



# Dynamic Laser Beam Welding of High-strength Aluminum Battery Enclosures

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Civan Lasers Europe GmbH



# What We Do.

01

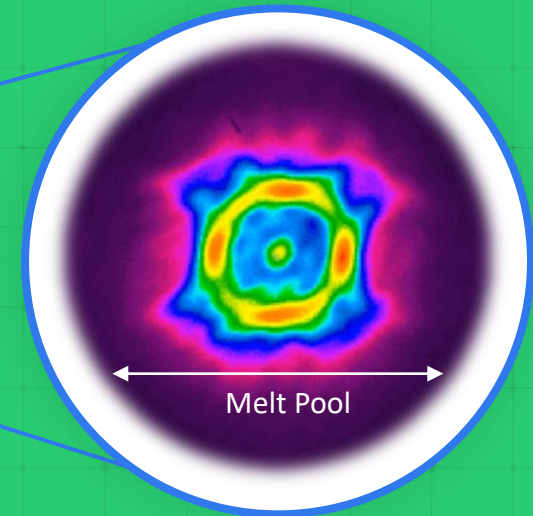
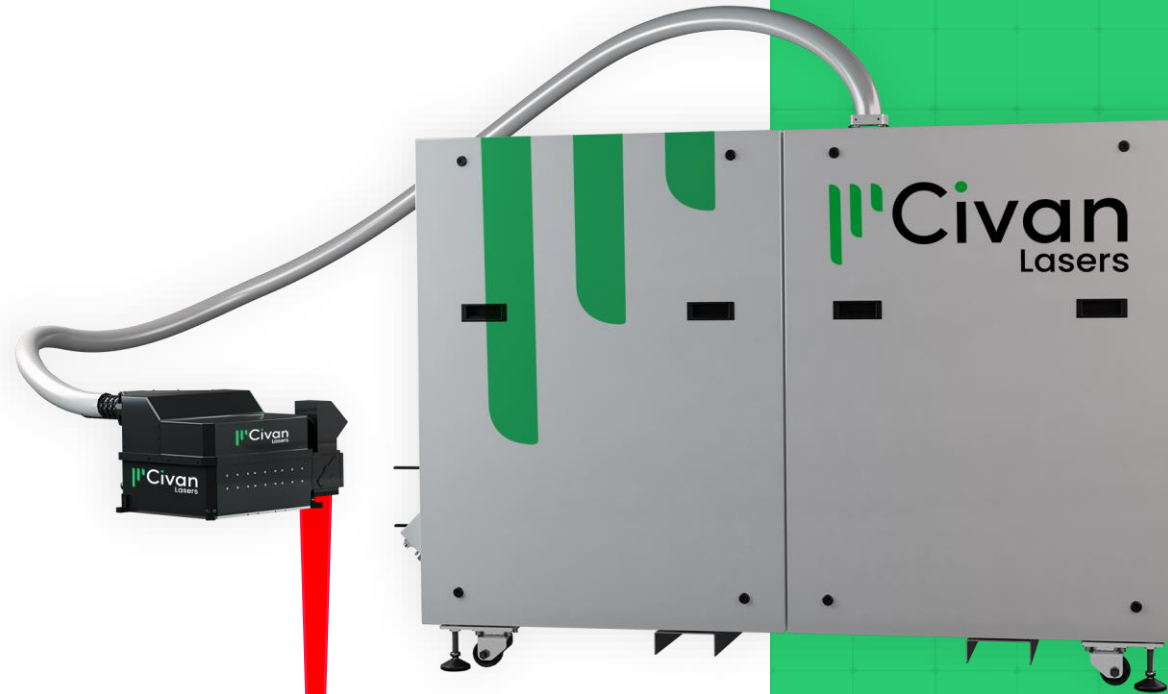
**Dynamic Beam Lasers**

02

**New category  
of laser technology**

03

**Making previously impossible  
applications a reality**



# About Civan Lasers

## The Most Advanced Laser for Welding.

- 01** First and only company to offer commercial laser based on CBC
- 02** All core technologies in house with more than 90 patents
- 03** 170 employees located in Jerusalem, Israel  
New application lab in Hannover, Germany
- 04** Lasers sold to the Automotive tier 1, Shipyards & Research Centers

### Awards



- Insights into welding aluminium using beam-shaping
- Inspire to push the boundaries of laser material processing

