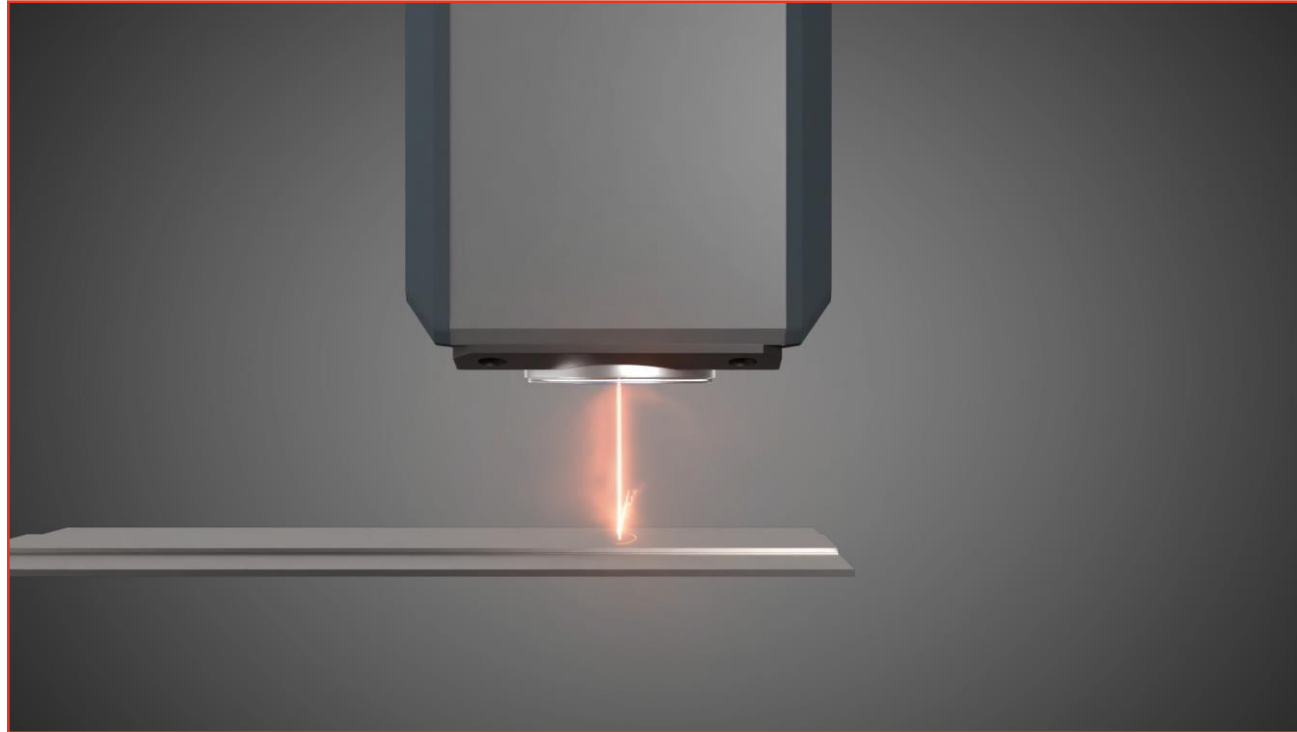


EPIC Online Technology Meeting on New Developments for Laser Welding



Multi-spectral Monitoring for Laser Processes
Dr. Sören Hollatz

VIDEO



OUR MAJOR GOALS FOR YOUR APPLICATIONS

1

Increase Process Monitoring Accuracy
→ Pseudo faults are super painful!

