Midel Photonics

Innovative **All-Reflective Laser Beam Shaping** for Material Processing based on Microstructured Mirrors

Start NextGen Laser Processing!

Say Hi to our Team.

Call us +49 (0)228/28-679710
Write us info@midel-photonics.de
Check us out www.midel-photonics.de
Get a coffee Maarstr. 96, 53227 Bonn, Germany

LinkedIn

Who is Midel Photonics?

Pioneers in reflective beam shaping. From laser experts - for the industry.

Midel Photonics

Dr. David Dung
Strategy & BizDev

Frederik Wolf
Sales & Finance

Dr. Christian Wahl
Technology

Dr. Christopher Grossert
Production & QM

2022
established

75+
developed solutions

45+
Years of expertise

FINALIST!
INNOVATION AWARD
LASER WORLD OF PHOTONICS
EUROPA SCIENCE

SELECTED CUSTOMERS & PARTNERS

EVOSYS LASERSOLUTIONS
aconity3D
IDS
BBW LASER TECHNIK
Fraunhofer ILT
BLZ Bayerisches Laserzentrum
TOS Lehrstuhl für Technologie Optischer Systeme | RWTH AACHEN UNIVERSITY
CENIDE Center for Nanointegration Duisburg-Essen | University Duisburg-Essen

HTGF

Backed by HTGF – Europe's largest tech investor – and leading industry experts, we are a strong partner who transforms your challenges into solutions.

Next Generation Laser Processing

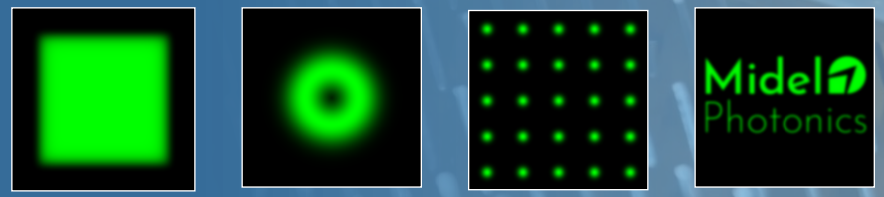
Midel Photonics

TAILORED BEAM SHAPES
ENHANCE LASER PROCESSES

For precision, speed and stability
we introduce:

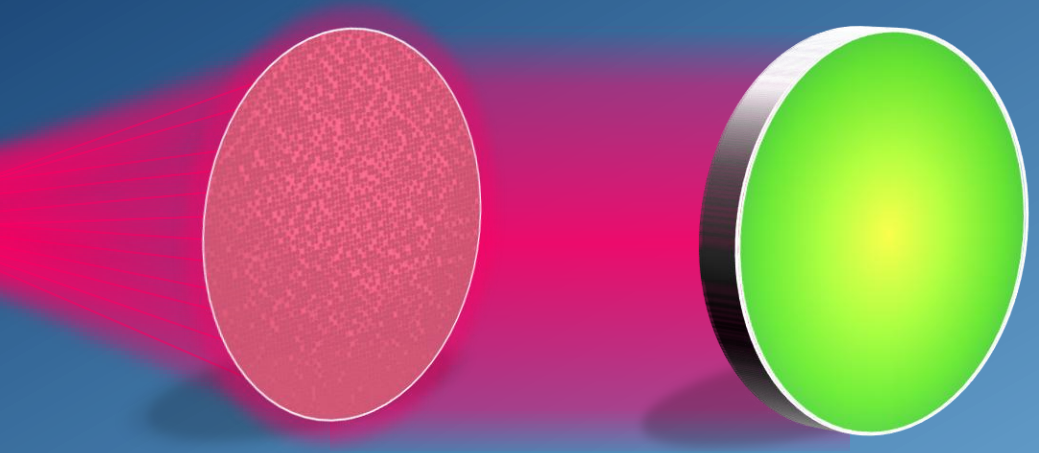
ALL-REFLECTIVE
LASER BEAM SHAPING

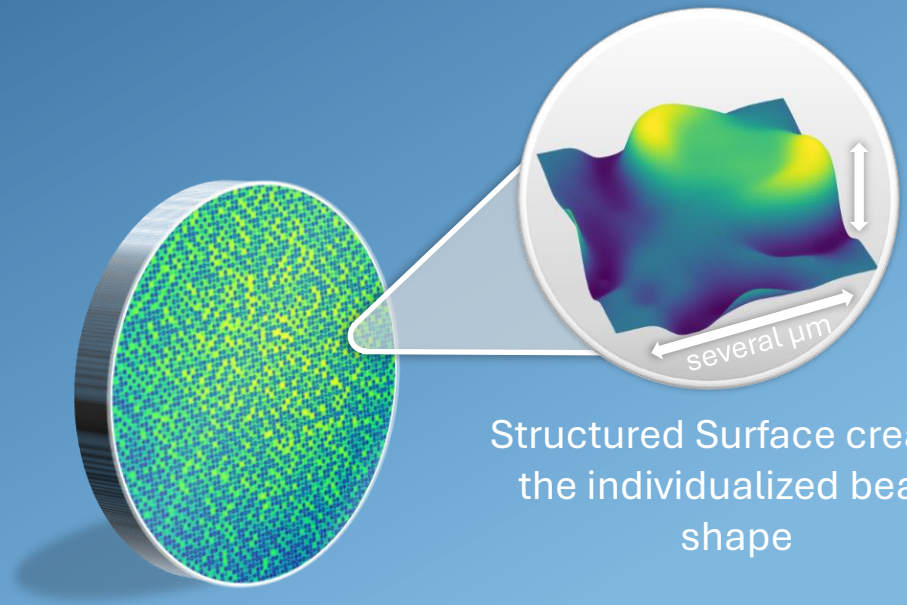
based on micro-structured mirrors



Our Technology: Micro-Delamination

Midel Photonics





Structured Surface creates the individualized beam shape

Produced in Days

Laser Process + High-Reflective Mirror Blank = **Reflective Beam Shaper**

For the experts: It‘s a continuous Diffractive Optical Element (DOE)

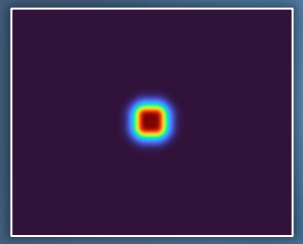
Solution Portfolio

Midel Photonics

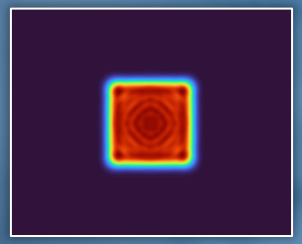
Precision

Beam Shaping

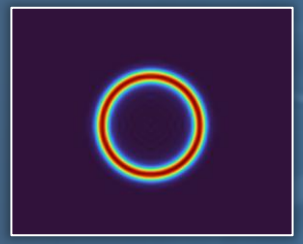
Flat-Tops (Focused)



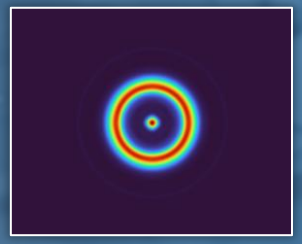
Flat-Tops (Area)