### Civan Lasers DBL





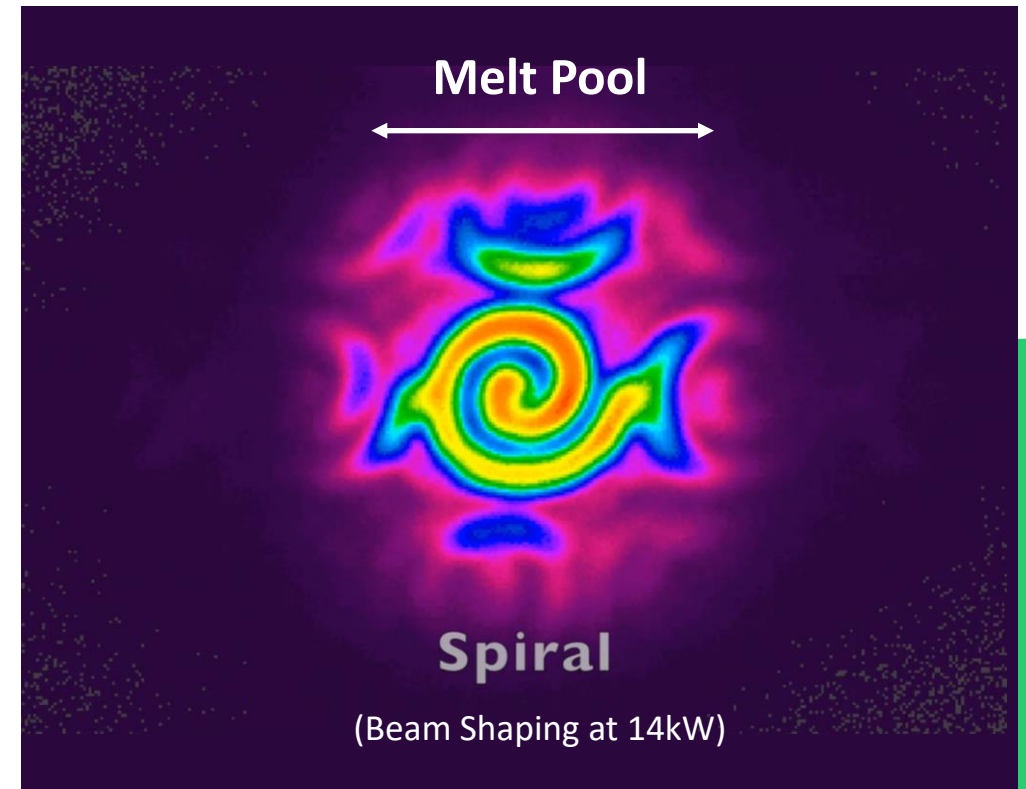
# Dynamic Beam Laser

# Dynamic Beam Laser

## Features:

- 01 Dynamic Beam Shaping – any arbitrary shape
- 02 Control of Shape Frequency – 1Hz to 40MHz
- 03 Shape Sequence – change shape every uSec
- 04 Focus Steering – tens of mm

