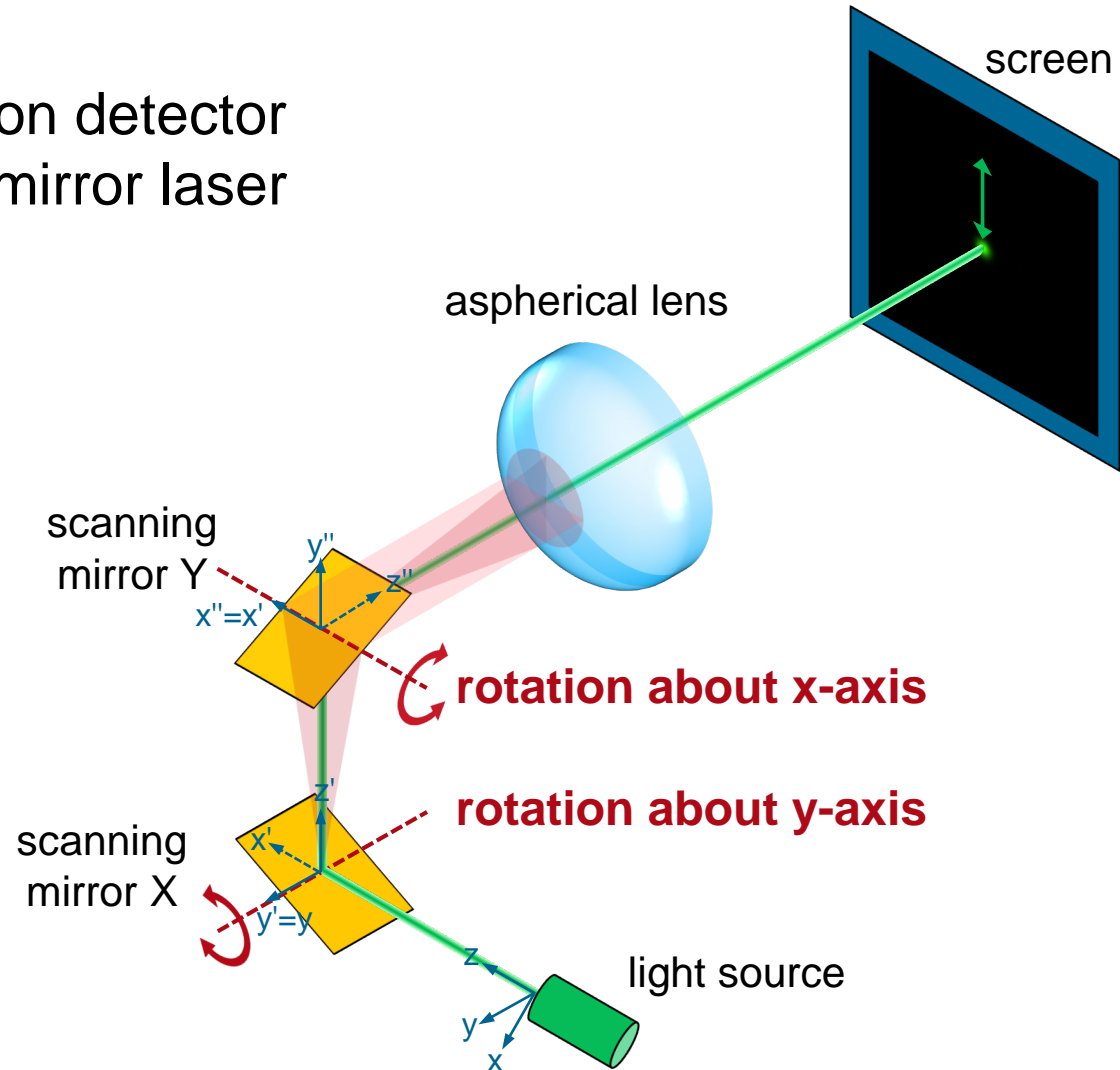Laser Systems > Scanning Systems
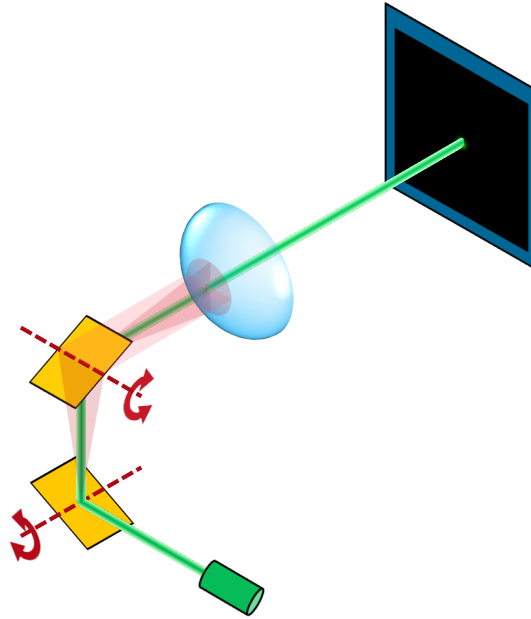
Performance Analysis of Laser Scanning System Using an Asphere

