Raytrace and Analysis

Requirements

Models: EllipticalReflector.oml

Properties: None

Editions: TracePro LC, Standard and Expert

Introduction

This tutorial uses an example TracePro model to illustrate opening and viewing model data, raytracing and displaying analysis output. The steps described are common to most TracePro analysis.

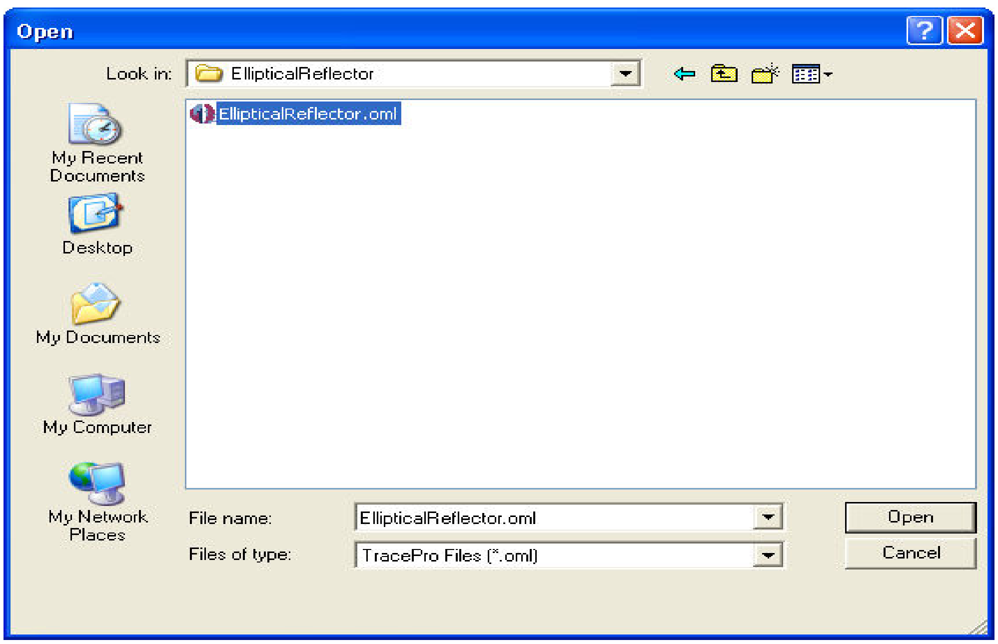


Figure 1. Open TracePro file EllipticalReflector.oml

1. Select the **File|Open** menu to display the Open file dialog box.
2. After the Open file Dialog box appears, browse to the location of the downloaded EllipticalReflector.oml file.
3. Click on the **EllipticalReflector.oml** file to open.
4. The extension of all TracePro files is OML. The OML file is based on the SAT format which is the ACIS standard file format. TracePro is built on the ACIS CAD Engine, which is used in many CAD programs and has Import/Export capability.

The Model Window

The elliptical reflector and metal halide bulb will appear as shown in the Model Window. The Global Origin is located at the XYZ Axis. All measurements are relative to this location. The Model Window is split into two panes showing the geometry and the System Tree

1. To resize the system tree, move the cursor to the splitter bar and wait until the cursor changes to a double bar cursor, hold the left mouse button down and pull the cursor to the right or left.
2. Alternatively, you can use the **Window|Split** menu to position the cursor.
3. When you first open the model, the model may not fit the screen, it may overfill it. To zoom it to the size of the screen, click on the zoom all icon (or select **View|Zoom|All**). 
4. The program will then size the full system to fit the screen. The system will now look as shown below.

