How to Model Light Sources in TracePro

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TracePro

Question:

What types of light sources can you model in TracePro?

Answer:

Pretty much anything.

Examples

- LEDs
- OLEDs
- Arc lamps
- Filament lamps
- Lasers
- Fluorescent lamps
- HID lamps
- Sun
- Sky
- Fire
- Fluorescence

Types of Light Sources in TracePro

- Grid Sources
- File Sources
- Surface Sources
- Bitmap Sources

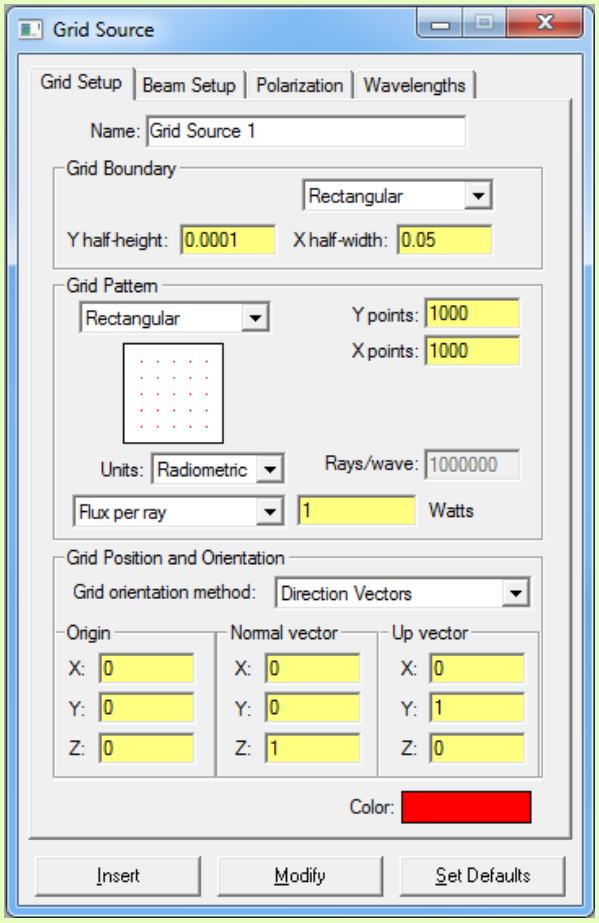
Grid Sources

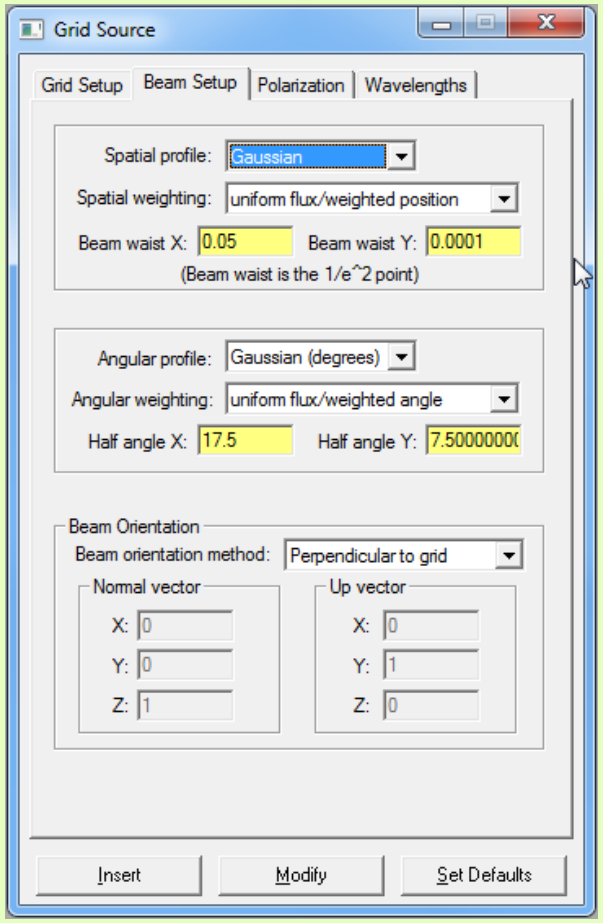
Best for:
- Planar sources that have a well defined boundary
- Sources that emit in a Lambertian or uniform manner
- Monochromatic and polychromatic sources

