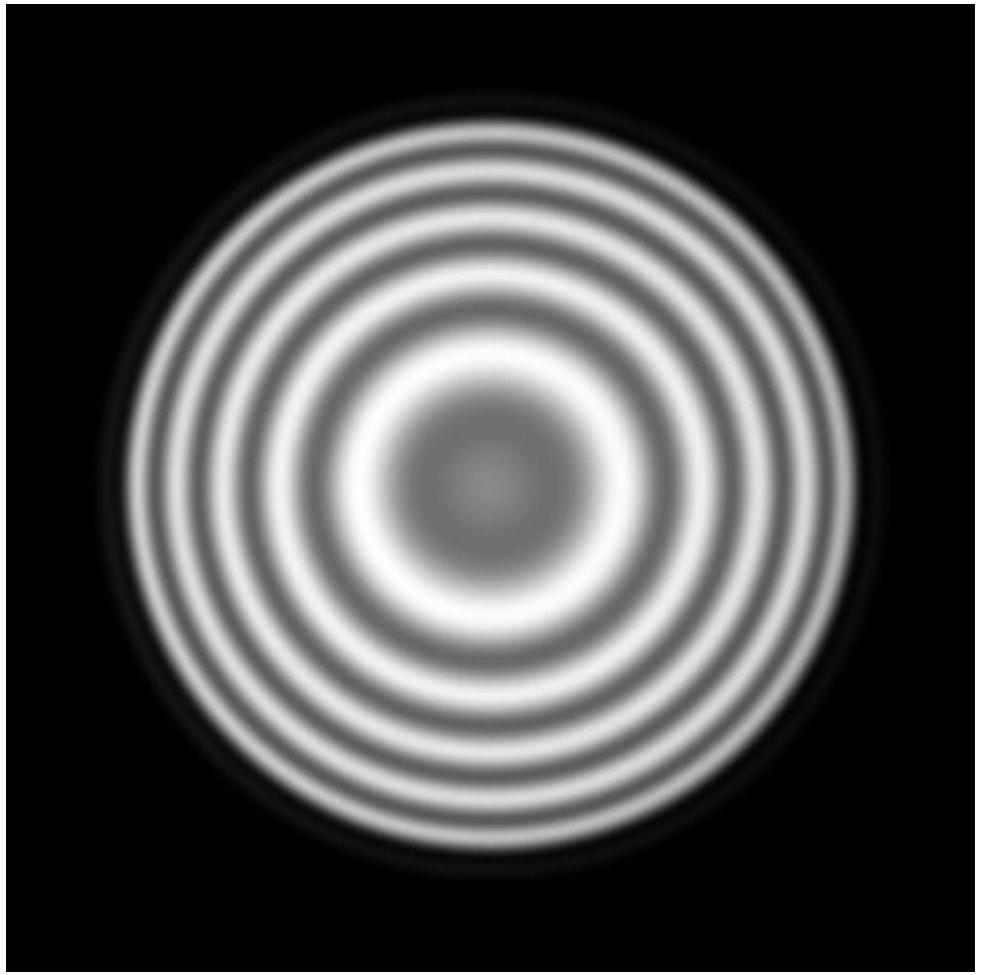
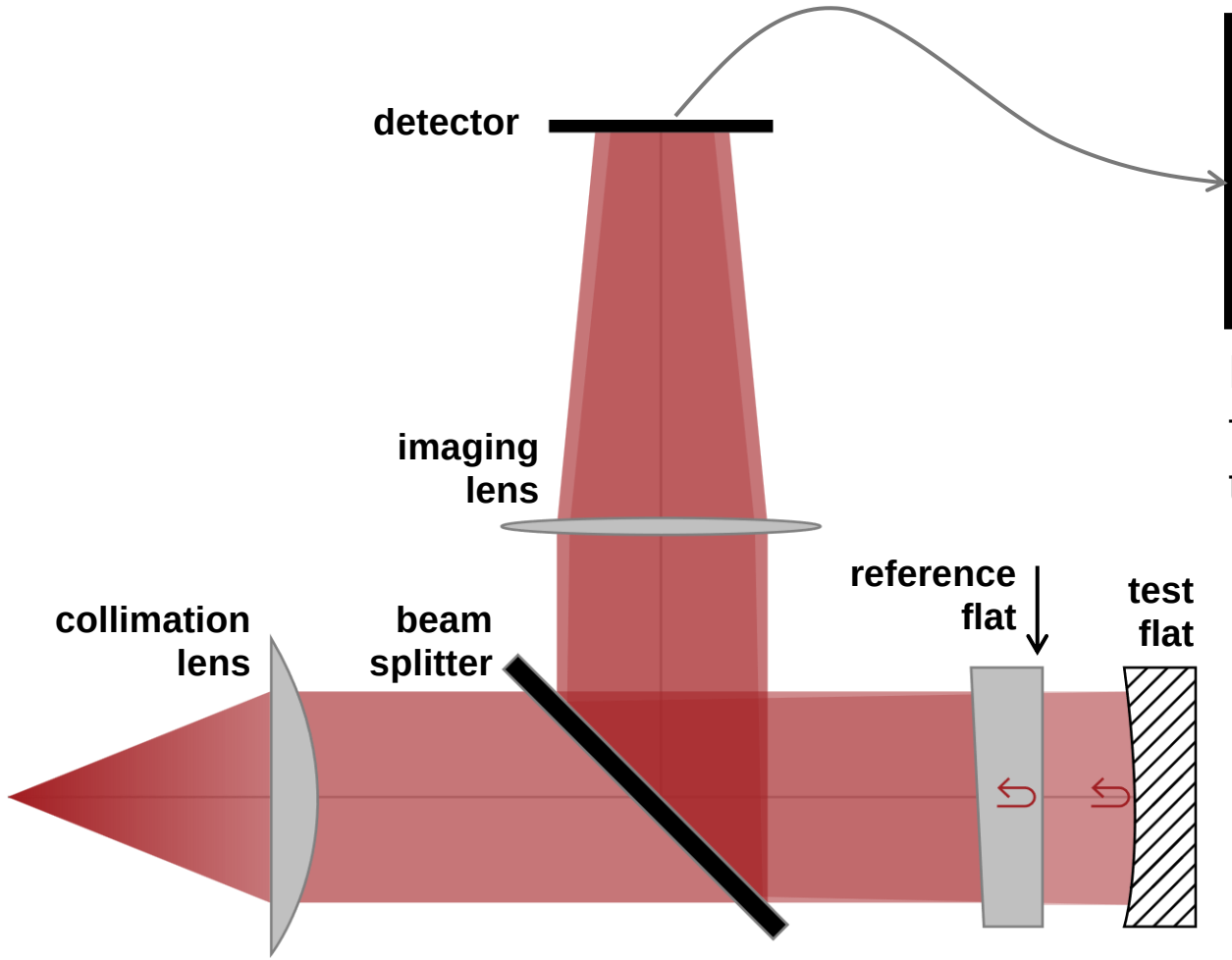
Fizeau Interferometer for Optical Testing