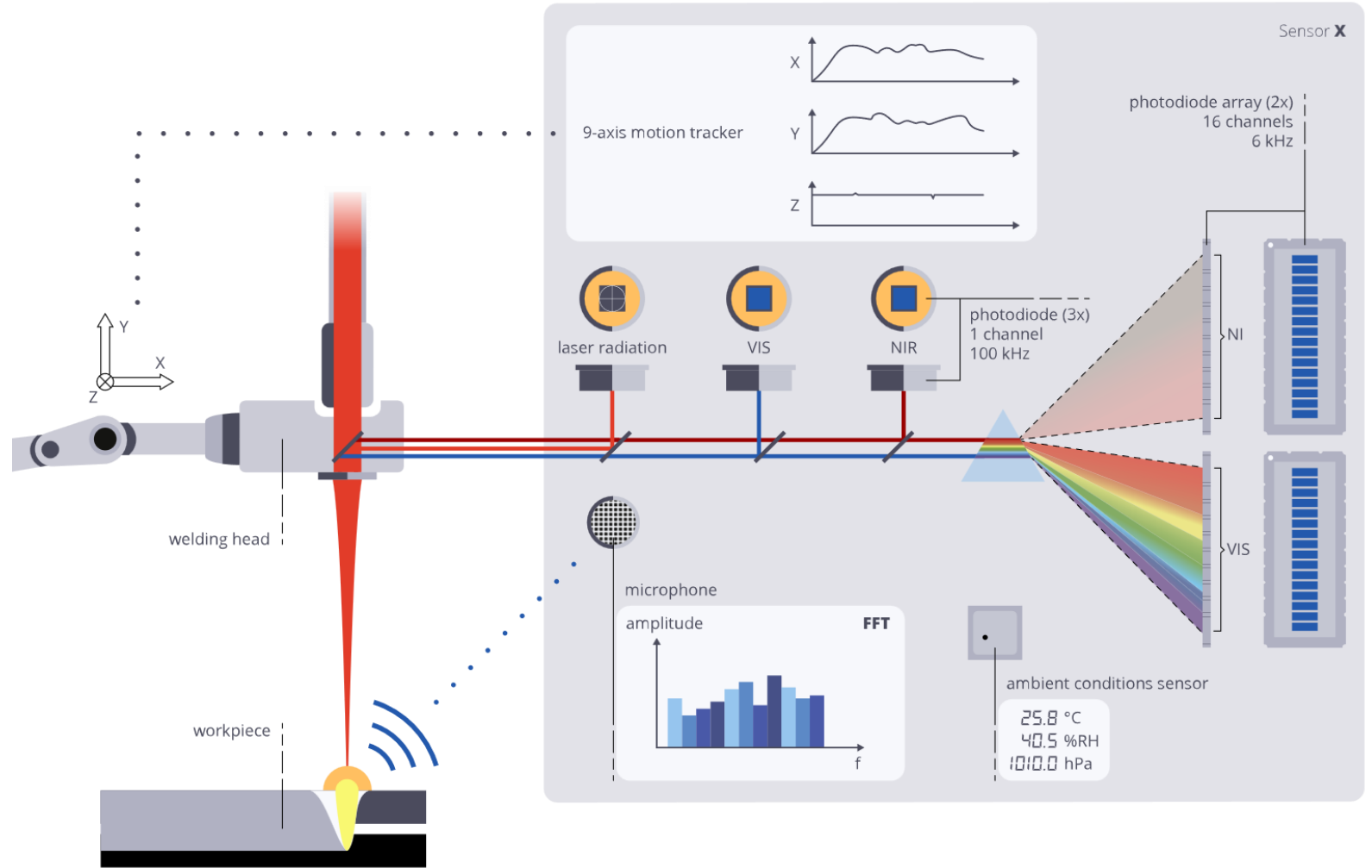
2

Classify faults
→ Looking for root causes in production is annoying!

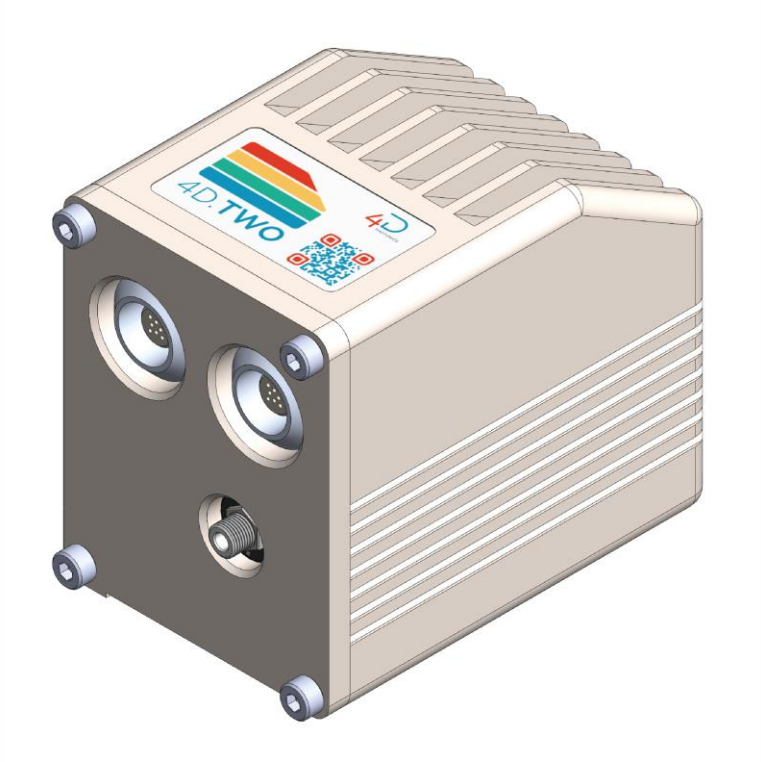
4D.TWO | SOME FACTS



> 1 M samples/s



WHAT'S THE BENEFIT?





