Observation of Gouy Phase Shift in a Mach-Zehnder Interferometer
Abstract

Convergent beams travelling through their focus from minus infinity to plus infinity not only experience the accumulation of the phase corresponding to the traversed optical path length, but also accrue a constant $\pi$ phase term, known as the Gouy phase shift, discovered by the scientist of the same name at the end of the nineteenth century. When such a beam interferes with a collimated one, the Gouy phase shift is revealed when the interference patterns generated on both sides of the focus are compared: the ring patterns are negatives of each other. This can be observed in a Mach-Zehnder.
Modeling Task

Gaussian beam
- waist radius 1 mm
- wavelength 680 nm

beam splitter

beam combiner

BK7

Interference (in front of focus)

Interference (behind focus)
Interference Pattern

By observing the center of the fringes, the change from constructive to destructive interference implies a $\pi$ -shift in the phase of the spherical wave.
Peek into VirtualLab Fusion

ray tracing through Mach-Zehnder interferometer

visualization of interference fringes at selected planes

in front of focus

behind focus
Workflow in VirtualLab Fusion

- Set up input field
  - Basic Source Models [Tutorial Video]
- Construct real components using surfaces
- Define position and orientation of components
  - LPD II: Position and Orientation [Tutorial Video]
- Set channels properly for non-sequential tracing
  - Channel Setting for Non-Sequential Tracing [Use Case]
VirtualLab Fusion Technologies

Field Solver

1. Crystals & anisotropic components
2. Waveguides & fibers
3. Scatterer
4. Diffusers
5. Diffractive beam splitters
6. SLM & adaptive freeform arrays
7. Nonlinear components
8. Micro lens & freeform arrays
9. Optical free space
10. Prisms, plates, cubes, ...
11. Lenses & freeforms
12. Apertures & boundaries
13. Gratings
14. Diffractive, Fresnel, meta lenses
15. HOE, CGH, DOE
16. Micro lens & freeform arrays

# idealized component
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<th>Observation of Gouy Phase Shift in a Mach-Zehnder Interferometer</th>
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| further reading | - [Mach-Zehnder Interferometer](#)  
- [Generation of Spatially Varying Polarization by Interference with Polarized Light](#) |