Abstract



Fizeau interferometers are a common type of optical metrology device in industry, and they are often used to test the quality of optical surfaces with high precision. With the help of the channel configuration in VirtualLab Fusion, we build up a Fizeau interferometer, and use it for testing different optical surfaces e.g. cylindrical and spherical ones. It is shown that the resulting interference fringes are sensitive to the surface profile.

Modeling Task

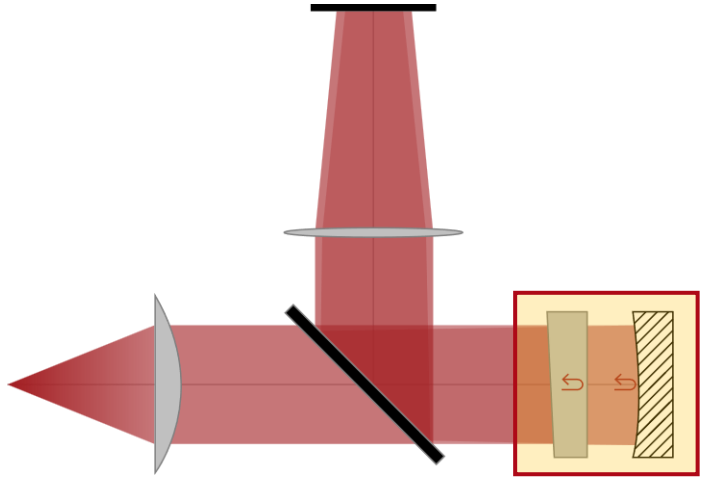


How does the interference fringe change for different test flats?

