Innovative beam forming concepts

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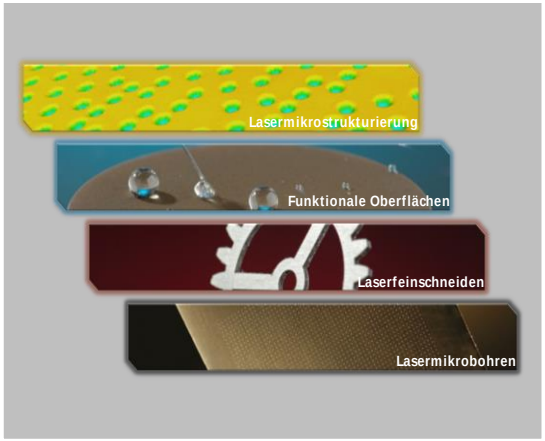
Appolo Workshop
BFH Burgdorf, November 4th 2015

Pulsar Photonics GmbH

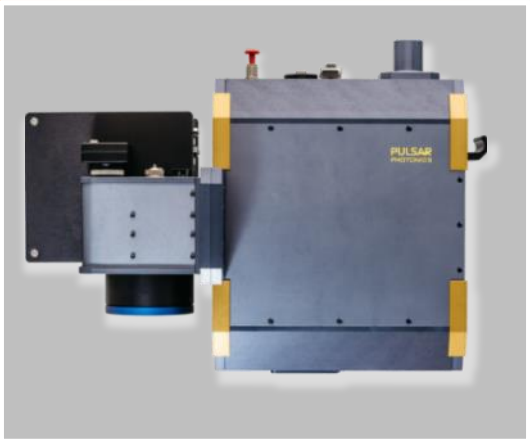
- Foundation: 2013
- Spin-off of Fraunhofer ILT
- Core competences:
  Process- and System technology
  for Laser micro processing