Task/System Illustration

Simulation of spots on detector deflected by a dual mirror laser scanning system.

screen

aspherical lens

scanning mirror Y

rotation about x-axis

rotation about y-axis
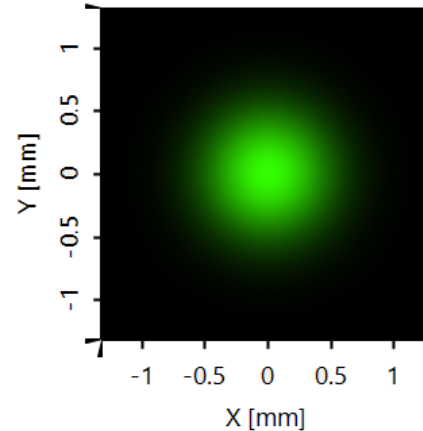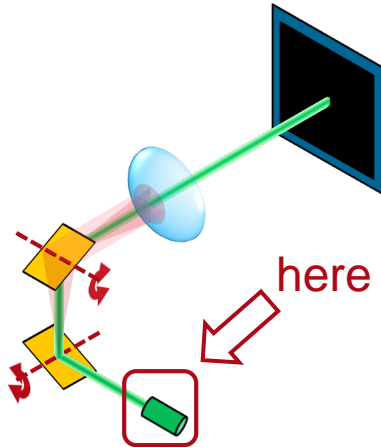
scanning mirror X

light source

Highlights

- modeling of user-defined scanning processes

- variety of selectable angle definitions

- fast simulation through full scanning and additional optical setup

- evaluation of distortion of scanned spots

Specification: Light Source

here

| Parameter	Description / Value & Unit
model/number	single mode laser from Laser Components: FP-D-532-1-C-F
coherence/mode	single Hermite Gaussian (0,0) mode
wavelength	532 nm
polarization	linear in x-direction (0°)
half angle divergence of beam intensity	0.02° × 0.02° (referring to $1/e^2$)
initial M^2	1.0 × 1.0

Specification: Galvanometer Mirror System
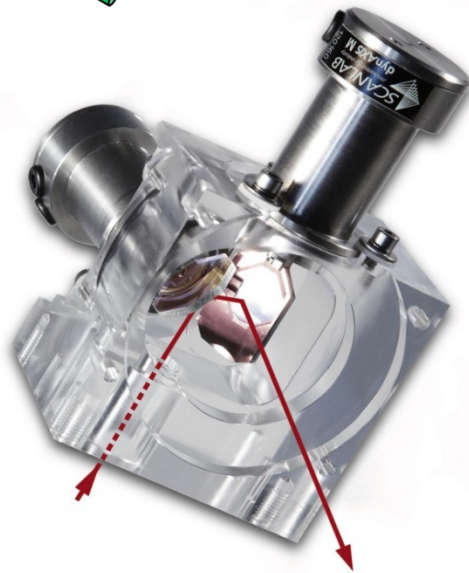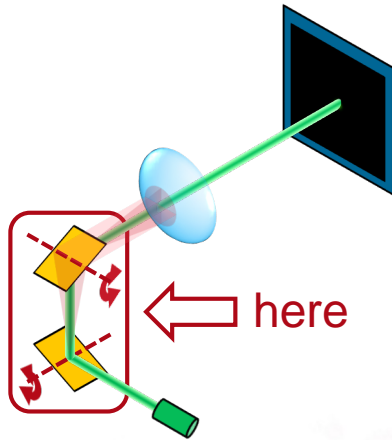
here


