4a Summer School
Efficient dynamic testing with IMPETUS®

S. Riemelmoser, M. Rollant
Traboch, 08.07.2020

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Summer School

1st week - Introduction and outlook

07. July - Introduction to VALIMAT® from test to material card
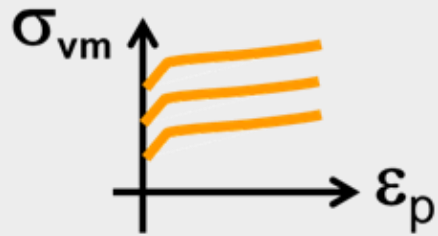
08. July - Efficient dynamic testing with IMPETUS®

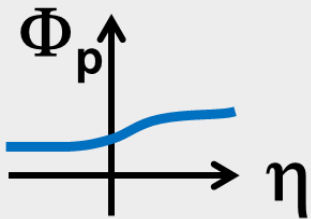**09. July** - Material card generation: vonMises plasticity (*MAT_024*), simple failure, setting up our Autofit

10. July - Summary: Lessons learned, outlook and upcoming features

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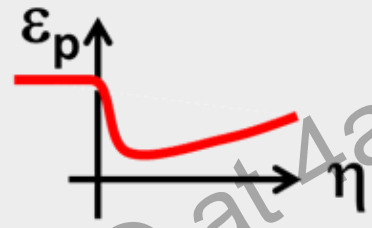# Intelligent reliable solutions for plastics, composites, metals, foams, ...

VALIMAT

σ_{vm} vs ε_p — Hardening

α — Anisotropic

Φ_p vs η — Triaxiality

ε_p vs η — Damage/Failure

for all material types
from test to validated material cards

IMPETUS
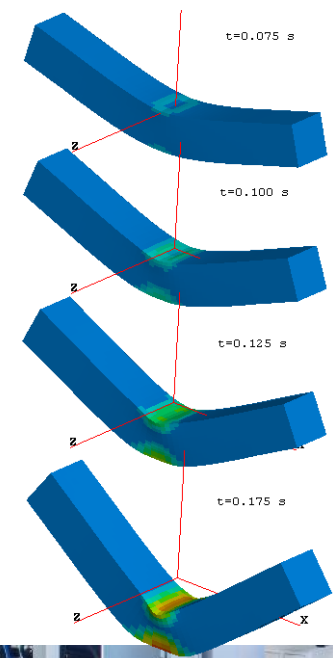
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efficient dynamic testing
plastics and composites

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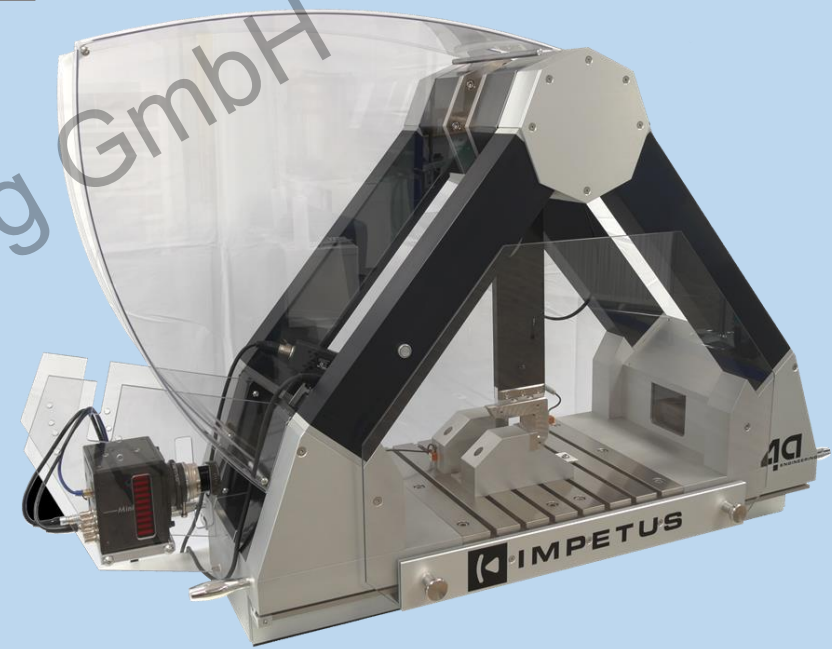
Material characterization - services

- efficient high-dynamic testing
- dynamic material behaviour
- plastics, foams, composites, …
- **validated material cards ready to use for your crash-simulation**

t=0.075 s

t=0.100 s

t=0.125 s

t=0.175 s

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validated material cards - injection mold for plastics

Dom & Wall thickness

Melt- & Weldlines
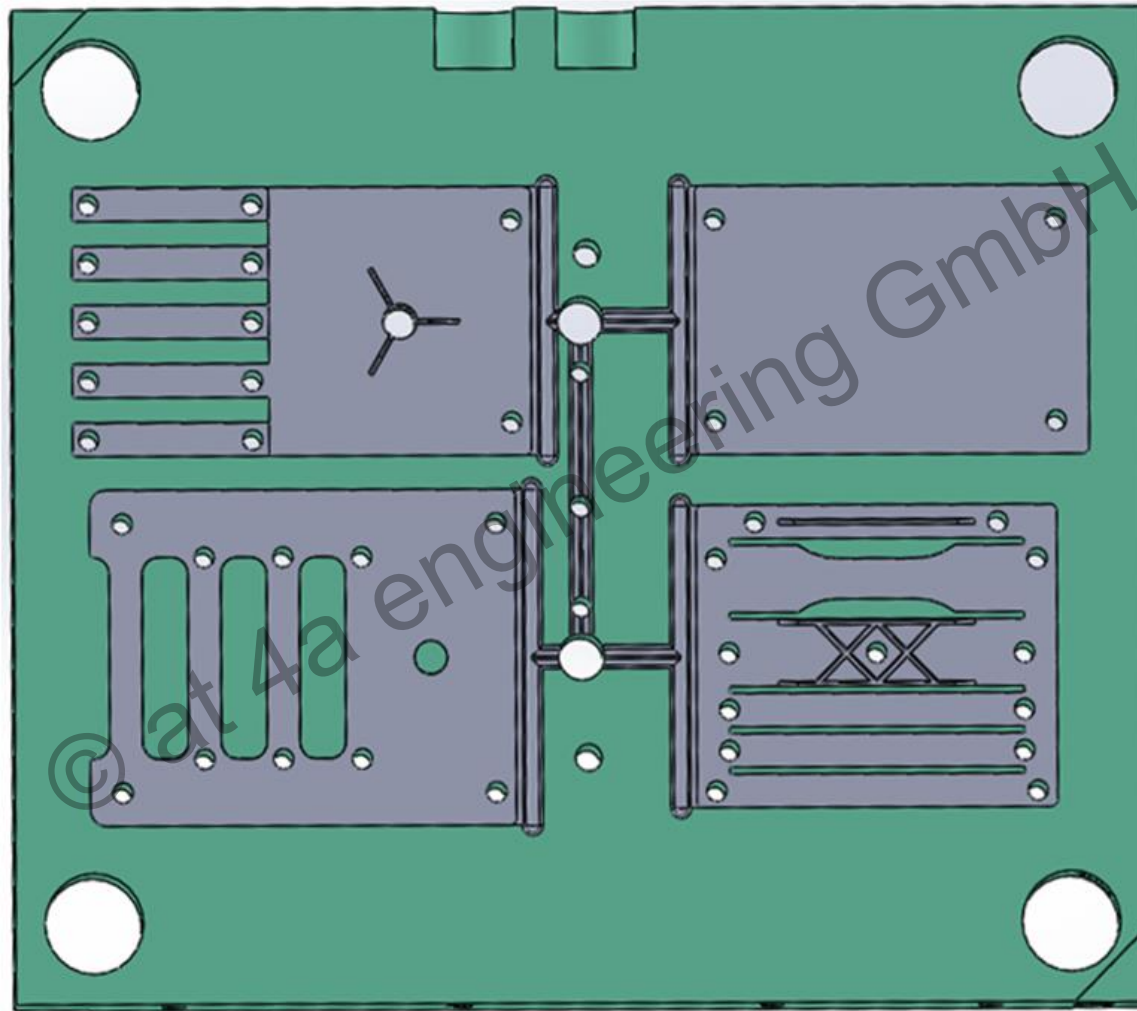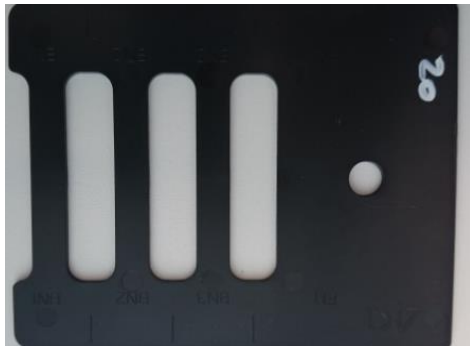
Plate 120 x 80 x 2 mm