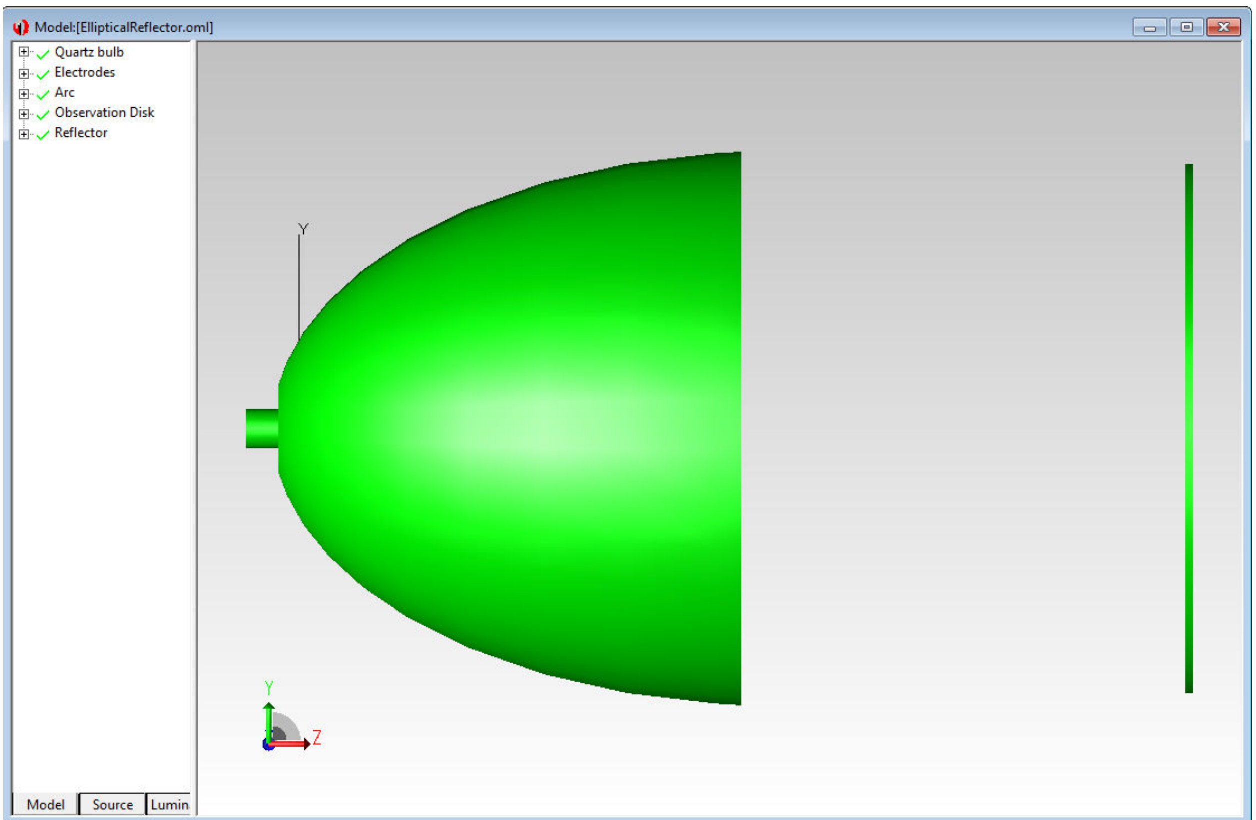
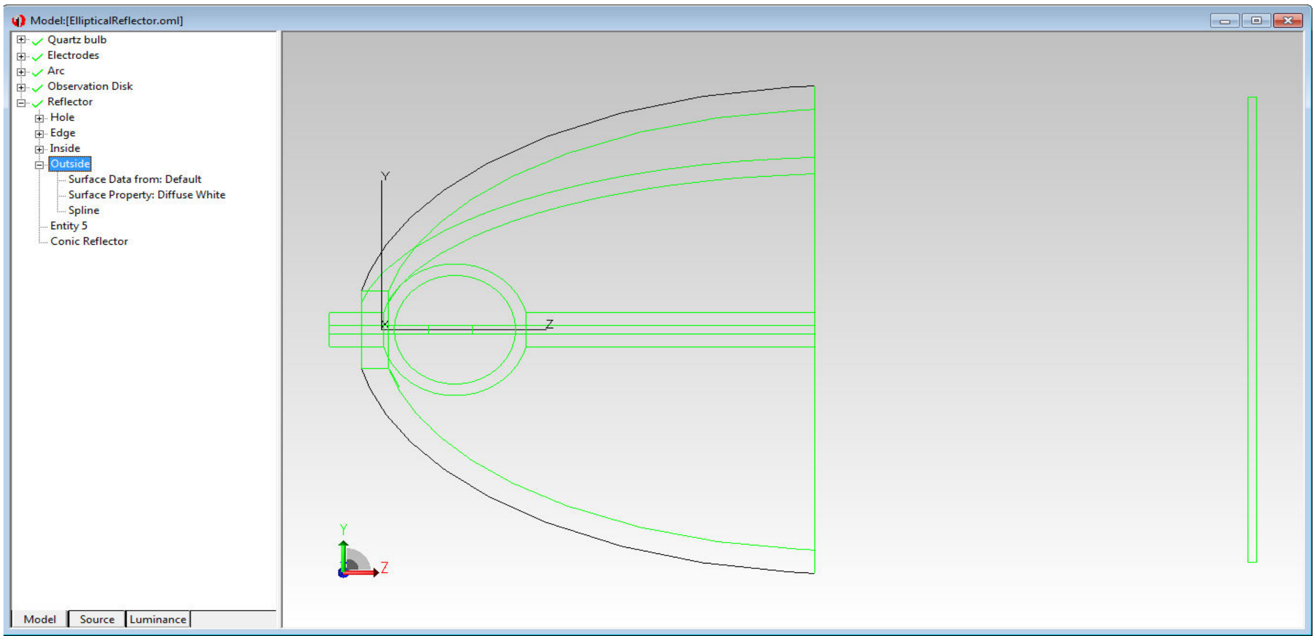


Figure 2 - TracePro Elliptical Reflector model

Now we can change from the Default **Render** Viewing mode to **Silhouette** Viewing mode view by selecting **View |Silhouettes.** This viewing mode makes it much easier to select surfaces and objects when setting up the system.



Using the System Tree

The System Tree contains all the information about the objects and surfaces in the system model.

1. Left Clicking the mouse button on the plus sign before an object or surface expands the item in the system tree, and shows information on that object or surface.
2. Clicking on the minus sign in front of an object or surface collapses this information.

This information consists of the surface properties, type of surface and material properties of an object. Further information may show if it is a source, an exit surface or if any other property is applied.