Donut, Bessel, Rings



Ring & Core Combinations



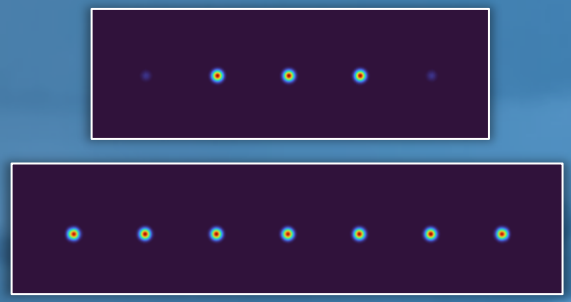
and many more

Optimal process
with tailored intensity

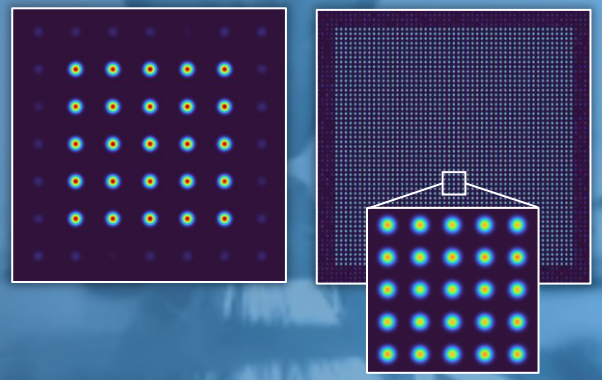
Speed

Beam Splitting

1D



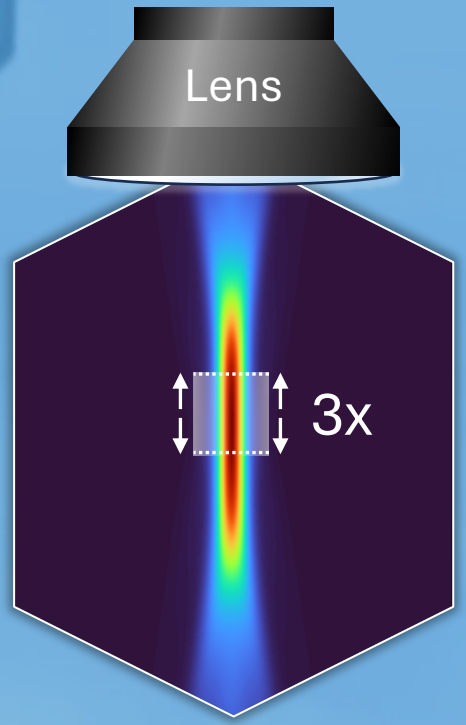
2D



Fast processing
with multiple beams

Stability

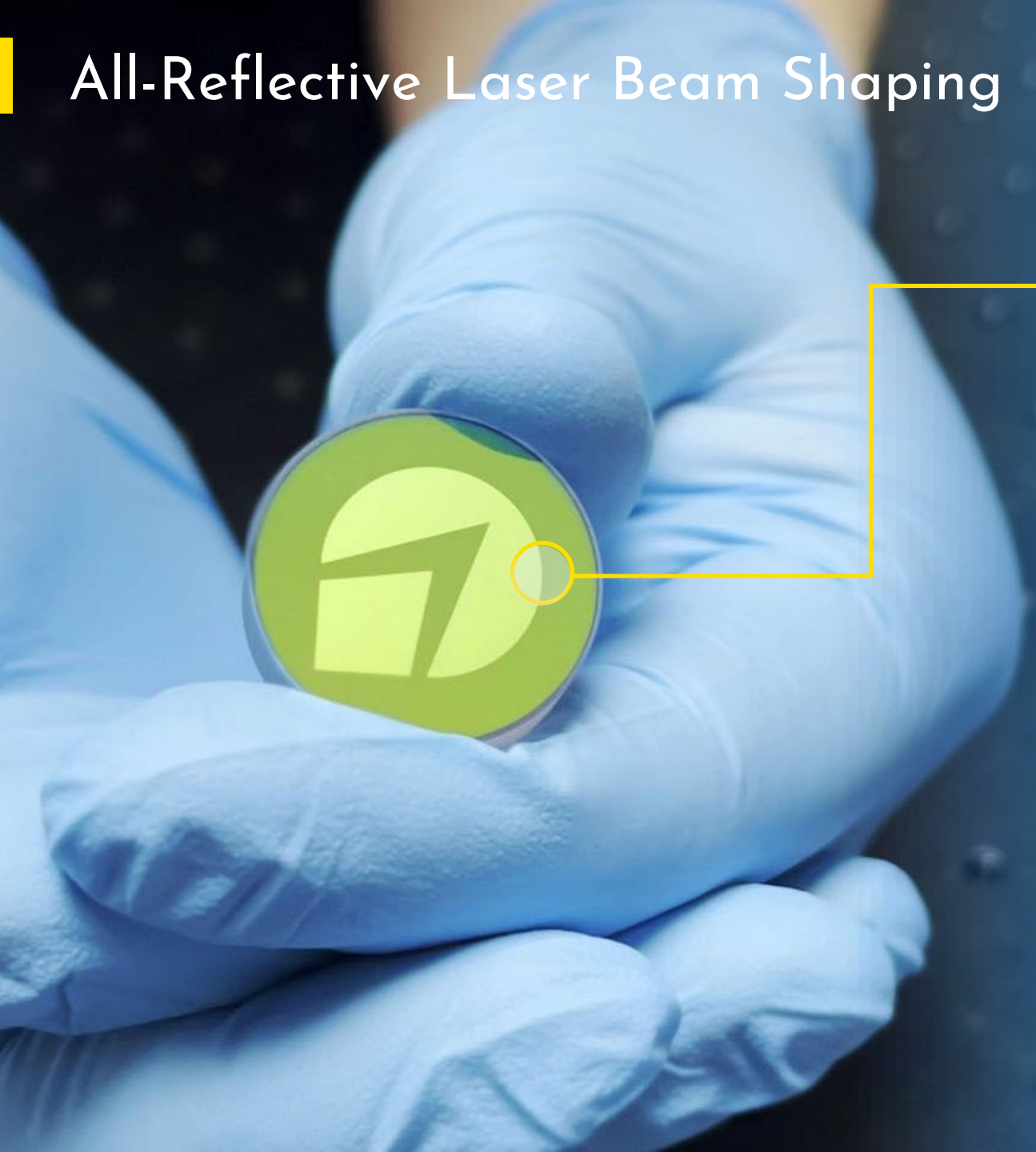
Focal Shaping



High reliability
with large depth of focus

All-Reflective Laser Beam Shaping

Midel Photonics



Core Benefits

System-Adapted with Individual Support: The winning strategy for beam shaping in industrial context

Valuable Features

Superior Productivity by unmatched efficiency in shaping laser light

Fast Delivery within 3 weeks

Baseline Criteria

All Lasers, all Power Levels: Deep-UV to Near-IR, femto to continuous, low power to 50kW+

Compatibility & Specifications

Midel Photonics

Compatible Laser Systems

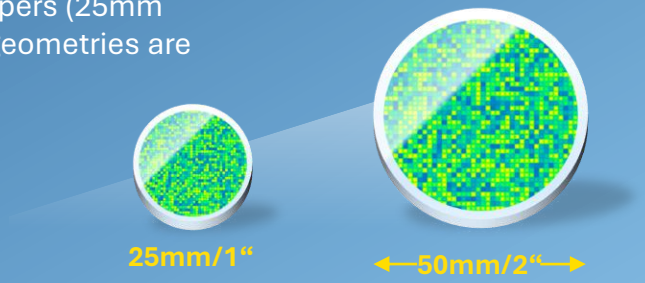
- **Ultra-short pulse (down to 200fs) and continuous wave lasers**
- **Low to high power (up to multi kilowatt regime)**
- **Laser wavelengths from DUV to NIR**

(D)UV	Blue	Green	NIR
266nm 355nm	450nm	515nm 532nm	1030nm 1064nm

Other laser wavelengths on demand (250nm-1070nm)

Available Geometries

We provide round beam shapers (25mm and 50mm in stock). Other geometries are available on demand.



