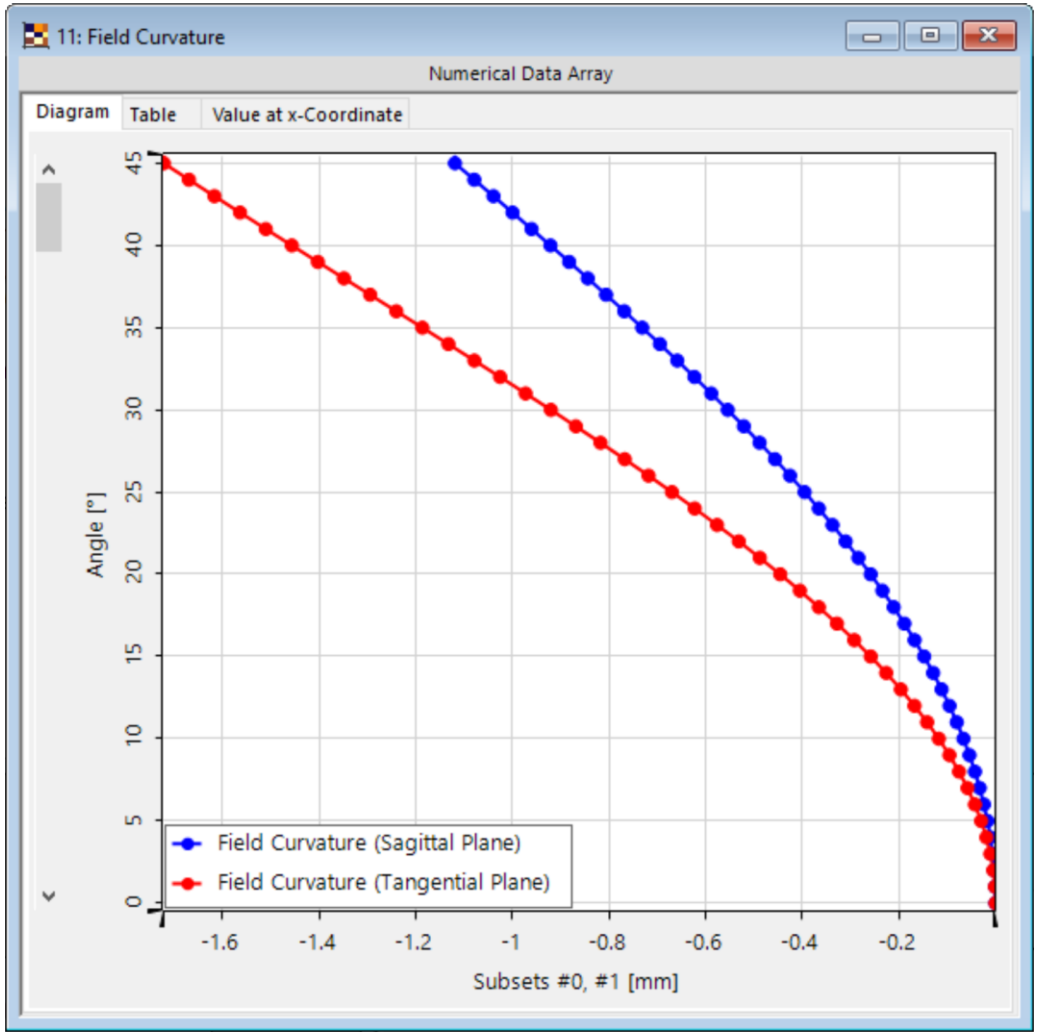
Field Curvature Analyzer

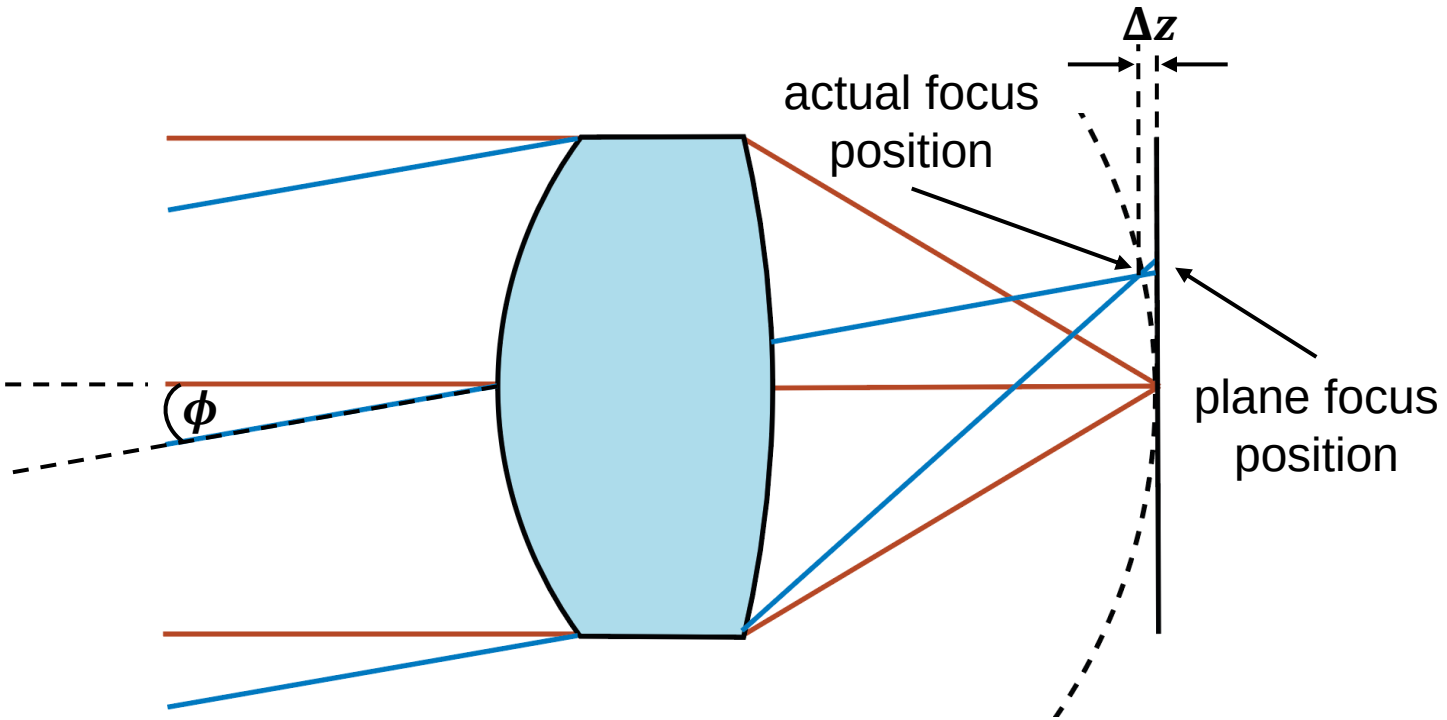
Abstract

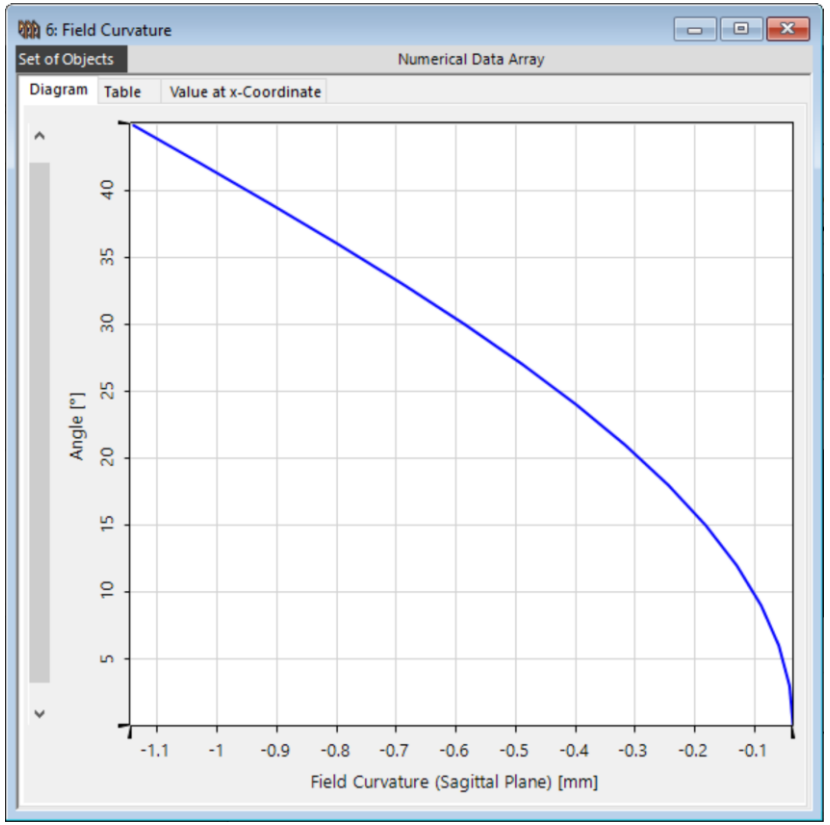


Although developments in modern optics have caused an explosion in the number of different components available, lenses continue to play a major role in optical systems. Due to their curved nature, the focal point of most lens systems will lay on a curve rather than a plane behind the lens. This leads to an angle-dependent deviation between the actual focal position and the intersection point of the light beam with a plane positioned at focal length behind the lens. Most detectors used in imaging, however, operate as