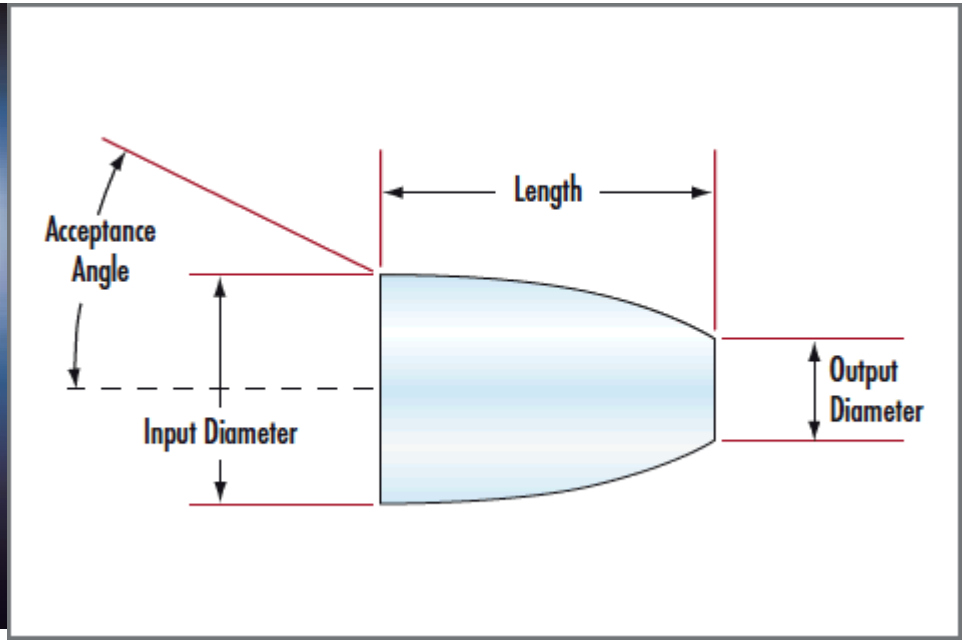
Lambda Research Corporation

Compound Parabolic Concentrator



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Introduction

- Compound Parabolic Concentrators (CPCs) are designed to efficiently collect and concentrate distant light sources, with some acceptance angle.

- Compound Parabolic Concentrators are critical components in solar energy collection, wireless communication, biomedical and defense research, or for any applications requiring condensing of a divergent light source.

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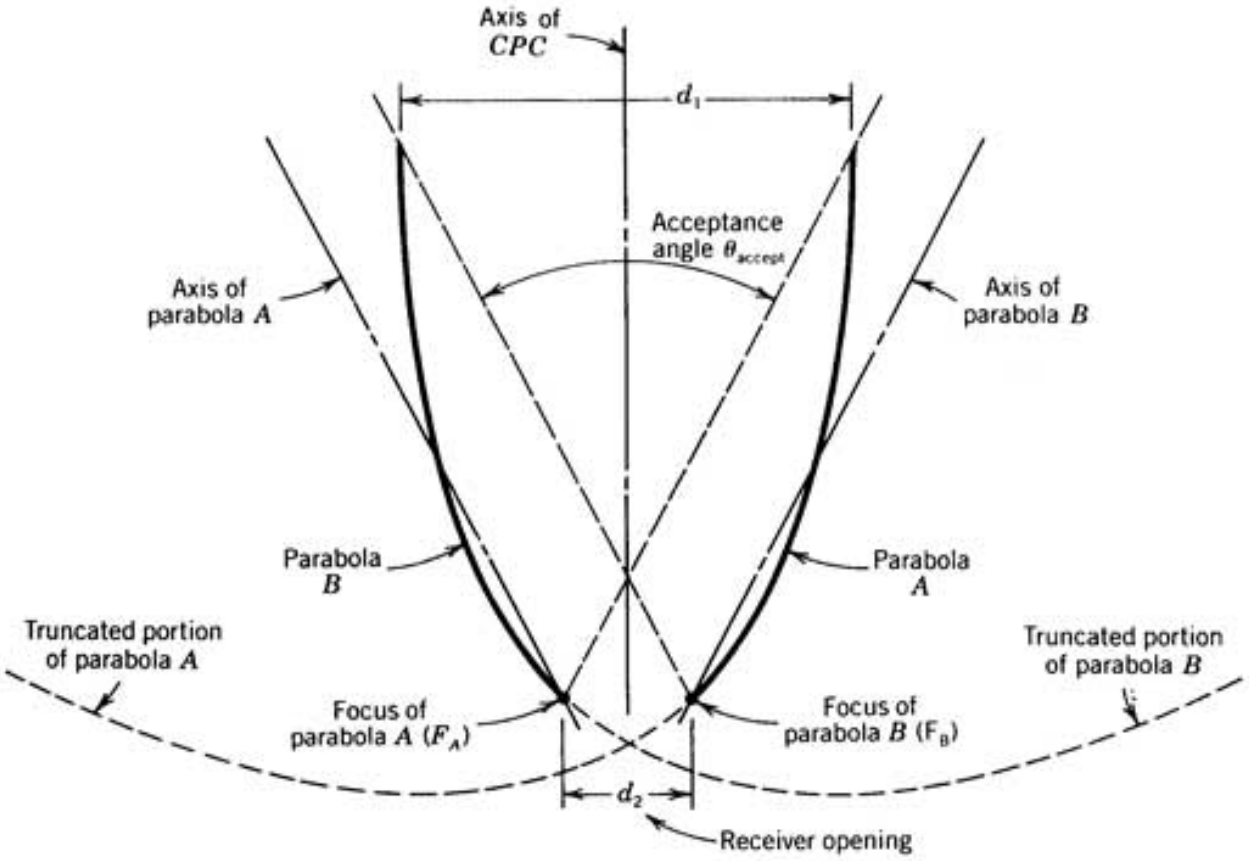
Layout



