

Defining / Applying Properties

- A database of surface properties and material properties is maintained by TracePro
- The user can define custom surface and material properties and add them to the database
- These custom properties become available for all subsequent models
- The application of these properties is easily accomplished and verified through the user interface

“Optical” Properties

- Surface Properties
 - Describes how light is reflected, transmitted, absorbed, and scattered at a surface
 - Energy is conserved: $a + r + t + \text{TISr} + \text{TISr} = 1$
 - Scatter portions (TISr, TISr) are described by Bidirectional Scatter Distribution Functions (BSDFs)
 - BRDF: Bidirectional Reflectance Distribution Function
 - BTDF: Bidirectional Transmittance Distribution Function
- Material Properties
 - Describes the material of the object in terms of its index of refraction and bulk absorption coefficient
 - Governs how light refracts into the object

Material Property Editor

Material Property Editor

Catalog: SCHOTT Name: BK7 ☒ Read Only

Description: Schott Glass

Interpolation: Sellmeier Milspec: 517642 Wv Range: 0 to 0

a1 1.03961212 a2 0.231792344 a3 1.01046945 a4 0.006000698 a5 0.020017914 a6 103.560653

Wavelength	Absorption
0.3	0.269414729593322
0.31	0.105526548416474
0.32	0.0421442062631305
0.334	0.0102586588775101
0.35	0.00281978487590033
0.365	0.0012036144651126
0.37	0.00100250836470886
0.38	0.000801604279507764

Interpolation
formula

Discrete index
values

Material Property Editor

Catalog: PLASTIC Name: Acrylic ☐ Edit Enable

Description:

Interpolation: Table Milspec: Wv Range: 700 to 400

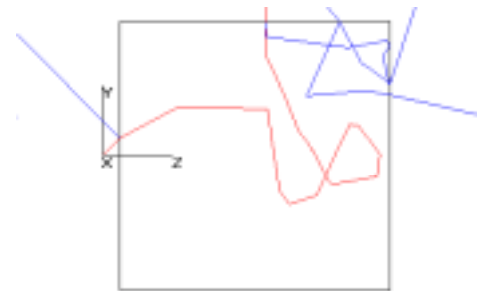
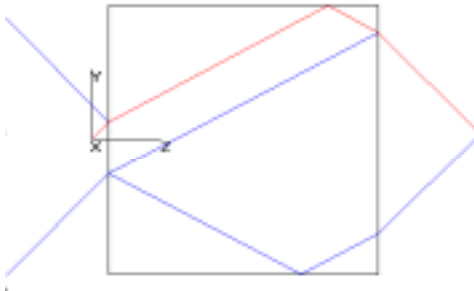
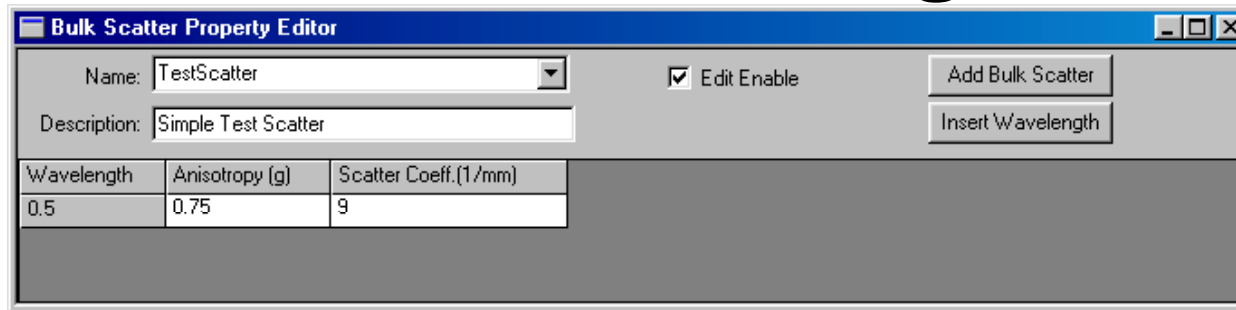
Wavelength	Index	Absorption
0.4861	1.496	0
0.5893	1.491	0
0.6563	1.488	0

Surface Property Editor

Angle	absorptance	specular refl	Integrated BRDF	BRDF A	BRDF B	BRDF g	specular trans	Integrated BTDF	BTDF A	BTDF B	BTDF g
0	0.01	0.01	0.0001324053657559	1e-005	0.015	2	0.9797226063471	0.000144988287127	1e-005	0.01	2