YOUR APPLICATION



YOUR KNOWLEDGE



YOUR BENEFIT



YOUR APPLICATION

Battery cell

Hairpin welding

Bipolar plates

E-mobility

Hydrogen

3D printing

Fuel cell

Structuring

Automotive

Aviation

Heat treatment

Copper welding

LPBF

Medical products

Cleaning

Electric components

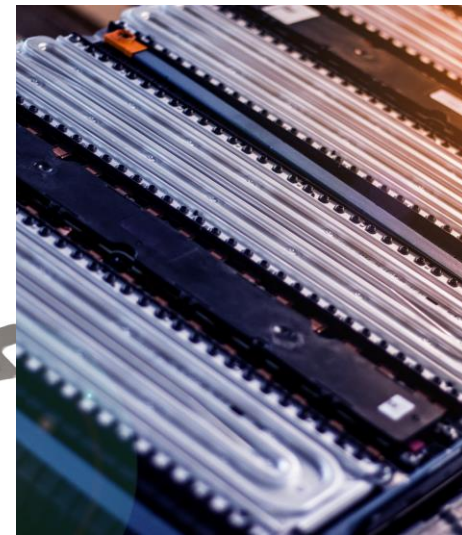
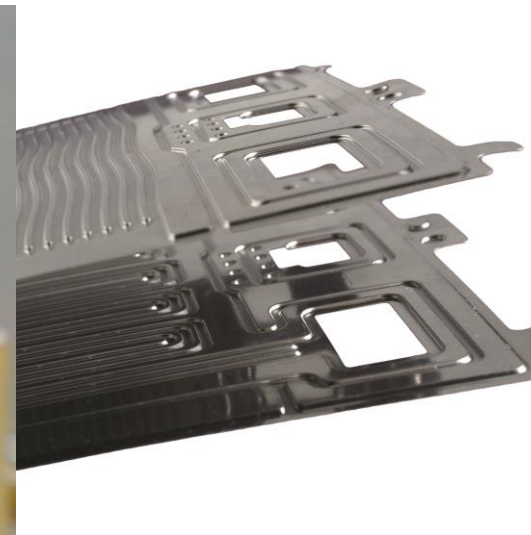
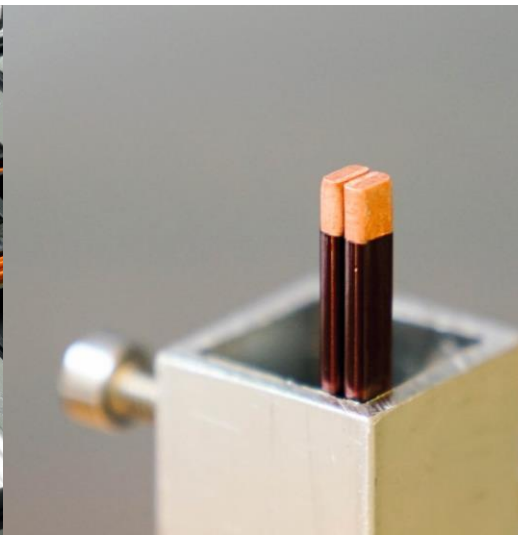
Glas cutting