Pulsar Photonics Production Site
Technology Park Herzogenrath

applications

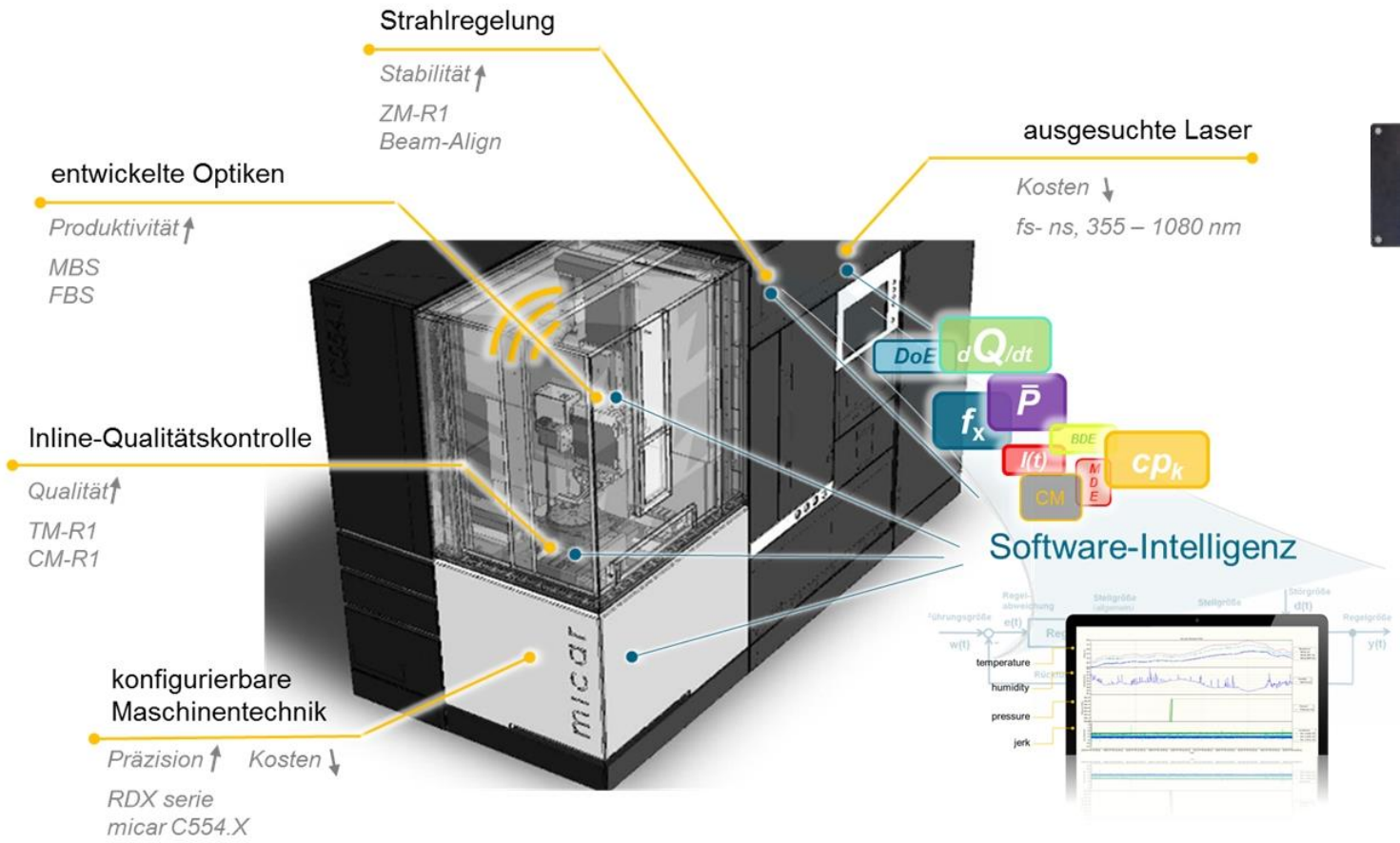


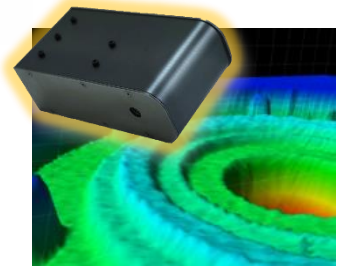
tooling



systems

Approach Increase of efficiency for USP-Laser processes

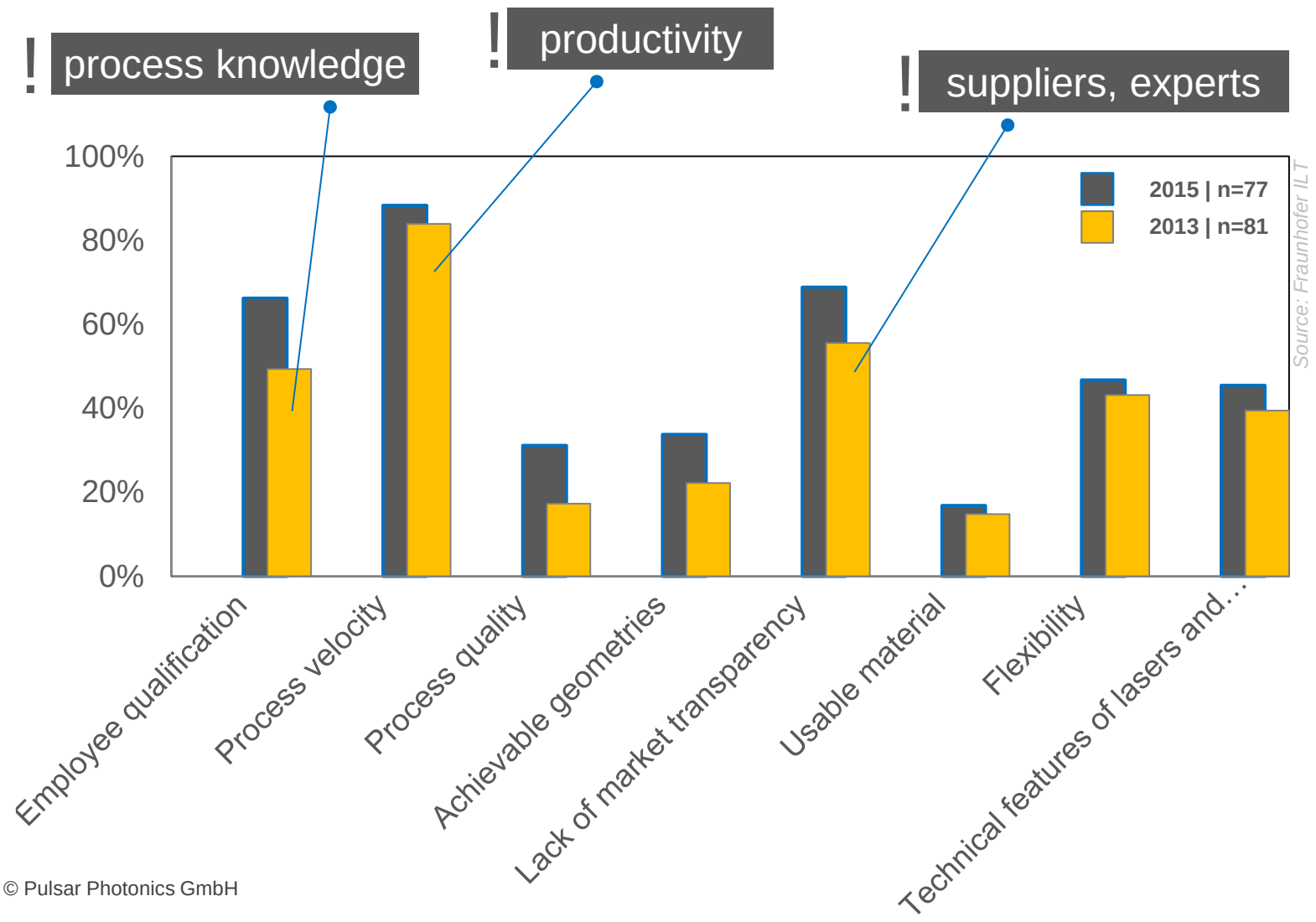




Efficiency = Productivity x Reliability

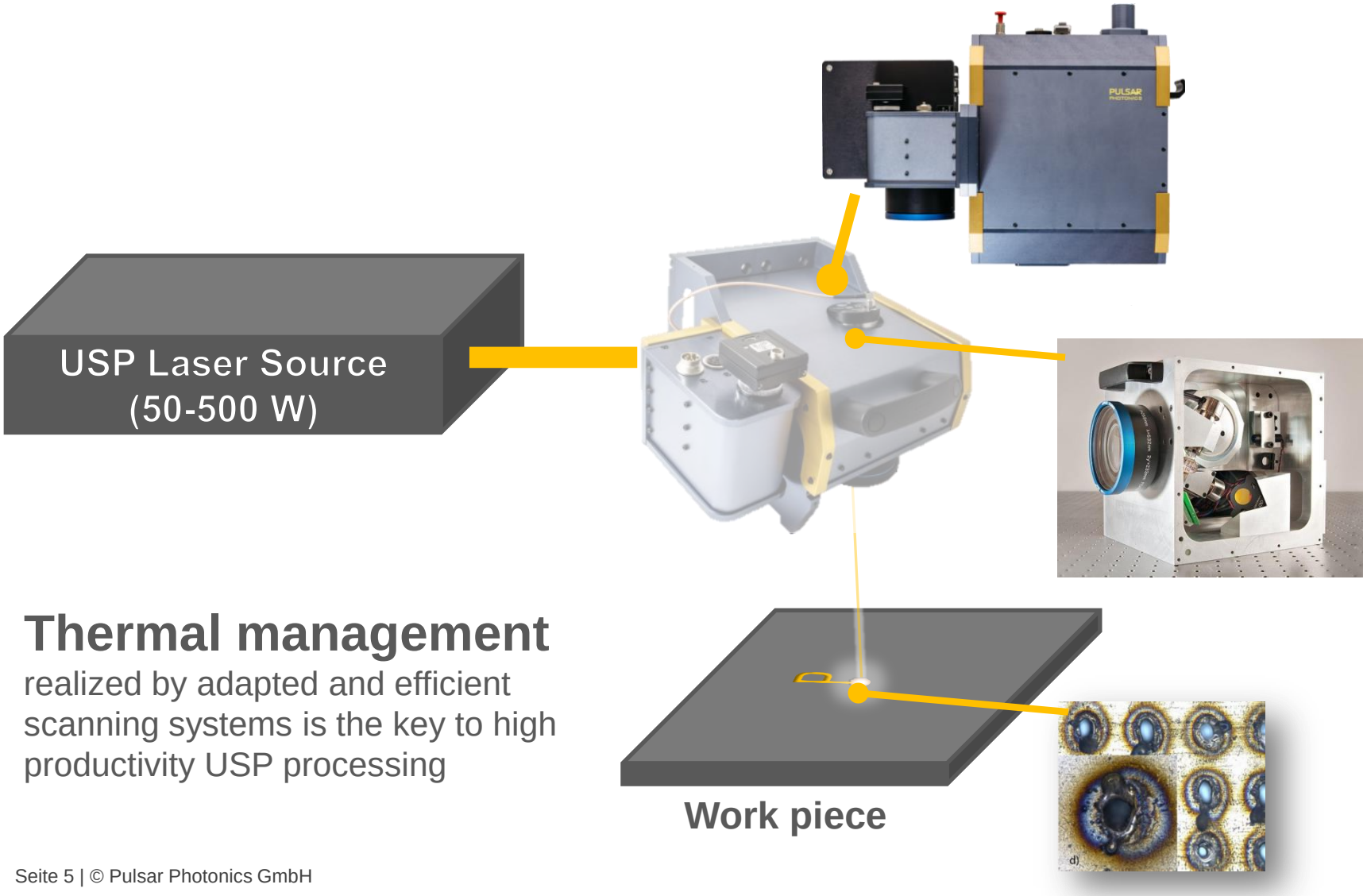
