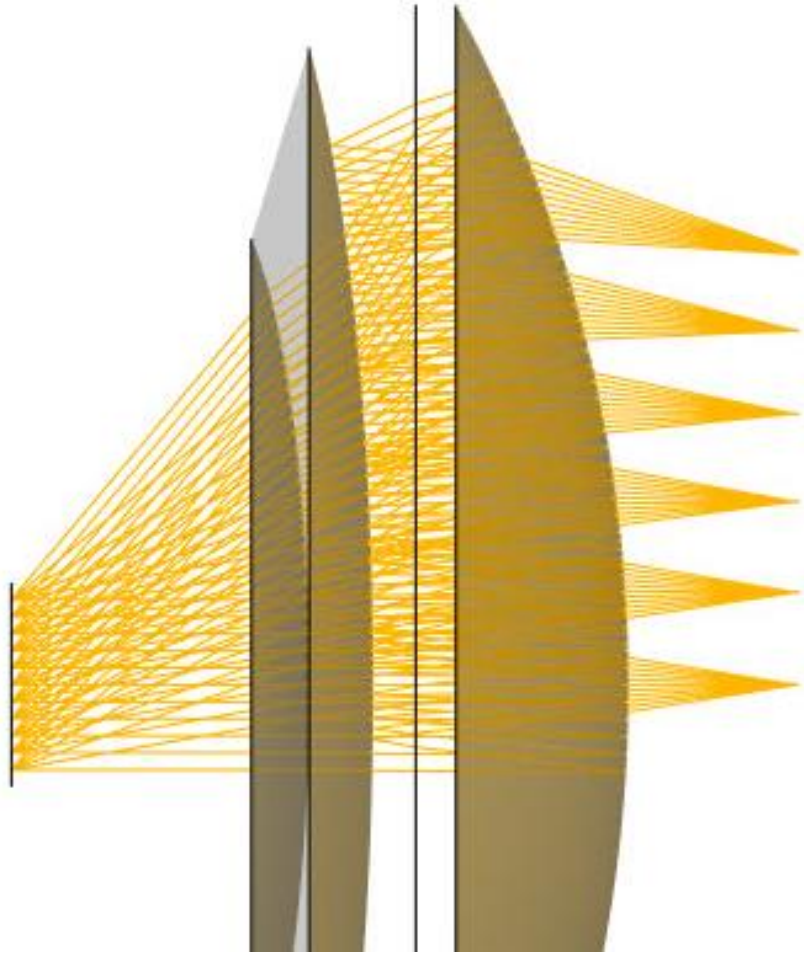# Catadioptric Imaging System Based on Pancake Lenses

Abstract

In order to reduce costs and weight, many modern application introduce smart ways to minituarize their optical systems. One particular implementation of this principle is the folded imaging system, in which the property of a focusing lens is distributed between multiple components. By cleverly manipulating the polarizations status of the propagated light, this system allows for multiple internal reflection, mimicking the functionality of a much bigger lens. In this Use Case we show the working principle of such a system. For this purpose, we defined a set of Plane Wave with different incident angles, which then are propagated through the system to calculate the focal spots at the end. This information can then be used to further optimize the setup, but this is out of the scope of this Use Case.
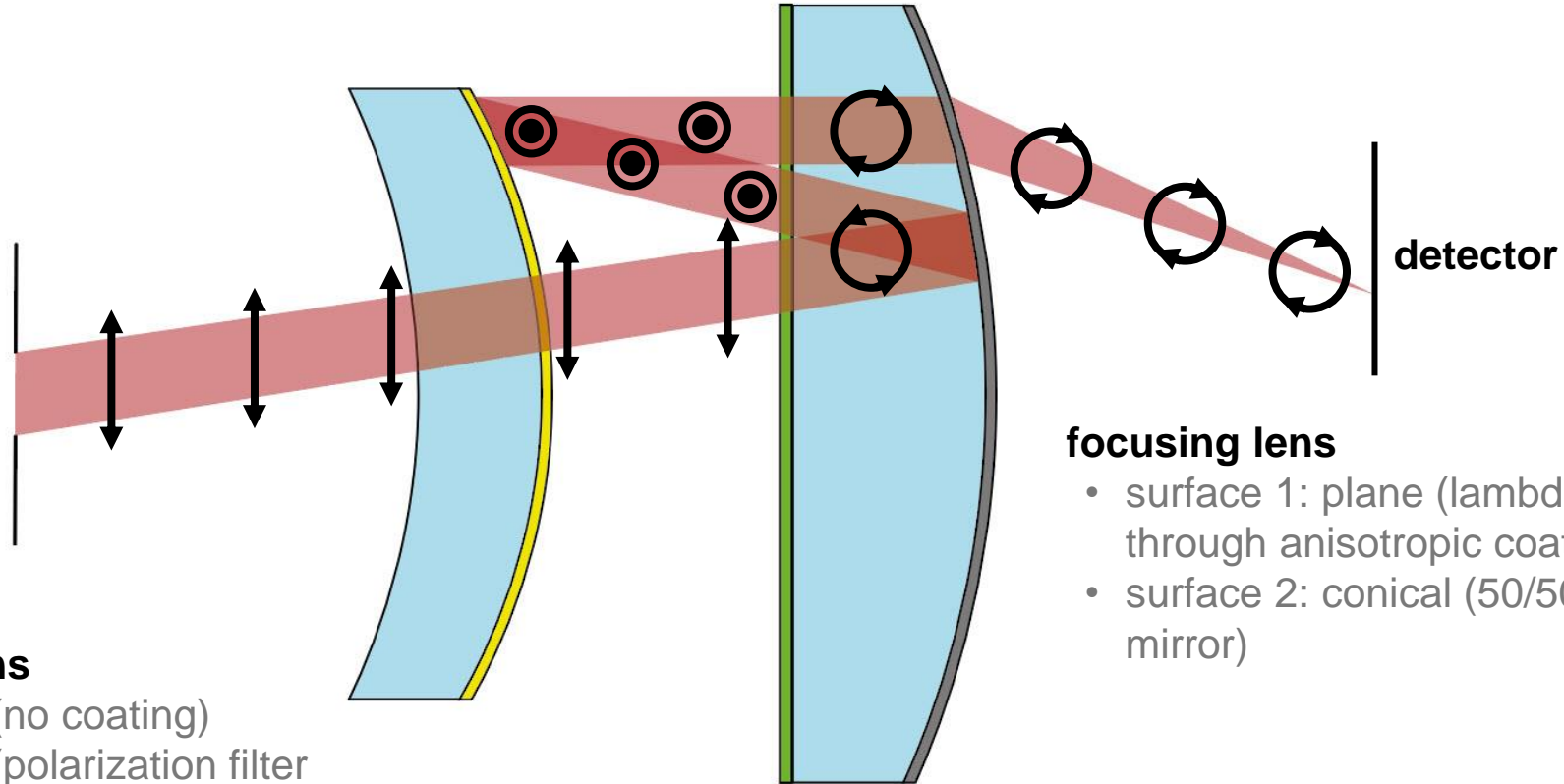
Scenario

multiple FOVs*
- Plane Wave
- 587.7 nm
- 0°- 40° incident angle

* for picture clarity only one FOV is depicted

detector

focusing lens
- surface 1: plane (lambda-quarter plate through anisotropic coating)
- surface 2: conical (50/50 semitransparent mirror)

reflective polarizer lens
- surface 1: aspheric (no coating)
- surface 2: aspheric (polarization filter through anisotropic coating)

(note: this Use Case does not include an optimization of the system, as it only discusses the working principle of such kind of systems.)