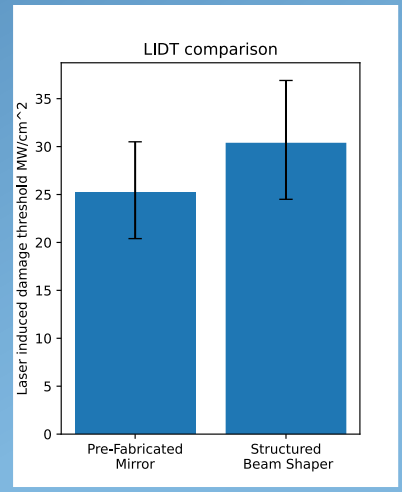
Damage Threshold Examples

Continuous Lasers:

LIDT for CW NIR (1µm):

- **Up to 30 MW/cm2**
- **Unaltered by microstructuring**

30 MW/cm2 corresponds to a 50kW laser beam with diameter of only 0.5mm!
Tested for IR, T(30s)-on-1 - ISO 21254-1:2011



Ultra Short Pulsed Laser

LIDT for 180fs UV (343nm):

- **Up to 235 mJ/cm2**
- **Unaltered by microstructuring**

Tested for UV, S(1000)-on-1 - ISO 21254-2

LIDARIS LIDT Service

Usecases

Macro Machining Examples

Start NextGen Laser Processing!

Say Hi to our Team.

Call us +49 (0)228/28-679710
Write us info@midel-photonics.de
Check us out www.midel-photonics.de
Get a coffee Maarstr. 96, 53227 Bonn, Germany

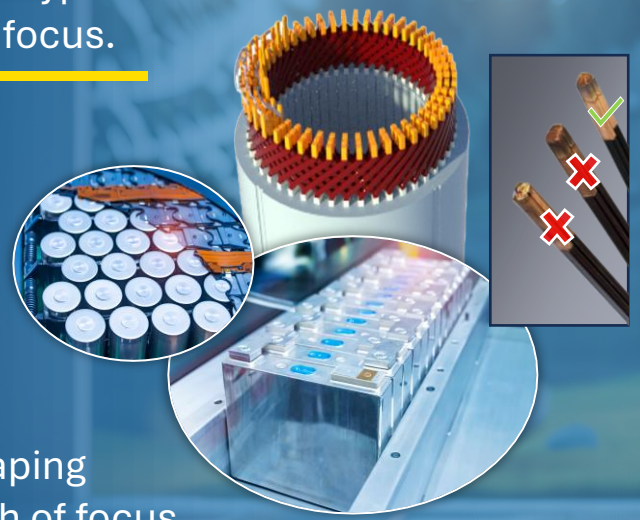
Laser Welding in E-Mobility

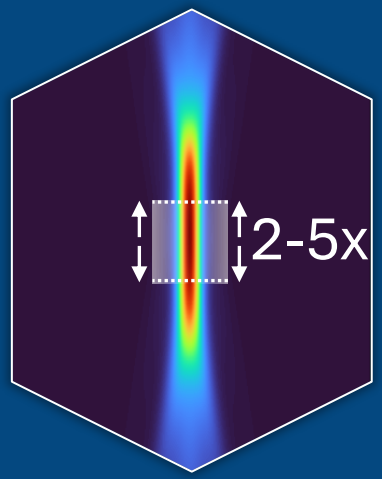
Our goal: Faster, more reliable welding of copper and aluminum for e-mobility applications.

From Bus Bars to Hair Pins

In laser welding, focus position significantly affects results. Regular laser beams struggle with typical height tolerances due to limited depth of focus.

Tolerance ±0.5mm



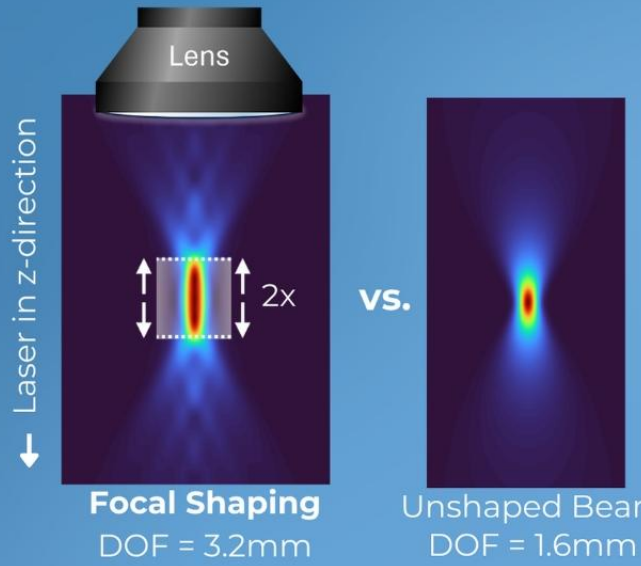


Solution

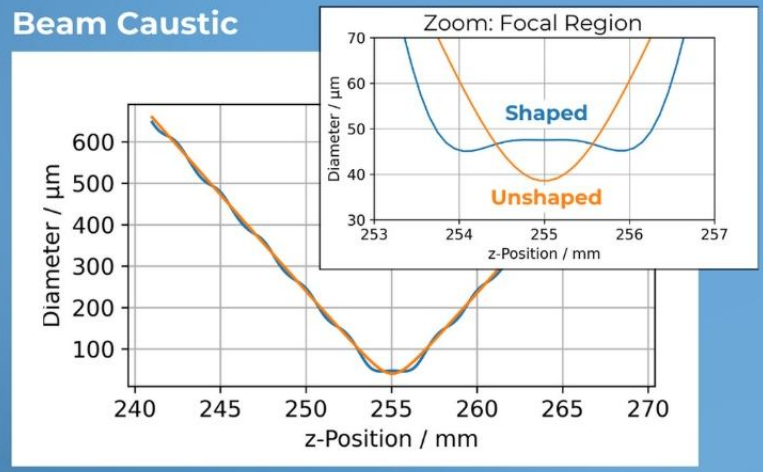
Using our focal shaping elongates the depth of focus.