Multi-Specimen & XX-Rib & Component

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validated material cards – packages

Comprehensive overview

- isoP - isotropic Plastic

- frP – fibre reinforced Plastic

- comP - composite

- foam

Materialcard detail	basic	standard	prof.
strain rate/hardening	isoP & frP		
compression/tension asymmetry			isoP & frP
damage/failure			isoP & frP
validation on component			isoP & frP

4a test packages
thermoplastic materials
setups & measurement definition

VALIMAT
IMPETUS

excellence in ..
from test to material card
efficient dynamic testing for
plastics, foams, composites, ...

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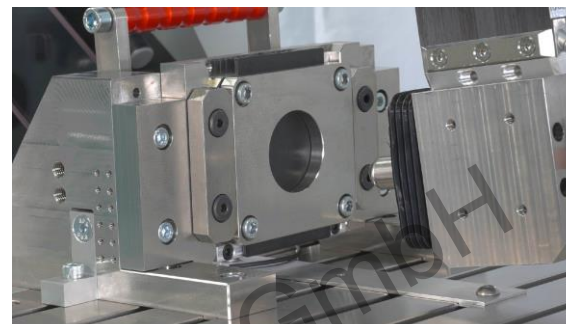*Standard package optionally includes temperature-based measurements

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3 POINT BENDING
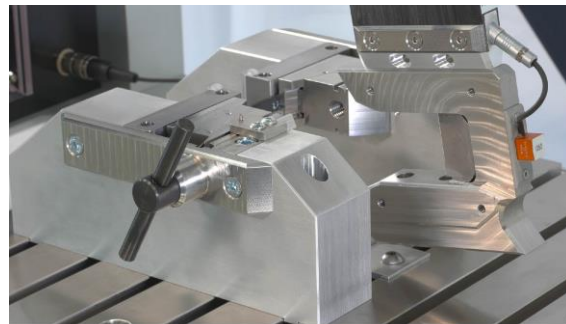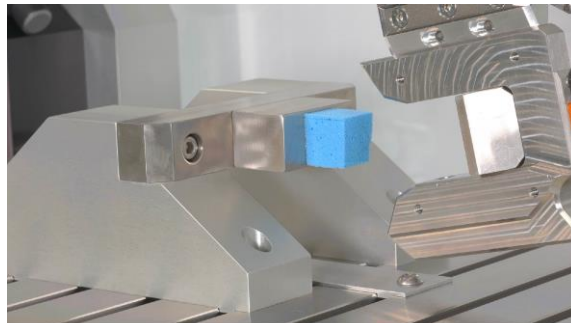