plane surfaces. This effect is called “field curvature” and represents an important aberration to consider in the performance analysis of any lens system. In this use case we introduce a specialized analyzer to investigate this effect.

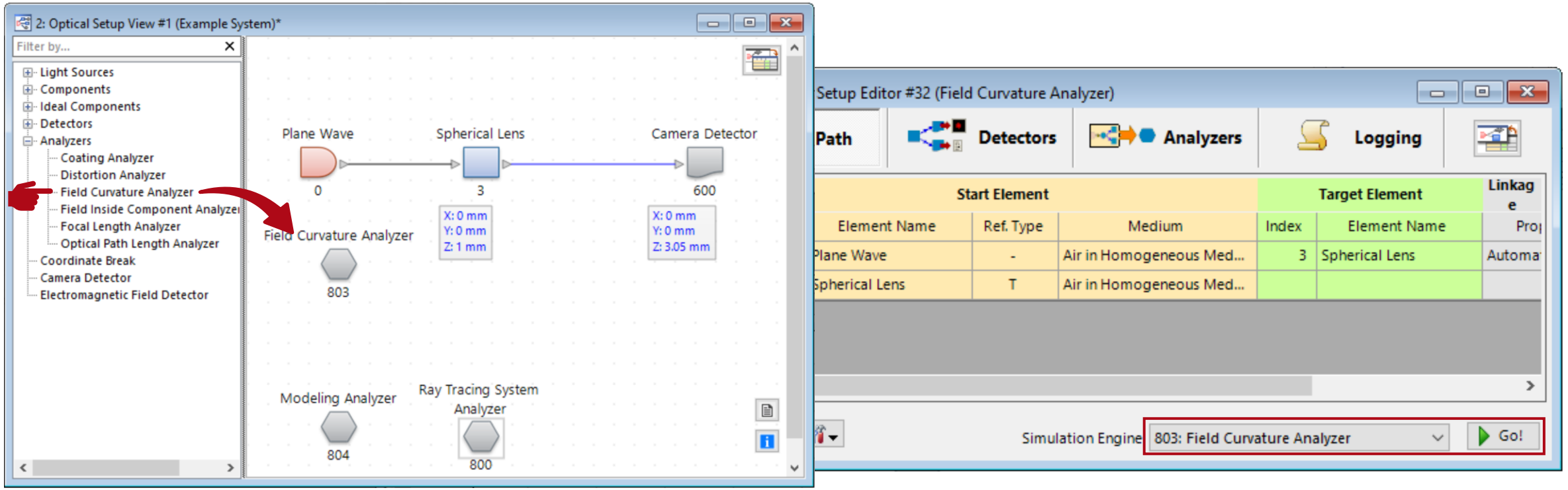
Field of Curvature

Field curvature, also known as “curvature of field”, is a common optical effect that causes a flat object to appear sharp in certain parts of the frame, instead of being uniformly sharp across the frame. This happens due to the curved nature of most optical elements, which project the image onto a curved surface, rather than flat. It is defined as a function between Δz and ϕ.