- If no specular data is entered, TracePro uses the Index from the Material property to calculate Fresnel reflectance and transmittance
- **Coating** allows specular data to be defined for wavelength and angle
- **Polarization** allows S & P specular data
- **Retroreflection** replaces Specular Transmittance
- **Solve for** assures conservation of energy and quick scatter calculations
- Data is relative to incident angle and wavelength

Bulk Scattering



- The bulk scattering property works in conjunction with an objects material property. To use bulk scattering you must apply a material property appropriate for the volume within which the scattering is to be modeled and to apply a Bulk Scattering property.

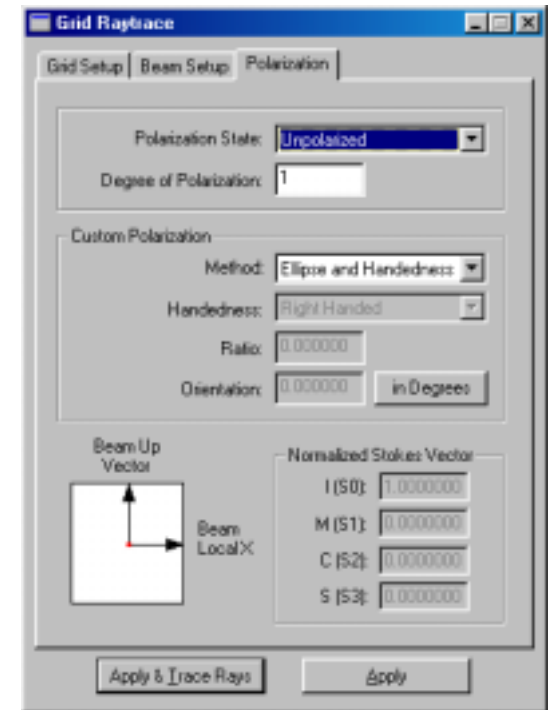
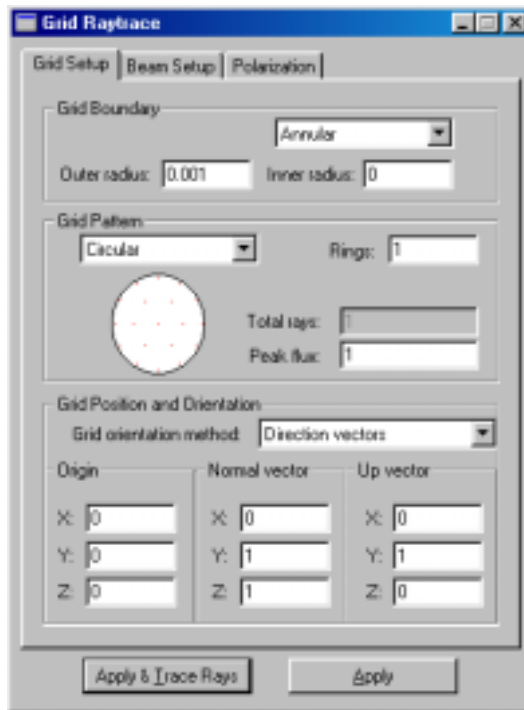
TracePro Properties

- Object or Volume Properties
 - Material
 - Bulk Scattering
 - Mueller Matrix
 - Raytrace
 - Importance Sampling
 - Gradient Index (2.1)
 - Class and User Data (2.1)
- Surface Properties
 - Surface
 - Color
 - Prescription
 - Importance Sampling
 - Exit Surface
 - Diffraction
 - Surface Source

Sources of Light

- Three distinct types of Sources are available in TracePro
 - Grid Sources: independent of model geometry
 - File Source (from Radiant Imaging and other sources)
 - Surface Sources: directly tied to a surface in the model

Grid Sources



File Sources

- ASCII file with position, direction and flux
- May be generated by hand, Excel, ProSource
- Incident Ray Table may be saved in Source Format

```
!! Source file: C:\TracePro\TraceProData\SF6Prism\SF6Prism.oml
```