TENSION BENDING

PUNCTURE TEST
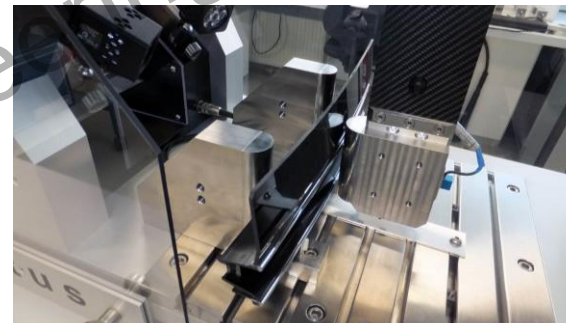

TENSION TEST

COMPRESSION TEST

SAMPLE MAGAZIN

COMPONENT TEST
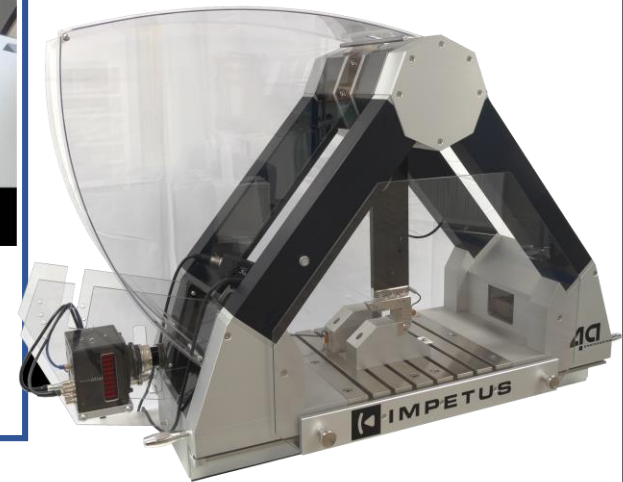
BASIC

STANDARD

PROFESSIONAL

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efficient dynamic testing

IMPETUS

plastics

engineering

production

excellence in testing

concepts

simulation

lightweight   prototypes

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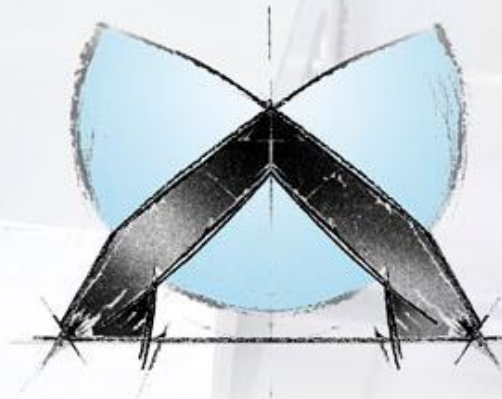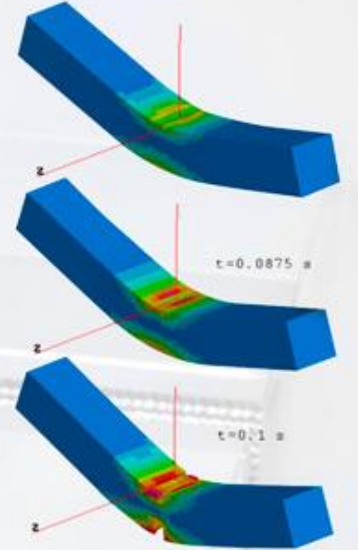
IMPETUS® data specification
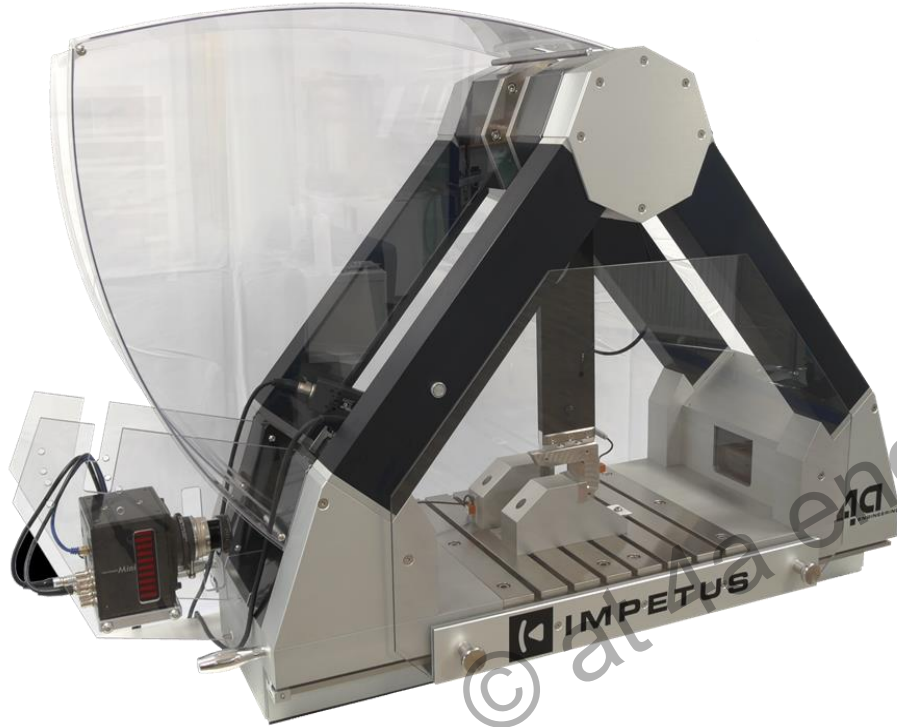
technical specifications

maximum energy	50J
length of swing arm	500mm
mass of swing arm	1.5 - 3.0kg
impact velocity	0.5 - 4.4m/s

weights and dimensions

L x W x H	1400 x 600 x 850mm
mass	165kg

desk load and dimensions minimum required

L x W x H	1500 x 800 x 800mm
minimum load	250kg

electrical supply data

230 VAC 50 Hz	0.5A
115 VAC 60 Hz	1.0A

5V camera trigger

output level high	>2.5V
output level low	<0.5V

Highspeed camera is an optional equipment and can be ordered separately.

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Photron High Speed Camera data specification

FASTCAM	NOVA S6 800K	NOVA S9 900K	NOVA S12 1000K	
CMOS Image Sensor	1024 x 1024	1024 x 1024	1024 x 1024	px
max. fps full resolution	6400	9000	12800	fps
max. Frame Rate	800000	900000	1000000	fps
Light Sensitivity	64000	64000	64000	ISO
L x W x H	217.2 x 120 x 120	217.2 x 120 x 120	217.2 x 120 x 120	mm
weight	3.3	3.3	3.3	kg

Vision Devices lighting data specification

LED VD7000

operating voltage	24 - 36	V
rated power	17 - 72	W
Luminous flux	2100	lm
Luminous flux boost	7280	lm
color temperature	6000	K
L x W x H	100 x 46 x 46	mm