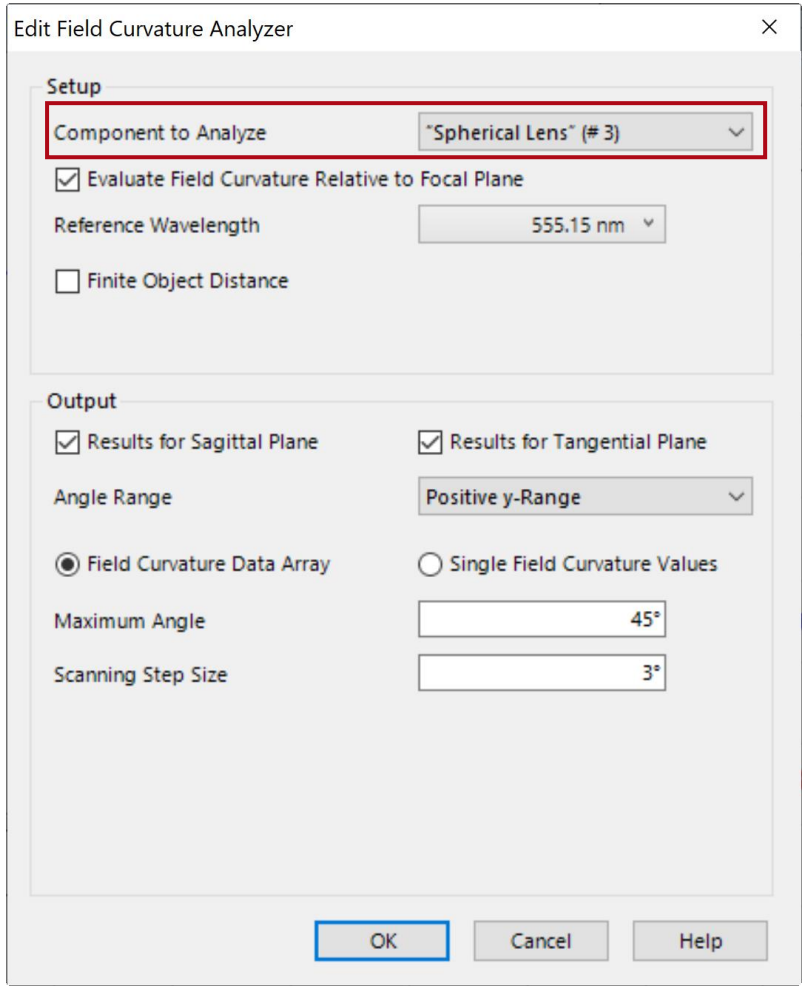
Where to Find the Field Curvature Analyzer



The *Field Curvature Analyzer* can be found in the *Analyzer* section of the *Optical Setup View* document.

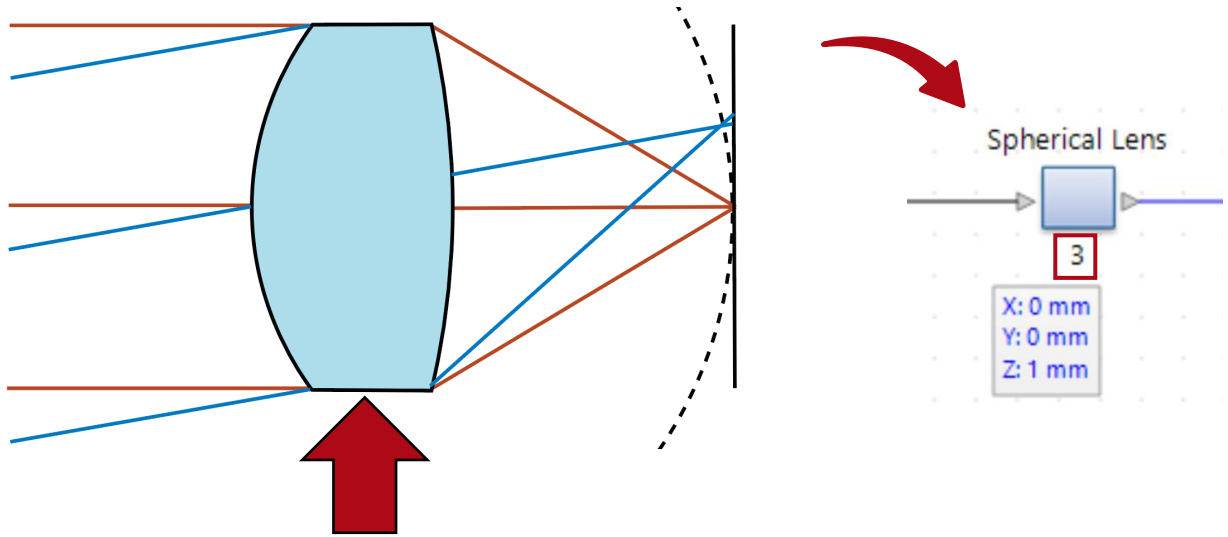
To run the analyzer, choose *Field Curvature Analyzer* as *Simulation Engine* in the *Optical Setup Editor*.

