

How to Model Light Sources in 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

Grid Source

Grid Setup | Beam Setup | Polarization | Wavelengths

Name: Grid Source 1

Grid Boundary: Rectangular

Y half-height: 0.0001 X half-width: 0.05

Grid Pattern: Rectangular

Y points: 1000 X points: 1000

Units: Radiometric Rays/wave: 1000000

Flux per ray: 1 Watts

Grid Position and Orientation: Grid orientation method: Direction Vectors

| Origin | Normal vector | Up vector |
|--------|---------------|-----------|
| X: 0 | X: 0 | X: 0 |
| Y: 0 | Y: 0 | Y: 1 |
| Z: 0 | Z: 1 | Z: 0 |

Color:

Insert Modify Set Defaults

Grid Source

Grid Setup | Beam Setup | Polarization | Wavelengths

Spatial profile: Gaussian

Spatial weighting: uniform flux/weighted position

Beam waist X: 0.05 Beam waist Y: 0.0001
(Beam waist is the 1/e² point)

Angular profile: Gaussian (degrees)

Angular weighting: uniform flux/weighted angle

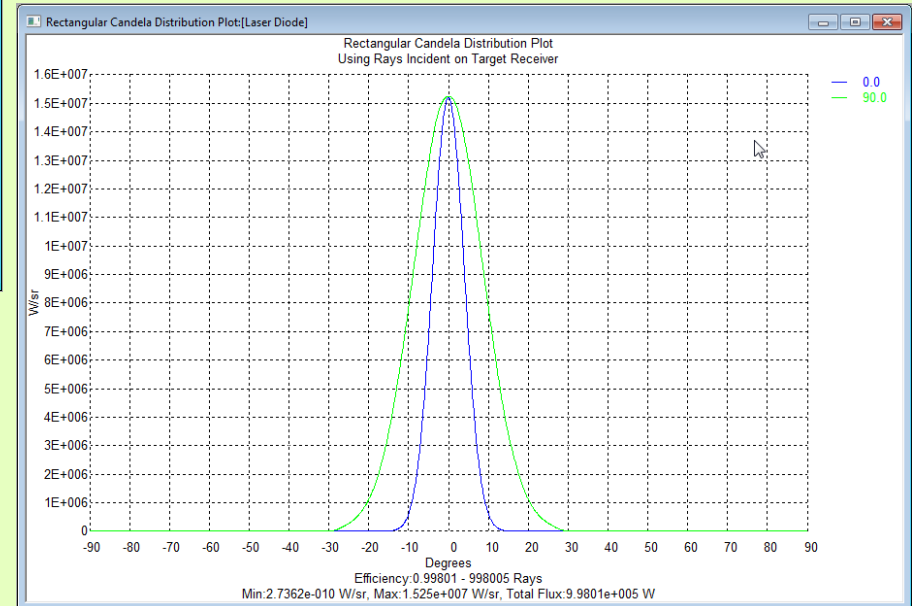
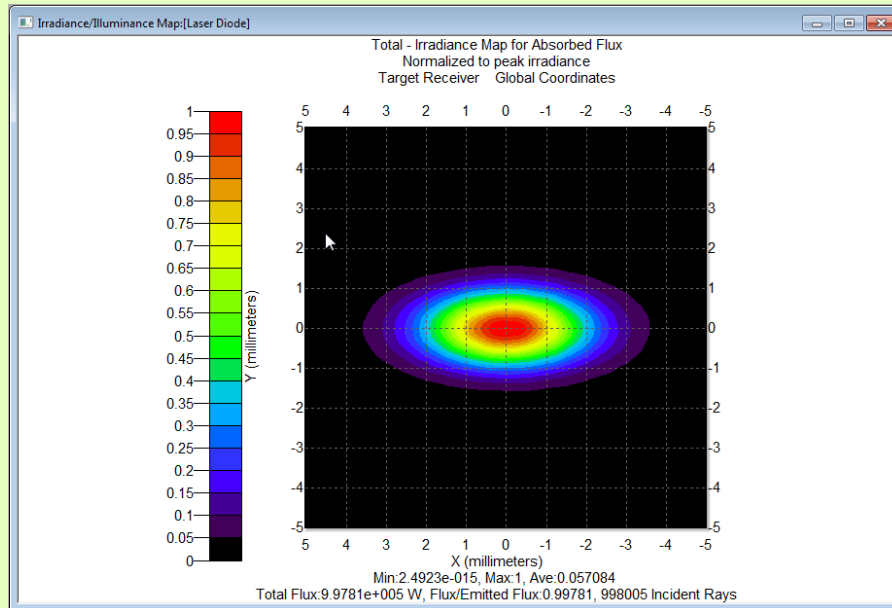
Half angle X: 17.5 Half angle Y: 7.5000000