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Problem

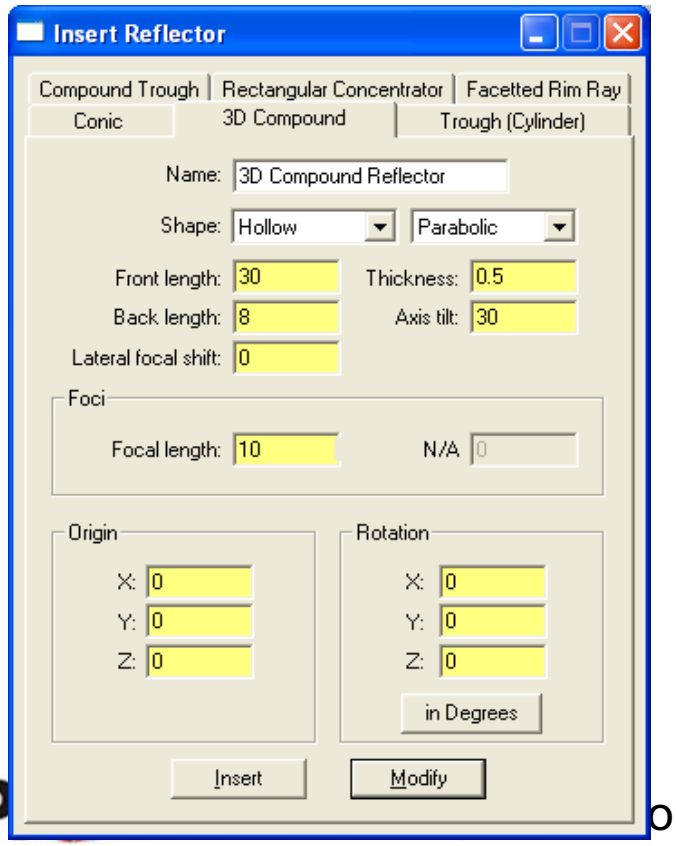
Compound Parabolic Concentrator having following parameter:

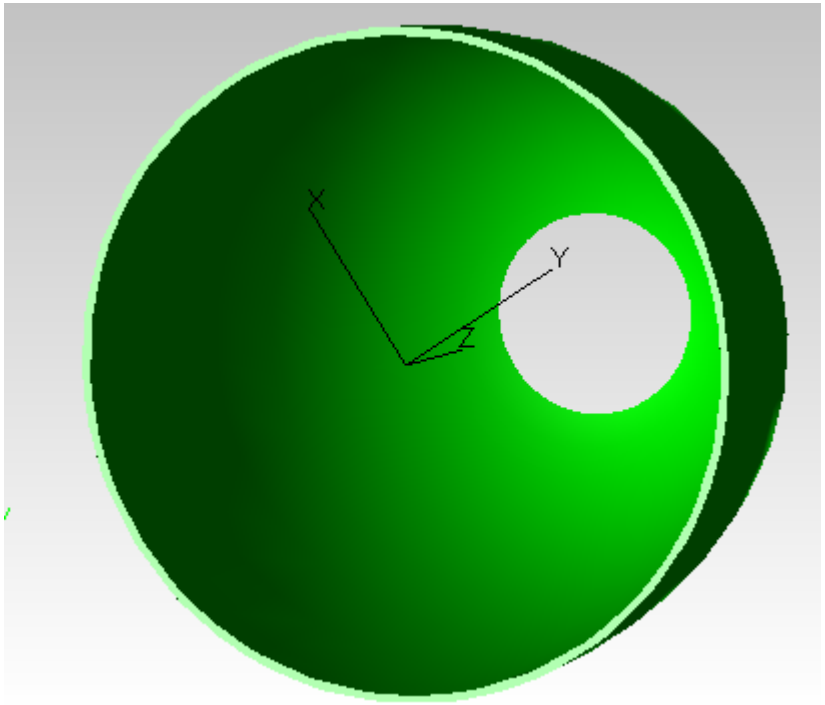
- Shape :Hollow & Parabolic
- Front length (the distance from the focal point to the entrance port end of the concentrator) : 30 mm
- Back length (the distance from the focal point to the exit port end of the concentrator) : 8 mm
- Lateral focal shift (equal to the exit port radius for a textbook concentrator): 0
- Thickness : 0.1 mm
- Axis tilt (equal to the acceptance angle for a textbook concentrator) : 30
- Focal length(s) : 10
- Origin (X, Y, Z coordinates of the center of the exit port) : (0,0,0)
- Rotation (X, Y, Z rotation angles about the center of the exit port) : (0,0,0)

Design

Open New Trace Pro:

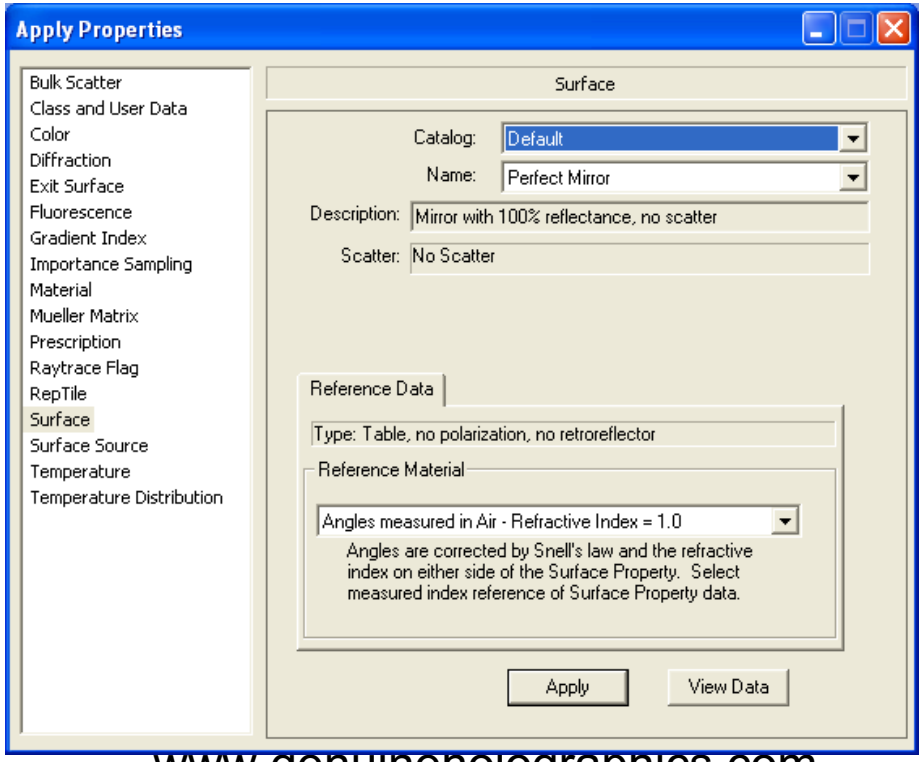
- Select > Insert > Reflector > 3D Compound
- Click Insert





