



# Using TracePro for LED Lighting Design Applications

Presented by :  
Lambda Research Corporation  
25 Porter Rd.  
Littleton, MA 01460  
[www.lambdares.com](http://www.lambdares.com)





Moderator:  
Andy Knight  
Technical Sales Manager  
Lambda Research Corporation

Presenter:  
Dave Jacobsen  
Senior Application Engineer  
Lambda Research Corporation

# Format

- A 25-30 minute presentation followed by a 10-15 minute question and answer session
- Please submit your questions anytime using Question box in the GoToWebinar control panel



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# In this webinar we will:

- Start with a basic specification and use that as a starting point for our LED lighting design
- Discuss how the specification will influence the choice of LEDs. Can we use a single LED, or will we need an array?
- Use the LED datasheet to create a custom Surface Source Property in TracePro
- Discuss setting up the initial model in TracePro and preparing the system for optimization
- Show how the Interactive Optimizer in TracePro can be used to optimize the system

# In this webinar we will:

- Explain how the Interactive Optimizer can be used with the Scheme macro language in TracePro to optimize the placement of LEDs and/or luminaires
- Validate the design using the analysis tools in TracePro
- Answer your questions in the Question and Answer session

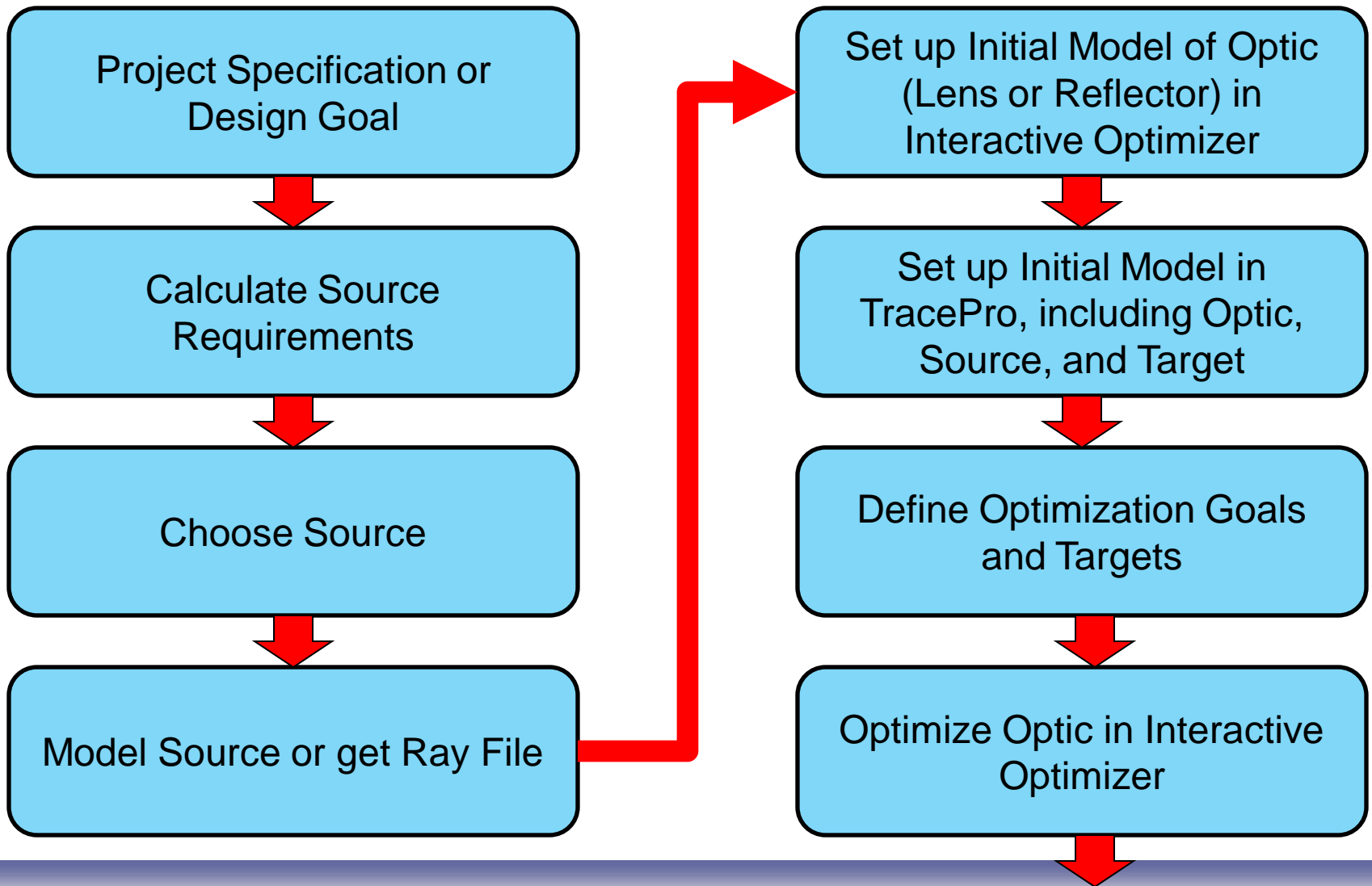
# Current TracePro Release

- TracePro 7.0.5
- Can be downloaded by anyone with a current Maintenance and Support Agreement
- [www.lambdares.com](http://www.lambdares.com)

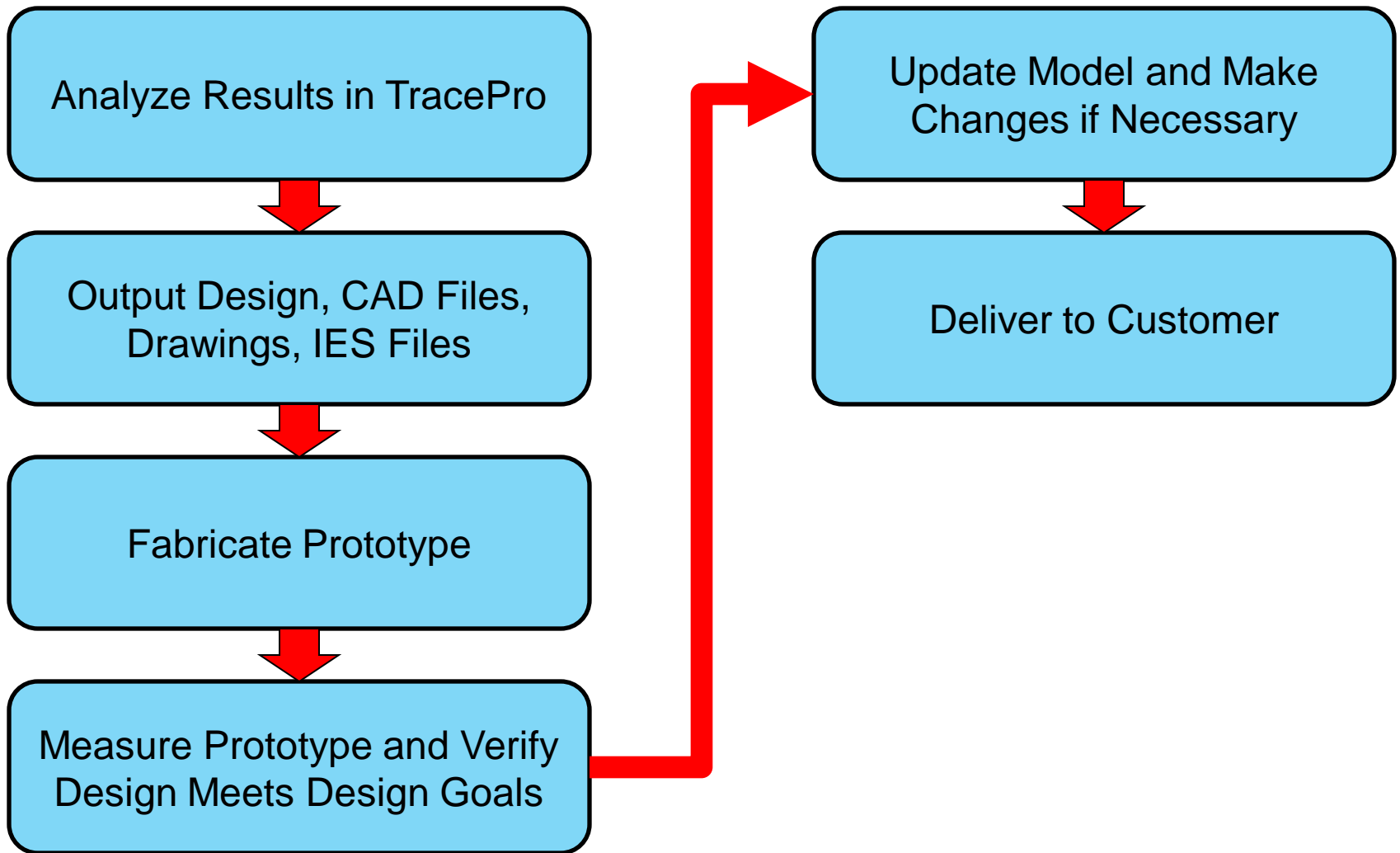
# Using TracePro for LED Lighting Design



# LED Lighting Design, Typical Workflow



# LED Lighting Design, Typical Workflow



# LED Lighting Design Using TracePro

## LED Luminaire Example

# Specification

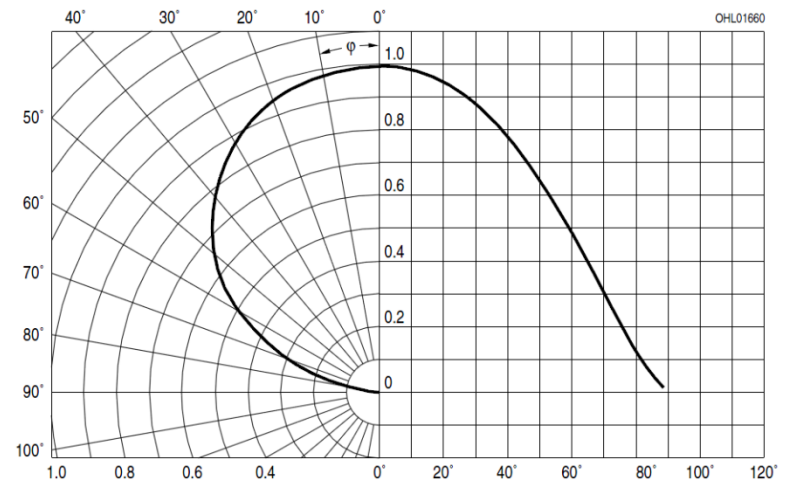
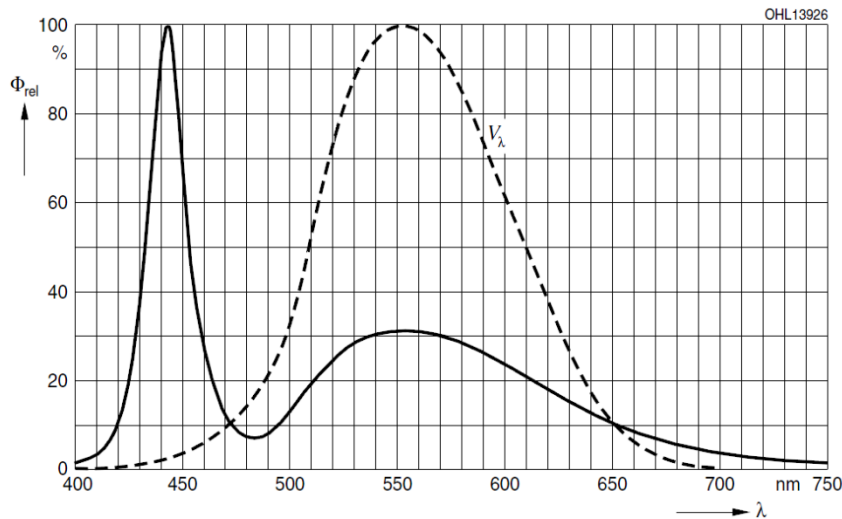
- Target Size = 9 x 10 meters
- Mounting height = 8 meters
- 14 Lux (lumens/square meter) at the target
- Color = White