Considerations:
- Not the best option for a 3-dimensional source
- May not be able to model more complex angular distributions

Examples:
- Fiber optics
- Laser diodes

Grid Source - Laser Diode Example





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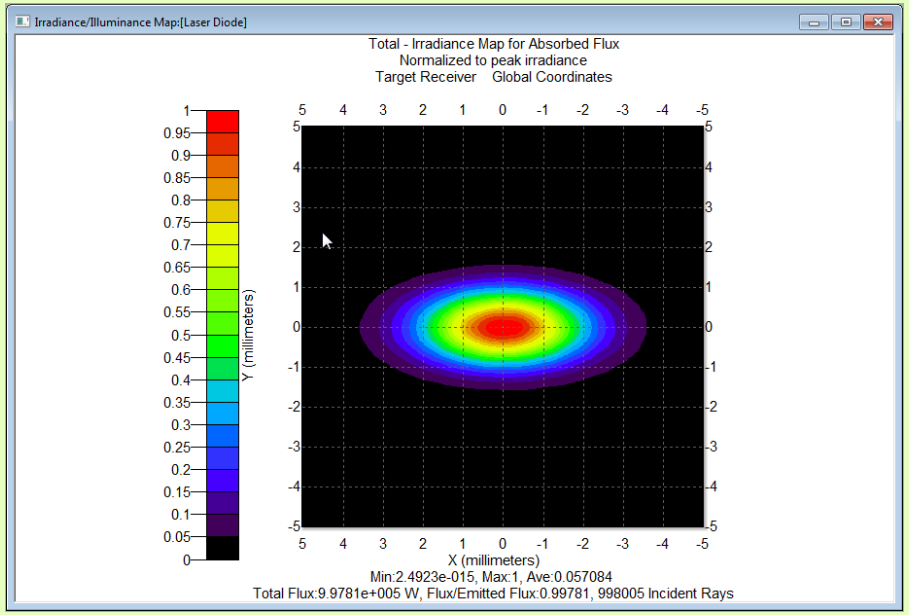
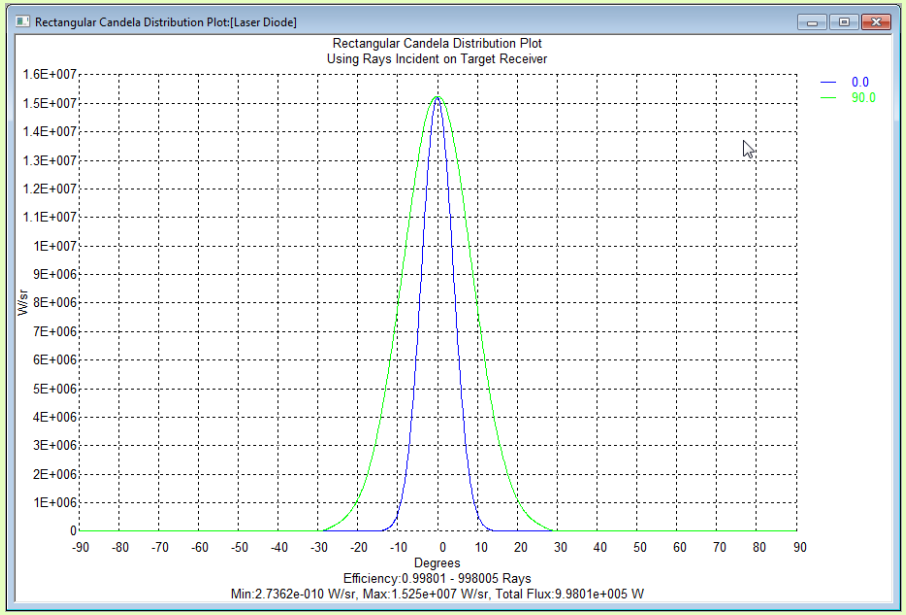
Grid Source - Laser Diode Example