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3 POINT BENDING
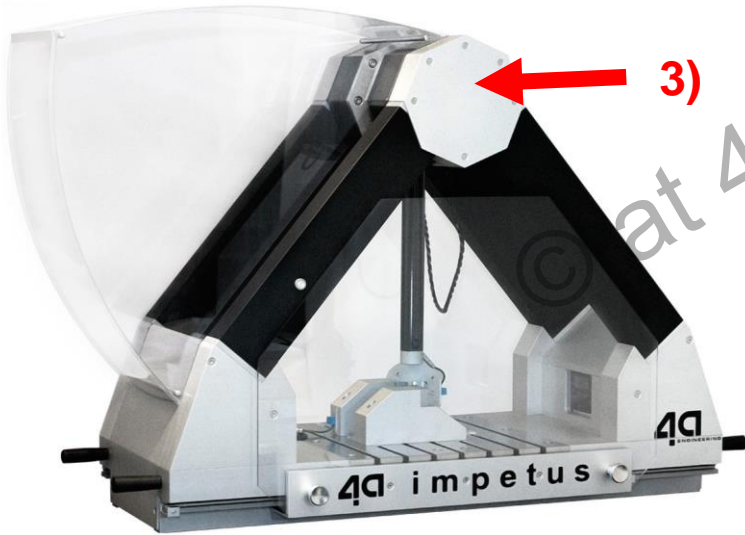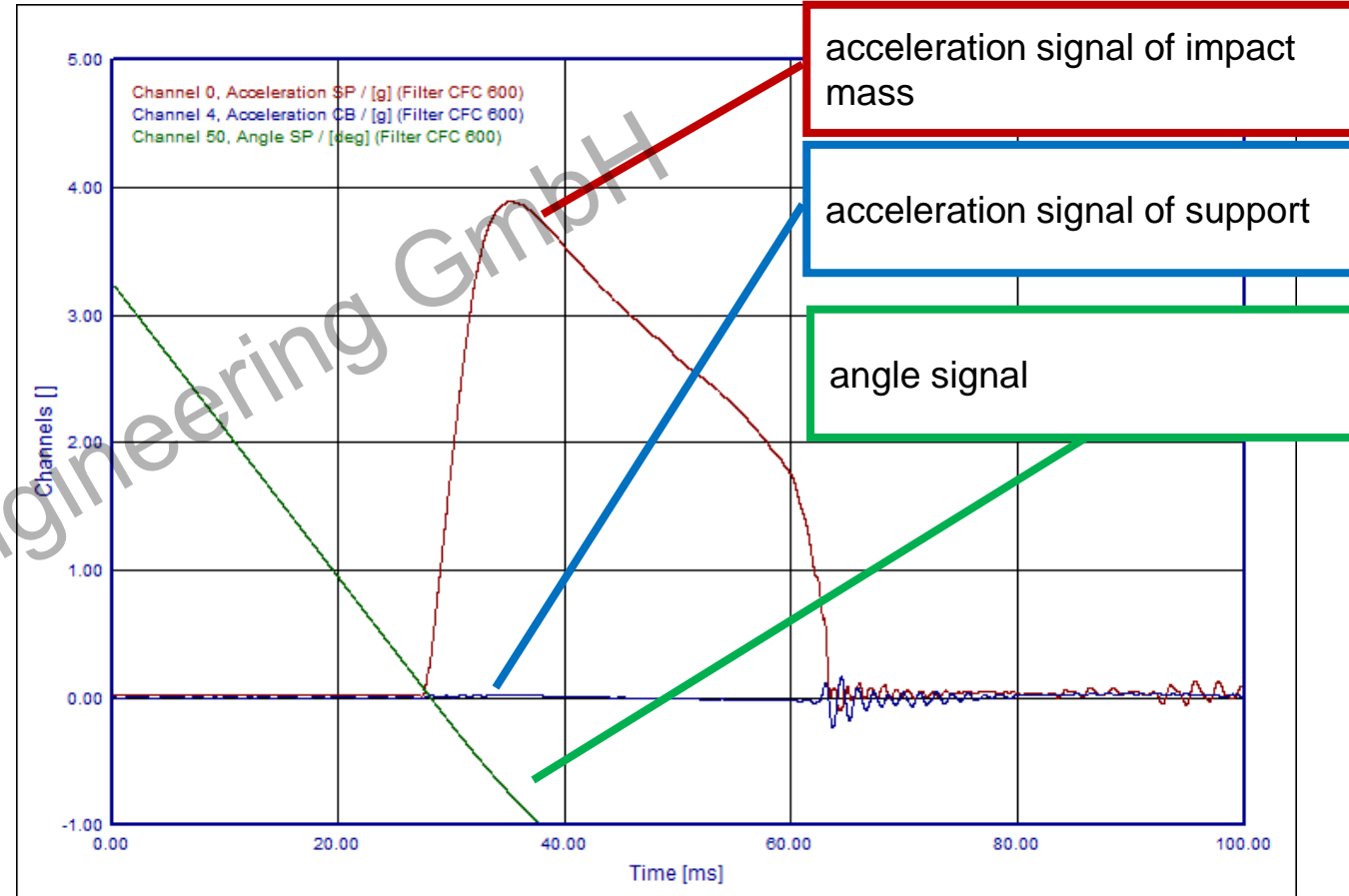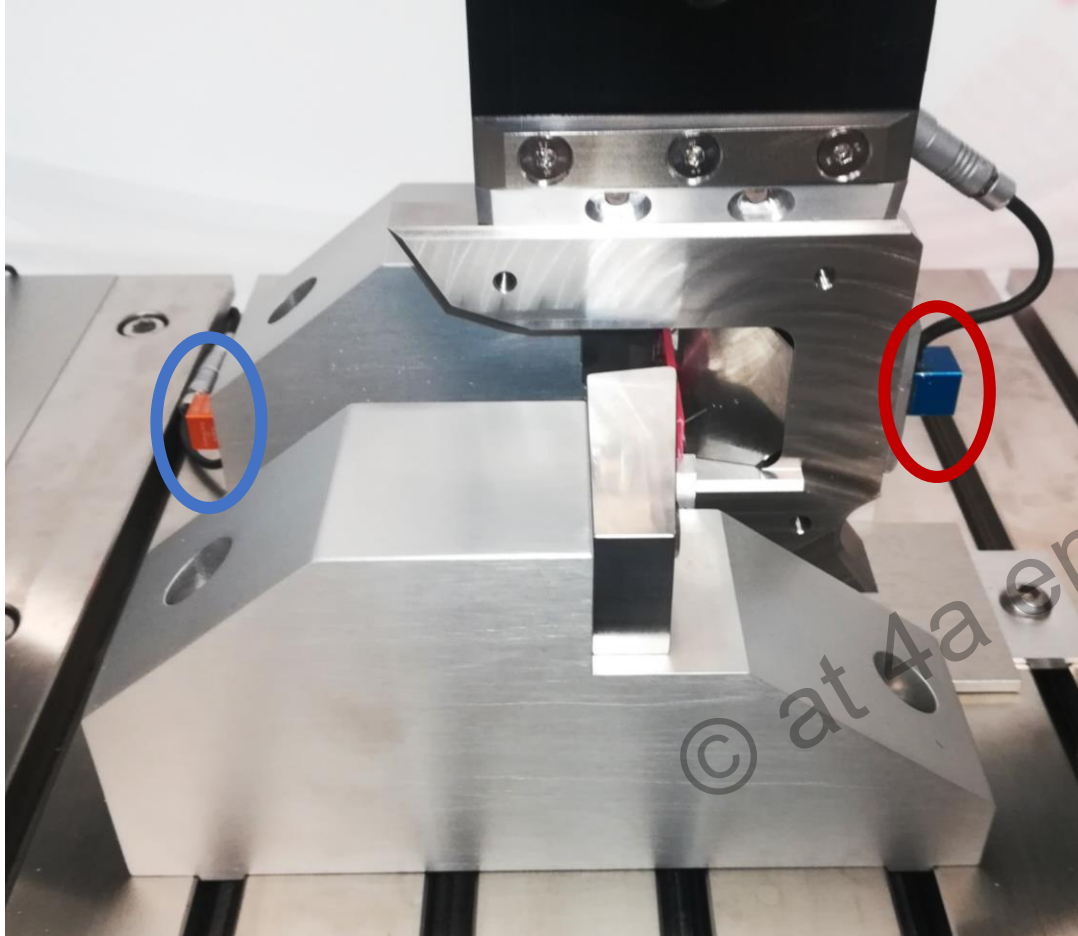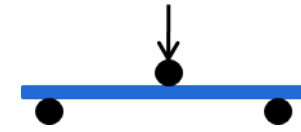
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Test setup – IMPETUS® 3-Point-Bending
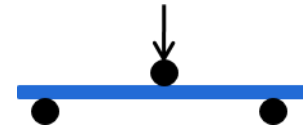
1) acceleration sensor on pendulum head