Component to Analyze

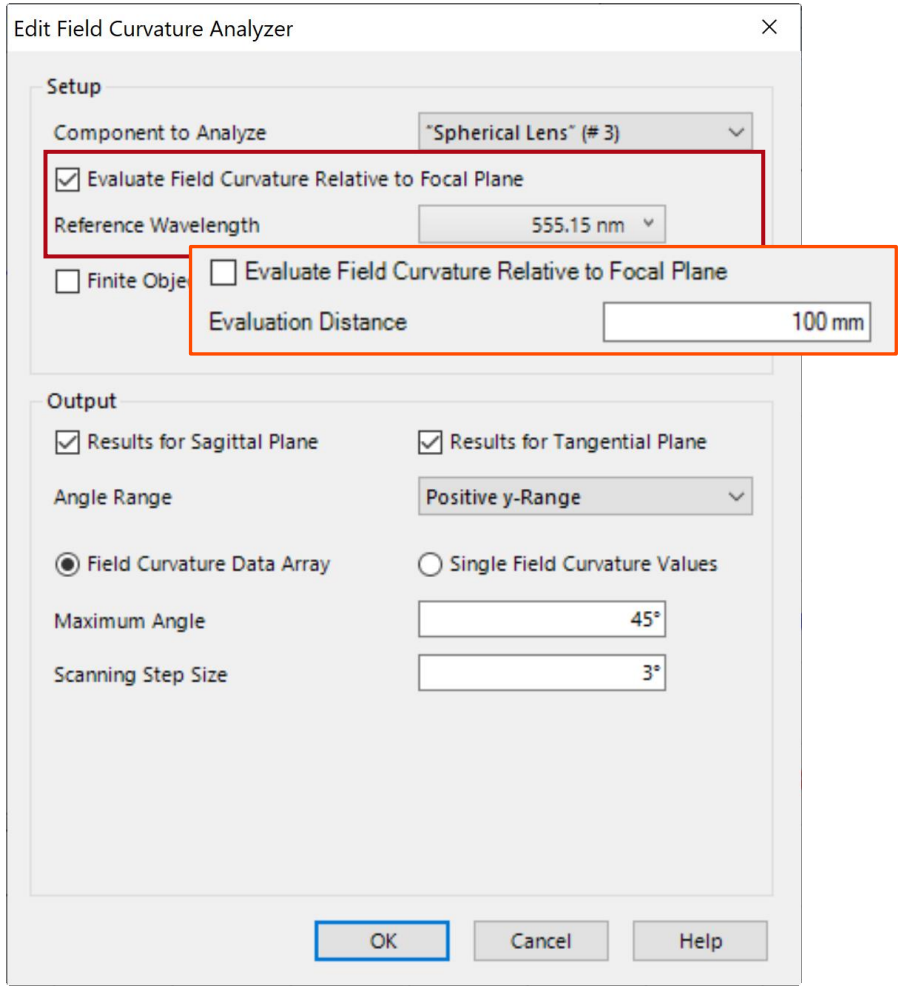


The *Field Curvature Analyzer* works independently from the actual optical system and its parameters. Therefore, the specific parameters need to be defined inside the analyzer.

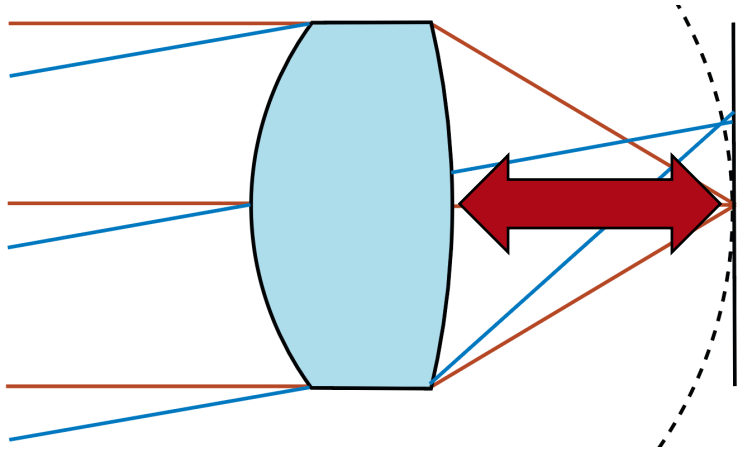
Component to Analyze: Define which component shall be analyzed. A dropdown-menu will show all available options. In case there are multiple components with the same name, the index below the component will help distinguishing them.



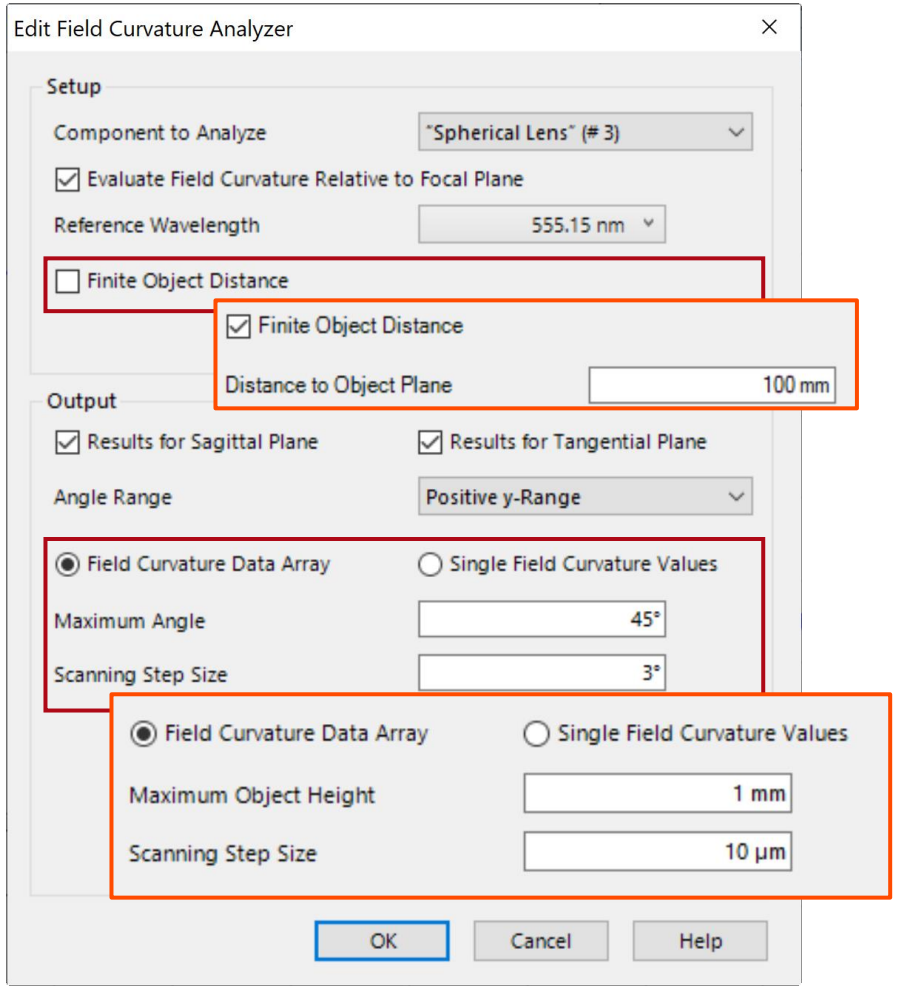
Evaluation Distance



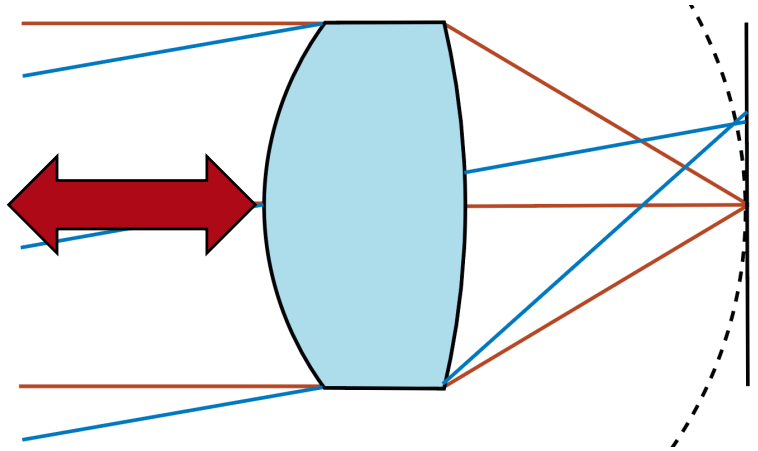
Evaluate Field Curvature Relative to Focal Plane: The distance to the desired reference plane can either be directly calculated (by effective focal length) or specified by the user.