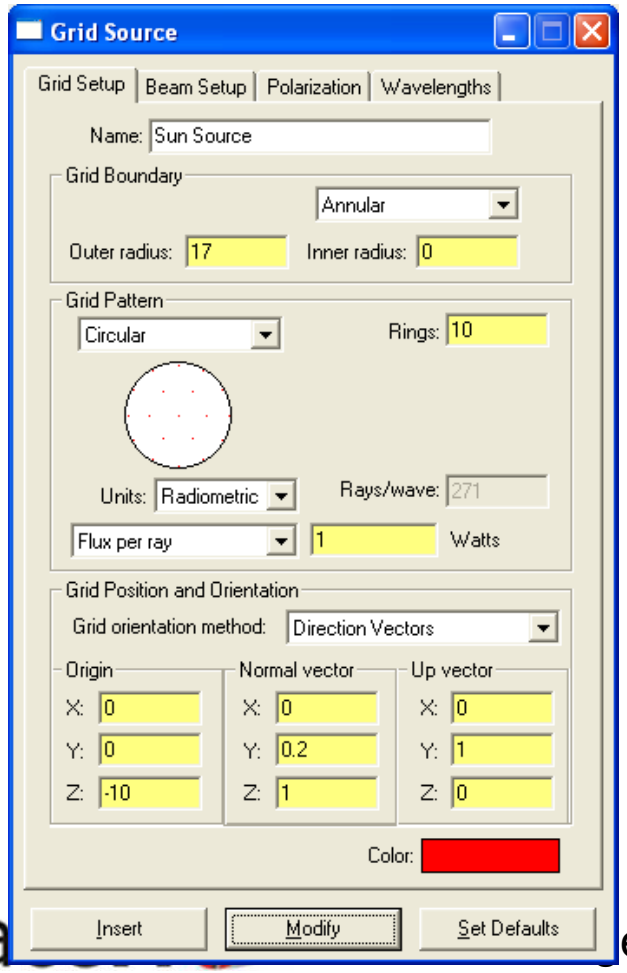
Properties

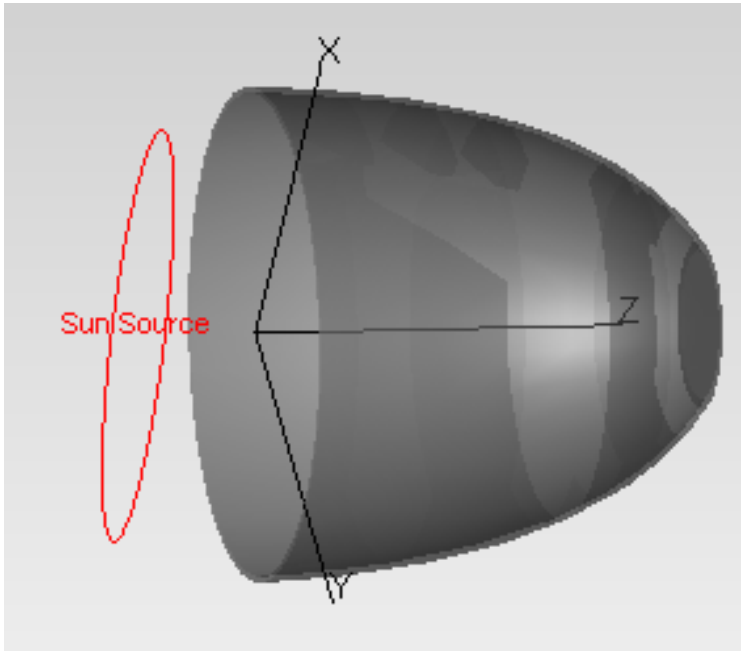
- Material : PMMA
- Color : Transparent
- Surface 0 (Inner Surface) : Perfect Mirror



Source

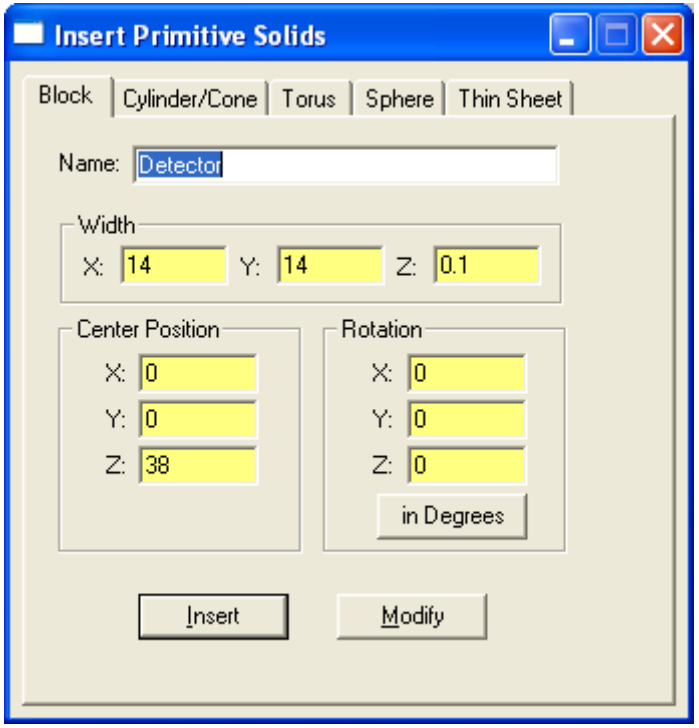
- Here we define collimated light source incident at certain angle.