- Reliable results
- Save process time
- Less rejects

Configuration Example: 2x Focal Elongation



Beam Caustic



Plotted values for λ=1070 nm, M2=1.4, f=255 mm, beam diameter=12 mm (1/e²)

Propagation Stable Ring-Core Shaping I

High Power Beam Analysis in Cooperation with PRIMES GmbH

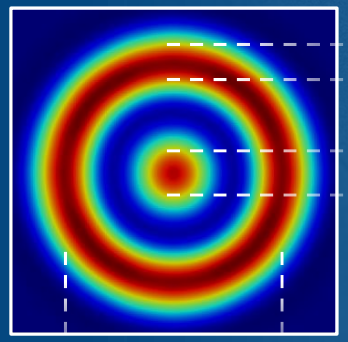
PRIMES Midel Photonics

Ring-Core Profile & Process Stability

In welding and additive manufacturing applications, ring-core solution often face challenges with height tolerances and thermal drift due to their limited depth of focus.

Primes invited us to investigate the performance of our Ring-Core Shapers using their new Ring-Beam Analysis

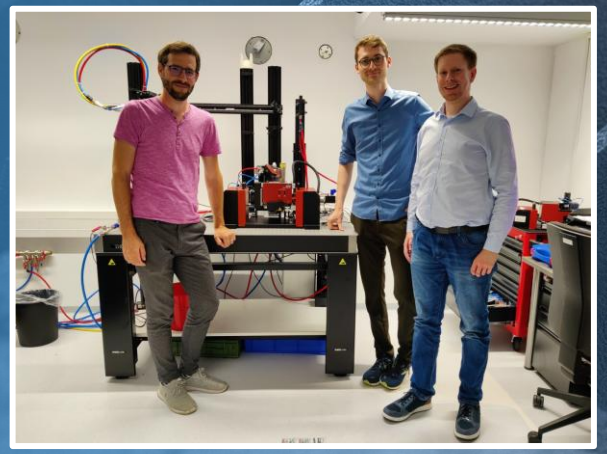
Thanks to Dr. Johannes Roßnagel und Dr. Andreas Rudolf

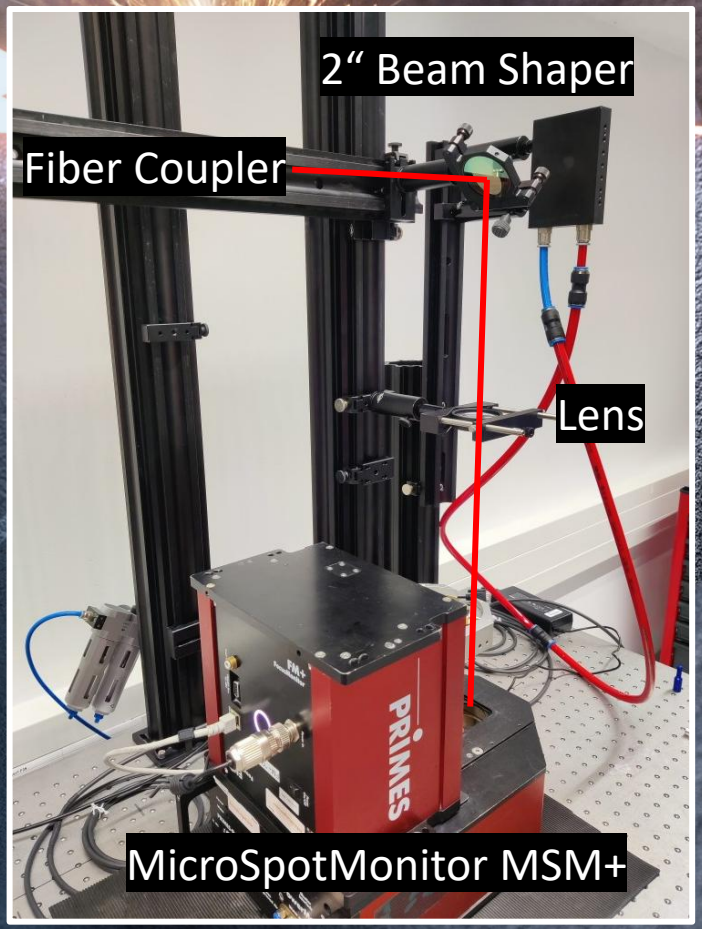


Ring Width
(~0.8 Spot Width)

Core Width
Diffraction Limited
$(M^2 \lambda f / 2\pi w_{in})$

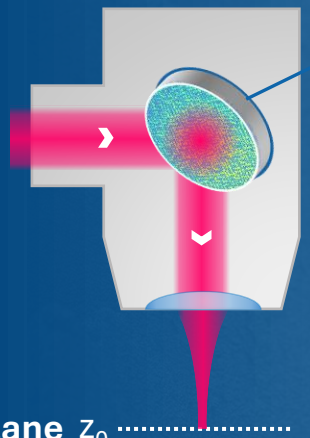
Ring Diameter
Individual





Propagation Stable Ring-Core Shaping II

Investigations at the Focal Plane



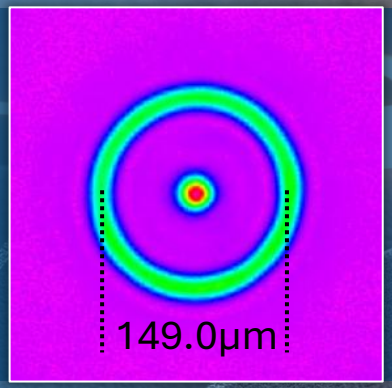
115W Single Mode	
Wavelength	1070nm
M^2	1.04
Diameter | Focal length	8.2 | 200 mm
Beam spot size	35 µm

3kW Multi Mode	
Wavelength	1070nm
M^2	18
Diameter | Focal length	14.5 | 200 mm
Beam spot size	338 µm

Performed Measurements with Primes MicroSpotMonitor MSM+ and new Ring-Beam Plugin with single- and multi-mode systems up to 3kW

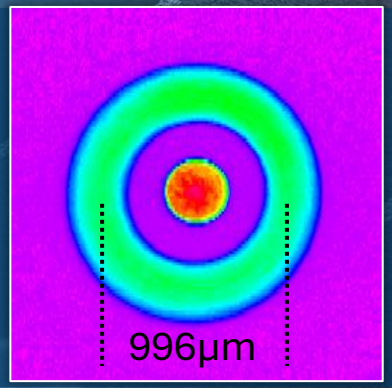
Measurement

Single Mode



Core Diameter: 34.7 µm
Ring Diameter: 149.0 µm
Ring Width: 26.6 µm
Homogenity Ring (Peak-Valley): 19%
Decentering Core-Ring: 1.6µm

Multi Mode



Core Diameter: 331 µm
Ring Diameter: 996 µm
Ring Width: 265 µm
Homogenity Ring (Peak-Valley): 18%
Decentering Core-Ring: 5.2 µm
Efficiency: 90% (75.6 Ring – 14.4 Core)

