Professorship of Laser-based Additive Manufacturing

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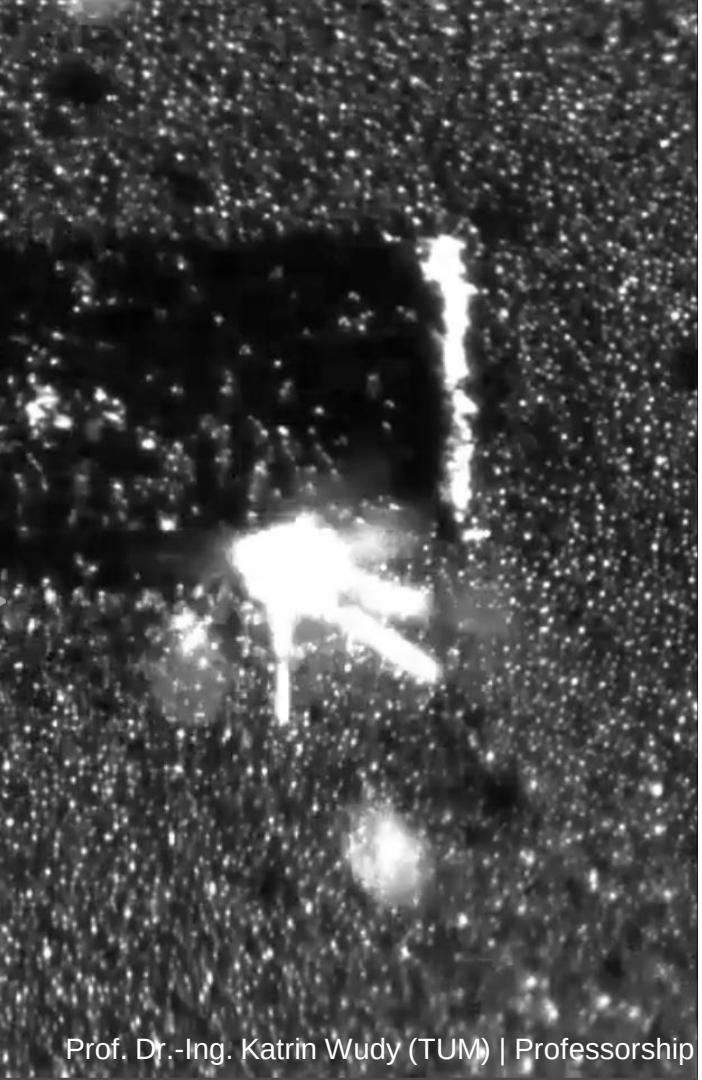


Introduction and Motivation

Highly dynamic and chaotic powder bed fusion process with spatter, denudation, and keyholing.

➔ **Insufficient reproducibility and productivity** with state-of-the-art Gaussian beam in PBF-LB/M.

Introduction and Motivation

Pocket tools

One size fits it all

[victorinox.com]

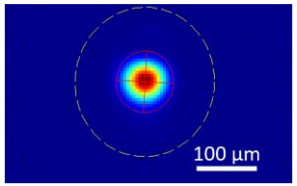
Compromises regarding **functionality**, **usability,** and **efficiency**

Multitool –
Set of tools in the same footprint

[victorinox.com]

Beam shaping multitool open **new possibilities**

Laser-based Powder Bed Fusion of Metals



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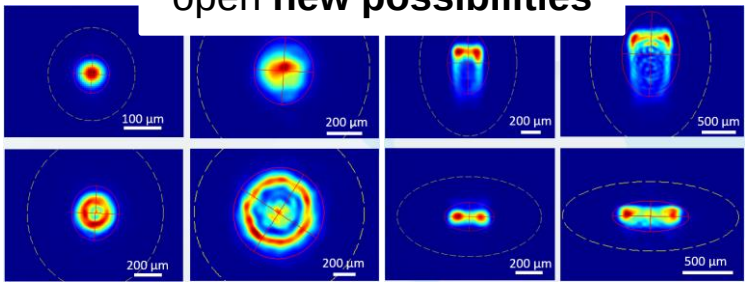
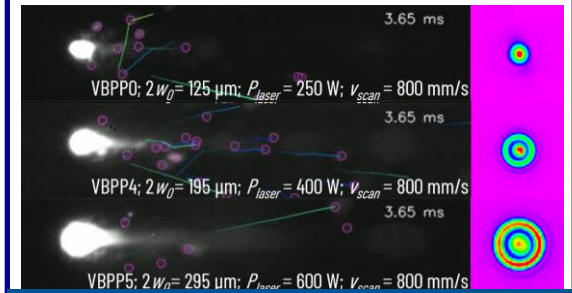