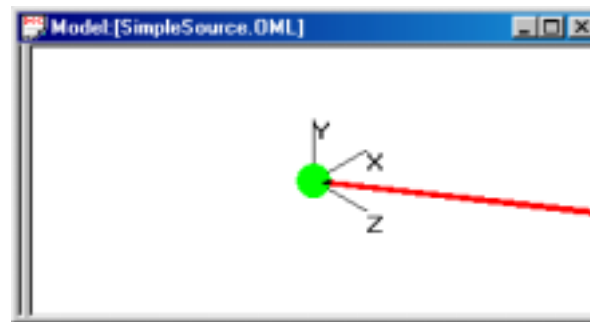
```
TracePro Version: 2 0 0
```

```
Data for Prism Surface 0
```

```
Linear Units in mm
```

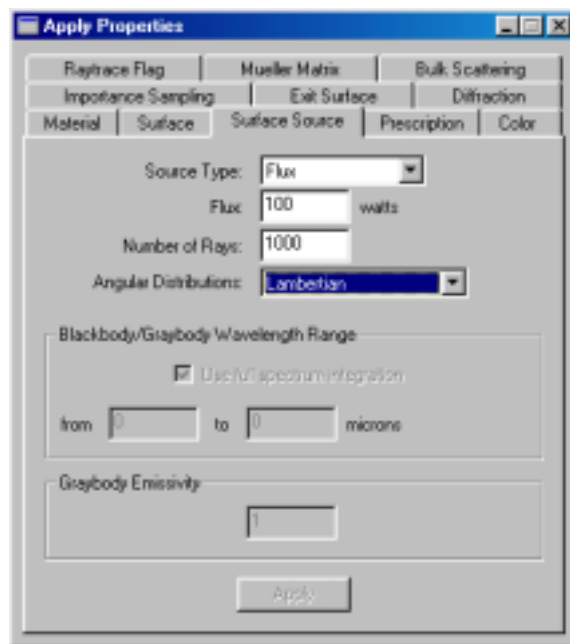
```
Data generated at 11:19:54 September 08, 1999
```

X Pos.	Y Pos.	Z Pos.	X Vec.	Y Vec.	Z Vec.	Inc Flux
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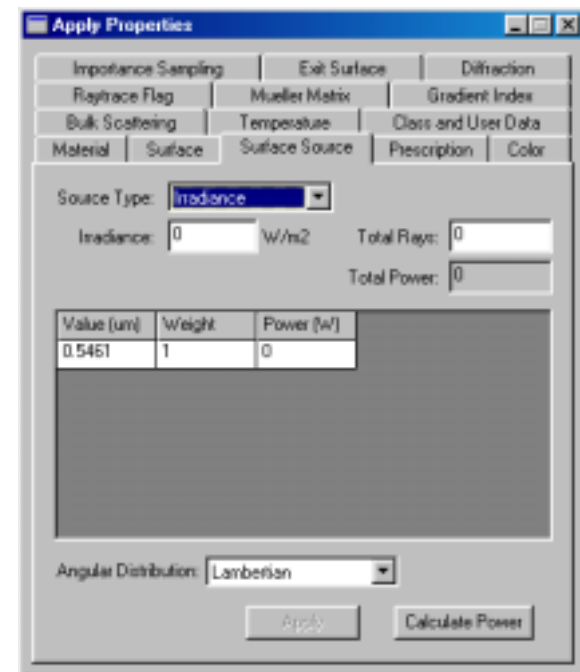


Surface Sources

- Any surface may be made into a source
- Flux may be entered by power, irradiance or temperature