2) acceleration sensor on counter bearing

3) angle sensor

4) radius of the fin: 2 mm

5) support radius: 2 mm

6) swing hammer mass: 1580 g
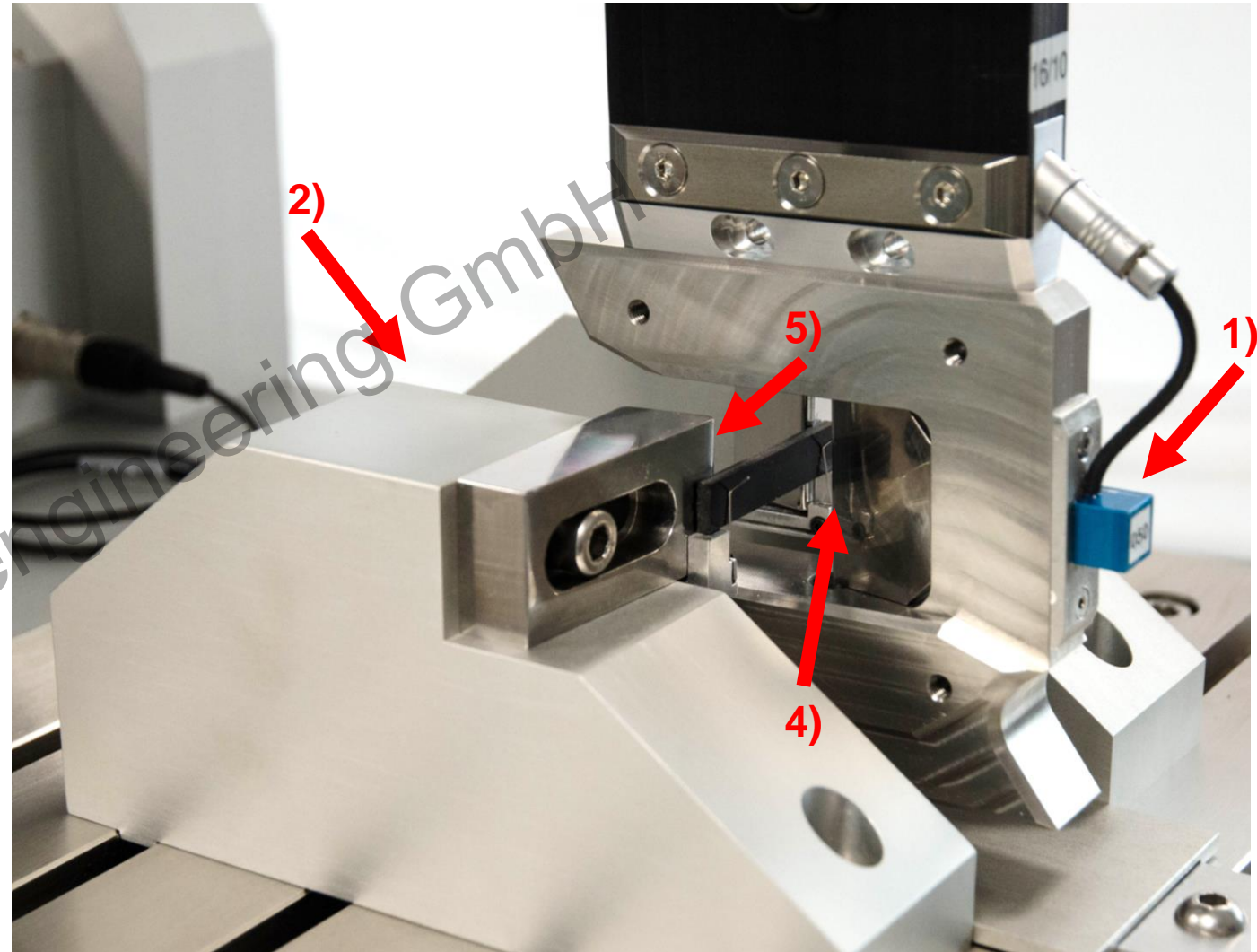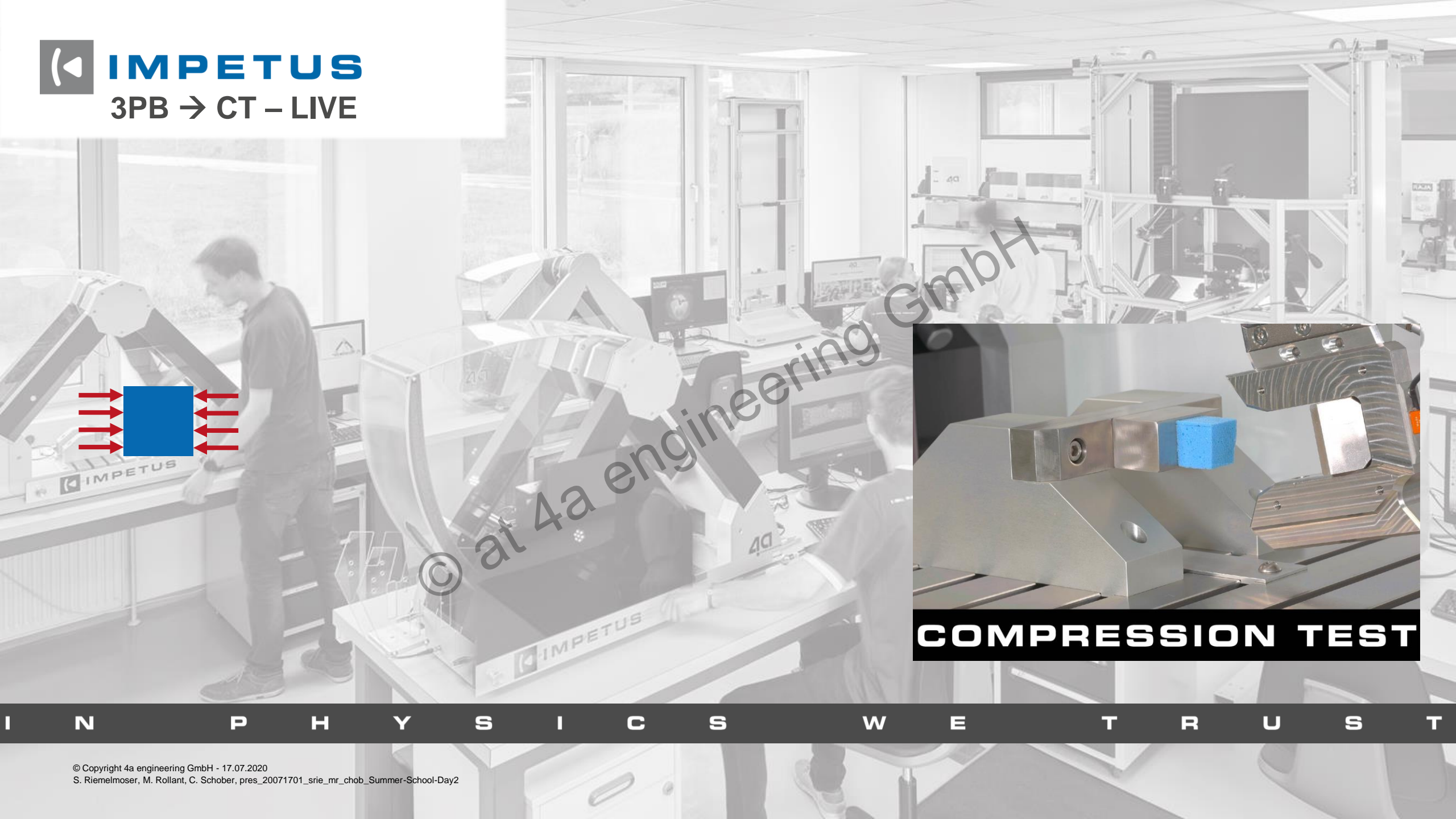
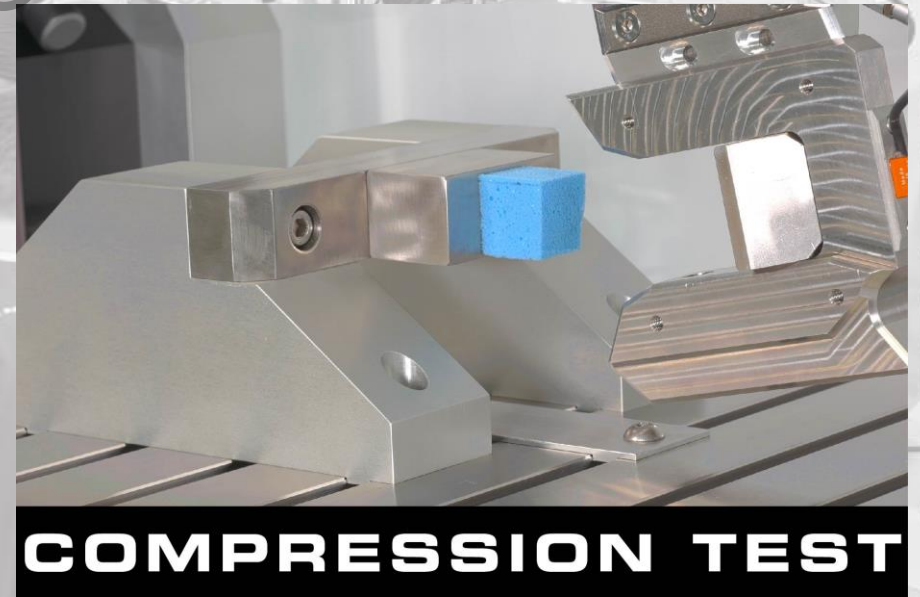IN PHYSICS WE TRUST