Survey

Barriers in the industrial implementation of ultra short pulsed laser processes



Factors that limit increase in productivity

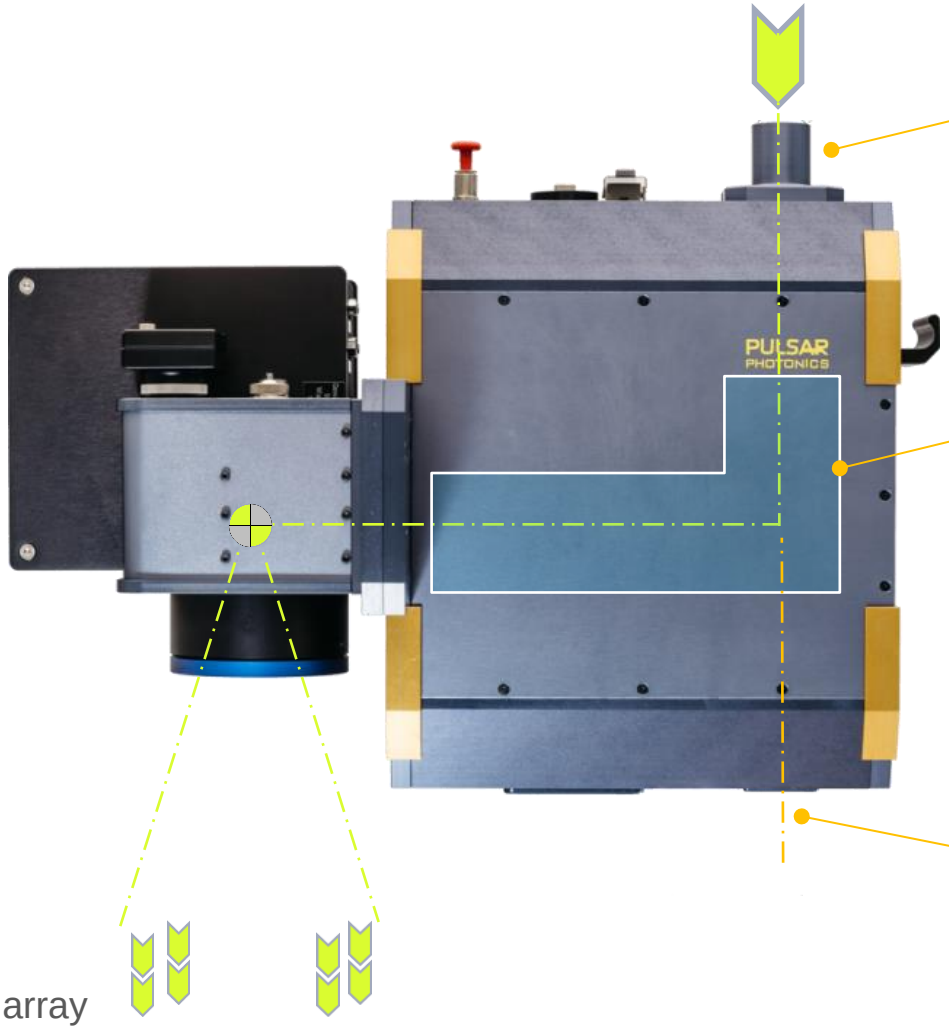
Solution to productivity problem



Thermal management
realized by adapted and efficient scanning systems is the key to high productivity USP processing