Measurements in excellent agreement with design & theory

Propagation Stable Ring-Core Shaping III

High Power Caustic-Measurements with PRIMES GmbH

PRIMES Midel Photonics

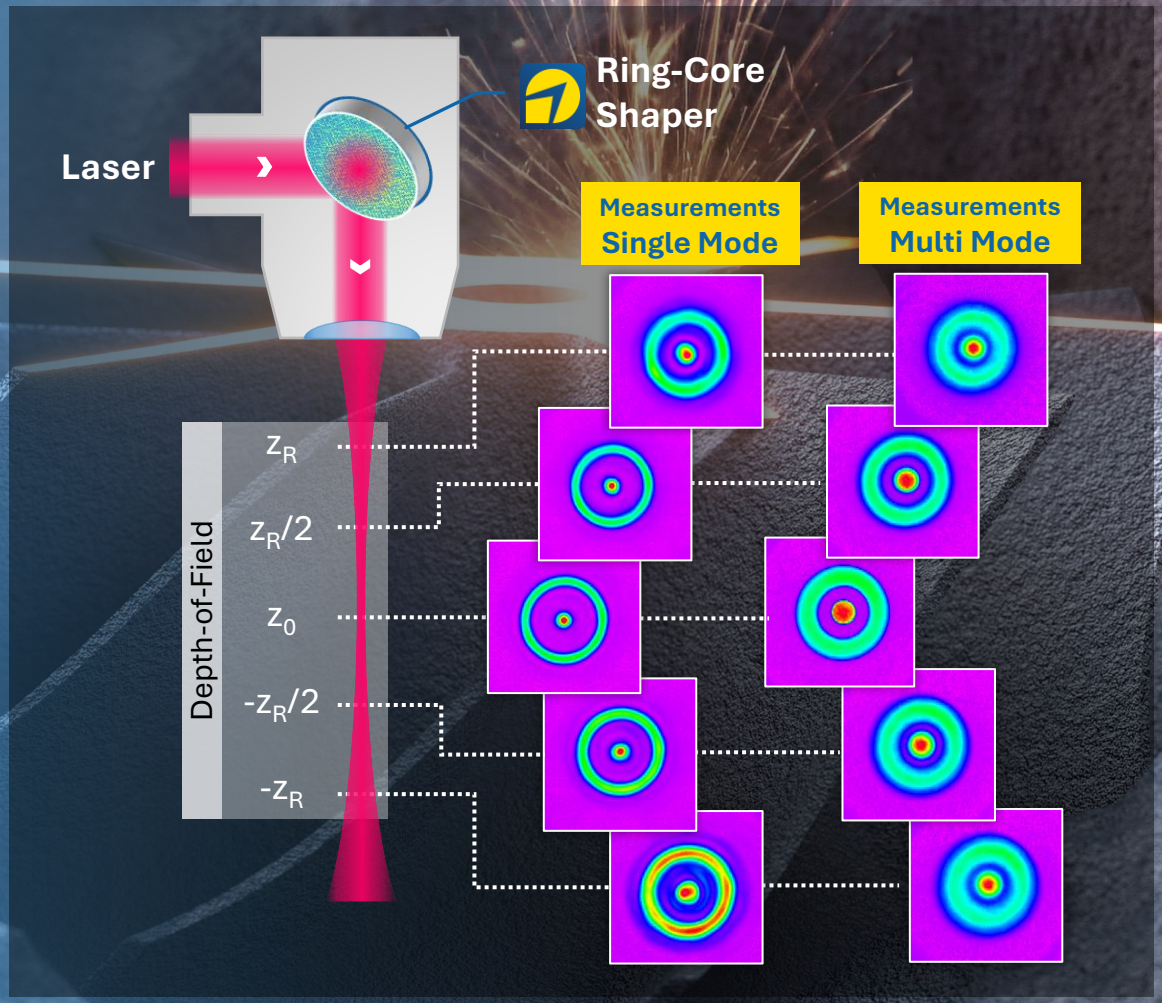
Ring-Core Profile meets Process Stability

In welding and additive manufacturing applications, ring-core solution often face challenges with height tolerances and thermal drift due to their limited depth of focus.

Solution

Experience precise and robust laser processing with our Ring-Core Shapers - stable over the entire Rayleigh length!

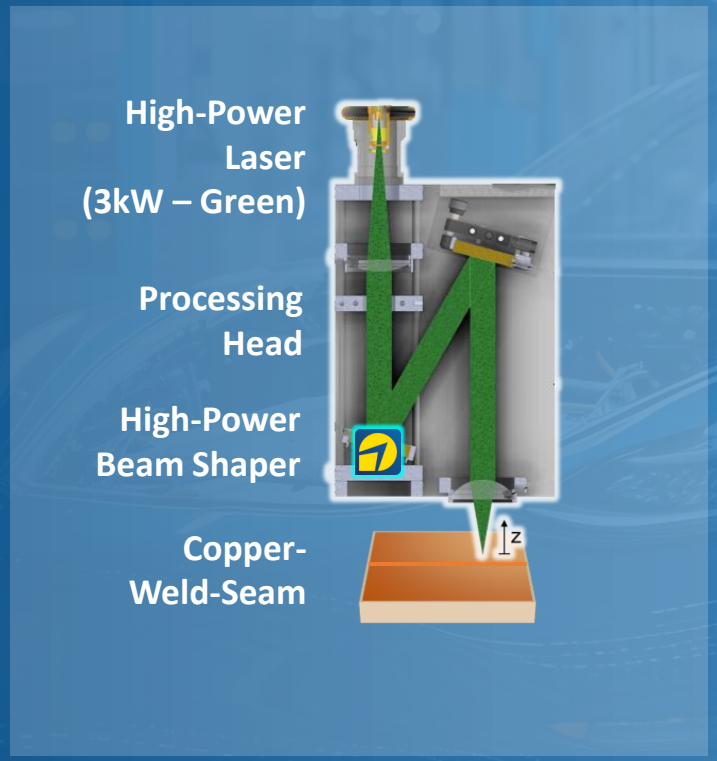
- **Up to 5x higher propagation stability (over full Rayleigh length)**
- Robust against thermal lensing
- Highest homogeneity
- Smallest feature size
- Customized ring diameters & power ratios