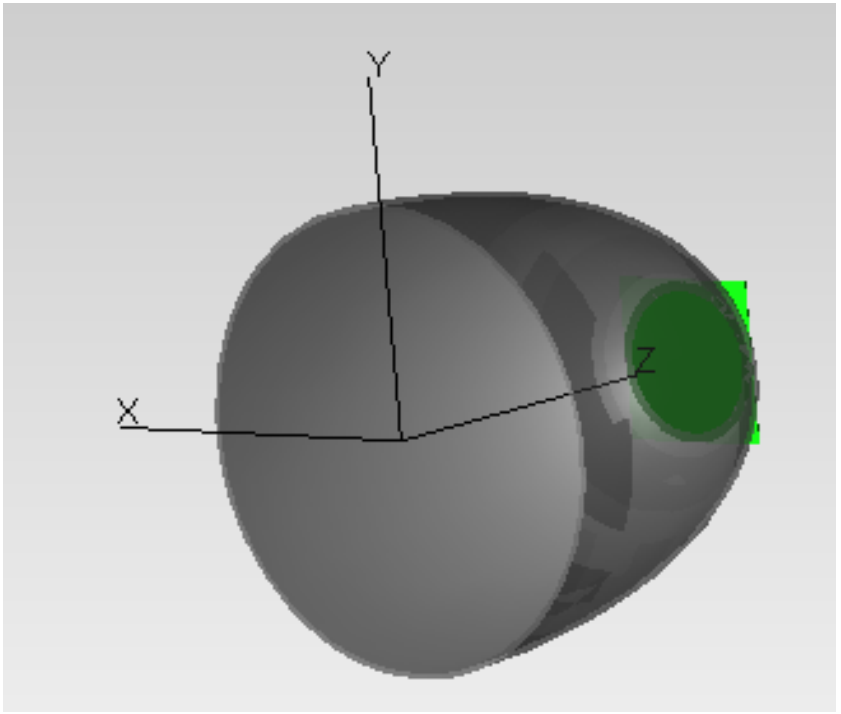




Detector

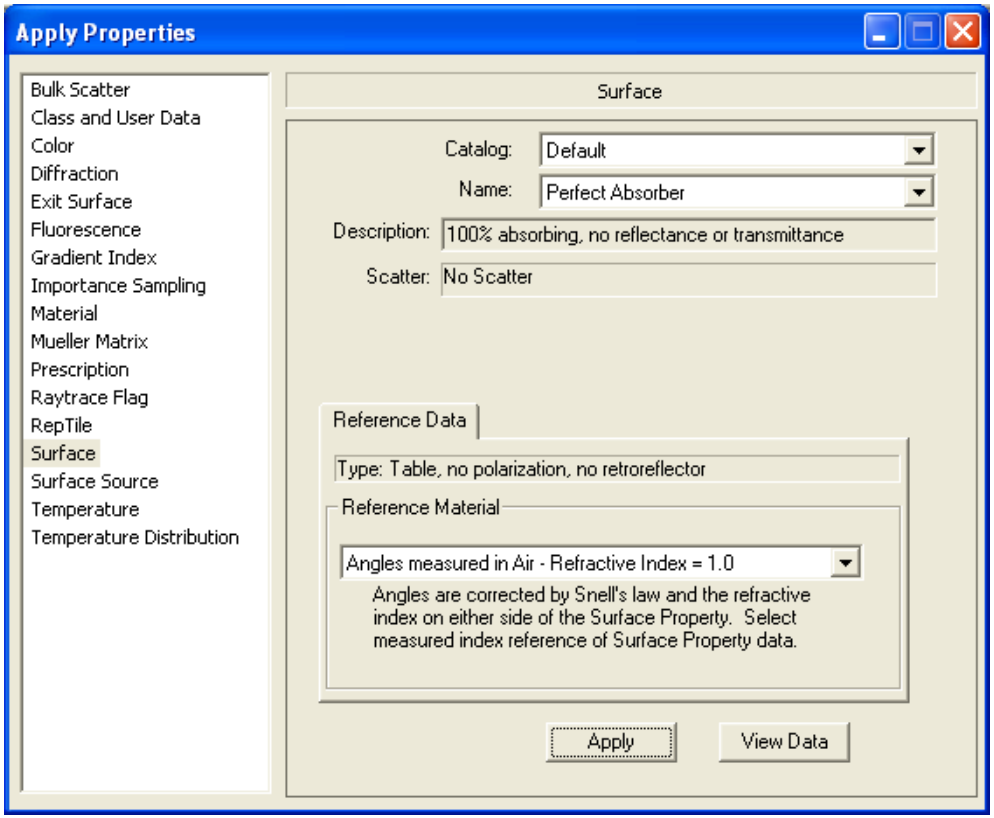
- Define Rectangular Block





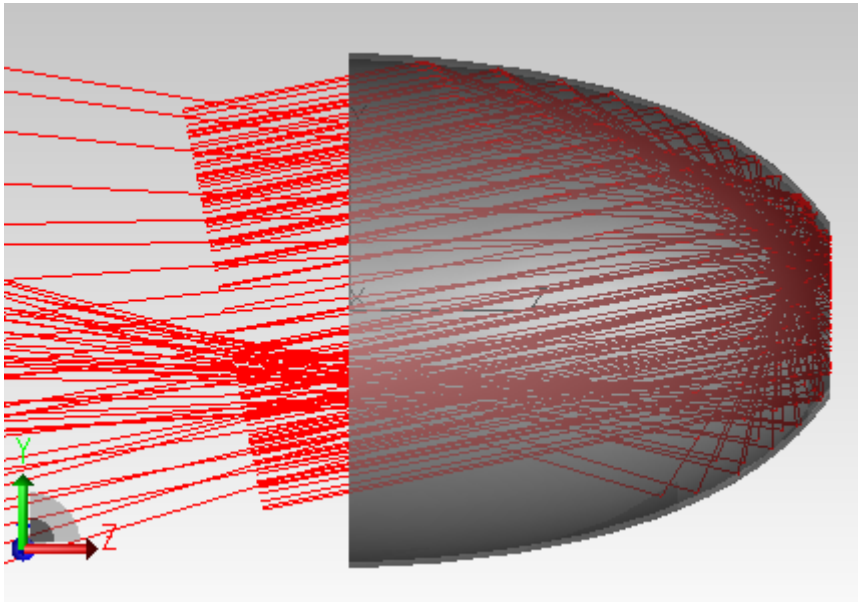
Detector Properties

- Define front surface “Surface1” as Perfect absorber.