Application

Laser bonding

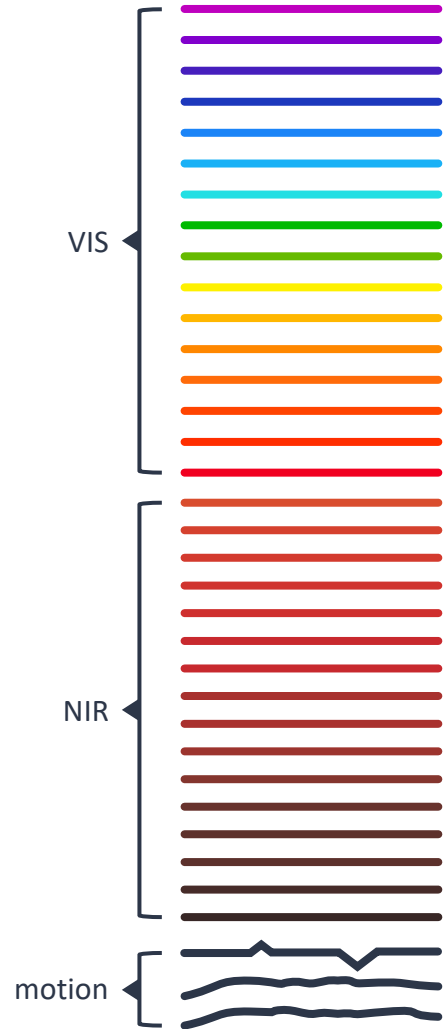
Drilling

Brazing



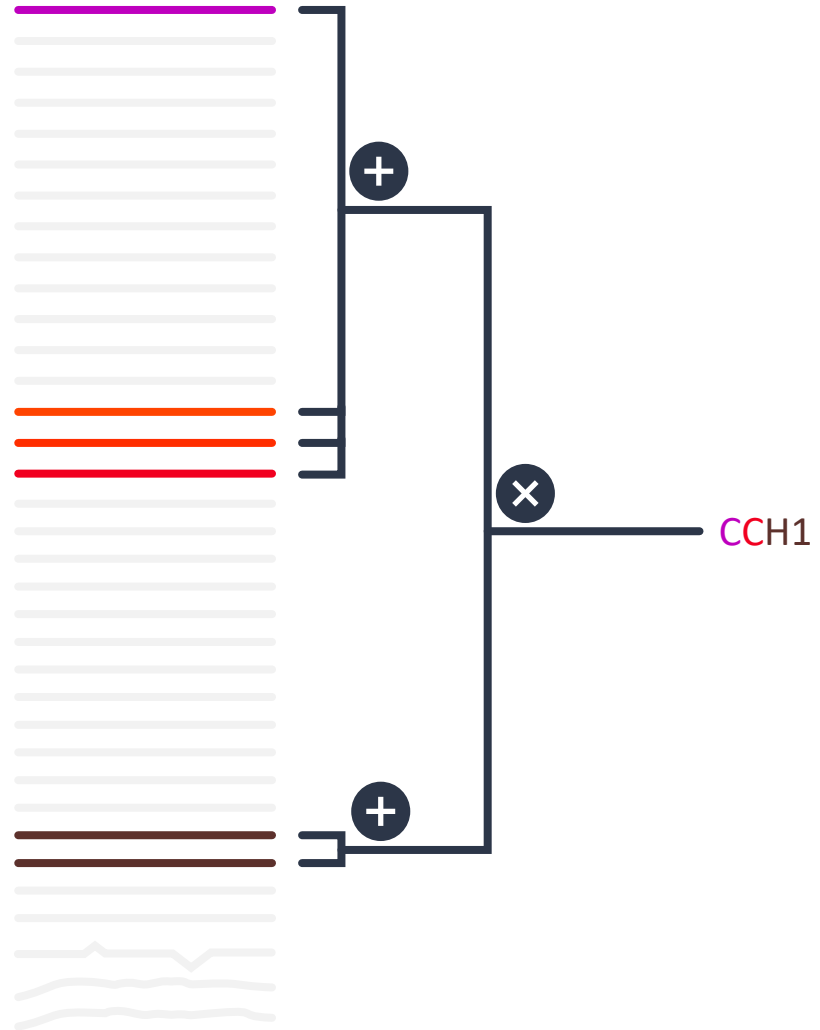


YOUR KNOWLEDGE





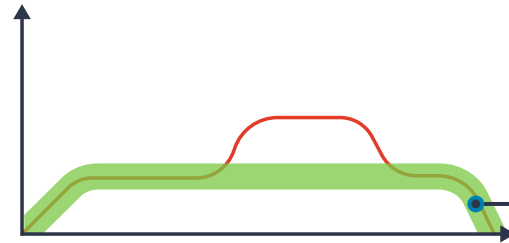
> Combined channel



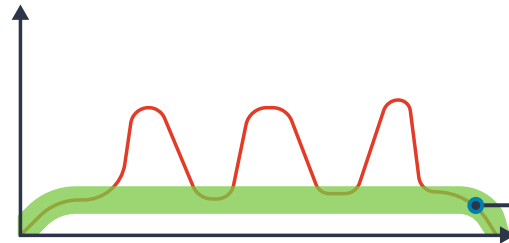


> Combined channel evaluation

CCH1 > Gap indicator >

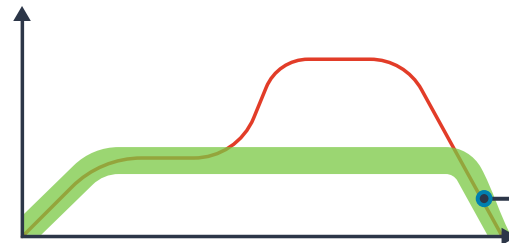


CCH2 > Spatter indicator >



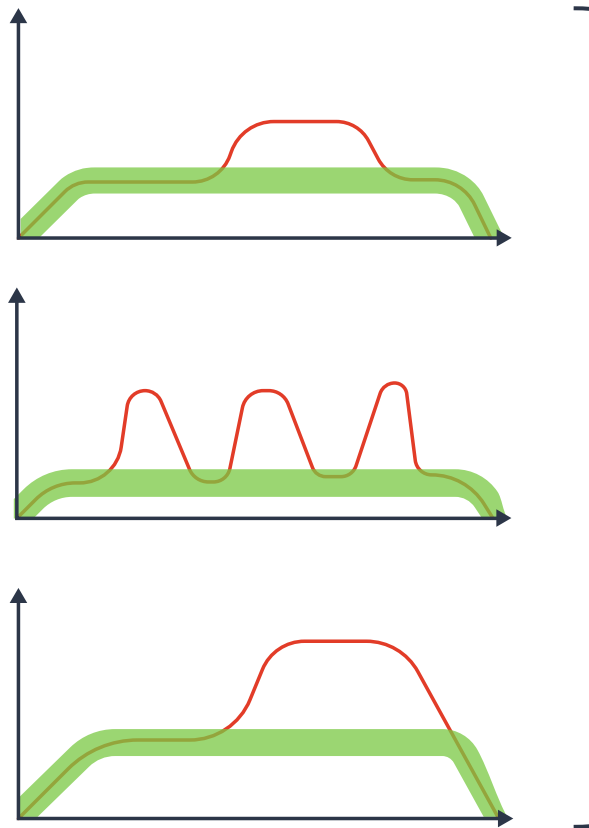
Scatter band evaluation

CCH3 > Temperature indicator >





> Combined channel evaluation



to PLC

>

Result

+

User information



or



Gap!
Spatter!
Temperature!



> NOK strategy

✘ Gap NOK > Send to scrap

✘ Spatter NOK > Inform operator

✘ Temperature NOK > Check quality

Check quality
↓
Be smart.
Adapt.
Benefit.





YOUR BENEFIT



Major benefits

- > Increase productivity by reducing scrap rate
- > Less pseudo faults through more accurate choice and combination of channels
- > Increase productivity by reducing down time
- > Find the root cause to your problem more quickly by fault classification



