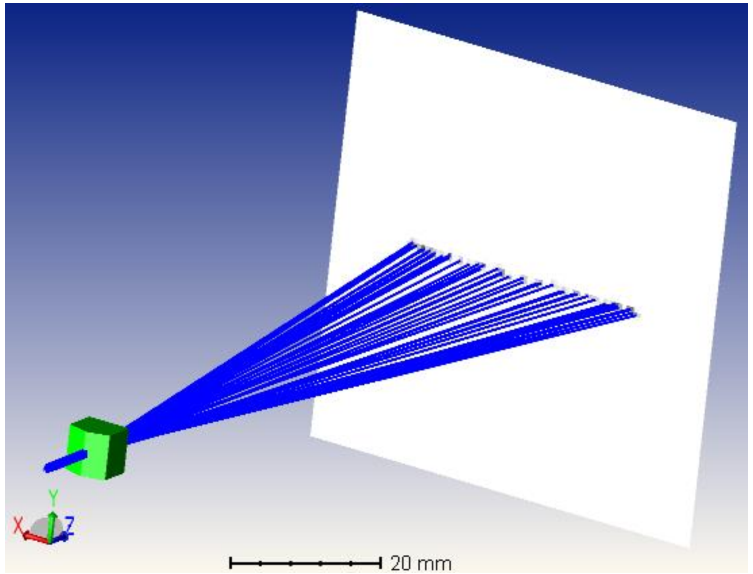
Lectures Notes on Optical Design using Zemax OpticStudio

Lecture 22

Some Non-Sequential Components



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Content

In this chapter we will investigate Folders and some NSC Components

- Folders
- Non-sequential Sources
- Non-sequential Detectors
- Non-sequential Geometry Objects
- Polygon Objects
- Examples

Folders

Konuları Listele | Görüntüle

Konu seçin: Bulunan: 207

Başlık	Konum	Dere
Folders	OpticStudio ...	1
Add Fold Mirror	OpticStudio ...	2
Load Archive	OpticStudio ...	3
Delete Fold Mirror	OpticStudio ...	4
Available Scatter Models	OpticStudio ...	5
Files	OpticStudio ...	6
Introduction (about the ...	OpticStudio ...	7
The 'Samples' Folder (T...	OpticStudio ...	8
Make Private Lens Cat...	OpticStudio ...	9
CAD Part: STL	OpticStudio ...	10
Source Illumination Map	OpticStudio ...	11
Scattering Models	OpticStudio ...	12
Source Directivity Plot	OpticStudio ...	13
Source Polar Plot	OpticStudio ...	14
Lens Catalogs	OpticStudio ...	15
Convert to Project Direc...	OpticStudio ...	16
OpticStudio Error Codes	OpticStudio ...	17
Archive Group	OpticStudio ...	18
Generate Radiant Sour...	OpticStudio ...	19
A Sample Extension Pro...	OpticStudio ...	20
Geometric Image Analysis	OpticStudio ...	21
Introduction (about exte...	OpticStudio ...	22
Image Simulation	OpticStudio ...	23
Import	OpticStudio ...	24
Physical Optics Propag...	OpticStudio ...	25
Polygon Object	OpticStudio ...	26
Creating ZPL Macros	OpticStudio ...	27
Partially Coherent Imag...	OpticStudio ...	28
Scattering (surface prop...	OpticStudio ...	29
Geometric Bitmap Imag...	OpticStudio ...	30
Export Polar Detector D...	OpticStudio ...	31
Ray Trace	OpticStudio ...	32
Extended Diffraction Im...	OpticStudio ...	33
Autosave	OpticStudio ...	34
FEA Fitting Process and...	OpticStudio ...	35
Specifying Which Glass...	OpticStudio ...	36
The Merit Function Edit...	OpticStudio ...	37
Other Settings	OpticStudio ...	38
MAKEFOLDER	OpticStudio ...	39
Universal Plot 2-D	OpticStudio ...	40
Using Table Glasses	OpticStudio ...	41
Source File	OpticStudio ...	42
IS Scatter Catalog Data	OpticStudio ...	43
Edit/Run	OpticStudio ...	44
New Universal Plot 1D	OpticStudio ...	45
Undo, Redo, and Reco...	OpticStudio ...	46
How OpticStudio Calls t...	OpticStudio ...	47
Convert CODE V to Opt...	OpticStudio ...	48
Universal Plot 1-D	OpticStudio ...	49
TOLERANCE	OpticStudio ...	50
New Universal Plot 2D	OpticStudio ...	51
The Tolerance Data Ed...	OpticStudio ...	52

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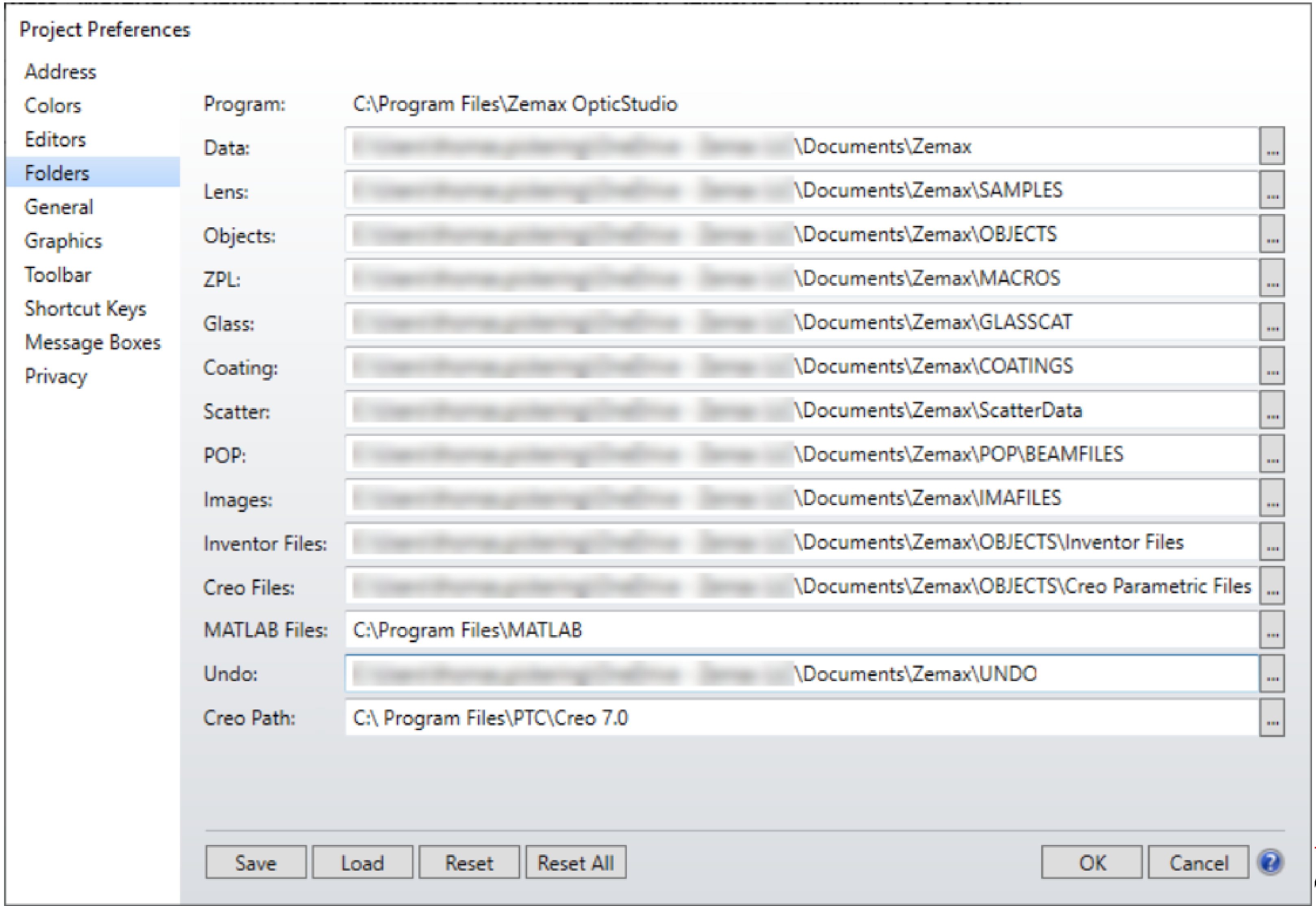
Folders

The Folders settings are available in the Project Preferences window, which can be displayed via a button in the System section of the Setup Tab. These settings determine where OpticStudio will place or search for certain types of files.



İçindekiler | Dizin | Ara | Sık Kullanılanlar

Aranacak sözcükleri yazın:

Non-sequential Sources

Konuları Listele | Görüntüle

Konu seçin: Bulunan: 43

Başlık	Konum	Derece
Non-sequential Sources	OpticStudio ...	1
Exceptions and Restrict...	OpticStudio ...	2
General Settings	OpticStudio ...	3
Methods of Using NSC ...	OpticStudio ...	4
Source Volume Ellipse	OpticStudio ...	5
Source DLL	OpticStudio ...	6
Source Volume Rectan...	OpticStudio ...	7
Source EULUMDAT File	OpticStudio ...	8
Source Two Angle	OpticStudio ...	9
Zernike Surface	OpticStudio ...	10
Source Filament	OpticStudio ...	11
Source Point	OpticStudio ...	12
Convert to NSC Group	OpticStudio ...	13
ZemaxSourceUnits Sou...	OpticStudio ...	14
Source Ray	OpticStudio ...	15
Adding New Source Ty...	OpticStudio ...	16
Source Rectangle	OpticStudio ...	17
Source Volume Cylinder	OpticStudio ...	18
Polarization (System Ex...	OpticStudio ...	19
Source Imported	OpticStudio ...	20
Source Tube	OpticStudio ...	21
Source File	OpticStudio ...	22
Source Object	OpticStudio ...	23
Coherence Length Mod...	OpticStudio ...	24
Source Ellipse	OpticStudio ...	25
Source Radial	OpticStudio ...	26
Units	OpticStudio ...	27
Converting sequential s...	OpticStudio ...	28
Non-sequential Geomet...	OpticStudio ...	29
Diffraction from NSC Ob...	OpticStudio ...	30
Parameters Common to ...	OpticStudio ...	31
Source Diode	OpticStudio ...	32
Source Diffractive	OpticStudio ...	33
Summary of NSC Sources	OpticStudio ...	34
Maximum Source File R...	OpticStudio ...	35
Object Placement	OpticStudio ...	36
Source IESNA File	OpticStudio ...	37
Placing Sources Inside ...	OpticStudio ...	38
Defining DLLs for Ray ...	OpticStudio ...	39
NSC Operands	OpticStudio ...	40
Non-sequential Compon...	OpticStudio ...	41
Diffraction (object prope...	OpticStudio ...	42
Source Gaussian	OpticStudio ...	43

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Non-sequential Sources

Sources include points, ellipses, rectangles, volumes, data files, and user defined types. Any source may be placed inside of any object, or not in any object, but not both (a source may not straddle an object boundary).

Next:

Summary of NSC Sources
Parameters Common to All Source Objects
Placing Sources Inside Objects
Adding New Source Types
Source Diffractive
Source Diode
Source DLL
Source Ellipse
Source EULUMDAT File
Source Filament
Source File
Source Gaussian
Source IESNA File
Source Imported
Source Object
Source Point
Source Radial
Source Ray
Source Rectangle
Source Tube
Source Two Angle
Source Volume Cylinder
Source Volume Ellipse
Source Volume Rectangle

İçindekiler | Dizin | Ara | Sık Kullanılanlar

Aranacak sözcükleri yazın:

Non-sequential Detectors

Konuları Listele | Görüntüle

Konu seçin: Bulunan: 16

Başlık	Konum	Derece
Non-sequential Detectors	OpticStudio ...	1
NSC Operands	OpticStudio ...	2
Optimization Operands (...	OpticStudio ...	3
Non-sequential Ray Tra...	OpticStudio ...	4
Non-sequential Compon...	OpticStudio ...	5
Detector Color Object	OpticStudio ...	6
Object Placement	OpticStudio ...	7
Detector Rectangle Obj...	OpticStudio ...	8
Non-sequential Geomet...	OpticStudio ...	9
Detector Volume Object	OpticStudio ...	10
Detector Surface Object	OpticStudio ...	11
Detector Polar Object	OpticStudio ...	12
Source Volume Rectan...	OpticStudio ...	13
Objects as Detectors	OpticStudio ...	14
Summary of NSC Detec...	OpticStudio ...	15
General Settings	OpticStudio ...	16

The Setup Tab > Editors Group (Setup Tab) > Non-sequential Component Editor > Non-sequential Detectors

Non-sequential Detectors

The available types of detectors in OpticStudio are described in this section.

Next:

Summary of NSC Detectors
Detector Color Object
Detector Polar Object
Detector Rectangle Object
Detector Surface Object
Detector Volume Object
Objects as Detectors

İçindekiler | Dizin | Ara | Sık Kullanılanlar

Aranacak sözcükleri yazın:

Konuları Listele   Görüntüle

Konu seçin: Bulunan: 97

Başlık	Konum	Derece
Non-sequential Geom...	OpticStudi...	1
Slide (non-sequential ...	OpticStudi...	2
Binary 1 (non-sequent...	OpticStudi...	3
Binary 2 (non-sequent...	OpticStudi...	4
Toroidal Hologram (no...	OpticStudi...	5
Sphere (non-sequenti...	OpticStudi...	6
Diffraction Grating (no...	OpticStudi...	7
Jones Matrix (non-seq...	OpticStudi...	8
Array (non-sequential ...	OpticStudi...	9
Cylinder 2 Volume	OpticStudi...	10
Tabulated Fresnel Ra...	OpticStudi...	11
ReverseRadiance Ta...	OpticStudi...	12
Annulus	OpticStudi...	13
Biconic Zernike Surfa...	OpticStudi...	14
Hologram Surface	OpticStudi...	15
Annular Aspheric Lens	OpticStudi...	16
Zernike Surface	OpticStudi...	17
Grid Sag Lens 2	OpticStudi...	18
Cone	OpticStudi...	19
CAD Assembly: Autod...	OpticStudi...	20
Paraxial Lens	OpticStudi...	21
Aspheric Surface 2	OpticStudi...	22
Wolter Surface	OpticStudi...	23
Grid Sag Lens	OpticStudi...	24
Binary 2A	OpticStudi...	25
Boolean Native	OpticStudi...	26
Torus Volume	OpticStudi...	27
Hologram Lens	OpticStudi...	28
Biconic Surface	OpticStudi...	29
Rectangular Roof	OpticStudi...	30
Triangular Corner	OpticStudi...	31
Standard Surface	OpticStudi...	32
Tabulated Faceted T...	OpticStudi...	33
Aspheric Surface	OpticStudi...	34
Fresnel 1	OpticStudi...	35
Lenslet Array 2	OpticStudi...	36
Toroidal Surface	OpticStudi...	37

☐ Önceki sonuçlarda ara
☑ Benzer sözcükleri eşleştir
☐ Yalnızca başlıklarda ara

Non-sequential Geometry Objects

OpticStudio NSC object types include ellipses, triangles, rectangles, spheres, cylinders, and other basic shapes. Complex objects such as arbitrary prisms, aspheric lenses, torics, toruses, and other optical components are also available. The reflective, refractive, and absorptive properties of these objects are determined by the material assigned to the objects.

For details on reflective, refractive, and absorptive properties, see the sections called "Using Material Catalogs" and "Polarization (system explorer)".

Each NSC object type is described in the following summary table, and in greater detail in the following sections. Note these basic objects may be combined to form more complex objects. See the "Object Placement" section of the "Non-sequential Overview" for information on placing objects inside or adjacent to one another.

For information on sources and detectors, please see the sections "Non-sequential Sources" and "Non-sequential Detectors".

If an object type is required that is not listed, please email technical support to suggest the new object type be added to OpticStudio.

Next:

Aranacak sözcükleri yazın:

Polygon Objects

Konuları Listele | Görüntüle

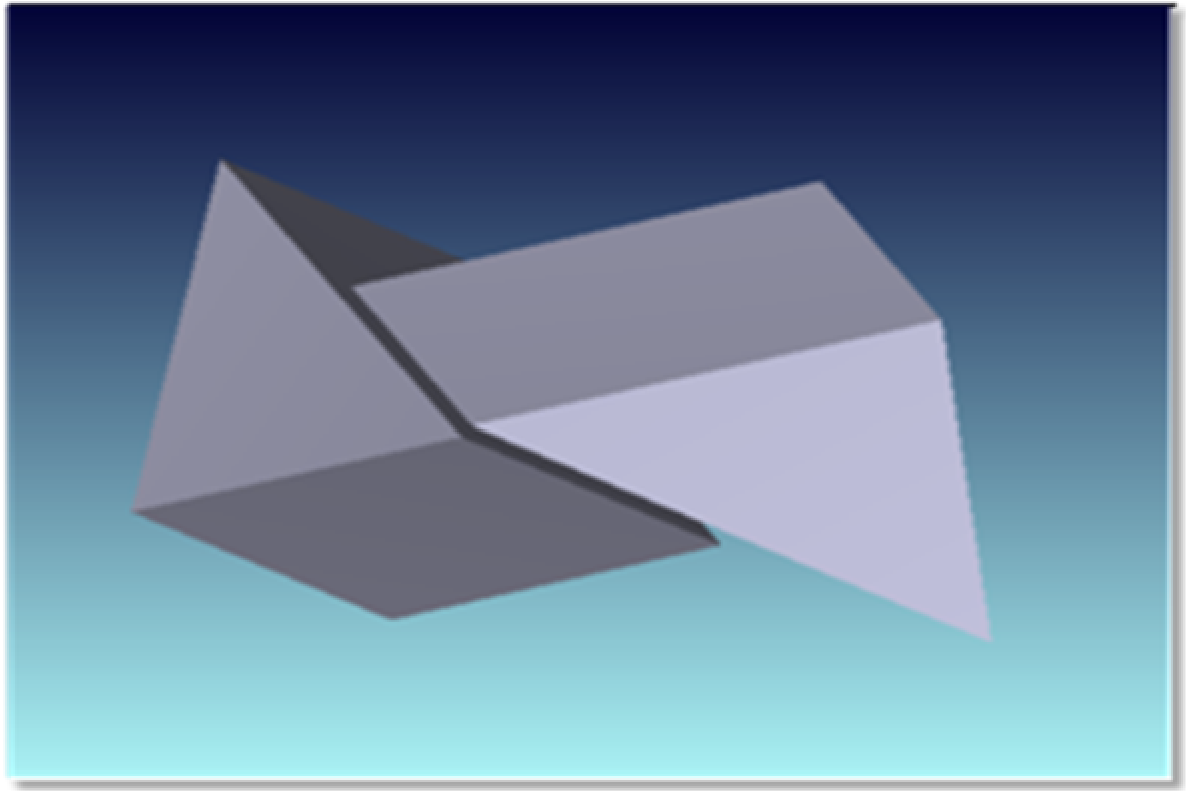
Konu seçin: Bulunan: 27

Başlık	Konum	Derece
Polygon Object	OpticStudi...	1
SETNSCPROPERTY...	OpticStudi...	2
Summary of NSC Obj...	OpticStudi...	3
Combine Objects	OpticStudi...	4
User Defined Object	OpticStudi...	5
CAD Part: STL	OpticStudi...	6
Create Polygon Object	OpticStudi...	7
Objects as Detectors	OpticStudi...	8
Non-sequential Geom...	OpticStudi...	9
Tutorial 1: 7-Cell Clust...	OpticStudi...	10
Refraction and Reflec...	OpticStudi...	11
User Defined Apertur...	OpticStudi...	12
General Settings	OpticStudi...	13
Convert to Project Dir...	OpticStudi...	14
Object Creation Com...	OpticStudi...	15
NSC Editor Toolbar	OpticStudi...	16
Detector Surface Obj...	OpticStudi...	17
Objects	OpticStudi...	18
Polygon	OpticStudi...	19
Edit Object Data File	OpticStudi...	20
Pyramid (objects)	OpticStudi...	21
Paraxial Lens	OpticStudi...	22
OpticStudio File Type...	OpticStudi...	23
Faceted Surface	OpticStudi...	24
Adding New Source ...	OpticStudi...	25
Lens	OpticStudi...	26
Aperture (surface pro...	OpticStudi...	27

☐ Önceki sonuçlarda ara

☑ Benzer sözcükleri eşleştir

Polygon Object



The polygon object is a very general user-defined object. It can be used to define an open polygon surface or a closed polygon volume with some portions reflective and others refractive or absorptive. The Polygon Object is based on a collection of 3D triangles whose vertices are placed in a file with the POB extension. See the “Defining Polygon Objects” for more details. Any Polygon Object may be used as a detector as described in “Objects as detectors” .