Modeling Task 1: Investigation of Polarization State in System

single FOVs
- Plane Wave
- 587.7 nm
- **0° incident angle**

reflective polarizer lens (RPS)

focusing lens (FL)

detectors
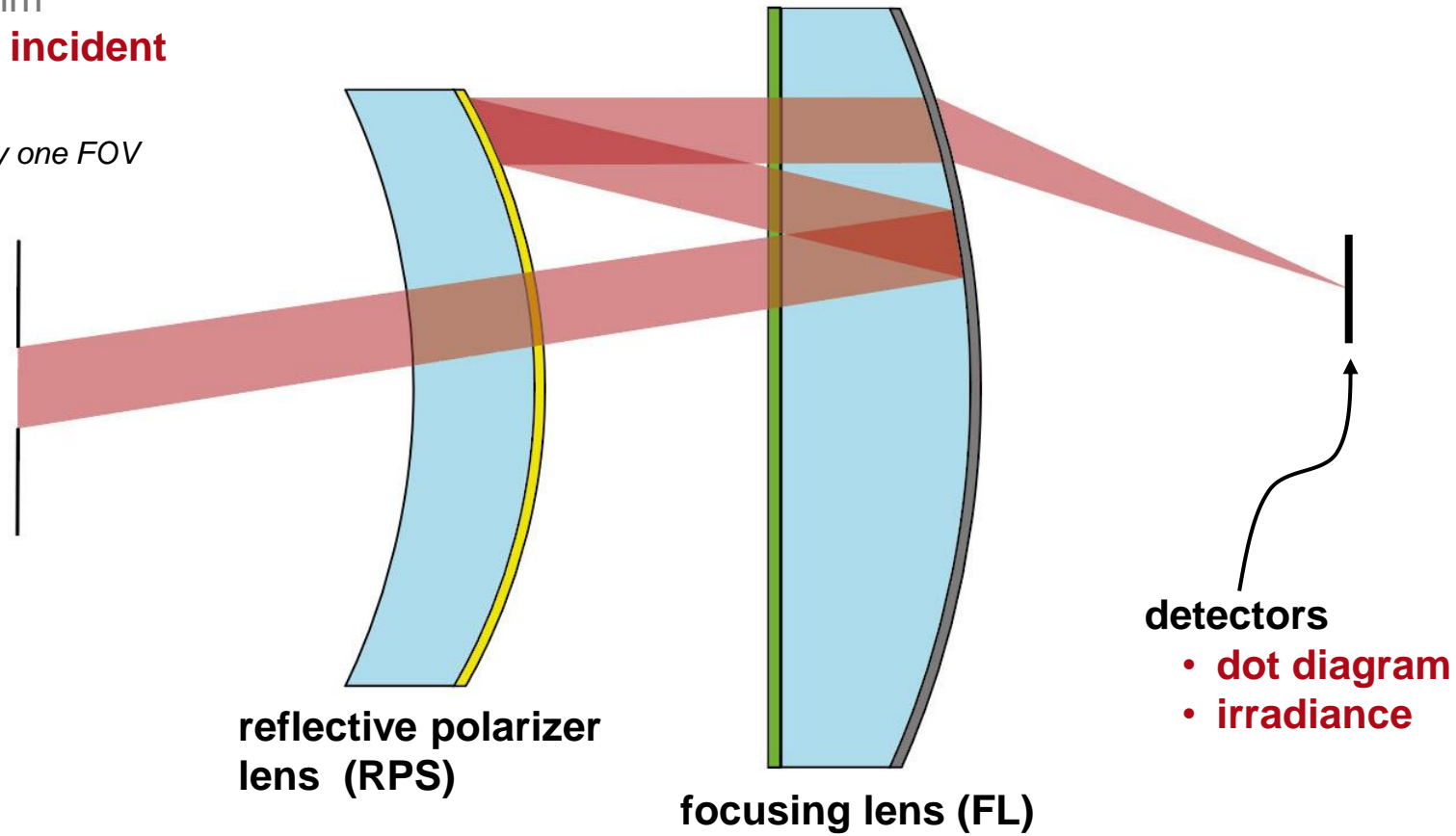- **polarization ellipses**
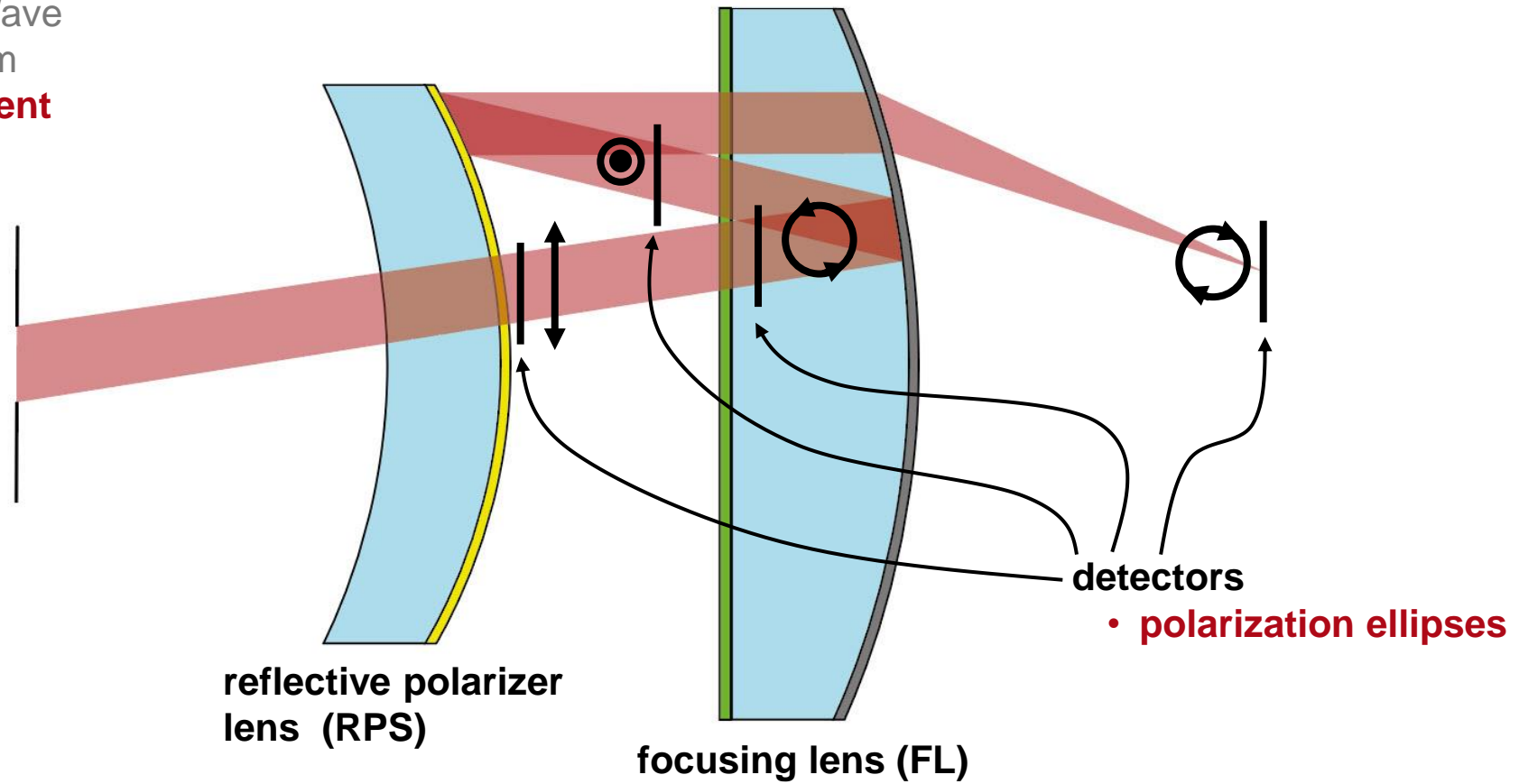
Modeling Task 2: Investigation of Focal Spots