Beam Orientation: Beam orientation method: Perpendicular to grid

| Normal vector | | Up vector | |
|---------------|------|-----------|------|
| X: 0 | Y: 0 | X: 0 | Y: 1 |
| Y: 0 | Z: 1 | Z: 0 | Z: 0 |

Insert Modify Set Defaults

Grid Source - Laser Diode Example



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

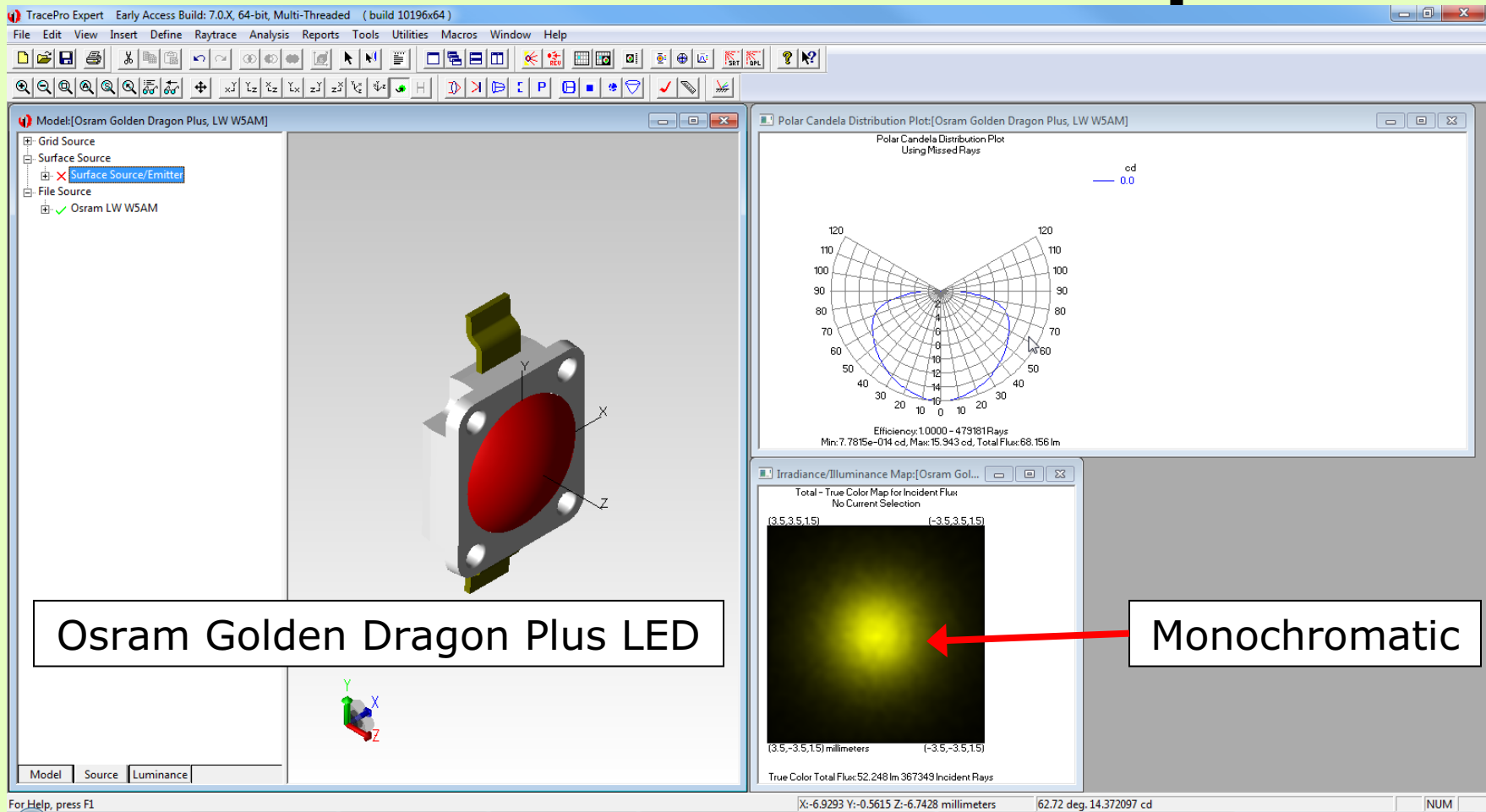
Considerations:

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

Examples:

- LEDs
- Luminaires

File Source – LED Example



Osram Golden Dragon Plus LED

Monochromatic

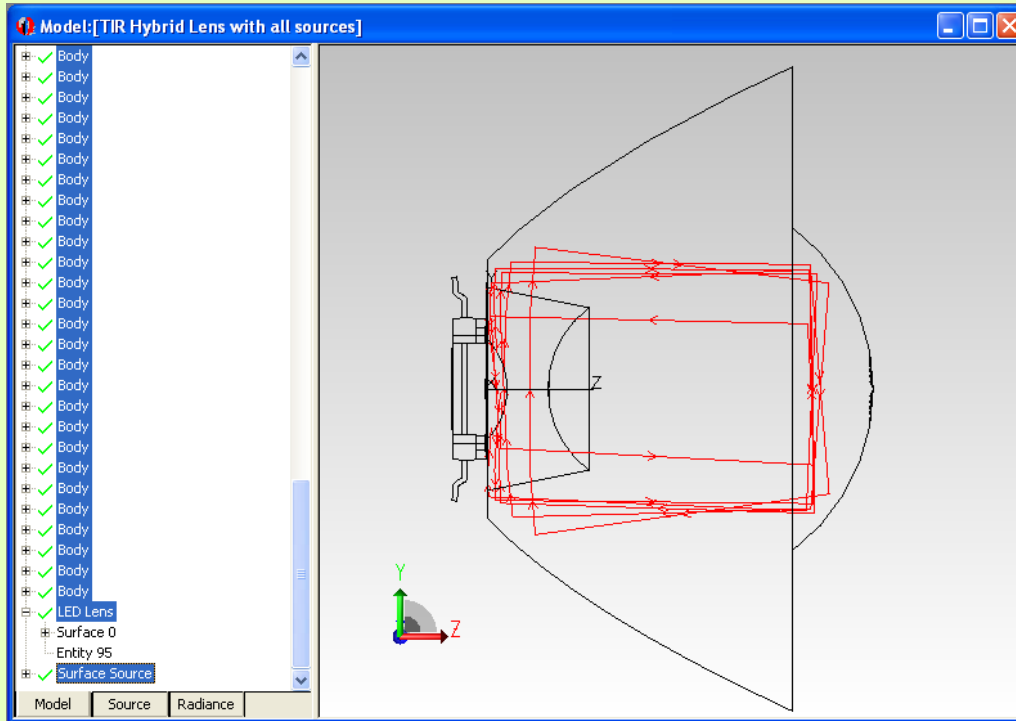
Example of File Source or Ray File Data

```
!! 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
0.0000000000000000e+000 0.0000000000000000e+000 4.9000000000000000e+001 0.0000000000000000e+000 0.0000000000000000e+000 1.0000000000000000e+000 9.164210624726462e-001
3.241904746004420e-002 0.0000000000000000e+000 4.9000000000000000e+001 -1.943468304810075e-002 0.0000000000000000e+000 9.998111287112282e-001 9.164242320047675e-001
1.620952373002205e-002 2.807571866689163e-002 4.9000000000000000e+001 -9.717341524050380e-003 -1.683092923415404e-002 9.998111287112282e-001 9.164242320047675e-001
-1.620952373002205e-002 2.807571866689163e-002 4.9000000000000000e+001 9.717341524050373e-003 -1.683092923415404e-002 9.998111287112282e-001 9.164242320047675e-001
-3.241904746004420e-002 1.158548475946197e-016 4.9000000000000000e+001 1.943468304810075e-002 0.0000000000000000e+000 9.998111287112282e-001 9.164242320047675e-001
-1.620952373002205e-002 -2.807571866689174e-002 4.9000000000000000e+001 9.717341524050387e-003 1.683092923415403e-002 9.998111287112282e-001 9.164242320047675e-001
1.620952373002205e-002 -2.807571866689163e-002 4.9000000000000000e+001 -9.717341524050380e-003 1.683092923415404e-002 9.998111287112282e-001 9.164242320047675e-001
5.712924240950290e-002 0.0000000000000000e+000 4.9000000000000000e+001 -3.569226746605052e-002 0.0000000000000000e+000 9.993628280275048e-001 9.164314560568593e-001
2.856462120475156e-002 2.856462120475134e-002 4.9000000000000000e+001 -3.091041034426859e-002 -1.784613373302526e-002 9.993628280275048e-001 9.164314560568593e-001
4.947537522558876e-002 4.947537522558876e-002 4.9000000000000000e+001 -1.784613373302526e-002 -3.091041034426859e-002 9.993628280275048e-001 9.164314560568593e-001
1.062959457824578e-016 5.712924240950290e-002 4.9000000000000000e+001 0.0000000000000000e+000 -3.569226746605052e-002 9.993628280275048e-001 9.164314560568593e-001
-2.856462120475145e-002 4.947537522558876e-002 4.9000000000000000e+001 1.784613373302525e-002 -3.091041034426859e-002 9.993628280275048e-001 9.164314560568593e-001