Typical dual axis galvanometer scanner [1]

Parameter	Value & Unit
type/model	dual-axis mirror assembly from Thorlabs: GVS002
mechanical scan angle	±12.5°
optical scan angle	±25°

Specification: Asphere as Scanning Optics

here

50 mm
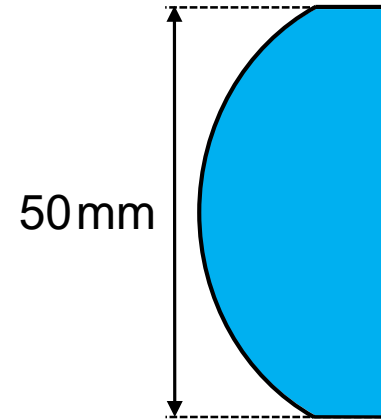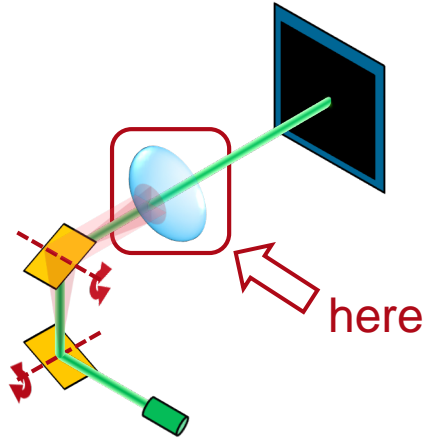
| Parameter	Value & Unit
type	convex-plano aspherical lens
model	Asphericon ALL50-100-S-U (A50-100LPX)
numerical aperture (NA)	0.23
material	N-BK7