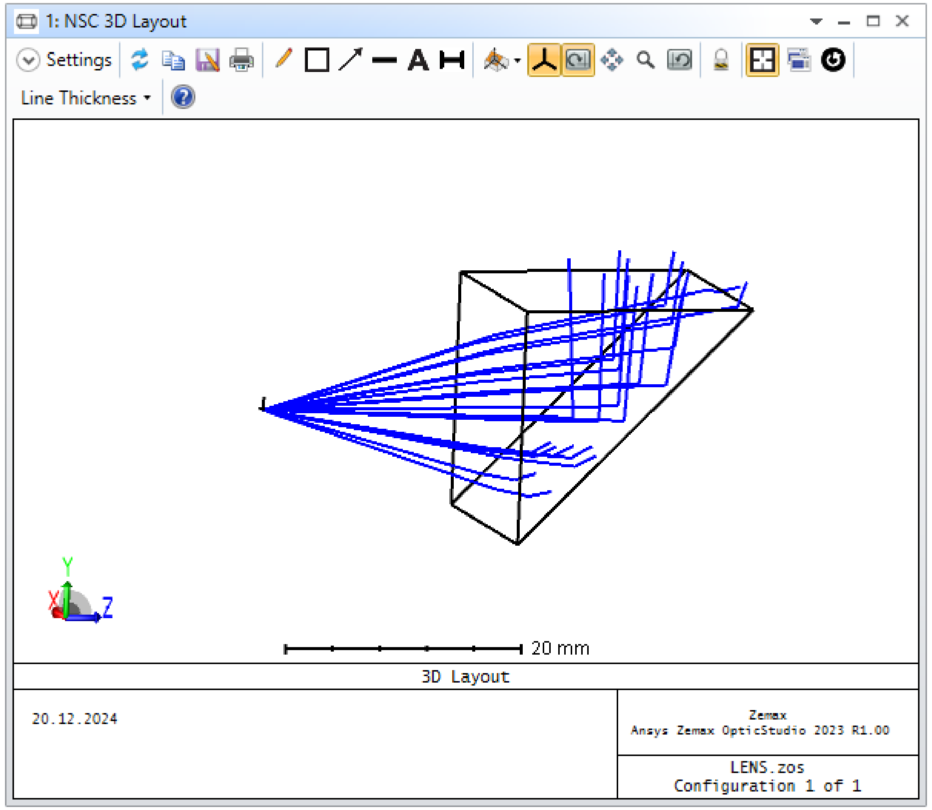
Example 22.1: Source Point and a Prism

Non-Sequential Component Editor

Update: All Windows

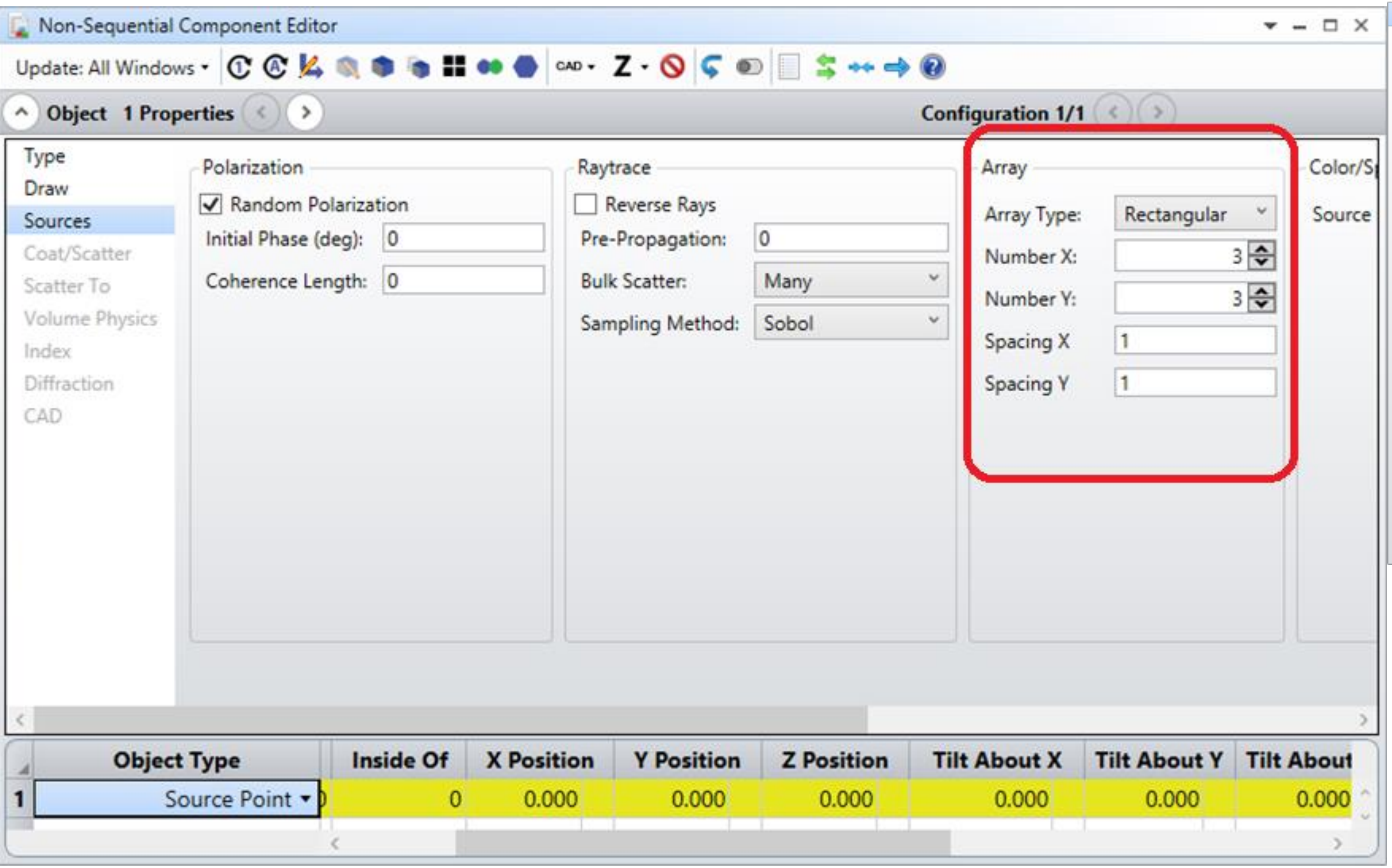
Object 1 Properties — Configuration 1/1

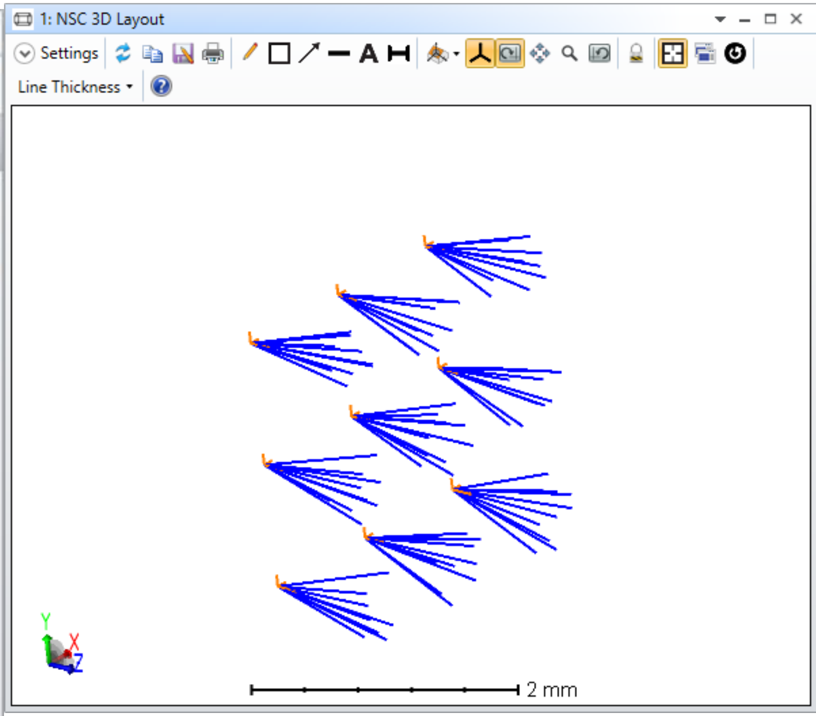
	Object Type	Comment	Ref Object	Inside Of	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	# Layout Rays	# Analysis Rays	Power(Watts)	Wavenumber	Color #	Cone Angle
1	Source Point		0	0	0.000	0.000	0.000	0.000	0.000	0.000	-	20	1E+05	1.000	0	0	20.000
2	Polygon Object	Prism45.POB	0	0	0.000	0.000	20.000	0.000	0.000	0.000	BK7	10.000	1				
3	Null Object		0	0	0.000	0.000	0.000	0.000	0.000	0.000	-						



Array of point sources

Consider we have a point source with cone angle 20º.





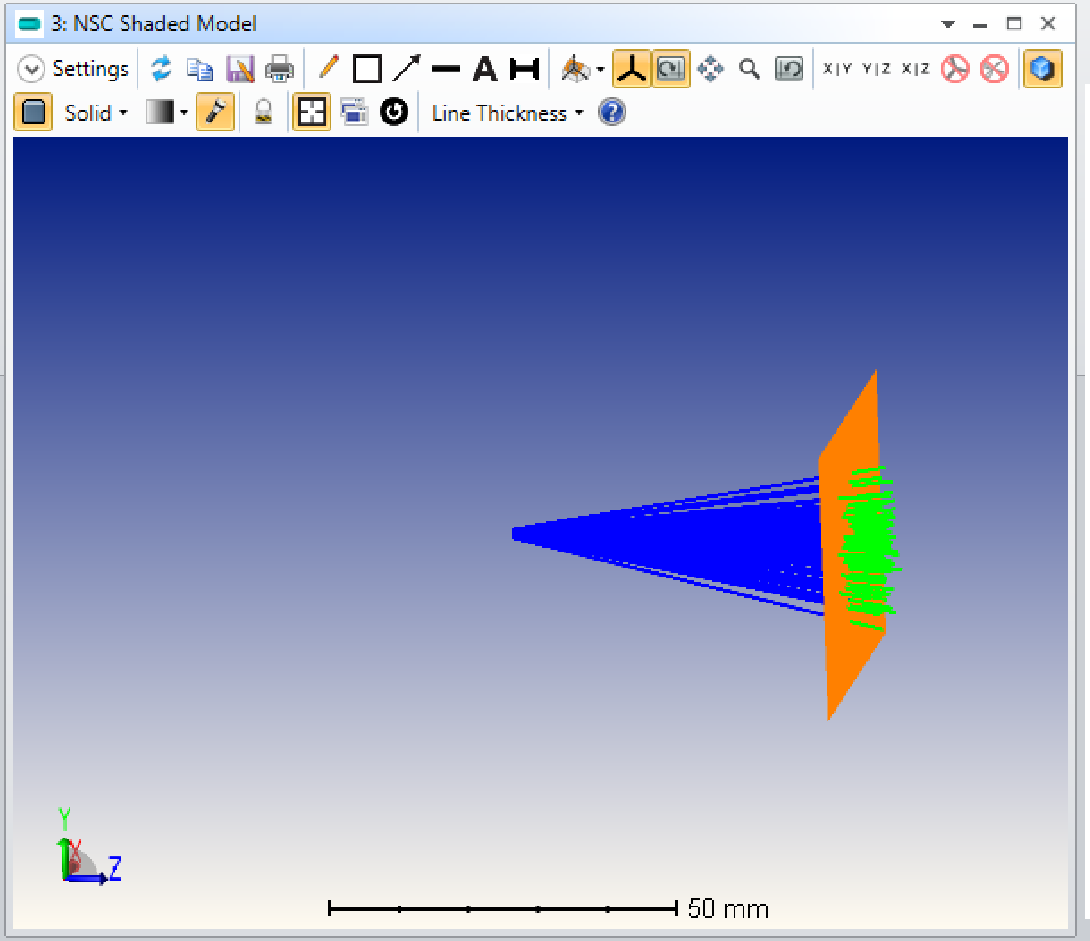
Example 22.2: Source Gaussian (Beam)

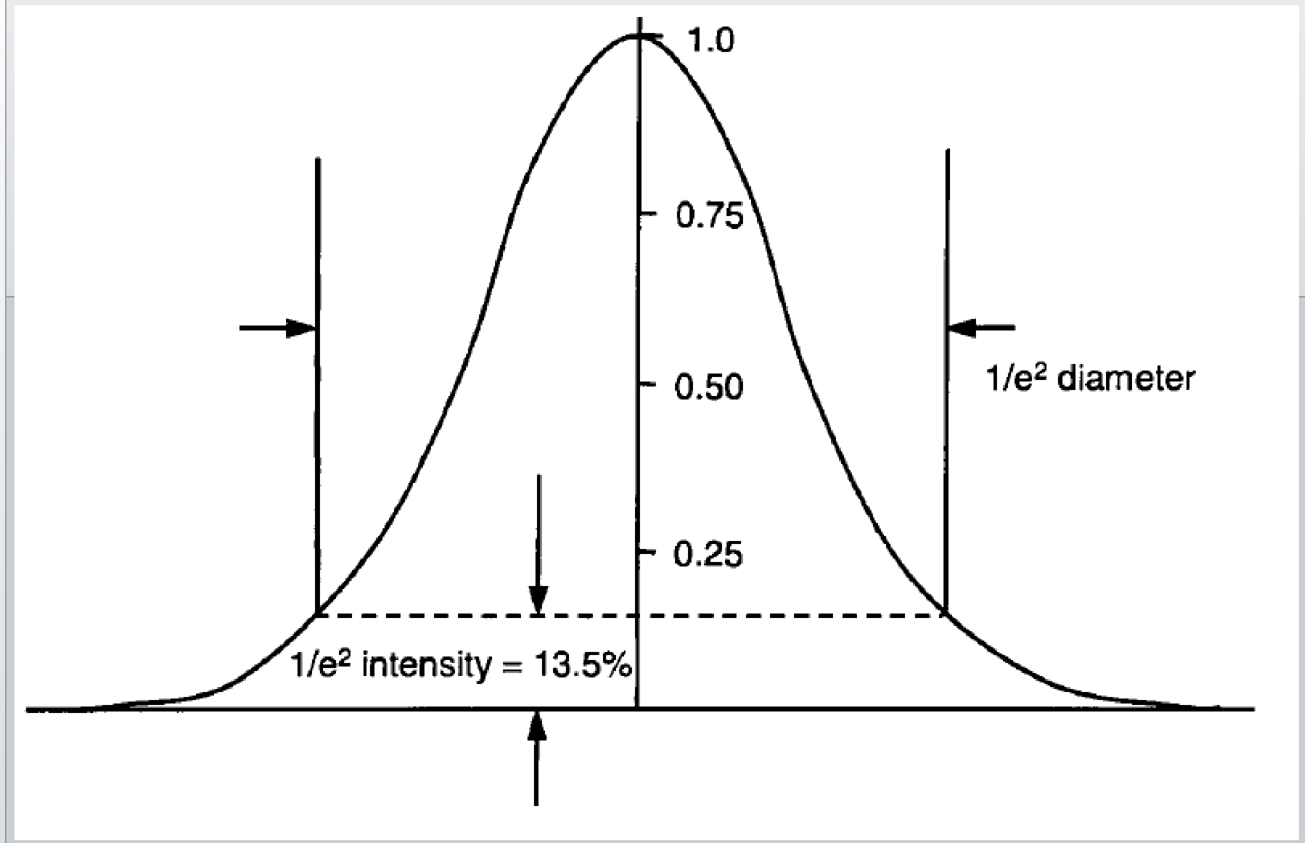
Non-Sequential Component Editor

Update: All Windows

Object 2 Properties | Configuration 1/1

	Object Type	Comme	Ref Object	Inside Of	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	X Half Width	Y Half Width	# X Pixels	# Y Pixels
1	Source Gaussian		0	0	0.000	0.000	0.000	0.000	0.000	0.000	-	100	1E+05	1.000	0
2	Detector Rectangle		0	0	0.000	0.000	50.000	0.000	0.000	0.000		20.000	20.000	100	100





Source File

- The Source File is a source whose **ray coordinates**, **cosines**, and **intensity** are defined in a user supplied file.
- The file extension may be either DAT or SDF and the file must be placed in the `<data>\Objects\Sources\Source Files` folder (see "Folders").
- The file format may be either **text** or **binary**, both formats are in Help File.