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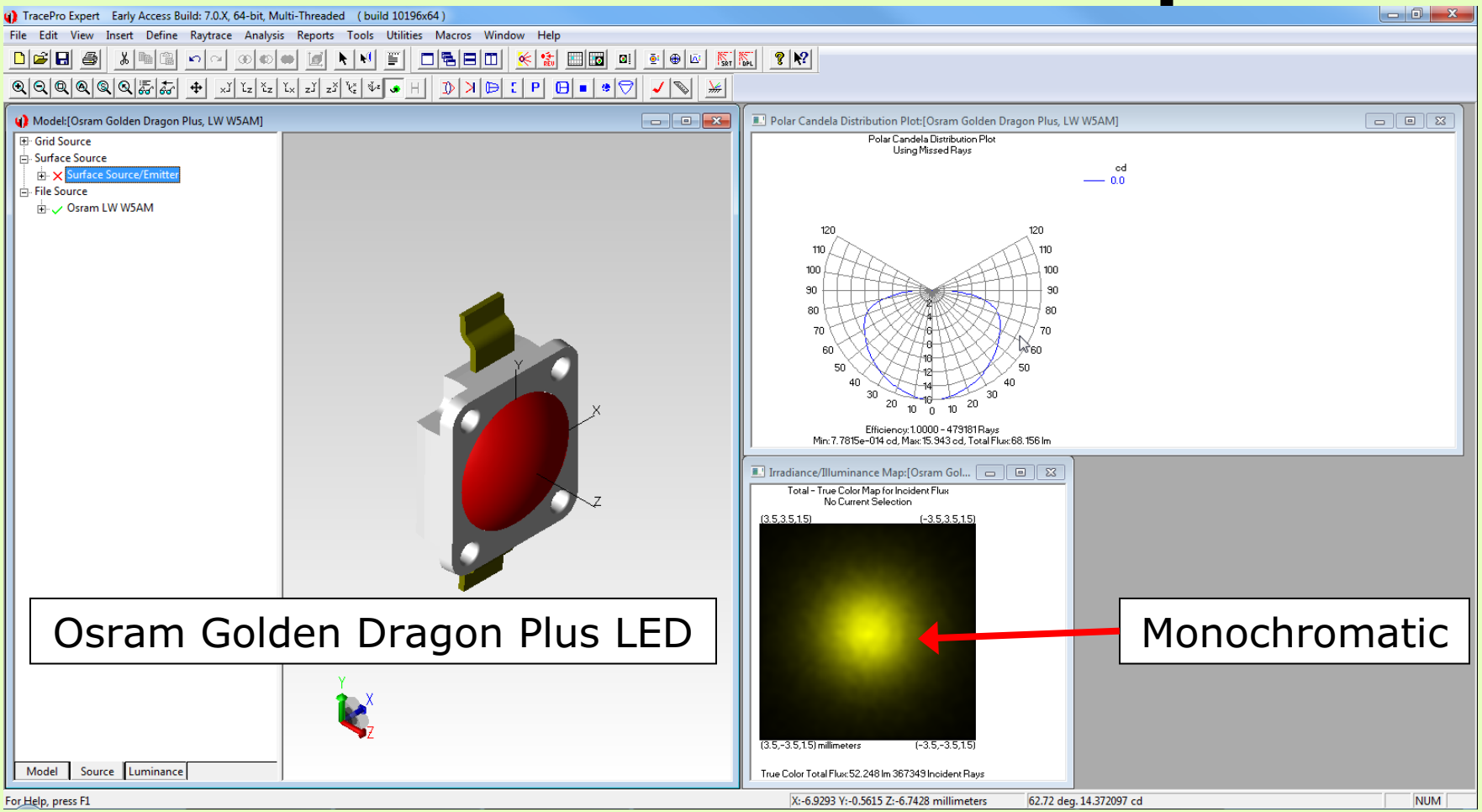
File Sources

Best for:
- Planar and 3-dimensional sources
- Sources that emit in complex angular distribution patterns
- Sources that can be modeled monochromatically
- Sources that have lenses and structural elements

Considerations:
- Defined monochromatically
- Not a good choice if emitted light will interact with source