Specification: Detectors

here
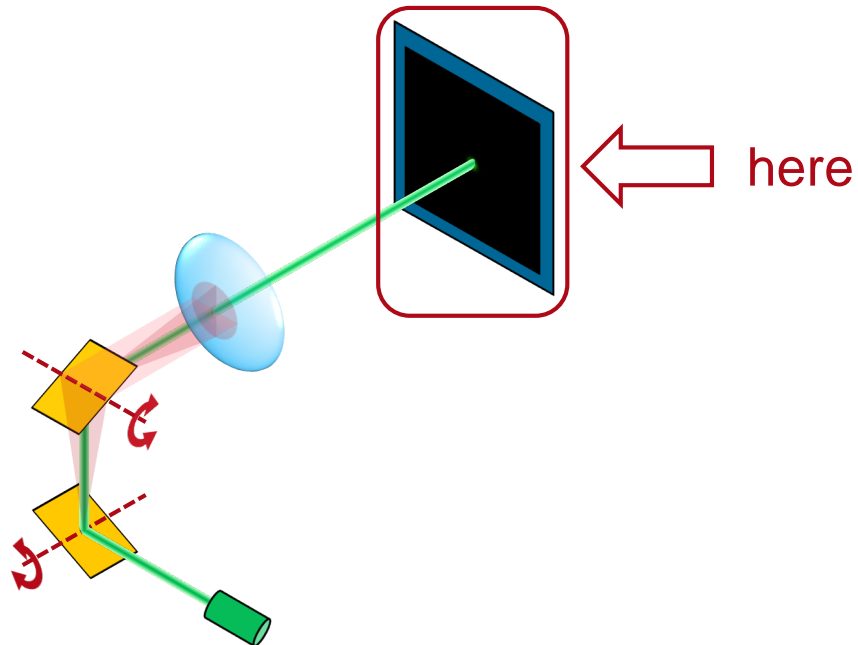
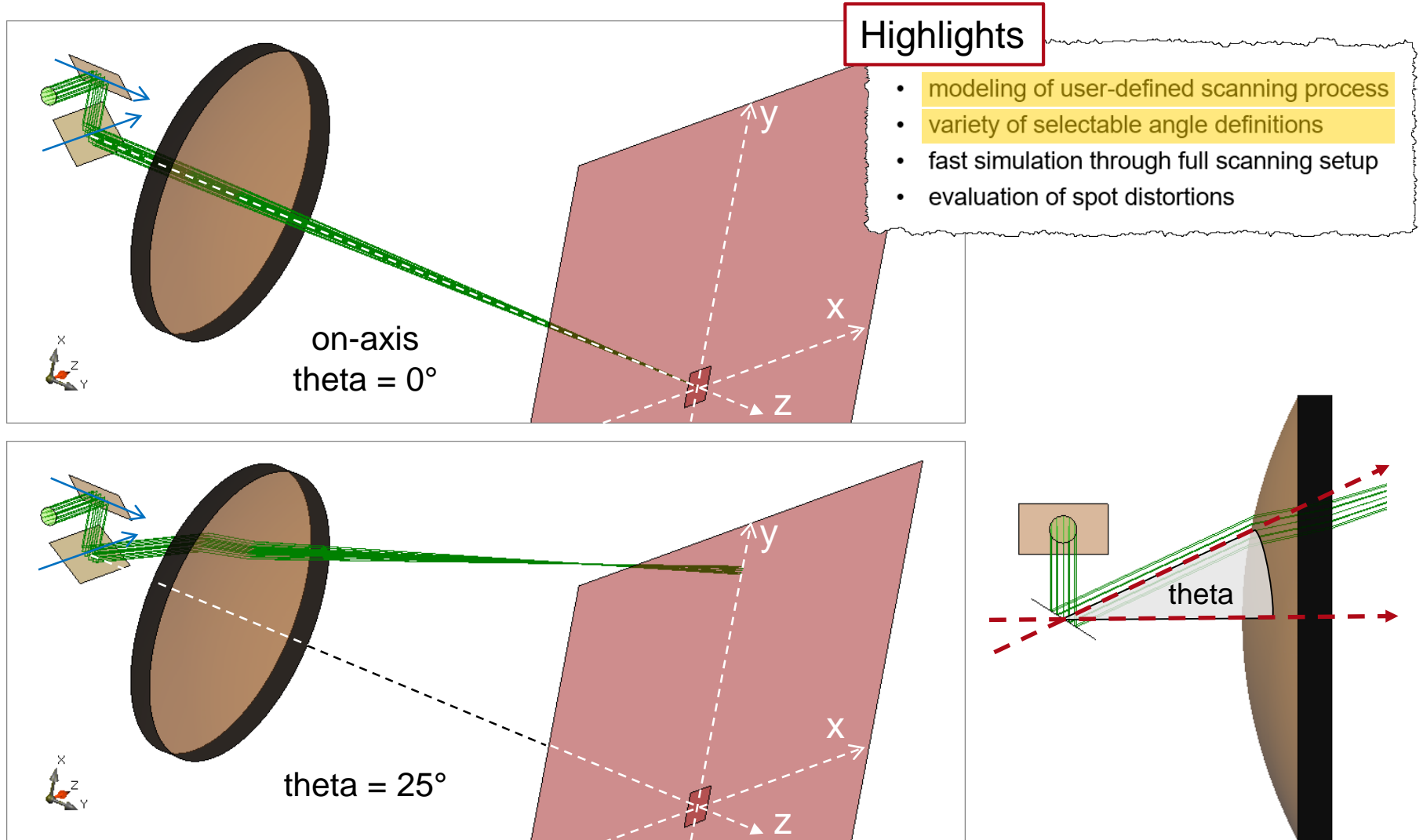| Position	Modeling Technique	Detector/Analyzers
full system	3D system ray tracing	3D illustration of system and ray propagation
target region	ray tracing	focal position
target region	field tracing	shape, size & quality of target spots