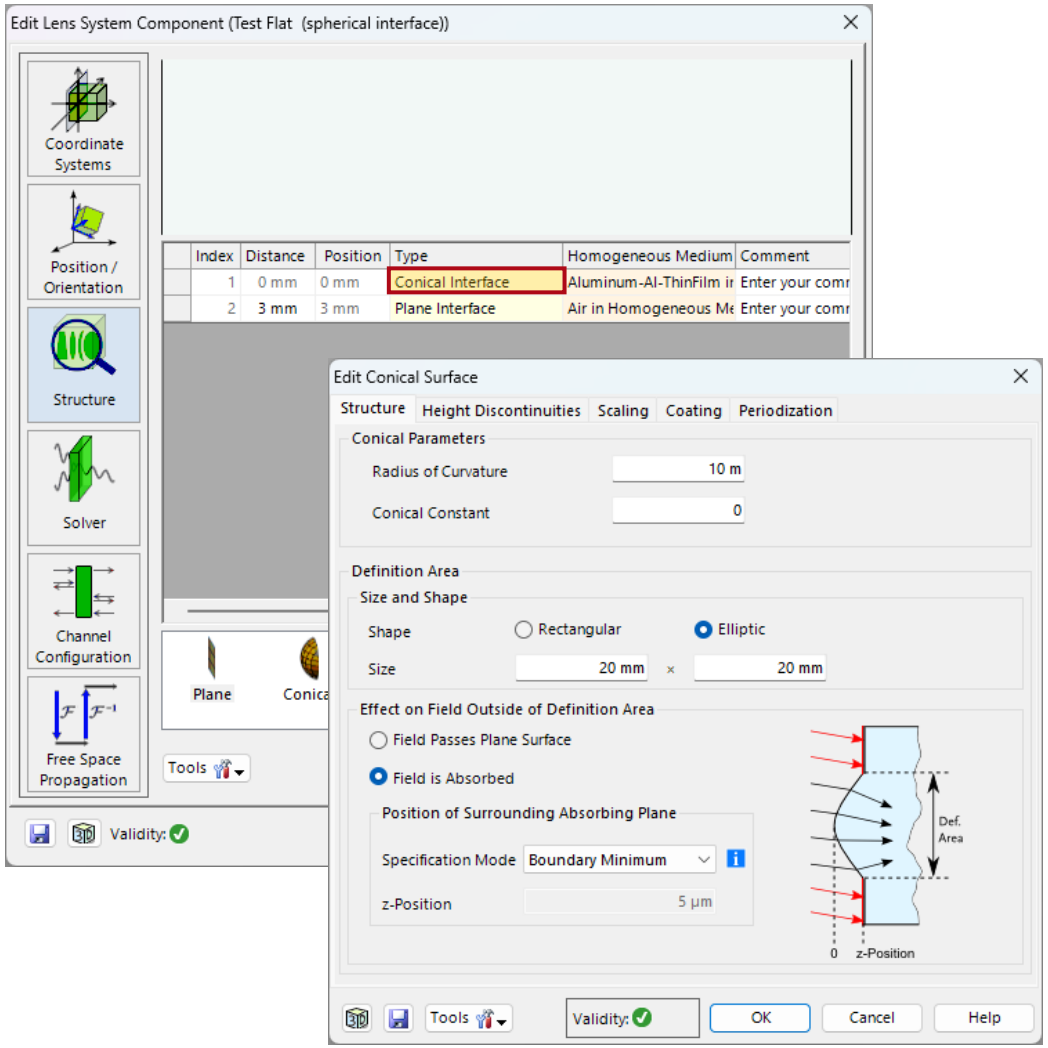
spherical wave

- wavelength 532 nm
- half-opening angle 26.6°

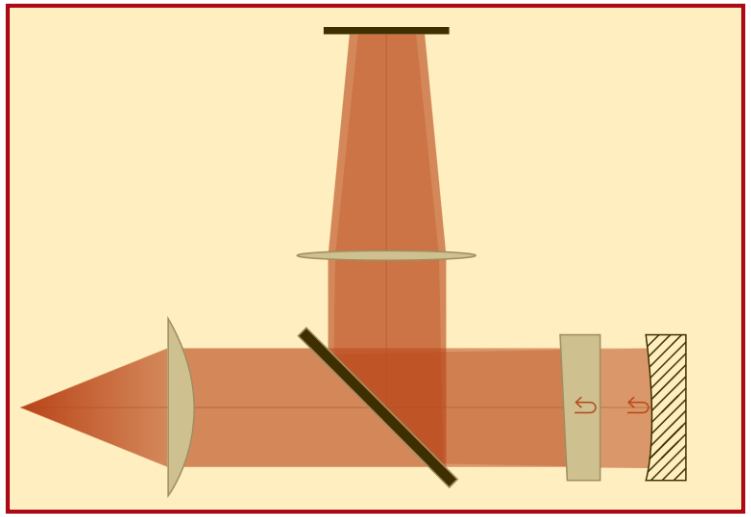
Test Surfaces

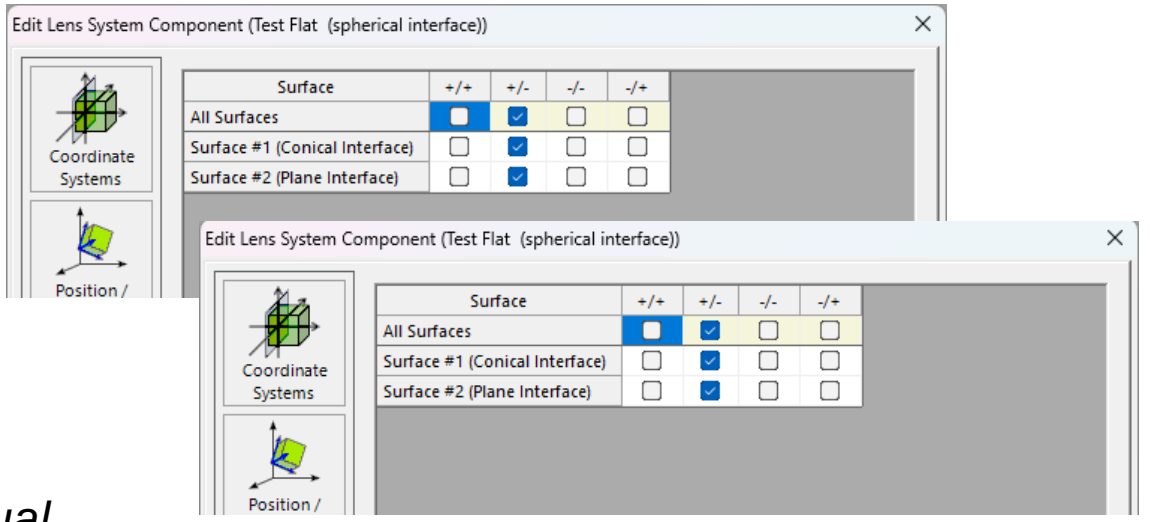


The *Lens System Component* allows for the easy definition of a component consisting of an alternating sequence of smooth surfaces and homogeneous, isotropic media. In terms of both the interfaces and the materials, it is possible to choose ready-made entries from the in-built catalogs or to customize your own for maximum flexibility. In this use case we use *Conical*, *Cylindrical* and *Plane Interfaces* to represent the tested surfaces.



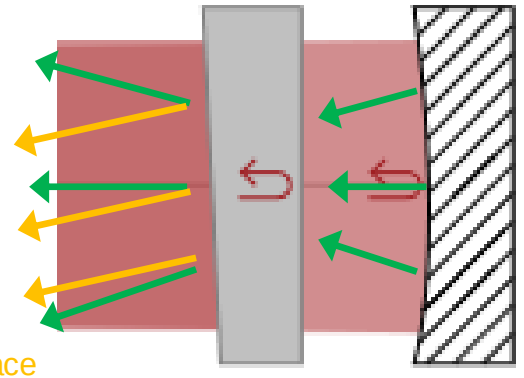
Non-Sequential Tracing





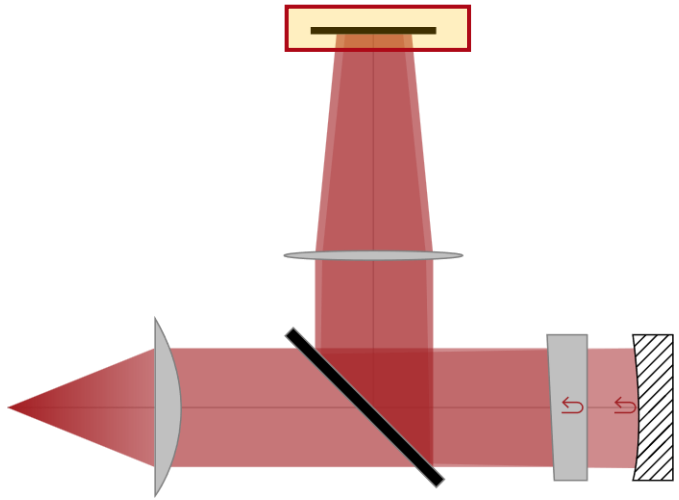
With the channel configuration mode toggle set to *Manual Configuration*, the user can specify, for each surface in the system, which channels to open for the simulation. When the simulation is run, a preliminary analysis of the active light paths will be performed (by the so-called *Light Path Finder*). The field will then be traced along these light paths by the engine, to the detectors present in the system.