multiple FOVs*
- Plane Wave
- 587.7 nm
- **0°- 40° incident angle**
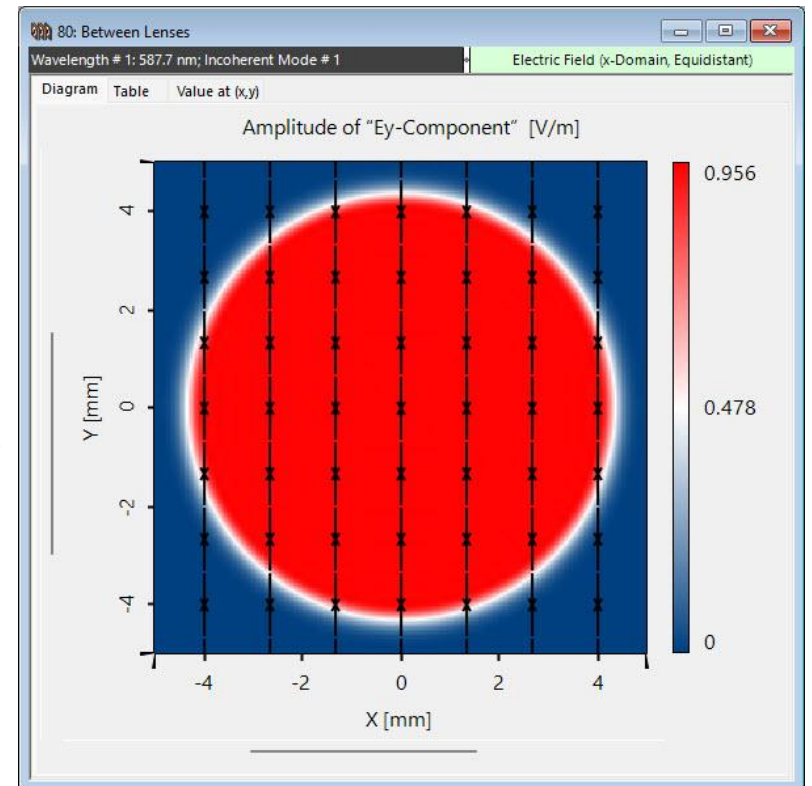
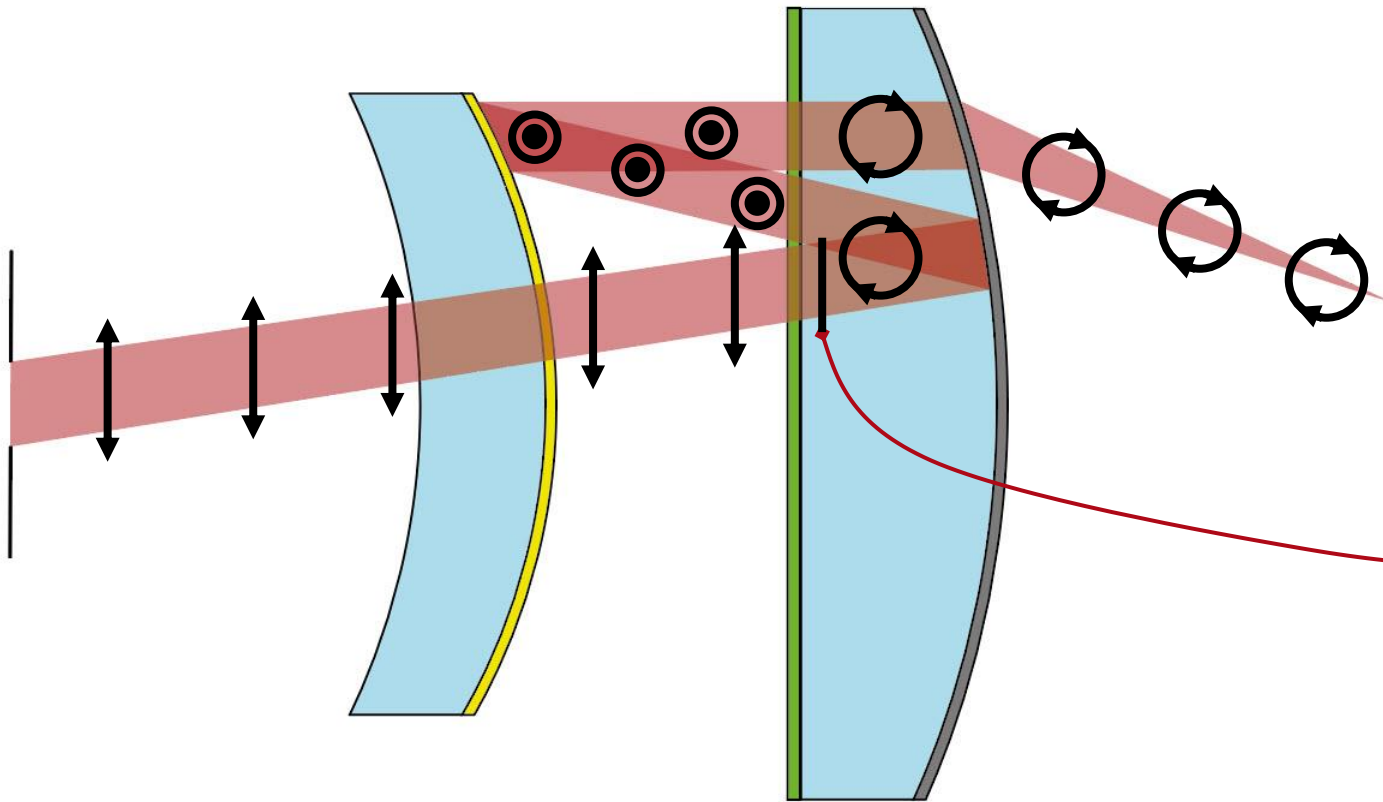** for picture clarity only one FOV is depicted*

reflective polarizer lens (RPS)

focusing lens (FL)