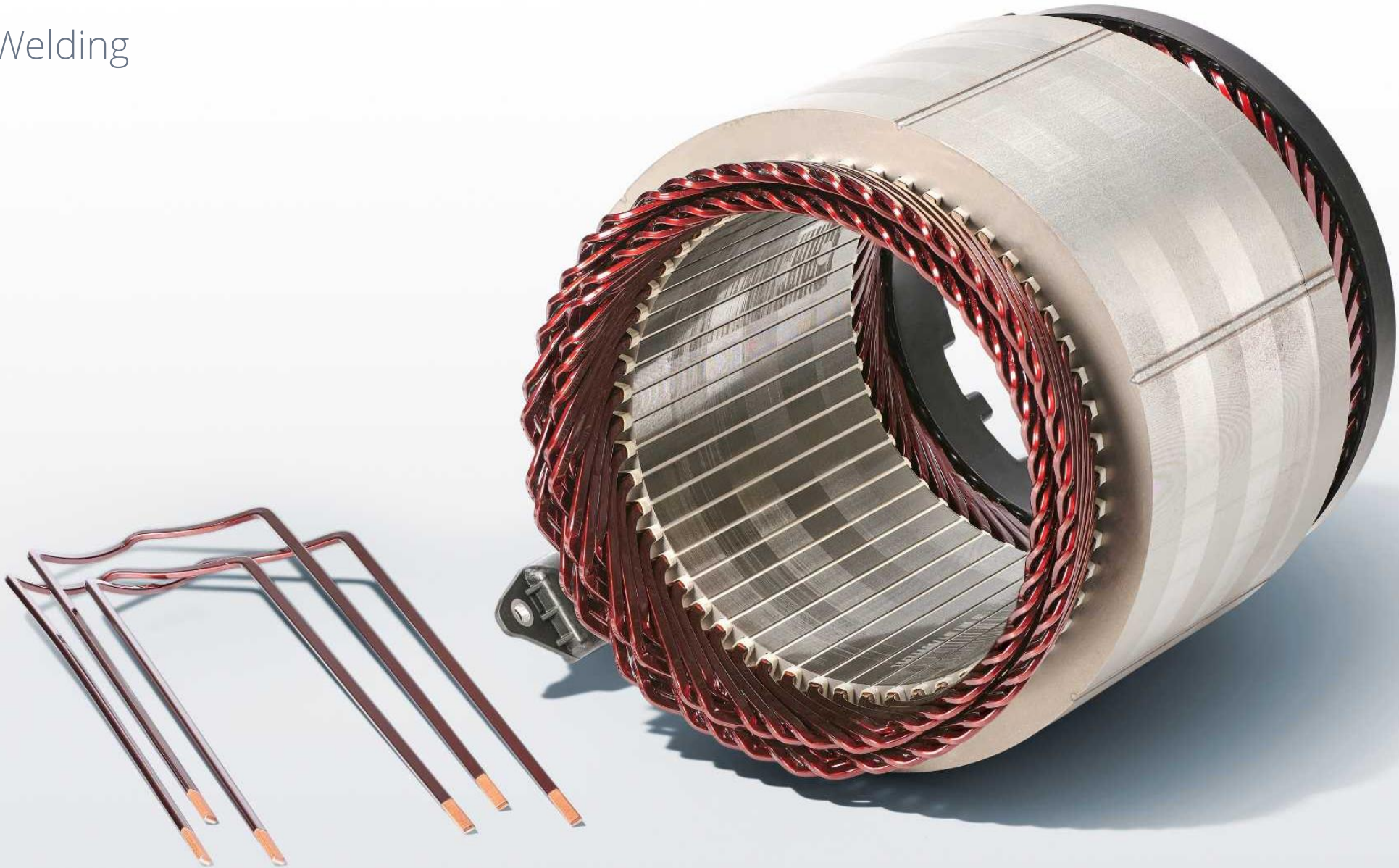
Gap in seam?



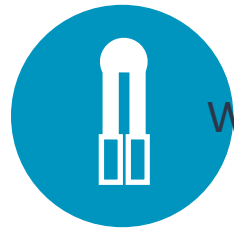
Tell maintenance to look after fixture, send single part to scrap.

RESULTS WITH 4D.TWO

Hairpin Welding



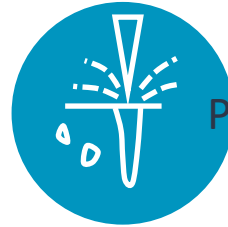
CHALLENGES OF HAIRPIN WELDING



Weld seam shape



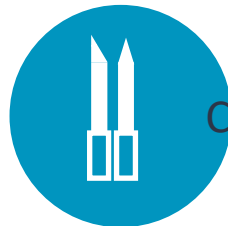
Copper (absorption rate, heat conduction, oxidation)



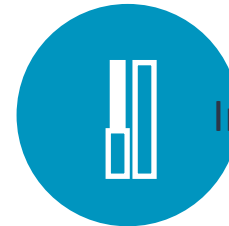
Process (melt pool dynamics, pores, spatters)