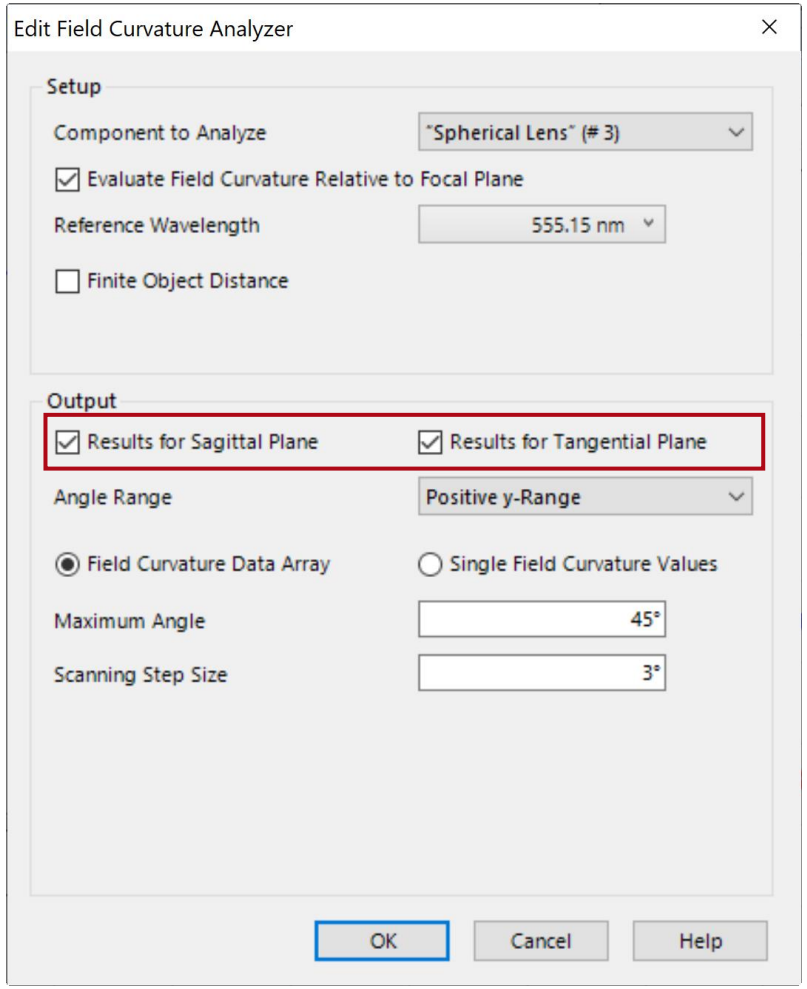
Object Distance



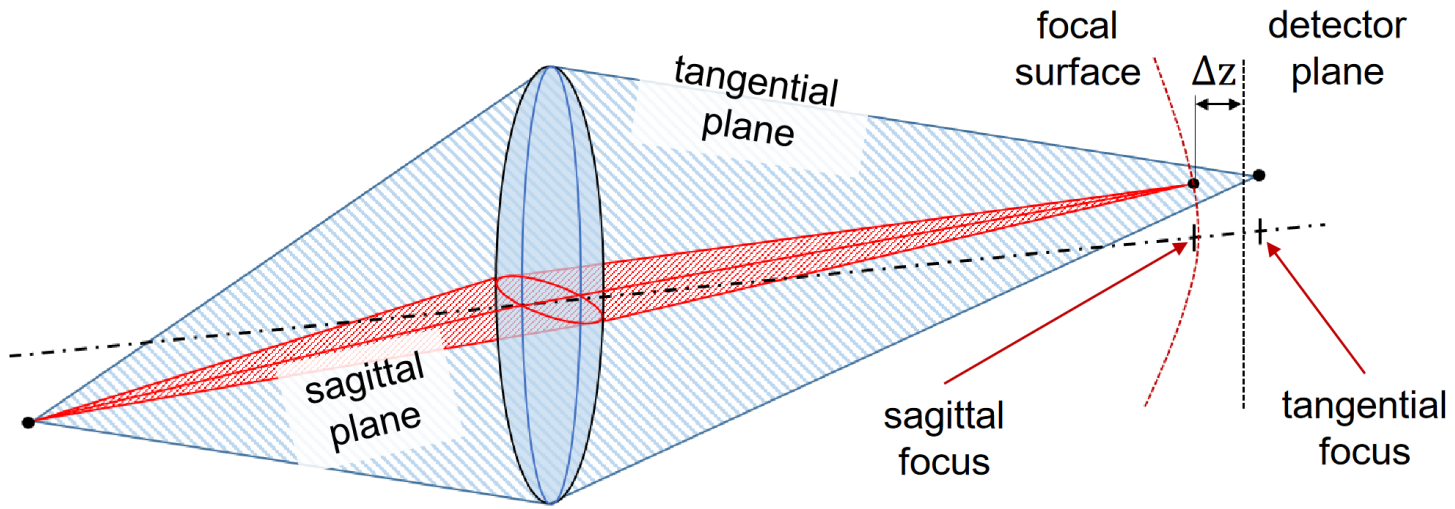
Finite Object Distance: Likewise, the distance between the source and the object needs to be set. It can either be infinite or a specific distance. In case of an infinite distance the evaluation will be performed on a range of angles, whereas for a specific distance a maximum object height needs to be defined.