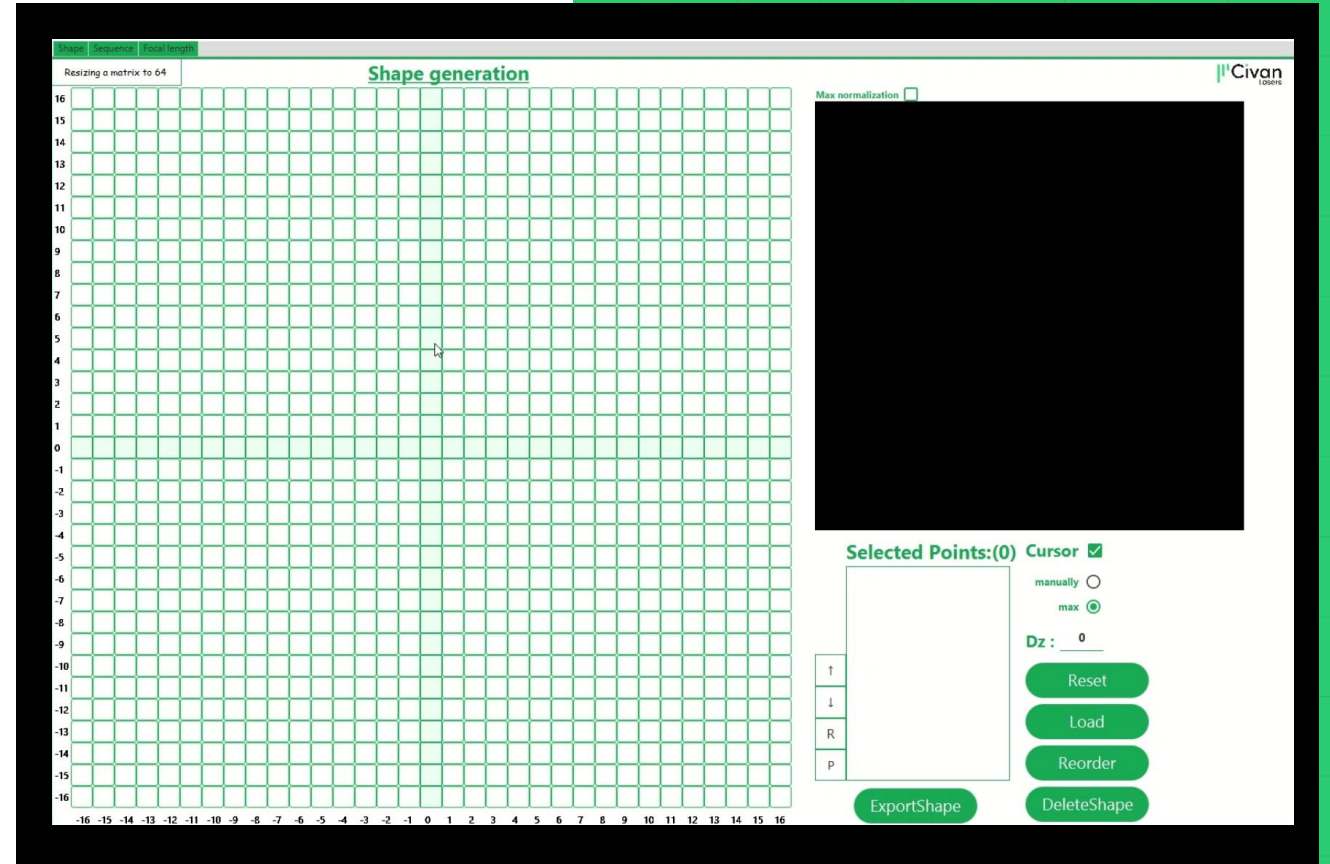
**High Power, Fast, Reliable**



# Design New Beam Shapes With Software

## Features:

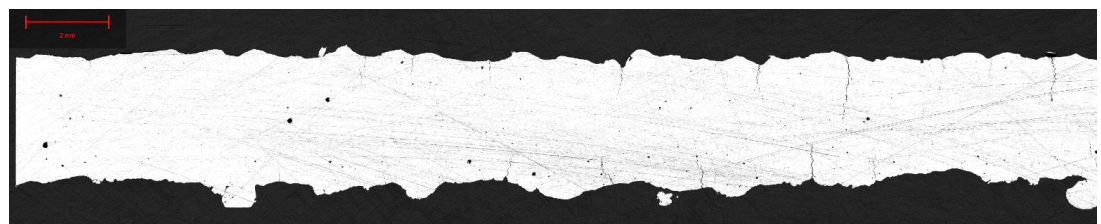
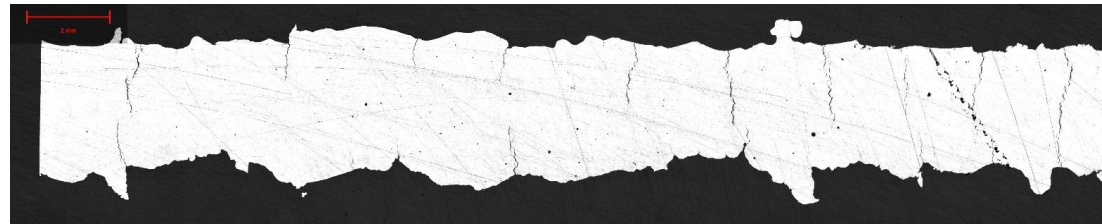
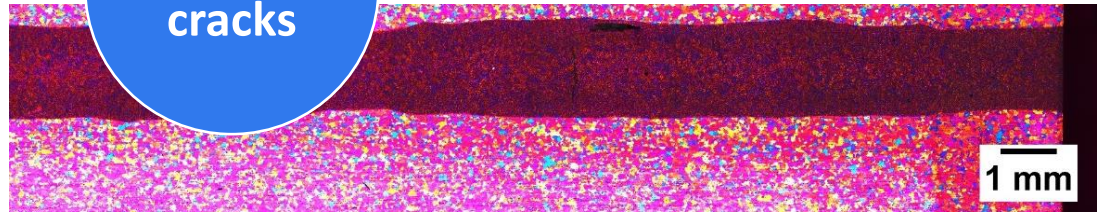
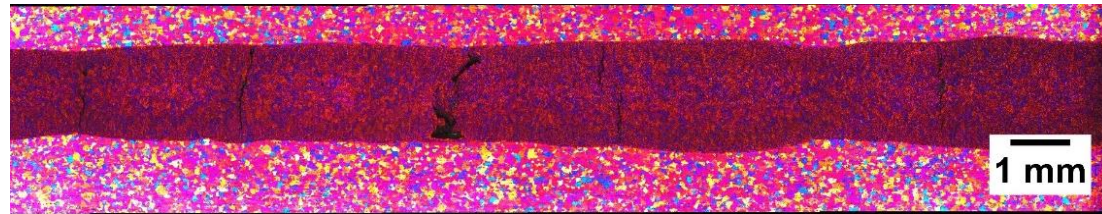
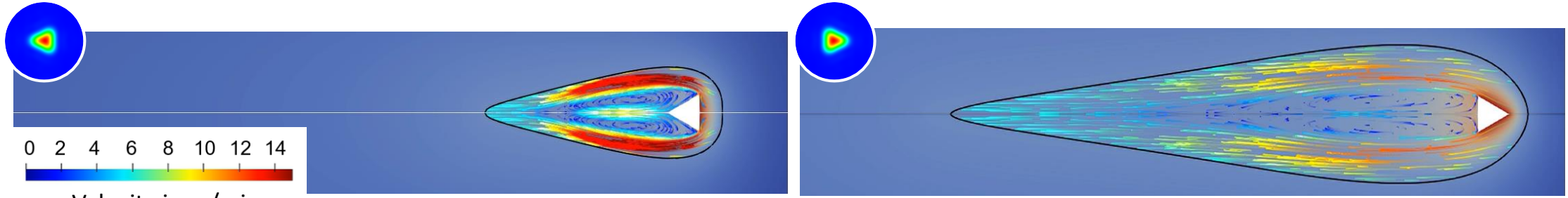
- 01 Design shape geometry
- 02 Define energy distribution
- 03 Control beam motion
- 04 Electro optically control of focus