detectors
- **dot diagram**
- **irradiance**

Simulation Results – Polarization State

Polarization State through the System
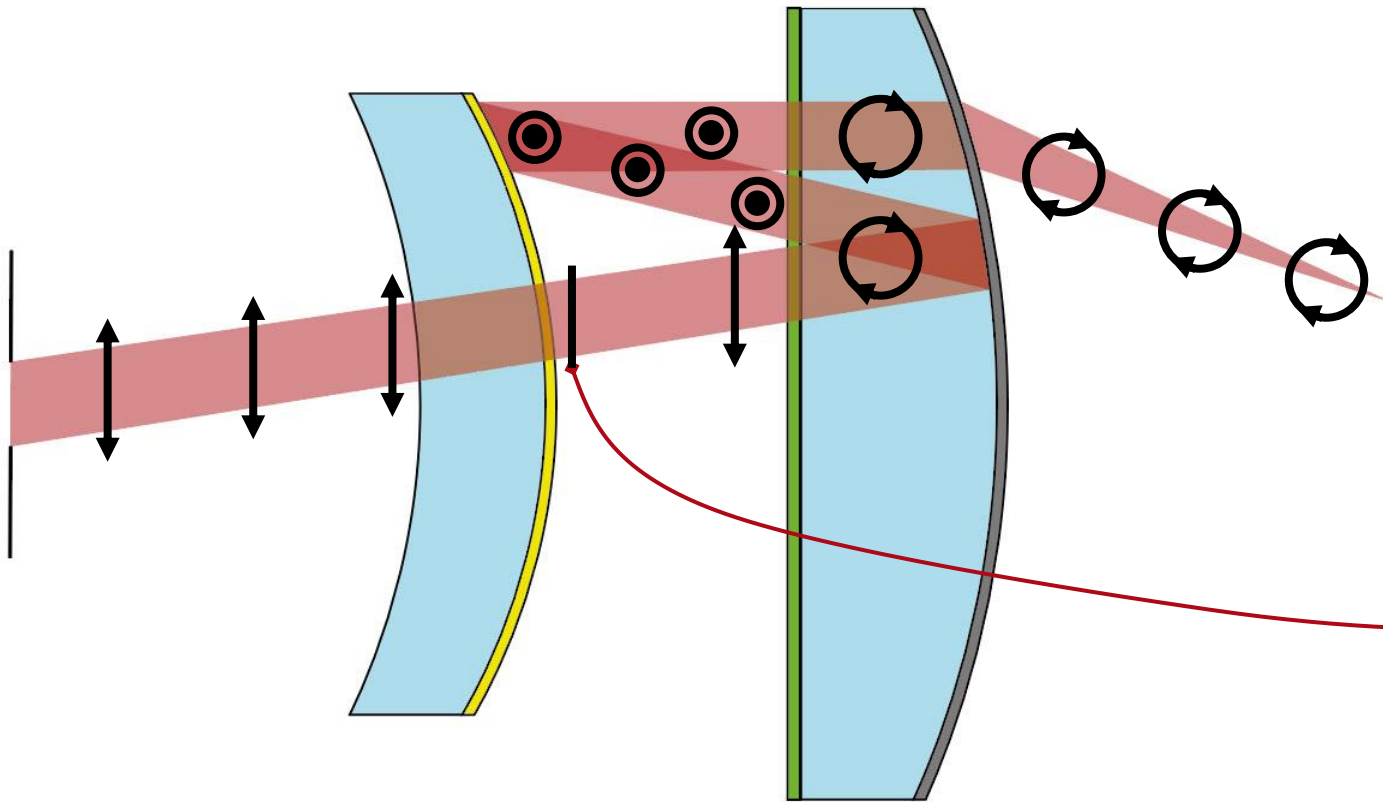
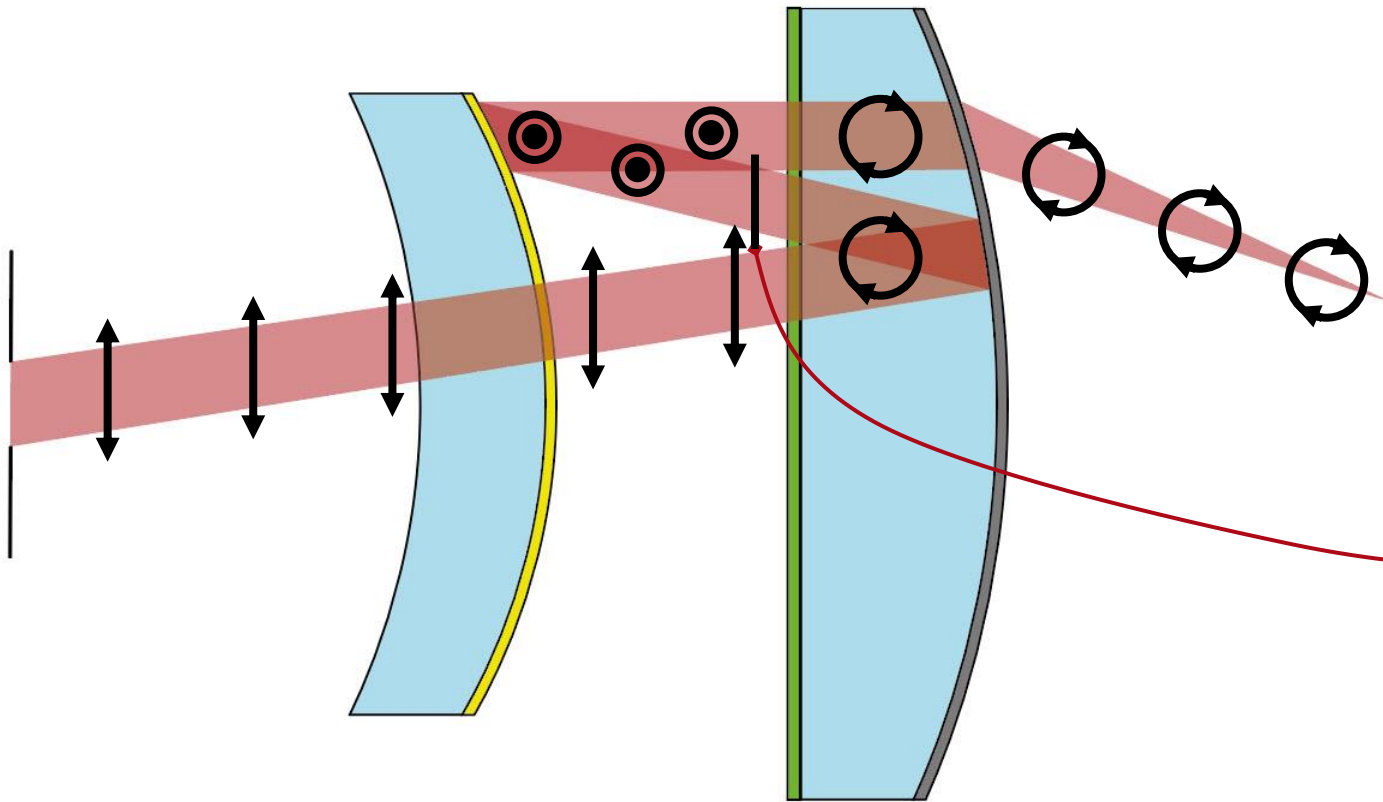The y-polarized light mostly transmits through the anisotropic coating of the first lens.