-4.947537522558876e-002 2.856462120475134e-002 4.9000000000000000e+001 3.091041034426859e-002 -1.784613373302526e-002 9.993628280275048e-001 9.164314560568593e-001
-5.712924240950290e-002 2.125918915649157e-016 4.9000000000000000e+001 3.569226746605052e-002 0.0000000000000000e+000 9.993628280275048e-001 9.164314560568593e-001
-4.947537522558876e-002 -2.856462120475134e-002 4.9000000000000000e+001 3.091041034426859e-002 1.784613373302525e-002 9.993628280275048e-001 9.164314560568593e-001
-2.856462120475134e-002 -4.947537522558876e-002 4.9000000000000000e+001 1.784613373302528e-002 3.091041034426858e-002 9.993628280275048e-001 9.164314560568593e-001
-3.18887837347375e-016 -5.712924240950290e-002 4.9000000000000000e+001 0.0000000000000000e+000 3.569226746605052e-002 9.993628280275048e-001 9.164314560568593e-001
2.856462120475156e-002 -4.947537522558876e-002 4.9000000000000000e+001 -1.784613373302526e-002 3.091041034426859e-002 9.993628280275048e-001 9.164314560568593e-001
4.947537522558876e-002 -2.856462120475134e-002 4.9000000000000000e+001 -3.091041034426858e-002 1.784613373302528e-002 9.993628280275048e-001 9.164314560568593e-001
7.840016396490235e-002 0.0000000000000000e+000 4.9000000000000000e+001 -5.271353434212828e-002 0.0000000000000000e+000 9.986096751469817e-001 9.164426412964354e-001
7.367205554622380e-002 2.681443531603167e-002 4.9000000000000000e+001 -4.953451923684252e-002 -1.802909057089728e-002 9.986096751469817e-001 9.164426412964354e-001
6.005800994492994e-002 5.039465399403187e-002 4.9000000000000000e+001 -4.038091005994879e-002 -3.388360673790594e-002 9.986096751469817e-001 9.164426412964354e-001
3.920008198245095e-002 6.789653365447013e-002 4.9000000000000000e+001 -2.635676717106415e-002 -4.565125986354653e-002 9.986096751469817e-001 9.164426412964354e-001
1.361404560129381e-002 7.720908931006365e-002 4.9000000000000000e+001 -9.153609176893731e-003 -5.191269730880322e-002 9.986096751469817e-001 9.164426412964354e-001
-1.361404560129376e-002 7.720908931006365e-002 4.9000000000000000e+001 9.153609176893725e-003 -5.191269730880322e-002 9.986096751469817e-001 9.164426412964354e-001
-3.920008198245095e-002 6.789653365447013e-002 4.9000000000000000e+001 2.635676717106413e-002 -4.565125986354653e-002 9.986096751469817e-001 9.164426412964354e-001
```