Multi Beam Scanner

Set-up MBS 532



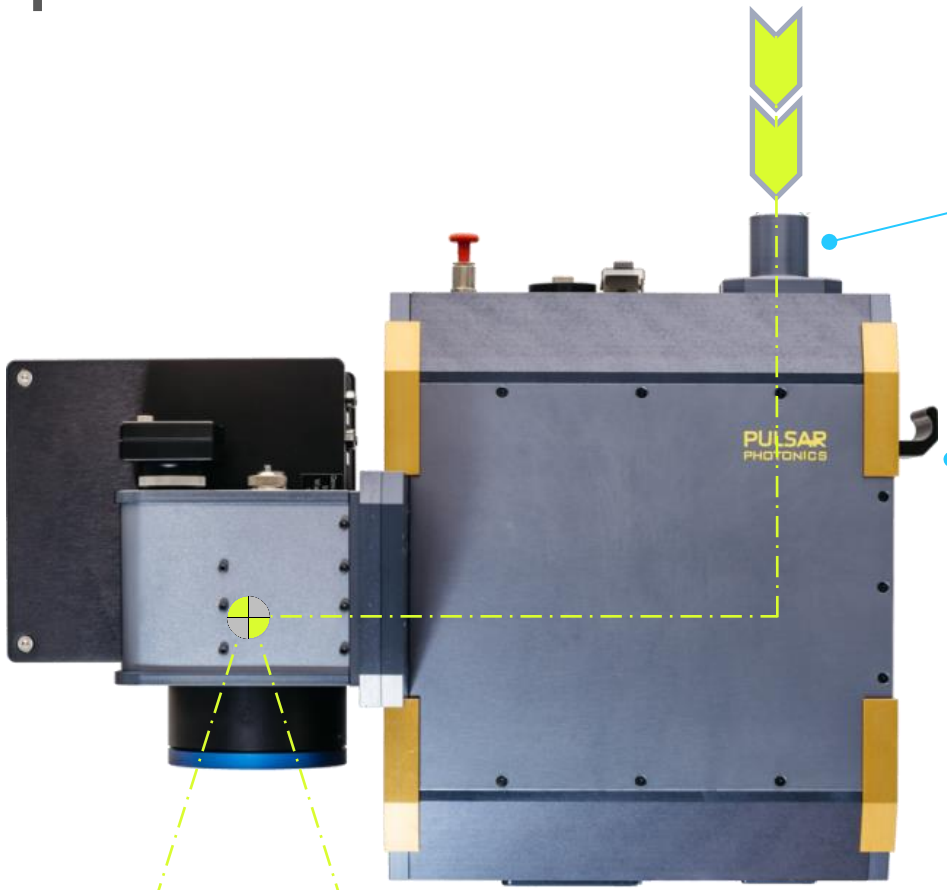
laser
aperture

beam splitting by DOE &
motorized multi-axes
beam alignment

coaxial
camera
port

scanning
of a spot array

Set-up *MBS 532 G3*



laser
aperture

exchangeable
beam splitter
(DOE)