Polarization State through the System

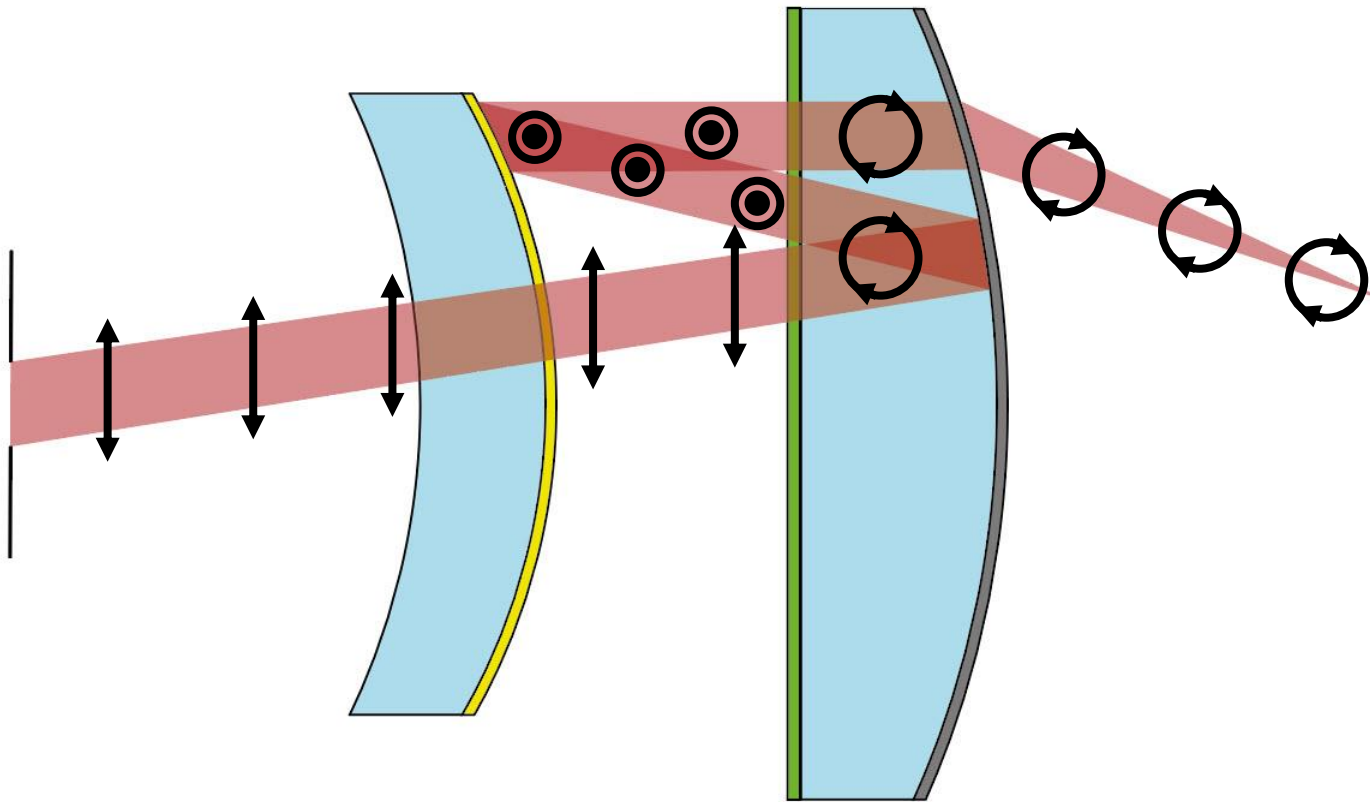Propagating through the quarter-wave plate it change its polarization status to circular.
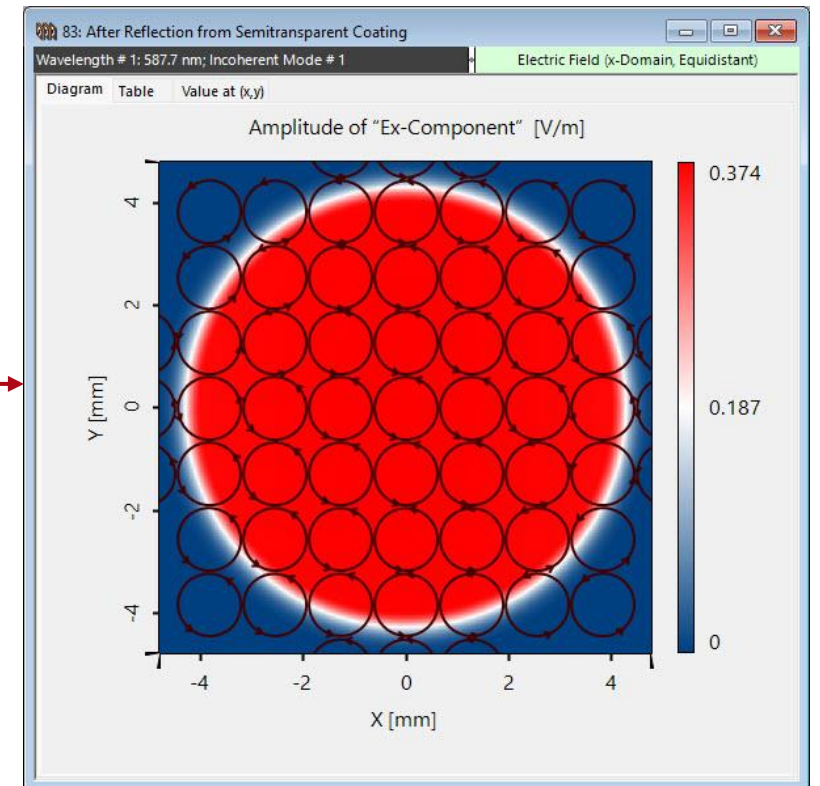
Polarization State through the System