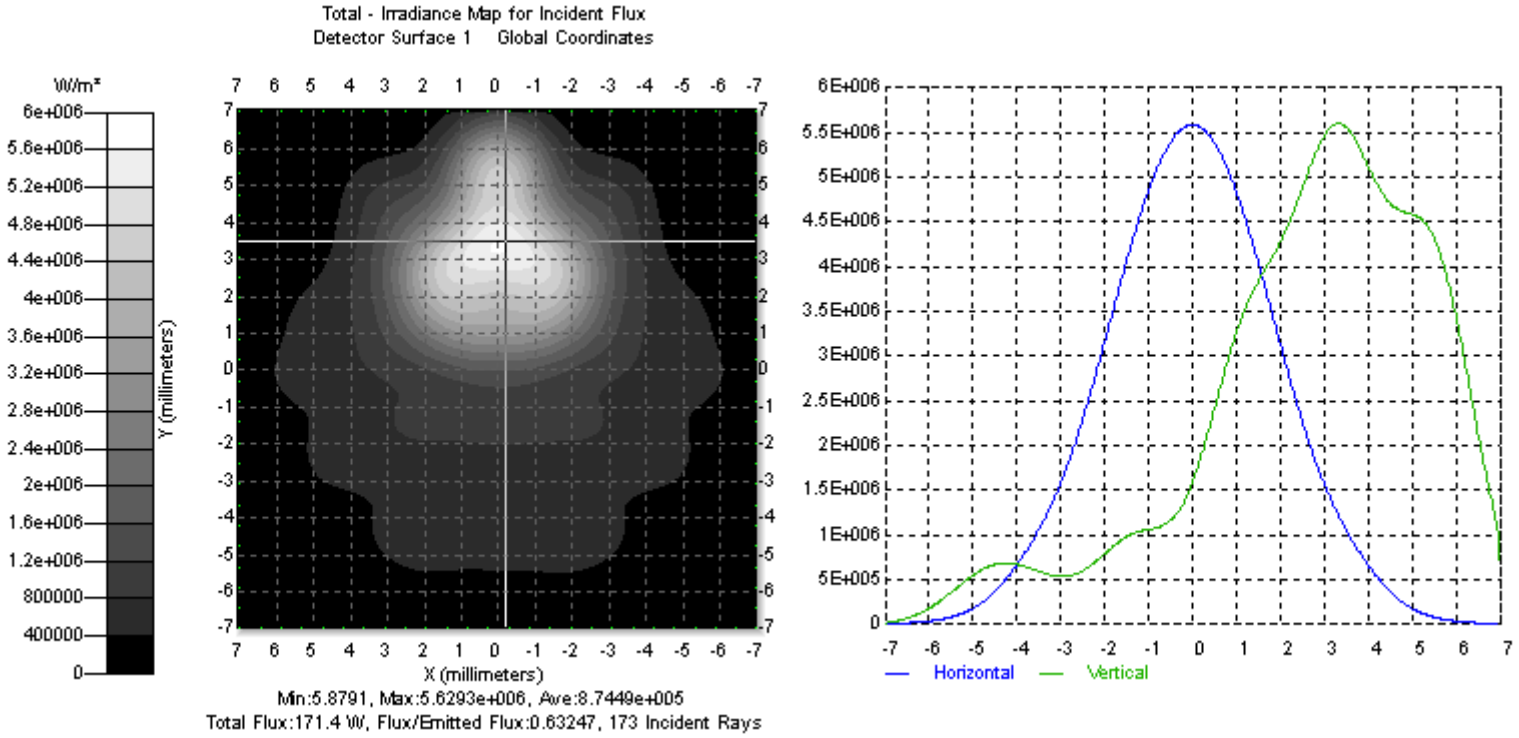
Trace Rays

- Raytrace > Tracerays

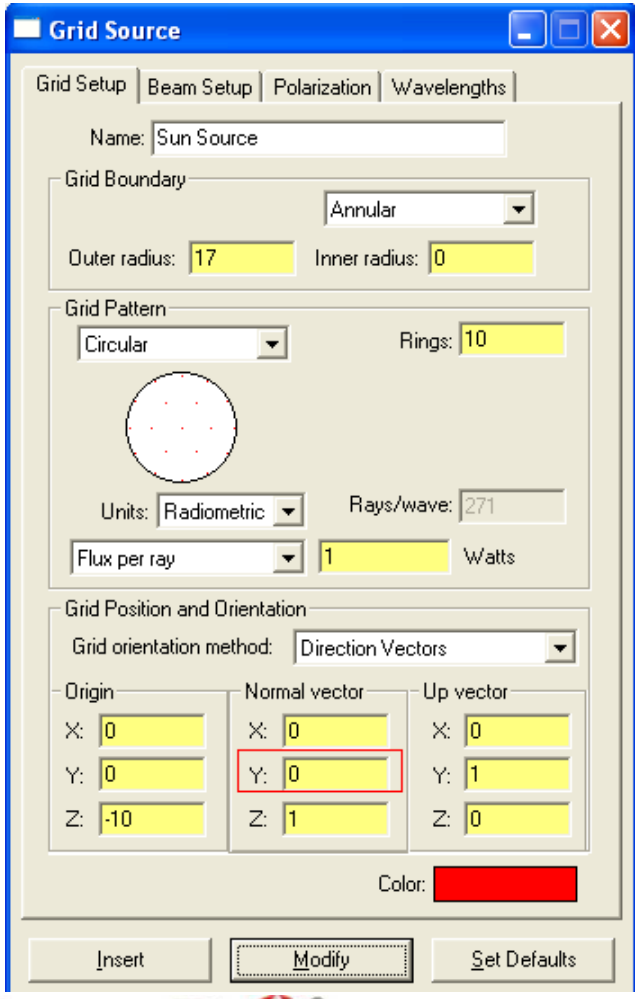


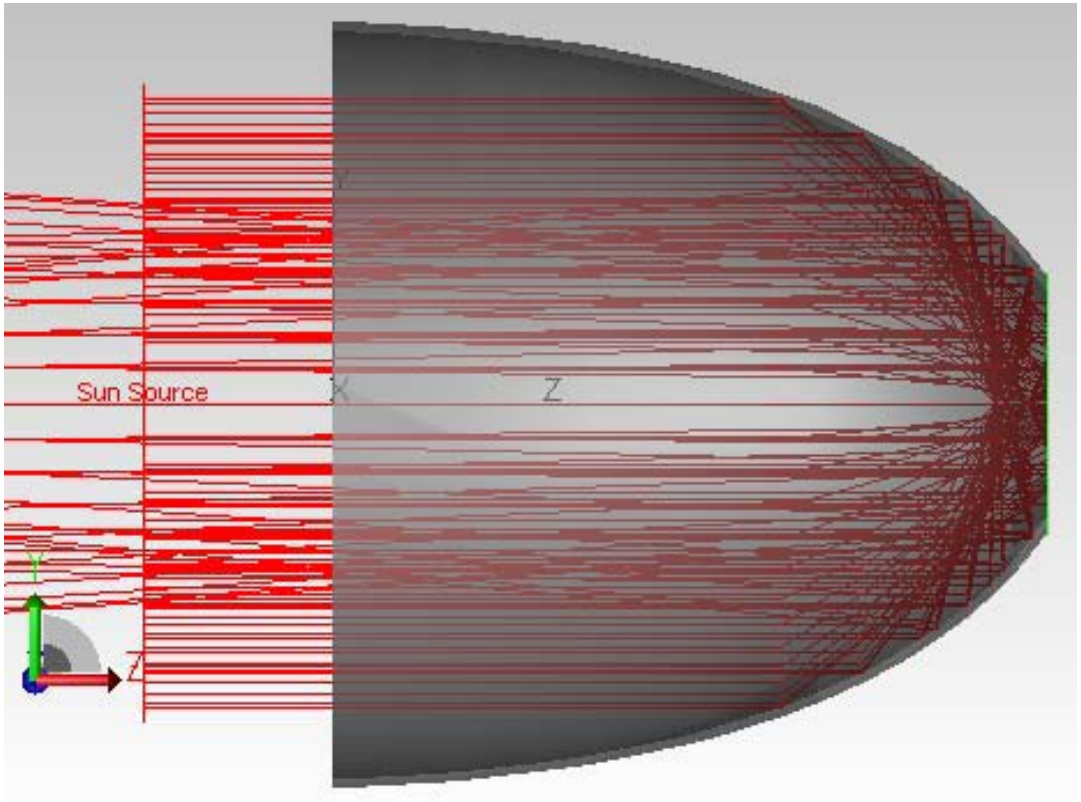
Analysis

- Select surface 1 of Detector

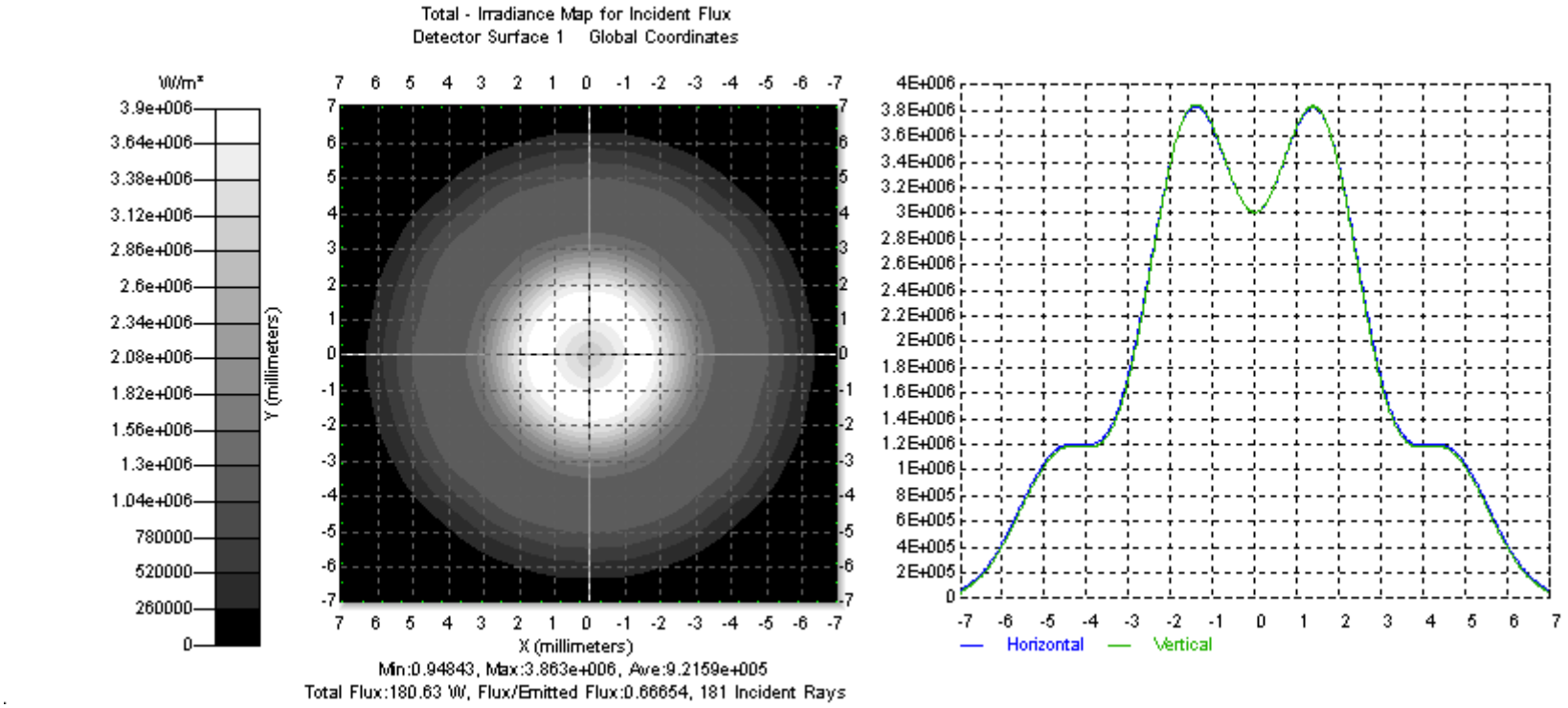


At 0 degree Incidence

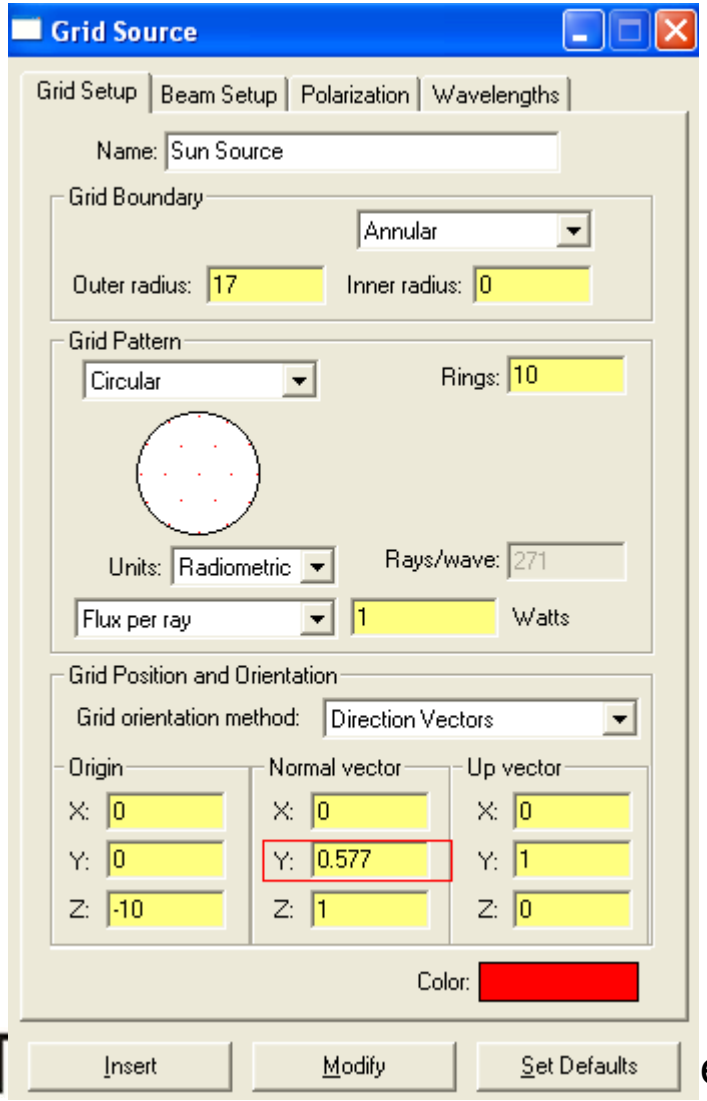


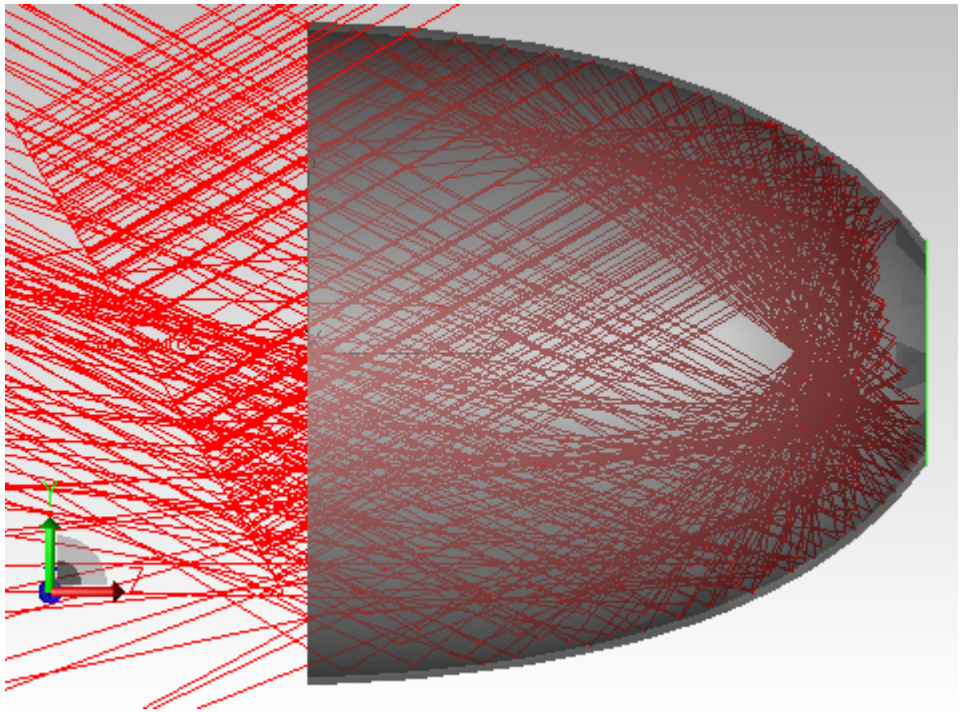


Analysis

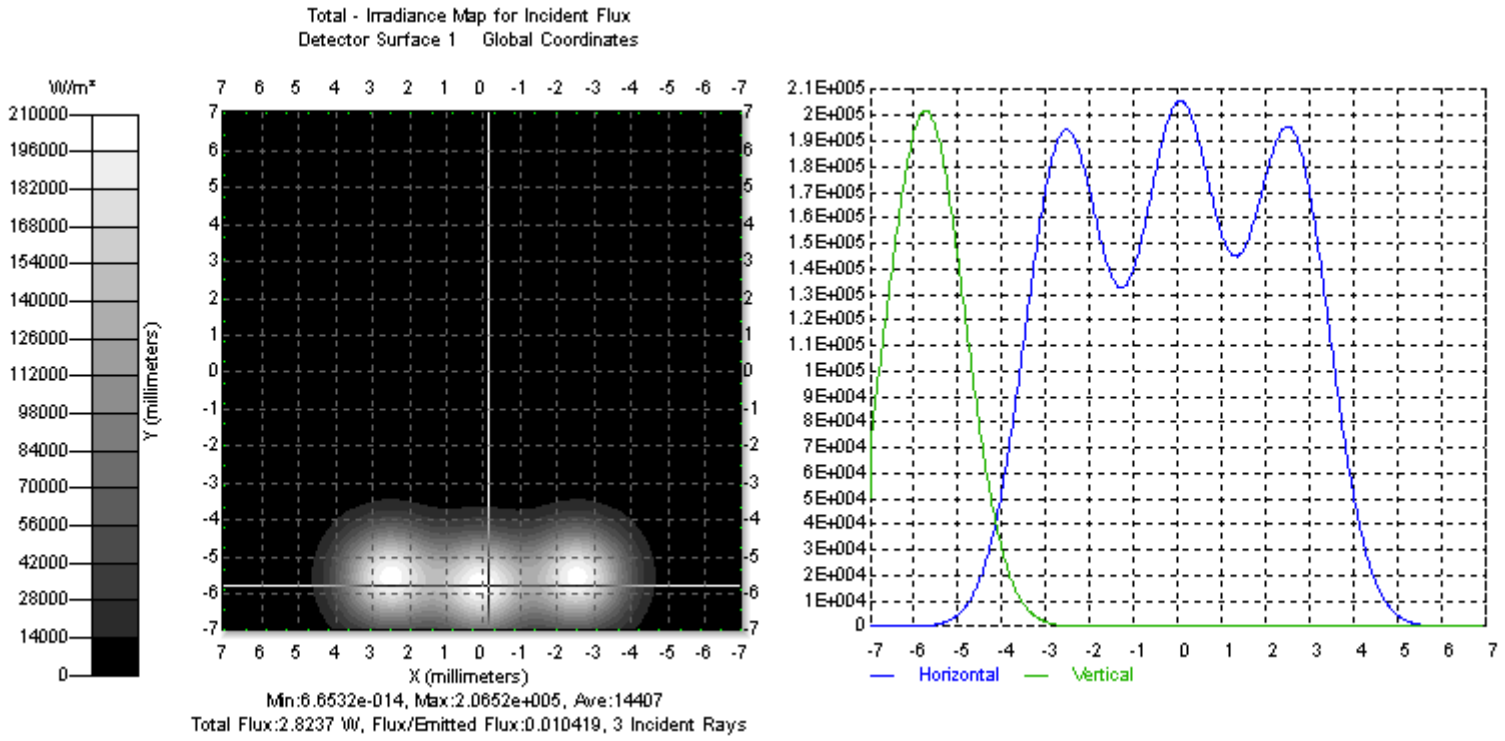

Total - Irradiance Map for Incident Flux
Detector Surface 1 Global Coordinates
W/m²
3.9e+006
3.64e+006
3.38e+006
3.12e+006
2.86e+006