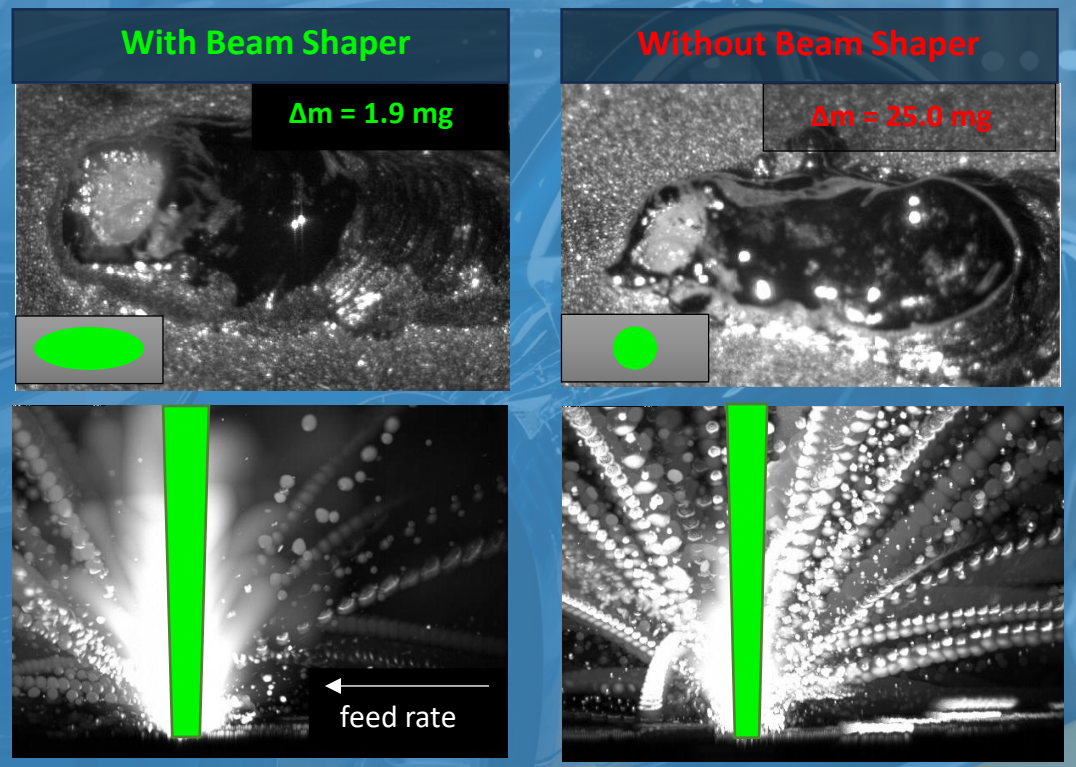


Performed Measurements with Primes MicroSpotMonitor MSM+ and new Ring-Beam Plugin with single- and multi-mode systems up to 3kW

New Shapes for Laser Welding

Copper welding is challenging. Elliptical flat-top beams stabilize the melt pool and drastically reduce spattering.





Kaufmann, Roth & Schmidt, *Int J Adv Manuf Technol* (2024) https://doi.org/10.1007/s00170-024-13180-z

- ✓ **Increased weld seam quality**
- ✓ **Up to 93% reduction of spatter**

Success Story: Plug & Play Beamshaping

Seamless integration for Indsutrial Laser Plastic Welding

Midel Photonics

Challenge

Complex plastic components in e-mobility require high thermal and chemical resistance – but push laser welding to its limits.

Our partner:

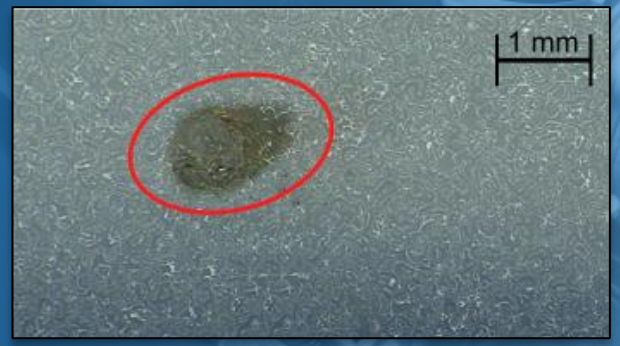
EVOSYS LASERSOLUTIONS

Seamless integration of Midel Photonics' beam shaping module into Evosys' laser welding platform.

Results and added value:

Evosys' high-precision platform was upgraded with Midel Photonics' beam shaping technology:

- **Welds high-performance plastics** that were previously unsuited for laser welding
- **Stable, reproducible seams** – even on complex geometries
- **Zero rejects**, meeting automotive and medical quality standards



Without Beamshaping

With Beamshaping

Success Story: Plug & Play Beamshaping

Seamless integration for Industrial Additive Manufacturing

Midel Photonics

Challenges for industrial laser systems

Beam shaping used to be complex and hard to integrate. With our plug & play modules, integration is simple – just like using a standard optic.

Our partner:

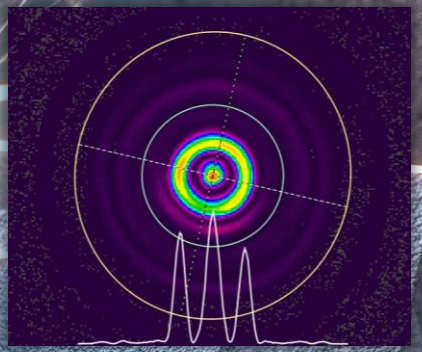
ACONITY 3D

Integration:

- Beam Shaper is integrated in a **user-exchangeable carrier**
- Operators can switch beam profiles directly at machine in **just a few minutes**

Results and added value:

- Ring-Core Shaping with **no measurable power loss** (up to 1kW)
- Robustness: Multiple insertions/removals with **reproducible intensity profile**



Higher Throughput	❯	**Increase Overall Productivity**
Fast Adaptability	❯	**Adapt Energy Distribution to suit specific materials**
Maximum Precision	❯	**Improve feature resolution and surface finish**

Midel Photonics

Usecases

Micro Machining Examples

Start NextGen Laser Processing!

Say Hi to our Team.

Call us +49 (0)228/28-679710
Write us info@midel-photonics.de
Check us out www.midel-photonics.de
Get a coffee Maarstr. 96, 53227 Bonn, Germany

LinkedIn

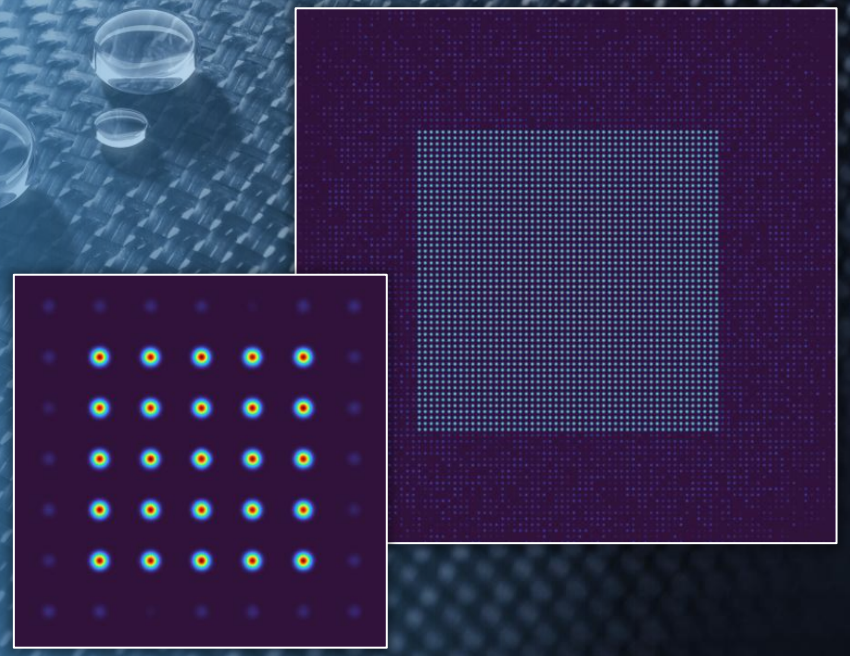
Multispot Micromachining

Unlocking New Potential in Area Micromachining with Ultra-Short Pulse Lasers

Midel Photonics

From Surface Structuring to Microhole Drilling

Ultra-short pulsed lasers enable parallelization with beam splitting. Balancing the numerous parameters of splitting solutions is challenging, yet essential for effective application.



Solution

Our adapted splitters take the priorities of the application into account and optimize all relevant parameters accordingly.

- Multispot Pattern
- Spot Angles/Pitch
- Overall Efficiency
- Homogenity
- Zeroth Order
- Residual Higher Orders

Smallest Beams for Micromachining

Enabling the smallest spots with diffraction-limited flattop beams

Midel Photonics

Challenge in Semiconductor Manufacturing

Laser spot sizes are limited by diffraction, restricting how small they can be. Achieving spots as close to this limit as possible is crucial for precision in lithography, etching, and micromachining.