Another propagation through the quarter-wave plate will change the polarization to linear in x. Hence, it will now mostly reflect on the anisotropic coating of the first lens.
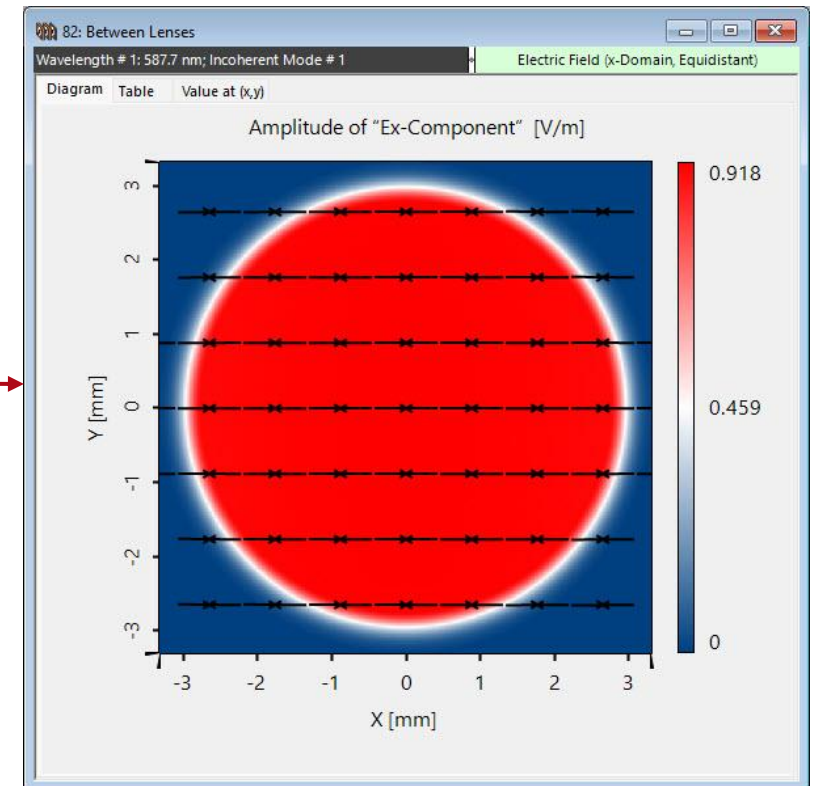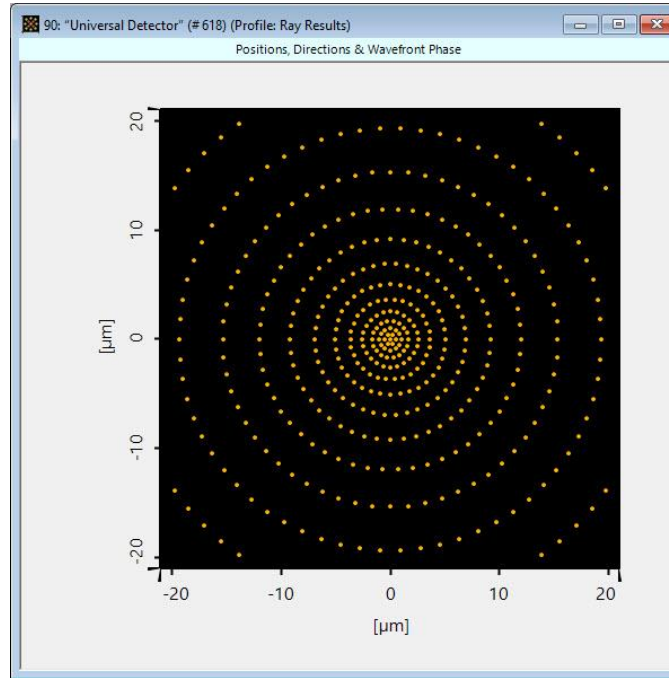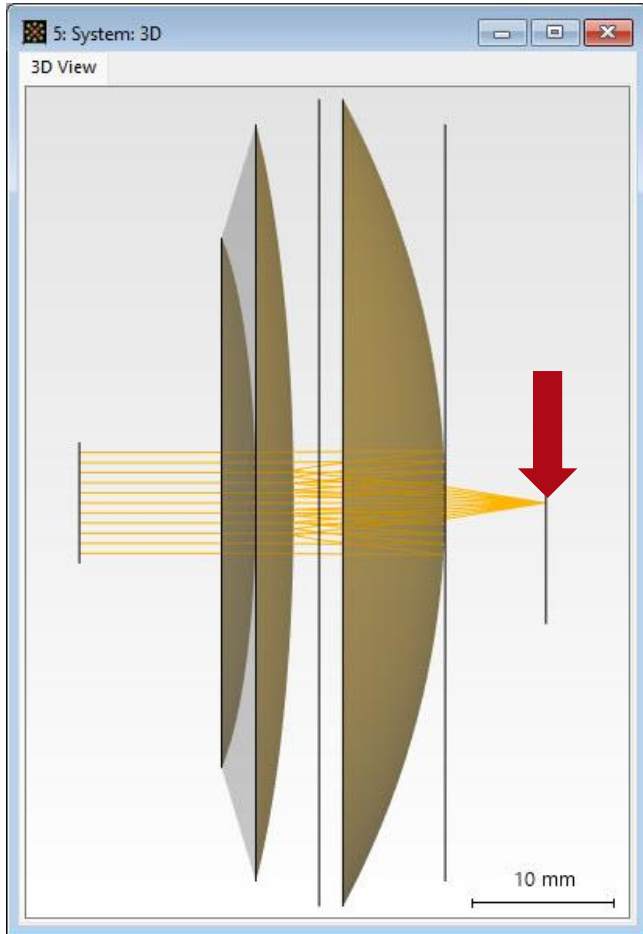
Polarization State through the System