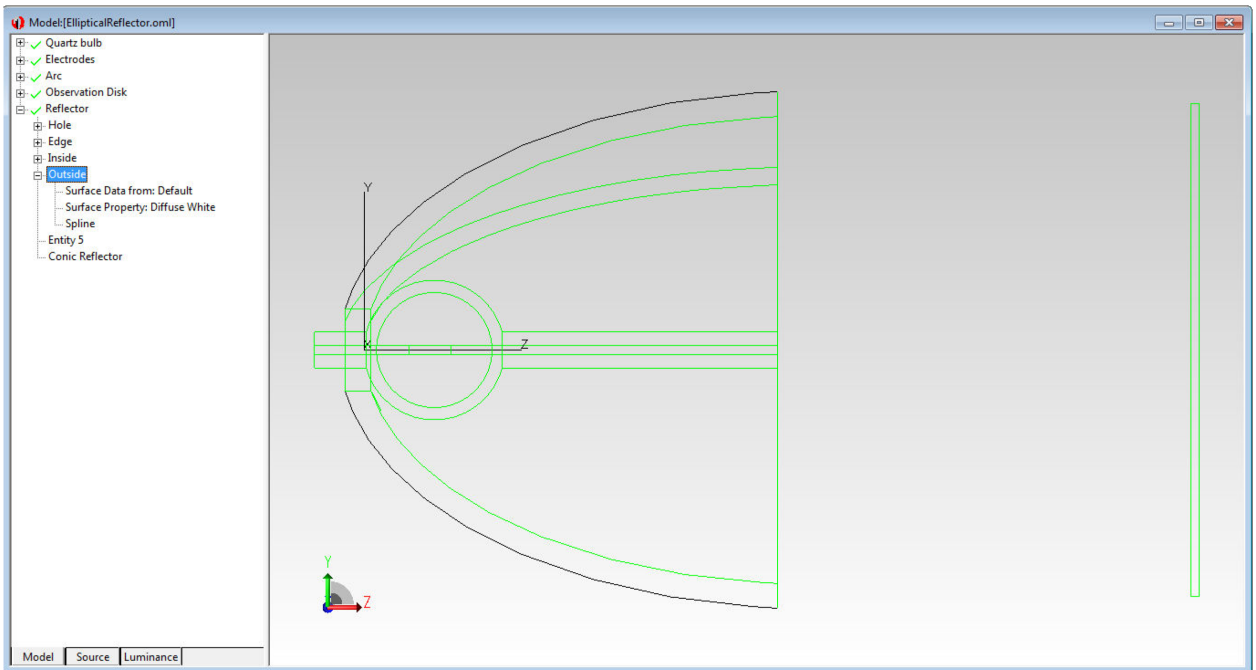


Figure 3 - System tree

Selecting Surfaces and Objects

There are two methods for selecting an object or surface in TracePro. You can use either the main viewing window or the system tree.

1. To use the main viewing window:

- Left mouse click on the Select Object icon to start the selection of objects (or use Edit|Select|Object).
- Left mouse click on the Select Surface icon to stat the selection of surfaces (or use Edit|Select|Surface).
- After clicking on the icon it will look pushed in.
- If the icons are grayed out first click on the main viewing screen to activate these icons.
- You can now select objects or surfaces by positioning the cursor on top of the object or surface to be selected and left mouse click. You can also select multiple surface and objects by holding down the <CTRL> key while performing the selection process.

2. To use the System Tree:

- Select an object or surface by clicking on the Object or Surface label in the system tree.
- The object or surface will be highlighted in black on the main viewing window and background highlighted in blue in the system tree as shown to the right.

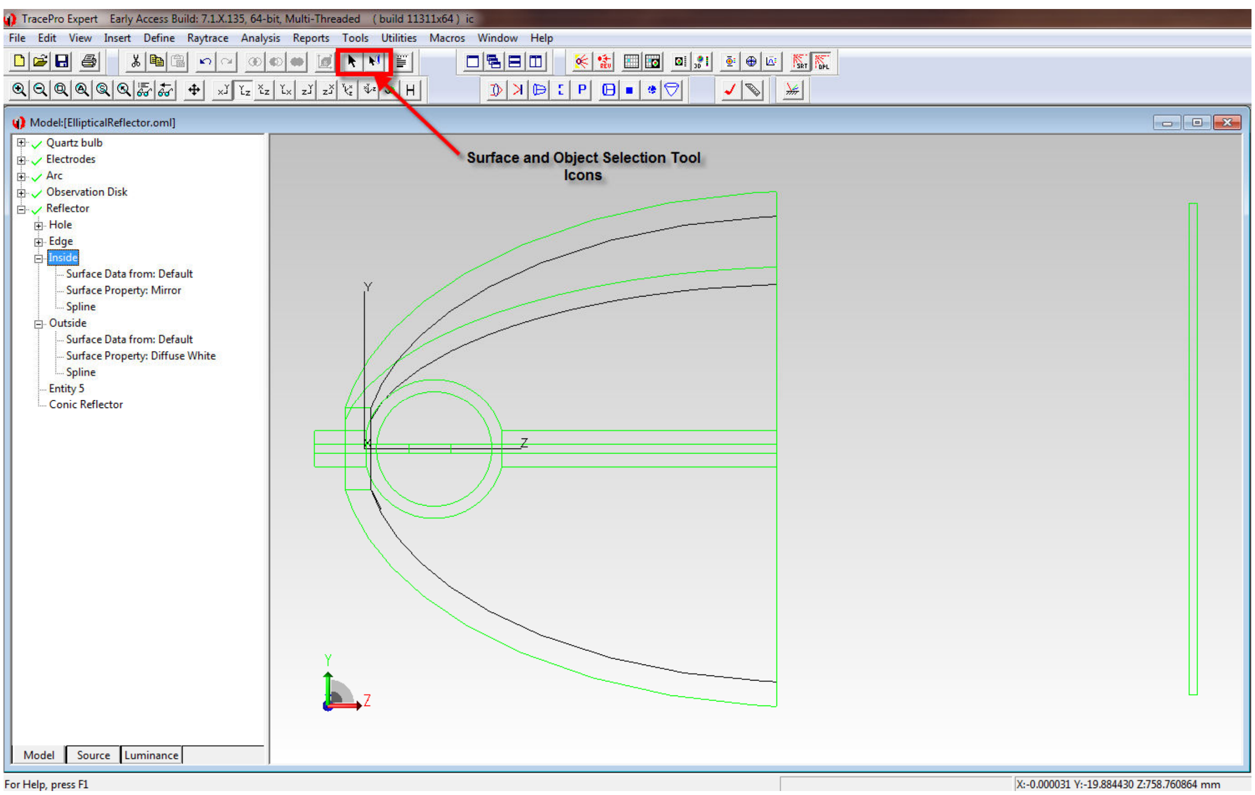


Figure 4 - Object and Surface selection

Modifying Surface Sources

This model uses a **Surface Source**. This source is defined on one of the surfaces of the **Arc** object. Open the **Arc** object definition by left mouse clicking on the "+" next to the **Cyl** surface. This will open the **Cyl** surface definition.