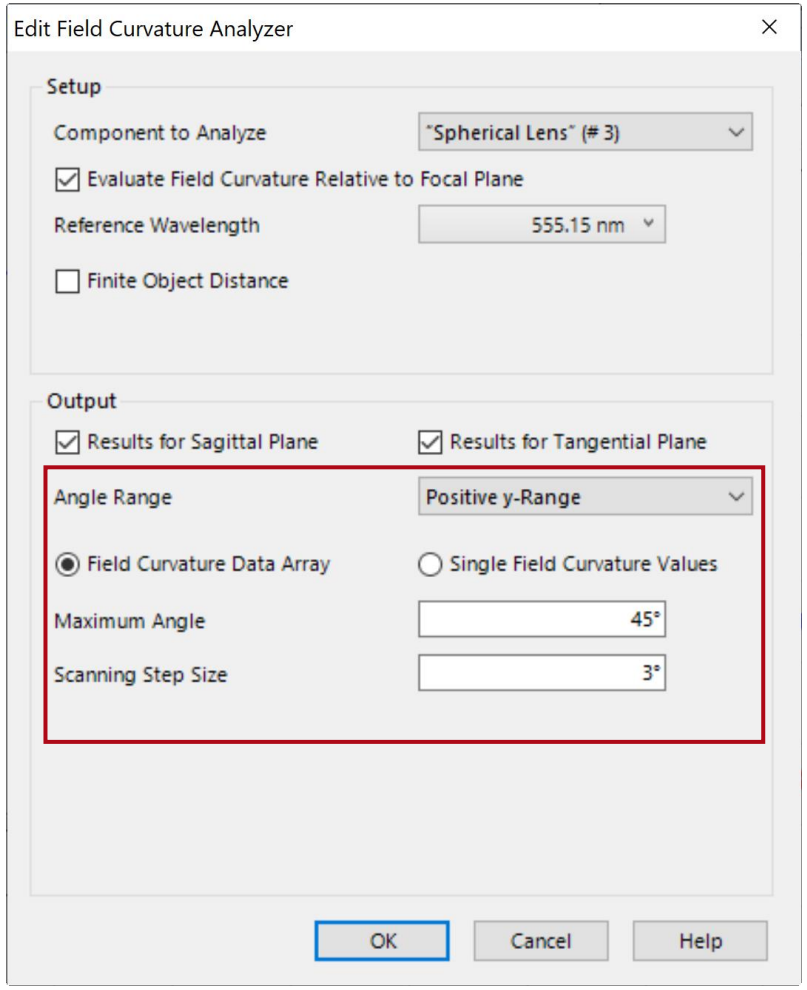
Tangential & Sagittal Plane

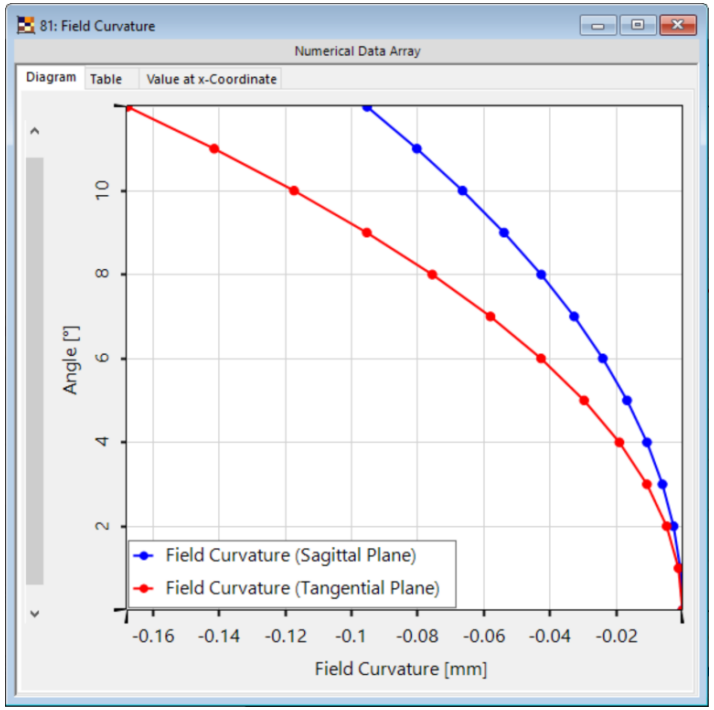


The evaluation can provide results for the tangential plane, the sagittal plane or both.