V2.0

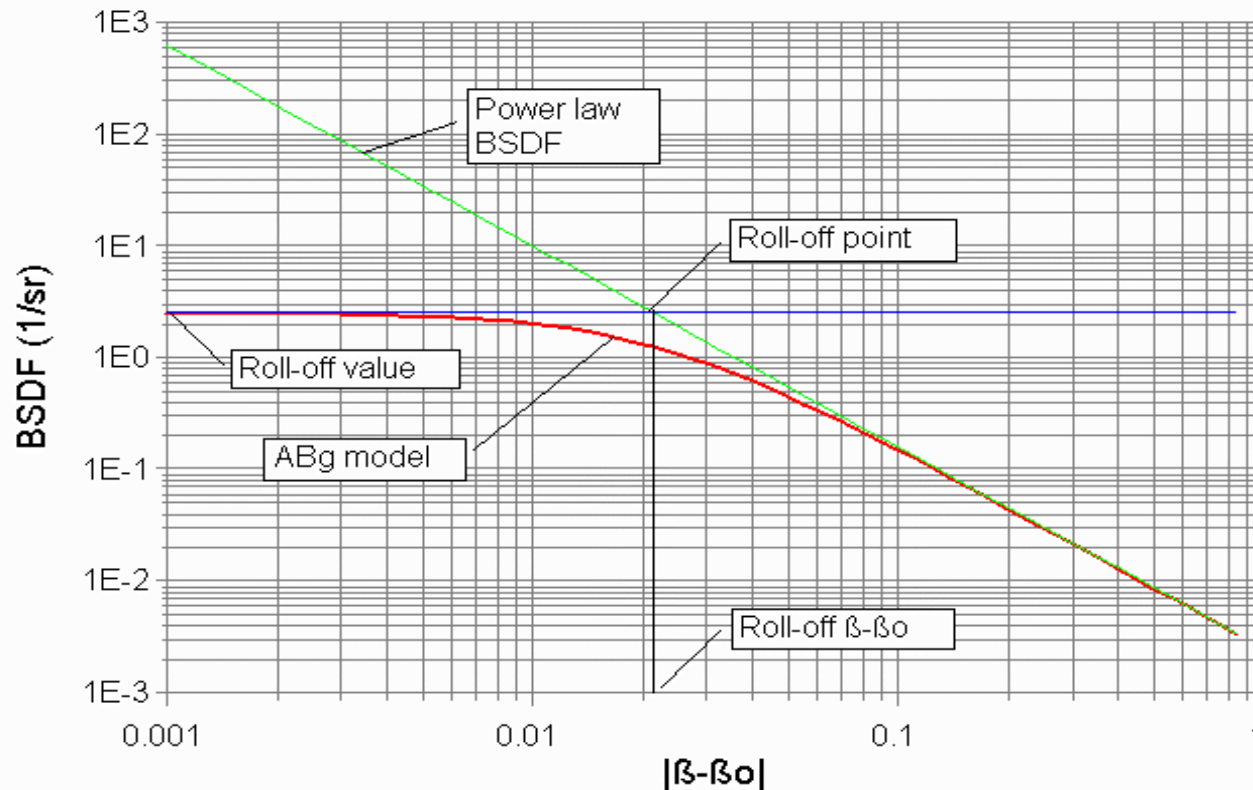


V2.1

True Scatter 3D Scatter Models

ABg BSDF model

$A=0.0025$, $B=0.001$, $g=1.8$



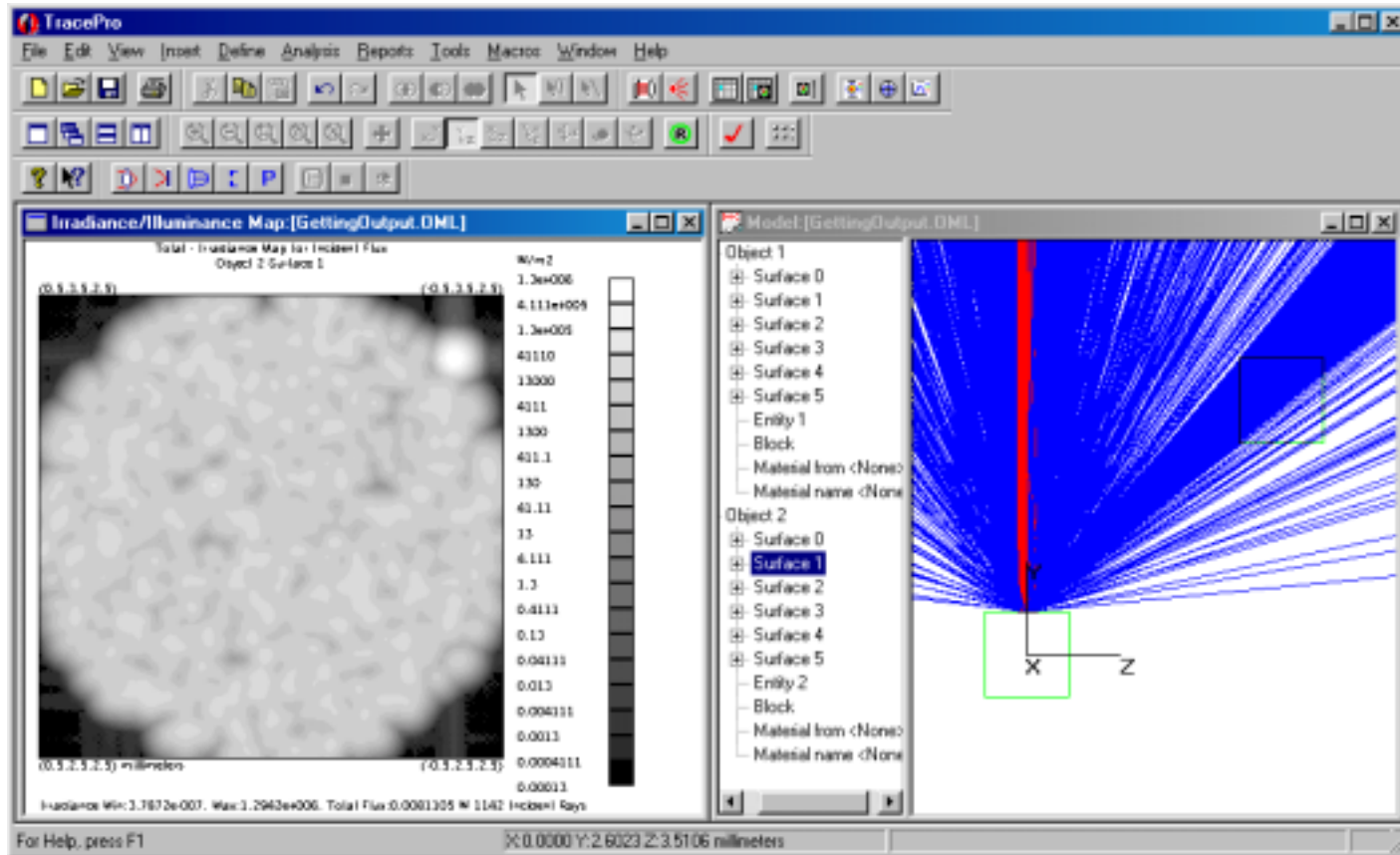
Getting Output

Analyzing the Results of a Raytrace

- TracePro has several ways to output data to analyze the results of a raytrace