# Case Studies

# High-strength aluminum – reduction of cracks



Al 7075

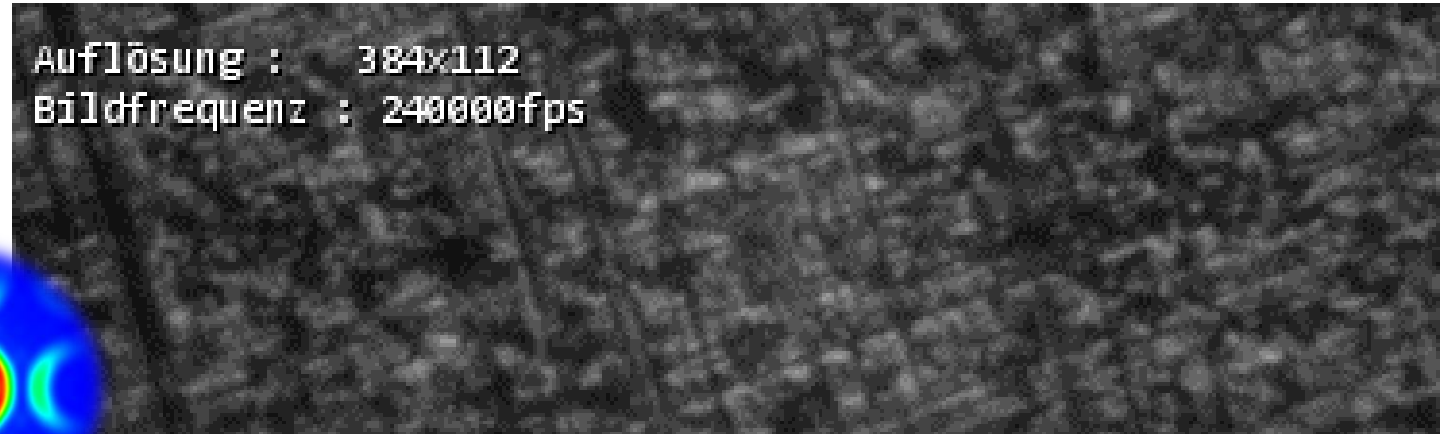
[Jonas Wagner, 2023, Influence of dynamic beam shaping on the geometry of the keyhole during laser beam welding]





# Beam Shape

Beam shape influence on melt flow dynamics and lifetime of the melt pool



Power

0.8 kW

Feed Rate

1 m/ sec

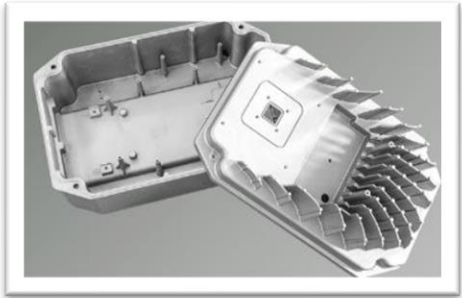
# Al Die Cast Case Study

## Benefits of Dynamic Beam Laser:

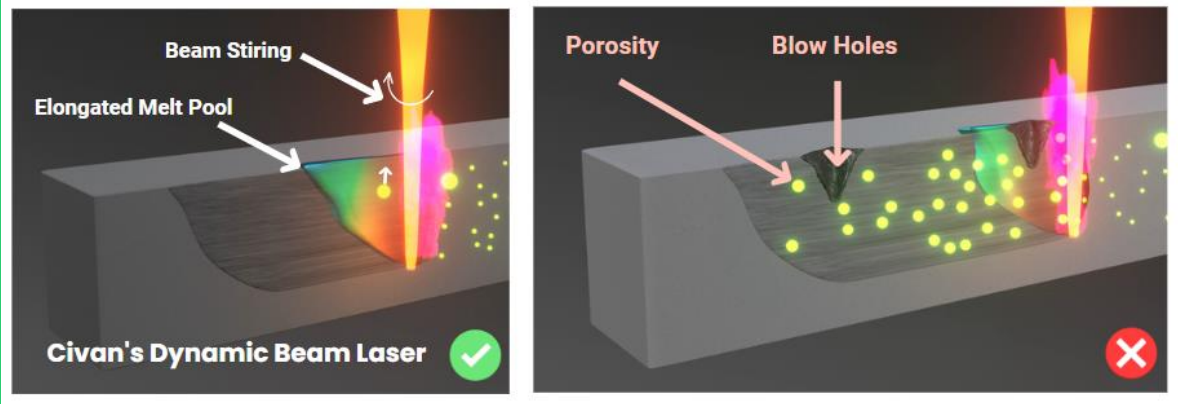
- 01 Increase welding speed by **x45**
- 02 Enables to weld parts with electronic components inside
- 03 Enables to re-work faulty welds