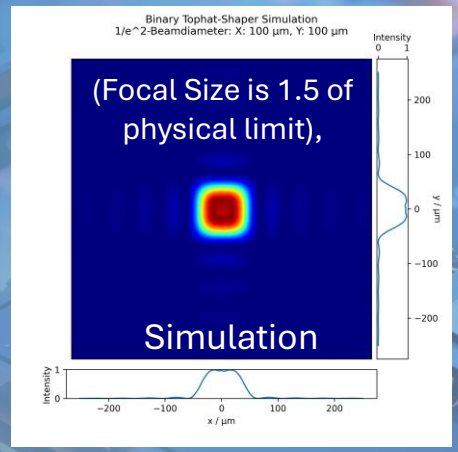
Solution

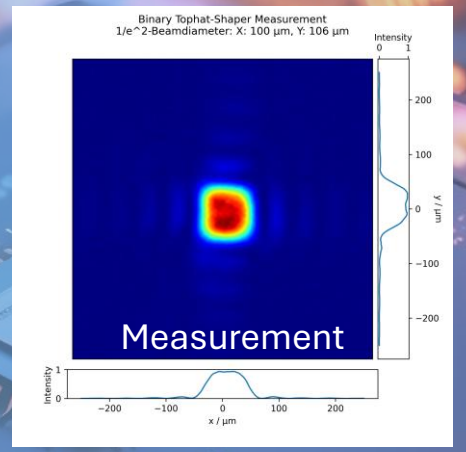
Our diffraction-limited flattop beams deliver highly uniform spots, optimized to reach the smallest sizes physics allows.

Two designs:

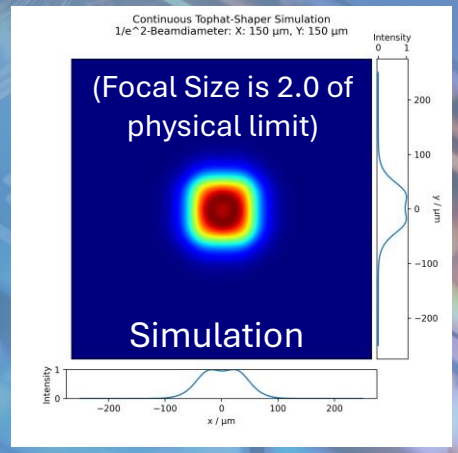
- (a) **Smallest Size** (1.5 of physical limit), Efficiency >90%, residual side bands
- (b) **Highest Efficiency** (>95%), No residual side bands. Small size (2.0 of physical limit)

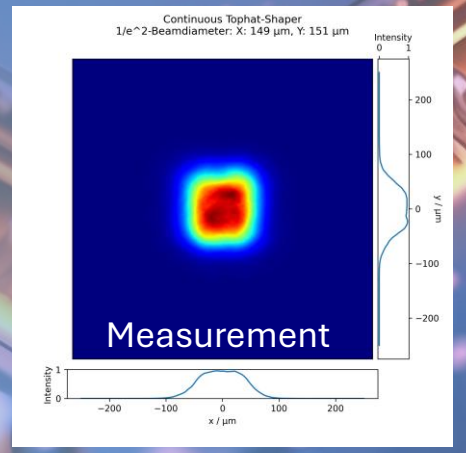
Version (a) **Smallest Size**





Version (b) **Highest Efficiency**





Versions also available in round or rectangular

Product Marking

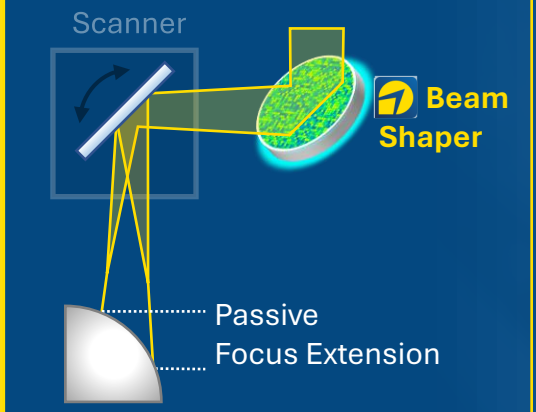
Robust & Compact Laser Marking Systems are key for product marking.

Midel Photonics

Challenges for laser marking systems

Achieving precise marking despite surface tolerances and unevenness, optimizing rejects and speed, and managing compact dimensions

Compact System



Solution

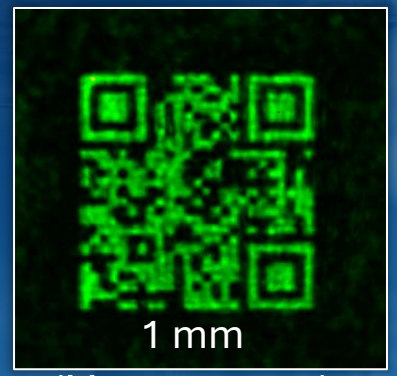
Using our combi function shapers replaces of a full focusing system

- Reliable Marking
- Robust with tolerances & unevenness
- Compact Setup: No need for active focus control & f-Theta

NEW: Next Level Complexity

QR-Code Beam Profiles

SCAN ME!



(Measurement)

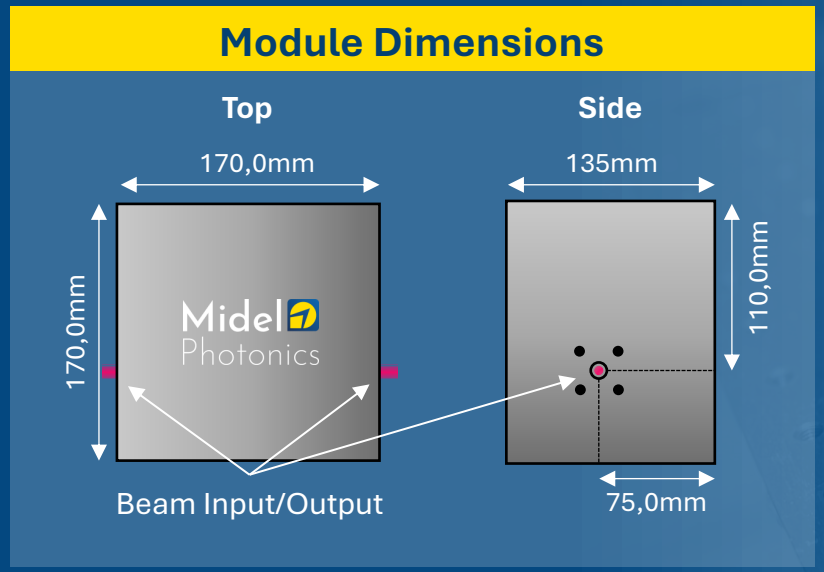
Modular Beam Shaping

A Compact Module Housing Midel's Beam Shapers, Ready-to-Use with Interchangeable Option