Result: 3D System Ray Tracing
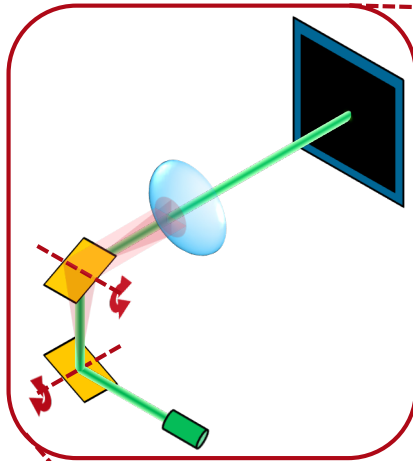
Highlights

- modeling of user-defined scanning process
- variety of selectable angle definitions
- fast simulation through full scanning setup
- evaluation of spot distortions
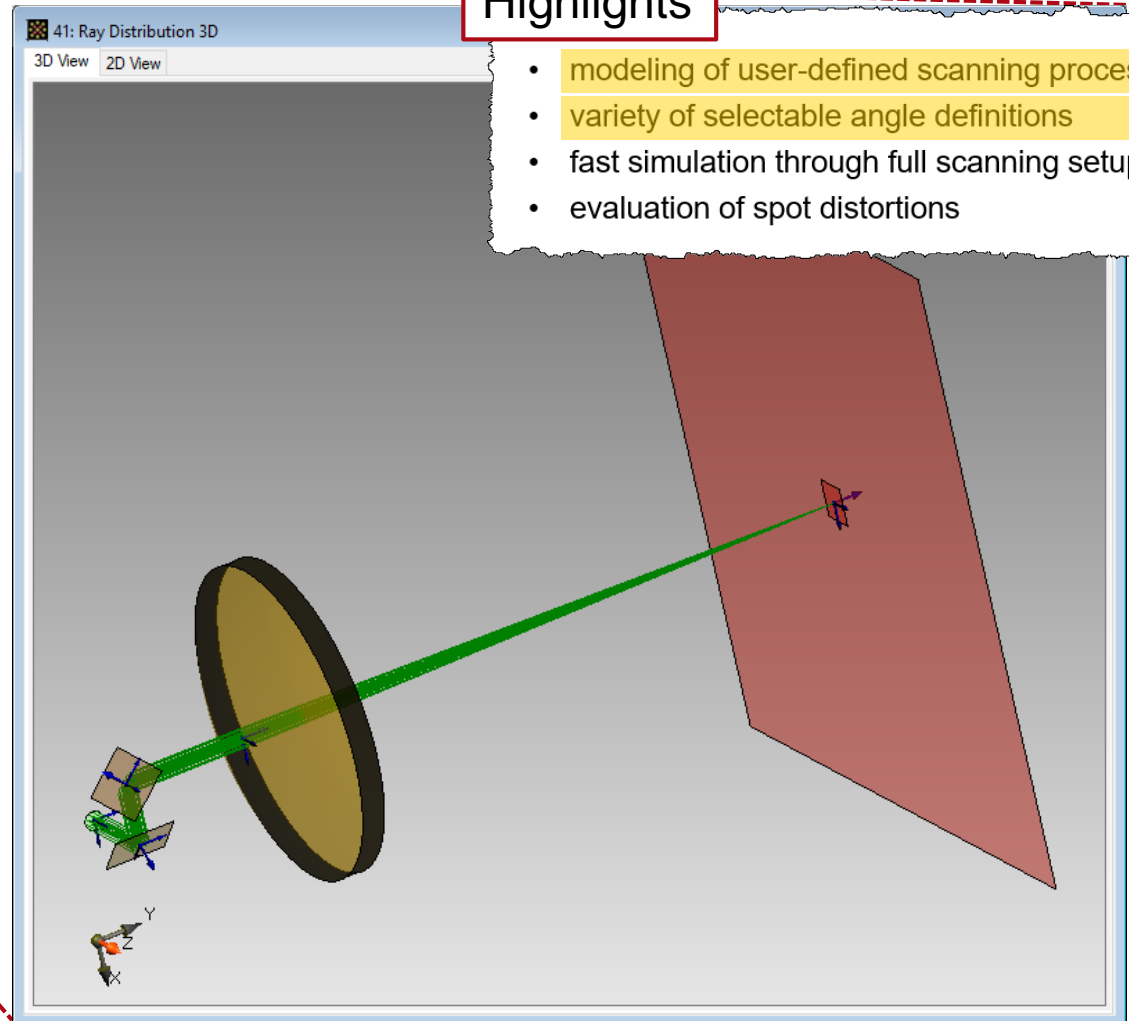
Results: 3D Ray Tracing (On- & Off-Axis)