[EOS]

Research highlight @ LBAM

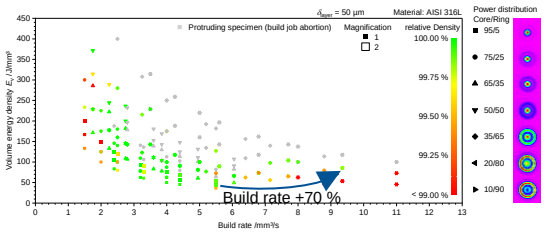
Enhanced process robustness

- Larger process window
  [Grünewald et al. 2021]
- Higher process robustness
  [Grünewald et al. 2025 (submitted)]
- Reduced spatter formation
  [Grünewald et al. 2023]



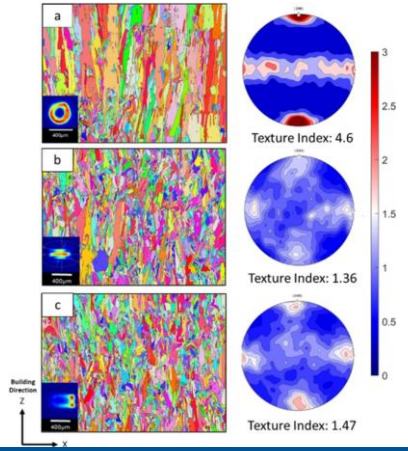
Process acceleration

- Productivity improvement
  [Grünewald et al. 2021]
- Increased build rate
  [Grünewald et al. 2024, Wudy et al. 2025 (accepted)]