We will see both formats.

Example 22.3: How to use LED (a binary source file)

LED manufacturers (such as Osram Opto Semiconductors) distribute comprehensive ray-tracing data files to be used in optical simulations such as

eulumdat file,
ray file and
spectrum file.

- In principle, LED is considered as a point source in **eulumdat file** which is used for a quick analysis.
- **The ray file** represents actual spatial and angular distribution of rays originating from the outer surface of LED. Therefore, ray files can be used in more realistic simulations.
- The spectral distribution of LED (wavelengths emitted and corresponding weights) are stored in **spectrum files**.

Two types (White and IR) of LED provided by Osram Company will be presented.

[If possible, show ray files and eulumdat files]

Examples:

- **LUW H9GP** a white LED having color temperature of 6500 K.
- **SFH 4718A** which is an IR LED whose peak irradiance is at 850 nm

After downloading LED's simulation files, you should copy and paste files to the related folders:

Put Geometry files (igs or step) in

`C:\<ZEMAX>\Objects\CAD Files`

Put Spectrum files must be in

`C:\<ZEMAX>\Objects\Sources\Spectrum Files`

Put Ray files in

`C:\<ZEMAX>\Objects\Sources\Source Files`

Example 22.4: Simple LED Collimator

We will use the LED (SFH4718A) placed at (0,0,0), a collimating plano-convex lens and a detector. In the lecture, I will show you both rectangular and polar detectors.

<u>Standard Lens</u>
Z pos = 4 mm (can be variable)
Clear1=Edge1=Clear2=Edge2 = 6 mm
Thickness = 6 mm
Radius2 = -6 mm
Conic2 = 0 mm

<u>Detector</u>
Z pos = 100 mm
X-Y Half Width = 100 mm
X-Y Pixel # = 100

	Object Type	Comment	Ref	Insi	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	Radius 1	Conic 1	Clear 1	Edge 1
1	CAD Part: STEP/IGES/SAT	SFH_4718A_20220909_geometry.STEP	0	0	0.000	0.000	0.000	0.000	0.000	0.000		1.000	1	5	5
2	Source File	rayfile_SFH_4718A_100k_20220909_Zemax.DAT	0	0	0.000	0.000	0.000	0.000	0.000	0.000	-	50	1E+05	1.000	0
3	Standard Lens		0	0	0.000	0.000	4.000	0.000	0.000	0.000	PMMA	0.000	0.000	6.000	6.000
4	Detector Rectangle		0	0	0.000	0.000	100.000	0.000	0.000	0.000		100.000	100.000	100	100

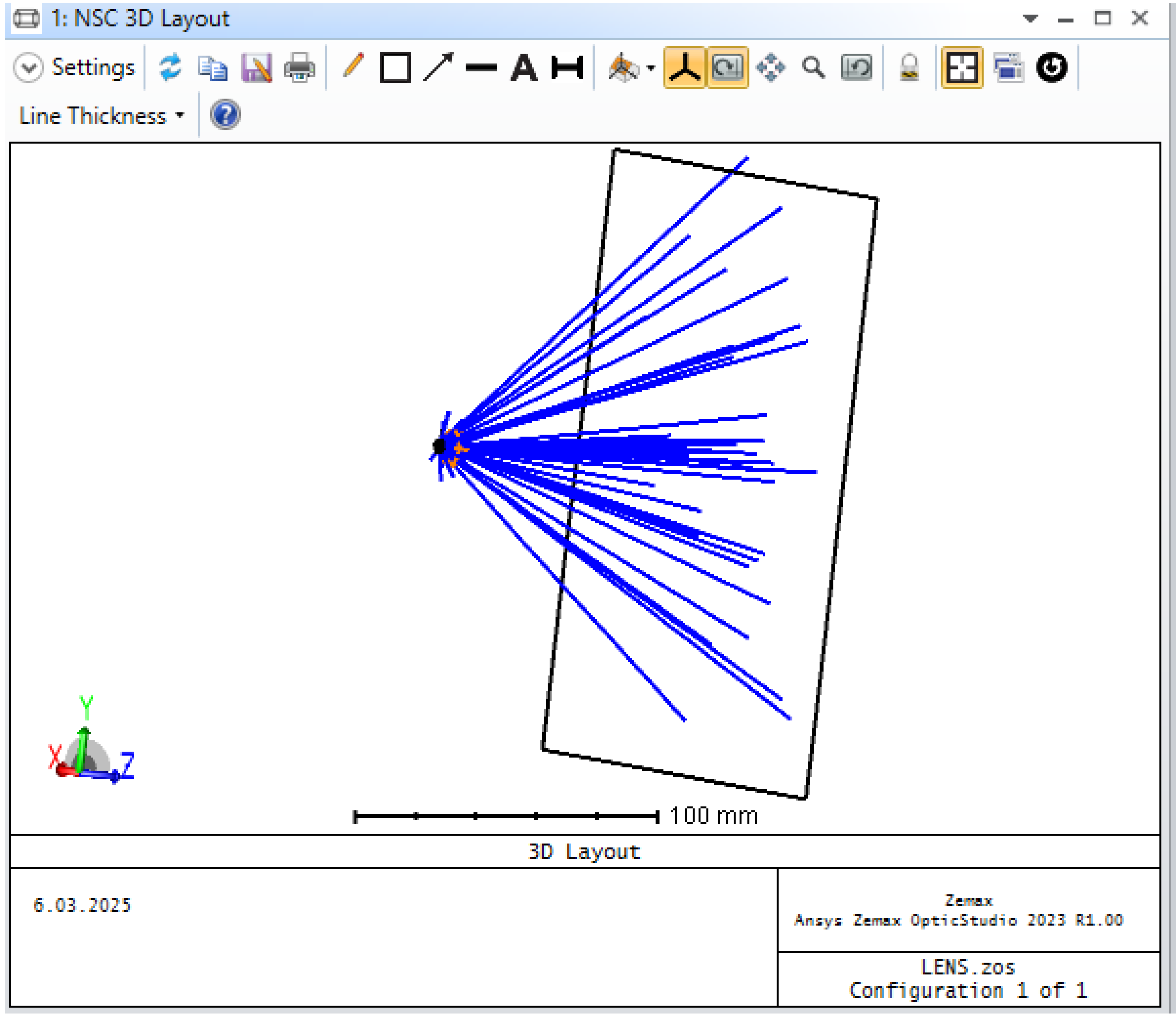
Merit Function Editor

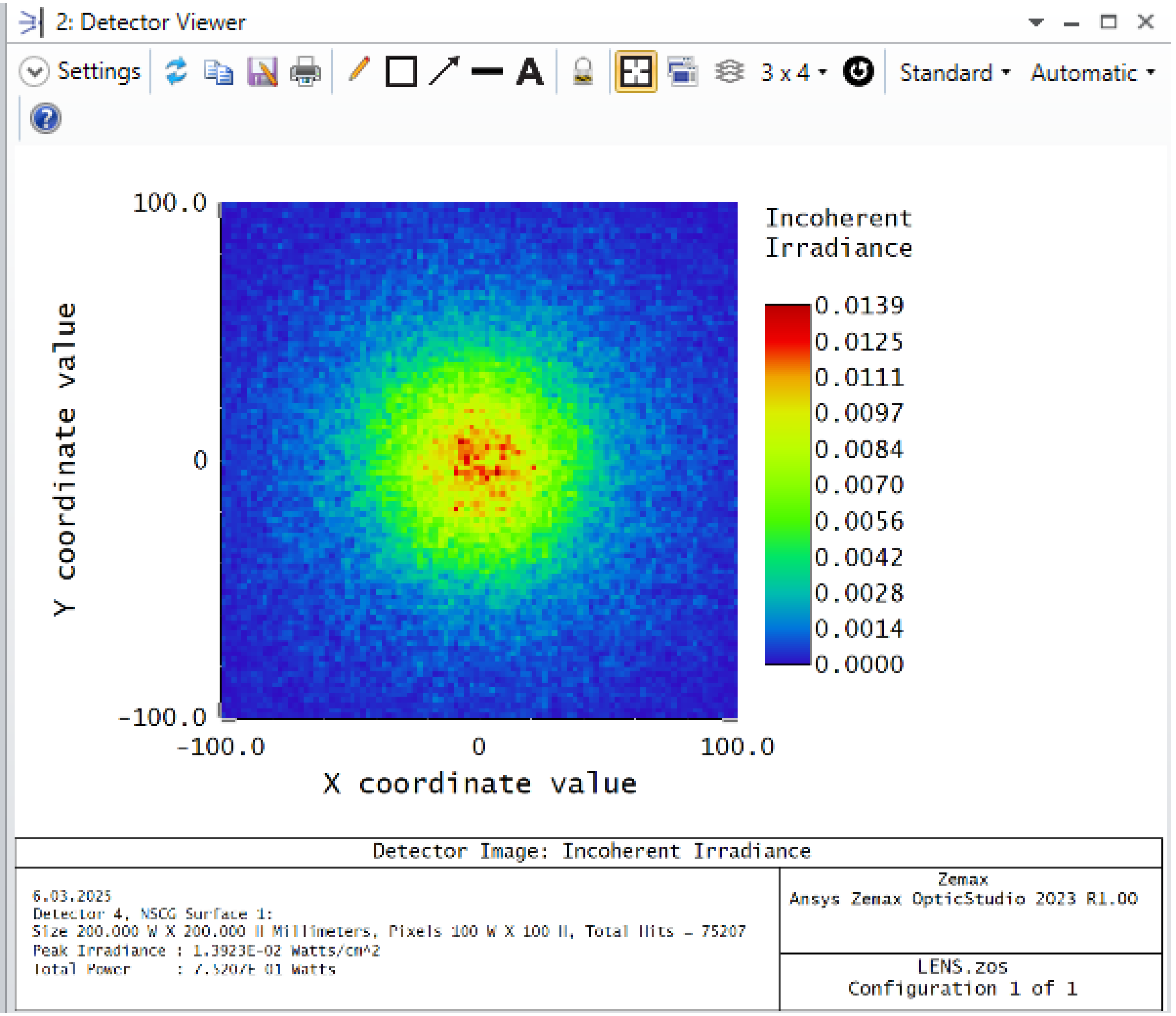
Wizards and Operands

Merit Function: 14.3097833683746

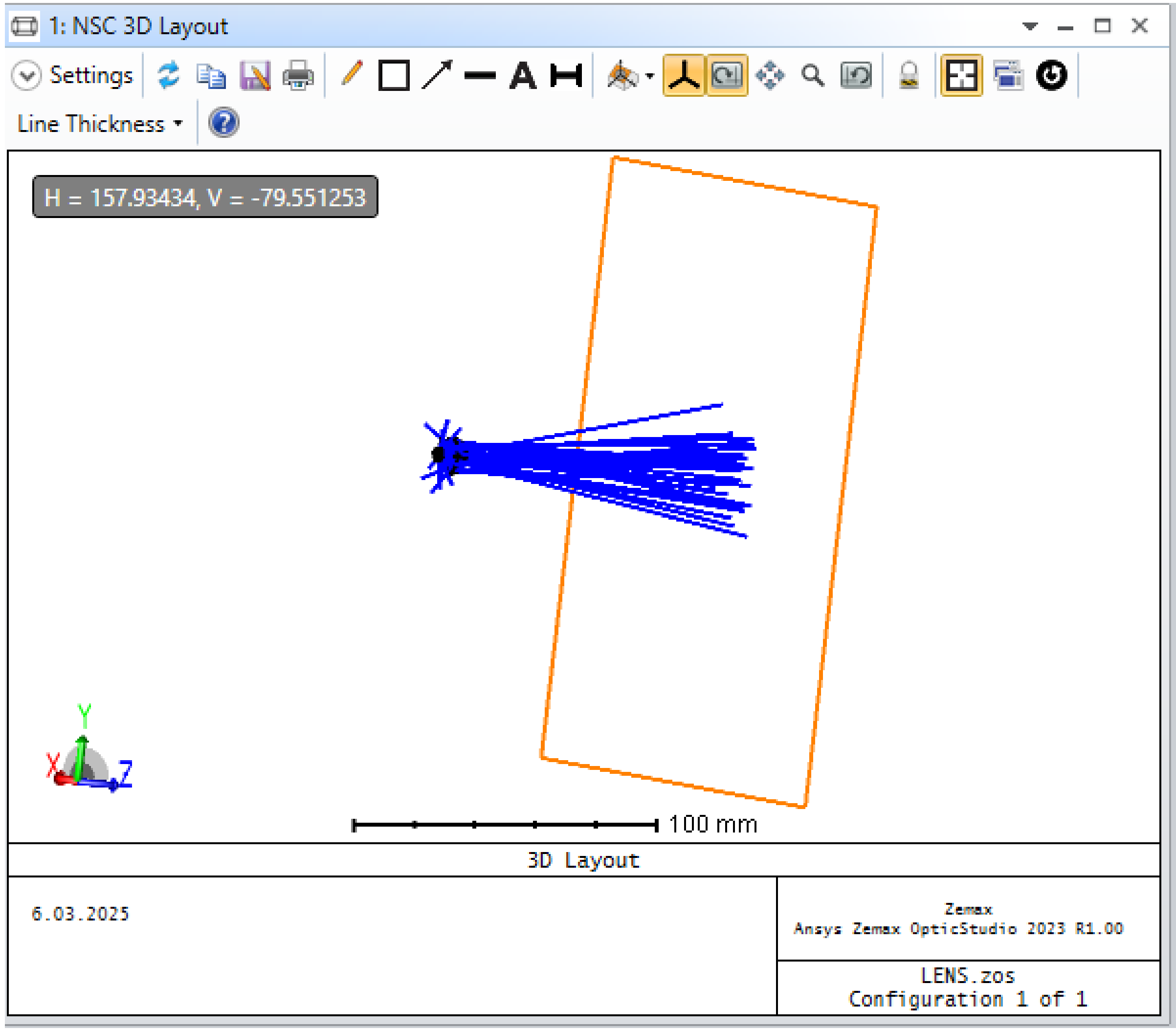
	Type	Surf	Det#	Pix#	Data	# Ignored	Spatial Frequency		Target	Weight	Value	% Contrib
1	NSDD	1	0	0	0	0	0.000		0.000	0.000	0.000	0.000
2	NSTR	1	0	0	0	0	1.000		0.000	0.000	0.000	0.000
3	NSDD	1	4	-9	0	1	0.000		0.000	1.000	14.310	100.000