Highlights

- modeling of user-defined scanning process
- variety of selectable angle definitions
- fast simulation through full scanning setup
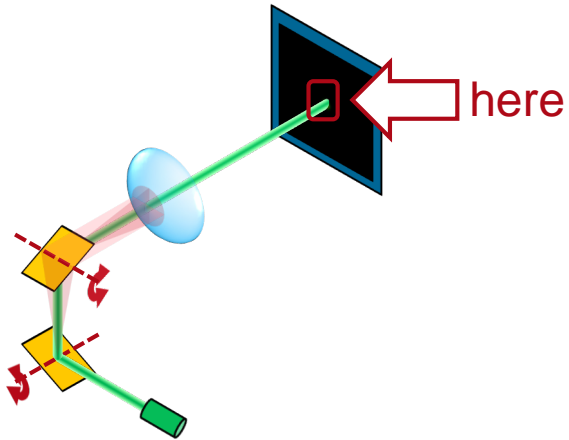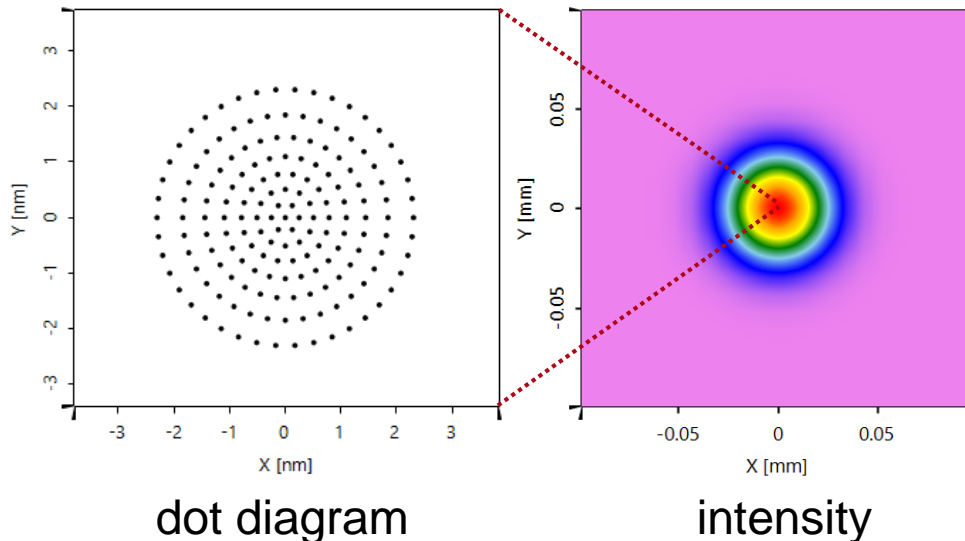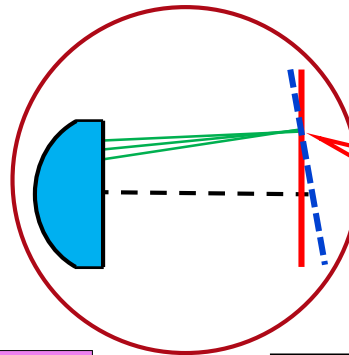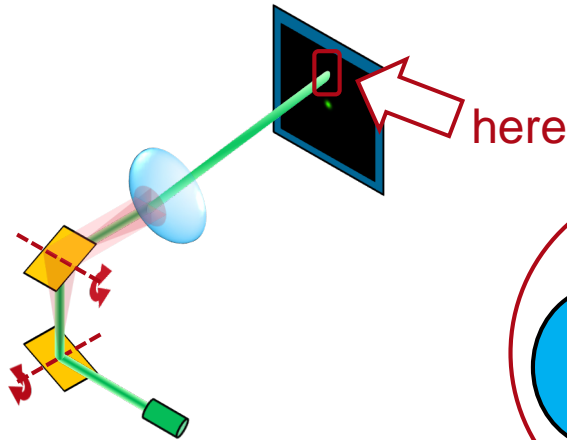- evaluation of spot distortions

on-axis
theta = 0°

theta = 25°

theta

Results: Beam Profile On-Axis

here

dot diagram

intensity

Parameters	Values / µm
RMS beam diameter (x × y) by ray tracing	0 µm × 0 µm below diffraction limit
focus spot 1/e^2 diameter (x × y) by field tracing	69 µm × 69 µm
M^2 value (x × y) by field tracing	1.00 × 1.00