Examples:
- LEDs
- Luminaires

File Source – LED Example



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Example of File Source or Ray File Data

```
!! Source file:

TracePro Release: 6 0 2 |
Data for Block 1 Surface 1
Linear Units in mm
Data generated at 15:51:06 January 20, 2010
X Pos.                  Y Pos.                  Z Pos.                  X Vec.                  Y Vec.                  Z Vec.                  Inc Flux
 0.000000000000000e+000  0.000000000000000e+000  4.900000000000000e+001  0.000000000000000e+000  0.000000000000000e+000  1.000000000000000e+000  9.164210624726462e-001
 3.241904746004420e-002  0.000000000000000e+000  4.900000000000000e+001 -1.943468304810075e-002  0.000000000000000e+000  9.998111287112282e-001  9.164242320047675e-001
 1.620952373002205e-002  2.807571866689163e-002  4.900000000000000e+001 -9.717341524050380e-003 -1.683092923415404e-002  9.998111287112282e-001  9.164242320047675e-001
-1.620952373002205e-002  2.807571866689163e-002  4.900000000000000e+001  9.717341524050373e-003 -1.683092923415404e-002  9.998111287112282e-001  9.164242320047675e-001
-3.241904746004420e-002  1.158548475946197e-016  4.900000000000000e+001  1.943468304810075e-002  0.000000000000000e+000  9.998111287112282e-001  9.164242320047675e-001
-1.620952373002205e-002 -2.807571866689174e-002  4.900000000000000e+001  9.717341524050387e-003  1.683092923415403e-002  9.998111287112282e-001  9.164242320047675e-001
 1.620952373002205e-002 -2.807571866689163e-002  4.900000000000000e+001 -9.717341524050380e-003  1.683092923415404e-002  9.998111287112282e-001  9.164242320047675e-001
 5.712924240950290e-002  0.000000000000000e+000  4.900000000000000e+001 -3.569226746605052e-002  0.000000000000000e+000  9.993628280275048e-001  9.164314560568593e-001
 4.947537522558876e-002  2.856462120475134e-002  4.900000000000000e+001 -3.091041034426859e-002 -1.784613373302526e-002  9.993628280275048e-001  9.164314560568593e-001
 2.856462120475156e-002  4.947537522558876e-002  4.900000000000000e+001 -1.784613373302526e-002 -3.091041034426859e-002  9.993628280275048e-001  9.164314560568593e-001
 1.062959457824578e-016  5.712924240950290e-002  4.900000000000000e+001  0.000000000000000e+000 -3.569226746605052e-002  9.993628280275048e-001  9.164314560568593e-001
-2.856462120475145e-002  4.947537522558876e-002  4.900000000000000e+001  1.784613373302525e-002 -3.091041034426859e-002  9.993628280275048e-001  9.164314560568593e-001
-4.947537522558876e-002  2.856462120475134e-002  4.900000000000000e+001  3.091041034426859e-002 -1.784613373302526e-002  9.993628280275048e-001  9.164314560568593e-001
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-2.856462120475134e-002 -4.947537522558876e-002  4.900000000000000e+001  1.784613373302528e-002  3.091041034426858e-002  9.993628280275048e-001  9.164314560568593e-001
-3.188878373473735e-016 -5.712924240950290e-002  4.900000000000000e+001  0.000000000000000e+000  3.569226746605052e-002  9.993628280275048e-001  9.164314560568593e-001
 2.856462120475156e-002 -4.947537522558876e-002  4.900000000000000e+001 -1.784613373302526e-002  3.091041034426859e-002  9.993628280275048e-001  9.164314560568593e-001
 4.947537522558876e-002 -2.856462120475134e-002  4.900000000000000e+001 -3.091041034426858e-002  1.784613373302528e-002  9.993628280275048e-001  9.164314560568593e-001
 7.840016396490235e-002  0.000000000000000e+000  4.900000000000000e+001 -5.271353434212828e-002  0.000000000000000e+000  9.986096751469817e-001  9.164426412964354e-001
 7.367205554622380e-002  2.681443531603167e-002  4.900000000000000e+001 -4.953451923684252e-002 -1.802909057089728e-002  9.986096751469817e-001  9.164426412964354e-001
 6.005800994492994e-002  5.039465399403187e-002  4.900000000000000e+001 -4.038091005994879e-002 -3.388360673790594e-002  9.986096751469817e-001  9.164426412964354e-001
 3.920008198245095e-002  6.789653365447013e-002  4.900000000000000e+001 -2.635676717106415e-002 -4.565125986354653e-002  9.986096751469817e-001  9.164426412964354e-001
 1.361404560129381e-002  7.720908931006365e-002  4.900000000000000e+001 -9.153609176893731e-003 -5.191269730880322e-002  9.986096751469817e-001  9.164426412964354e-001
-1.361404560129376e-002  7.720908931006365e-002  4.900000000000000e+001  9.153609176893725e-003 -5.191269730880322e-002  9.986096751469817e-001  9.164426412964354e-001
-3.920008198245095e-002  6.789653365447013e-002  4.900000000000000e+001  2.635676717106413e-002 -4.565125986354653e-002  9.986096751469817e-001  9.164426412964354e-001
```