 - Irradiance/Illuminance Maps
 - Candela/Intensity Plots
 - Incident Ray Tables
 - Ray Histories
 - Surface Flux Reports
- All reports, maps, and tables can be exported for post-processing

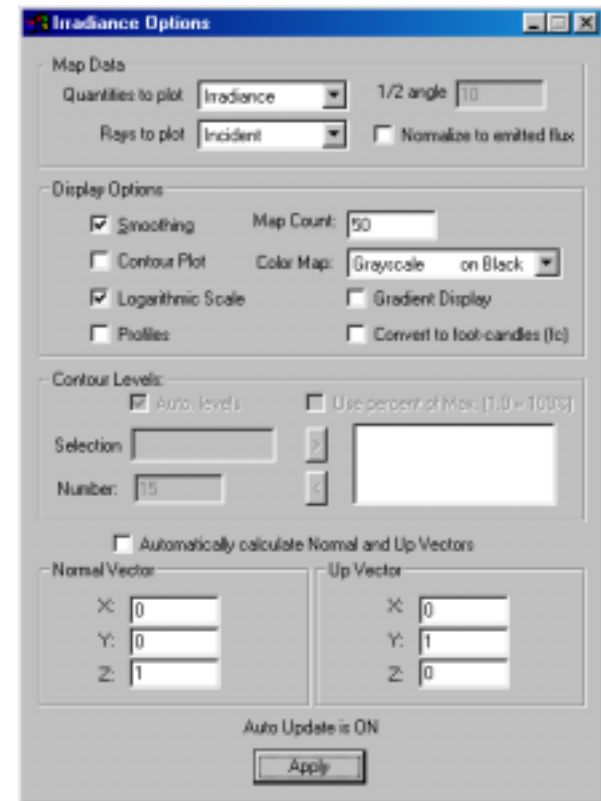
Irradiance/Illuminance

- Importance Sampling example.