Alignment and Clamping



Cutting edges

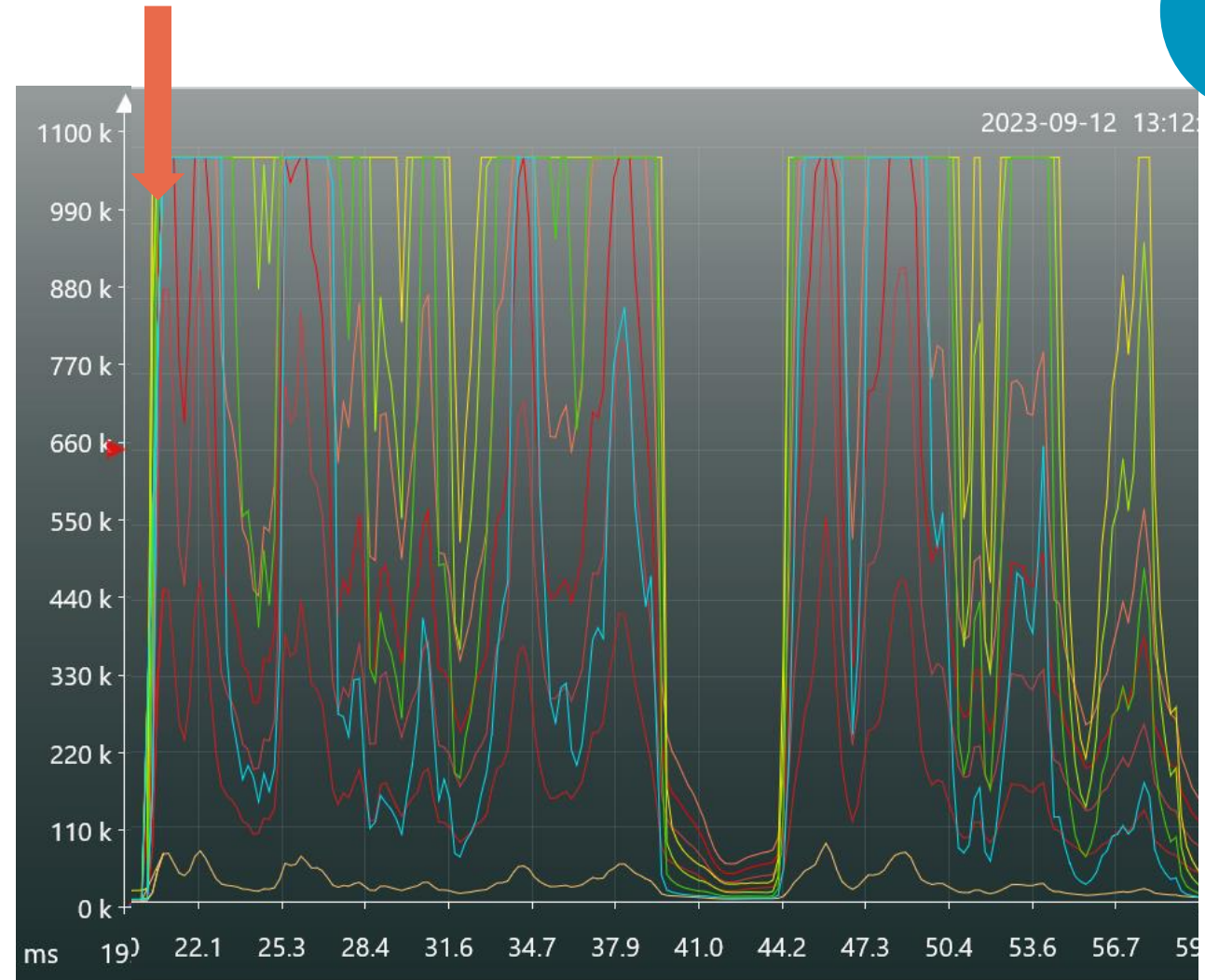
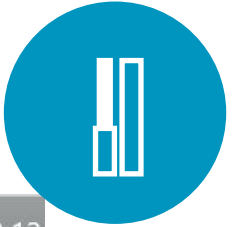


Insufficient removal of insulation

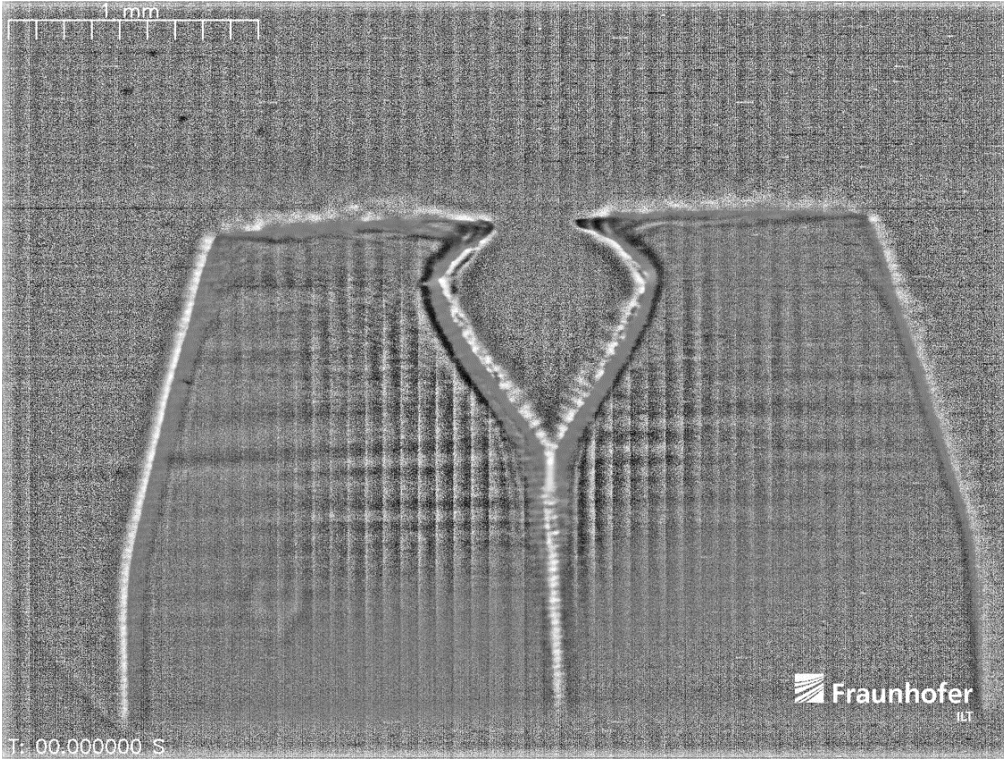
HAIRPIN WELDING WITH HIGH-SPEED VIDEOGRAPHY