- **Can be 1 million+ lines long**
- **Monochromatic only**

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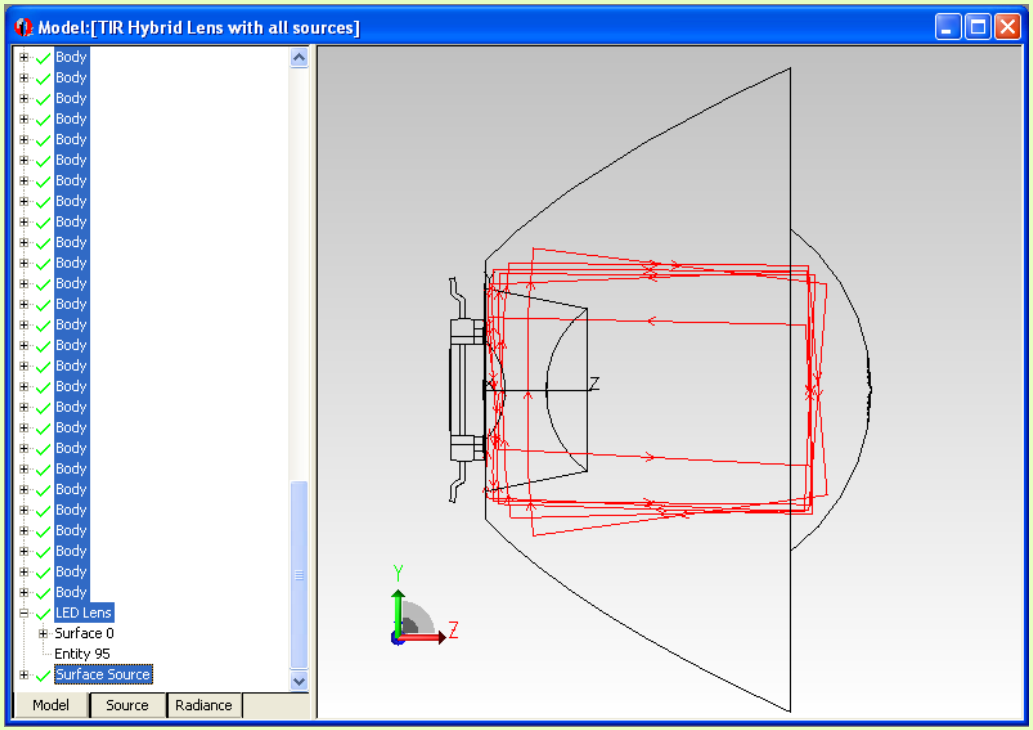
Example of Emitted Light Interacting with Source



Small percentage of rays shown

- Some of the light emitted by the LED is totally internally reflected by the lens
- Ray sorting feature in TracePro® is used to show rays that are hitting the LED's lens dome
- Approximately 0.1% of initial flux is impinging back on the source

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Surface Sources

Best for:
•Detailed source models
•Sources that emit in complex angular and spectral distribution patterns
•Where modeling the interaction of light with the source structure is important

Considerations:
•Models can be more complex to make
•Need accurate material and surface properties

Examples:
•LEDs
•Lamps such as arc and filament
•Complete optical systems

Example of Surface Source Property Data

Emission can vary as a function of:
- **Temperature**
- **Wavelength**
- **Polar Angle**
- **Azimuth Angle**