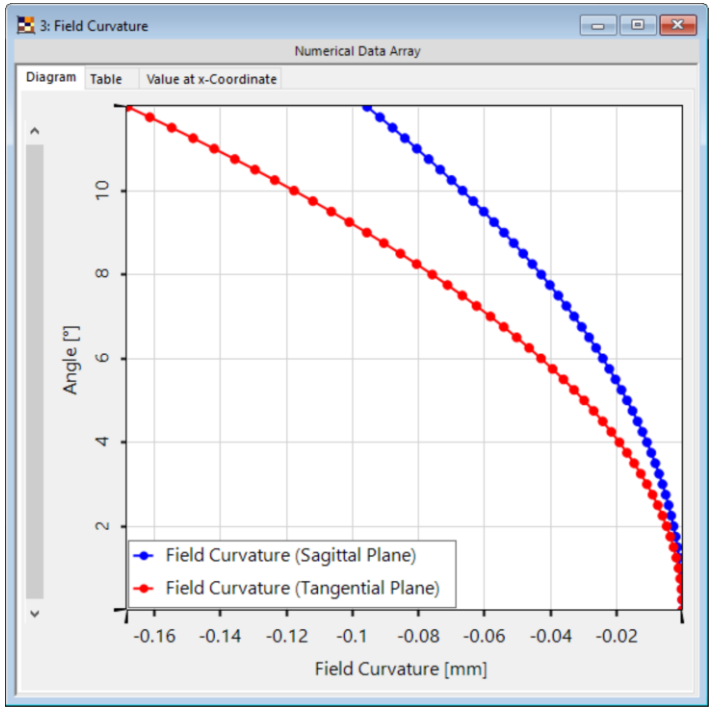


Sampling Parameters





Maximum Angle	12°
Scanning Step Size	1°

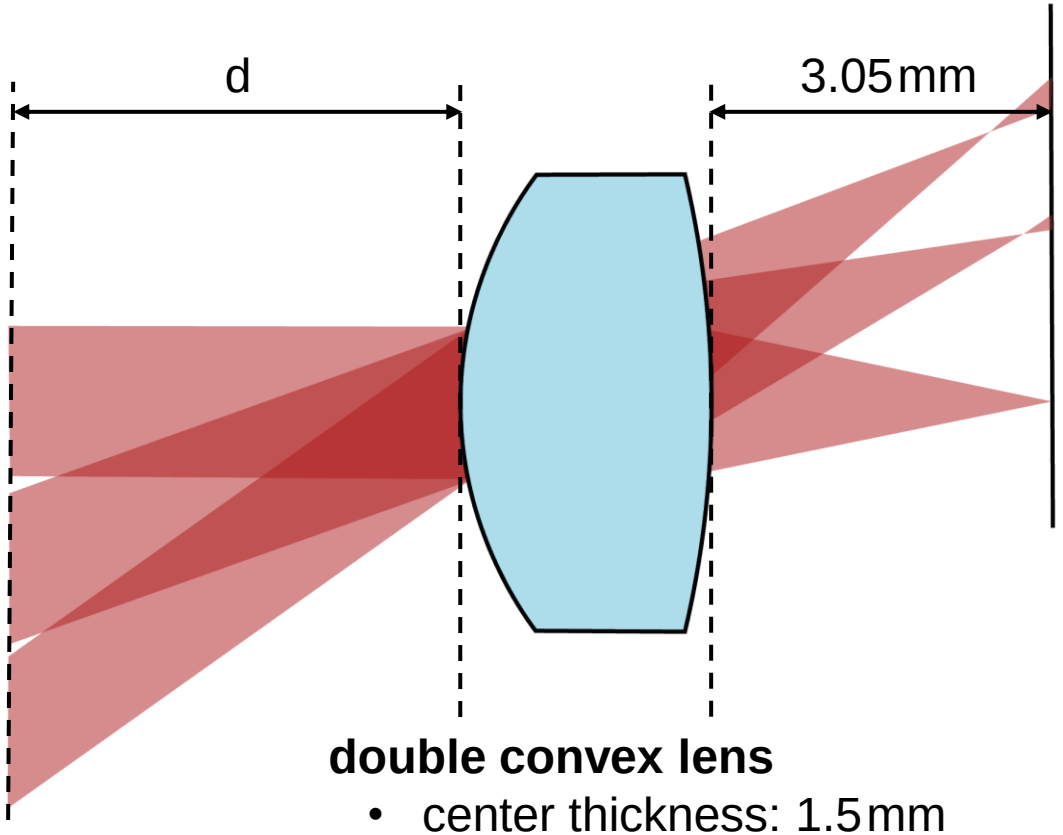


Maximum Angle	12°
Scanning Step Size	0.25°

Example: Field Curvature of a Spherical Lens

input field

- Incident angle/object height depending on case
- wavelengths:
  - 470.13 nm
  - 510.14 nm
  - 555.15 nm
  - 610.17 nm
  - 650.18 nm

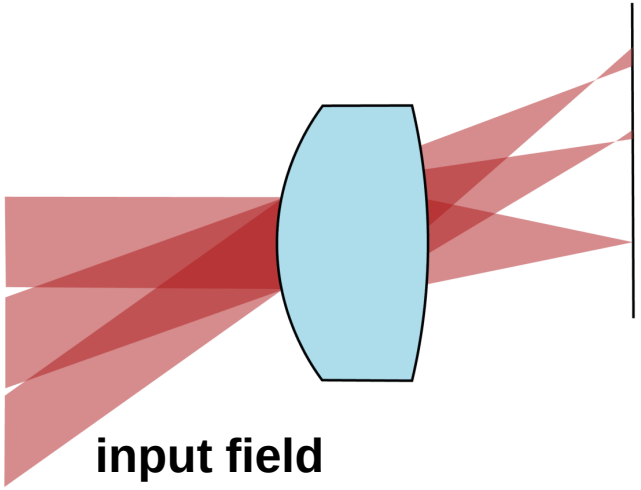


double convex lens

- center thickness: 1.5 mm
- r1: 4 mm
- r2: 3.5 mm
- material: N-BK7

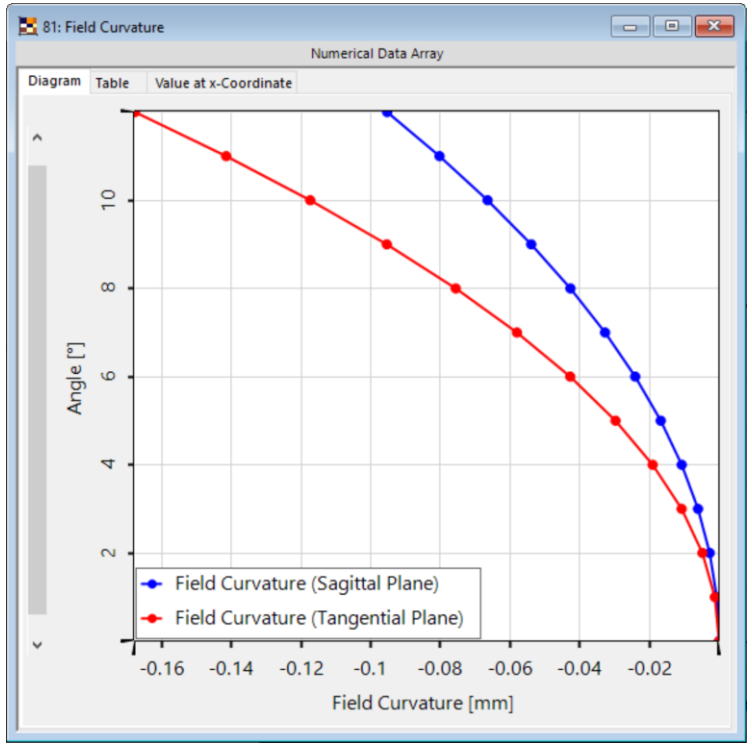
case 1: infinite distance d, 0°–12° angular range
case 2: d = 100 mm, 1 mm object height

Sagittal & Tangential Plane for Single Wavelength

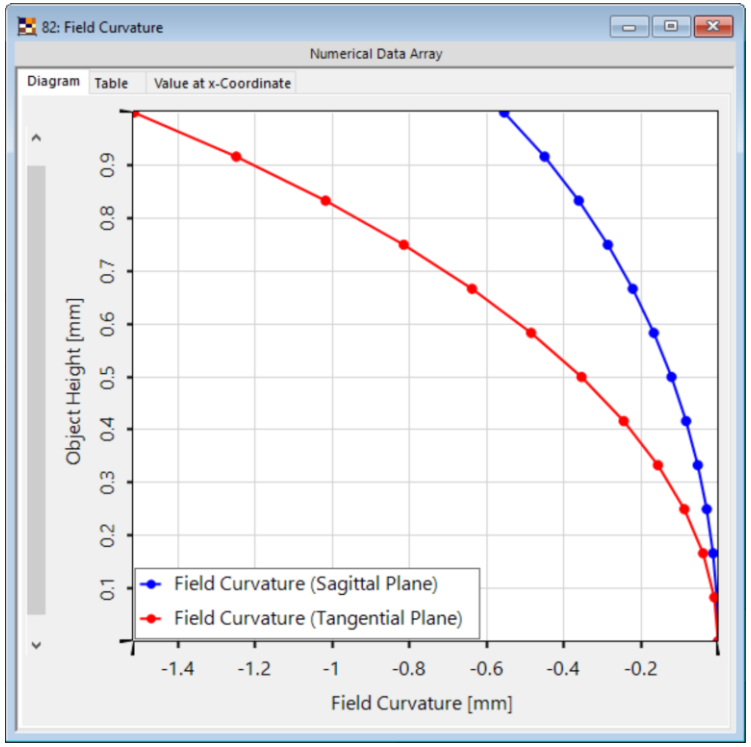


input field

- wavelengths:
  - 470.13 nm
  - 510.14 nm
  - **555.15 nm**
  - 610.17 nm
  - 650.18 nm

