

Scenario 08.01 Eigenmode computation of laser resonators

This scenario demonstrates how eigenmodes and eigenvalues of laser resonators can be computed. Resonators with idealized components (mirrors, lenses) and real components with index modulated media are considered.

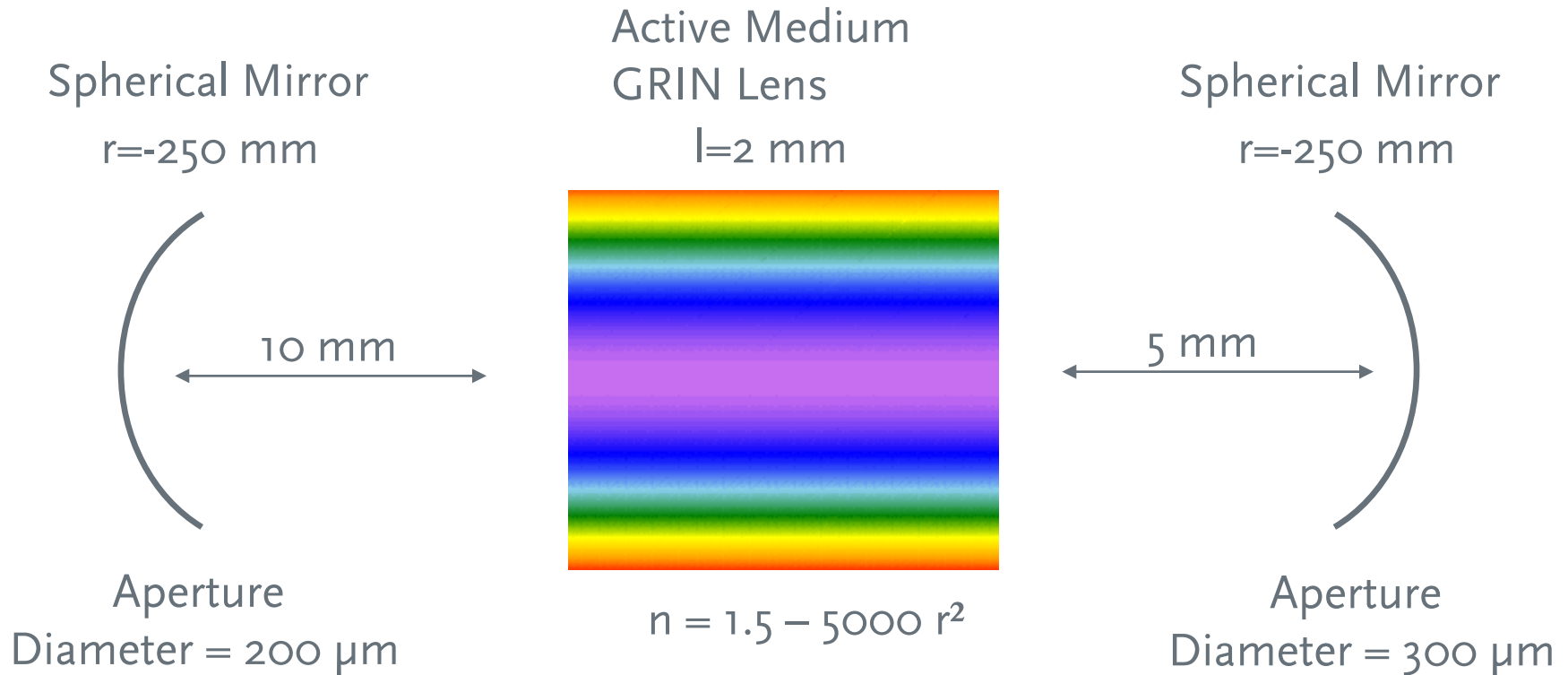
Keywords: laser resonator, eigenmodes, eigenvalues