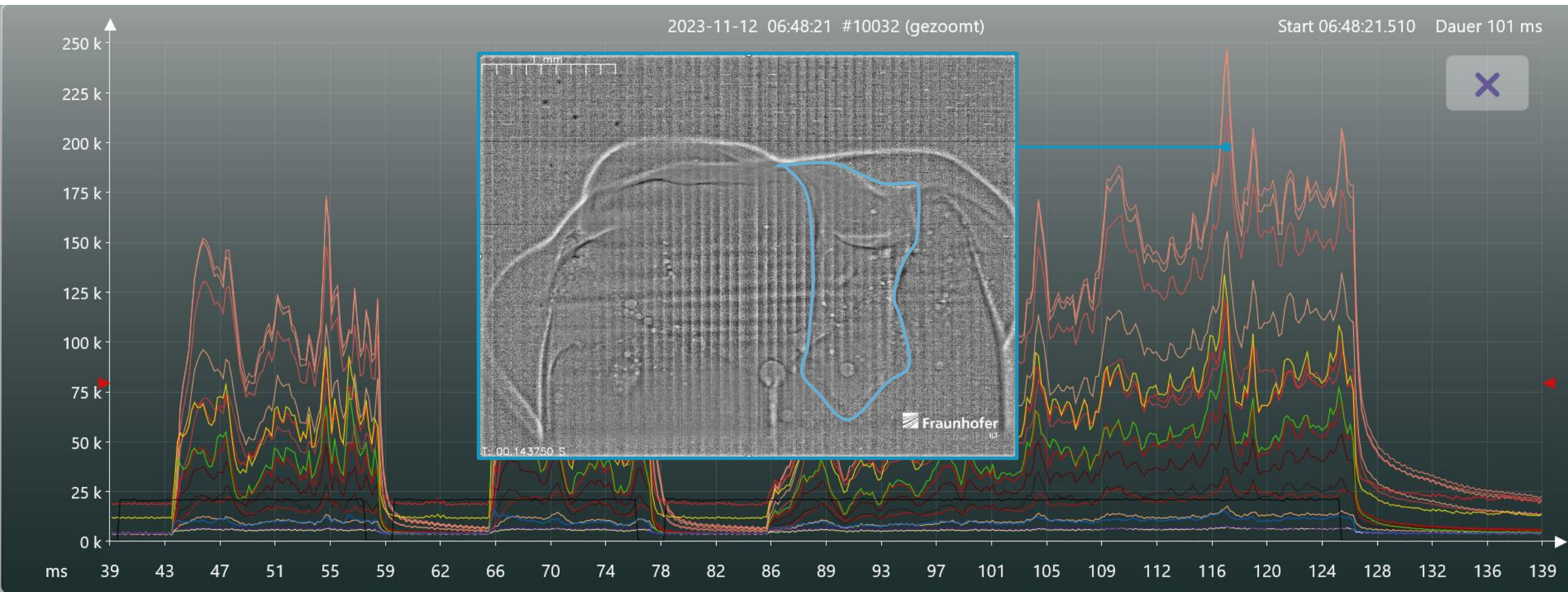
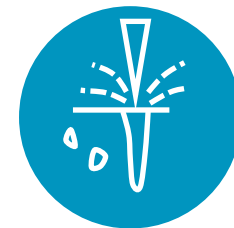
HAIRPIN WELDING WITH INSUFFICIENT REMOVAL OF INSULATION



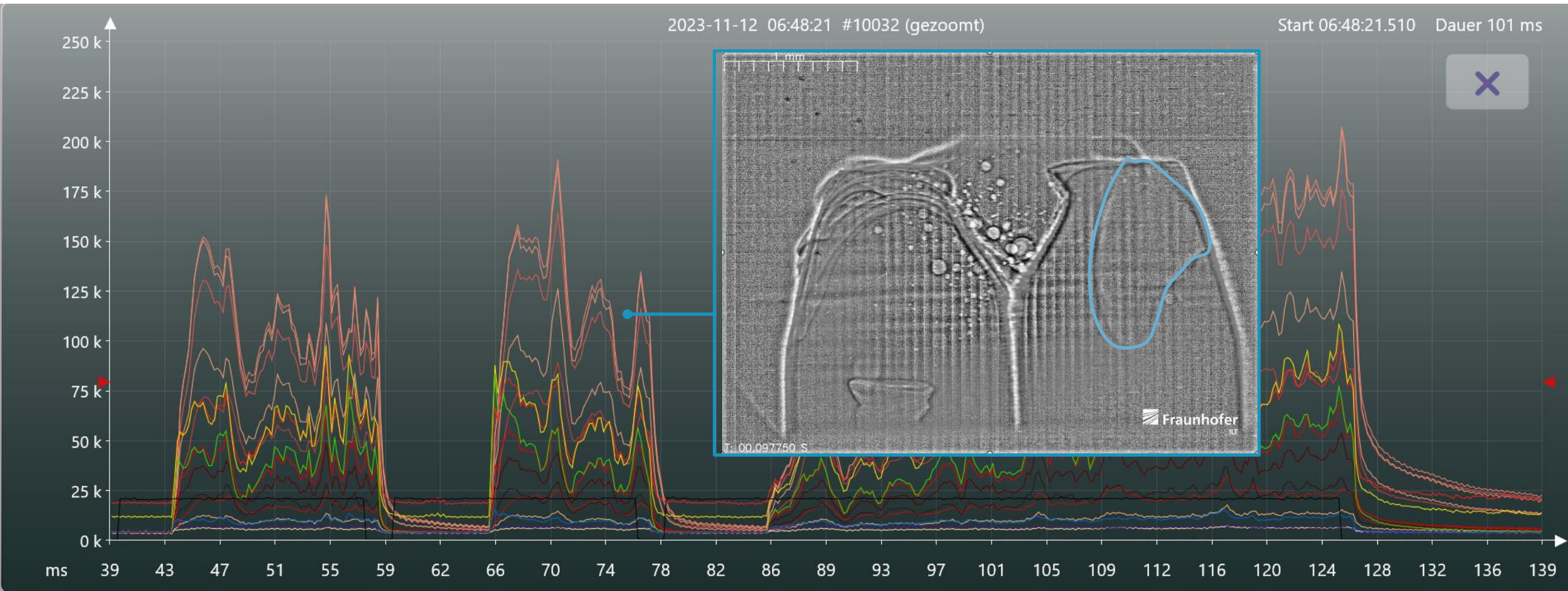
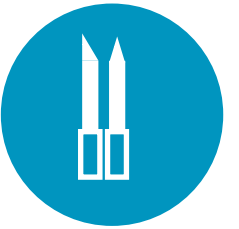
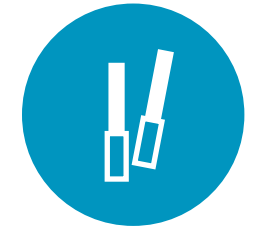
HAIRPIN WELDING WITH SYNCHROTRON VIDEO