**Camera Case**  
Welding case with electronic components inside



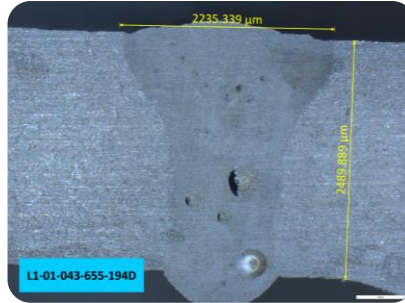
**Heat Exchanger**  
Welding air-tight, hermetically sealed



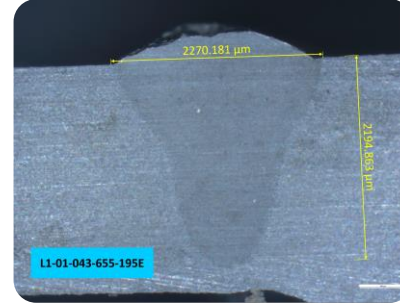
- Al Die Cast is the most cost-effective manufacturing method for serial production of complex part
- However, Die Cast parts are very difficult to weld, thereby limiting the use of Die Cast in many application
- Currently Die cast parts are usually joint using stir friction welding which is slow and requires special design to withstand the friction
- Using Dynamic Beam Laser, high quality, gas tight welding is possible at high speed

	Friction Stir Welding	Dynamic Beam Laser
Welding Feed Rate	0.2m/ min	9m/ min

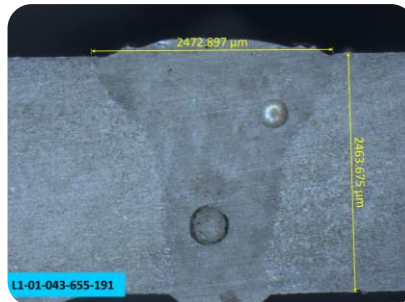
# Dynamic Beam Laser Welding Al Die Cast.



1.8% porosity



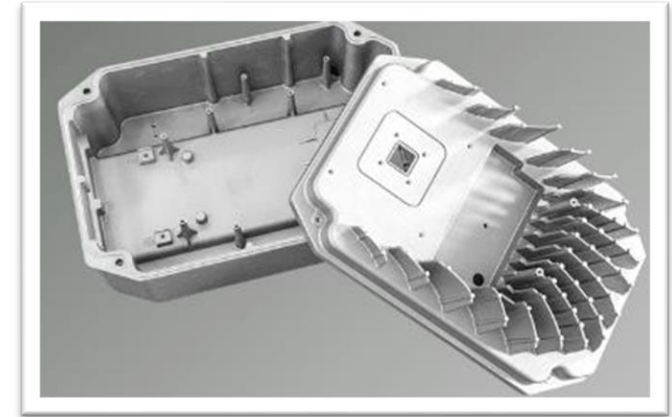
0% porosity



1.2% porosity

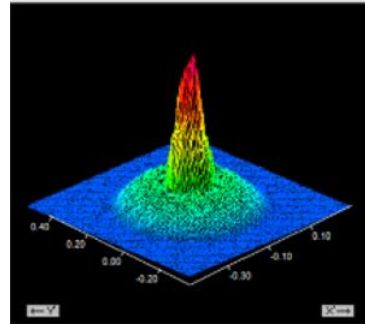
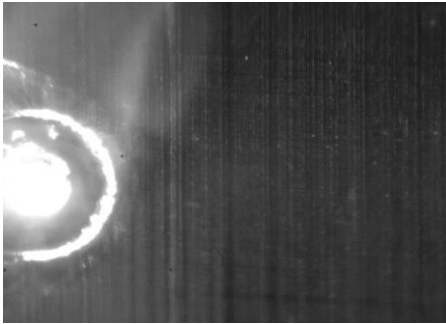


