

## **RGB Diffuser using Lightguide Approach**

# Abstract

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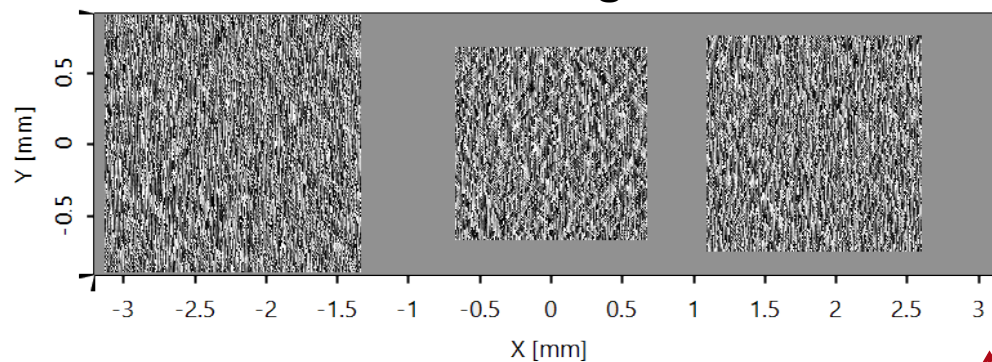


In this demo we show how to design a diffuser for distinct target pattern for each of the RGB wavelengths. Furthermore, we will generate a Lightguide setup for guiding and separated outcoupling of the RGB modes. In the last step, we apply the diffuser transmission functions to the outcoupled modes and propagating them into the far field to generate white light pattern.

# Task/System Illustration

**Source:  
Plane Wave**

**RGB Transmission Regions**



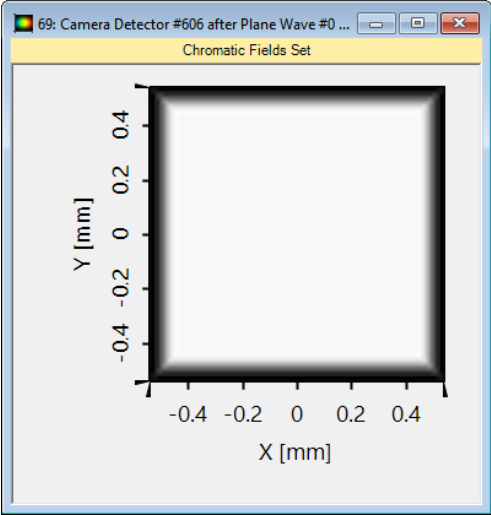
**Lightguide Component**



**Far Field  
Propagation**



# Specifications: Source



Parameter	Description / Value & Unit
type	plane wave
spectrum	473 nm (weight 0.8) 532 nm (weight 0.62) 635 nm (weight 1.05)
polarization	linear in x-direction (0°)

# Workflow

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1. Design of diffuser for distinct target pattern for each of the RGB wavelengths.
2. Generation of Lightguide setup for guiding and separated outcoupling of the RGB modes
  - calculation of region and grating parameters to separate the spectral modes within the Lightguide
3. Applying the diffuser transmission functions to the outcoupled modes and propagating them into the far field to generate white light pattern
  - placing the transmission functions at the correct locations
  - applying special detector to propagate the fields from diffractive zone to diffractive zone in far field

## Specification: Target Pattern

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# Specification: Diffuser Design 473nm

66: X:\OneDrive\...\02a\_RoK\_SE\_LTLogoDiffuser\_473nm.seditor\*

### Design Parameters Summary

An overview of the most important design parameters can be seen below.

#### Output Field Parameters


Pattern Ø - Desired :	235.3027778 mm	128.7638889 mm	Achieved :	235.3747425 mm	128.8474055 mm
Resolution - Desired :	706.6149483 µm	703.6278081 µm	Achieved :	706.8310584 µm	704.0841829 µm
Offset :	0 mm	0 mm	Imported Data:		
Maximum Relative Stray Light Intensity:	10 %		X:\OneDrive\Dokumente\Workspace\01_R&D\LightShaping_IntegratedOptics		

#### Optical Setup Parameters

Optical Setup :	Paraxial Far Field	Distance DOE-Target Plane :	2 m
Surrounding Material :	Air		

#### Diffractive Optical Element / Transmission Parameters

Pixel Size :	2 µm	3.67 µm	Transmission Type :	Phase-Only
Number of Pixels :	669	366	Contains Discrete Levels	Yes
Period :	1.338 mm	1.34322 mm	Number of Height Levels :	8
Aperture Diameter :	2 mm	2 mm		
Aperture Shape :	Rectangular			

Validity: 

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# Specification: Diffuser Design 532nm

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### Design Parameters Summary

An overview of the most important design parameters can be seen below.