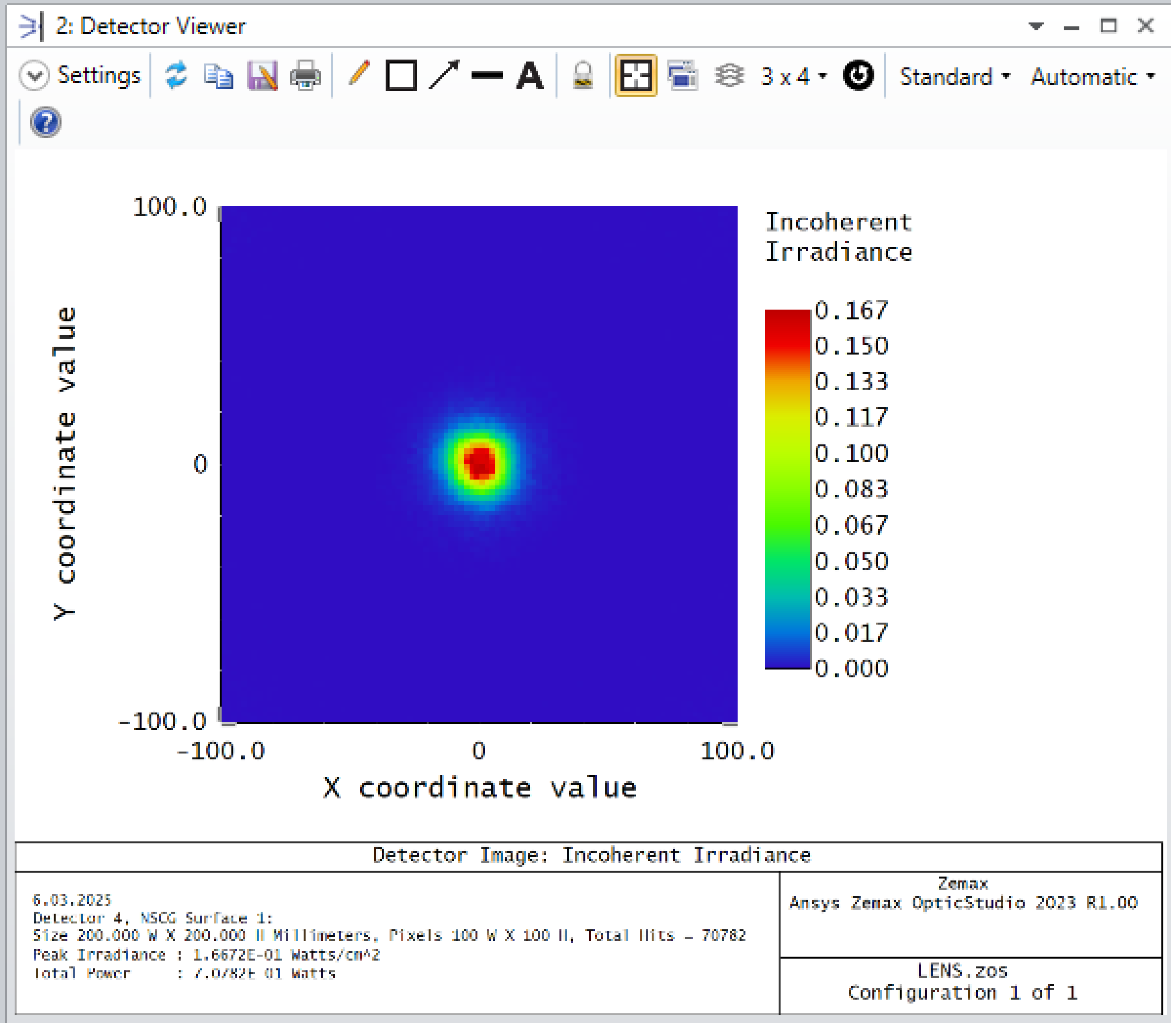
Without collimating lens



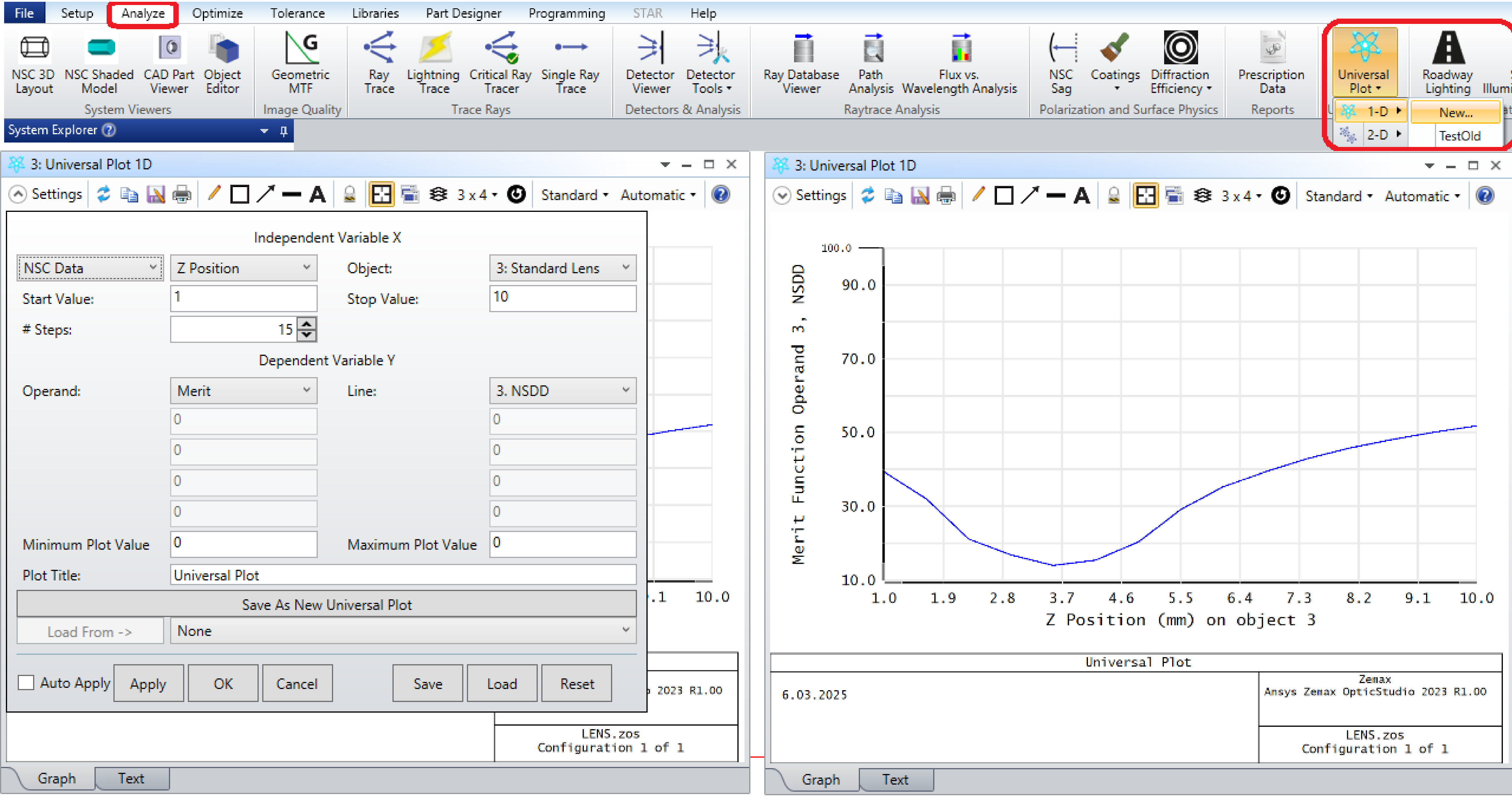


With collimating lens

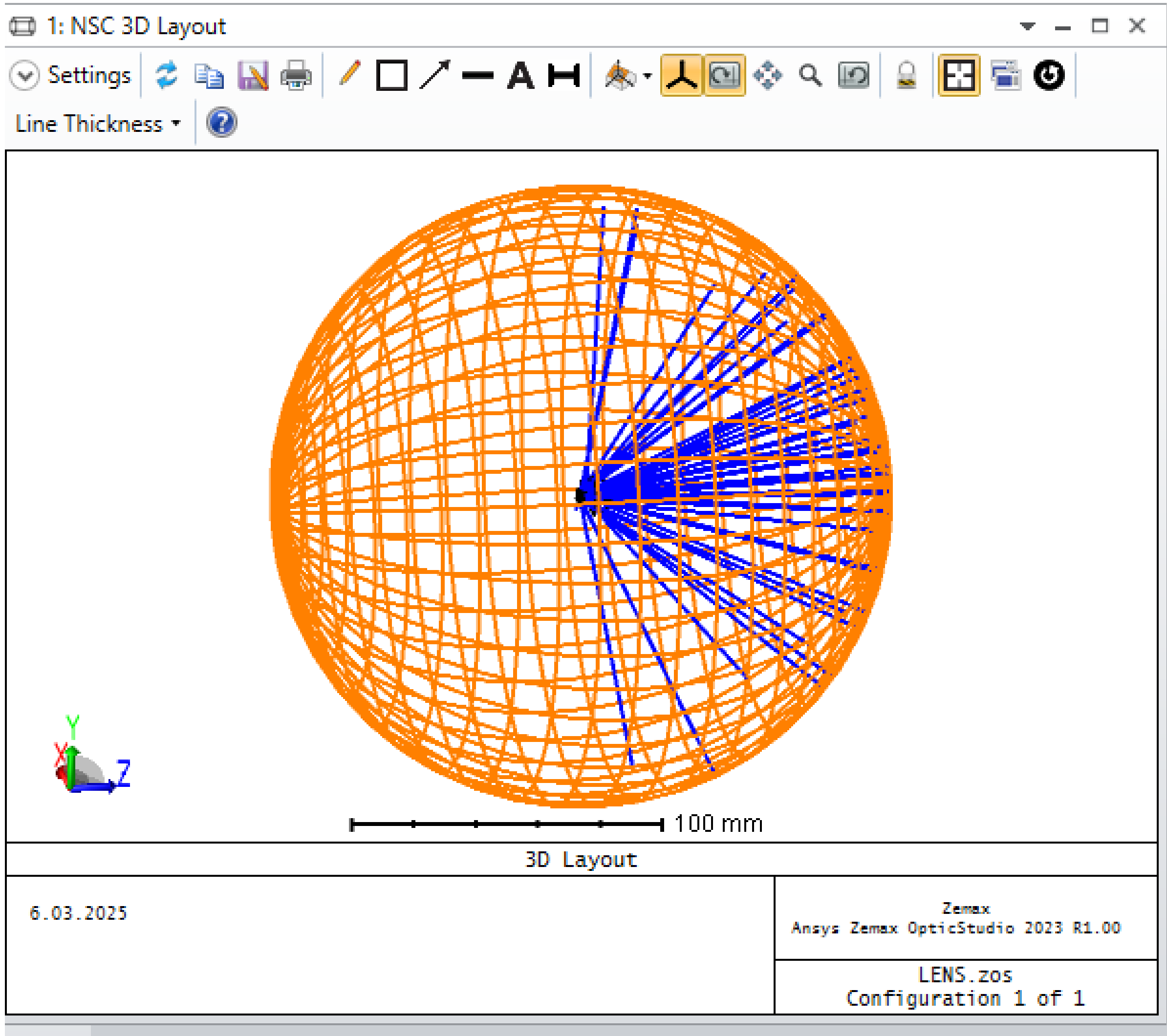


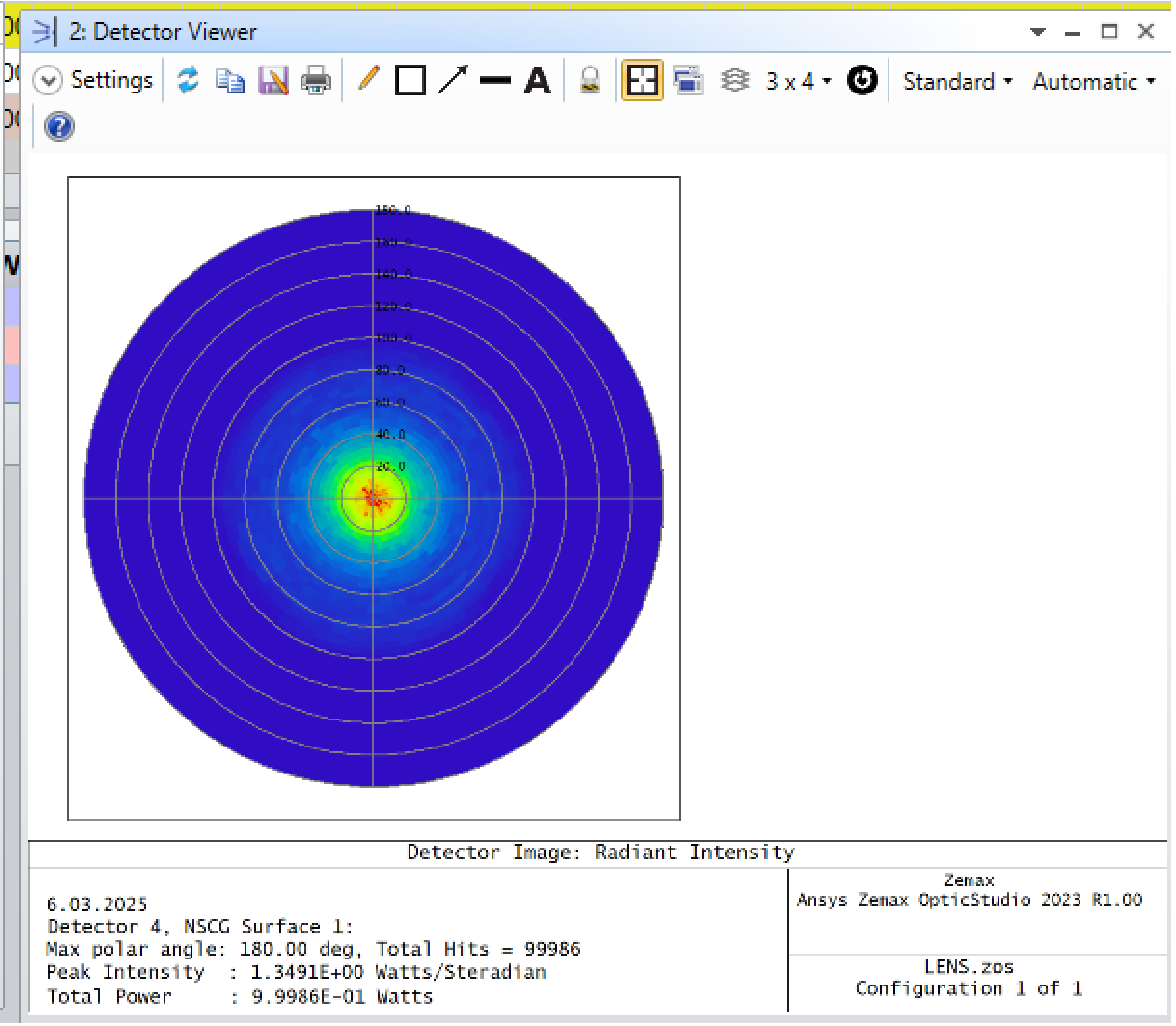


Universal Plot



Polar detector





Example 22.5: Text Source File

The text Source File consists of a single line of header data with just two integer numbers of the form:

```
number_of_rays  dimension_flag
```

The remaining lines in the file are of the format:

```
x y z l m n intensity wavelength
```

Example source file:

```
5 4
2.53 7.53 12.98  0.59  0.49 0.63  1.0  0.444
2.50 7.77 17.36 -0.45  0.67 0.64  1.0  0.425
2.31 9.65 52.21  0.12 -0.70 0.69  1.0  0.407
2.34 9.41 47.81  0.47 -0.53 0.69  1.0  0.539
2.32 9.54 50.11  0.56  0.52 0.63  1.0  0.500
```

where

number_of_rays	is the total number of rays in the file.
dimension_flag	is 0 for meters, 1 for inches, 2 for cm, 3 for feet, and 4 for mm.
x y z	are initial coordinates of the ray.
l m n	are direction cosines (unit vector) of the ray.
intensity	is the intensity of the ray in the range [0,1].
wavelength	is the wavelenth of the ray in micrometers.

See also course web page for Gaussian, Lambertian and Cherencov source file generators written in matlab.

Example 25.6: Beam Expander Performance

See Chapter 7 before this example.

In Sequential mode, select two lenses from Edmund Optics stock.

#45-008: EPD =   6 mm & EFL = −12 mm.

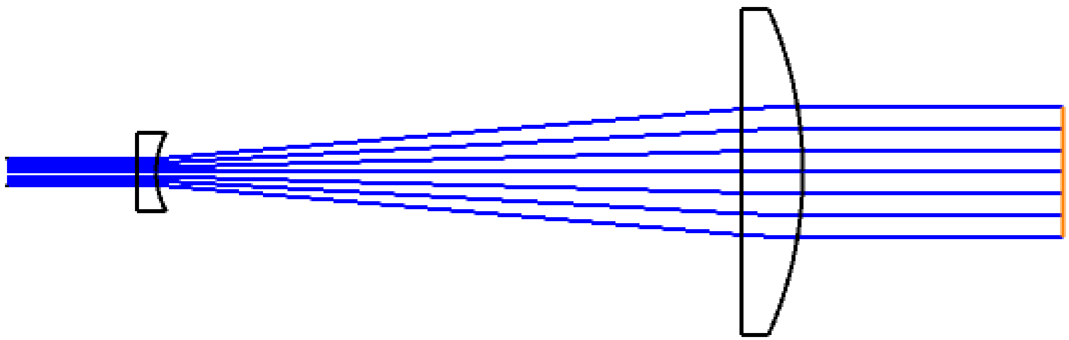
#45-127: EPD = 25 mm & EFL = +60 mm

λ = 633 nm

Input beam size is 2 mm.

Input beam size is 10 mm.

Optimize system to obtain 5x beam expander.



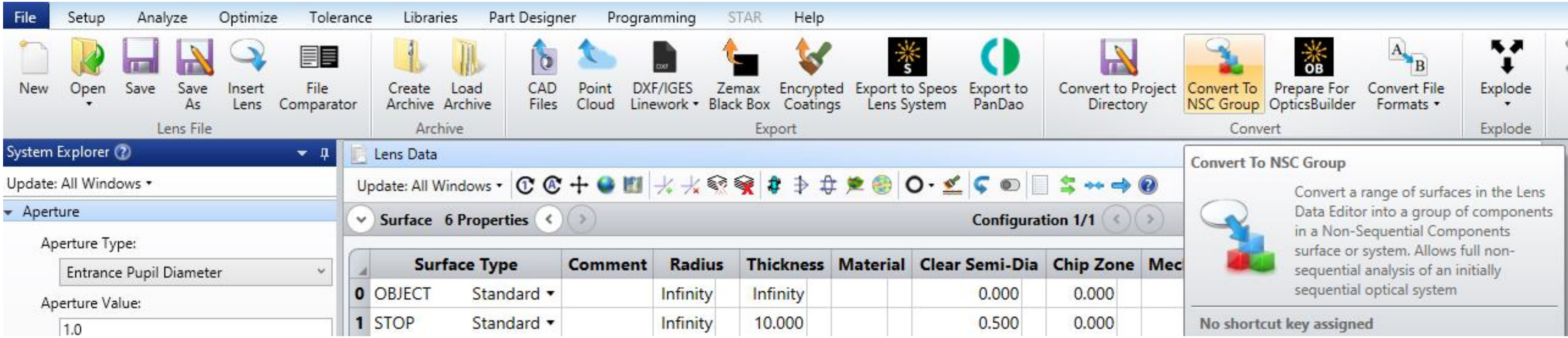
Lens Data

Update: All Windows

Surface 6 Properties — Configuration 1/1

#	Surface Type		Comment	Radius	Thickness		Material	Clear Semi-Dia		Chip Zone	Mech Semi-Dia	Conic	Coating	TCE x 1
0	OBJECT	Standard		Infinity	Infinity			0.000		0.000	0.000	0.000		0.00
1	STOP	Standard		Infinity	10.000			1.000		0.000	1.000	0.000		0.00
2	(aper)	Standard	45008	Infinity	1.500		N-BK7	2.700	U	0.300	3.000	0.000		
3	(aper)	Standard		6.200	45.014	V		2.700	U	0.300	3.000	0.000		0.00
4	(aper)	Standard	45127	Infinity	4.700		N-BK7	12.000	U	0.500	12.500	0.000		
5	(aper)	Standard		-31.010	20.000			12.000	U	0.500	12.500	0.000		0.00
6	IMAGE	Standard		Infinity	-			5.061		0.000	5.061	0.000		0.00