0% porosity

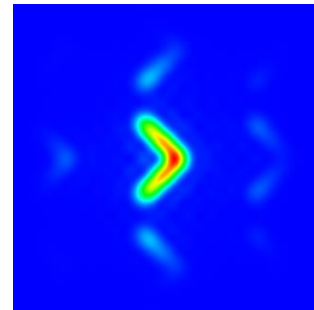
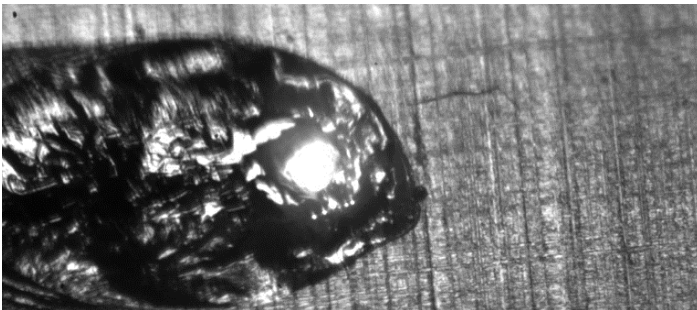
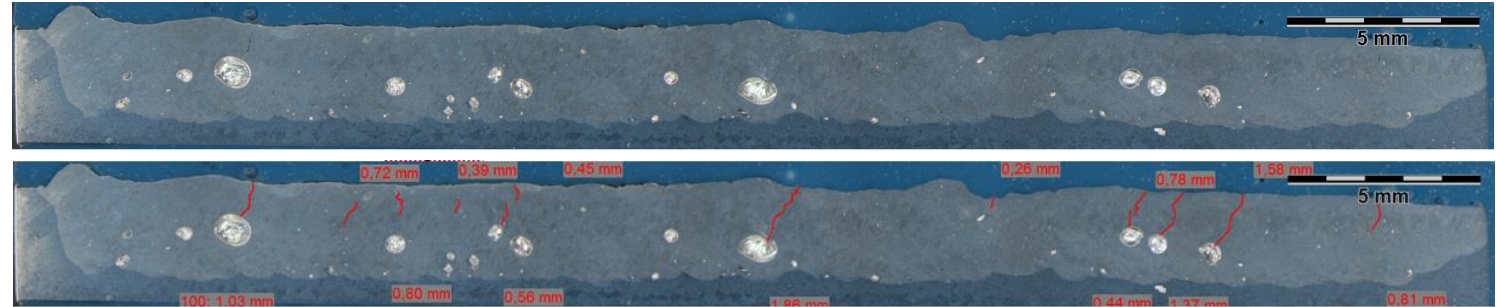


# Comparison of different beam shapes

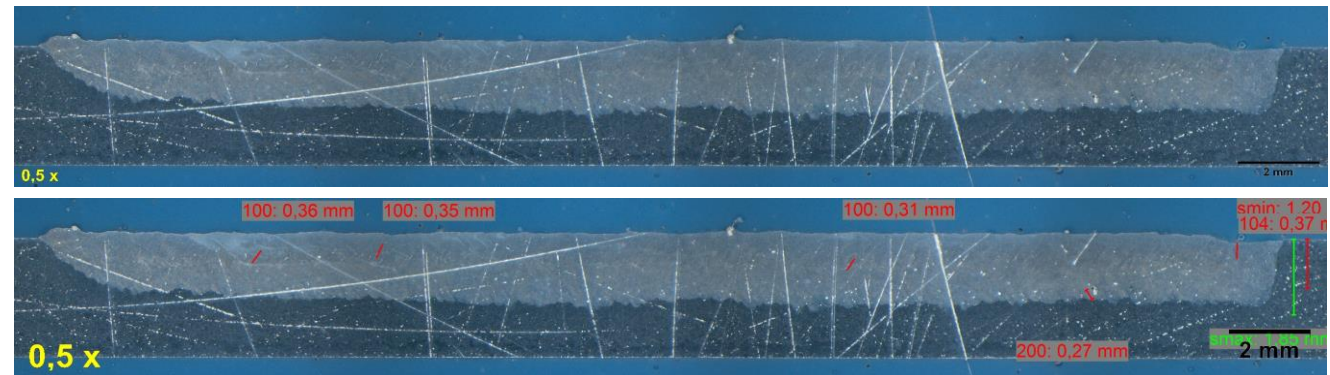
Aluminum AW 6060 or AlMgSi0,5



Parameter: Trumpf Disk laser, BLW 50/50, focal diameter 250/1000;  
power = 4,5 kW, speed = 100 mm/s

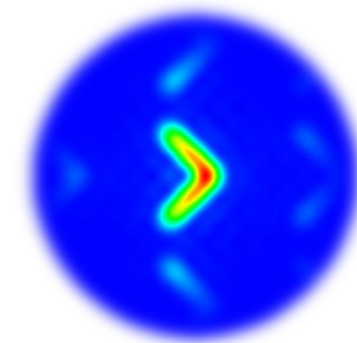
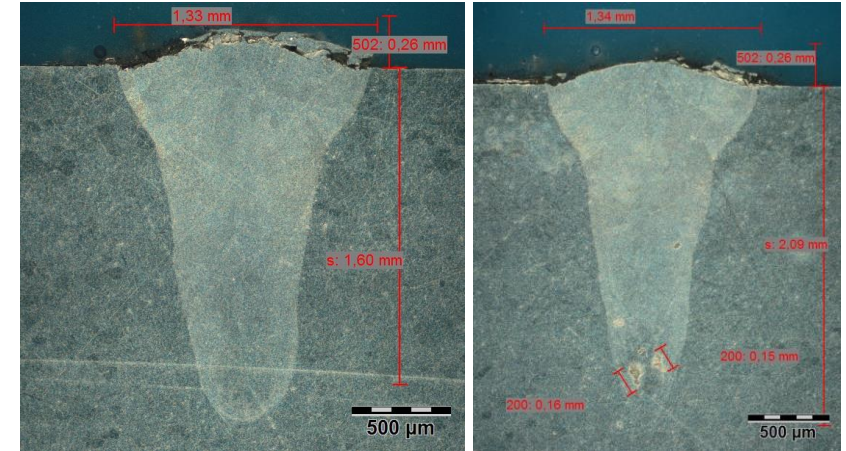