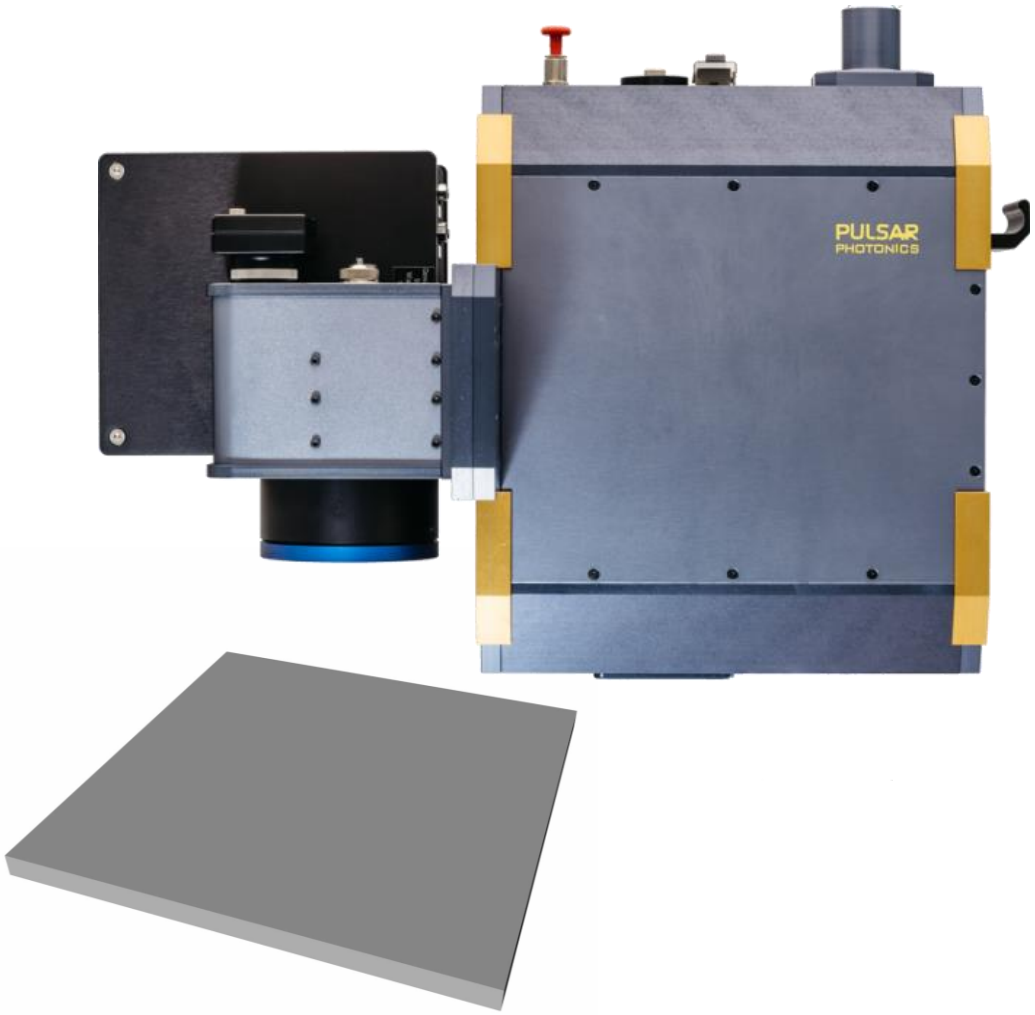
coaxial
camera
port

optical
grating

scanning
of a spot array

Multi Beam Scanner

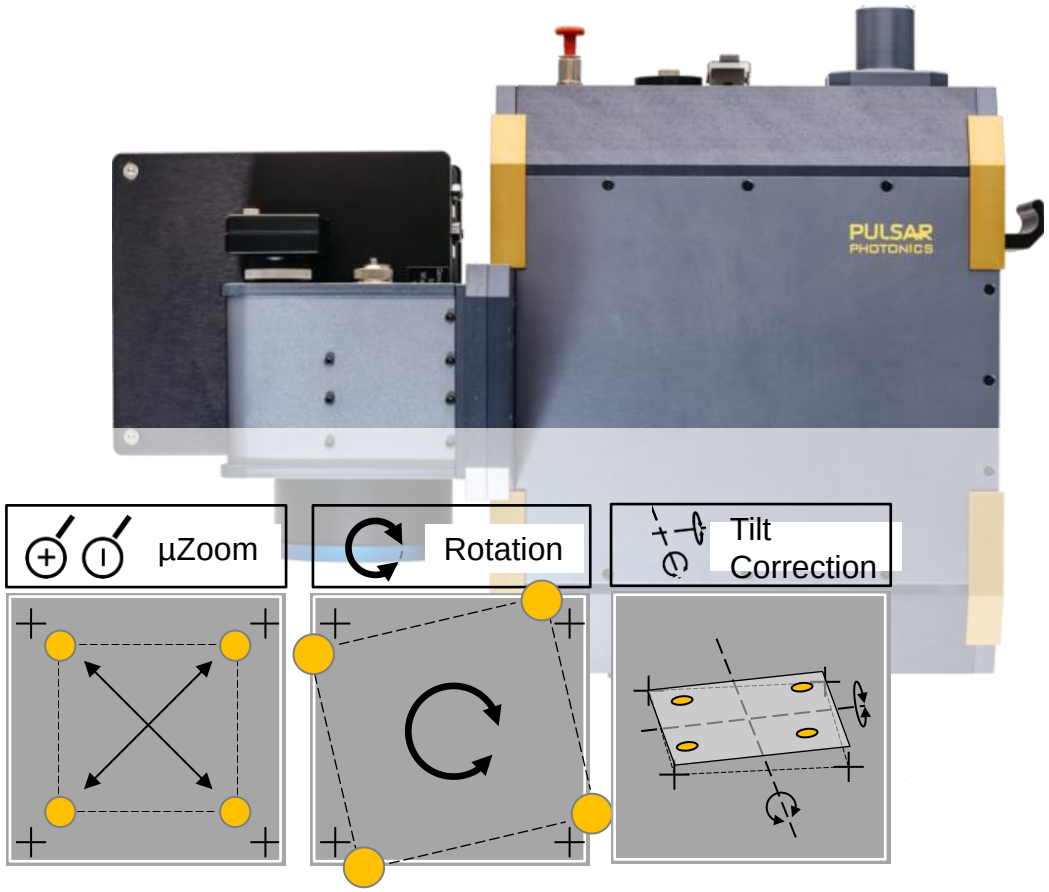
parallel processing by beam splitting

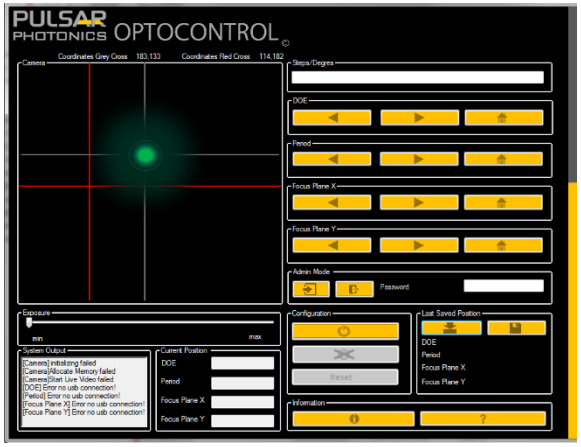


- Max. 100 W
- Beam Diameter: 3-6 mm
- 523 nm / 1064 nm
- Beam splitter
  (free design of DOE)
- 22 kg (scanner included)
- Alignment control
- Field Size: 7x7mm @ f100 mm
  Spot Position Error <3 µm
- Optical efficiency >70 %
  Spot uniformity <7 %

Multi Beam Scanner

Software assisted alignment





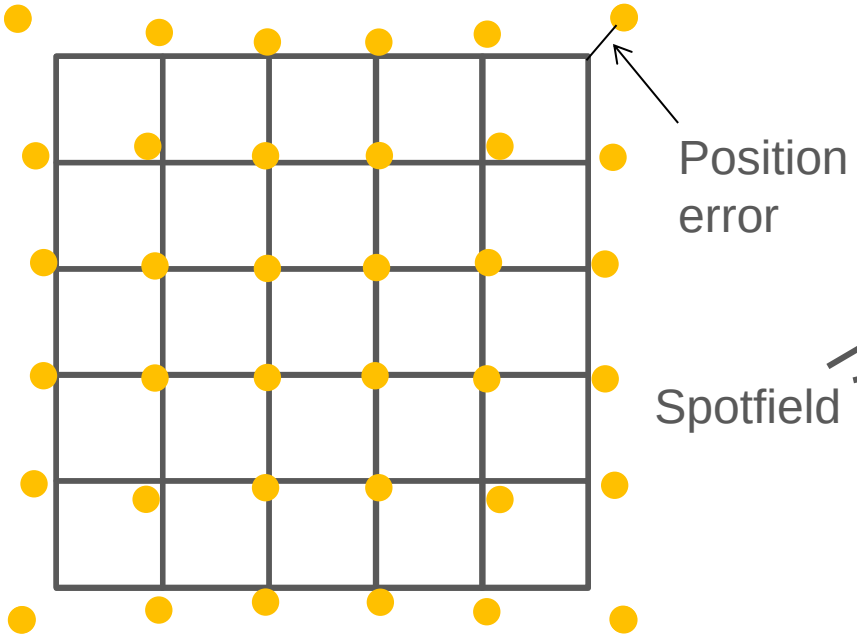
software kit

initial alignment

Limits of the MBS system

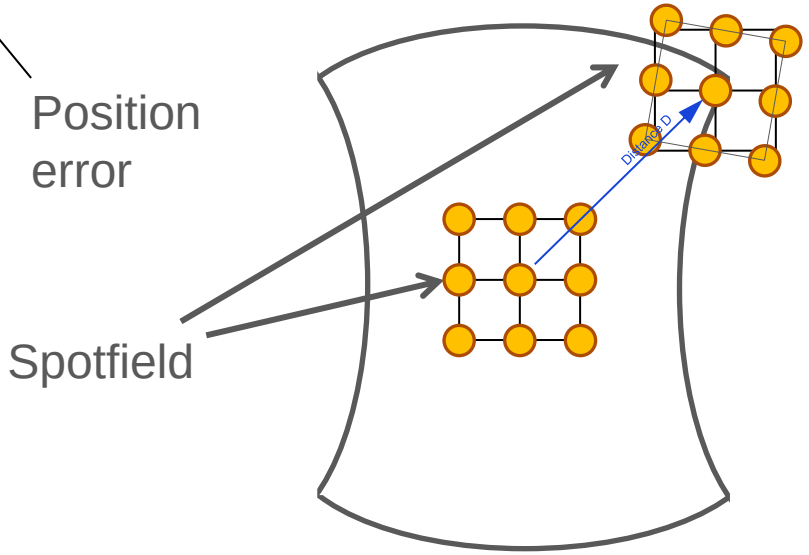
Disortion of the spot grid due to optical effects