Channel Setting for Non-Sequential Tracing



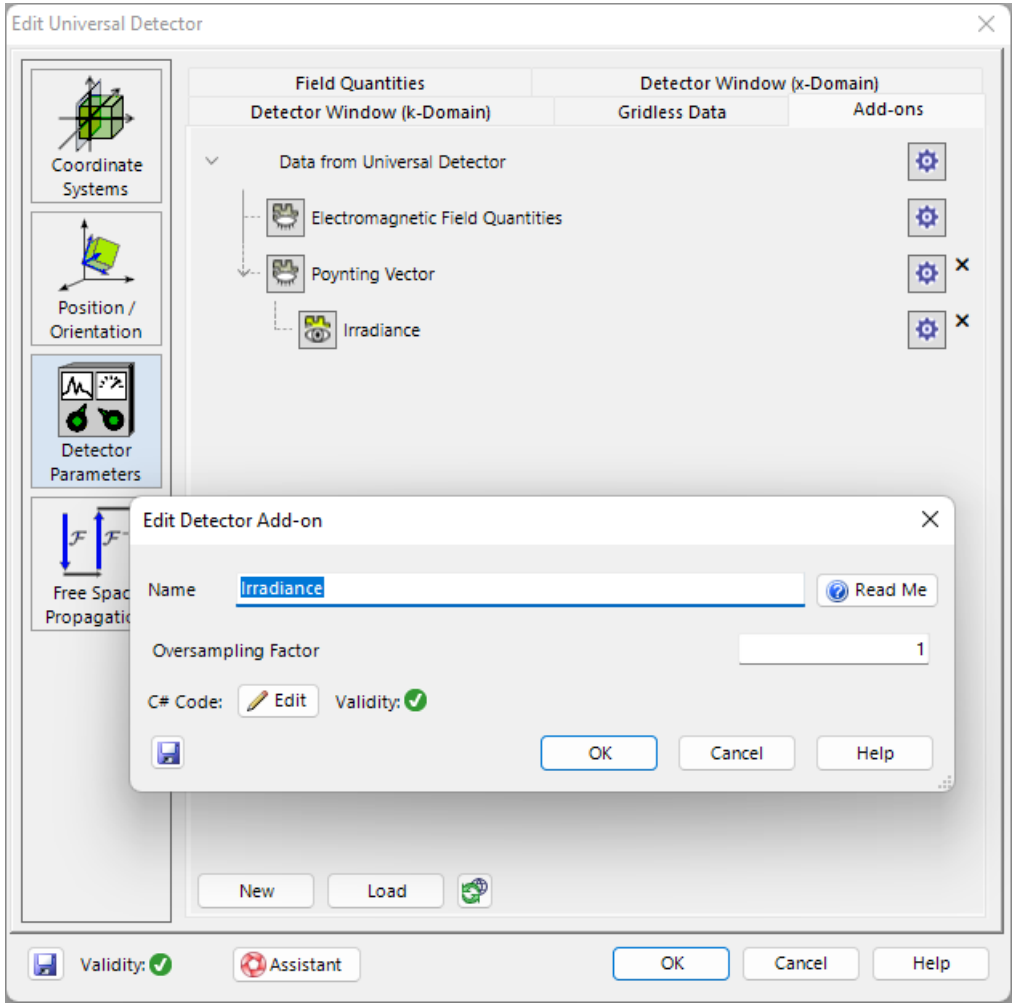
reflection on first surface
reflection on second surface

Universal Detector & Detector Add-Ons

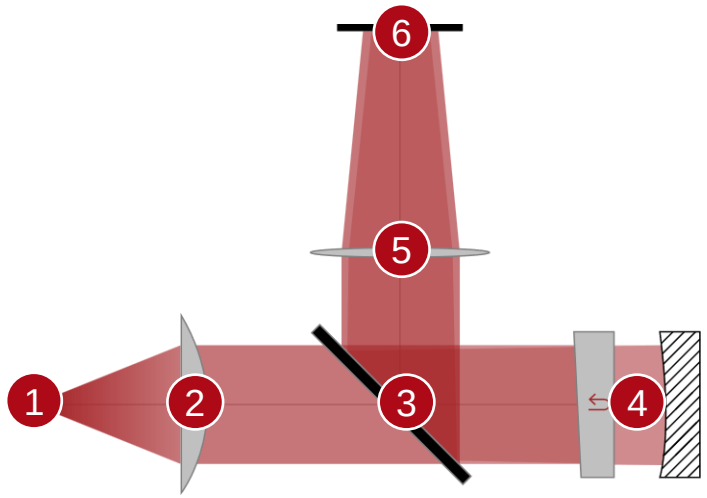


The *Universal Detector* allows the evaluation of the impinging field and the calculation of various physical quantities through so-called *Add-ons*. One of the provided *Add-ons* provides as a result the irradiance in space domain. For more information, see:

Universal Detector

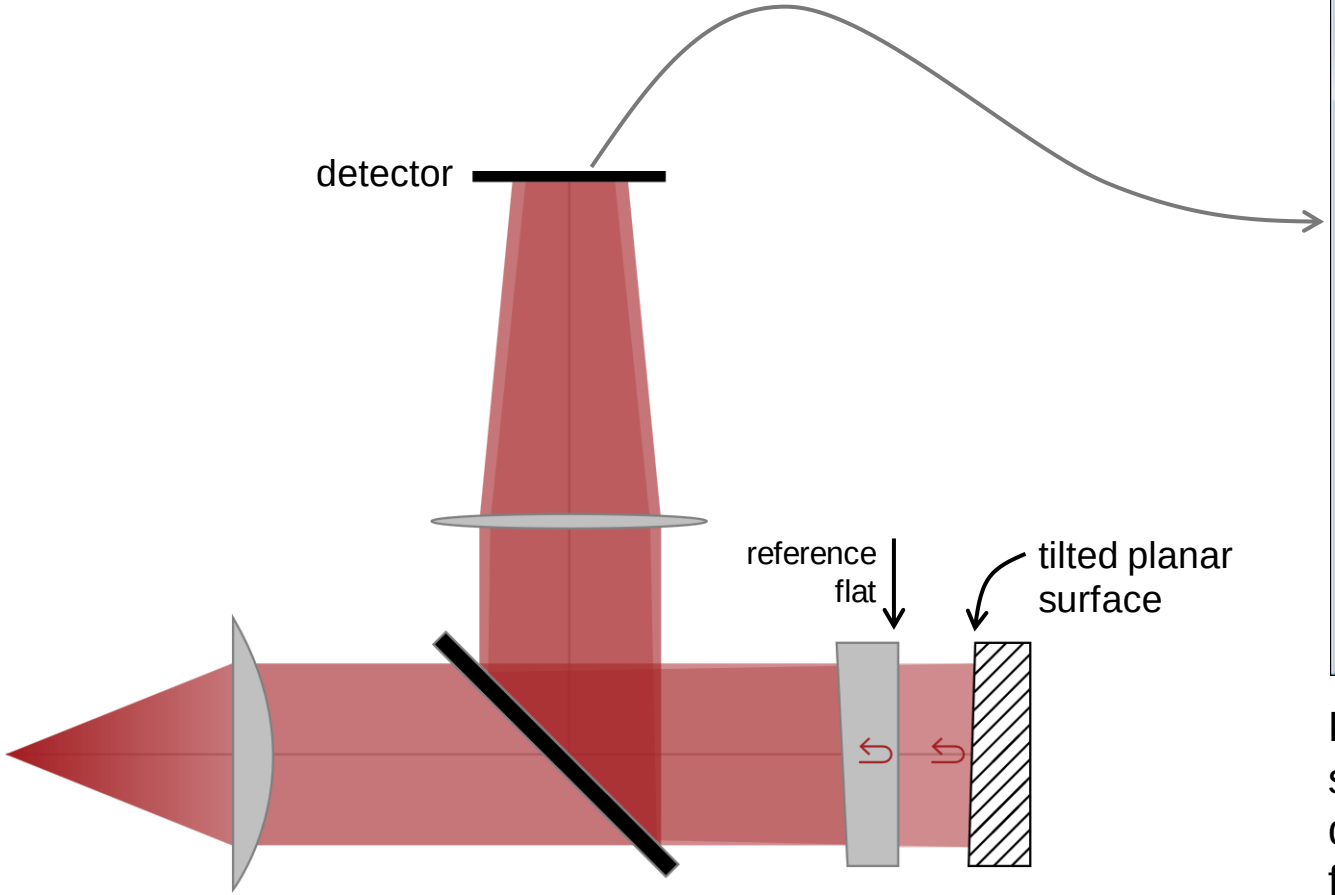


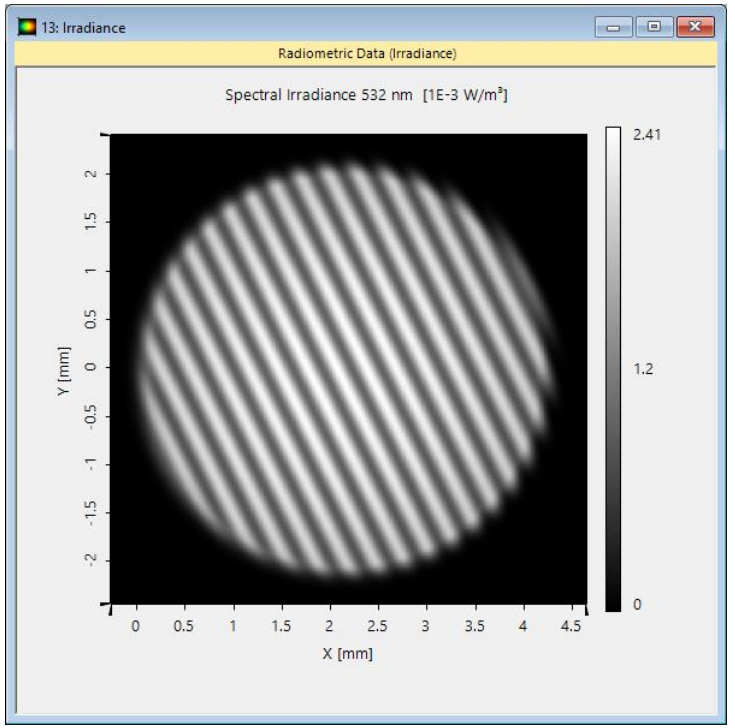
Summary – Components...