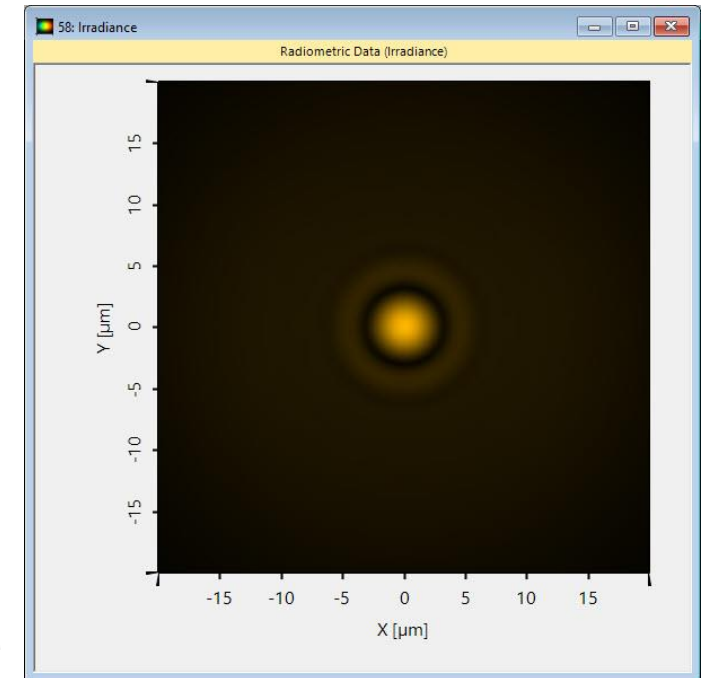After a final passing through the quarter-wave plate, the light is focused with a circular polarization state.
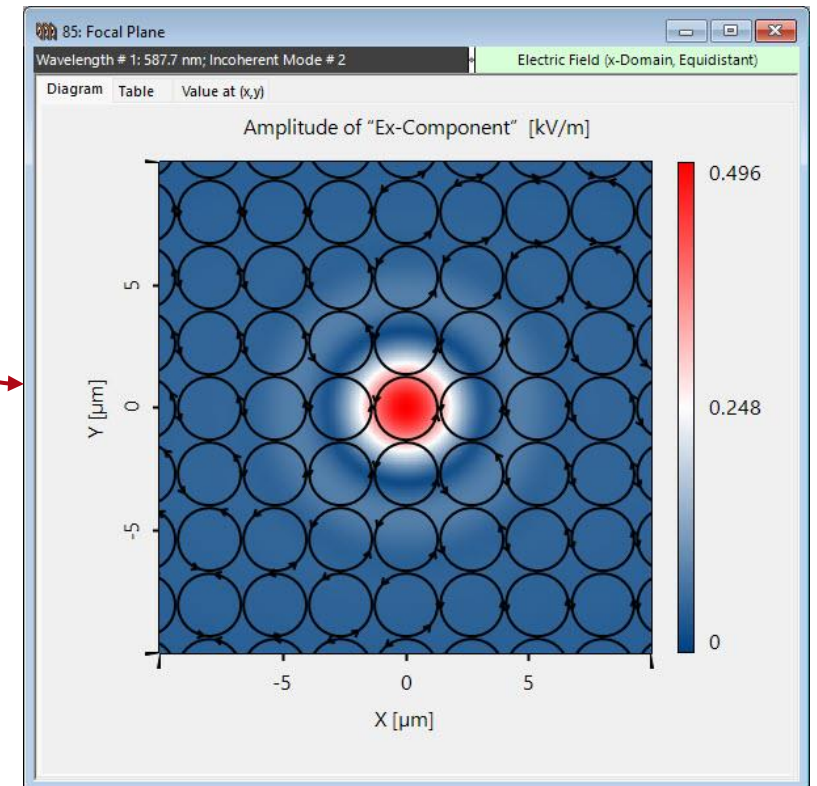
Simulation Results – Focal Investigation
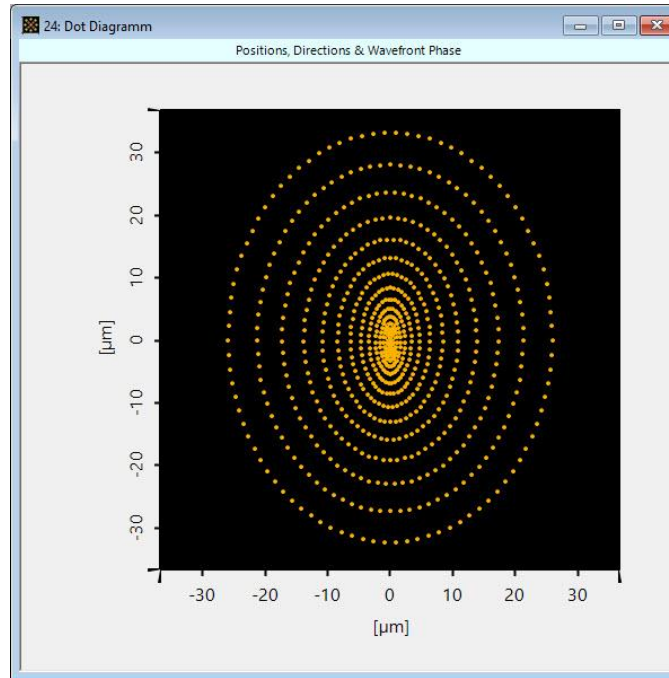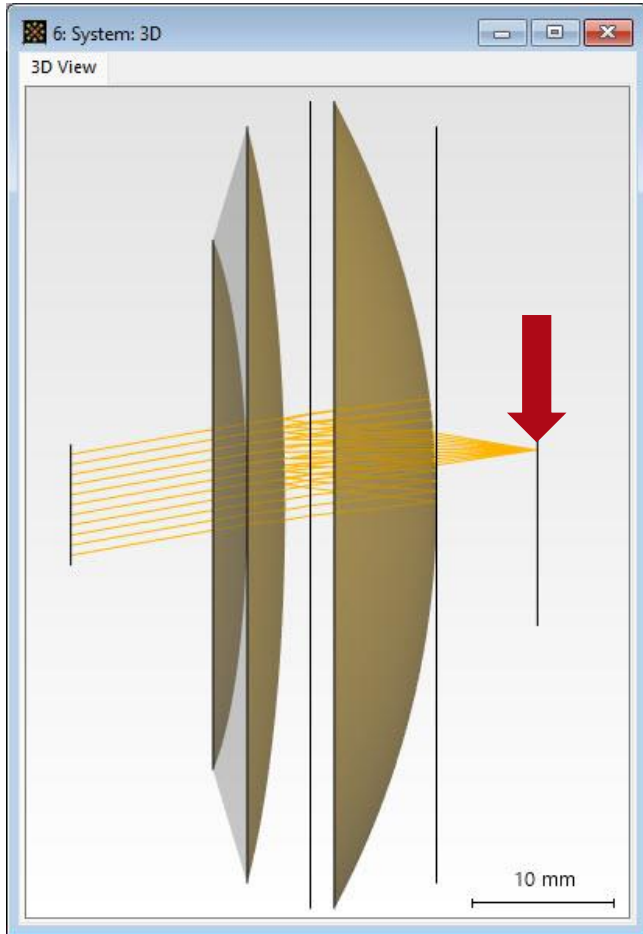
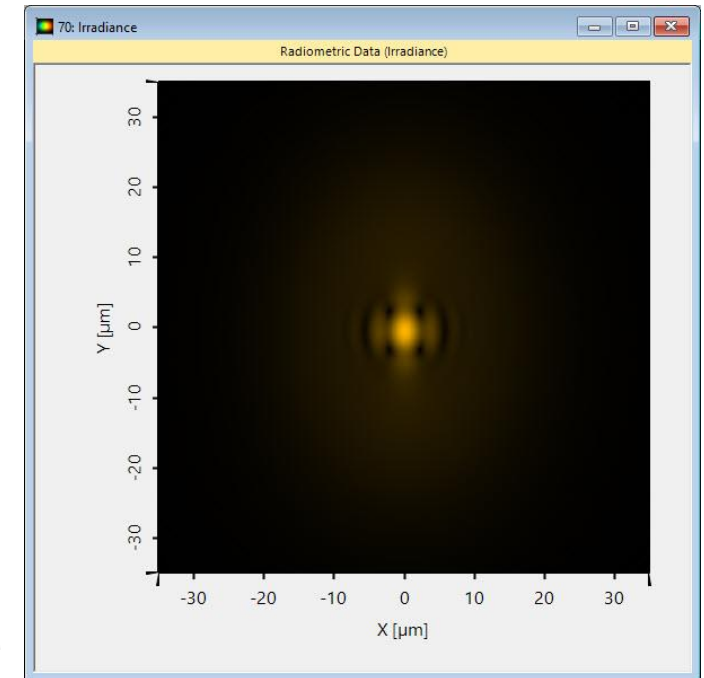# Dot Diagram & Irradiance of the Modes – 0°