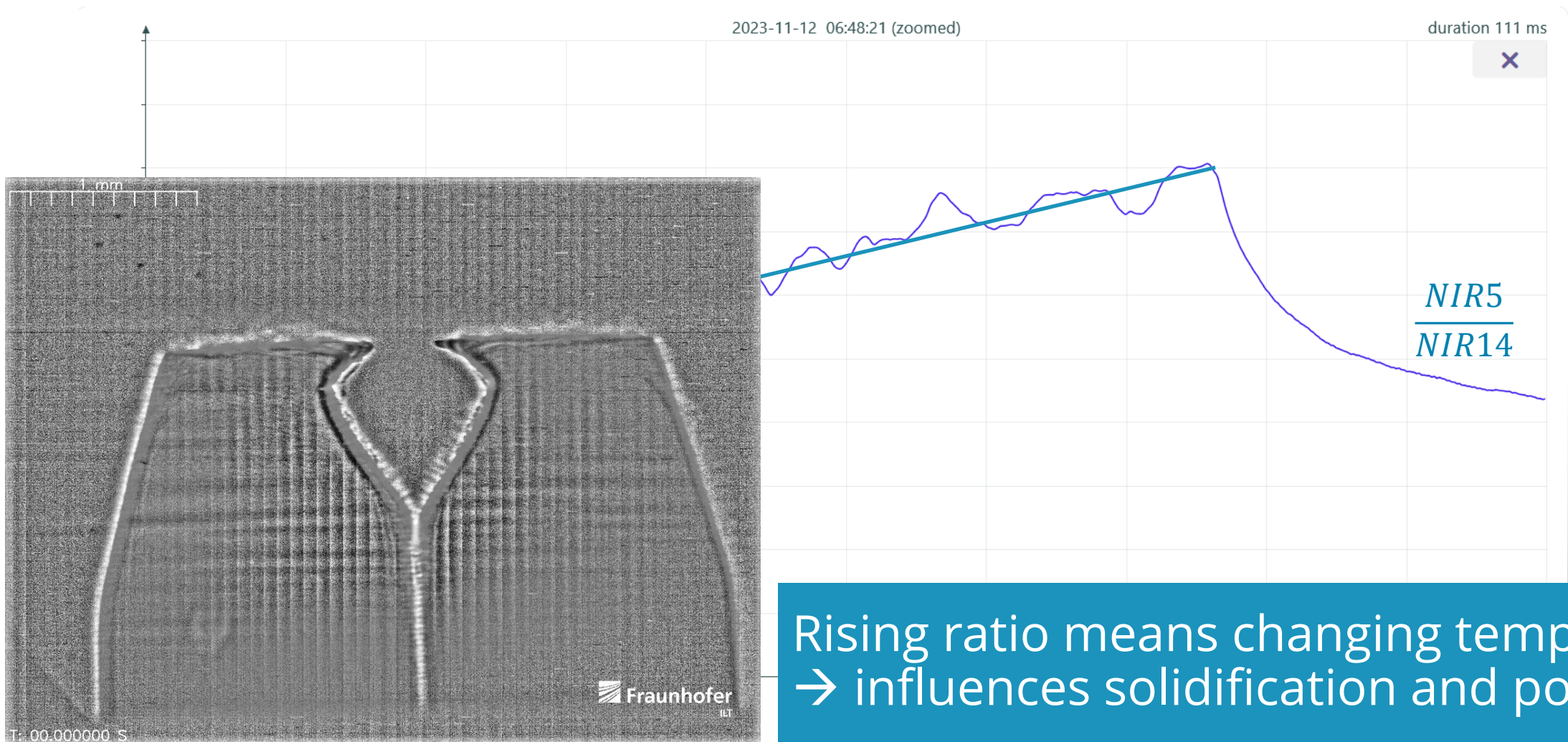
KEYHOLE INSTABILITIES



KEYHOLE BENDING DUE TO POSITIONING AND CUTTING EDGES



TEMPERATURE ANALYSIS WITH RATIO PYROMETRY



Rising ratio means changing temperature
→ influences solidification and pores?

SUMMARY

What we can do for you...

- Provide you with a reliable multi-spectral process monitoring system
- ONE Sensor for any application
- Defect identification and classification

> > >

What you can do for us...

- New applications or new laser processes for our system
- Help us to prove it
- Generate data with our system
- Partners for scientific or industrial cooperation
- Provide external data to our system for an extended data fusion
- Market Access
- Automation of production, calibration, optic adjustment

Thanks.

DANKE!

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NOT THE ANSWER TO LIFE, THE UNIVERSE AND EVERYTHING.