Now, convert Sequential objects to NSC Group

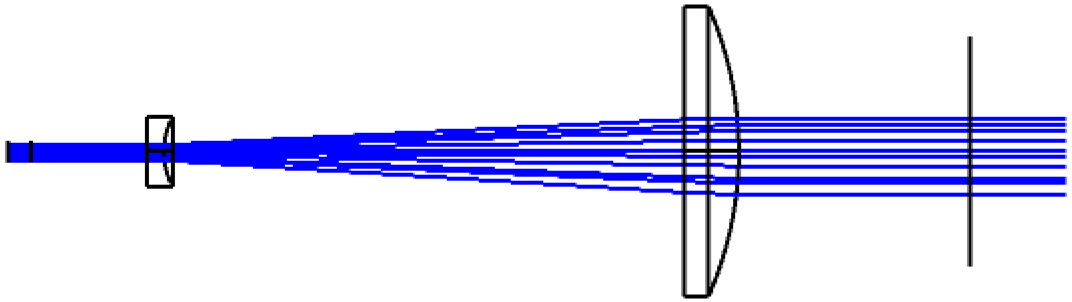


Non-Sequential Component Editor

Update: All Windows

Object 5 Properties — Configuration

	Object Type	Comment	Ref Object	Inside Of	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	F
1	Source Ellipse	Field 1	0	0	0.000	0.000	-2.000	0.000	0.000	-180.000	-	
2	Annulus	aperture 1	0	0	0.000	0.000	0.000	0.000	0.000	0.000	ABS...	
3	Standard Lens	surfaces 2-3	0	0	0.000	0.000	10.000	0.000	0.000	0.000	N-BK7	
4	Standard Lens	surfaces 4-5	0	0	0.000	0.000	56.514	0.000	0.000	0.000	N-BK7	
5	Null Object	Image Plane	0	0	0.000	0.000	81.214	0.000	0.000	0.000	-	
6	Detector Rectangle	Field 1	5	0	0.000	0.000	0.000	0.000	0.000	0.000		



Then,

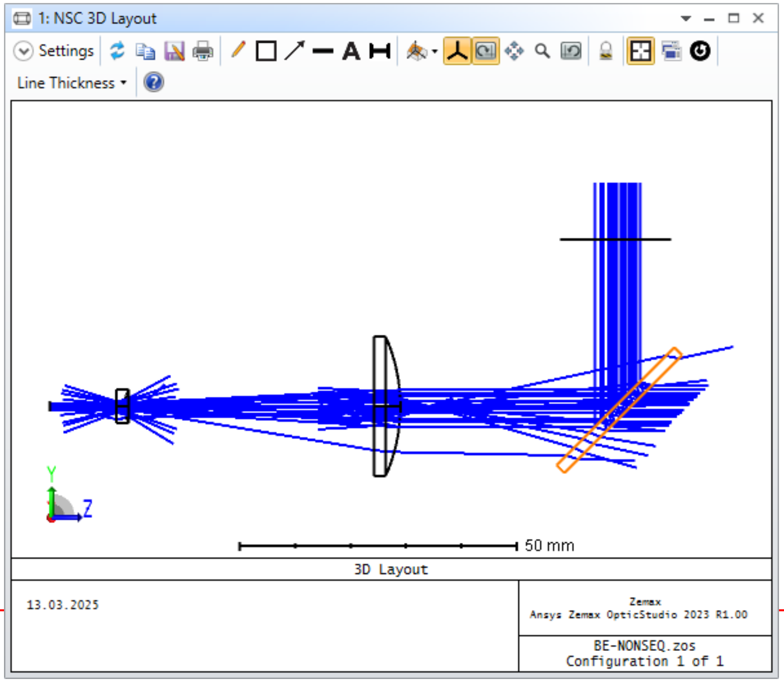
- Delete Annulus (this was aperture stop in sequential mode)
- Add Rectangular Volume to define a beam splitter
- Rotate and displace detector.

Non-Sequential Component Editor

Update: All Windows

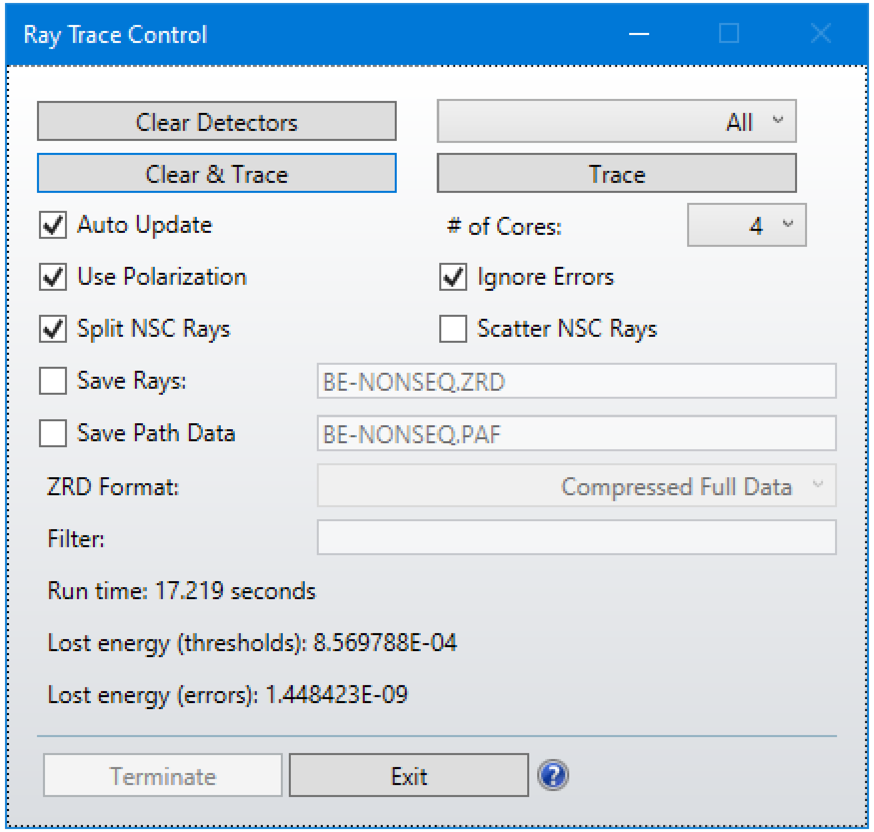
Object 4 Properties — Configuration 1/1

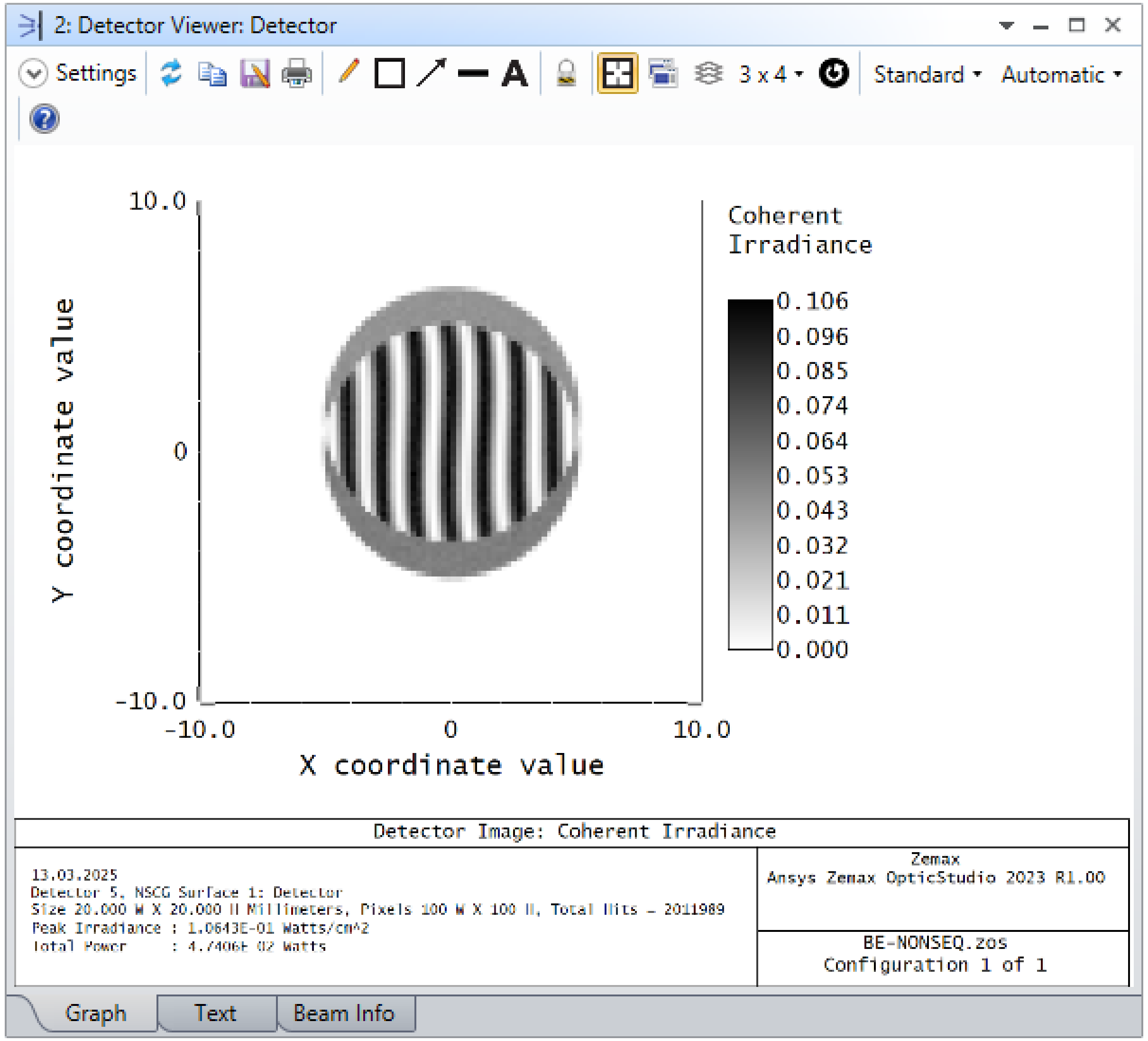
	Object Type	Comment	Ref Object	Inside Of	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	X1 Half Width	Y1 Half Width	Z Length	X2 Half Width	Y2 Half Width	Front X Angle	Front Y Angle	Rear X Angle
1	Source Ellipse	Source	0	0	0.000	0.000	-2.000	0.000	0.000	-180.000	-	10	1E+06	1.000	0	1	1.000	1.000	0.000
2	Standard Lens	Lens1	0	0	0.000	0.000	10.000	0.000	0.000	0.000	N-BK7	-0.000	0.000	3.000	3.000	1.500	6.200	0.000	3.000
3	Standard Lens	Lens2	0	0	0.000	0.000	57.000	0.000	0.000	0.000	N-BK7	-0.000	0.000	12.500	12.500	4.700	-31.010	0.000	12.500
4	Rectangular Volume	Beam splitter	0	0	0.000	0.000	100.000	45.000	0.000	0.000	N-BK7	15.000	15.000	2.000	15.000	15.000	0.000	0.000	1.000E-02
5	Detector Rectangle	Detector	0	0	0.000	30.000	100.000	90.000	0.000	0.000		10.000	10.000	100	100	0	0	0	0



After ray tracing, Show Data as Coherent Irradiance in Detector Viewer

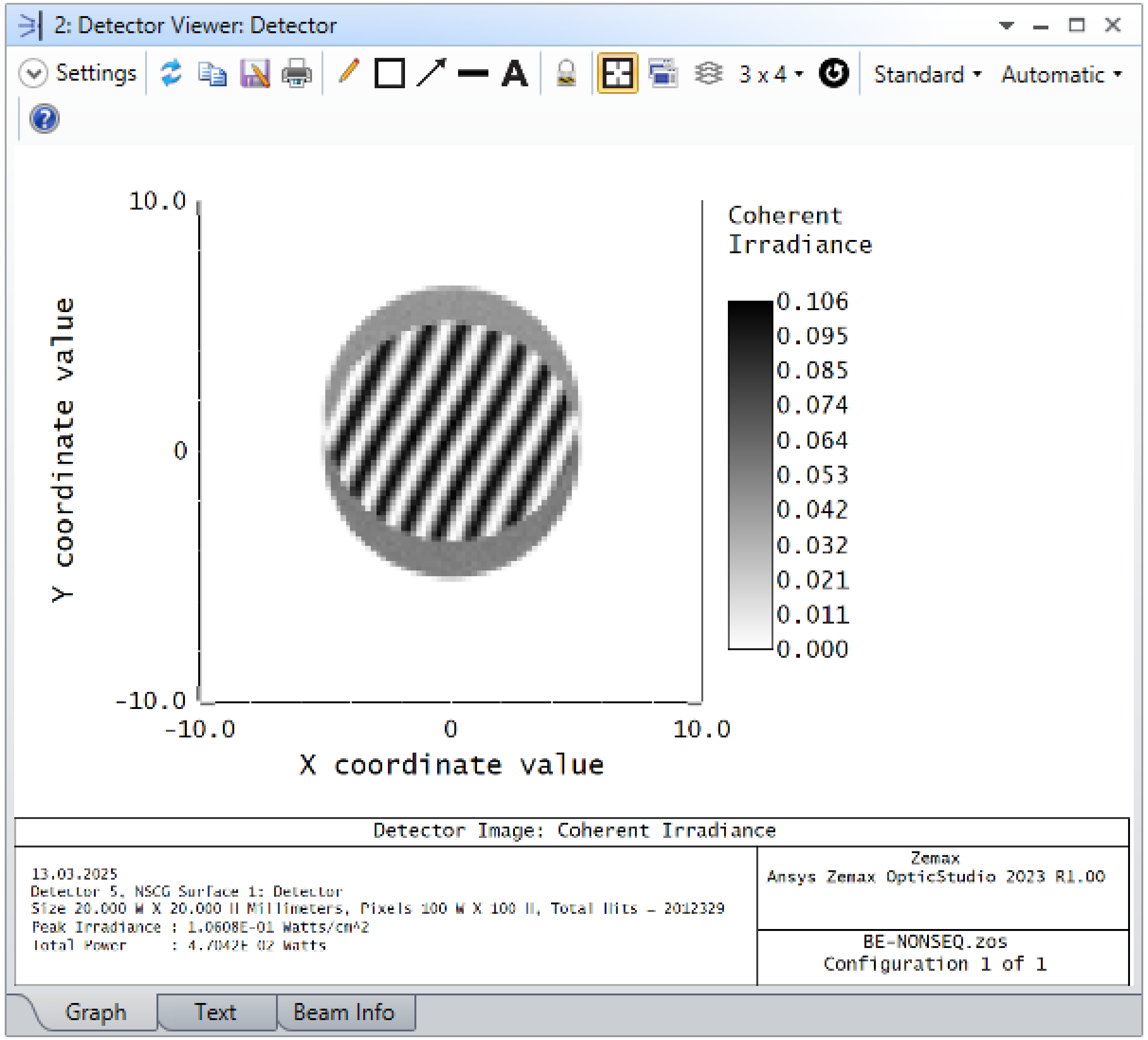
Z position of Lens2 is **56.514** mm



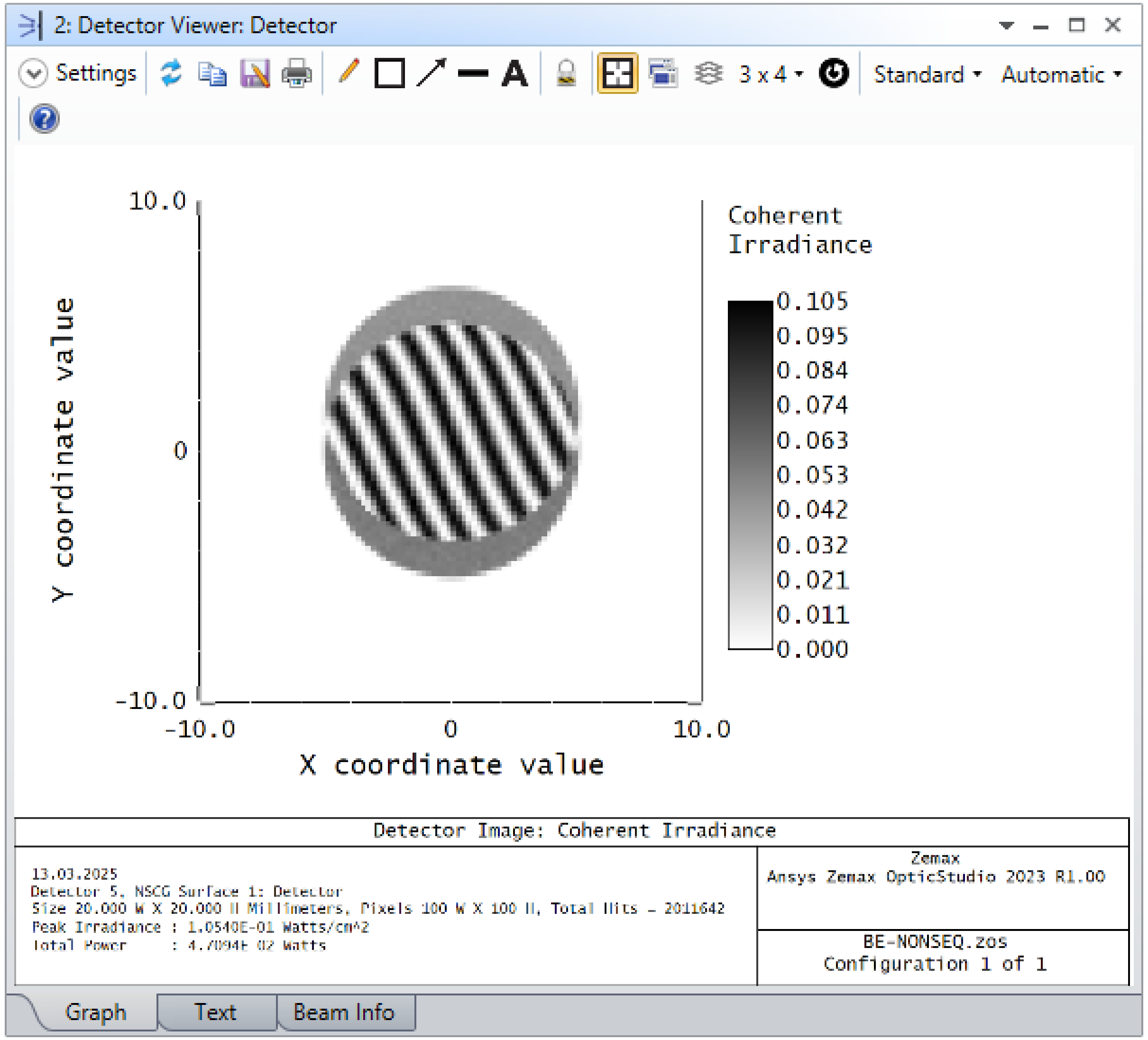


By changing Z position of Lens2 you can tilt the interferance pattern on the detector!