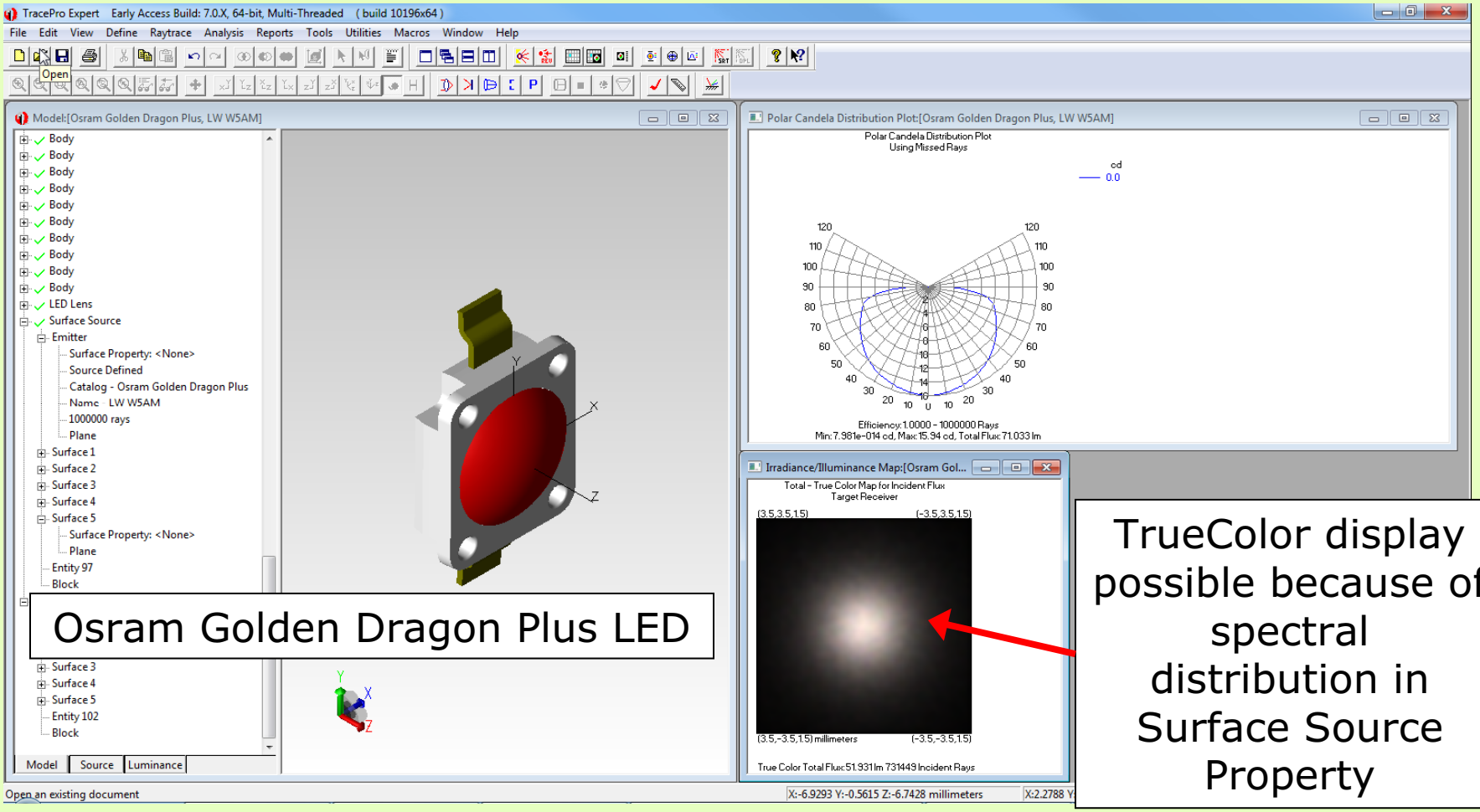
Note:
Units should be consistent.
If spectrum is defined in radiometric units then emission should be as well.

```
TracePro Surface Source Property Data
File Name       C:\Documents and Settings\
TracePro Release: 6 0 2
Database Version: 4 1 0
Data generated at 17:08:48 January 22, 2010

Name    PKI FX-1150
Catalog Flashlamps
Description
User_Data       1
Spectral Type    3
Angular Type     4
Units    0
Quantity         1
Emission         1
Wavelength1      0
Wavelength2      0
Angle1   90
Angle2   10

Temperature     Wavelength      PolarAngle      AzimuthAngle    Emissivity
300             0.204           0               0               0.1621716
300             0.204           0               20              0.1621716
300             0.204           0               40              0.1621716
300             0.204           0               60              0.1621716
300             0.204           0               80              0.1621716
300             0.204           0               100             0.1621716
300             0.204           0               120             0.1621716
300             0.204           0               140             0.1621716
300             0.204           0               160             0.1621716
300             0.204           0               180             0.1621716
300             0.204           0               200             0.1621716
300             0.204           0               220             0.1621716
300             0.204           0               240             0.1621716
300             0.204           0               260             0.1621716
300             0.204           0               280             0.1621716
300             0.204           0               300             0.1621716
300             0.204           0               320             0.1621716
300             0.204           0               340             0.1621716
300             0.204           2.045           0               0.161919
300             0.204           2.045           20              0.1619135
300             0.204           2.045           40              0.161946
300             0.204           2.045           60              0.1620167
300             0.204           2.045           80              0.162176
```