Dynamic Beam Laser Parameter: frequency = 222,2kHz; power = 1,8 kW, speed = 100 mm/s

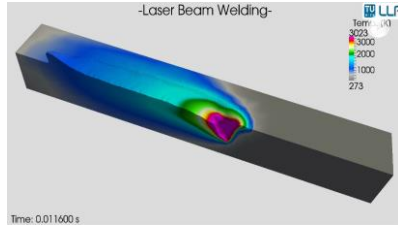


# Aluminum AW 6060 or AlMgSi0,5

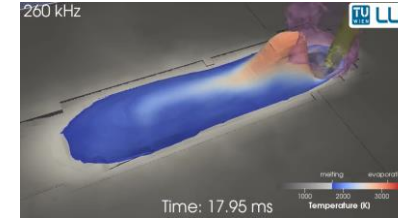
- V beam shape with high medium frequency, **100 mm/s**
  - Very low porosity, crack free
  - At this welding speed cracks were normally always visible



# Conclusion - Dynamic Beam Capabilities



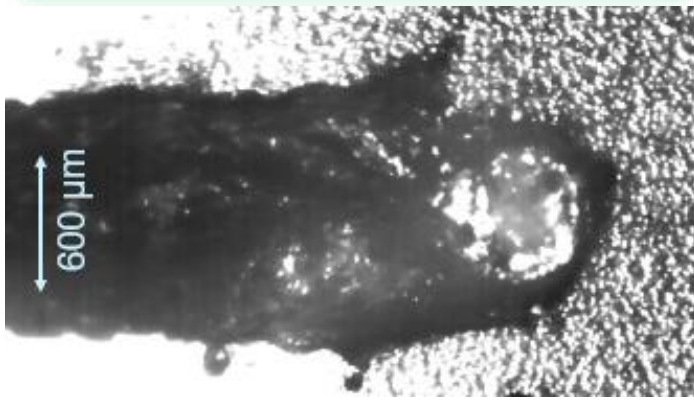
Control over thermal distribution and Thermal gradients in space and in time



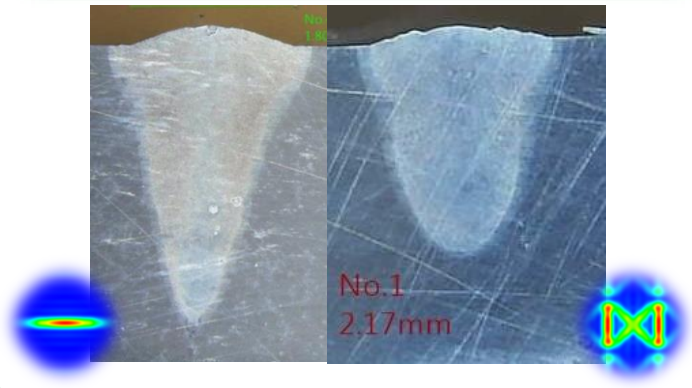
Control over dynamic flow of molten material in melt pool



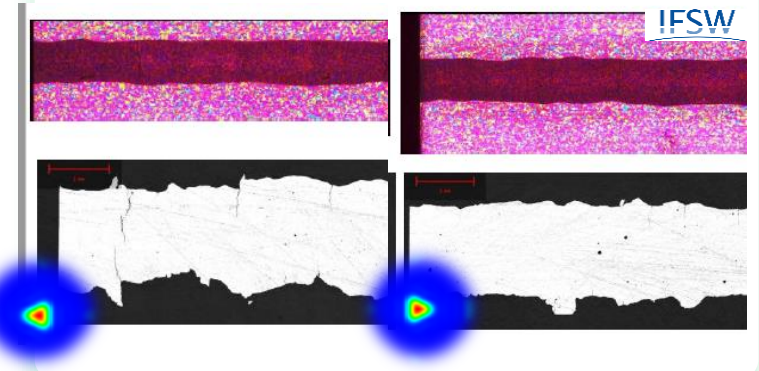
Stabilize Keyhole & melt pool



Tailor weld geometry



Solidification



# Thank you!



Interested in seeing it yourself?  
Visit us at our new application lab in Hannover, Germany