Z position of Lens2 is **56.000** mm

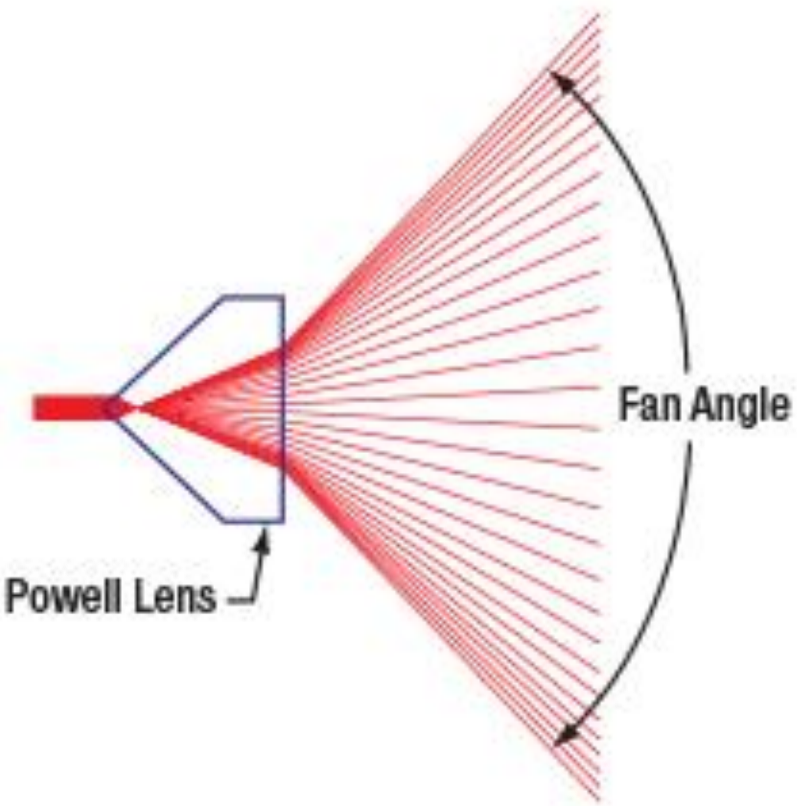


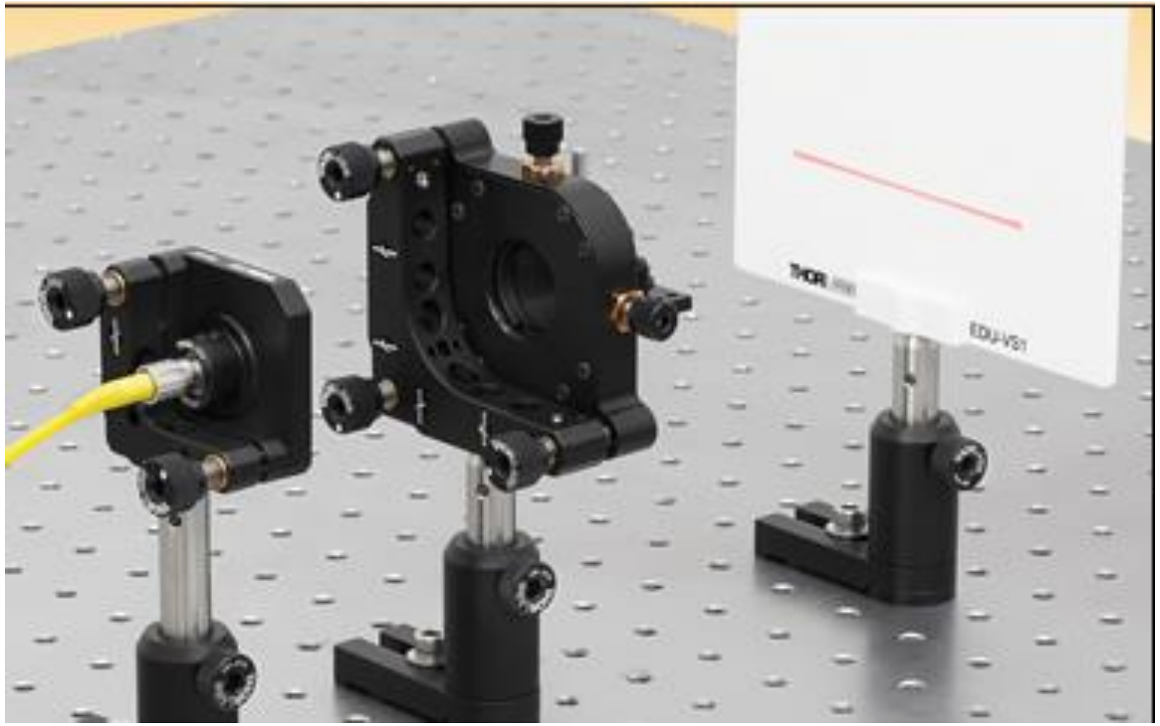
Z position of Lens2 is **57.000** mm



Powell Lens

Powell Lenses, also known as laser line generating lenses,
create straight and uniform laser lines by fanning out collimated beams in one dimension.





See also: https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=13875

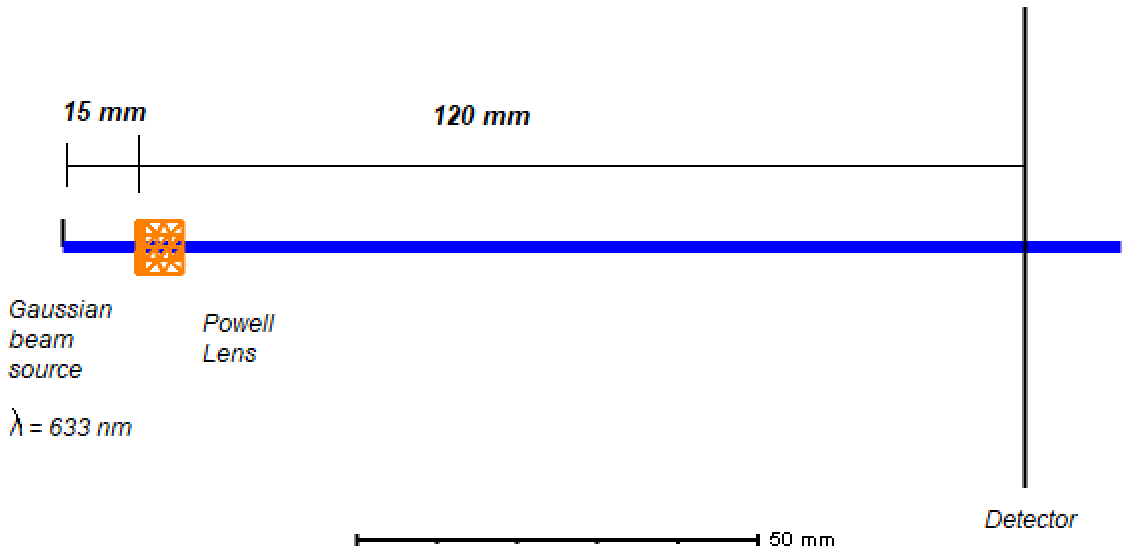
Example 22.7: LGL130 Powell lens from Thorlabs

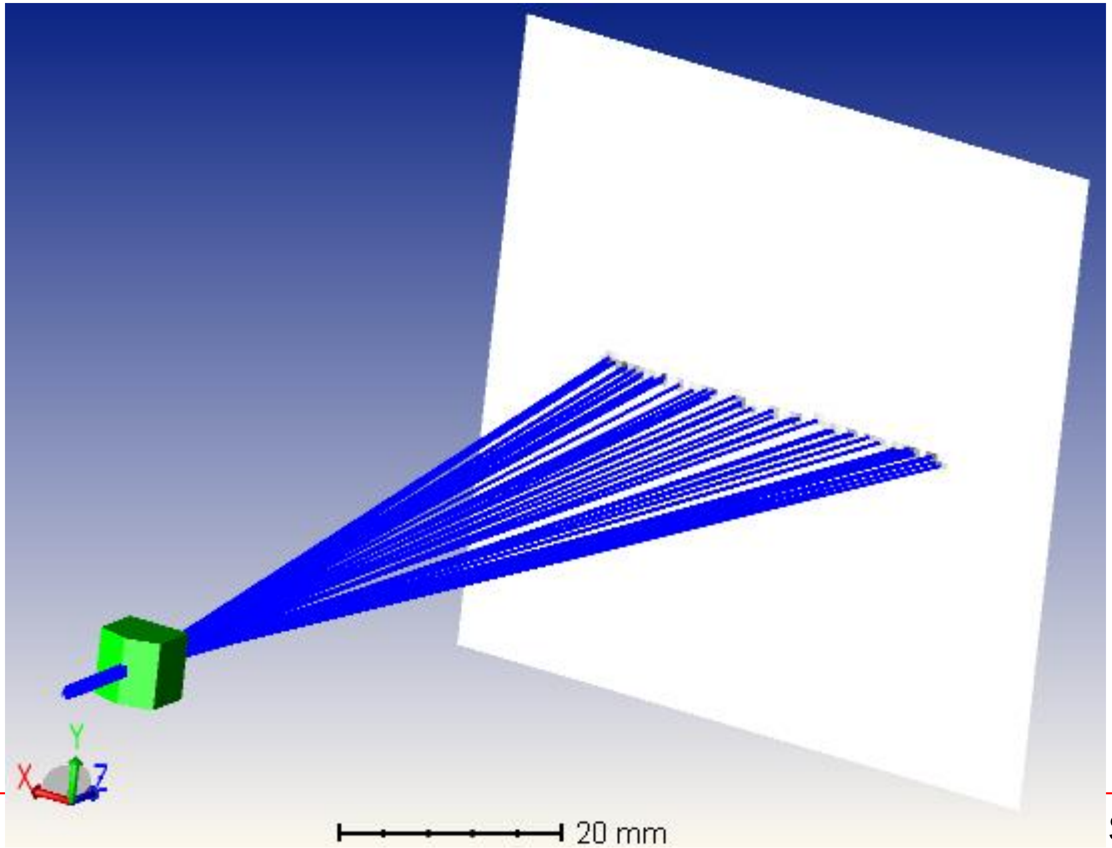
Non-Sequential Component Editor

Update: All Windows

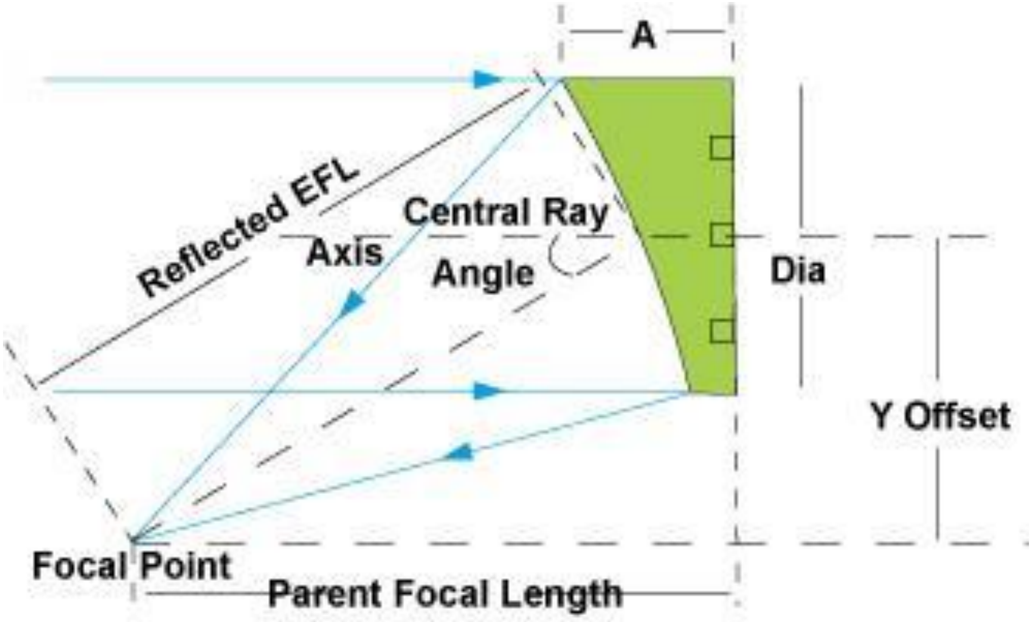
Object 1 Properties — Configuration 1/1

	Object Type	)f	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	# Layout Rays	# Analysis Rays	Power(Watts)	Wavenumber	Color #	Beam Size	Position
1	Source Gaussian	0	0.000	0.000	0.000	0.000	0.000	0.000	-	50	1E+04	1.000	0	0	0.500	0.000
2	CAD Part: STEP/IGES/SAT	0	0.000	0.000	15.000	0.000	0.000	90.000	BK7	1.000	1	5	5	5		
3	Detector Rectangle	0	0.000	0.000	120.000	0.000	0.000	0.000		30.000	30.000	100	100	0	0	0





Off-Axis Mirrors (OAP)



The off-axis parabolic mirror is an important design form in the optics industry.

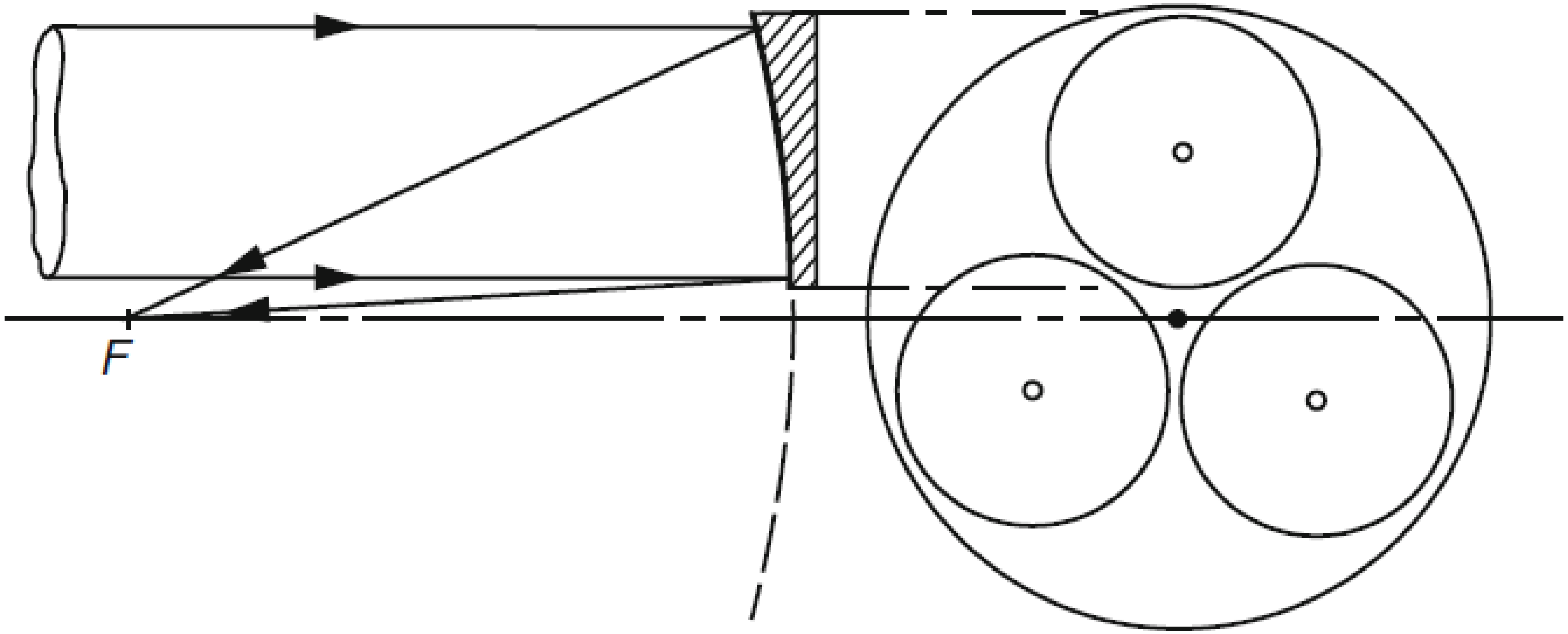
Parabolic mirrors have the ability to focus collimated light without introducing spherical aberration.

OAP mirror is simply a side section of a parent parabolic mirror. Collimated light that is incident to an OAP mirror is focused to a point. However, unlike a centered parabolic mirror, an OAP mirror has an advantage in that it allows more interactive space around the focal point without disrupting the beam.

Commertial Products:

- Edmund Optics
  https://www.edmundoptics.com/f/aluminum-off-axis-parabolic-mirrors/39488
- Thorlabs
  https://www.thorlabs.com/navigation.cfm?guide_id=15

If the obstruction caused by the image receiver is undesirable, an off-axis parabola may be used The only practical way to construct such a mirror is to make a large on-axis mirror and cut as many off-axis mirrors from it as are needed. Such mirrors are used in mirror monochromators and as Schlieren mirrors for wind tunnel applications.



Cutting three off-axis parabolic mirrors from one large paraboloid.