… of Optical System	… in VirtualLab Fusion	Model/Solver/Detected Magnitude
1. source	*Spherical Wave*	point source with aperture
2. collimation lens	*Ideal Lens Component*	transmission function
3. beam splitter	*Ideal Beam Splitter*	transmission function
4. reference/test surface	*Lens System Component*	Local Plane Interface Approximation (LPIA)
5. imaging lens	*Ideal Lens Component*	transmission function
6. detector	*Universal Detector* with *Irradiance Add-on*	irradiance

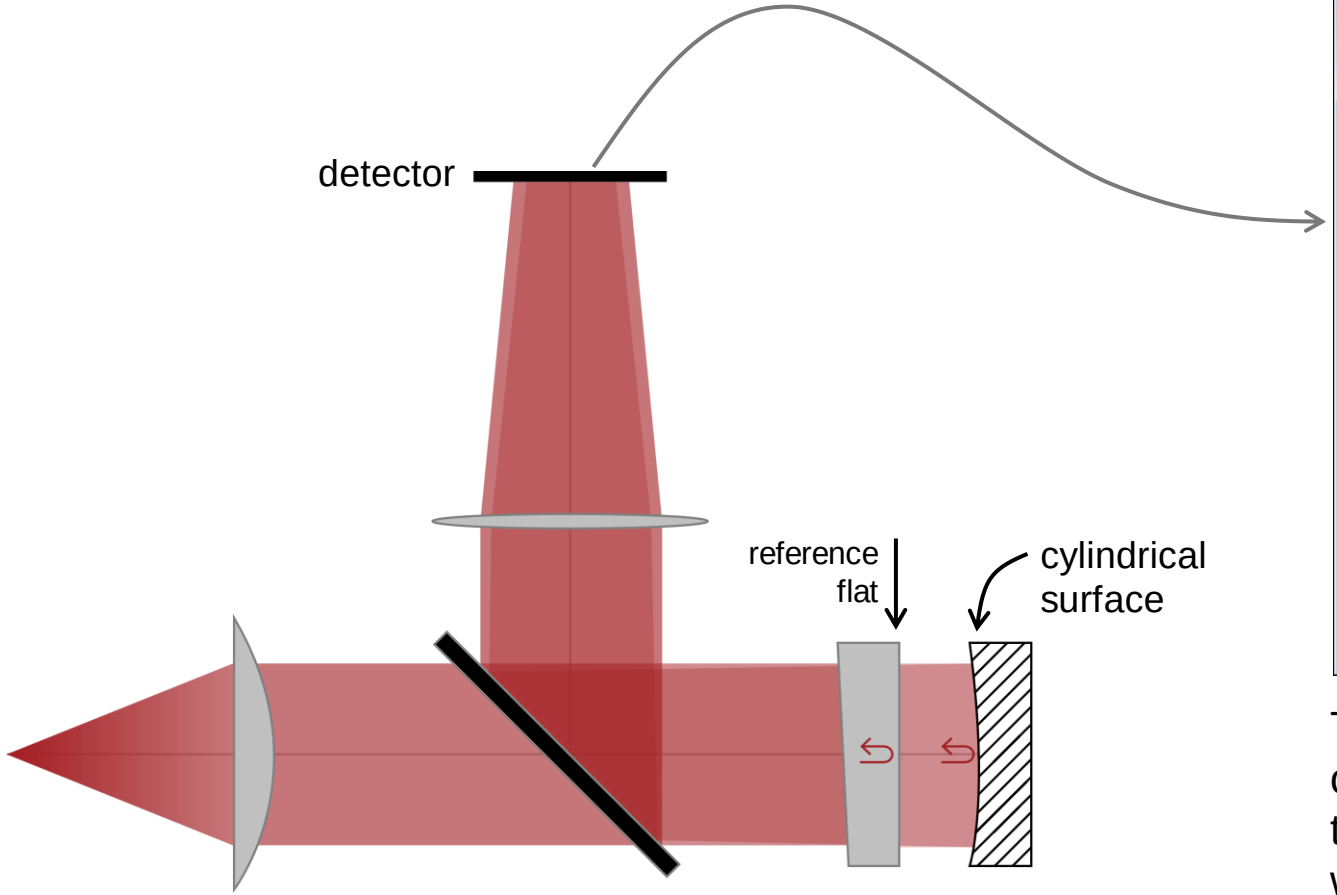
Tilted Planar Surface under Observation

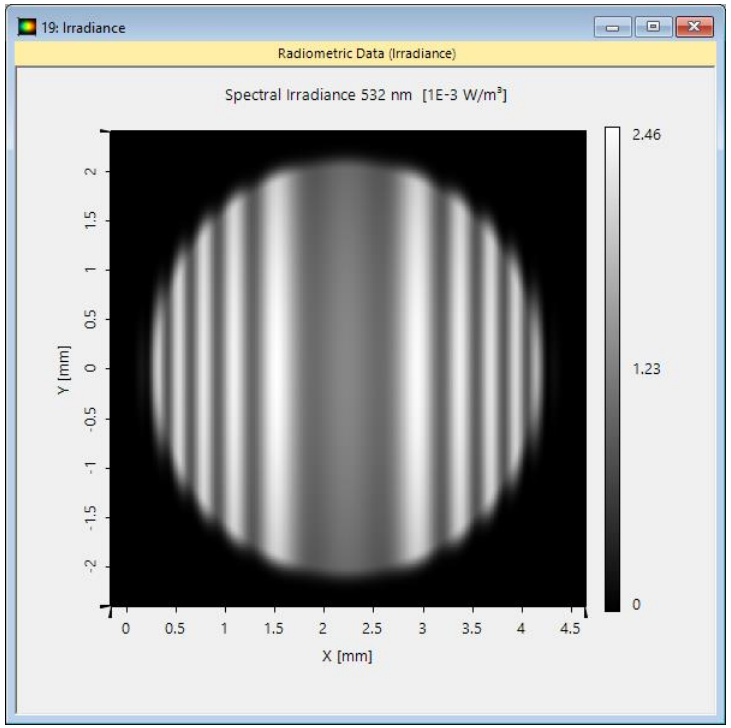




Reflections from the test planar surface are still plane waves, but with slightly different direction, therefore leading to parallel striped fringes.