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# Appendix

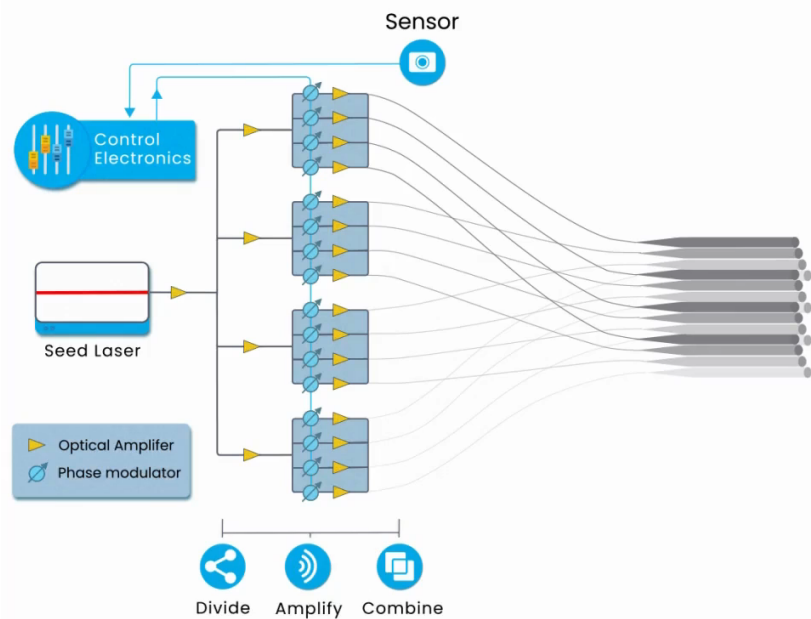


# Coherent Beam Combining (CBC)

Coherent Beam Combining (CBC) of Fiber Lasers



Optical Phased Array (OPA)



# EV's Battery Cooling Plates Case Study



## Benefits of Dynamic Beam Lasers in comparison to Brazing:

- 01 Save cost per part
- 02 Saving \$M in running costs
- 03 Reduced carbon footprint



Battery cooling plate



Vacuum brazing furnace

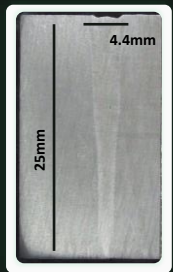


Laser Welding of Cooling Plates

- 01 Battery cooling plates are part of the Battery Thermal Management System
- 02 Today manufactures are using brazing to join the plates
- 03 Dynamic Beam Lasers can weld with feed rate of 30m/ min which is better alternative for manufactures
- 04 Laser Welding allows to use new aluminum alloys that are recyclable and not possible to join in brazing

	Brazing	Dynamic Beam Laser
System cost (M€)	4-5	1 - 2
Power consumption	4 MW	0.5 MW
Footprint	800 SQM	25 SQM

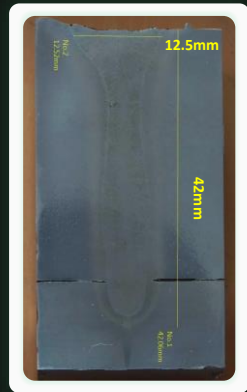
# Deep Penetration with Dynamic Beam Laser.



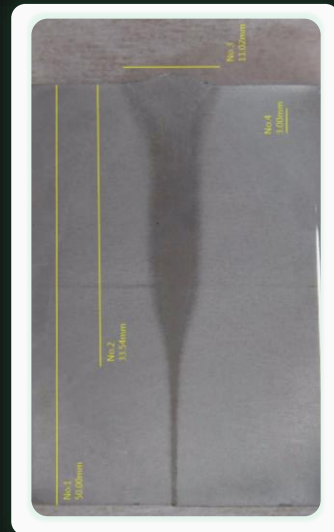
25 mm



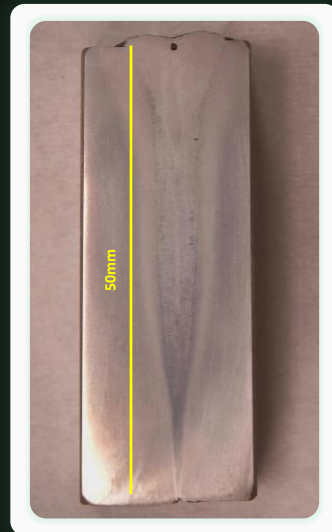
40 mm



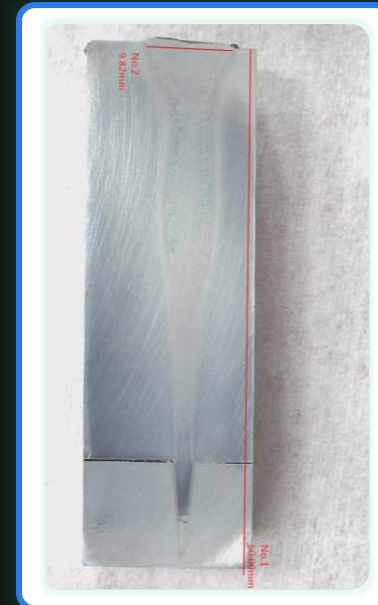
42 mm



50 mm



50 mm



60 mm



70 mm