Position error: <3 µm at f=100 mm



Position accuracy of spots relative to another

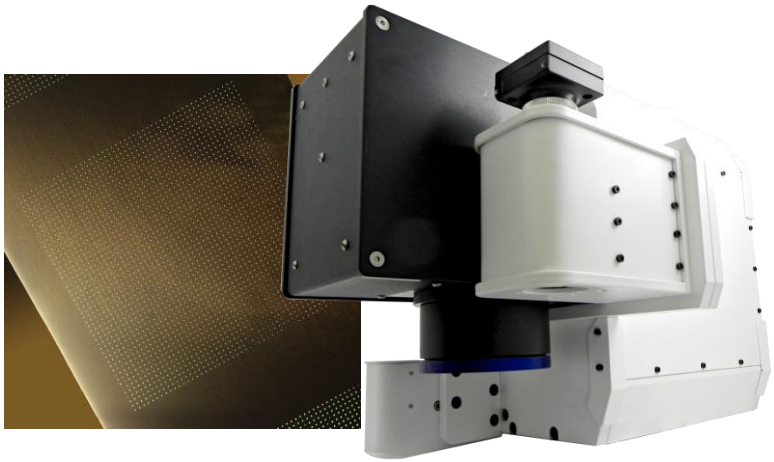
Position error dependant on scaninng angle

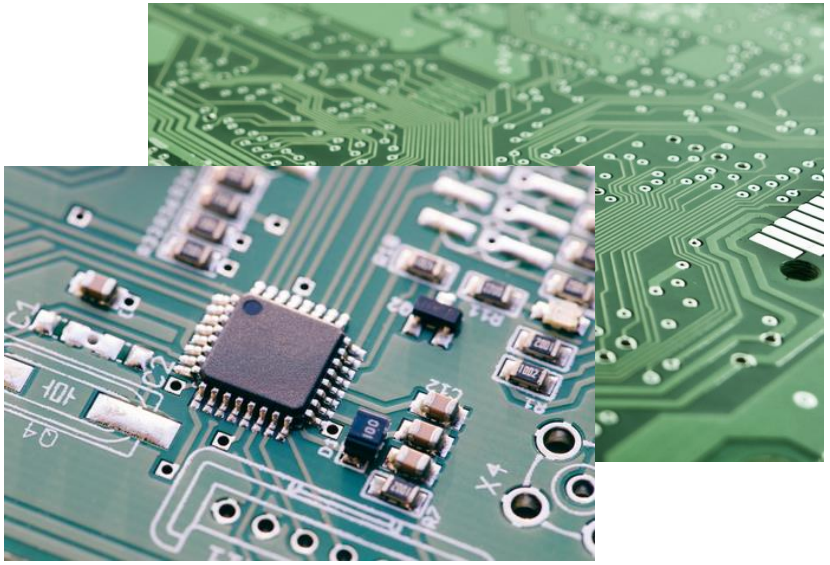


Distortion of the spot field due to focussing optics

Application in Electronics

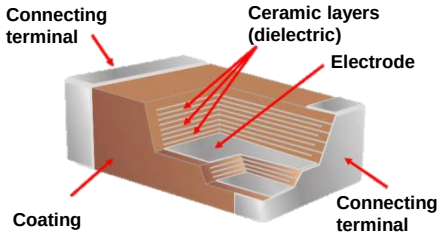
Multibeam Technology for LTCC-Processing





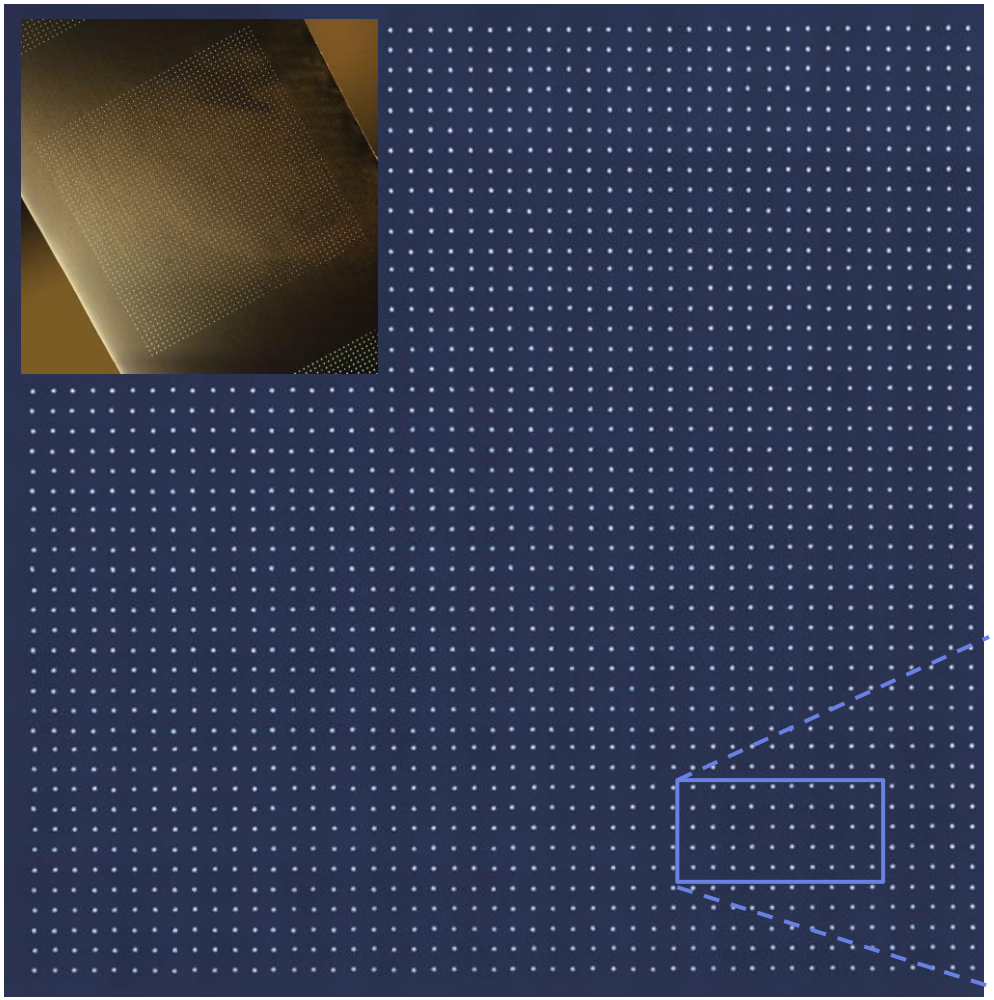
Green ceramics on carrier foil

- Via-hole diameter Ø20-25 µm
- Hole distance 100 µm
- Target Drilling rate 5.000 sec^{-1}