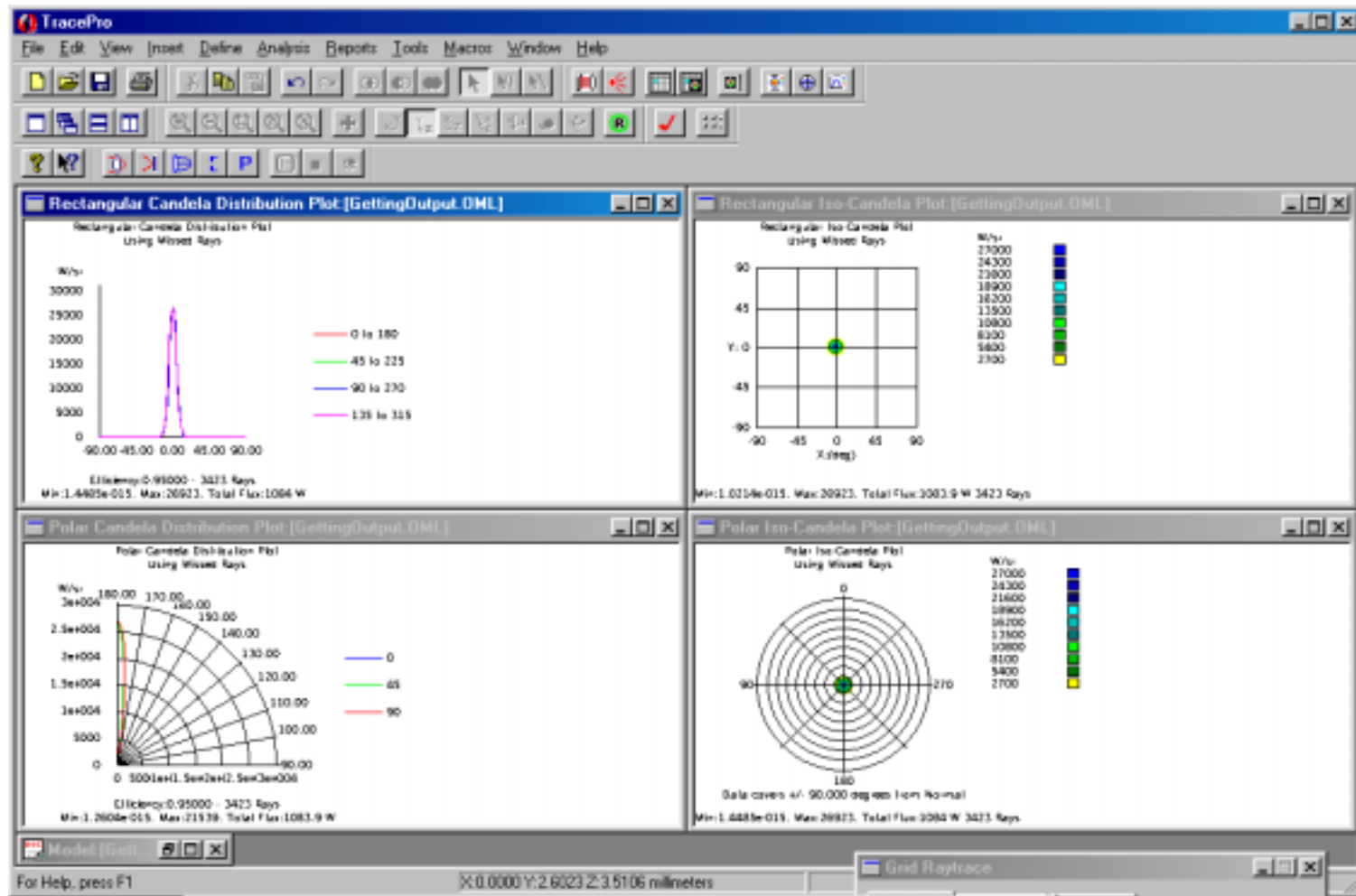


Irradiance/Illuminance

- Map and Display Options
 - Irradiance, Radiance (simple), CIE
 - Incident or absorbed flux
 - Smoothing, colors, contours
 - Data size
- Normal and Up Vector
 - Selected surface is projected to a plane
 - Normal is perpendicular to plane
 - Up defines relative +Y axis or Up on screen.
- Output Options
 - Text data, Bitmap or DXF via File SaveAs