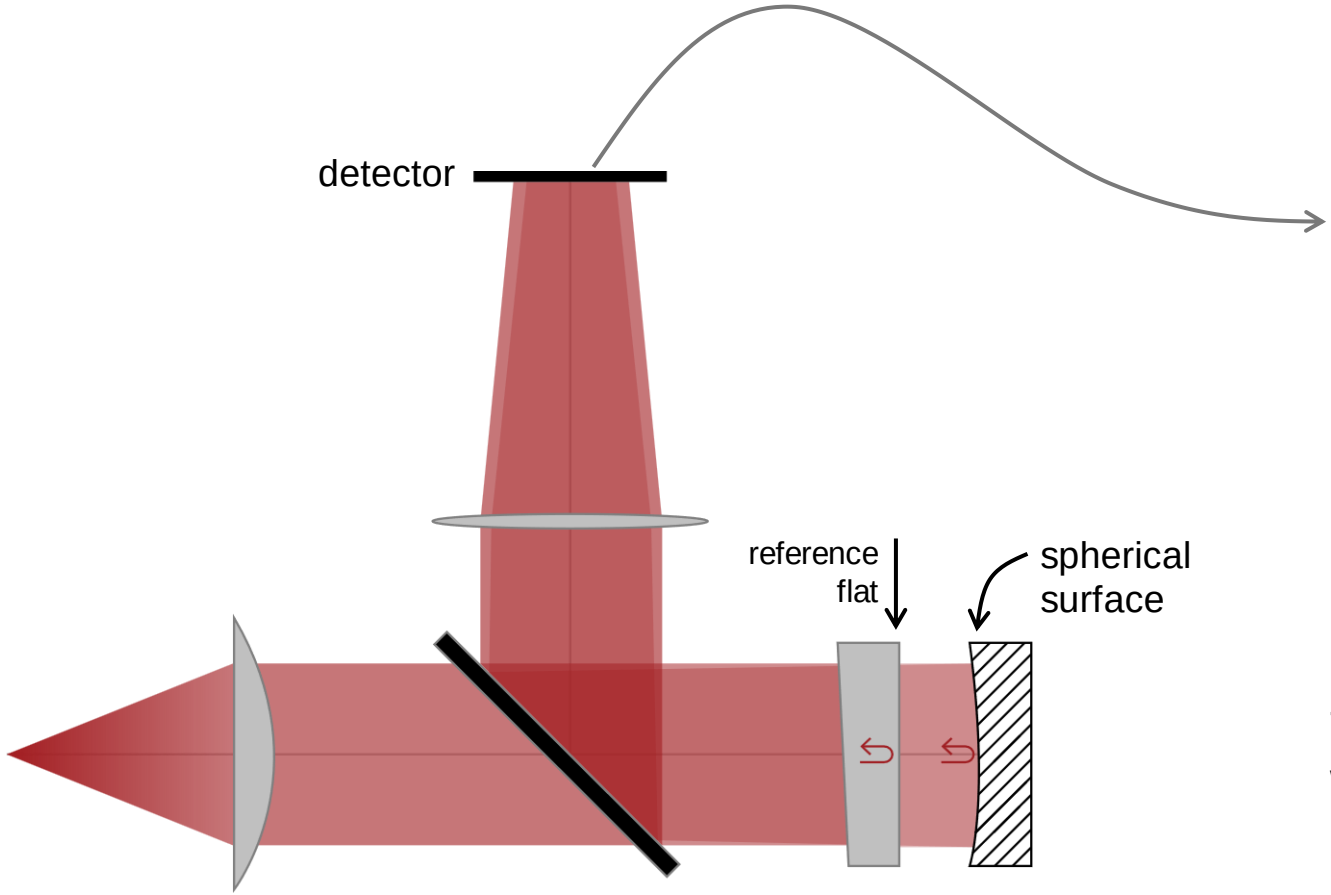
Cylindrical Surface under Observation

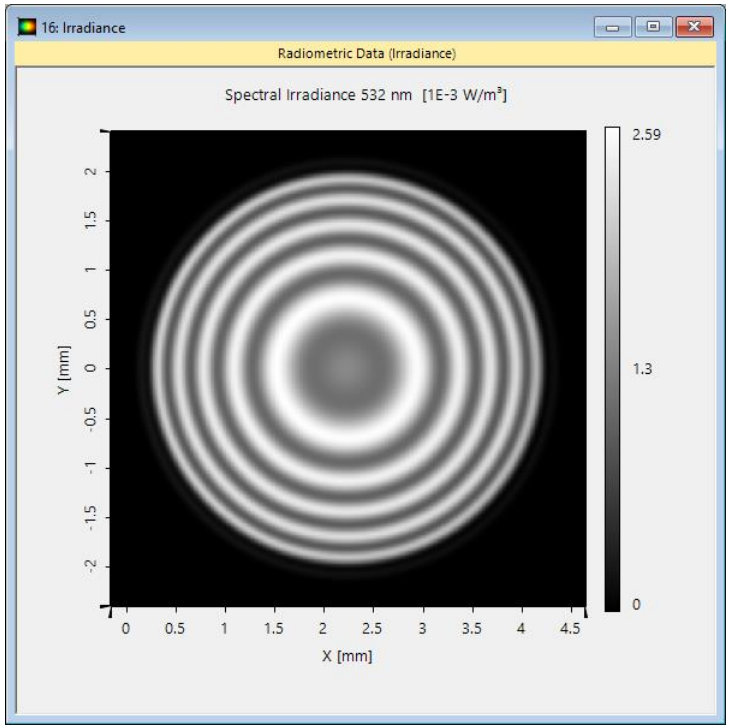




The reflected wavefront from the test cylindrical surface gets curved in one direction, therefore leading to parallel striped fringes but with varying pitch.