1. You can now modify this **Cyl** surface in the **System Tree** by right mouse clicking inside the main viewing window. A dialog box will appear with multiple options. Left mouse click on the **Properties** option. An **Apply Properties** Dialog Box will appear as shown in the figure below. Another quick method of bringing up the **Apply Properties** Dialog Box to the correct set of information in the system tree is to double left mouse click on any of the surface property information in the system tree. For instance double left mouse clicking on the Flux=10.00000 lumens in the system tree brings up the Apply Properties dialog.
2. Change the number of rays from 100000 to 7500 and left mouse click on the **Apply Button**. The information for the source definition will change to 7500 rays in the **System Tree**. Now, reset the number of rays back to 100000.

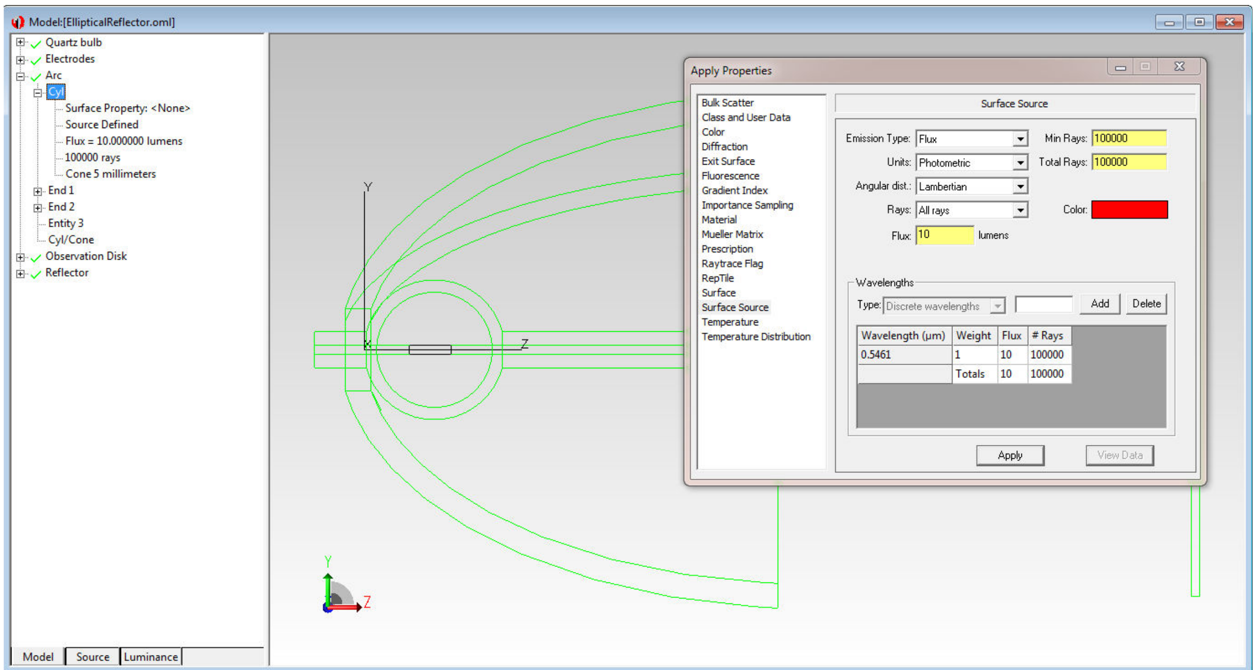


Figure 5 - Apply Properties dialog box

Tracing Rays

To trace rays from the **Cyl** surface source, click on the **Trace Rays** icon.

1. The program will first perform an audit and compute Voxels function. The Audit function tests the system geometry for defective objects, and then applies the properties and materials to each object and surface. Voxelization is a method of "allocating" the geometry in the model to specific zones to improve raytrace speed. Increasing the number of voxels improves raytrace speed at the expense of Audit speed. The number of Voxels can be set in the **Raytrace | Raytrace Options Advanced Tab** dialog.

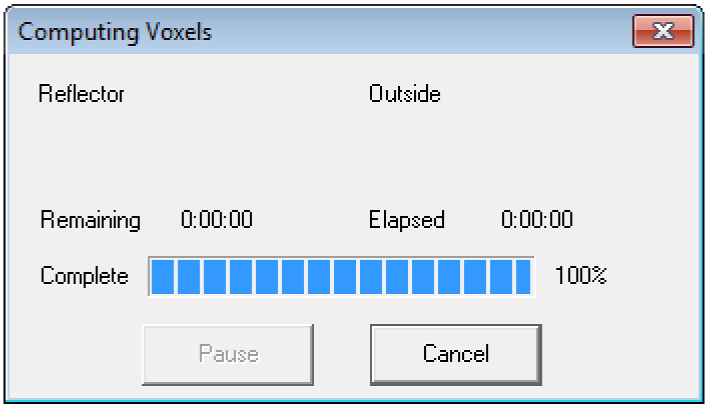


Figure 6 - Performing Audit dialog box

2. After the Audit function is complete the program will trace all 100000 rays. A Raytrace Progress report is displayed. The Progress report displays the number of rays traced so far and an estimate of how long the ray trace will take. It will also show you the wavelength for each source.