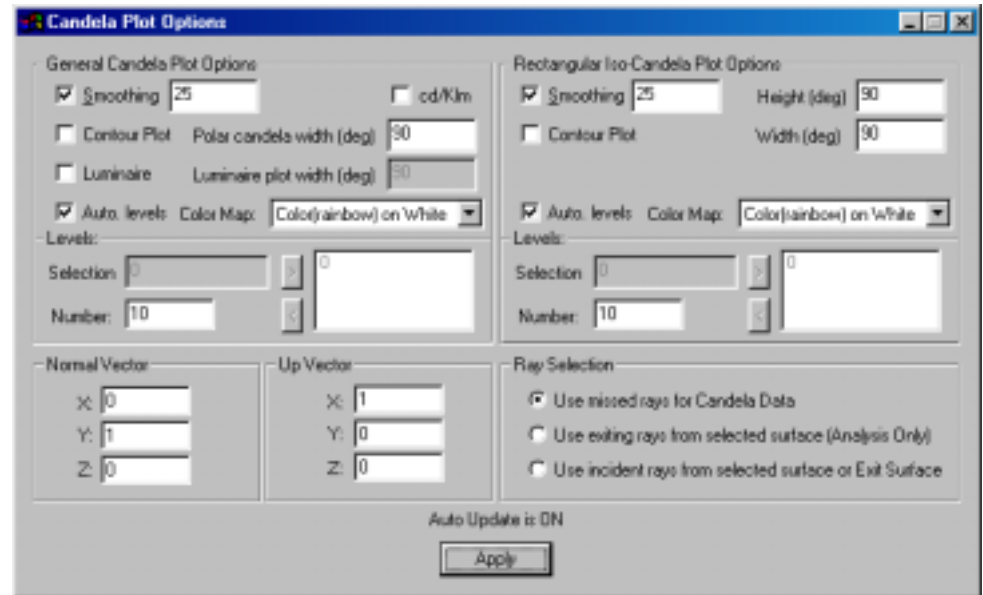


Candela Plots



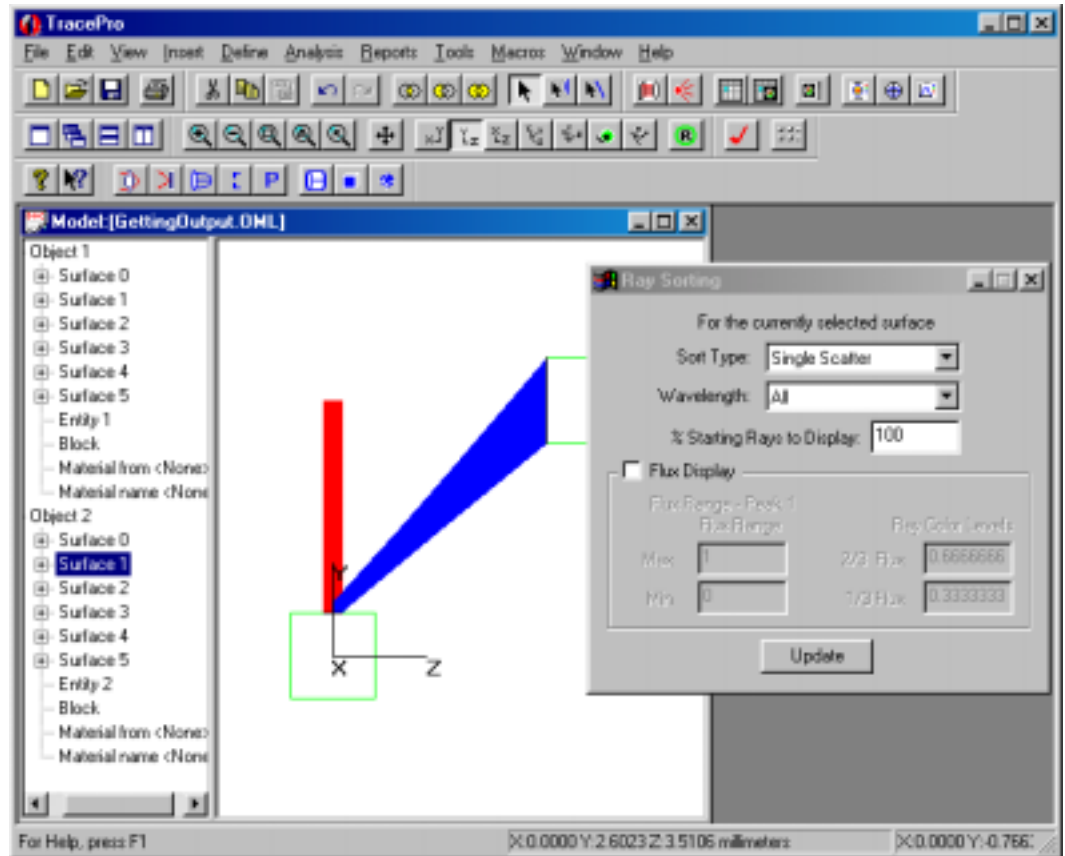
Candela Plots

- Candela is energy per solid angle.
- TracePro uses the ray direction to fill angular bins.
- Iso-Candela data is collected for a hemisphere and projected to a plane.
- Rectangular Iso-Candela data is projected onto a plane and collected in to square bins.
- Polar and Rectangular distributions are collected into bands.



Ray Sorting

- Allows selection of a subset of displayed rays.
 - Selected Surface
 - Scattered rays
 - Wavelength
 - Percentage of rays



Ray Tables

- Incident Ray Tables display rays for a selected surface.
- Ray History Tables display ray path from source to selected surface.

Incident Ray Table:[GettingOutput.OML]												
Object 2 Surface 1												
Ray Number	Wavelength	Start Ray	Ray Node	Type	History	Flux	X Pos.	Y Pos.	Z Pos.	X Vec.	Y Vec.	Z Vec.
1	0.5461	1	3	ImpRefl		5.93493e-006	-0.297043	2.68444	2.5	-0.0891174	0.655364	0.750037
2	0.5461	2	3	ImpRefl		5.96136e-006	-0.282217	2.75324	2.5	-0.0853465	0.667053	0.740105
3	0.5461	3	3	ImpRefl		5.9991e-006	0.12391	3.41885	2.5	0.0314641	0.759797	0.649398
4	0.5461	4	3	ImpRefl		6.02066e-006	0.225082	2.70482	2.5	0.0683563	0.660676	0.747552
5	0.5461	5	3	ImpRefl		6.05173e-006	0.167369	2.82529	2.5	0.0507346	0.680182	0.731286
6	0.5461	6	3	ImpRefl		5.77117e-006	0.456405	2.82859	2.5	0.133131	0.674749	0.725941