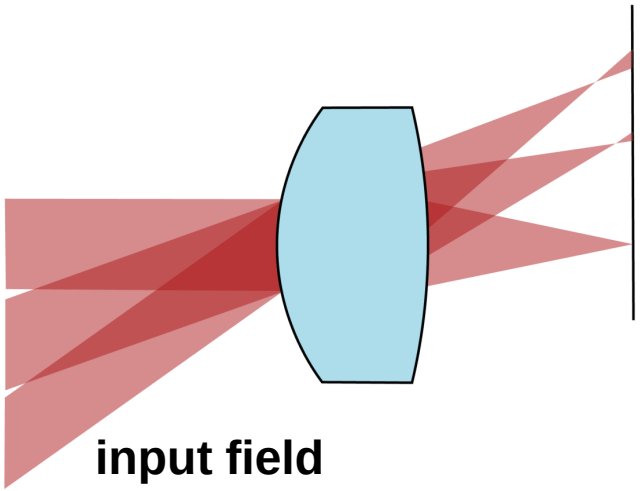


a) Field curvature vs. angle



b) Field curvature vs. height

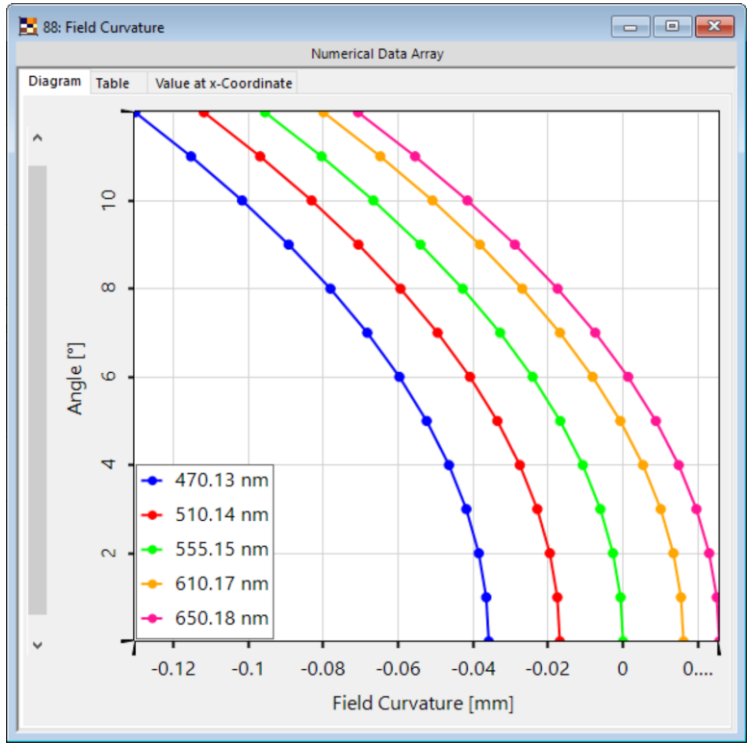
Investigation for Multiple Wavelengths



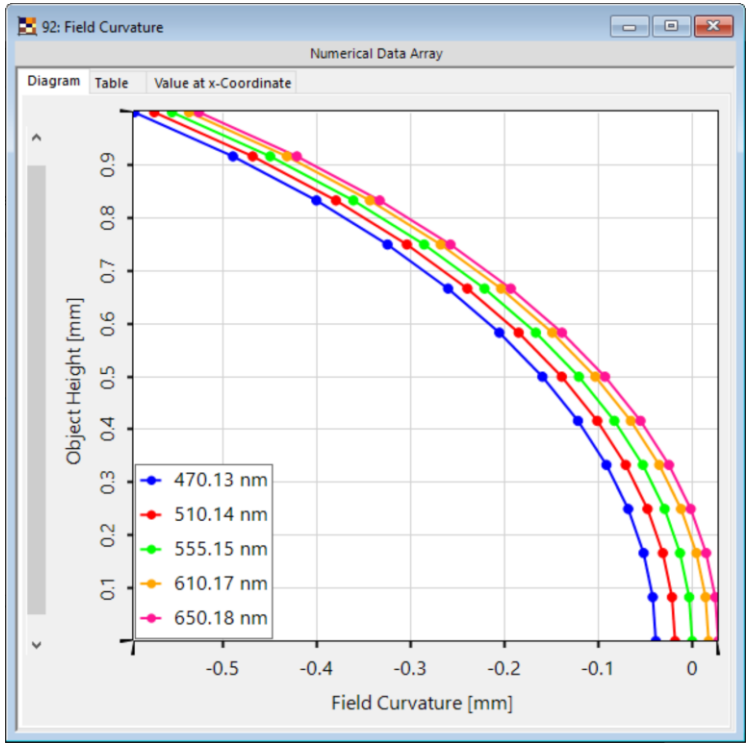
input field

- wavelengths:
  - **470.13 nm**
  - **510.14 nm**
  - **555.15 nm**
  - **610.17 nm**
  - **650.18 nm**

sagittal plane field curvature for multiple wavelengths:



a) Field curvature vs. angle



b) Field curvature vs. height

For more information about formatting VirtualLab Fusion documents, see:

How to Format VirtualLab Fusion Results

Document Information

title	Field Curvature Analyzer
document code	SWF.0002
document version	2.0
software edition	VirtualLab Fusion Basic
software version	2021.1 (Build 1.180)
category	Feature Use Case
further reading	• Distortion Analyzer • How to Format VirtualLab Fusion Results • Focus Investigation behind Aspherical Lens • Evaluation of an F-Theta Scanning Lens