Required Toolboxes: Laser ResonatorToolbox

Related Tutorials: FS.009

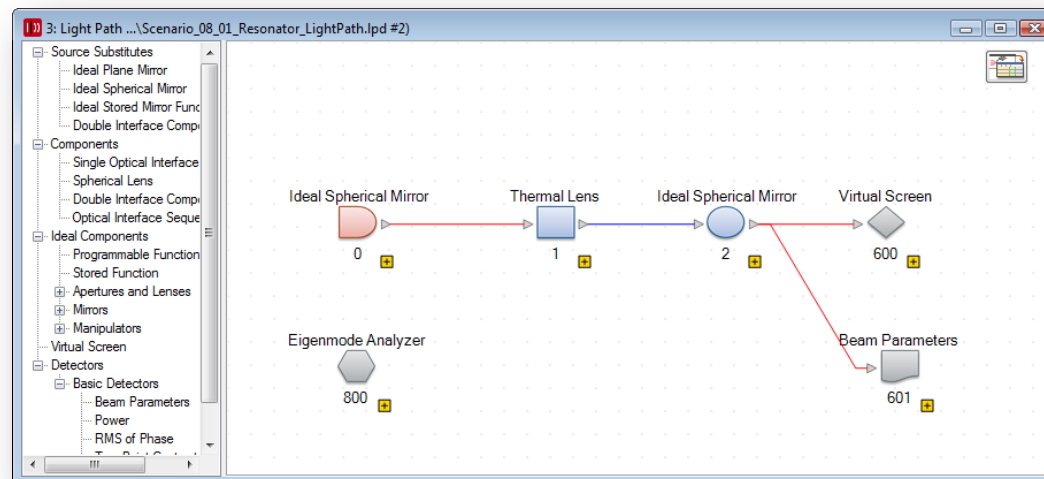


Modeling Task



Modeling Task

- Eigenmodes, including higher modes are to be computed
- Comparison between Fox-Li and Arnoldi algorithm
- Beam parameters (radius, M^2) are computed