**simulation time:
~4s !!!**

Results: Beam Profile Off-Axis

here

detector plane normal to optical axis (not tilted)

Parameters	Values / μm
RMS beam diameter (x × y) by ray tracing	265 μm × 729 μm can't consider intensity modulation
focus spot 1/e² diameter (x × y) by field tracing	179 μm × 465 μm
M² value (x × y) by field tracing	1.00 × 1.13

simulation time: ~5s !!!

dot diagram   intensity

Results: Beam Profile Off-Axis (Tilted Detector)
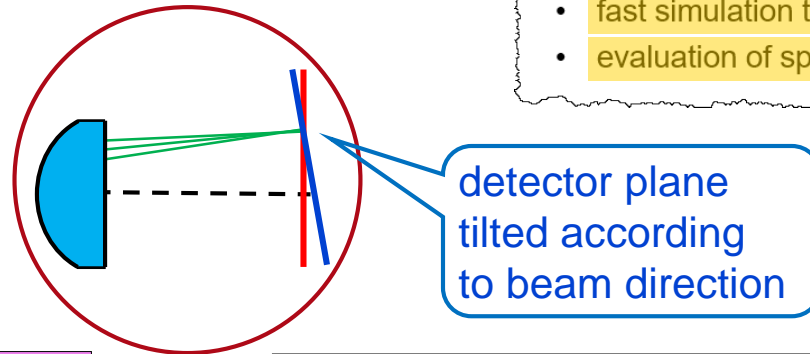
here

detector plane tilted according to beam direction

dot diagram

intensity

Parameters	Values / µm
RMS beam diameter (x × y) by ray tracing	265 µm × 677 µm can't consider intensity modulation
focus spot 1/e² diameter (x × y) by field tracing	179 µm × 432 µm
M² value (x × y) by field tracing	1.00 × 1.05

simulation time: ~5s !!!