# Calculate Source Requirements

- Target Area = 90 square meters
- Calculated Angular Beam = 30-degrees, half angle
- Calculated Total Lumens = 1260 lumens (used 2000 lumens as design goal)
- Individual LED Lumens = 60 lumens
- Minimum Number of LEDs Required = 34
- Number of LEDs Used = 60

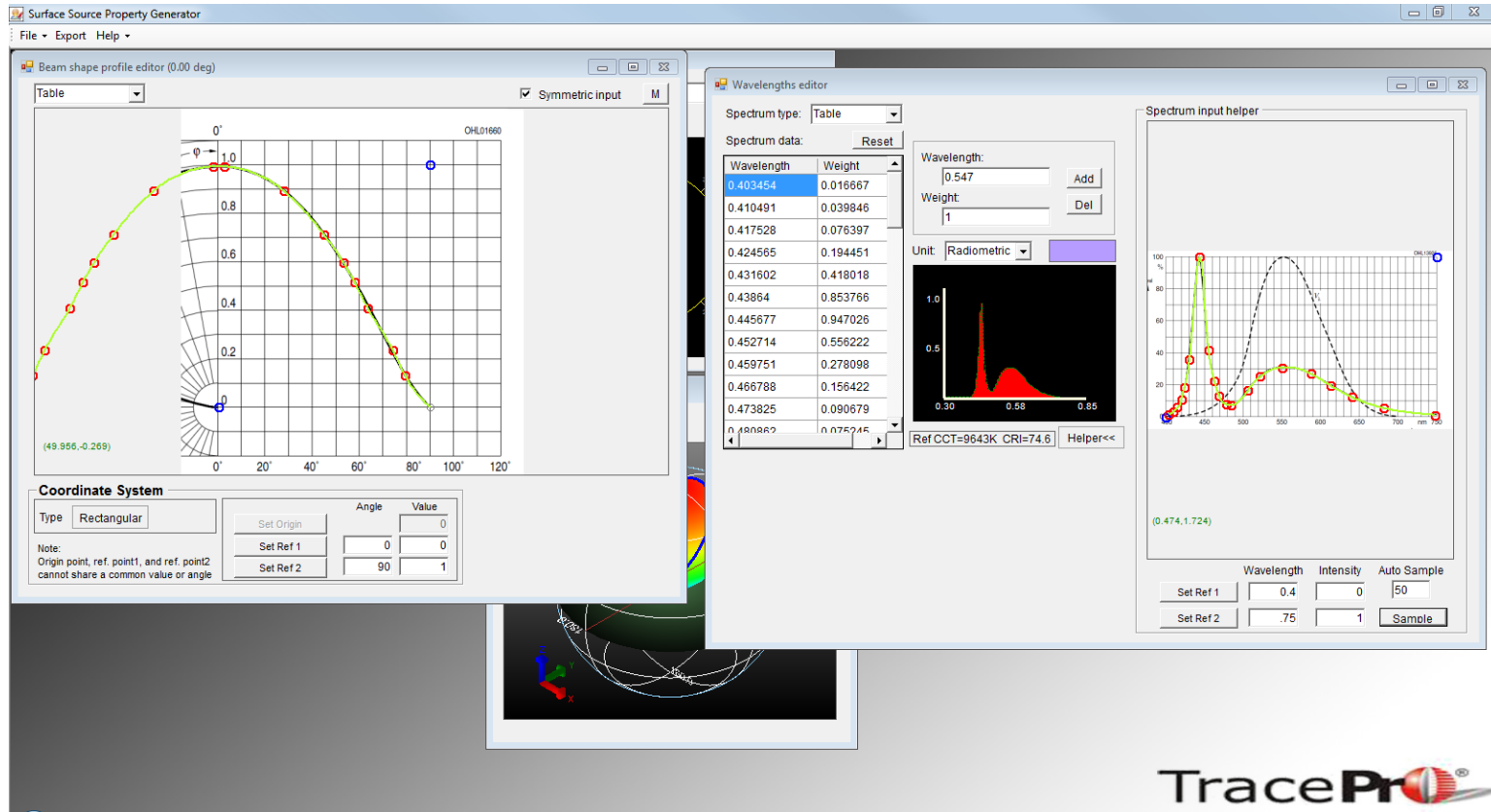
# LED Selection

- White LED
- Datasheet for LED lists 60-130 lumens
- Using 60 lumen value and 60 LEDs yields 3600 lumens total



Osram Golden Dragon LUW-W5SM

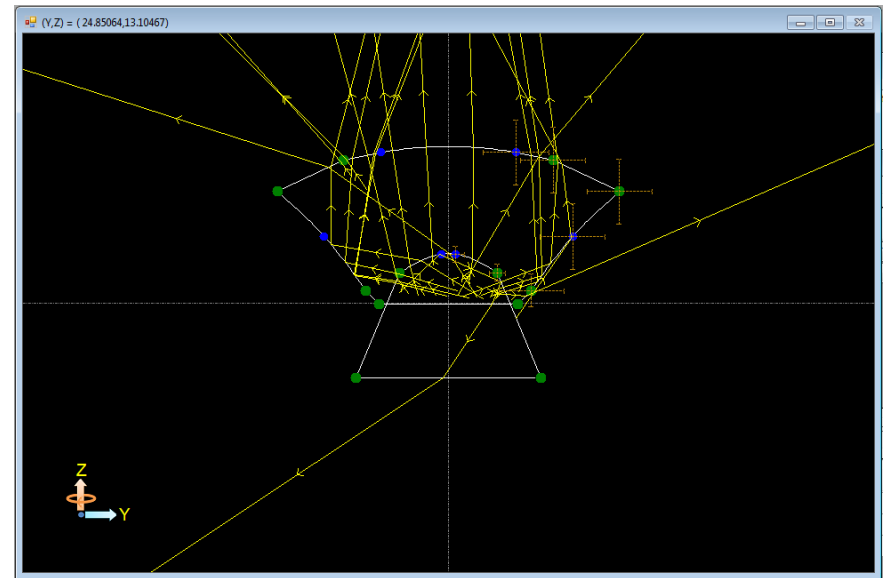
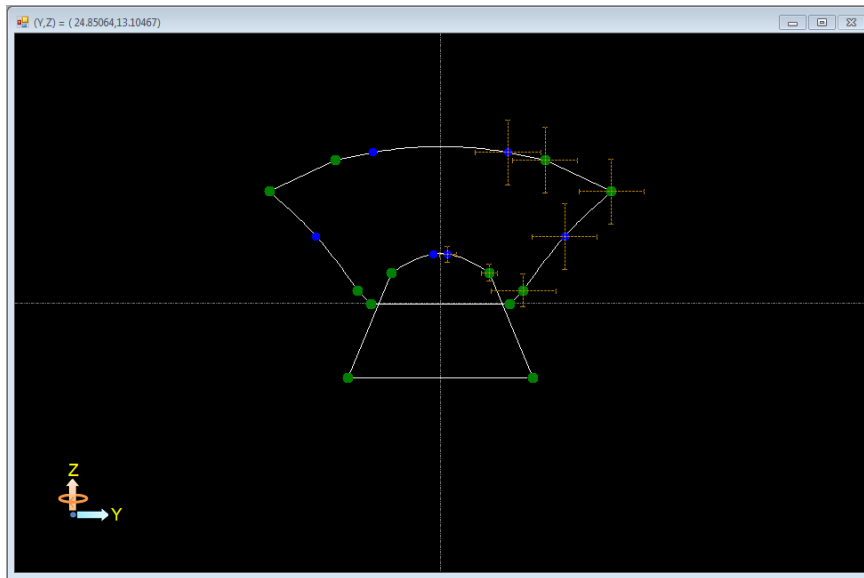
# LED Source Model



Model LED in Surface Source Property Generator Utility in TracePro

Tutorial Video at: <http://www.lambdares.com/videos/>

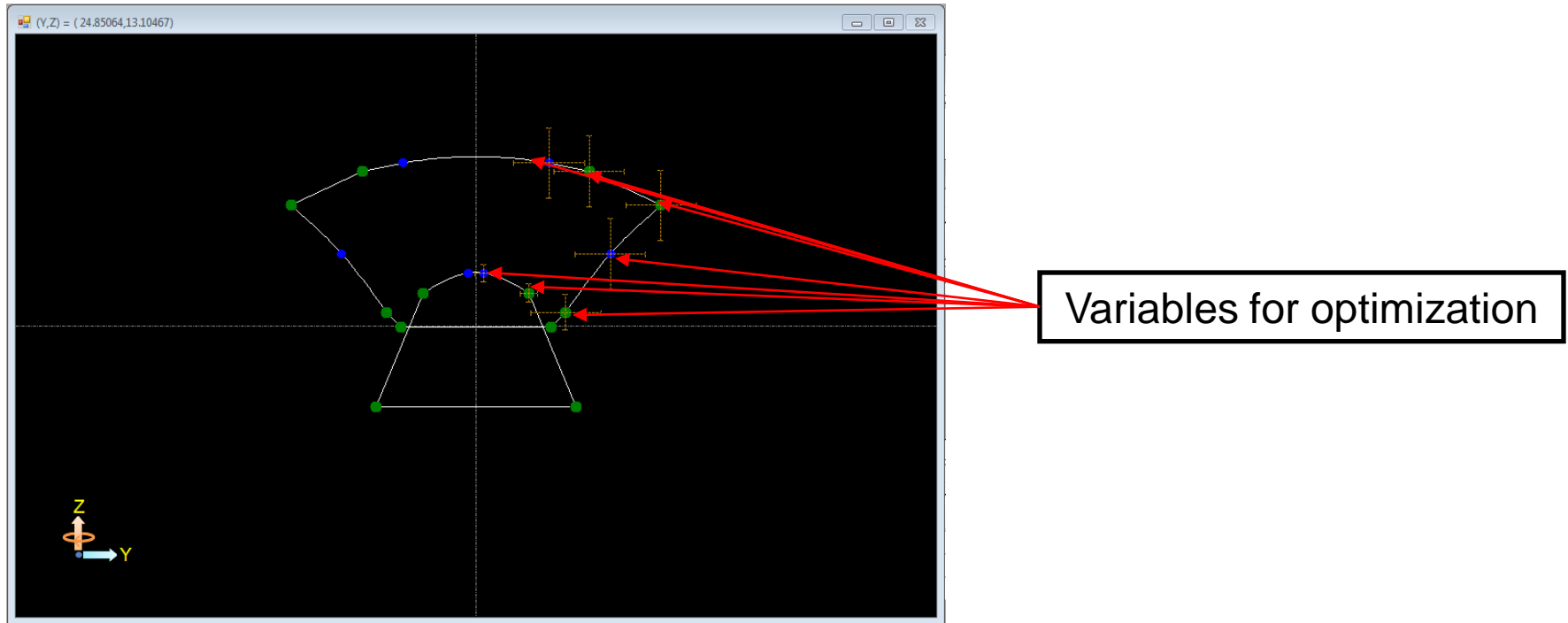
# Initial Lens Model in Interactive Optimizer



Sketch initial lens model in Interactive Optimizer. Use Ray Display to see where the light is going to achieve a good starting condition for optimization