- Can be 1 million+ lines long
- Monochromatic only



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

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

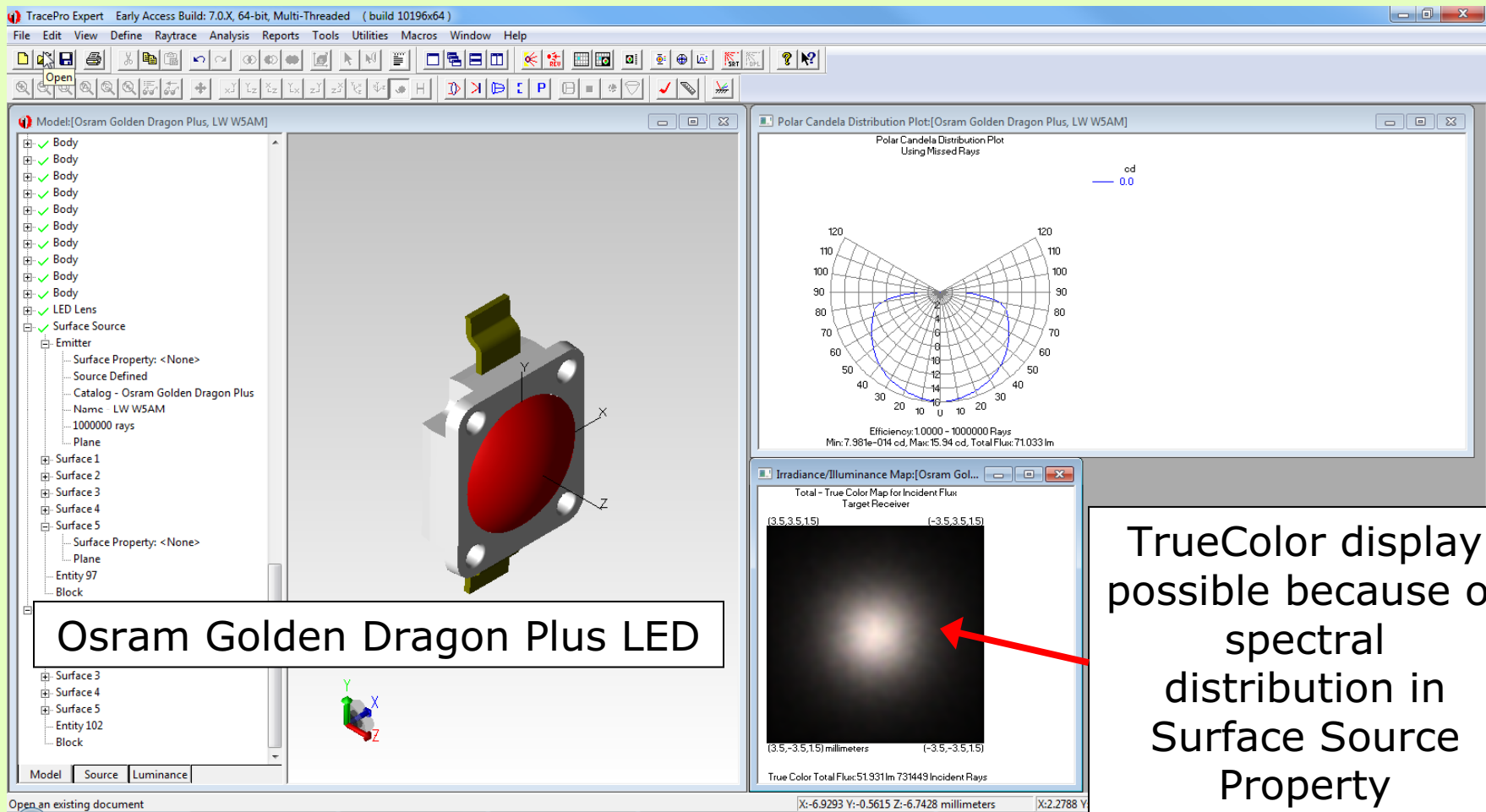
Note:
Units should be consistent.
If spectrum is defined in
radiometric units then
emission should be as well.

```