#### Output Field Parameters


Pattern Ø - Desired :	235.3027778 mm	128.7638889 mm	Achieved :	235.2026167 mm	128.7391677 mm
Resolution - Desired :	706.6149483 µm	703.6278081 µm	Achieved :	706.3141643 µm	703.4927194 µm
Offset :	0 mm	0 mm	Imported Data:		
Maximum Relative Stray Light Intensity:	10 %		X:\OneDrive\Dokumente\Workspace\01_R&D\LightShaping_IntegratedOptics		

#### Optical Setup Parameters

Optical Setup :	Paraxial Far Field	Distance DOE-Target Plane :	2 m
Surrounding Material :	Air		

#### Diffractive Optical Element / Transmission Parameters

Pixel Size :	2 µm	3.67 µm	Transmission Type :	Phase-Only
Number of Pixels :	753	412	Contains Discrete Levels	Yes
Period :	1.506 mm	1.51204 mm	Number of Height Levels :	8
Aperture Diameter :	2 mm	2 mm		
Aperture Shape :	Rectangular			

Validity: 

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# Specification: Diffuser Design 635nm

68: X:\OneDrive\...\03a\_RoK\_SE\_LTLogoDiffuser\_635nm.seditor\*

### Design Parameters Summary

An overview of the most important design parameters can be seen below.

#### Output Field Parameters


Pattern Ø - Desired :	235.3027778 mm	128.7638889 mm	Achieved :	235.4092958 mm	128.6783933 mm
Resolution - Desired :	706.6149483 µm	703.6278081 µm	Achieved :	706.9348221 µm	703.1606192 µm
Offset :	0 mm	0 mm	Imported Data:		
Maximum Relative Stray Light Intensity:	10 %		X:\OneDrive\Dokumente\Workspace\01_R&D\LightShaping_IntegratedOptics		

#### Optical Setup Parameters

Optical Setup :	Paraxial Far Field	Distance DOE-Target Plane :	2 m
Surrounding Material :	Air		

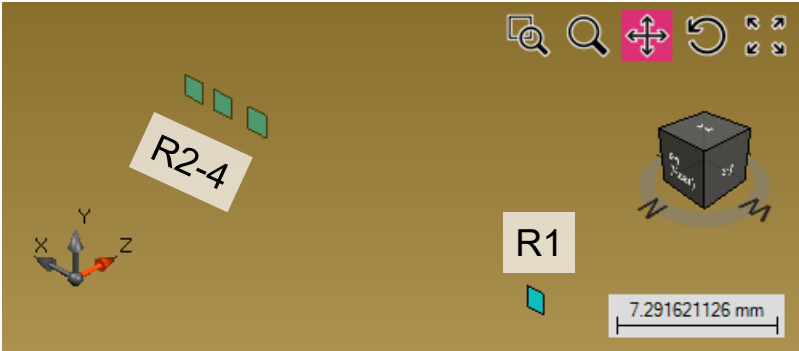
#### Diffractive Optical Element / Transmission Parameters

Pixel Size :	2 µm	3.67 µm	Transmission Type :	Phase-Only
Number of Pixels :	898	492	Contains Discrete Levels	Yes
Period :	1.796 mm	1.80564 mm	Number of Height Levels :	8
Aperture Diameter :	2 mm	2 mm		
Aperture Shape :	Rectangular			

Validity: 