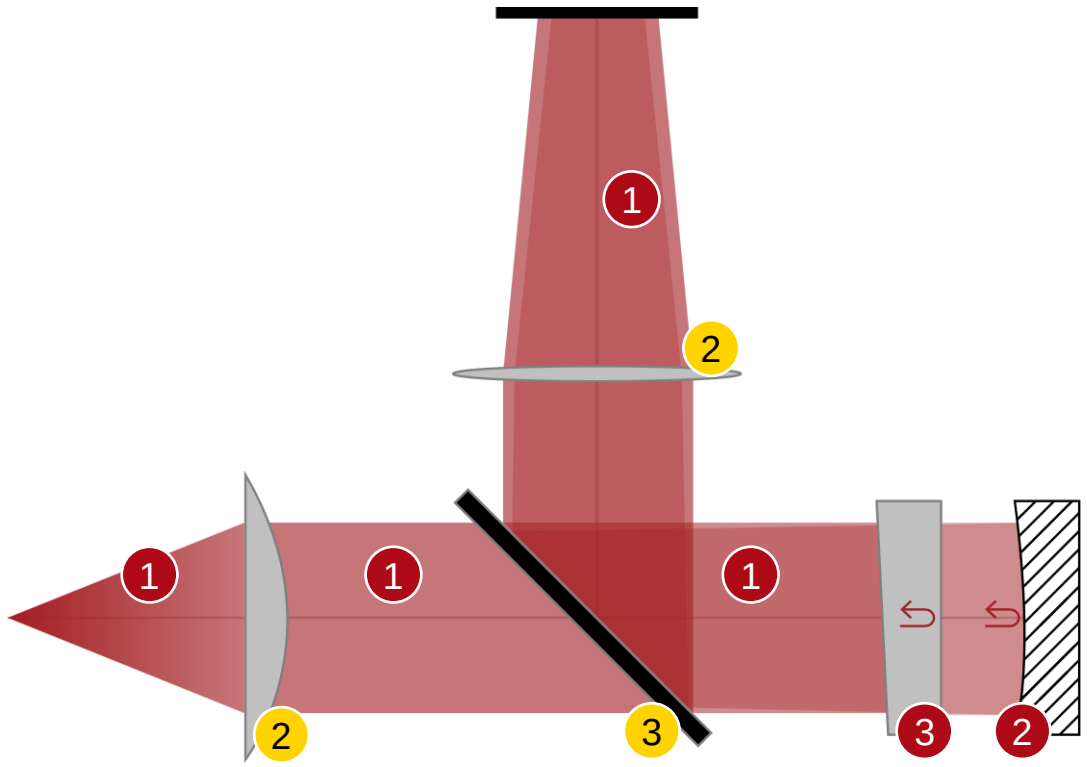
Spherical Surface under Observation

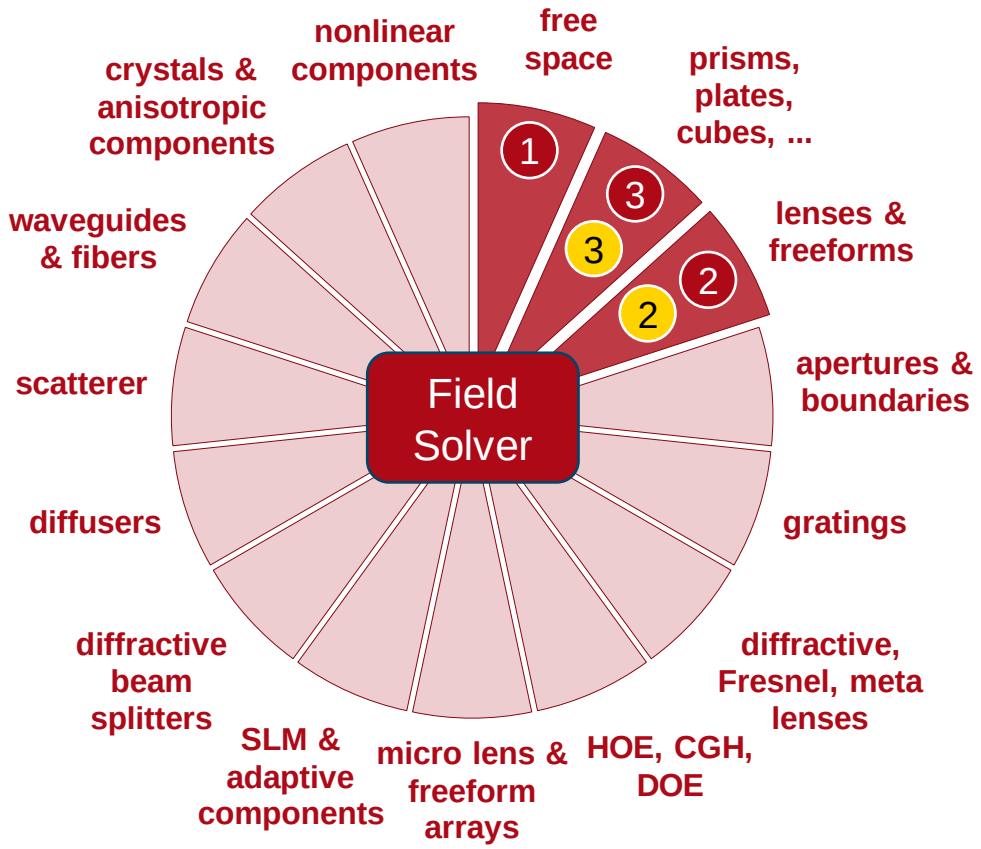




The spherical surface changes the reflected wavefront radially, thus the interference fringes appear as concentric rings.

VirtualLab Fusion Technologies





Document Information

title	Fizeau Interferometer for Optical Testing
document code	IFO.0009
document version	2.1
software edition	VirtualLab Fusion Basic
software version	2023.1 (Build 1.556)
category	Application Use Case
further reading	• Universal Detector • Channel Setting for Non-Sequential Tracing • Laser-Based Michelson Interferometer and Interference Fringe Exploration • Mach-Zehnder Interferometer