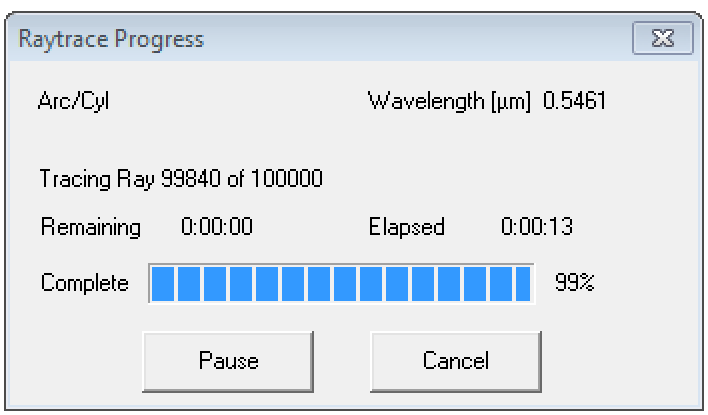


Figure 7 - Raytrace Progress dialog box

Viewing the Raytrace

On completion of the ray trace all rays are displayed on the main viewing window. If this does not occur check to make sure the **Display Rays** option in the **Analysis Menu** is checked.

By default, the color of each ray traced indicates the flux of the ray. Red rays have flux from 100 to 66 percent of their beginning ray flux. Green rays have flux between 66 and 33 percent and Blue rays are between 33 and 0 percent.

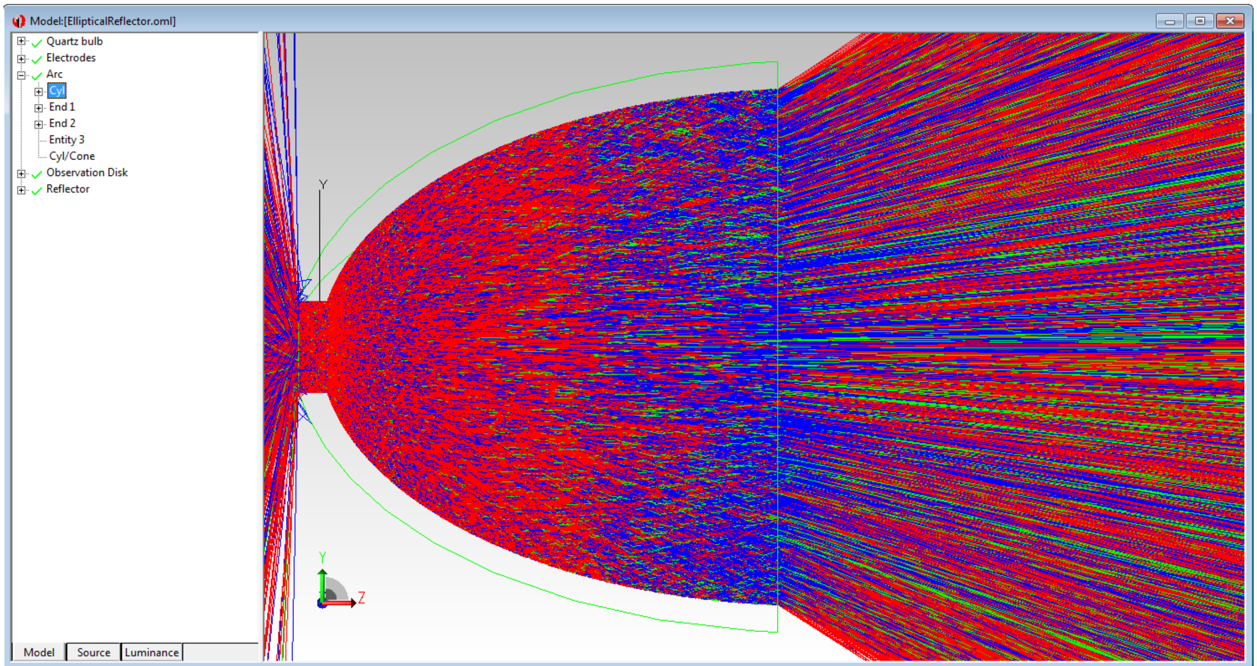


Figure 8 - Raytrace of 100,000 rays

Raytrace Mode and Irradiance Plots

There are two modes to analyze systems in TracePro, **Analysis** and **Simulation** mode. Analysis mode lets the user look at Irradiance/Illuminance Maps and Candela plots on any surface. Simulation mode lets the user look at only exit surfaces that must be defined before a ray trace takes place. Simulation mode uses much less virtual memory due to the smaller amount of information saved and usually traces faster.

By default **Analysis** mode is on. Start by looking at an **Irradiance/Illuminance** map for this system.

1. First, select the **Observation Disk** object and then the **Front** surface.
2. Next click on the **Irradiance Maps** icon to see the plot shown at the left side of the figure below.
3. Click on the **Tile Vertical** icon to split the screen to show both the System View and Irradiance Map at the same time as shown in the figure below.