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# Specification: Lightguide



## Lightguide Specification

Parameter	Value & Unit
type	parallel planes
thickness	2mm
material	fused silica

## Region Specification

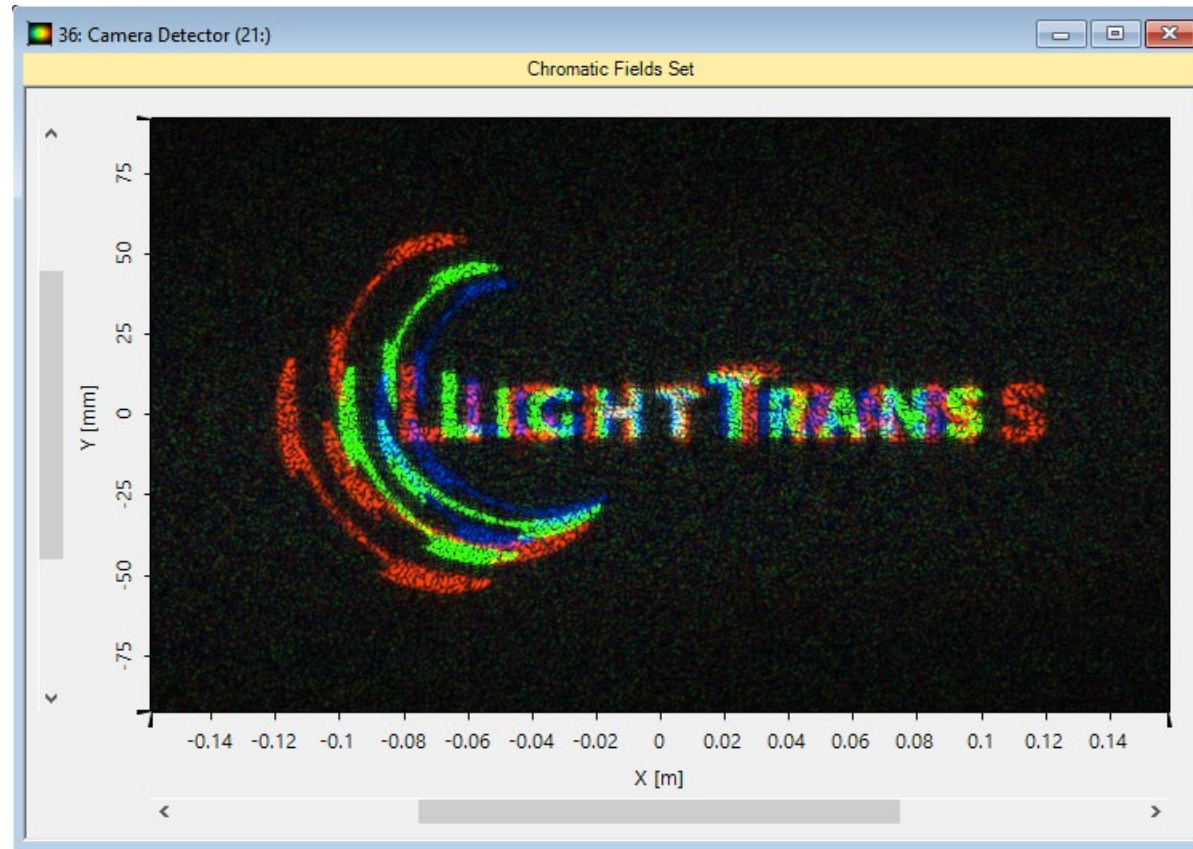
Region	Parameter	R1
R1	size	1.1mm × 1.1mm
	position	0 × 0
R2	size	1.1mm × 1.1mm
	position	19.95006187mm × 0mm
R3	size	1.1mm × 1.1mm
	position	22.17533831mm × 0mm
R4	size	1.1mm × 1.1mm
	position	24.0194502mm × 0mm