Ray History Table:[GettingOutput.OML]													
Object 2 Surface 1 Ray Number 1													
Wavele	Ray Node	Start Ray	X Pos.	Y Pos	Z Pos.	Flux	OPL	X Vec.	Y Vec.	Z Vec.	Type	History	Object Surface
0.5461	1	1	0	3	0	1	0	0	-1	0		Emitted	
0.5461	2	1	0	0.5	0	1	2.5	-0.0891174	0.655364	0.750037	ImpRefl		Object 1 Surface 4
0.5461	3	1	-0.2970	2.6844	2.5	5.93493e-006	5.83317	0	0	0		At Surface	Object 2 Surface 1

Flux Report

- Display summary information for all surfaces and objects in the mode.
- Provides options for wavelength selection.

Flux Report:[GettingOutput.OML]							
Display flux report for: wavelength totals							
Object Name	Number	Incident	Absorbed	Lost	Surface Area	Catalog	Material Property
Surface Name	of rays	[watts]	[watts]	[watts]	[sq mm]		Surface Property
Object 1			0			<None>	<None>
Surface 0	0	0	0	0	1		<None>
Surface 1	0	0	0	0	1		<None>
Surface 2	0	0	0	0	1		<None>
Surface 3	0	0	0	0	1		<None>
Surface 4	1141	1141	57.0499999999999	1083.94053973839	1		Mirror
Surface 5	0	0	0	0	1		<None>
Object 2			0			<None>	<None>
Surface 0	105	0.00193899467009391	0	0.00193899467009391	1		<None>
Surface 1	1142	0.00814250514813184	0	0	1		<None>
Surface 2	1	0.00131775645450247	0	0	1		<None>
Surface 3	52	0.000304547287052339	0	0.000304547287052339	1		<None>
Surface 4	935	0.00692011689571357	0	0.00692011689571357	1		<None>
Surface 5	51	0.000296602749774495	0	0.000296602749774495	1		<None>