2.6e+006
2.34e+006
2.08e+006
1.82e+006
1.56e+006
1.3e+006
1.04e+006
780000
520000
260000
0
Y (millimeters)
X (millimeters)
Min:0.94843, Max:3.863e+006, Ave:9.2159e+005
Total Flux:180.63 W, Flux/Emitted Flux:0.66654, 181 Incident Rays
Horizontal
Vertical

At 30 Degree

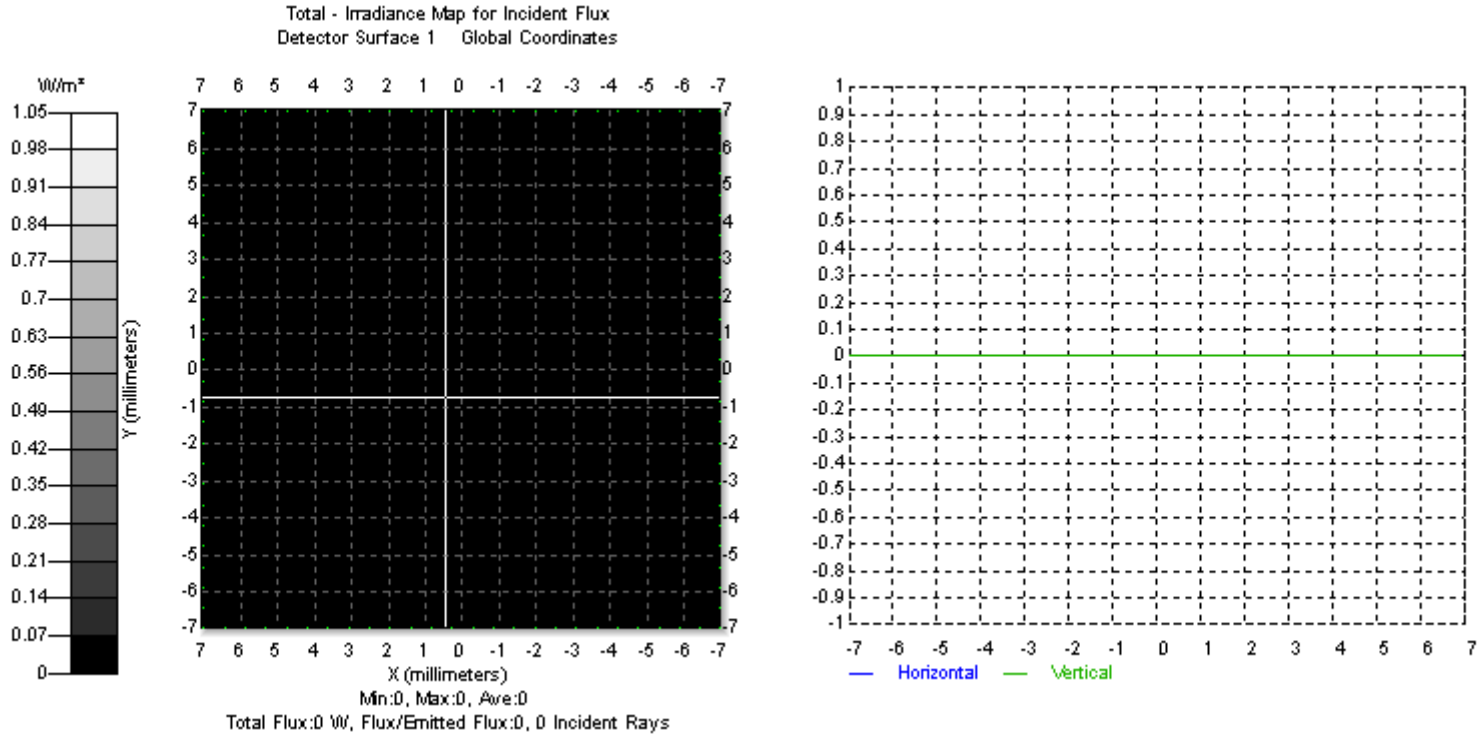

Grid Source
Grid Setup
Beam Setup
Polarization
Wavelengths
Name: Sun Source
Grid Boundary
Annular
Outer radius: 17
Inner radius: 0
Grid Pattern
Circular
Rings: 10
Units: Radiometric
Rays/wave: 271
Flux per ray
1
Watts