# Specification: Gratings



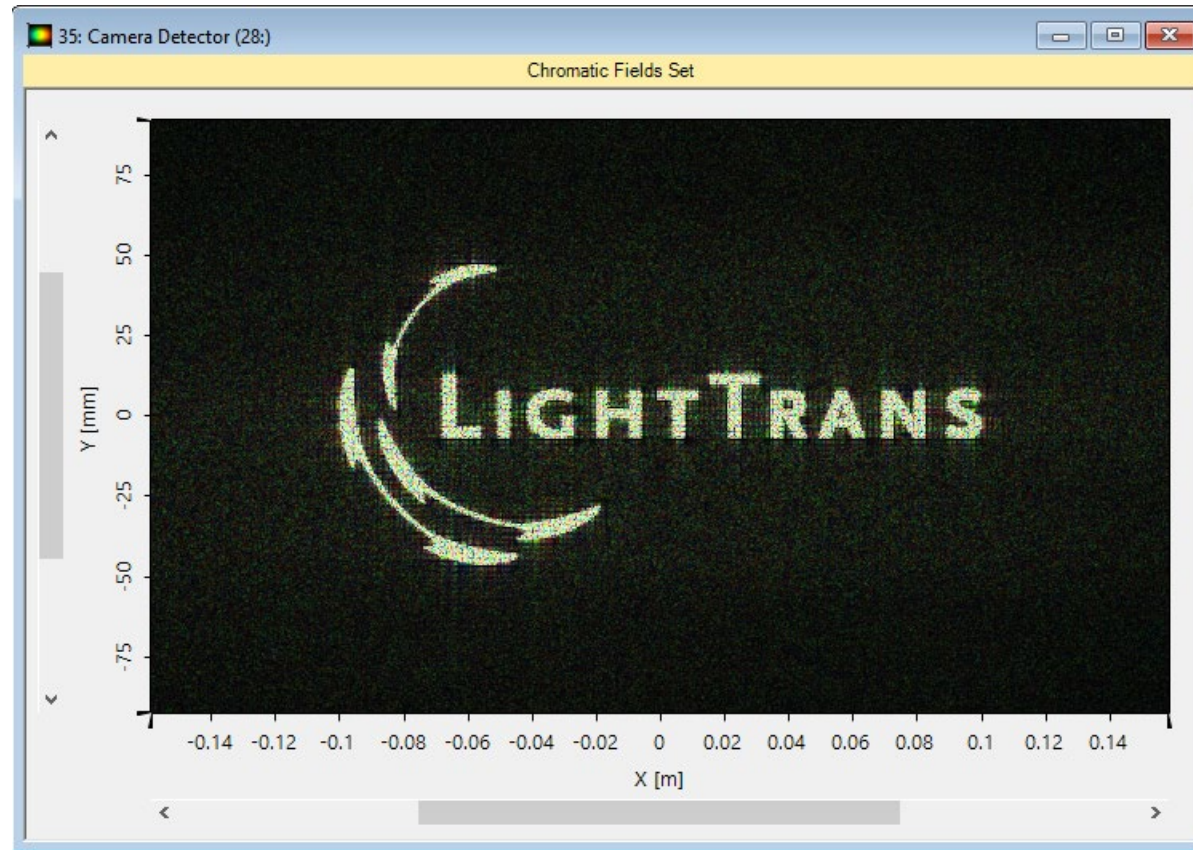
Parameter	Value & Unit
grating type G1	ideal grating
grating period G1	455nm
Specified Orders / Efficiency G1	T(1) / 100%
grating type G2	ideal grating
grating period G2	455nm
Specified Orders / Efficiency G2	T(-1) / 100%

# Result: RGB for Transmission@532nm



The transmissions designed for 532nm is analyzed by propagating RGB with far field operator (as comparison for the final result).

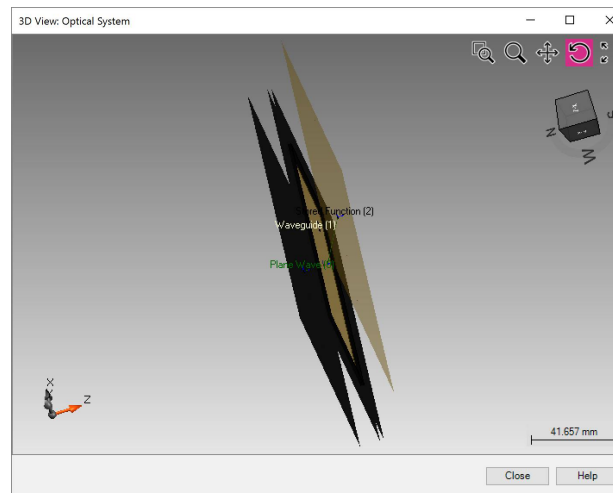
# Result: RGB for RGB Transmissions



The three transmissions are manually added to HFS and propagated by far field operator (as check for the final result).