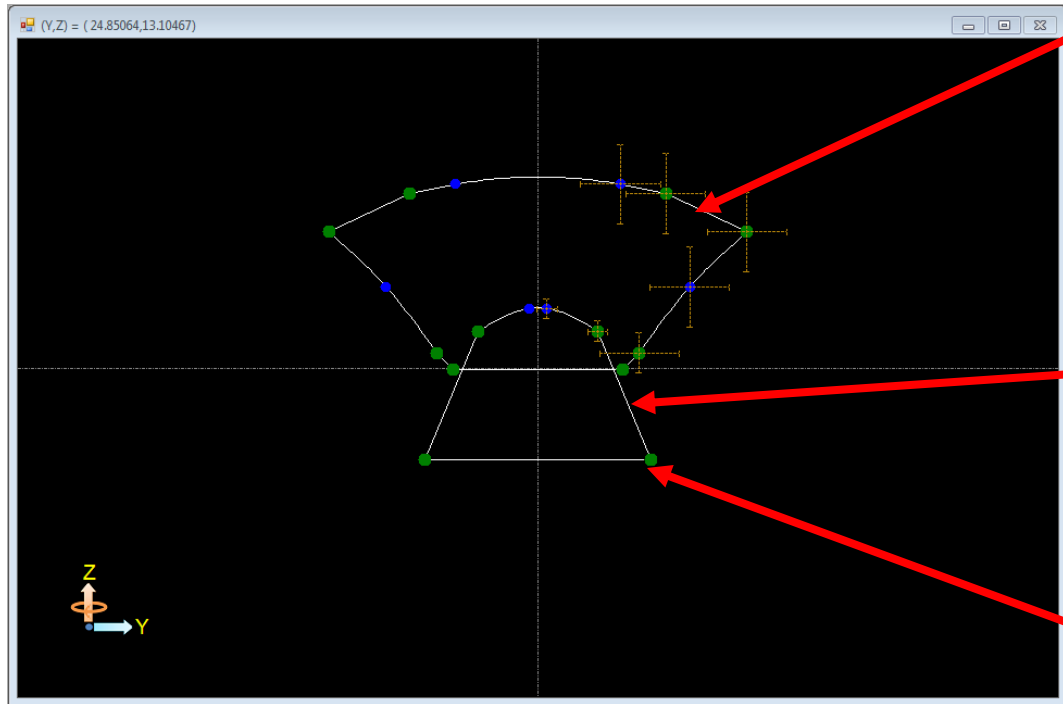


# Initial Lens Model in Interactive Optimizer



Define points to be used as variables for optimization. Variables can also be set to limit the maximum or minimum size of the lens.

# Initial Lens Model in Interactive Optimizer



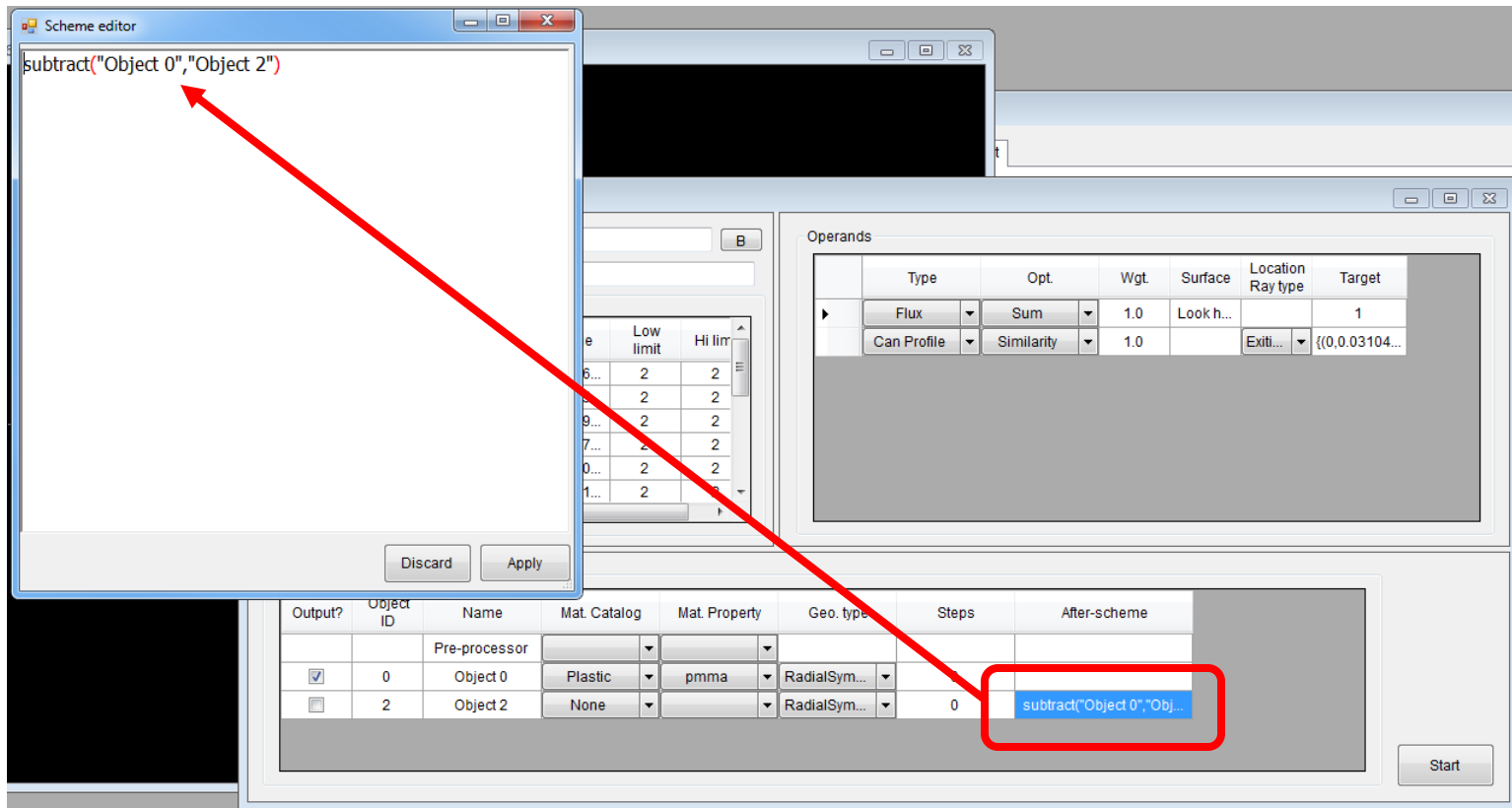
Object 0

This object is subtracted from the lens using the After-Scheme option to create space for the LED in the lens

Object 2

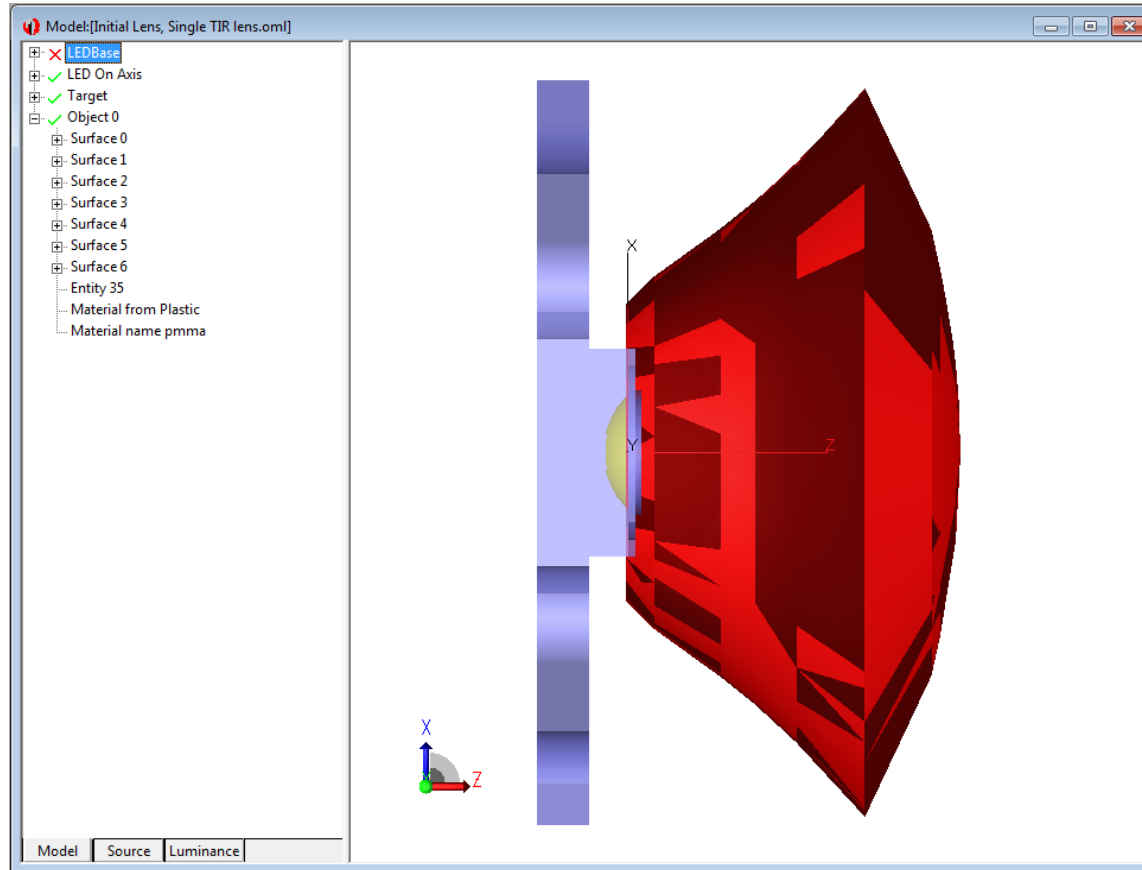
The After-Scheme option in the Interactive Optimizer allows you to run Scheme macros as part of the optimization process. In this case the Scheme macro creates the space for the LED in the lens.

# Initial Lens Model in Interactive Optimizer



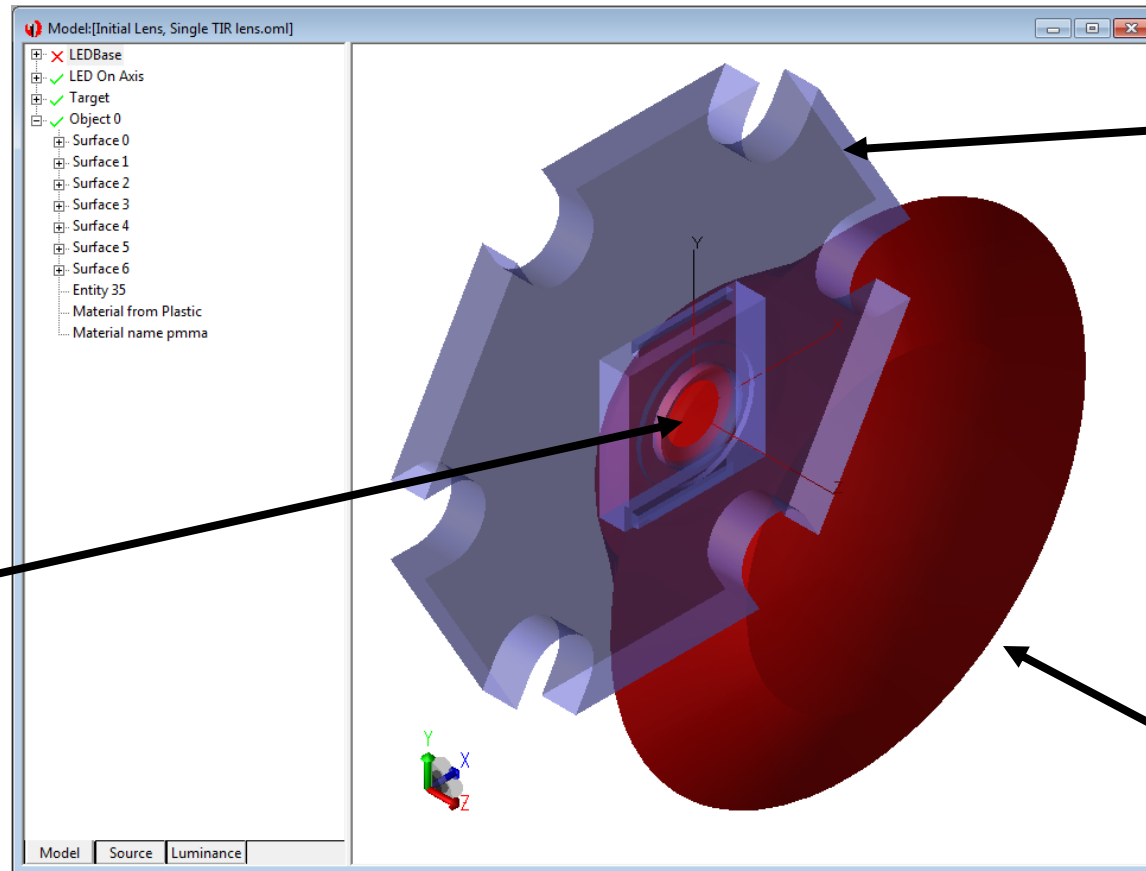
The After-Scheme option in the Interactive Optimizer allows you to run Scheme macros as part of the optimization process. In this case the Scheme macro creates the space for the LED in the lens.