Measurement signals – IMPETUS® 3-Point-Bending

acceleration signal of impact mass

acceleration signal of support

angle signal

Channel 0, Acceleration SP / [g] (Filter CFC 600)
Channel 4, Acceleration CB / [g] (Filter CFC 600)
Channel 50, Angle SP / [deg] (Filter CFC 600)

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IMPETUS
3PB – LIVE

3 POINT BENDING

COMPRESSION TEST

IMPETUS

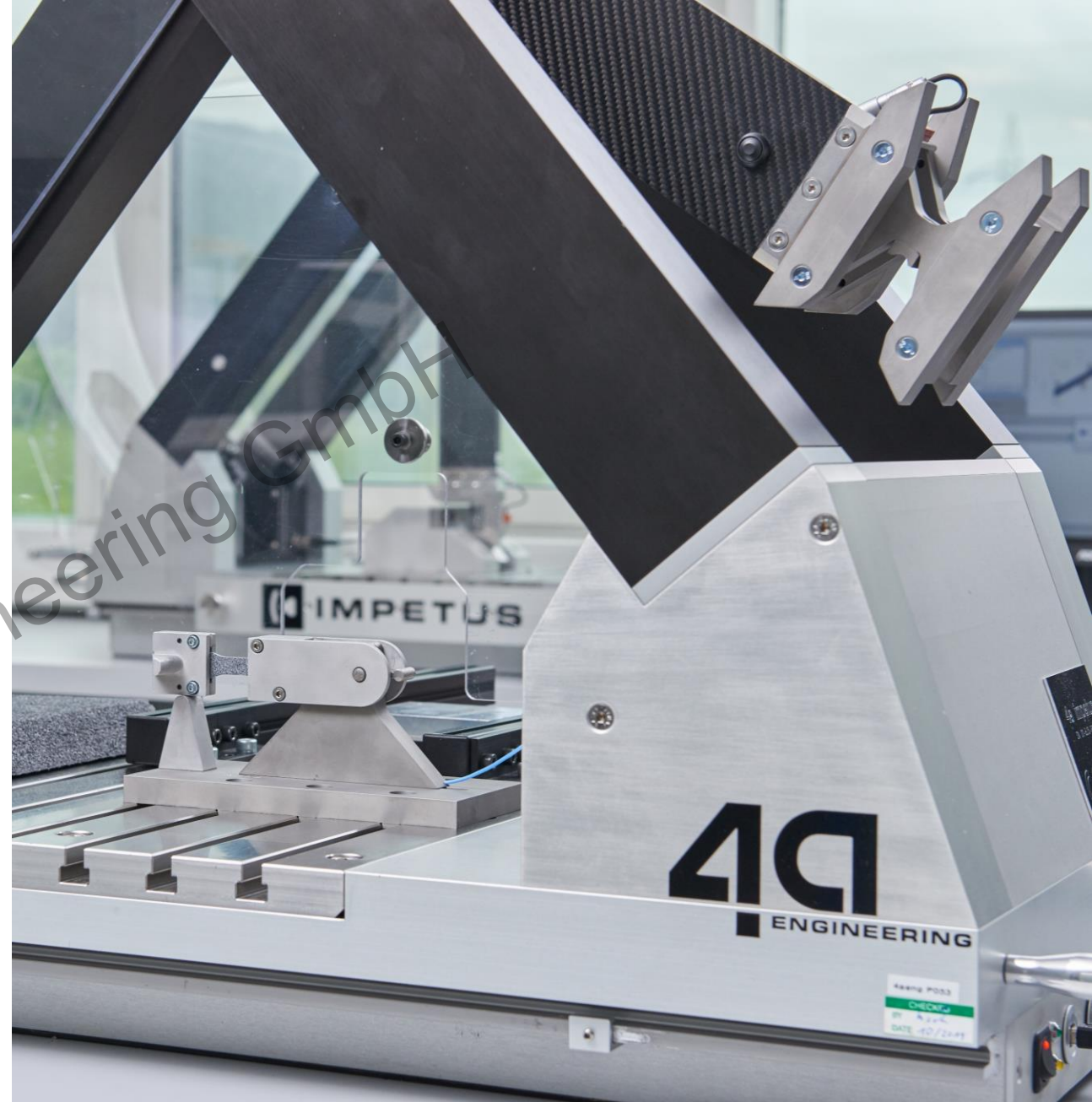PT – LIVE
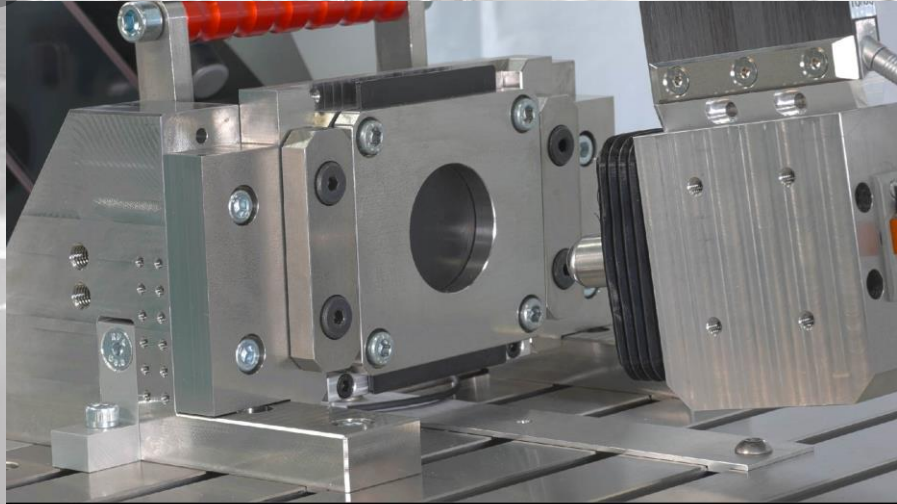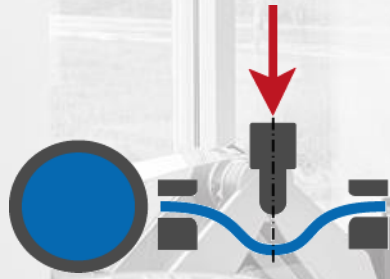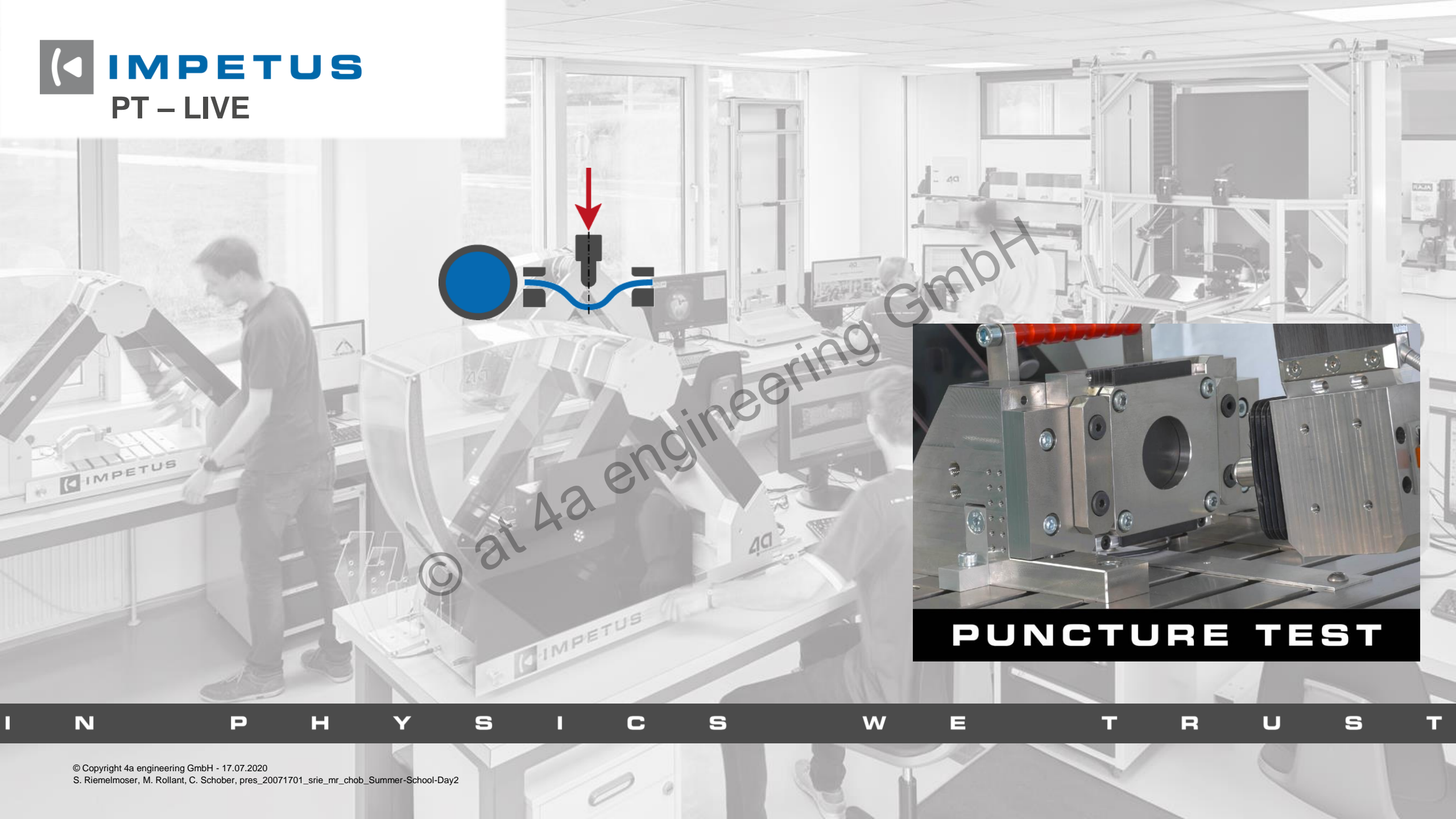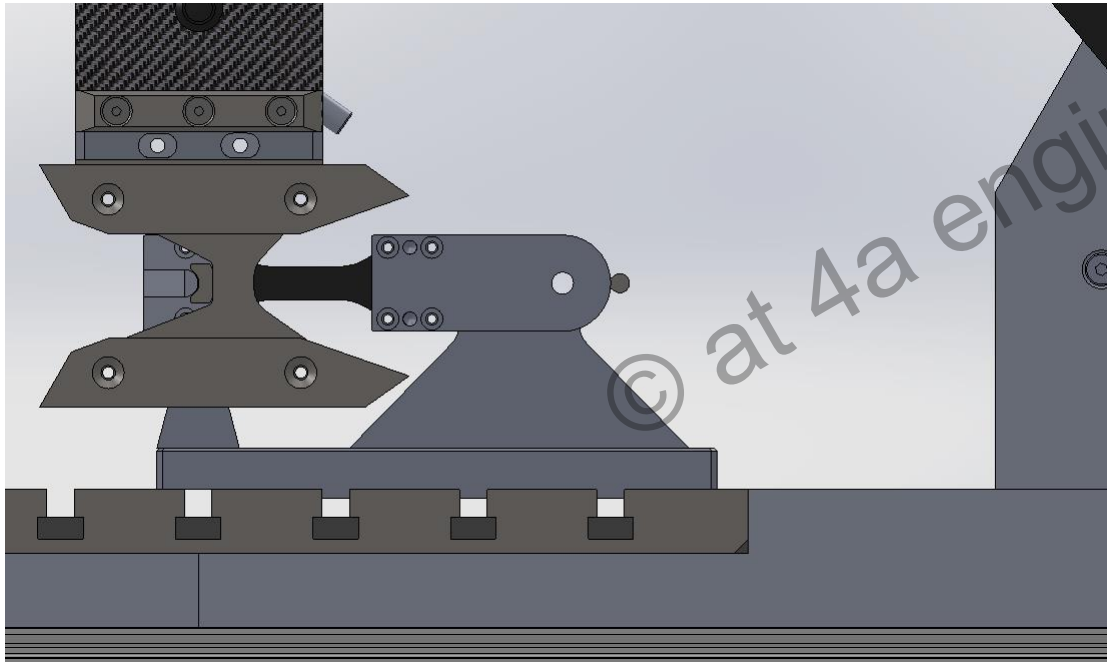
PUNCTURE TEST