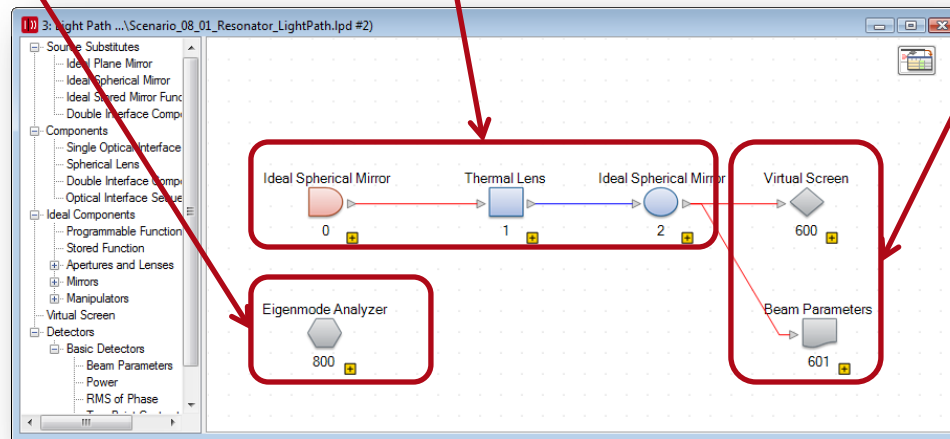


Light Path of Resonators

Eigenmode
Analyzer

Resonator
System

Detectors for interior
Modes



Eigenmode Computation

4: O:\SCM\...\Scenario_08_01_Results_IterationDocument_Arnoldi.iter

Start

Iteration	0	1	2	3	4	5	6	7
Eigenmode	Harmonic Field	Harmonic Field	Harmonic Field	Harmonic Field	Harmonic Field	Harmonic Field	Harmonic Field	Harmonic Field
Eigenvalue, 1st	0.999999975	0.617211695	0.894842554	0.909121092	0.919245196	0.919571607	0.91957232	0.91957232
Eigenvalue, 2nd		0.617211695	0.797996674	0.814960042	0.845940539	0.848760334	0.848755006	0.848755006
Deviation, absolute (rescaled)	0	0	3.06344437E-09	1.64026348E-10	1.40111948E-10	8.91072726E-12	3.38433711E-14	4.6001E-15
Deviation, relative (rescaled)	0	0	0.195024929	0.0338518837	0.0220254851	0.00153345849	5.3814747E-06	7.2783E-07
Losses	5.02876019E-06 %	61.9049724 %	19.9256803 %	17.349884 %	15.498827 %	15.438806 %	15.4386748 %	15.4386748 %
Radius X	100 μm	100 μm	64.9856951 μm	63.1067274 μm	61.6980961 μm	61.6952249 μm	61.6942291 μm	61.6942291 μm
Radius Y	100 μm	100 μm	64.9856965 μm	63.106727 μm	61.6980994 μm	61.695223 μm	61.6942332 μm	61.6942332 μm

Output from Selection

Combined Output as Harmonic Fields Sets

Settings for Sequence of ...

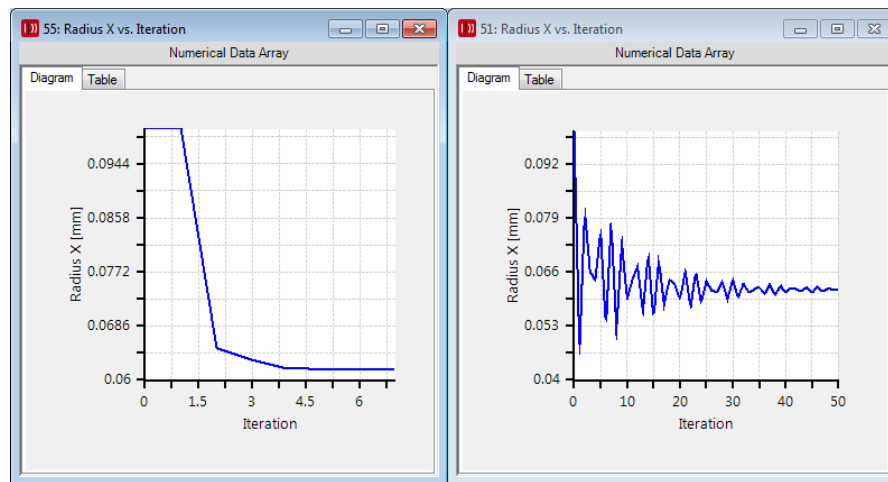
1D Fields 2D Fields

Show LPD

Logging of eigenvalues, losses, radius and deviation during iteration. Values refer to reference plane.

Simulation Results: Convergence

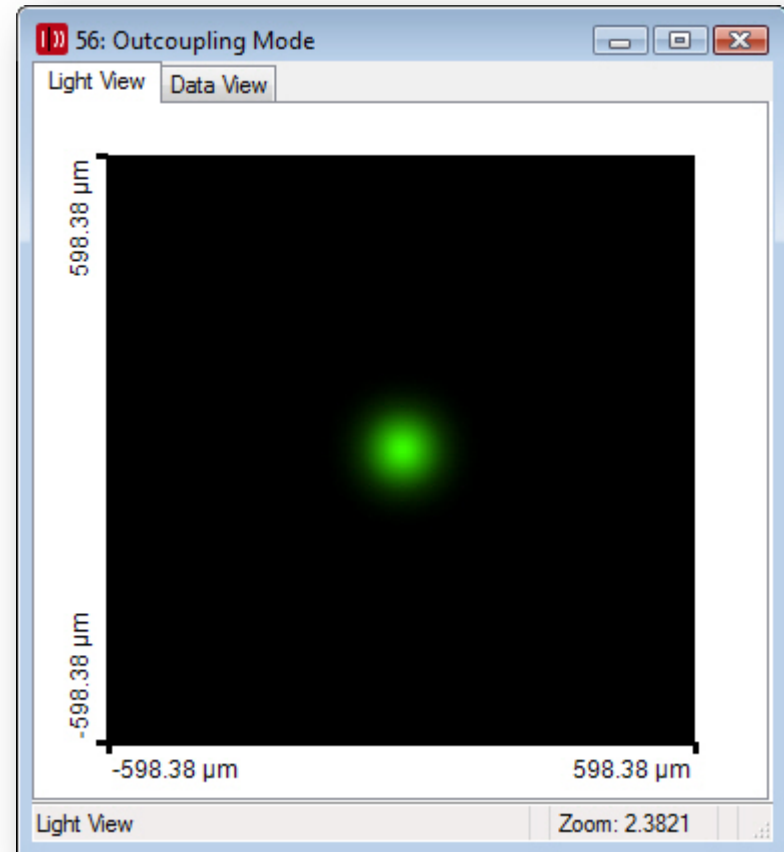
- Eigenmode analysis by Arnoldi and Fox-Li algorithm
- Fox-Li (right) monitors the laser oscillation
- Arnoldi (left) requires less iterations until convergence.