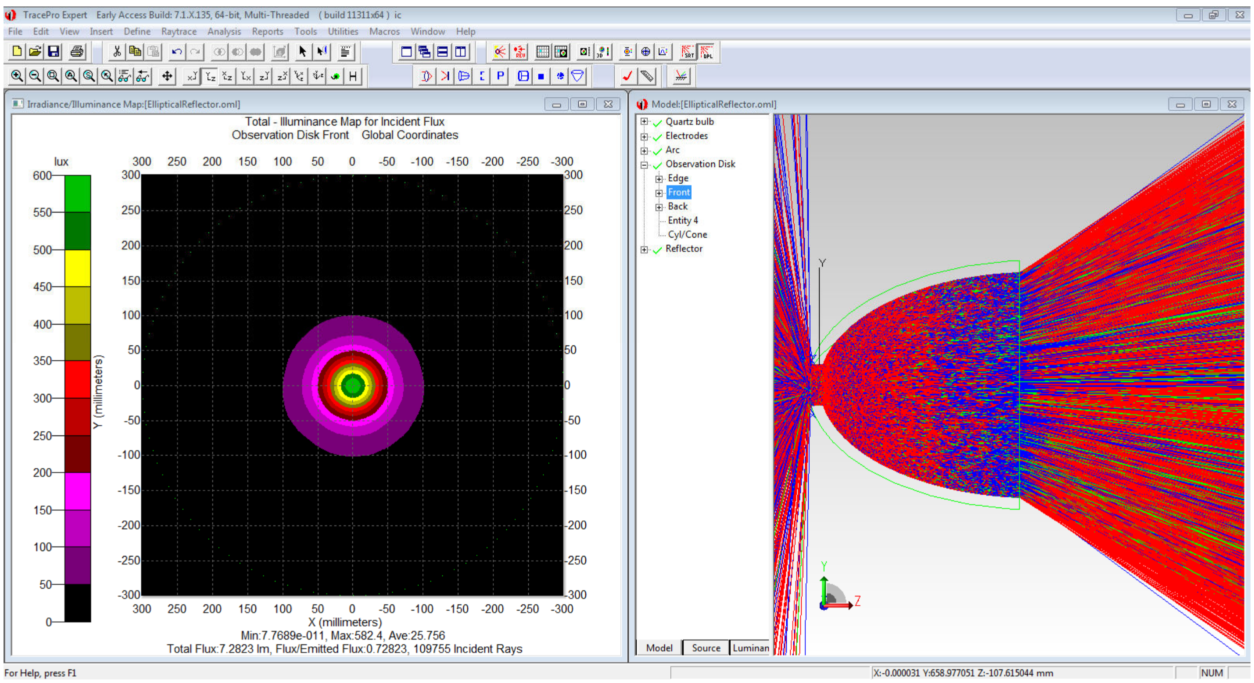


Figure 9 - Irradiance map of rays traced with the front of the observation disk selected in the system tree

Understanding the Irradiance Options

The **Irradiance/Illuminance Options** dialog box is shown below. This dialog box is available from the **Analysis Menu** and is used to set all the parameters for the **Irradiance/Illuminance Map**.

The default Rays to Plot setting is Absorbed rays. If you do not see any irradiance/illuminance on a surface, change this option to **Incident** and an Irradiance/Illuminance Map should appear. This system is set to Radiometric units so that all output units are shown in Watts and Watts per meter squared.

To change radiometric units to Photometric, select **Analysis|Raytrace Options** and change the Radiometric Units setting, this will automatically update your irradiance plot to photometric units, if it is displayed.

The foreground and background colors of the map are set using the **Color Map** option. Black&White and Grayscale maps are good for sending maps over faxes or Black and White printers. Color is best for pseudo-color display.

The **No. of Pixels** option determines the number of pixels used by the map to collect rays. A value of 20 divides the detector into a 20x20 grid of pixels, counts the rays striking each section of the grid and then totals the energy of these rays together. Larger counts show more detail and provide a more accurate view of what is happening on the map. Smaller counts let you trace fewer rays and get a quick, approximate idea of what the system looks like.

The **Smoothing** option applies a Gaussian smoothing across the detector pixels to smooth out choppy or non-contiguous data. Use this to trace fewer rays while debugging your system or while in early design stages and let the Gaussian smoothing function fill in the missing data.

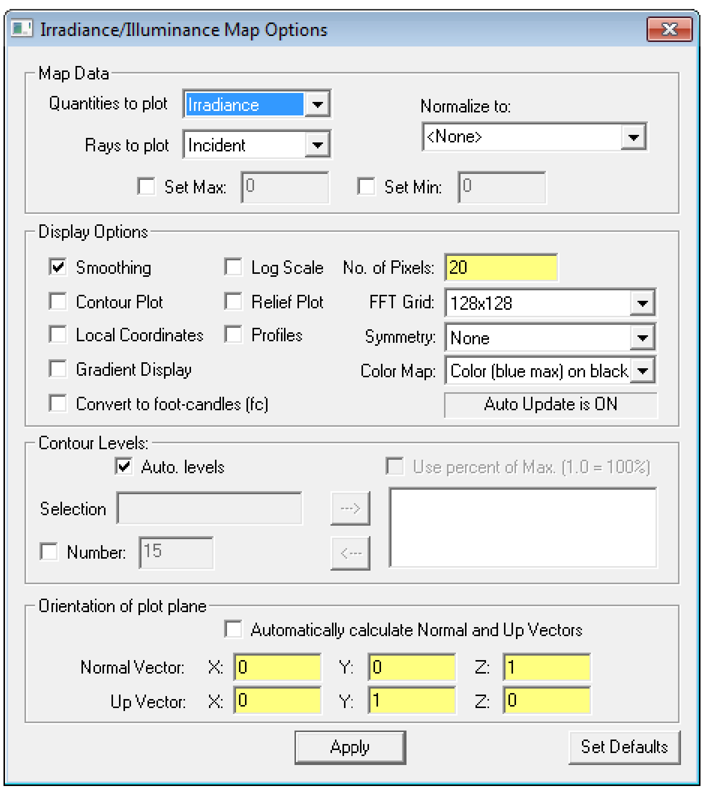


Figure 10 - Irradiance/Illuminance Map Options

Understanding the Irradiance Options

The **Profiles** option creates cross sectional plots of the map. Clicking anywhere on the map will show across section in both profiles of a horizontal and vertical cut through the map. The profiles intersect at the point you clicked.