Example 22.8: Modeling an off-axis parabolic mirror

This example is extracted from Zemax Knowledgebase

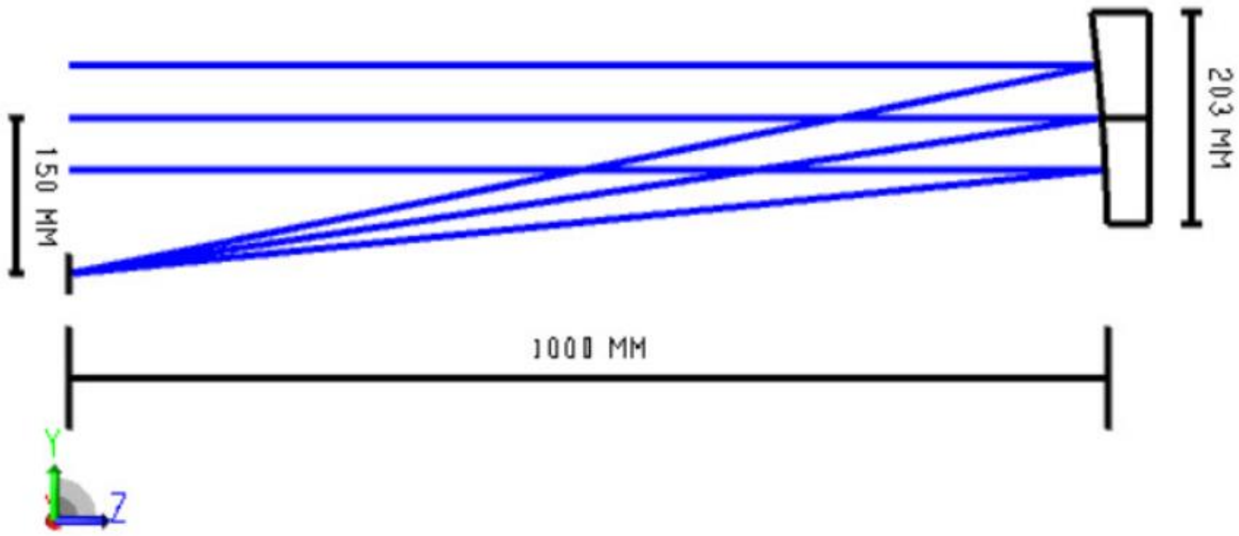
Design specifications:

ENPD = 100 mm

EFFL = 1000 mm

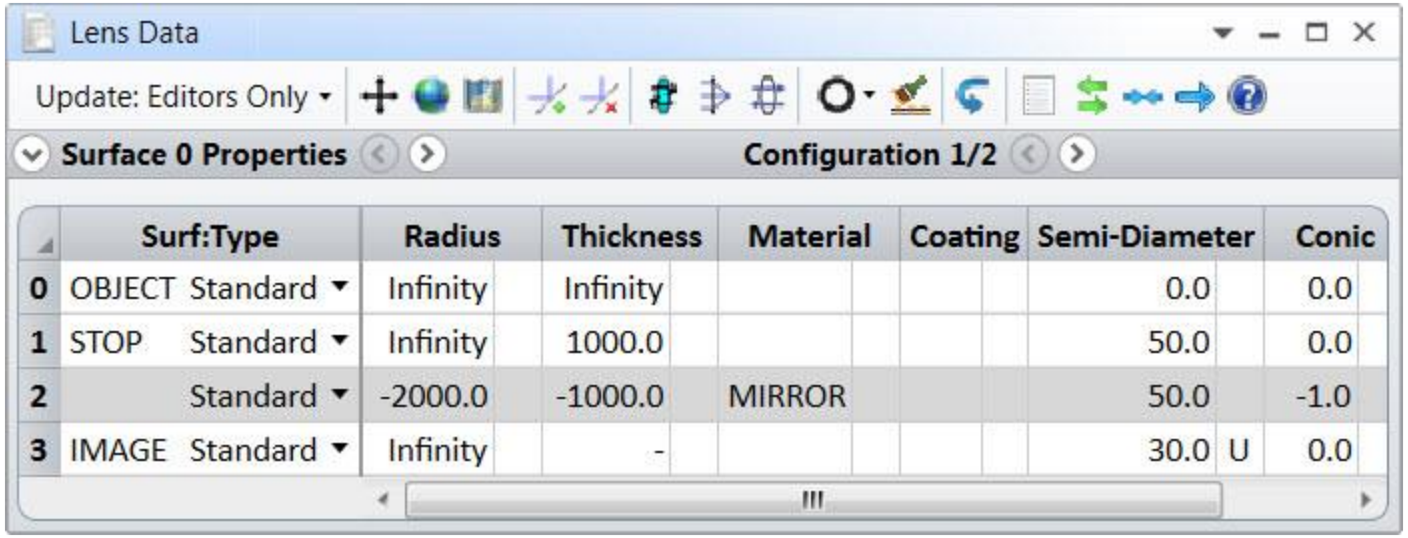
Off-axis distance = 150 mm

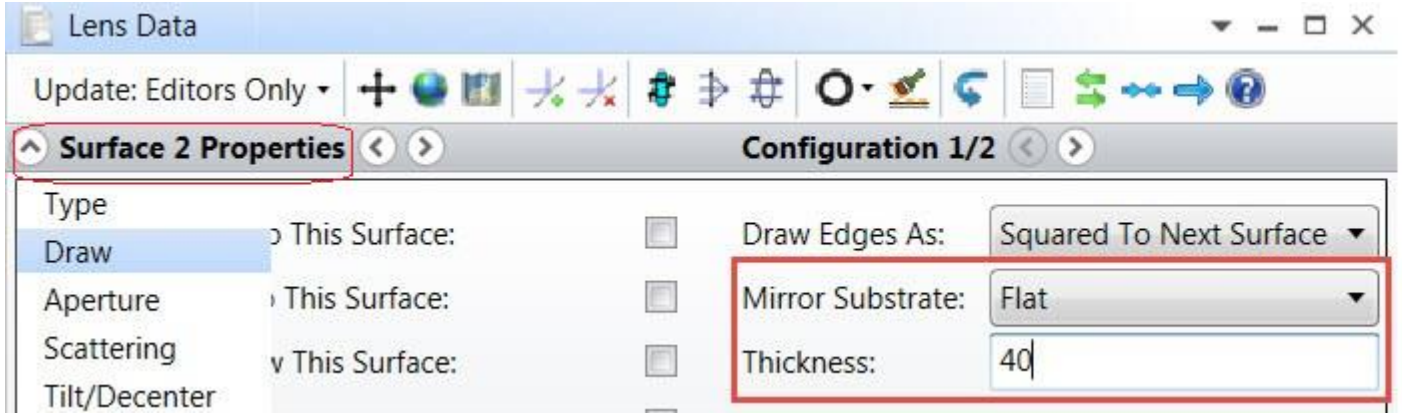
Component physical diameter = 203 mm



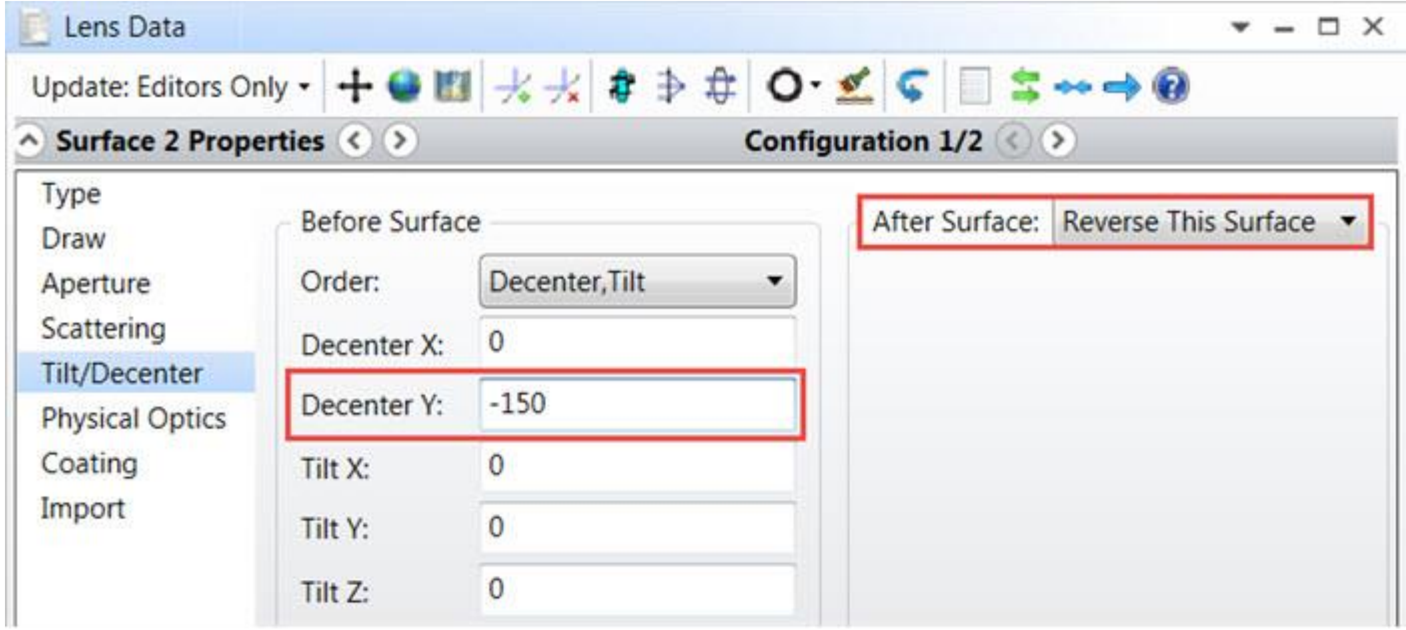
We will model a commercially-available off-axis parabolic mirror.
The goal of this example is to be able to tilt the mirror about the X axis at any point along the optical axis (Z axis). Back surface of the substrate is perpendicular to the optical axis.

We will start a new **Sequential Mode** session:

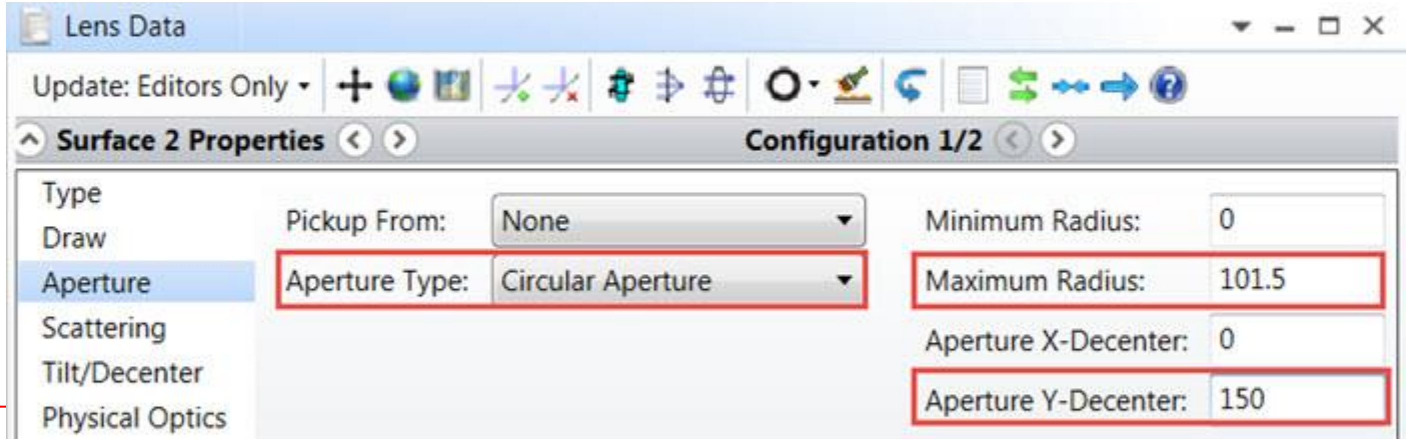




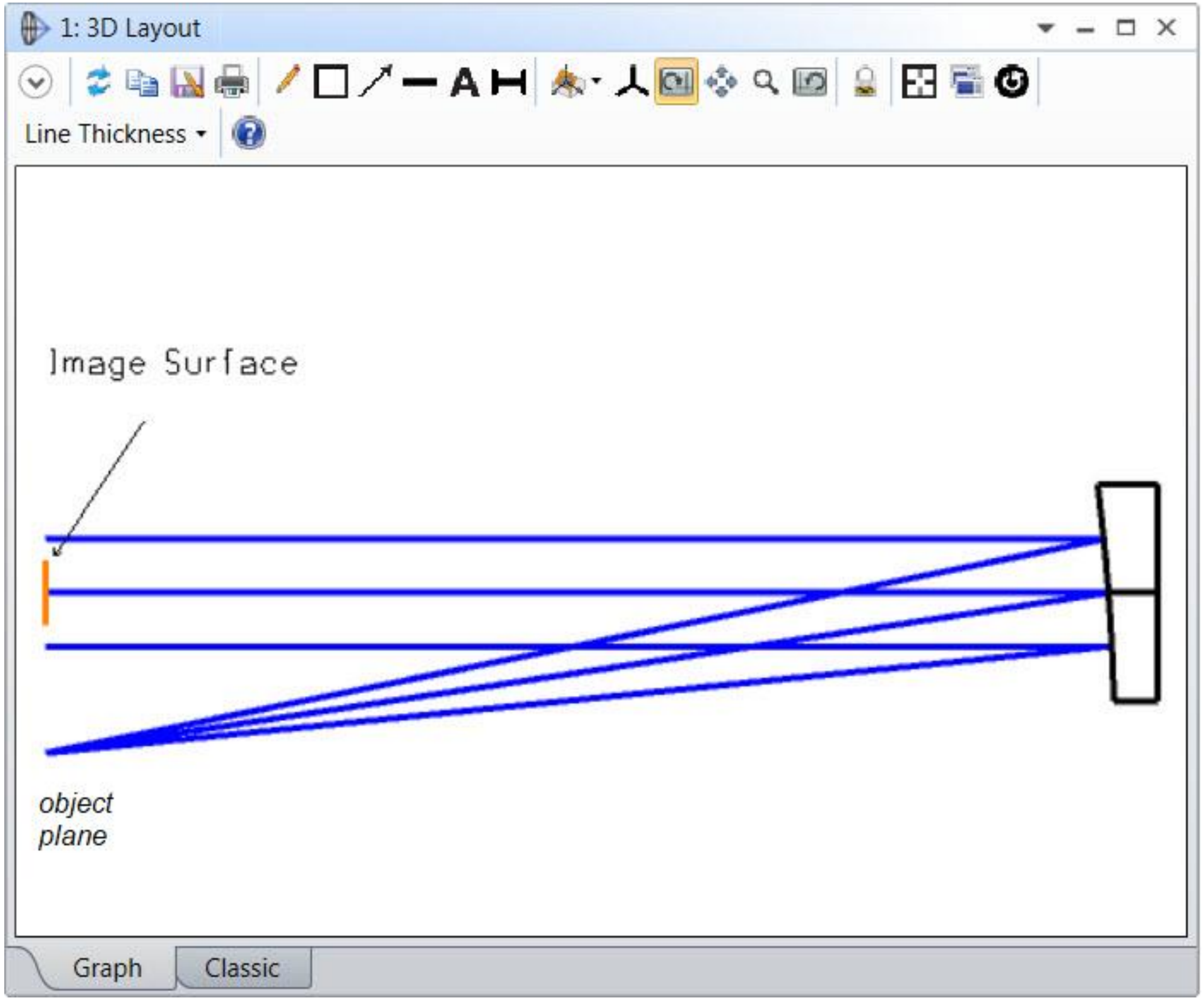
Add off-axis distance which is 150 mm



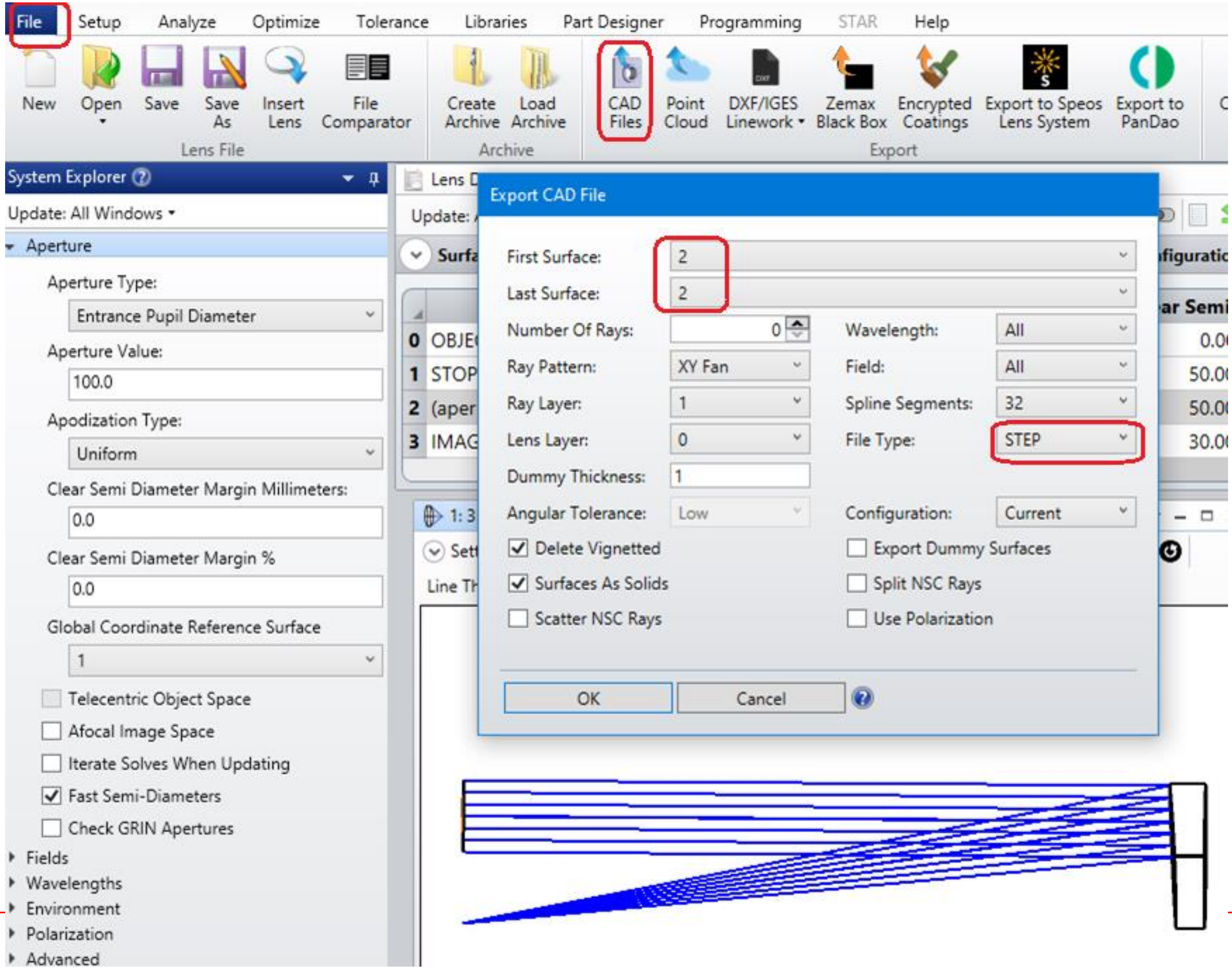
Specify the physical diameter of the mirror as 203 mm.