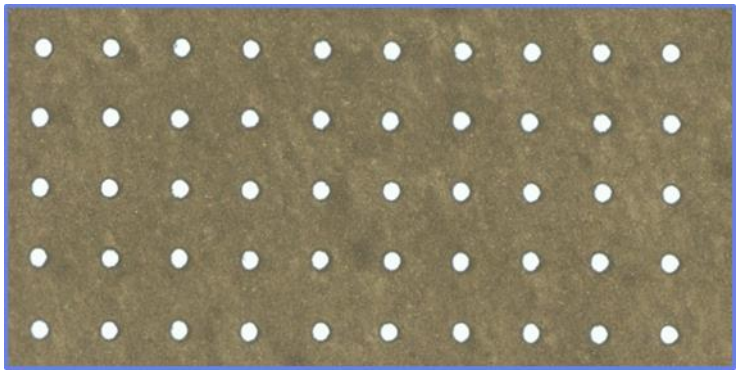


Application in Electronics

Multibeam Technology for LTCC-Processing

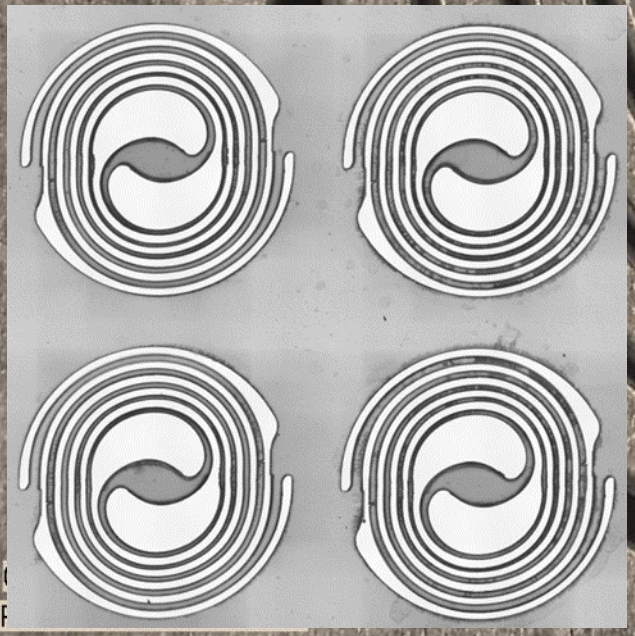


- Laser 40W@532nm
- Multibeam 4x4
- Hole diameter Ø23 ±1,5 µm
- Drilling rate
  - Maximum: 14 kHz
  - Average: >6.4 kHz



Laser processing of multiple parts

Parallel production of micro springs in steel



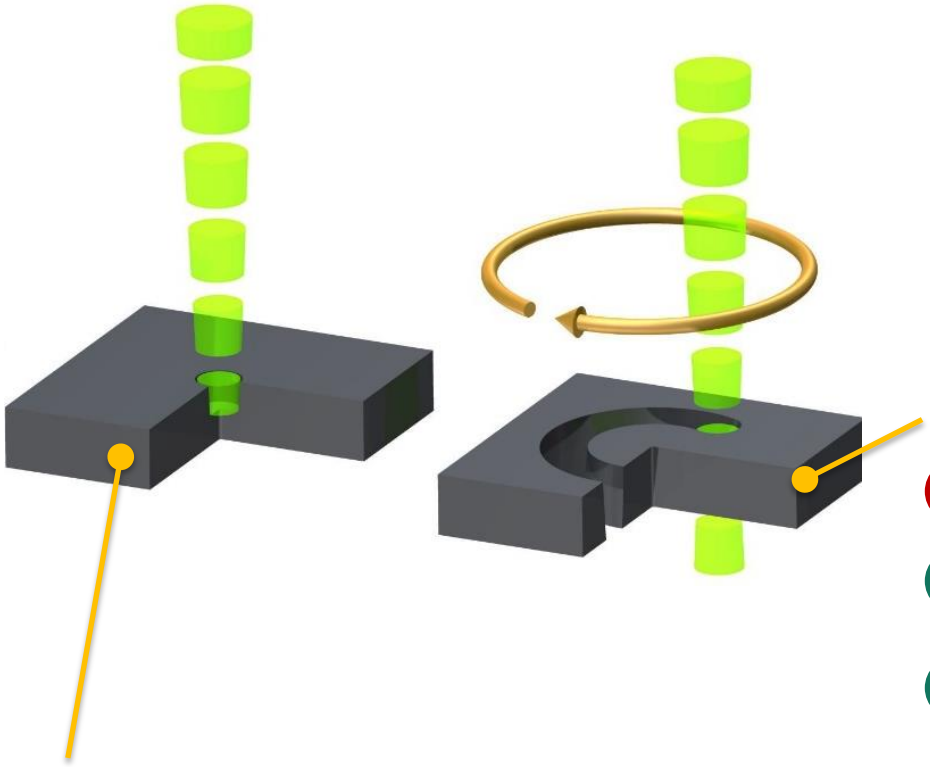
Micro springs:

- Foil thickness: 30 µm
- Diameter spring: 5 mm
- Kerf width: 50 µm
- 2 x 2 laser processing

50.00 um/div

Efficient Drilling of large diameter holes

Percussion drilling vs. trepanning



Trepanning (cutting)