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IMPETUS®- new efficient dynamic tensile test

IN PHYSICS WE TRUST
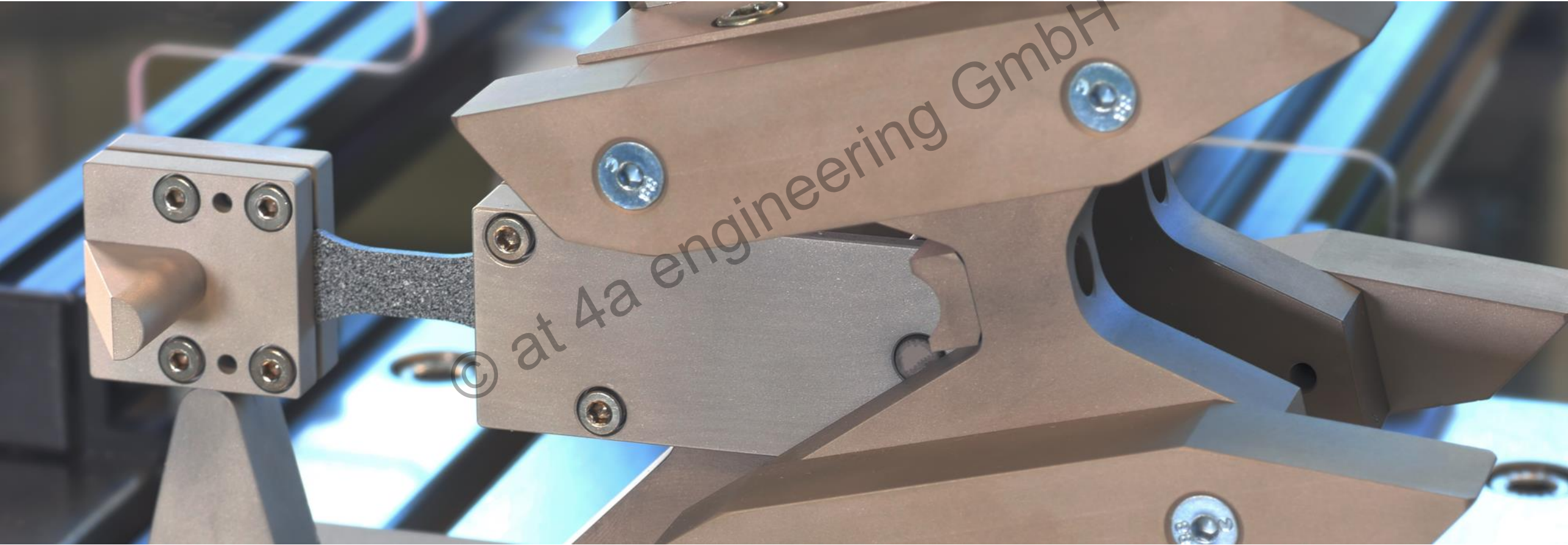
IMPETUS® - dynamic tensile test