# Initial Model in TracePro



Export the initial lens design from the Interactive Optimizer and use that to set-up the model in TracePro

# Initial Model in TracePro



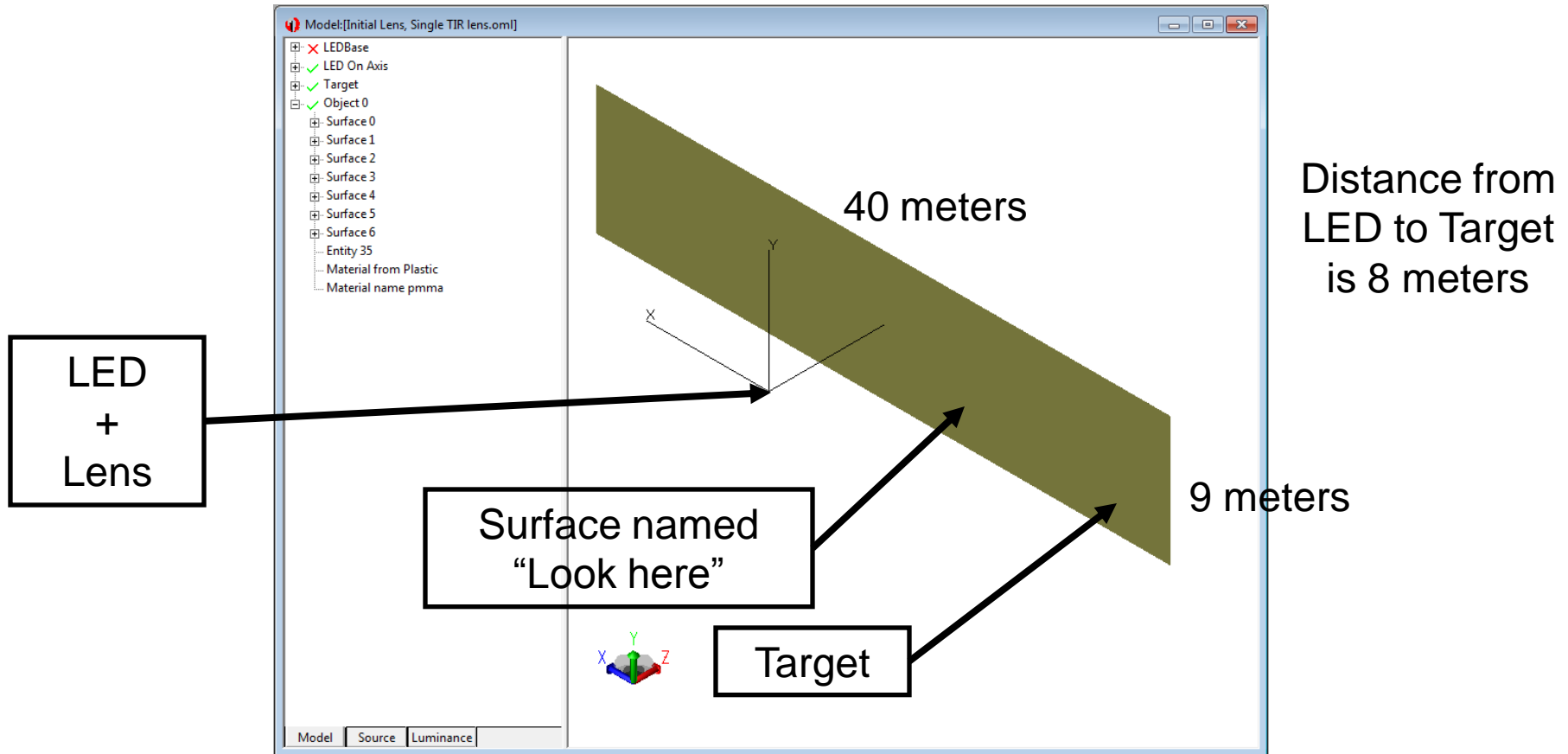
LED

Surface with  
Surface  
Source  
Property with  
LED  
properties

Lens

Insert model for LED and place Surface Source Property with LED properties on the appropriate surface to create the light source.

# Initial Model in TracePro



Insert Target surface. Name the surface facing the LED/Lens. This surface will be the one used by the optimizer to calculate results.

# Define Optimization Goals and Targets

Optimization

Save path: C:\Spline Surface Optimizer Data\Webinar B

File prefix: Lens1

Variables

Object / Var name	ID	Type	Value	Low limit	Hi lim
0	11	Pos-Y	10.456...	2	2
0	11	Pos-Z	6.8305...	2	2
0	7	Pos-Y	6.3969...	2	2
0	7	Pos-Z	8.7447...	2	2
Obj 0/ Crv 10	1	Pos-Y	4.1210...	2	2
Obj 0/ Crv 10	1	Pos-Z	9.2171...	2	2

Operands

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Flux	Sum	1.0	Look h...		60
Can Profile	Similarity	1.0		Exti...	{{(0,0.03104...

Named surface

Objects

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	Plastic	pmma	RadialSym...	0	
<input type="checkbox"/>	2	Object 2	None		RadialSym...	0	subtract("Object 0","Obj...

Start

Define 2 optimization targets, equally weighted. The first is for Flux on the “Look here” surface. This is set to 60 lumens, the maximum output of the LED.

# Define Optimization Goals and Targets

The screenshot shows the 'Candela target definer' window. On the left, a circular plot shows a profile with a 30-degree beam. The 'Symmetric input' checkbox is checked. The graph shows a profile with a 30-degree beam. A table lists 'Angle' and 'Value' pairs. A red arrow points from the table to a target value of 0.03104 in a dropdown menu.

Angle	Value
-180.0000	0.0000
-28.5976	-0.0025
-27.3555	0.9793
-0.0310	0.9857
0.0310	0.9857
27.3555	0.9793
28.5976	-0.0025
180.0000	0.0000

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	Plastic	pmma	RadialSym...	0	
<input type="checkbox"/>	2	Object 2	None		RadialSym...	0	subtract("Object 0","Obj...

The second optimization target is a Candela Profile. The Candela Profile target is set to a 30-degree beam in this case.



# Define Optimization Goals and Targets

Optimization

Save path: C:\Spline Surface Optimizer Data\Webinar

File prefix: Lens1

Object / Var name	ID	Type	Value	Low limit	Hi limit
0	11	Pos-Y	10.456...	2	2
0	11	Pos-Z	6.8305...	2	2
0	7	Pos-Y	6.3969...	2	2
0	7	Pos-Z	8.7447...	2	2
Obj 0/ Crv 10	1	Pos-Y	4.1210...	2	2
Obj 0/ Crv 10	1	Pos-Z	9.2171...	2	2

Operands

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Flux	Sum	1.0	Look h...		60
Can Profile	Similarity	1.0		Exti...	{{(0,0.03104...

Objects

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	Plastic	pmma	RadialSym...	0	
<input type="checkbox"/>	2	Object 2	None		RadialSym...	0	subtract("Object 0","Obj...

Start

Define the file paths for saving the results as well as the Material Property for the lens and the Geometry type.

# Optimize the Lens in the Interactive Optimizer

The screenshot shows the 'Optimization' window in TracePro. It is divided into several sections:

- Save path:** C:\Spline Surface Optimizer Data\Webinar
- File prefix:** Lens1
- Variables:** A table listing optimization variables.
- Operands:** A table defining optimization operands.
- Objects:** A table listing objects in the model.
- Start Button:** A button labeled 'Start' is highlighted with a red rectangle.

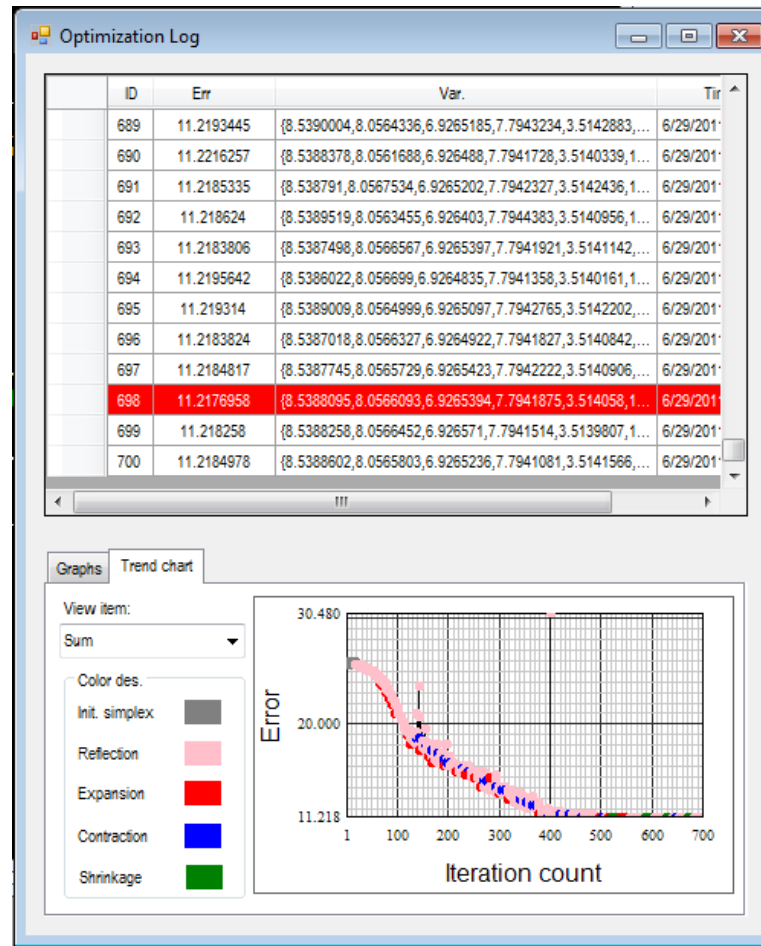
Object / Var name	ID	Type	Value	Low limit	Hi lim
0	11	Pos-Y	10.456...	2	2
0	11	Pos-Z	6.8305...	2	2
0	7	Pos-Y	6.3969...	2	2
0	7	Pos-Z	8.7447...	2	2
Obj 0/ Crv 10	1	Pos-Y	4.1210...	2	2
Obj 0/ Crv 10	1	Pos-Z	9.2171...	2	2

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Flux	Sum	1.0	Look h...		60
Can Profile	Similarity	1.0		Exti...	{{(0,0.03104...

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	Plastic	pmma	RadialSym...	0	
<input type="checkbox"/>	2	Object 2	None		RadialSym...	0	subtract("Object 0","Obj...