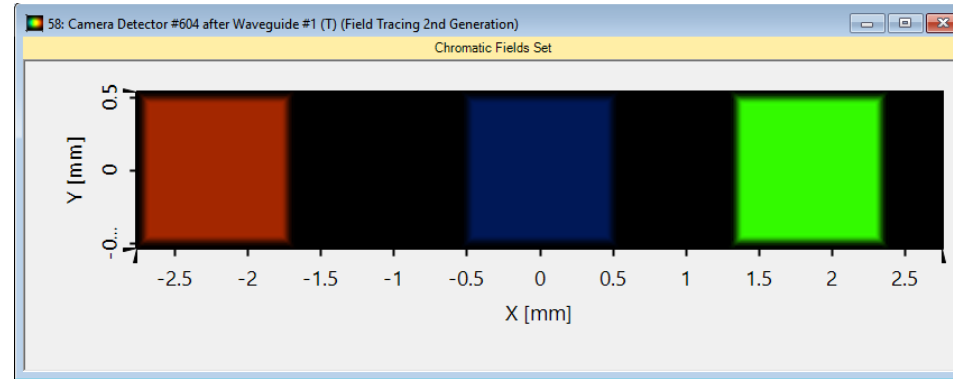
## Remark:

- The idea of using three separated transmission components does not work because the path finder hitting a single transmission does not find the other two transmissions components
- Hence, the separated transmissions are combined to a single transmission function by adding them together.

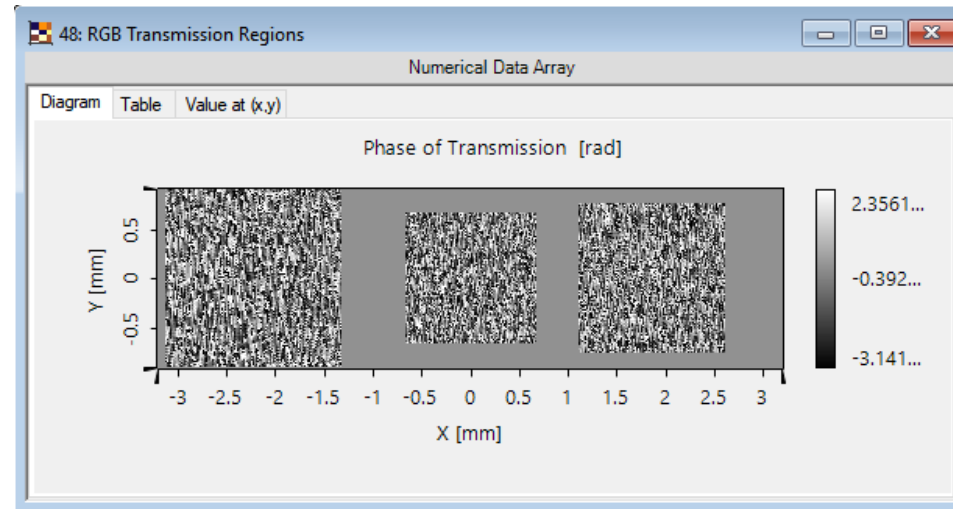


# Result: RGB Transmission Regions

Intensity at the  
Lightguide  
Output



Transmission  
Component behind  
Lightguide Output

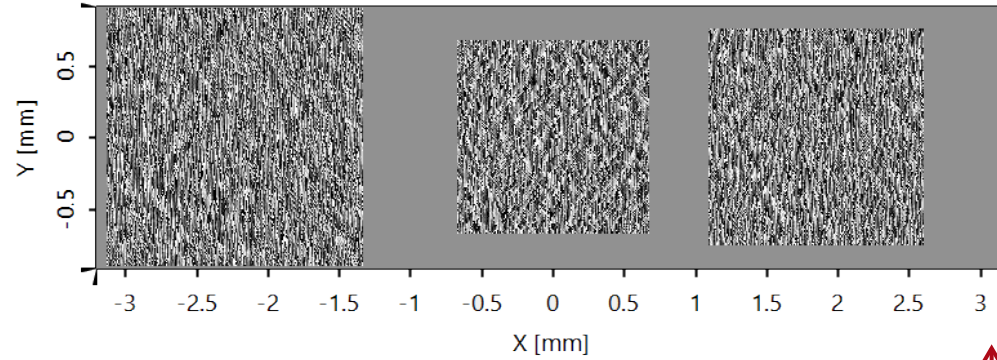


The designed transmissions are combined to a single transmission, which is located at the output of the Lightguide component.