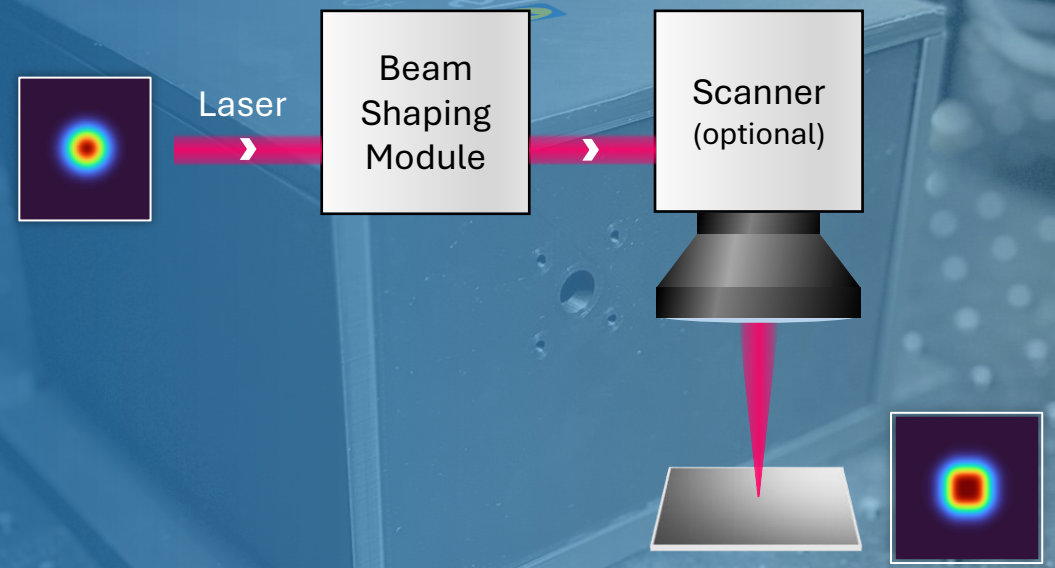
Midel Photonics

Features

- **Linear Design:** Fits any beam path – ideal for retrofitting.
- **Internal Magnetic Mounting:** Effortless switching between beam shapers or Gaussian beams.
- **Future-Proof:** Compatible with all Midel beam shapers.



Contact us for custom solutions tailored to your needs!

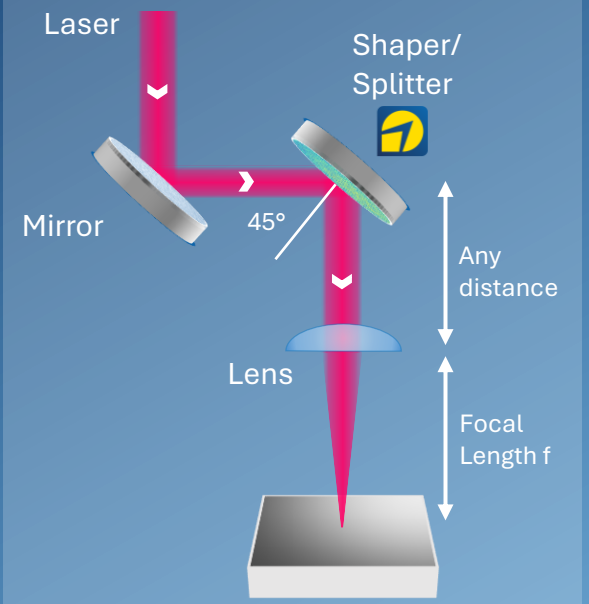


General Integration Options

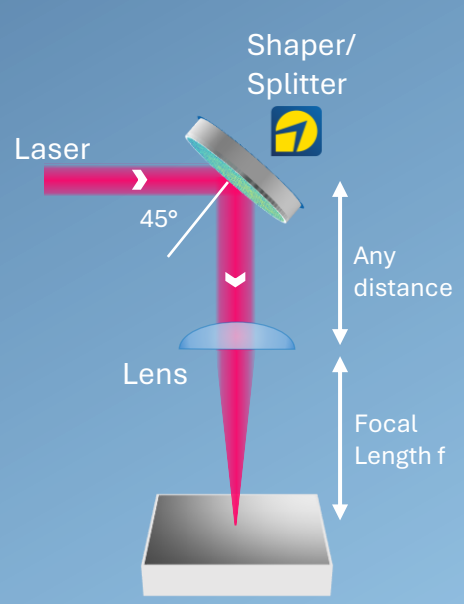
We offer both, folded integration of our reflective beam shapers or linear integration with our module solutions (with reflective beam shaper inside)

Midel Photonics

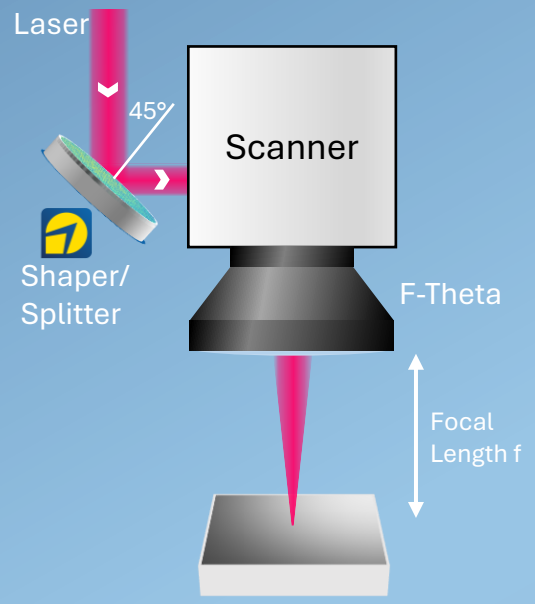
Parallel / Z-Folded



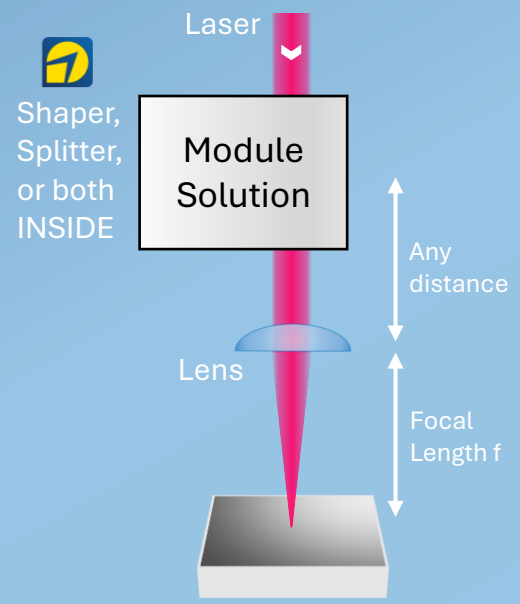
Folded



Scanner



Linear



Other configurations and angles-of-incidence (AOI) available

Your Road to Success

Using the power of beam shaping to optimize your laser systems for production can be challenging. We accompany you along the way.

- Requirements
- Test scenarios
- First Prototypes and feedback

- Optimization
- Validation in pre-series
- Intensive testing in application environment

- Final Design
- Final Specifications
- Quality Management

Your Application – Our Solution

With our comprehensive solution portfolio
we address various laser applications

Midel Photonics

WELDING

MARKING

ADDITIVE

SEMICONDUCTOR

CUTTING

STRUCTURING

Start NextGen Laser Processing!

Say Hi to our Team.

Call us +49 (0)228/28-679710
Write us info@midel-photonics.de
Check us out www.midel-photonics.de
Get a coffee Maarstr. 96, 53227 Bonn, Germany

LinkedIn