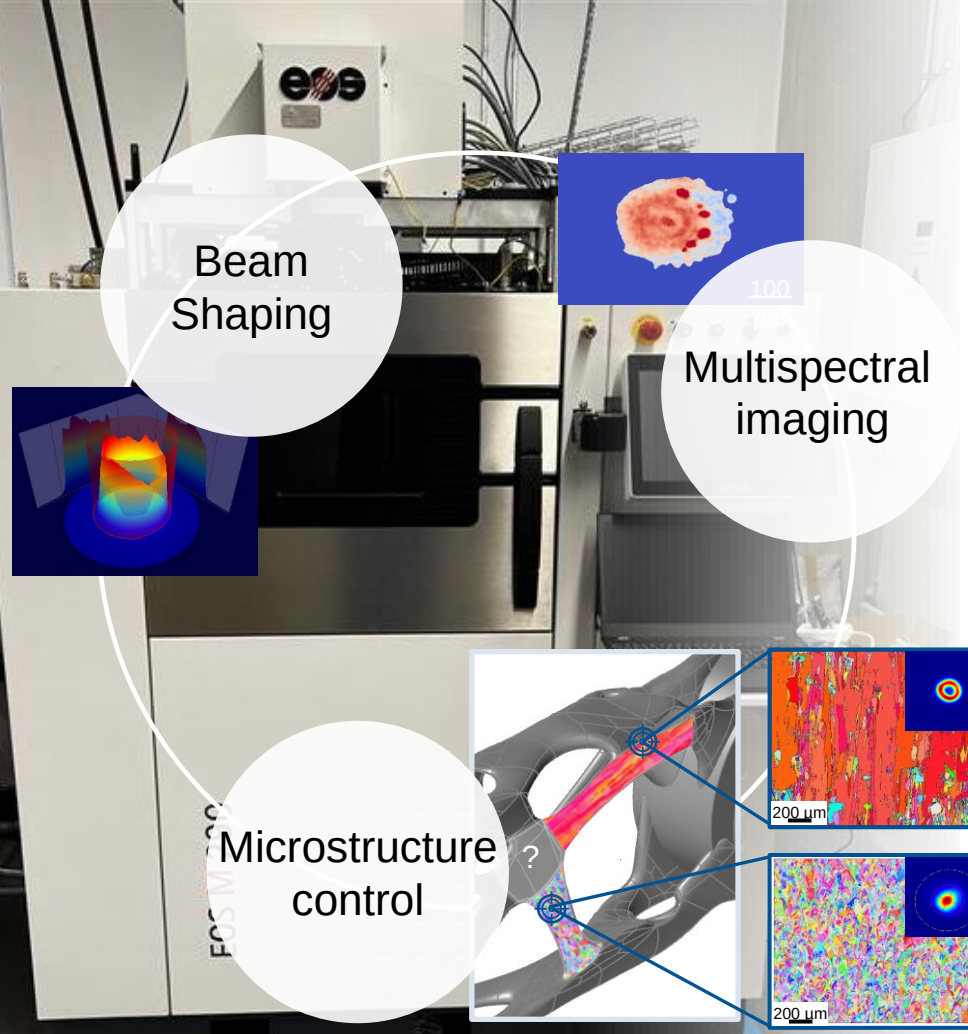


Tailoring of microstructure

- Dependence of beam profile
  [Mirzabeigi et al. 2024]



Alternative beam profiles offer enormous potential for tailoring energy input in laser-based powder bed fusion of metals



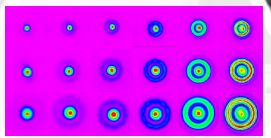
ETN project idea

- **Innovative process strategies:** Combining new beam shapes with monitoring systems to enable:
  - Processing of new hard-to-weld materials
  - Acceleration of the process (by a factor of min. 3) and reducing the costs per part
  - Tailoring of the microstructure and properties

Experimental setup with extended exposure and monitoring options

Laser: nLIGHT AFX-1000

Scanner: RAYLASE AM-MODULE



Spatter detection: High-speed camera

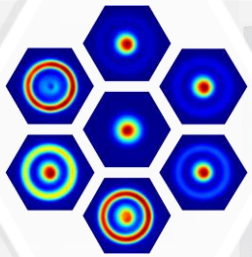
Absorption signal: Integrating Sphere

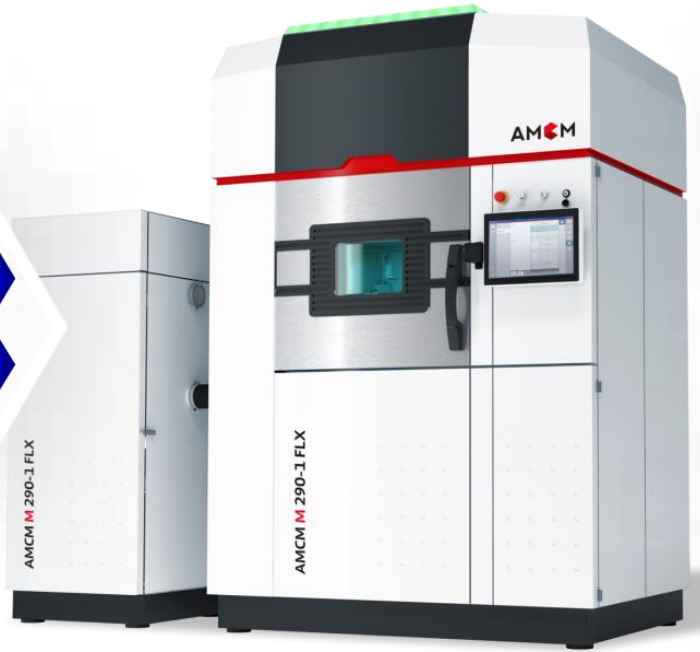
Temperature measure-ment: Multi-spectral imaging

Industrial setup with higher TRL coming in June

Laser:
nLIGHT
AFX-1500

Scanner:
SCANLAB
intelliSCAN





Source: AMCM

Optimized
shielding
gas flow

Process
monitoring:
Exposure OT

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