The **Normal** and **Up Vector** selection sets the projection plane that all rays will be collected on. If you have a doubt about what the collection plane is, the program can automatically calculate the **Normal** and **Up** vector for you. Just click on the **Automatically calculate Normal and Up Vector** box. Remember you must click **Apply** before any option is applied to the map.

- The normal vector is the vector that is perpendicular to the collection plane.
- The Up vector is parallel to the vertical side of the plane.

If the **Normal** and **Up** vector are defined with the wrong values, the map may look incorrect. This incorrect map may look like a slice if the selected plane is perpendicular to the correct plane or may show no results at all.

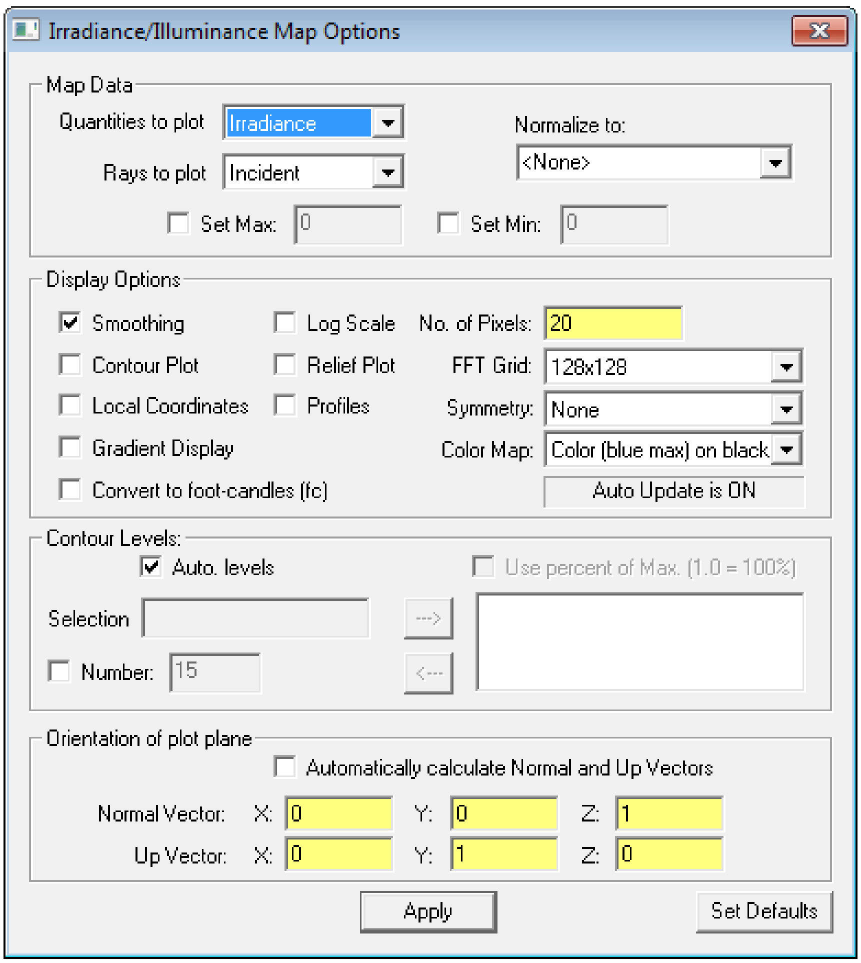


Figure 11 - Irradiance/Illuminance Map Options (same as used in figure 10)

Incorrect Normal and Up Vectors

Irradiance map of the observation plane with the wrong **Normal** and **Up** vectors have been selected as shown in the figure below. The plot is no longer displayed correctly in the plane of the observation surface.