Beam radius over number of iterations.

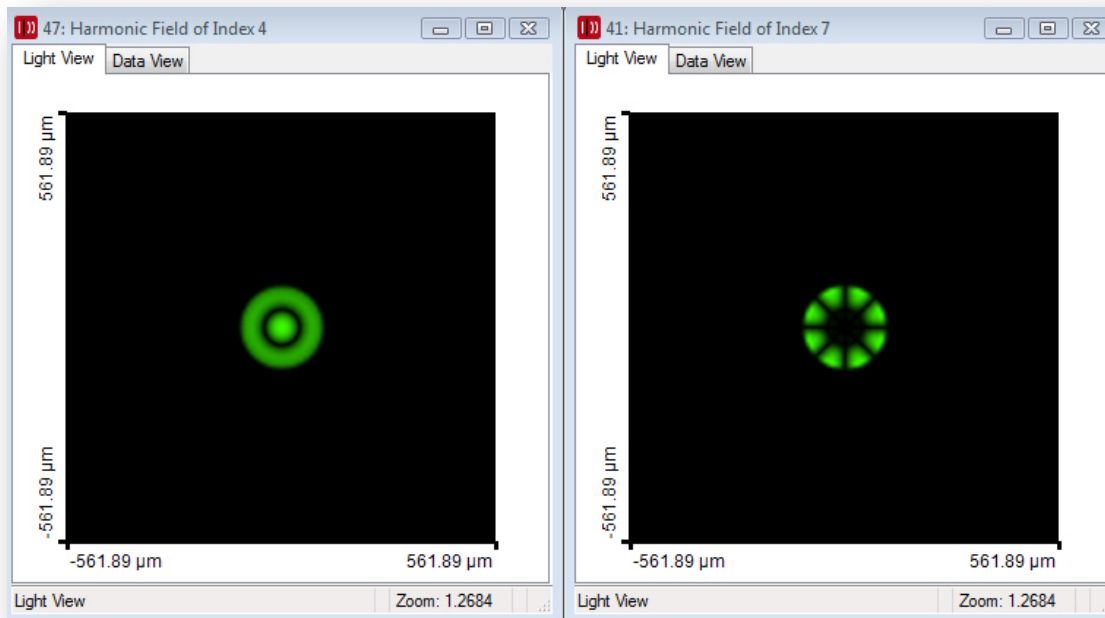
Simulation Results: Out-coupling Mode

The out-coupling mode of the resonator can be computed.



Simulation Results: Higher Eigenmodes

Arnoldi algorithm allows computation of higher order modes.



Conclusion

- Laser Resonator Toolbox allows to analyze Eigenmodes of laser resonators.
- VirtualLab™ allows laser resonator setup including mirrors, active medium, lenses, micro structured components.
- Fundamental mode and higher order modes can be calculated.