Grid Position and Orientation
Grid orientation method: Direction Vectors
Origin
X: 0
Y: 0
Z: -10
Normal vector
X: 0
Y: 0.577
Z: 1
Up vector
X: 0
Y: 1
Z: 0
Color:
Insert
Modify
Set Defaults



Analysis


Total - Irradiance Map for Incident Flux
Detector Surface 1 Global Coordinates
W/m²
210000
196000
182000
168000
154000
140000
126000
112000
98000
84000
70000
56000
42000
28000
14000
0
Y (millimeters)
X (millimeters)
Min:6.6532e-014, Max:2.0652e+005, Ave:14407
Total Flux:2.8237 W, Flux/Emitted Flux:0.010419, 3 Incident Rays
Horizontal
Vertical

At 31 Degree


Total - Irradiance Map for Incident Flux
Detector Surface 1 Global Coordinates
W/m²
1.05
0.98
0.91
0.84
0.77
0.7
0.63
0.56
0.49
0.42
0.35
0.28
0.21
0.14
0.07
0
Y (millimeters)
7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6 -7
X (millimeters)
Min:0, Max:0, Ave:0
Total Flux:0 W, Flux/Emitted Flux:0, 0 Incident Rays
1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 -0.1 -0.2 -0.3 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9 -1
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7
Horizontal
Vertical