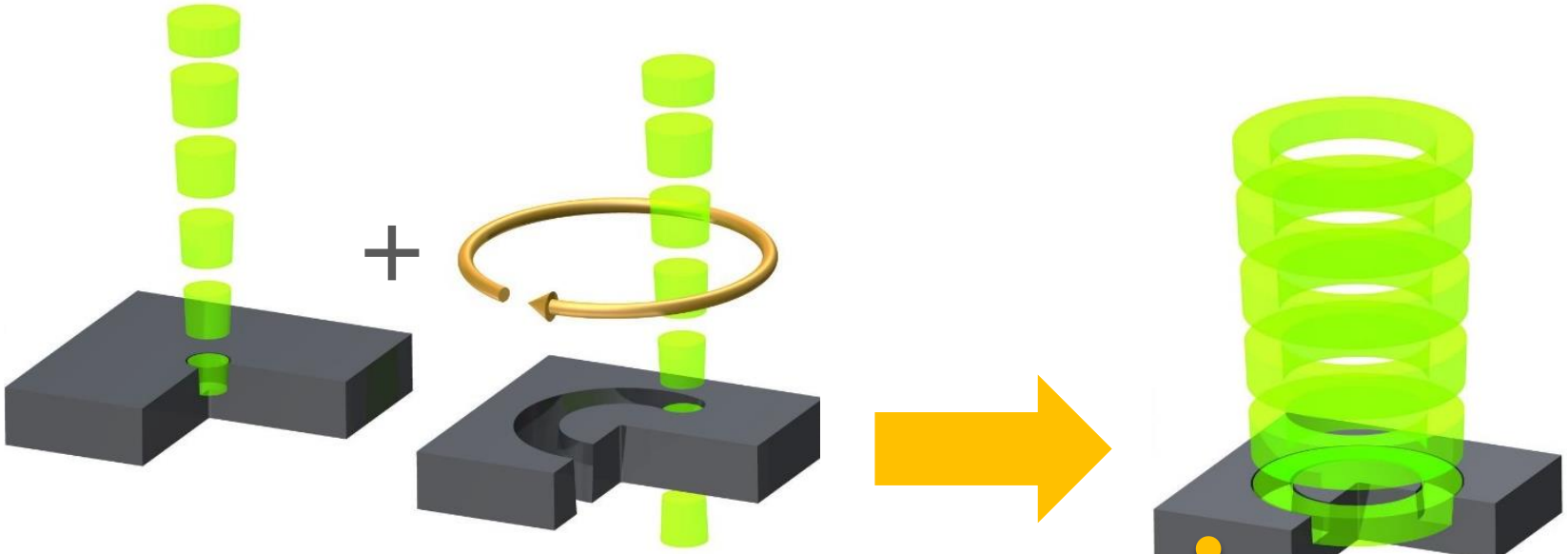
- \- Low drilling rates
- \+ Efficient material removal for large diameter holes
- \+ Precise hole contour

Percussion drilling

- \+ High drilling rates (Point & Shoot mode)
- \+ Efficient material removal for small diameter holes
- \- Large diameter drilling difficult or inefficient

Efficient Drilling of large diameter holes

Percussion drilling with doughnut profiles



Vortex element

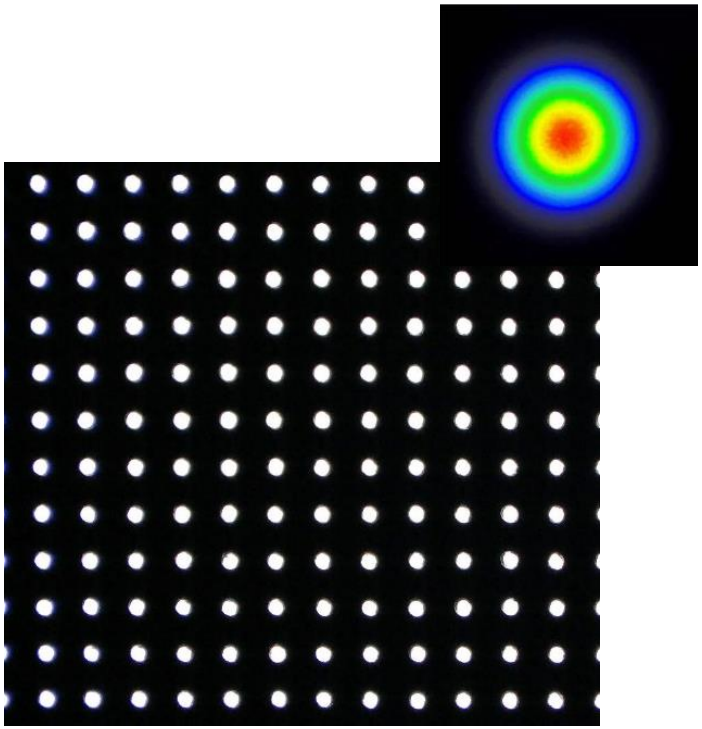
Modified percussion drilling

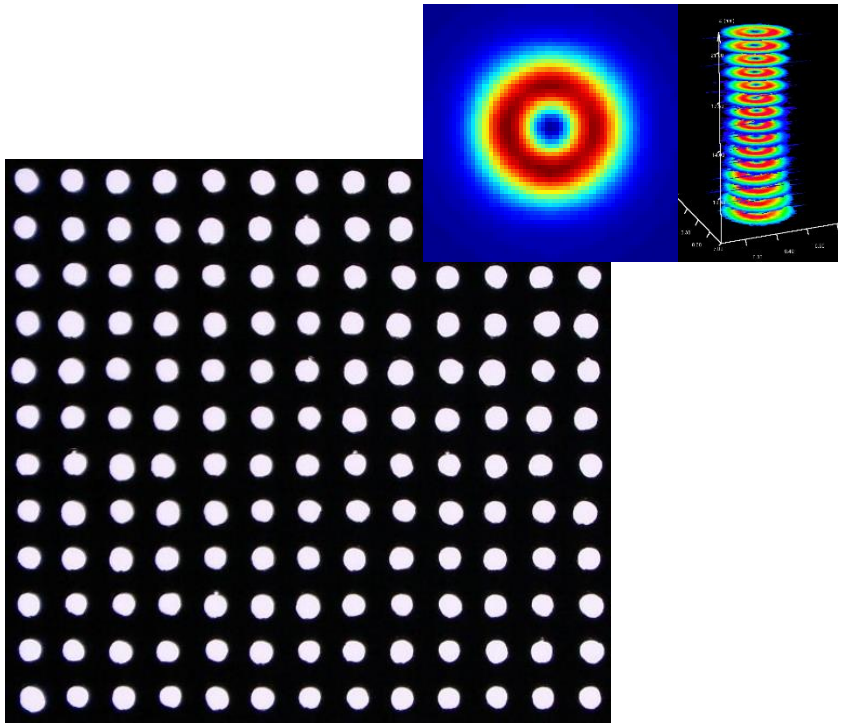
- \+ High drilling rates (Point & Shoot mode)
- \+ Efficient material removal for large diameter holes

Efficient Drilling of large diameter holes

Vortex Elements for generation of doughnut intensity profile

PULSAR PHOTONICS





Gaussian beam shape

- Foil thickness: 25µm
- Hole diameter 40µm
- Percussion drilling

Doughnut beam shape

- Foil thickness: 25µm
- Hole diameter 80 µm
- Percussion drilling!

Flexible Beam Shaper

Design of a flexible beam shaping system using phase modulators

Active Cooling
of phase modulator

- Beam-shaping using a phase modulator
- Control software for intensity pattern generation
- Active Cooling for high power laser processing
- Scan-head integration

DIGITAL
PHOTONIC
PRODUCTION

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