Surface Source – LED Example



Osram Golden Dragon Plus LED

TrueColor display possible because of spectral distribution in Surface Source Property

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Bitmap Sources

Best for:
•Making TracePro File Sources from image file formats such as BMP, GIF, JPG, PNG, and MOV

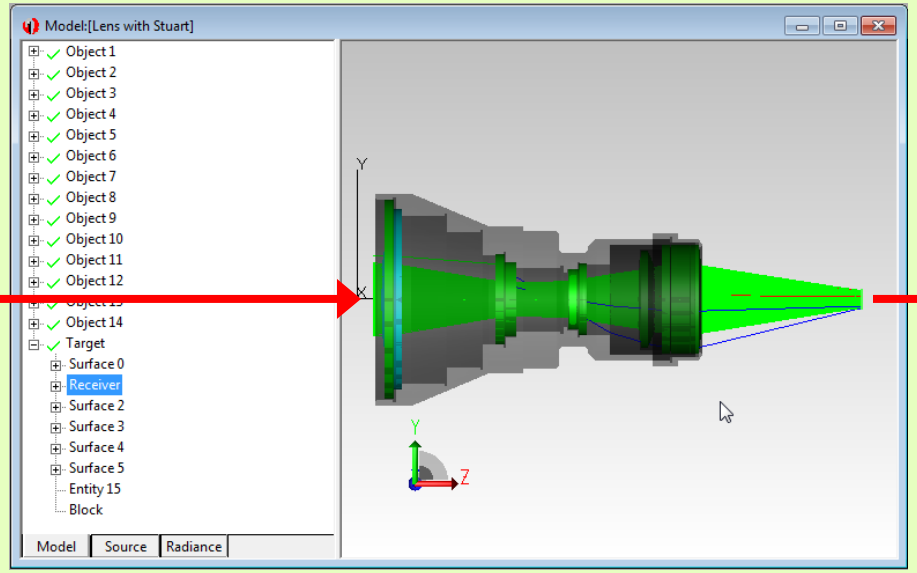
Considerations:
•Resulting File Sources can be very large

Examples:
•Tracing images through systems in TracePro

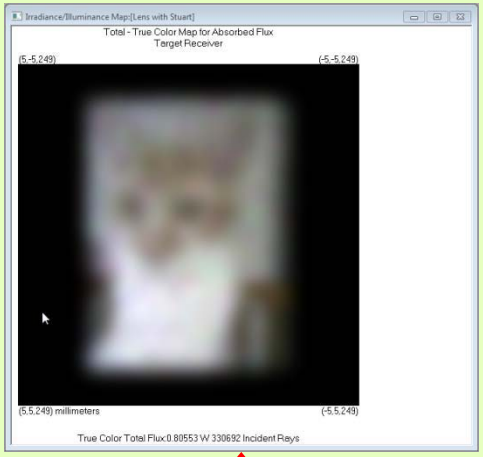
Bitmap Sources

Object

Lens system in TracePro



Image



Bitmap image and Bitmap Source Utility is used to create a File Source for TracePro

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