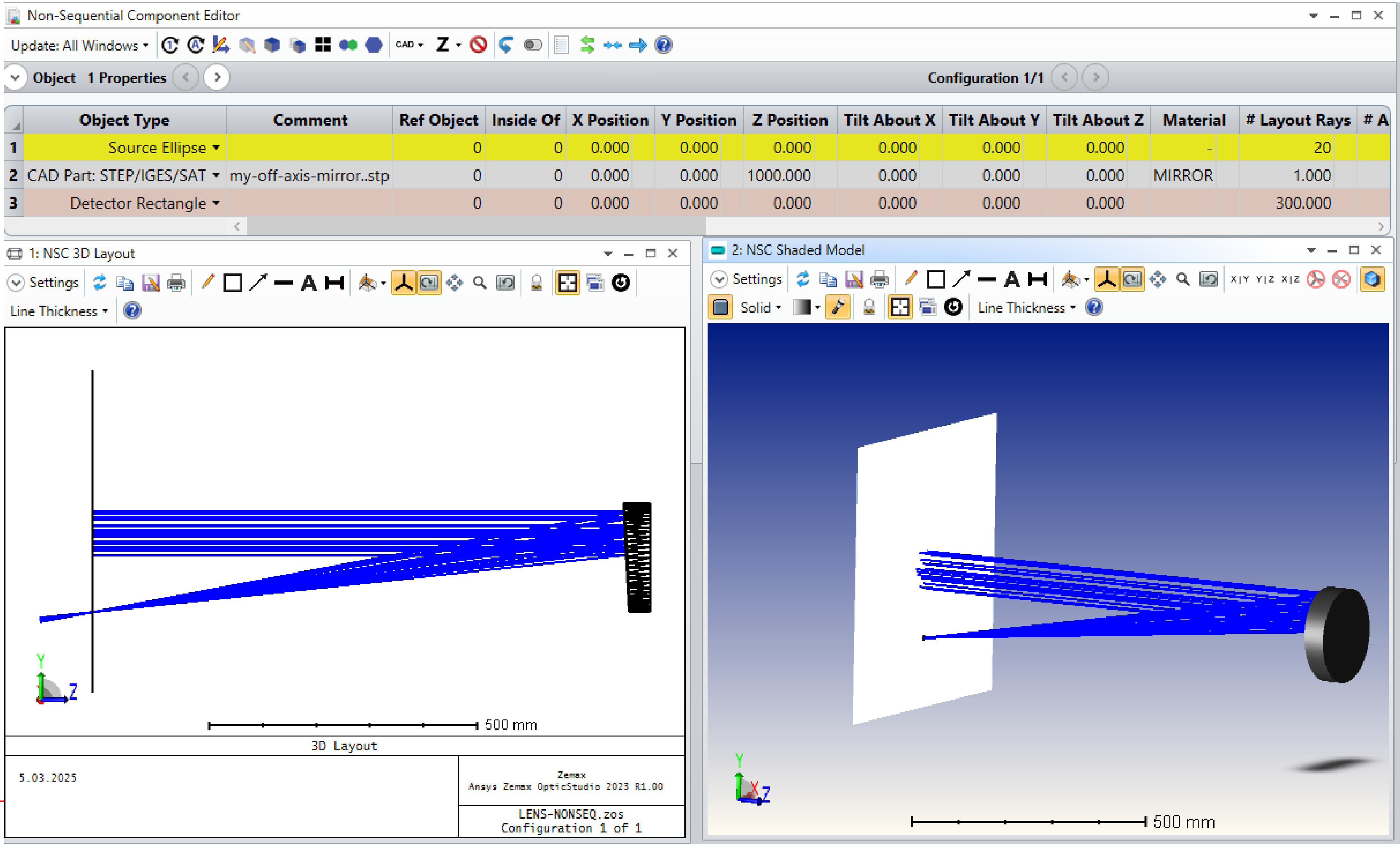
Final form of the design.



We can convert design (mirror) to a CAD object to be used as non-sequentail component, by using **CAD Files** button in file menu. Save as **my-off-axis-mirror.stp**



Now, you can switch to Non-sequential mode. Add source ellipse, off-axis mirror and a detector.



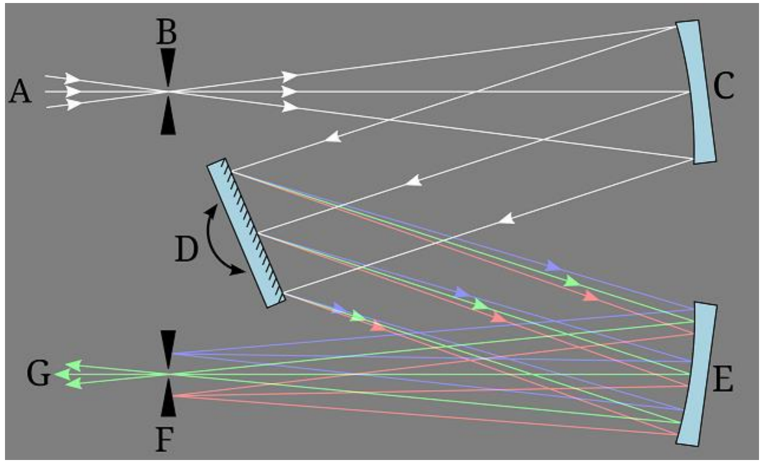
	Object Type	Comment	Ref Object	Inside Of	X Position	Y Position	Z Position	Tilt About X	Tilt About Y	Tilt About Z	Material	# Layout Rays	# A
1	Source Ellipse		0	0	0.000	0.000	0.000	0.000	0.000	0.000	-	20	
2	CAD Part: STEP/IGES/SAT	my-off-axis-mirror..stp	0	0	0.000	0.000	1000.000	0.000	0.000	0.000	MIRROR	1.000	
3	Detector Rectangle		0	0	0.000	0.000	0.000	0.000	0.000	0.000		300.000	

Monochromator

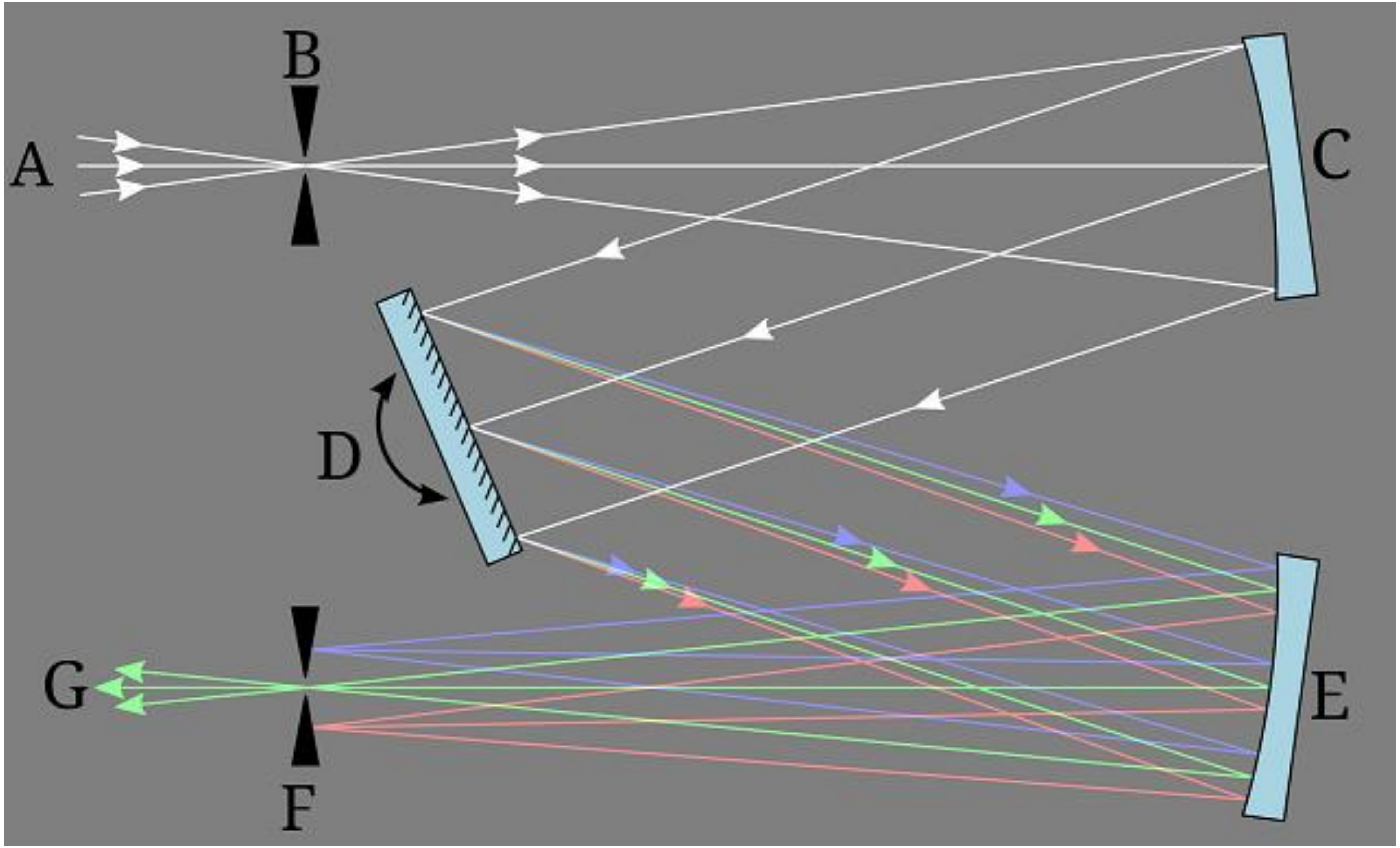
Wikipedia says:

A monochromator is an optical device that transmits a mechanically selectable narrow band of wavelengths of light chosen from a wider range of wavelengths available at the input.

In the common Czerny–Turner design, the broad-band illumination source (A) is aimed at an entrance slit (B). The amount of light energy available for use depends on the intensity of the source in the space defined by the slit (width × height) and the acceptance angle of the optical system. The slit is placed at the effective focus of a curved mirror (the collimator, C) so that the light from the slit reflected from the mirror is collimated (focused at infinity). The collimated light is diffracted from the grating (D) and then is collected by another mirror (E), which refocuses the light, now dispersed, on the exit slit (F). In a prism monochromator, a reflective Littrow prism takes the place of the diffraction grating, in which case the light is refracted by the prism.

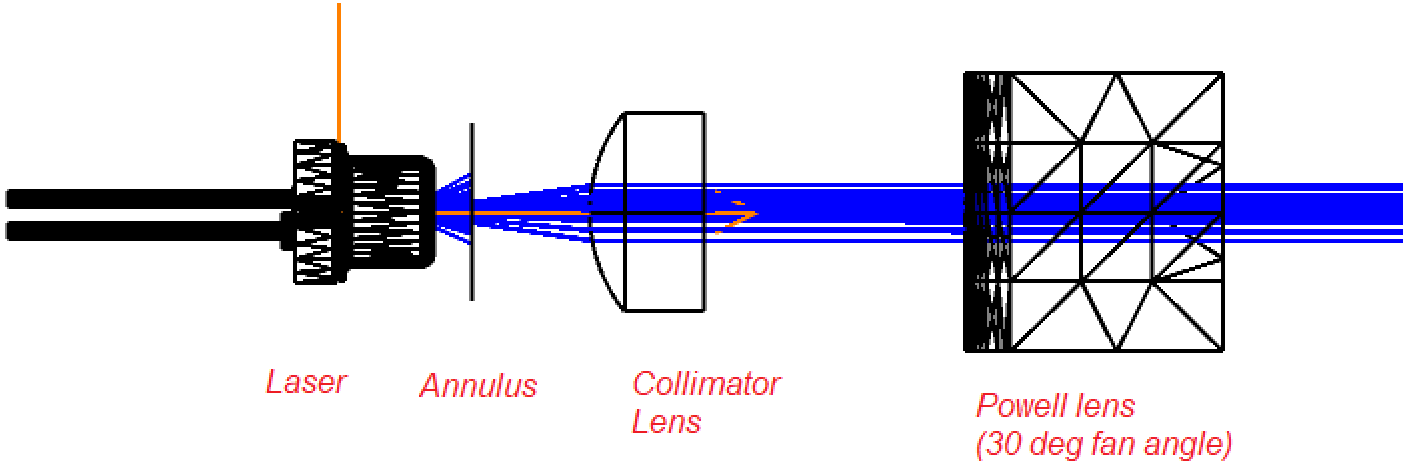


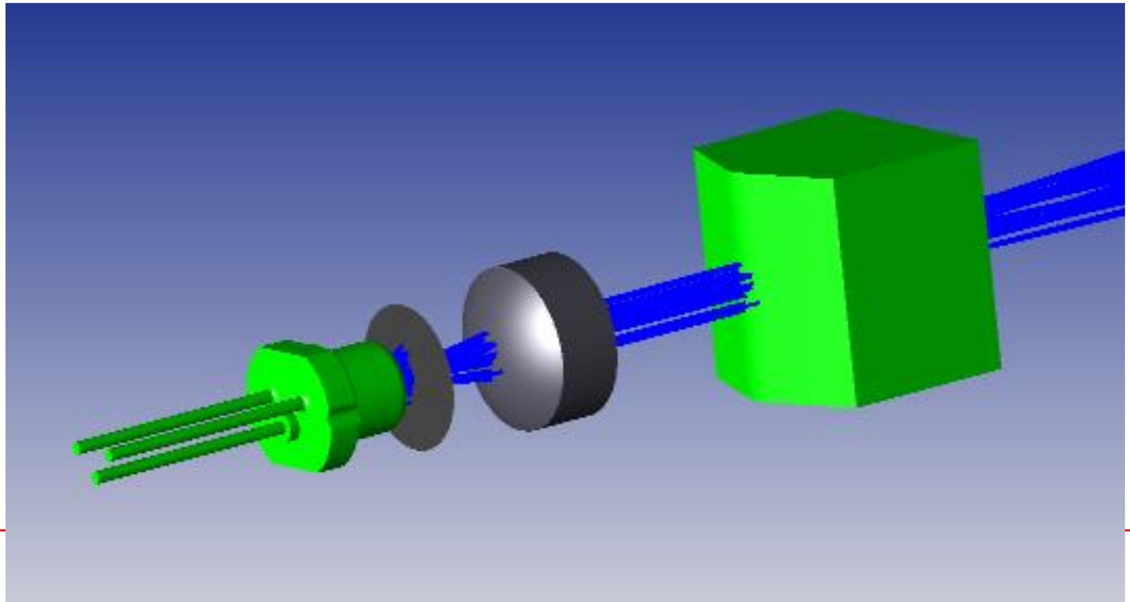
Monochromator

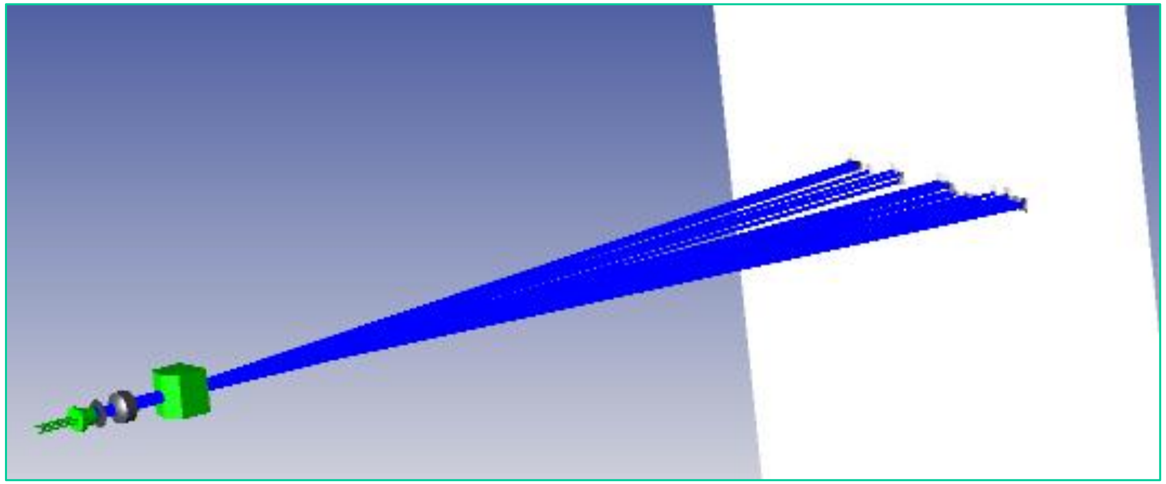


Exercise 1

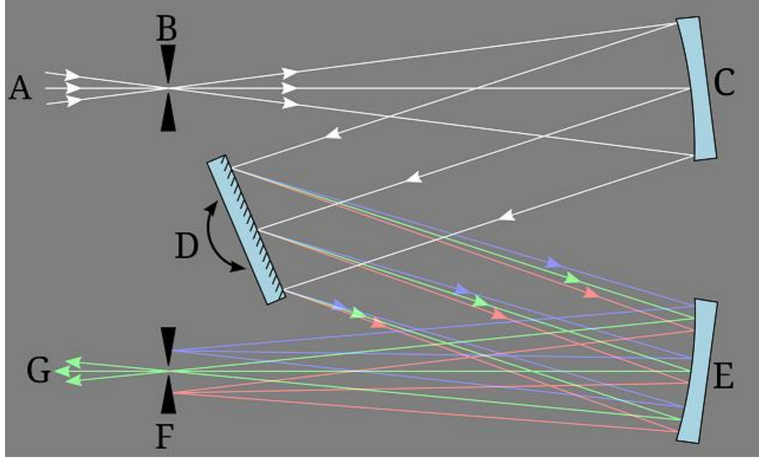
Consider OSRAM Metal Can TO38, PLT3 520D Laser at 633 nm, plano-convex lens from Edmund optics, and the LGL130 Powell lens. The lens will be used to collimate the laser beam, while an annulus will filter out (kill) larger-angle rays from the source. Implement the following design in Zemax







Exercise 2



Implement Czerny–Turner design in Zemax.

For simplicity, you can put

- Point Source at point B (and set wavelength to Phtotopic Bright)
- Annulus at point F with a small diameter (to simulate slit)
- Detector Color at point G

Then, you can play with angular position of the reflecting grating to select desired wavelength at the output slit.

Exercise 3

Try to simulate a 8x beam expander similar to Exercise 25.6.

Use suitable lenses from Edmund catalog

Light source is a Gaussian beam with λ = 1064 nm, beam size 2 mm and position100 mm.

- In squential mode, define source using Object Cone Angle.
- Then, collimate the light with a plano convex lens.
- Then, use two more lenses to expand beam size to about 16 mm.
- In Nonsquential mode, Investigate the performance of the beam exapander on the detector.