dot diagram
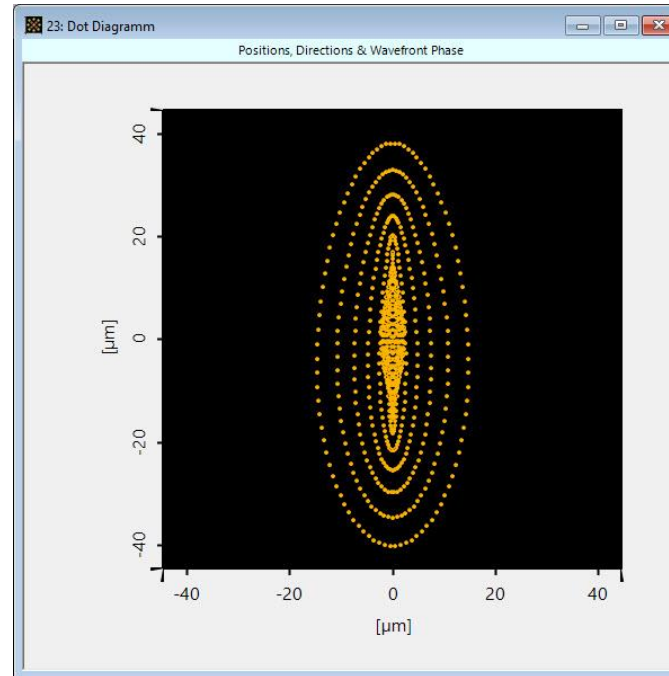
irradiance

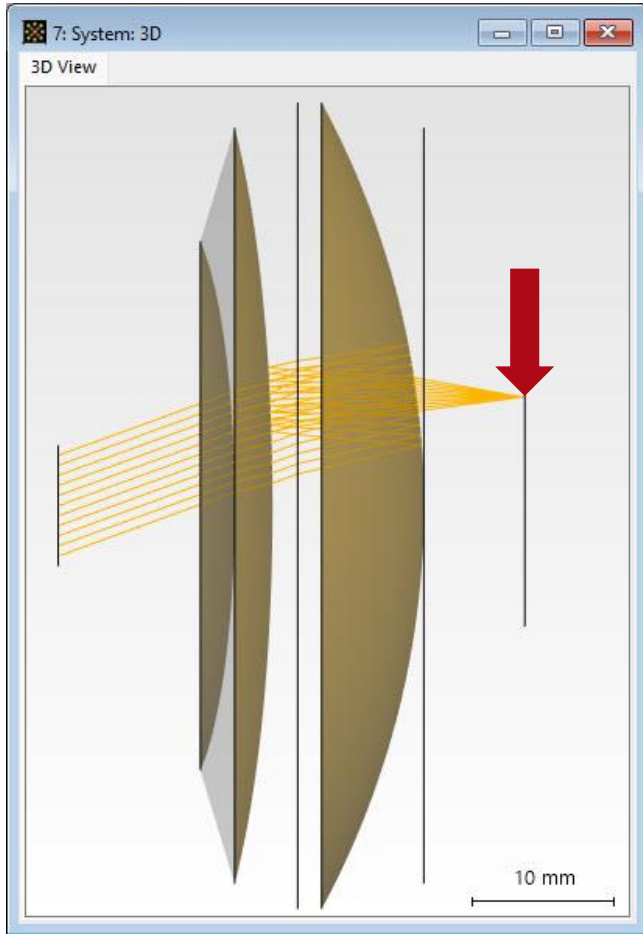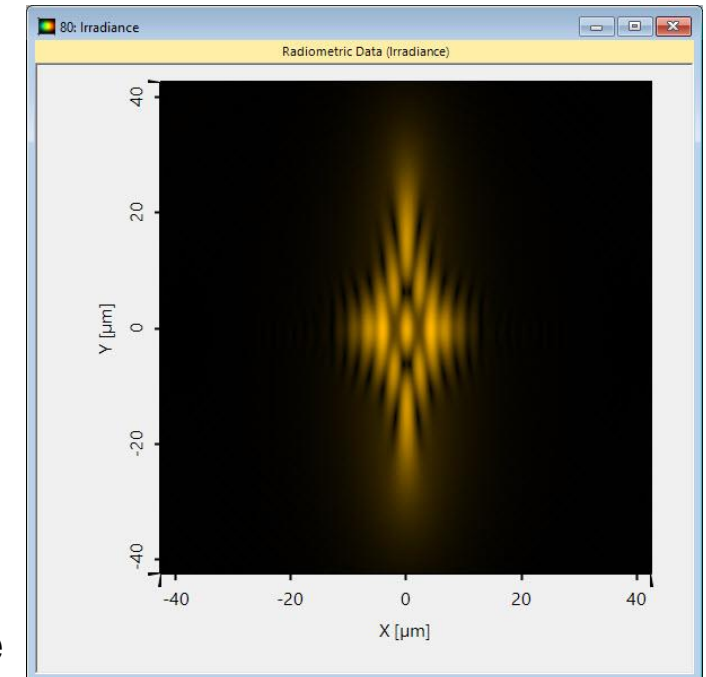# Dot Diagram & Irradiance of the Modes – 10°

dot diagram
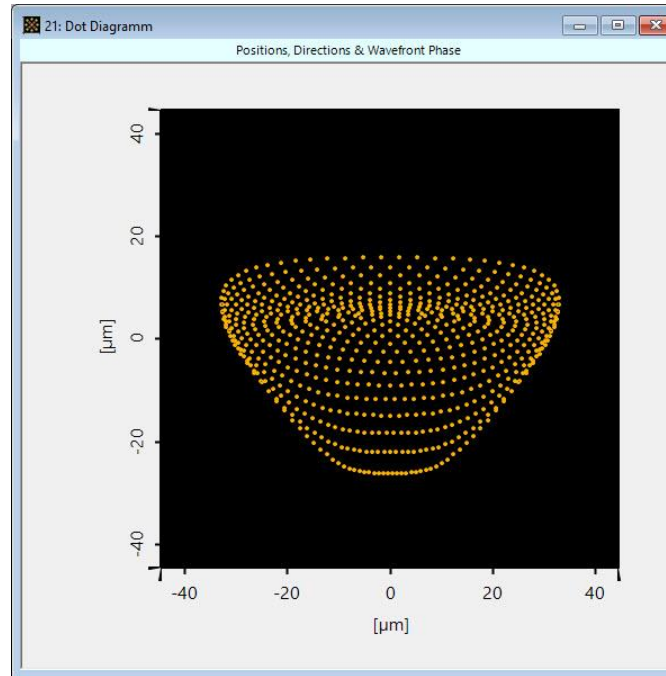
irradiance

Dot Diagram & Irradiance of the Modes – 20°
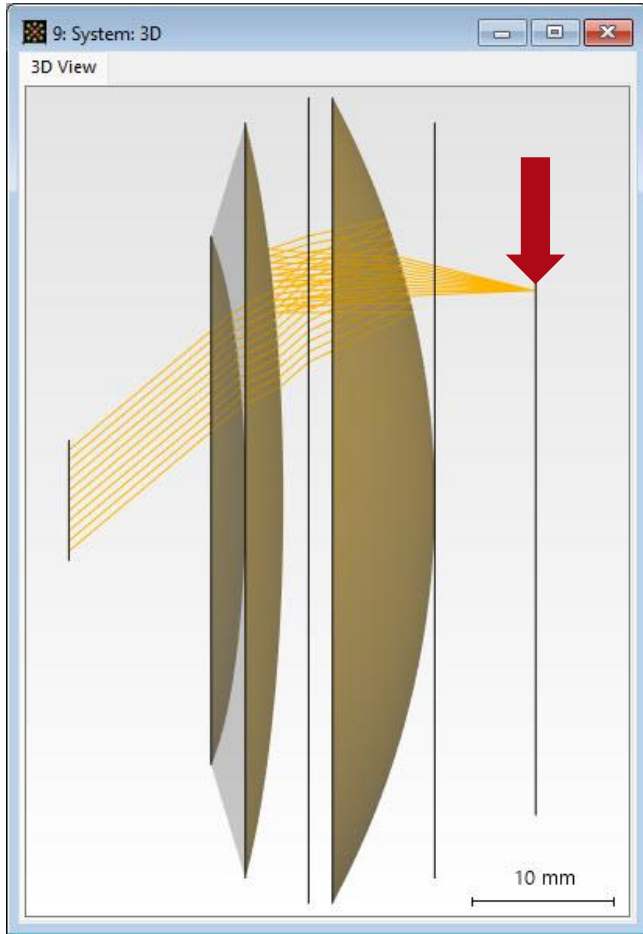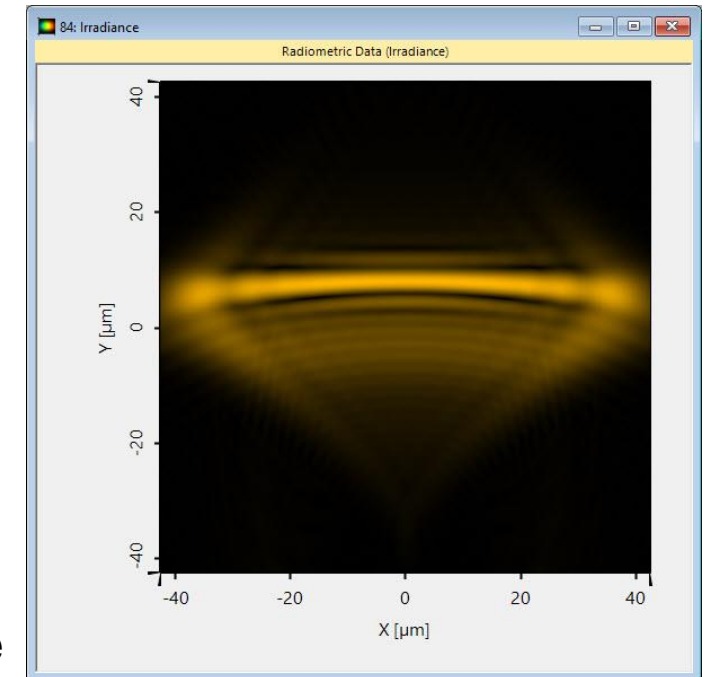
dot diagram

irradiance

Dot Diagram & Irradiance of the Modes – 40°

dot diagram

irradiance

Document Information

title	Catadioptric Imaging System Based on Pancake Lenses
document code	CRO.0008
document version	1.0
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