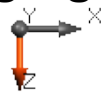
# Result: Illustration Lightguide Setup

Source:  
Plane Wave

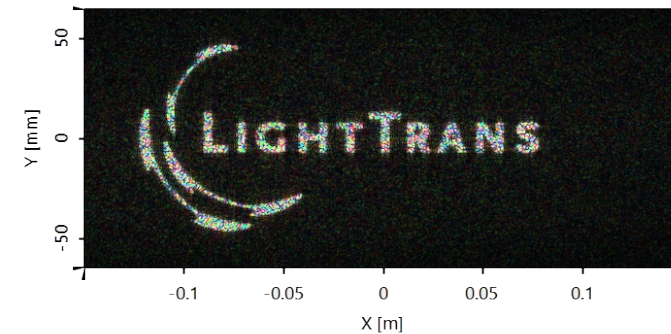
RGB Transmission Regions



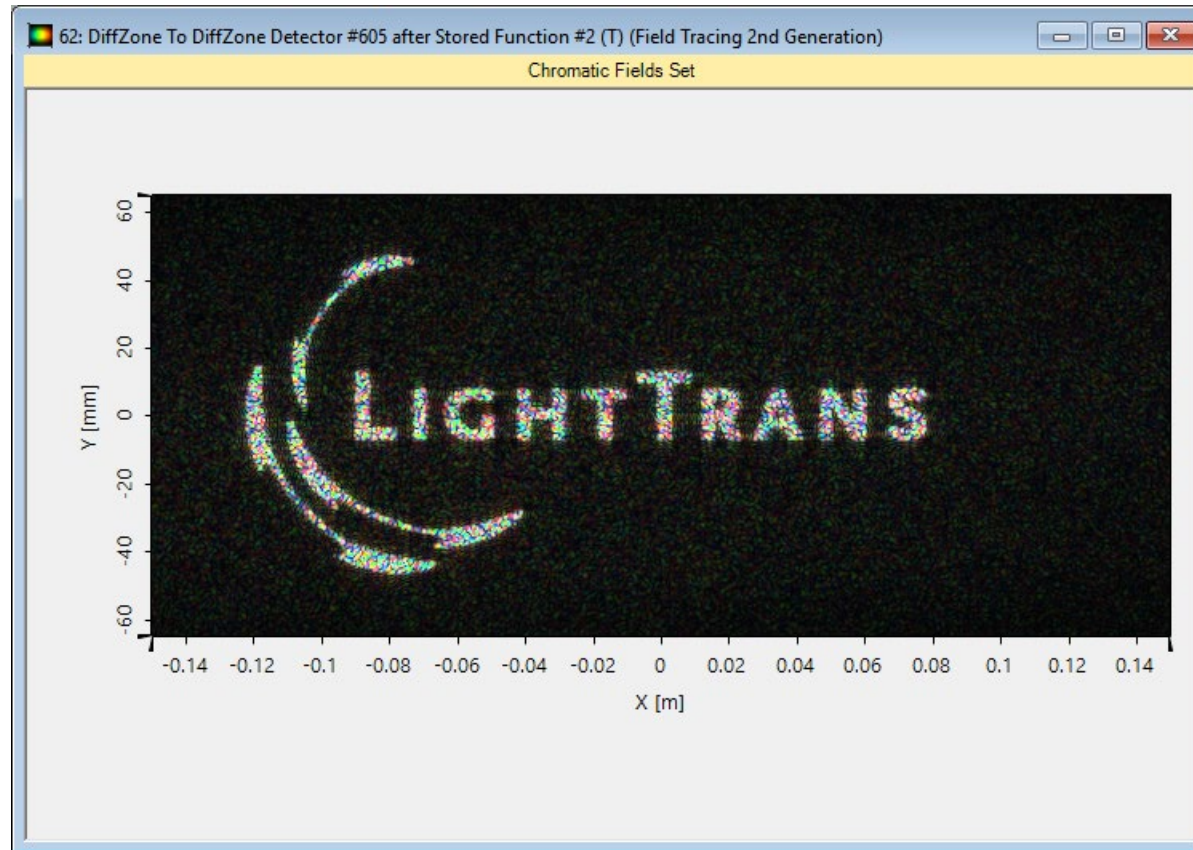
Lightguide Component



Far Field  
Propagation



# Result: Camera Detector Lightguide Setup



# Document Information

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title	RGB Diffuser using Lightguide Approach
document code	Demo.0005
version	1.0
VL version used for simulations	7.0.2.6
category	Demo
further reading	- <a href="#"><u>Design of a Diffractive Diffuser to Generate a LightTrans Mark</u></a>

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