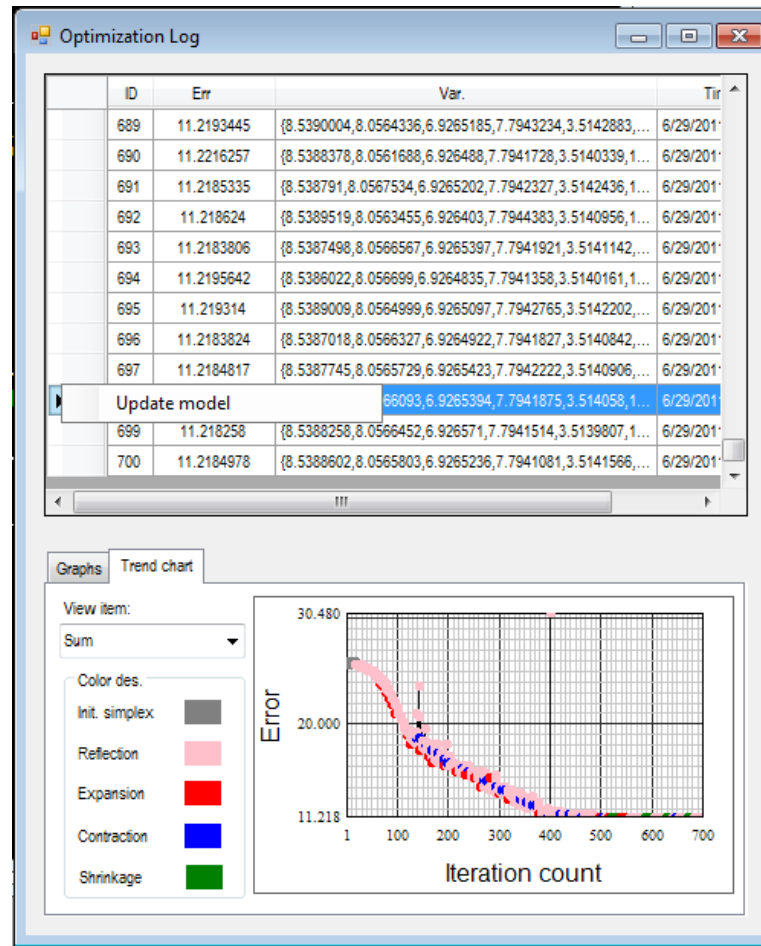
Start the optimization.

# Optimize the Lens in the Interactive Optimizer



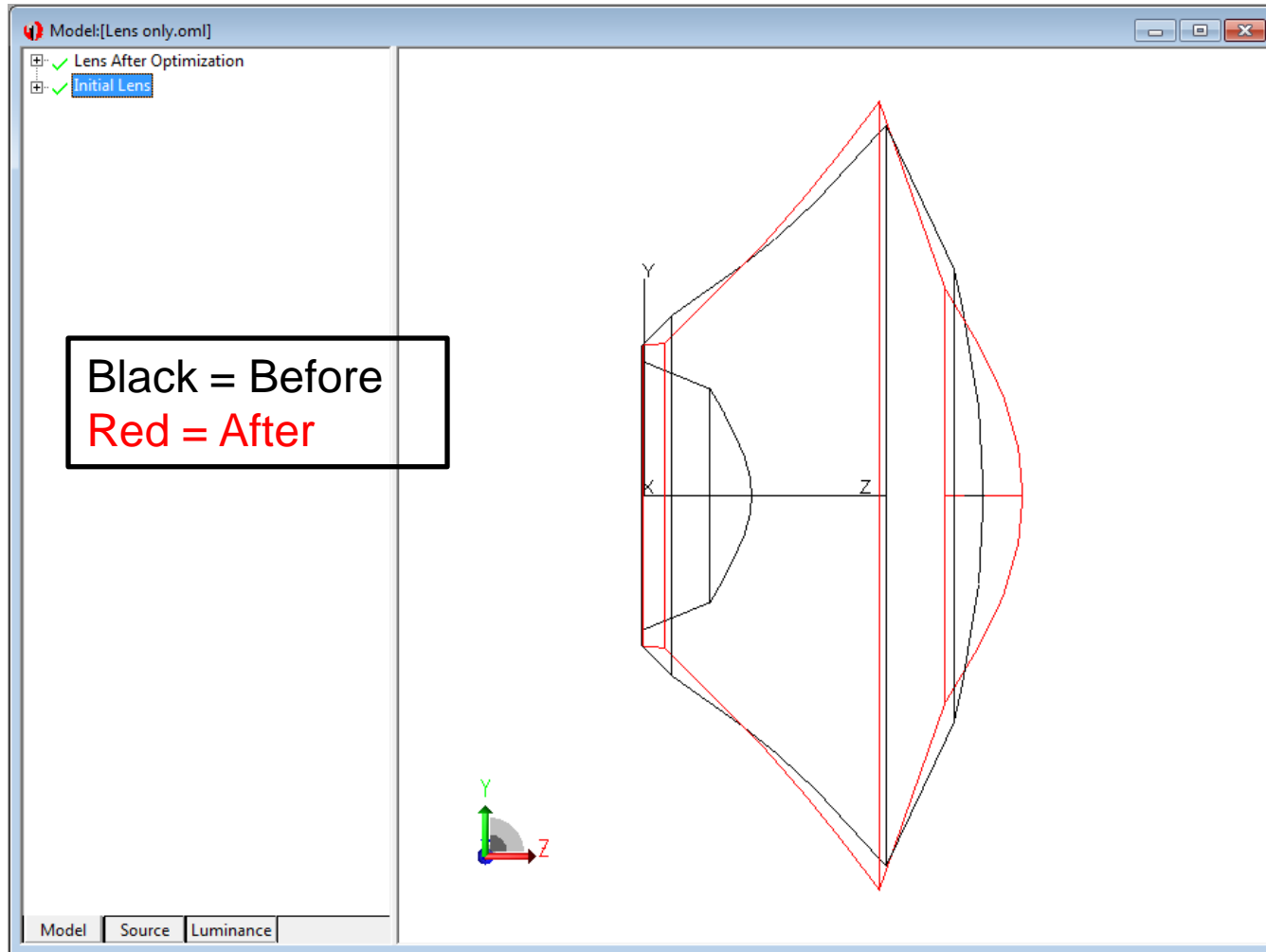
Optimization Log for lens optimization. 700 iterations run, about 30-seconds per iteration. Total time approximately 6 hours.

# Optimize the Lens in the Interactive Optimizer



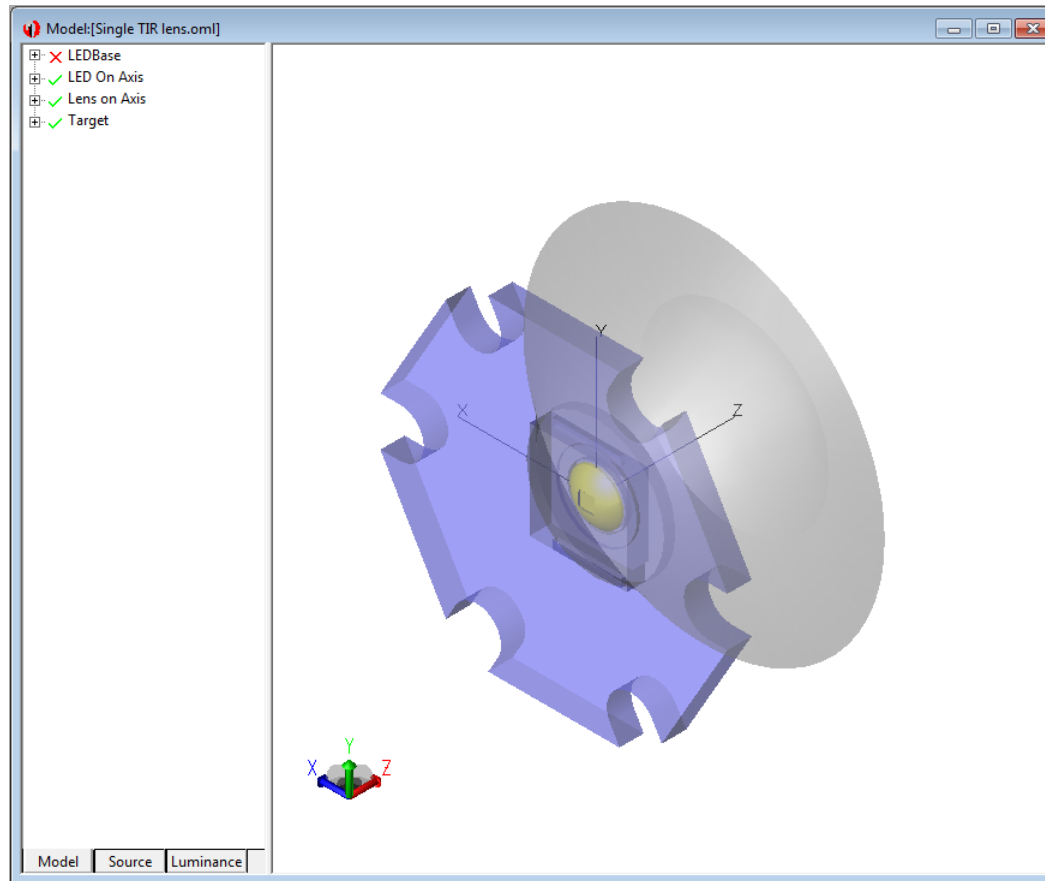
Export the optimized lens design to TracePro

# Optimize the Lens in the Interactive Optimizer



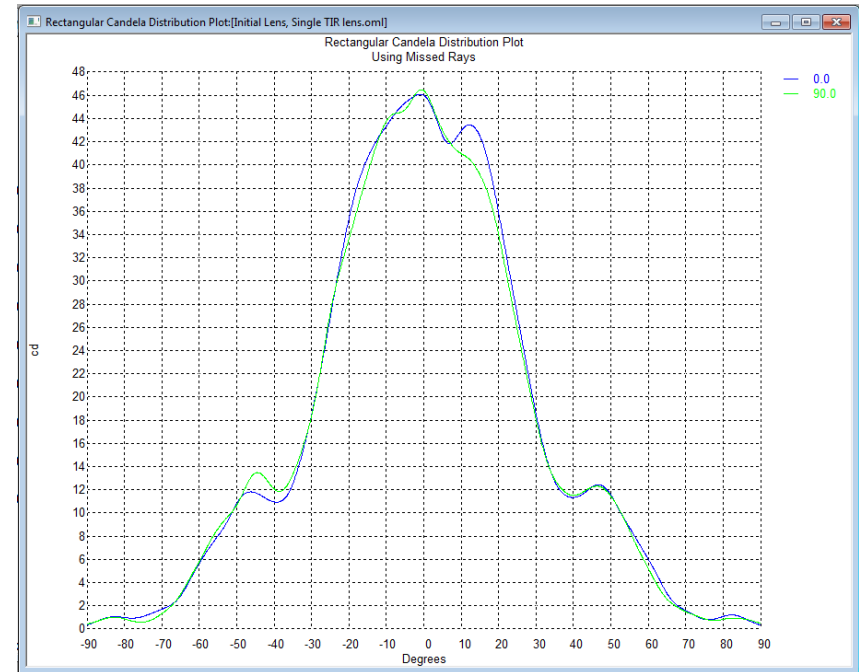
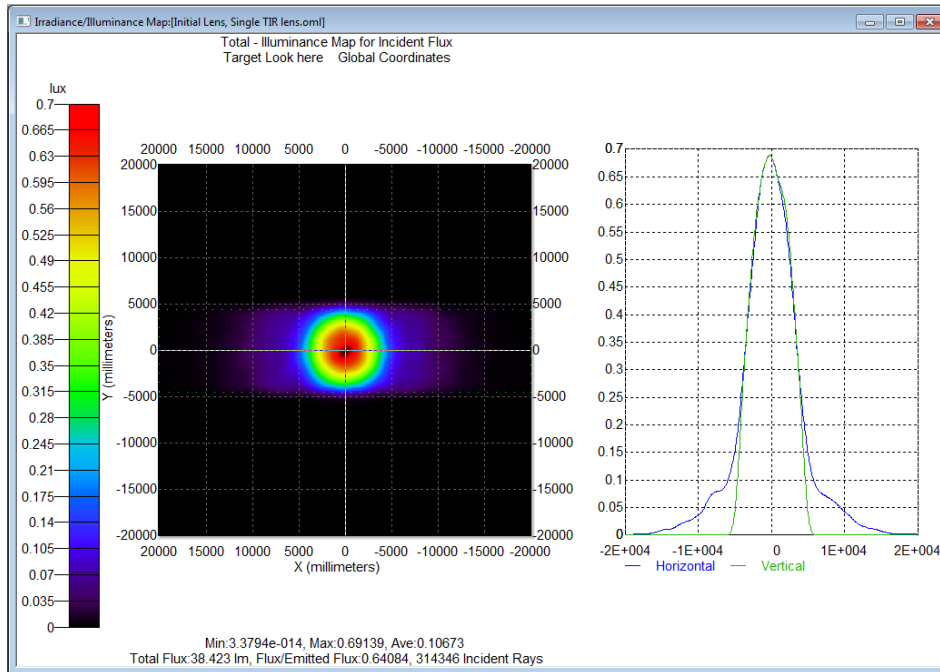
Lens Design Before and After Optimization