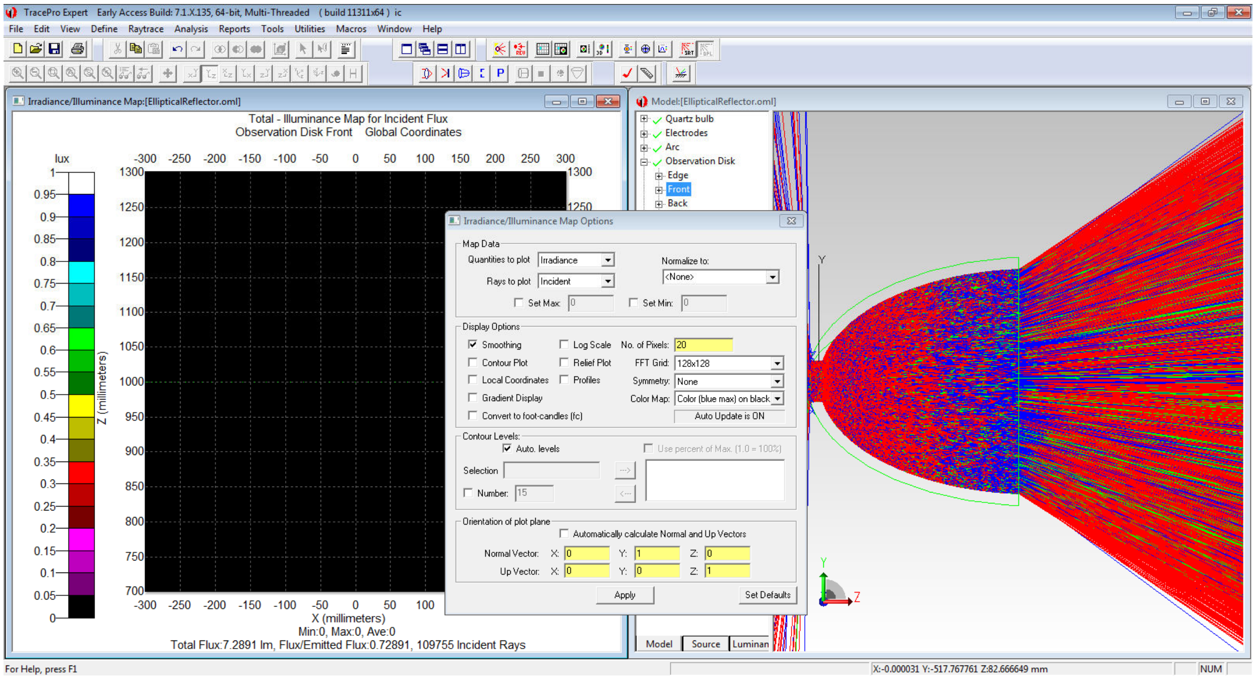


Figure 12 - Irradiance/Illuminance Map with options changed

3D Irradiance/Illuminance Map

To display a **3D Irradiance/Illuminance map** on all of the surfaces and objects selected in the system tree, select the **Analysis | 3D Irradiance/Illuminance** Option. To create a **3D Irradiance/Illuminance Map** of the Elliptical Reflector system that we have been working on, follow these steps:

1. Turn the ray display off, **Analysis | Display Rays** or click on the Display Ray icon.
2. Select the **Observation Disk|Front** surface and **Reflector|Inside** surface in the System Tree.
3. Set the **3D Irradiance/Illuminance Map Options**, **Analysis | 3D Irradiance/Illuminance Options** as shown in the figure 13 below.
4. To show the 3D map select **Analysis | 3D Irradiance/Illuminance** or click on the icon.

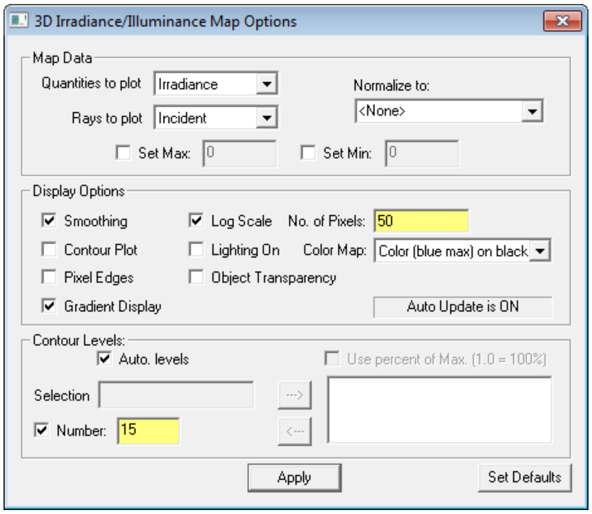


Figure 13 – 3D Irradiance/Illuminance Map with options set

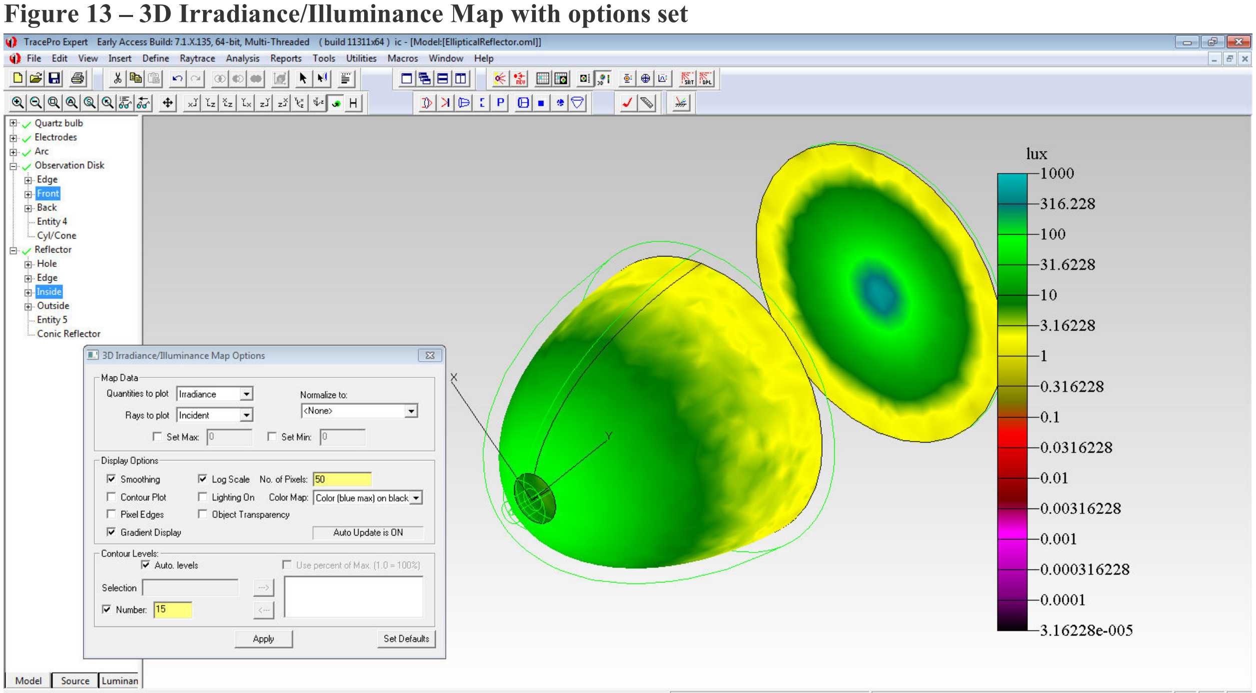


Figure 14 – 3D Irradiance/Illuminance Map of the Elliptical Reflector System