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



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:

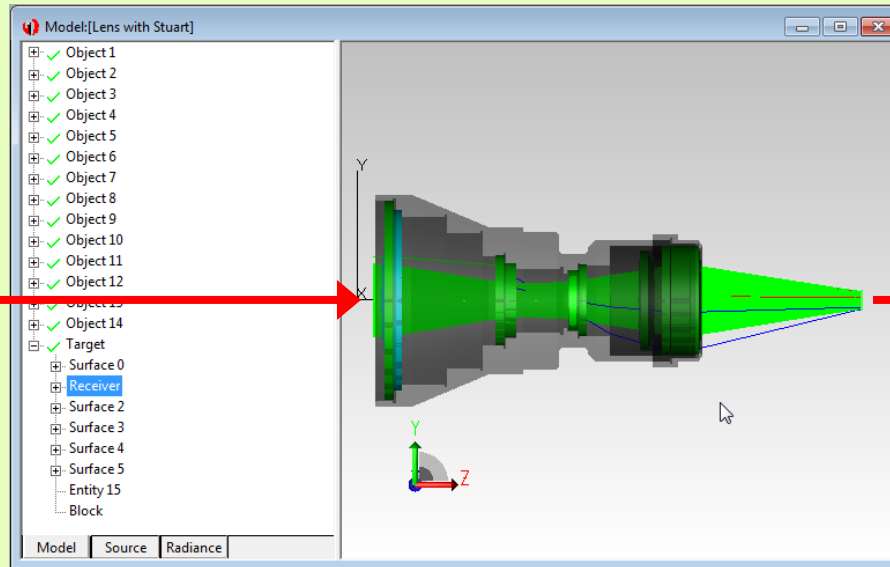
- Tracing images through systems in TracePro

Bitmap Sources

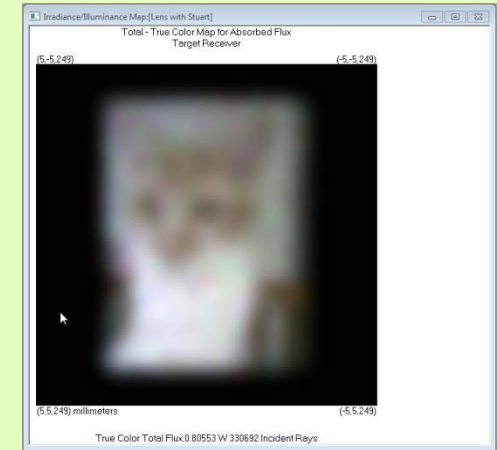
Object



Lens system in TracePro



Image



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