# Analyze the Results in TracePro



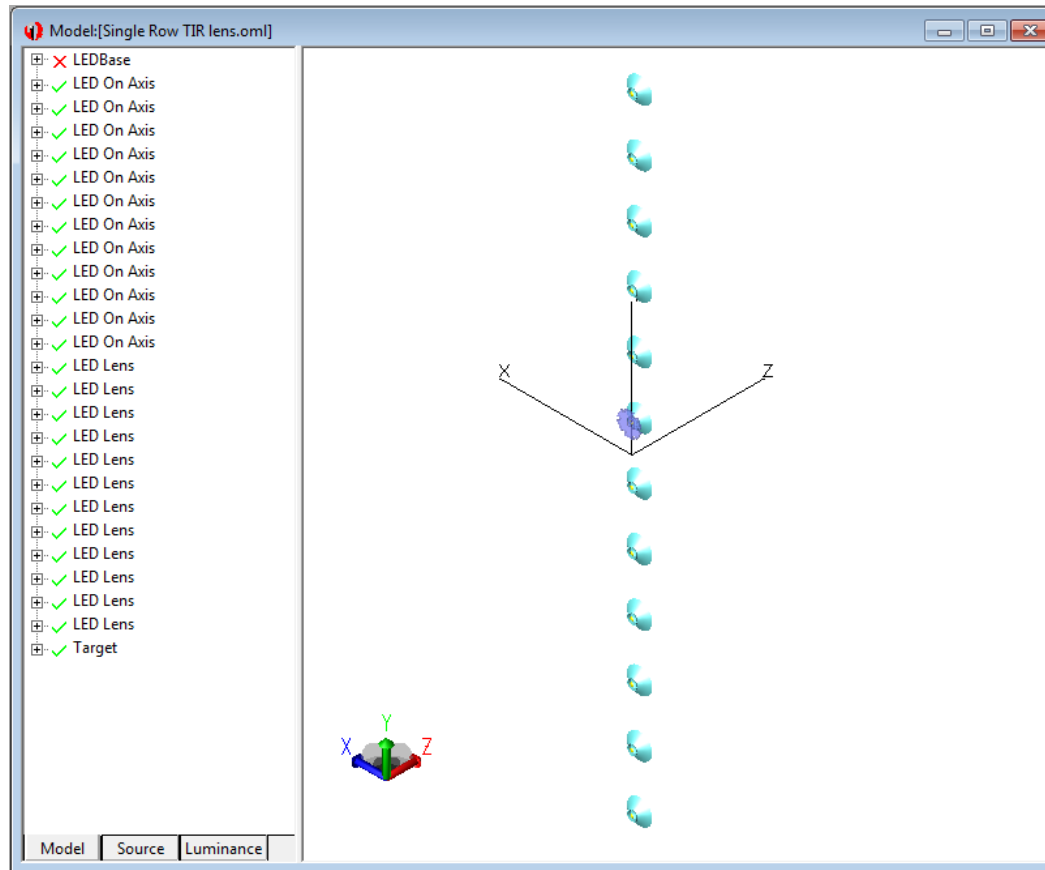
Single LED centered on target.

# Analyze the Results in TracePro



Irradiance Map and Candela Plot of Single LED and Lens.

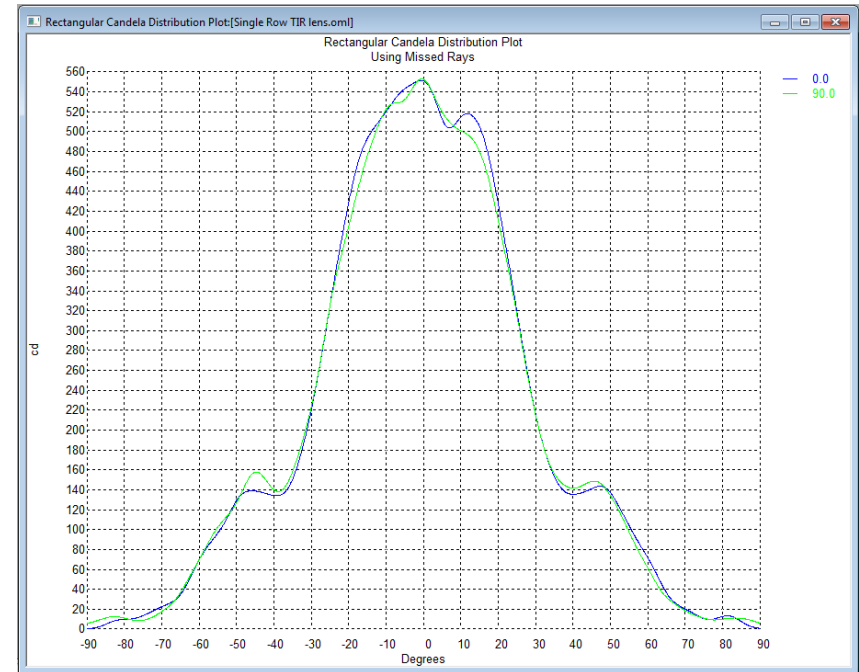
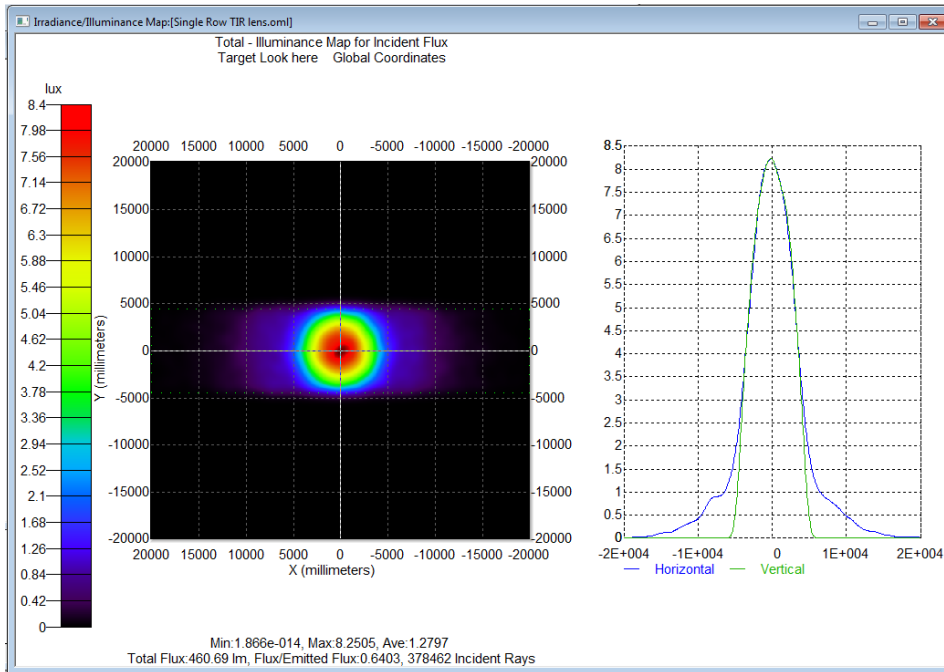
# Analyze the Results in TracePro



Single column of 12-LEDs and Lenses.  
Axis of the column is along the narrow 9 meter side of the target,  
centered on the 40 meter side.