Results: Scan Process

Highlights

- modeling of user-defined scanning process
- variety of selectable angle definitions
- fast simulation through full scanning setup
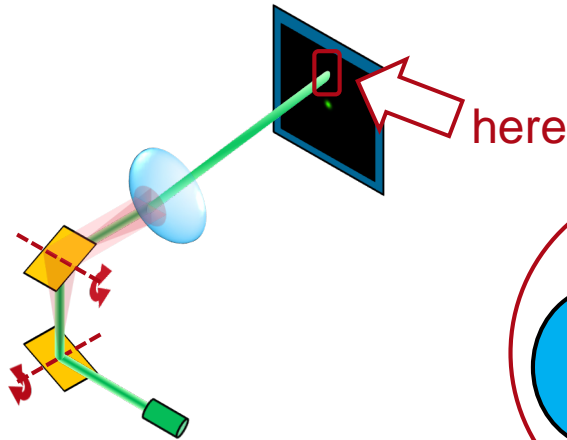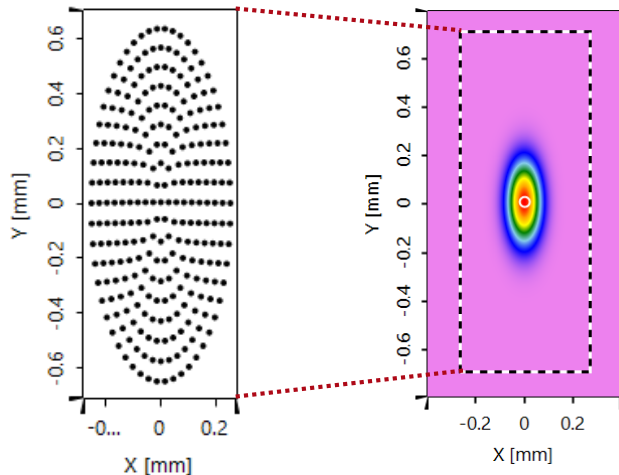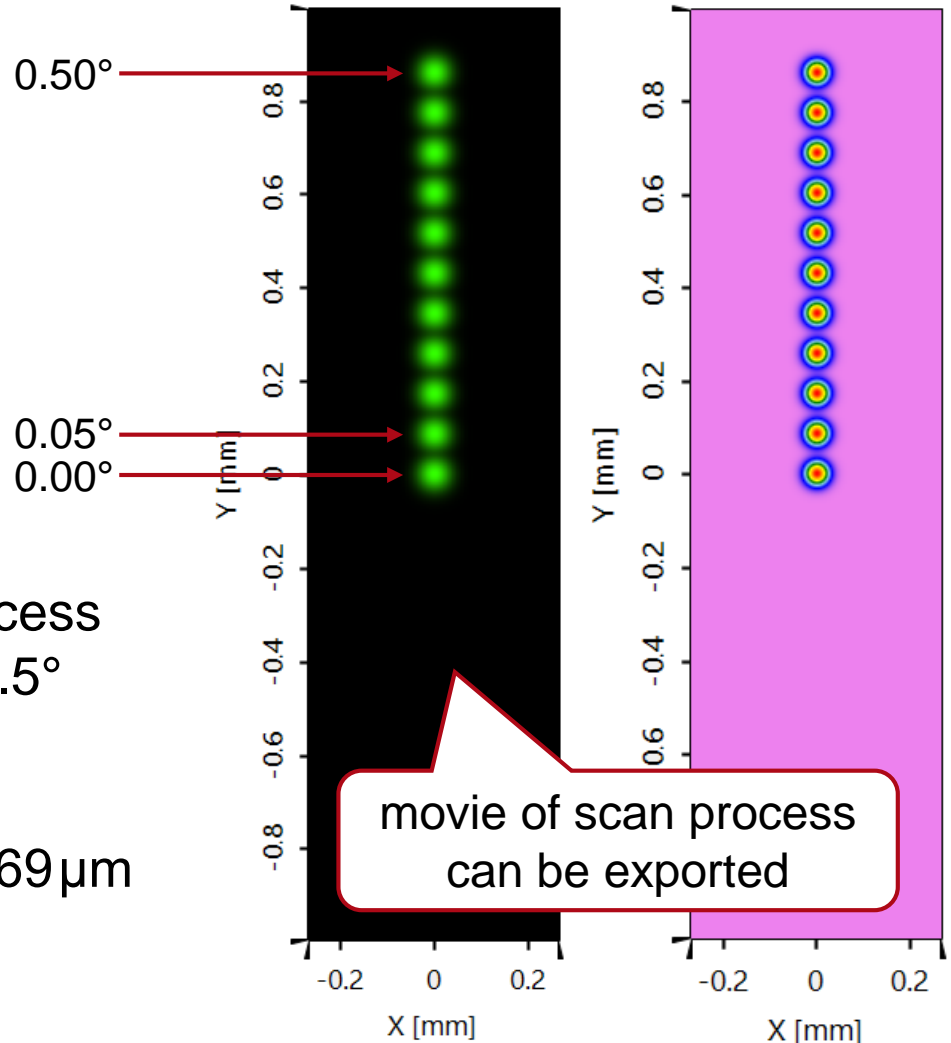- evaluation of spot distortions

illustrated simulation of scan process for deflection angles from 0° to 0.5°

$1/e^2$ diameter of paraxial spots ~69μm

simulation time: ~7s !!!

0.50°

0.05°
0.00°

movie of scan process can be exported

Document & Technical Info

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category	Laser Systems > Scanning Systems (SS)
author	Roberto Knoth, Hartwig Crailsheim (both LightTrans)
used VL version	7.0.0.29

Specifications of PC Used for Simulation	
Processor	i7-4910MQ (4 CPU cores)
RAM	32GB
Operating System	Windows 10