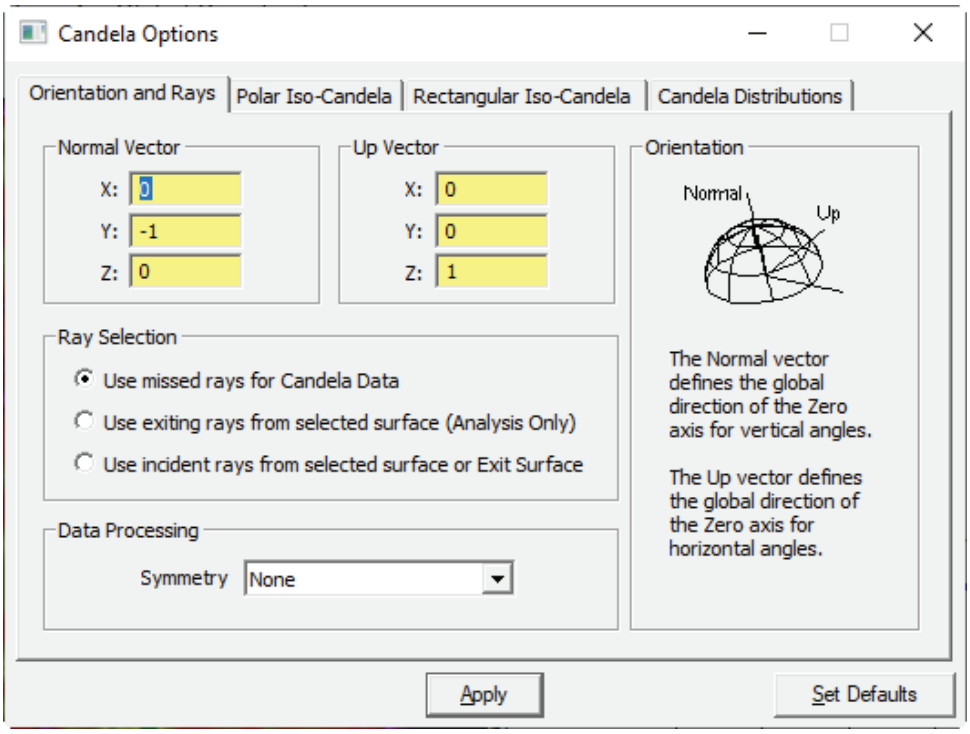
1. Select **Anaylsis|Irradiance/Illuminance Maps**.
2. A summary of the plot is located at the bottom. The *Flux/Emitted Flux* number at the bottom of the plot shows the ratio of the incident flux on the surface divided by the flux emitted from the source, i.e. the grid of rays. The line plot at the right shows the cross-sectional profiles anywhere that you click on the irradiance map. The green line in the right hand plot shows the vertical cross section of the irradiance map and the blue line shows the horizontal. By selecting the relief map irradiance option you can change the irradiance map into a 3D representation, with height indicating irradiance or illuminance. Notice that the number of rays hitting the exit surface is over 10,000 which is more than you originally traced in the grid source. This is due to rays hitting the exit surface, splitting into Fresnel components and reflecting back to the entrance face where it is again Fresnel reflected back to the exit face.

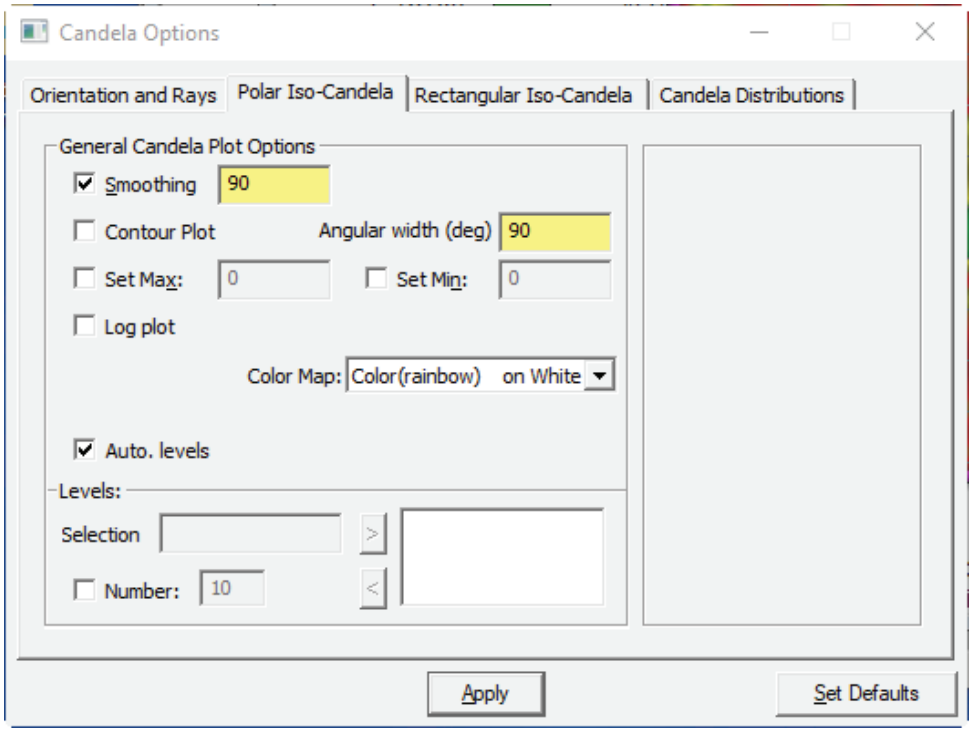


Candela Options

The **Candela Map Options** may be set at any time to modify the display of the Candela Plots.

1. Select **Analysis|Candela Options** to open the Options dialog box, update the options as shown for the Orientation and Rays tab and the Polar Iso-Candela tab, and click **Apply**.





Polar Iso-Candela Plots

Candela Plots provide information on the angular distribution of flux and are often based on "Missed Rays" in TracePro.

1. Select **Anaylsis|Candela Plots>Polar Iso-Candela** to open a Polar Iso-Candela window.
2. A summary of the plot is located on the bottom of the plot.

To decrease the noise in the plot, increase the number of rays in the grid source and re-run the ray-trace.