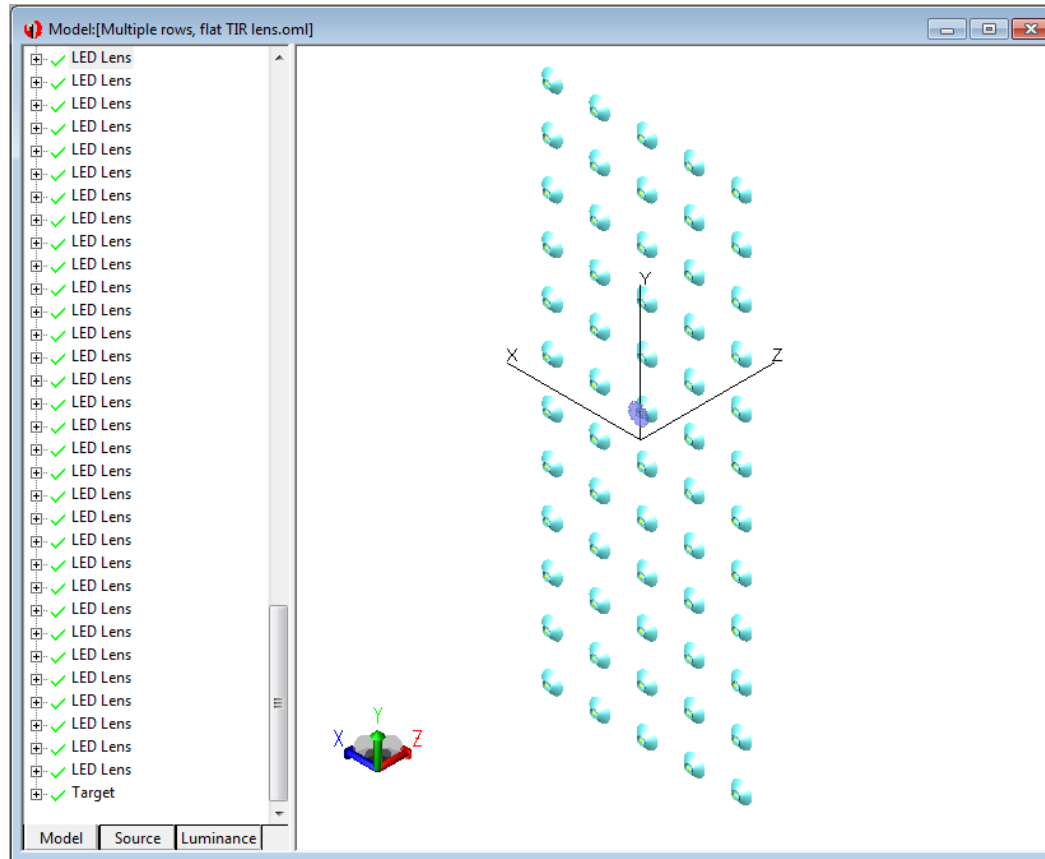


# Analyze the Results in TracePro



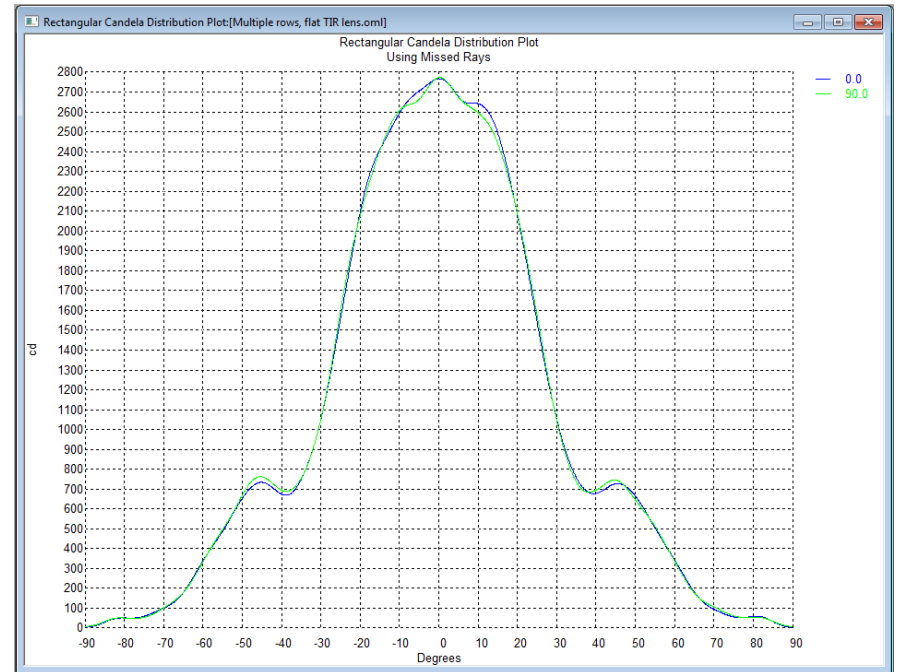
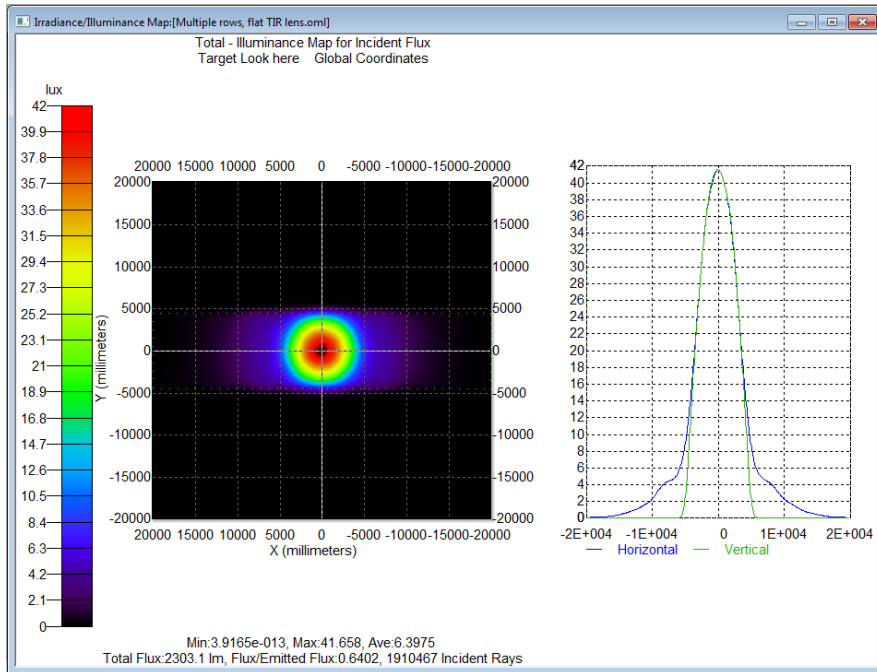
Irradiance Map and Candela Plot of single column of 12 LEDs and Lenses.

# Analyze the Results in TracePro



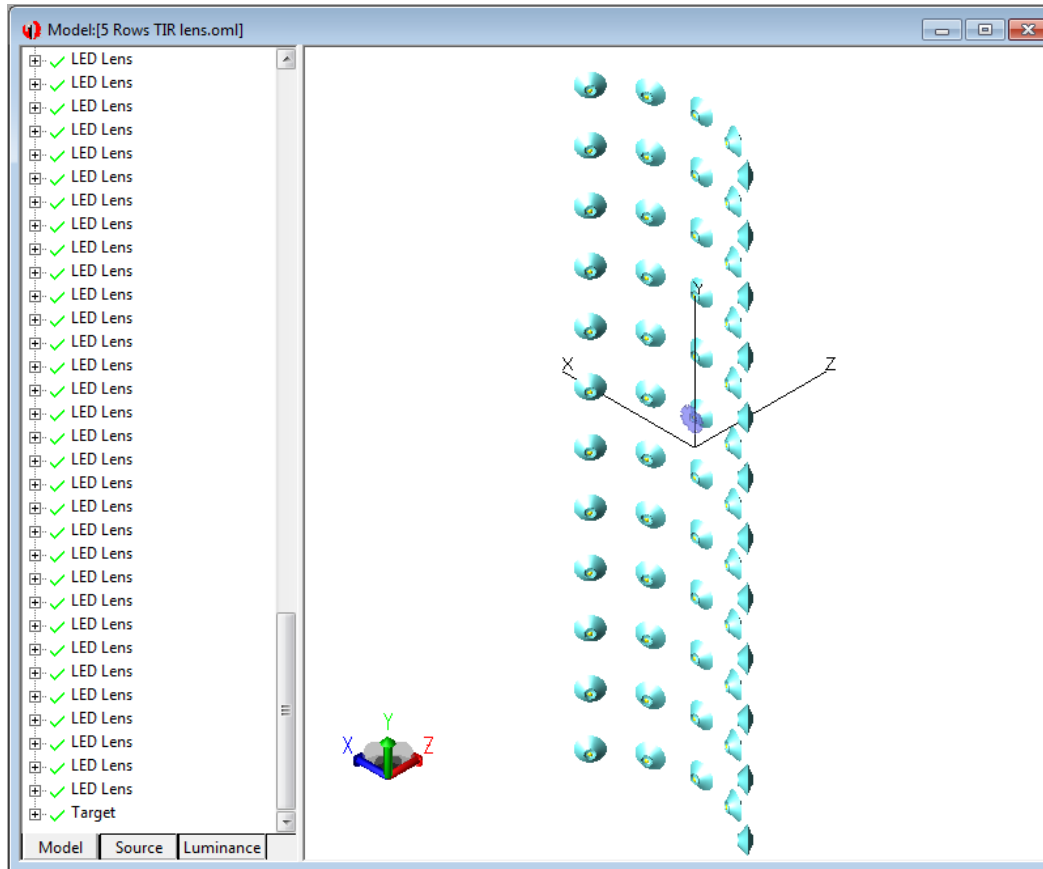
5 rows of 12 LEDs and Lenses in a column. Linear spacing on the rays.

# Analyze the Results in TracePro



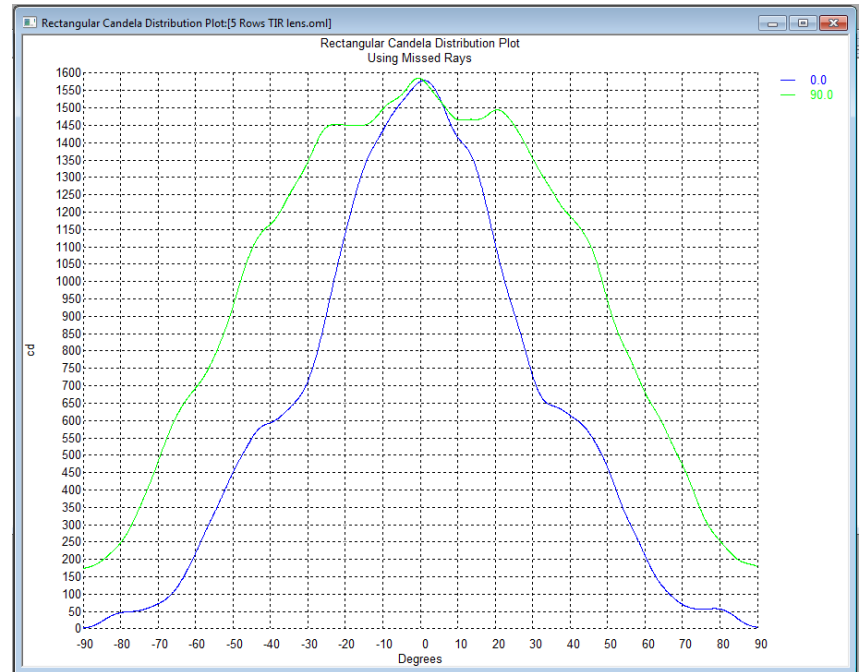
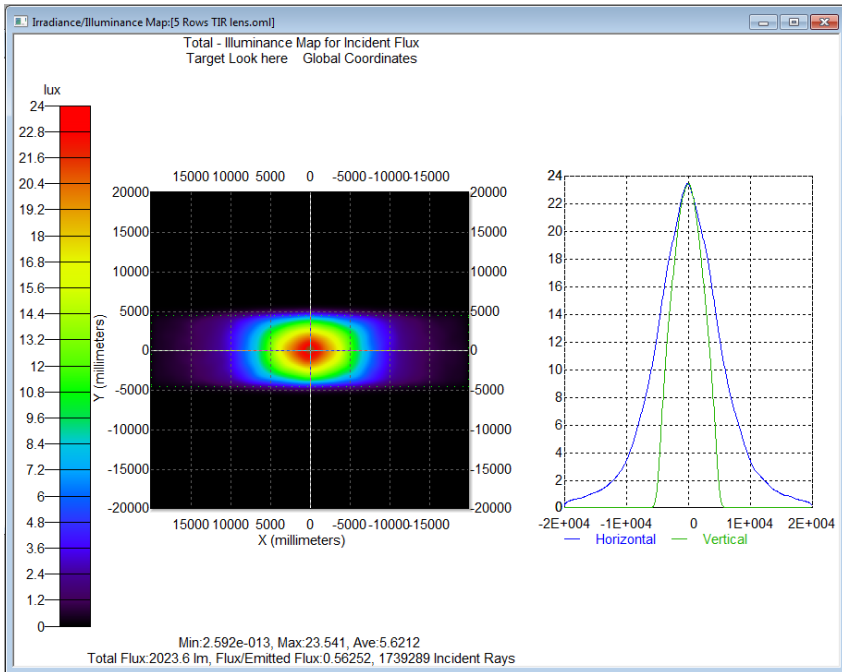
Irradiance Map and Candela Plot of 5 rows of 12 LEDs and Lenses in a column.  
Each column is spaced linearly.

# Analyze the Results in TracePro



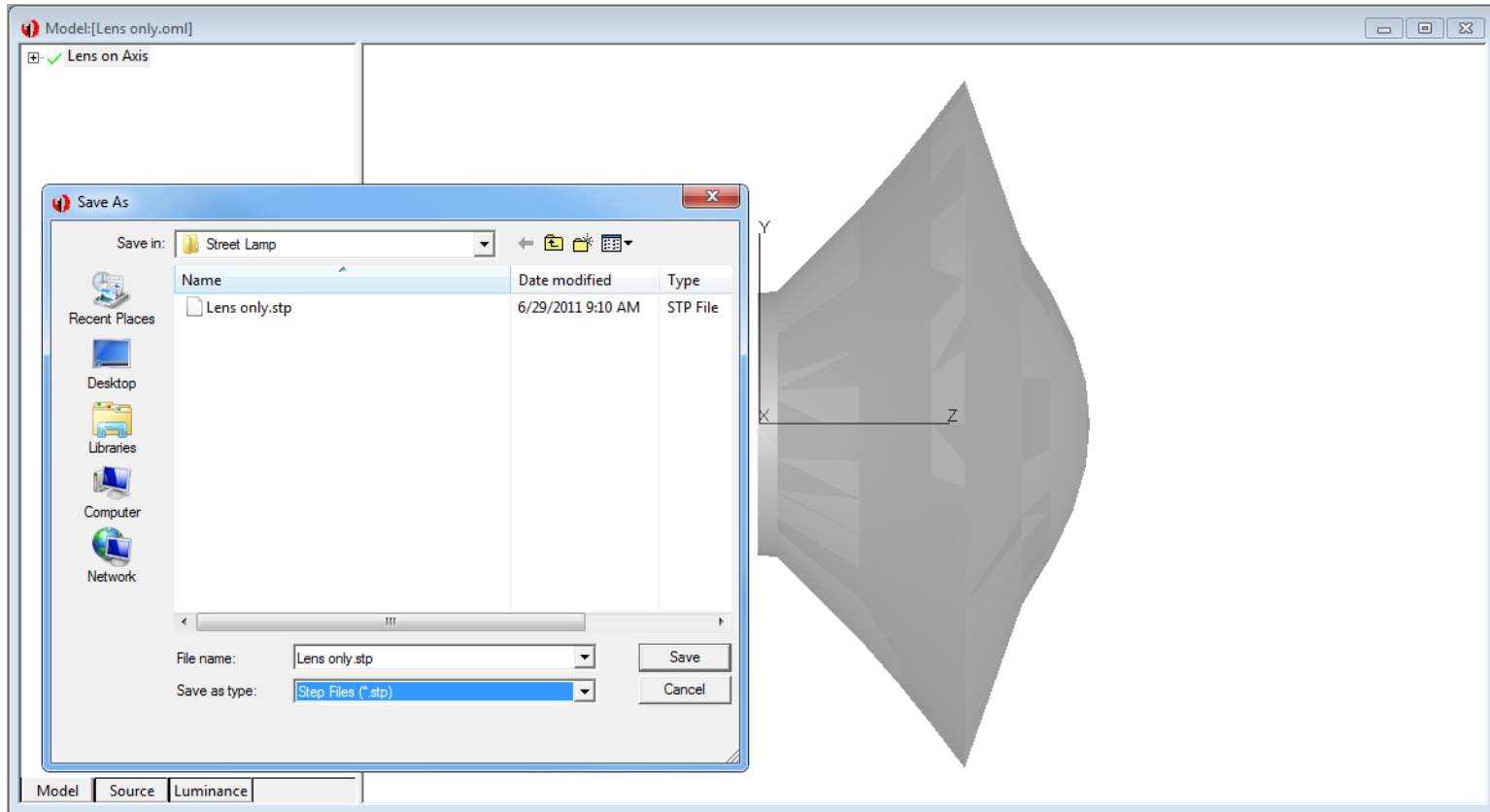
5 rows of 12 LEDs and Lenses in a column. Each column is rotated with respect to the center column.

# Analyze the Results in TracePro



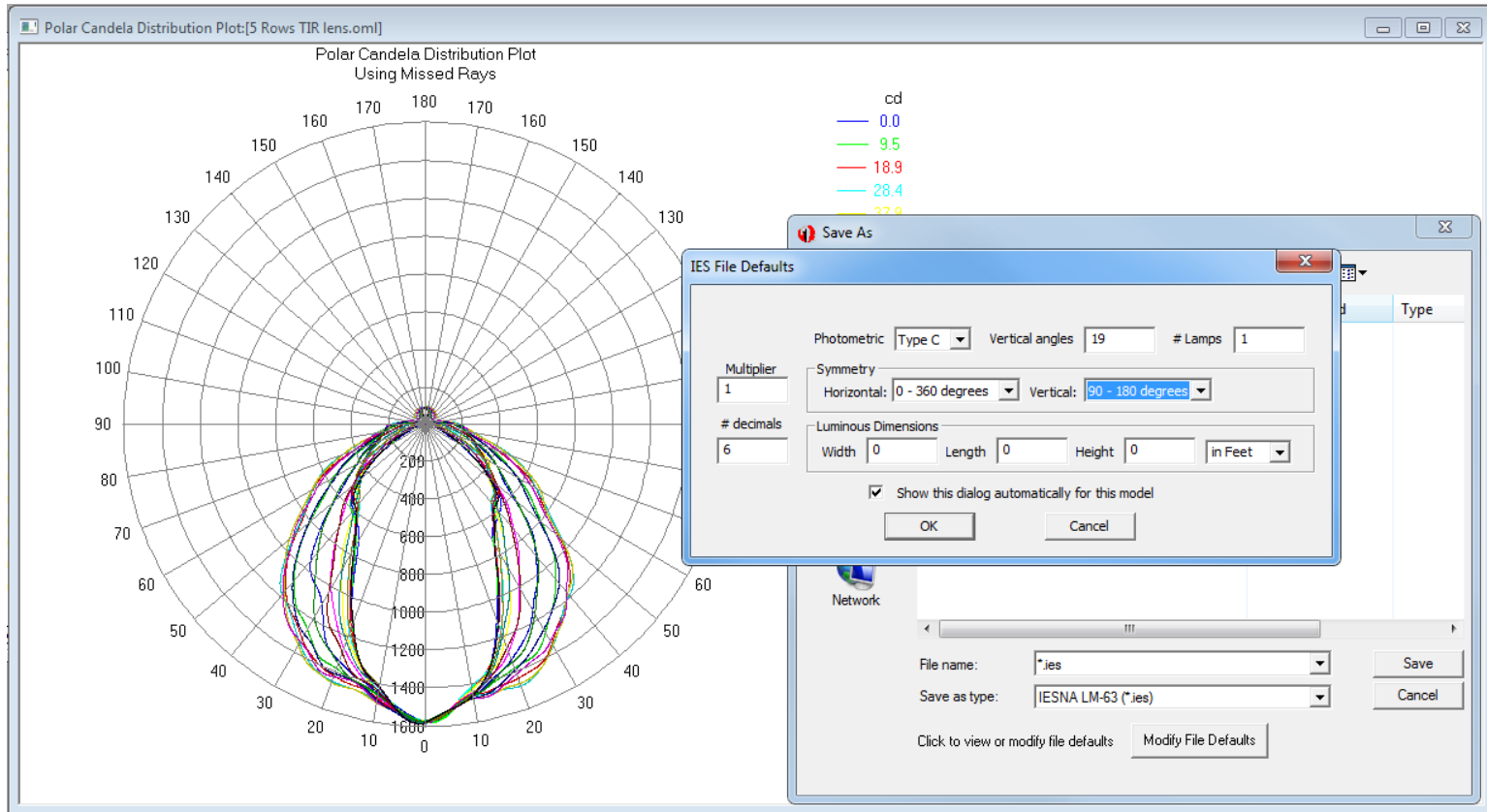
Irradiance Map and Candela Plot of 5 rows of 12 LEDs and Lenses in a column. Each column is rotated with respect to the center column.

# Output the Design



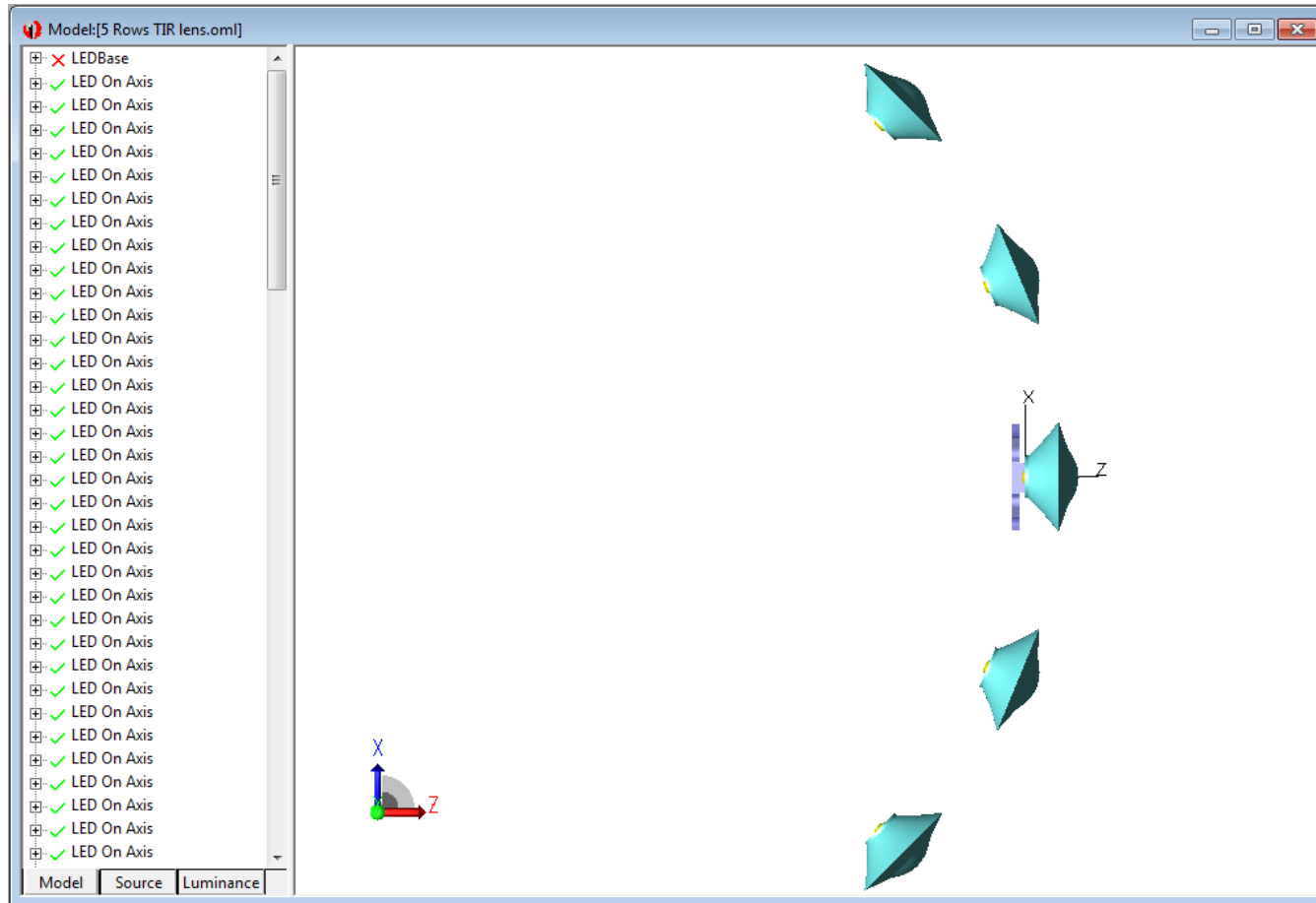
Generate CAD models, in SAT, STEP, or IGES file formats, of the lens for fabrication.

# Output the Design



Generate IES/LDT files in TracePro for use in other programs such as LITESTAR 4D from OxyTech.

# Using Interactive Optimizer and the Scheme Macro Language to Optimize Position



A Scheme Macro run through the Interactive Optimizer can be used to find the optimal angular separation for the columns of LEDs.



# Additional Resources

- Past TracePro Webinars available at <http://www.lambdares.com/webinars/>
  - February 2010, Interactive Optimizer
  - March 2010, Interactive Optimizer
  - July 2010, Modeling Light Sources in TracePro
  - September 2010, Interactive Optimizer
  - October 2010, Using IES and Eulumdat Files in TracePro
  - February 2011, Design Verification and Analysis Tools in TracePro
- Tutorial Videos available at <http://www.lambdares.com/videos/>
  - Making an LED Surface Property

# Acknowledgements

We would like to thank the AMOC of Hong Kong Polytechnics University for providing the initial design for this luminaire.

# Special Offers

## Special Offer #1

\$1000 USD off the price of the TracePro Bridge for SolidWorks

## Special Offer #2

Save 50% on back maintenance and support.

Contact your local sales representative for full details.

Offers valid May 1<sup>st</sup> – July 31<sup>st</sup>, 2011

**Thank You**

# Questions and Answers

**For Additional Information  
Please Contact:**

**Lambda Research Corporation  
Littleton, MA  
978-486-0766  
[www.lambdares.com](http://www.lambdares.com)**