- Hardware consists of 3 main parts
  - counter bearing system
  - sample clamping
  - pendulum impactor head
    - → Ease of use operation!

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Measurement technique
What we basically measure during the test?

- Time [ms]
  - time-synchronous data is essential

- Force [N]
  - piezo load cell 20 kN

- Stroke [mm]
  - incremental angle sensor
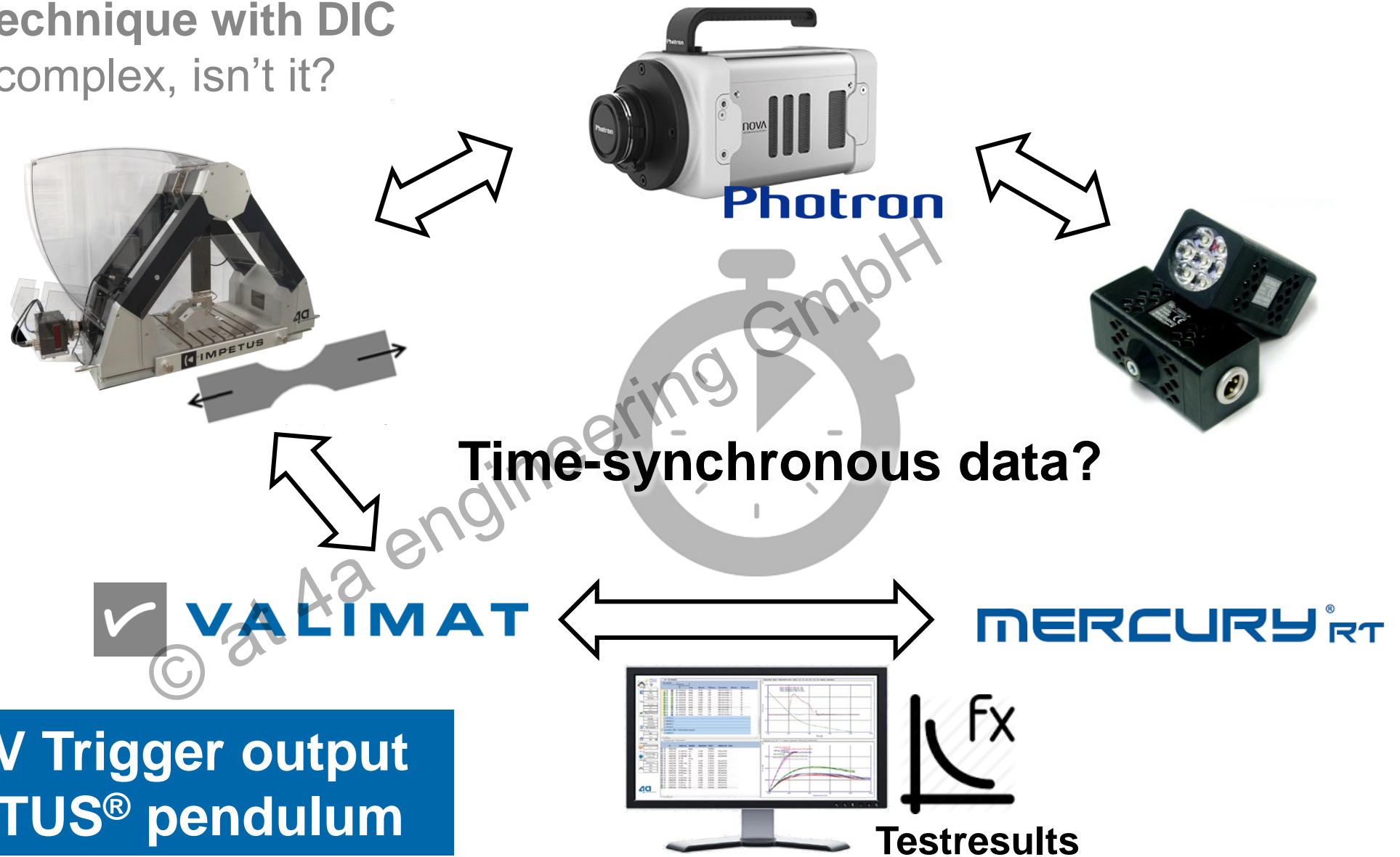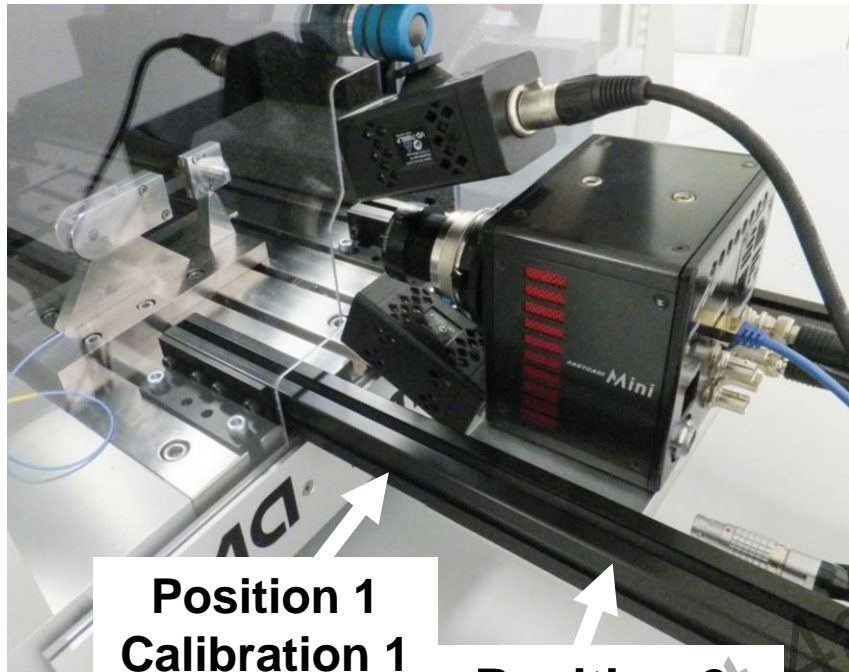 - **digital image correlation (DIC)** → **Now it's getting complex, isn't it?**
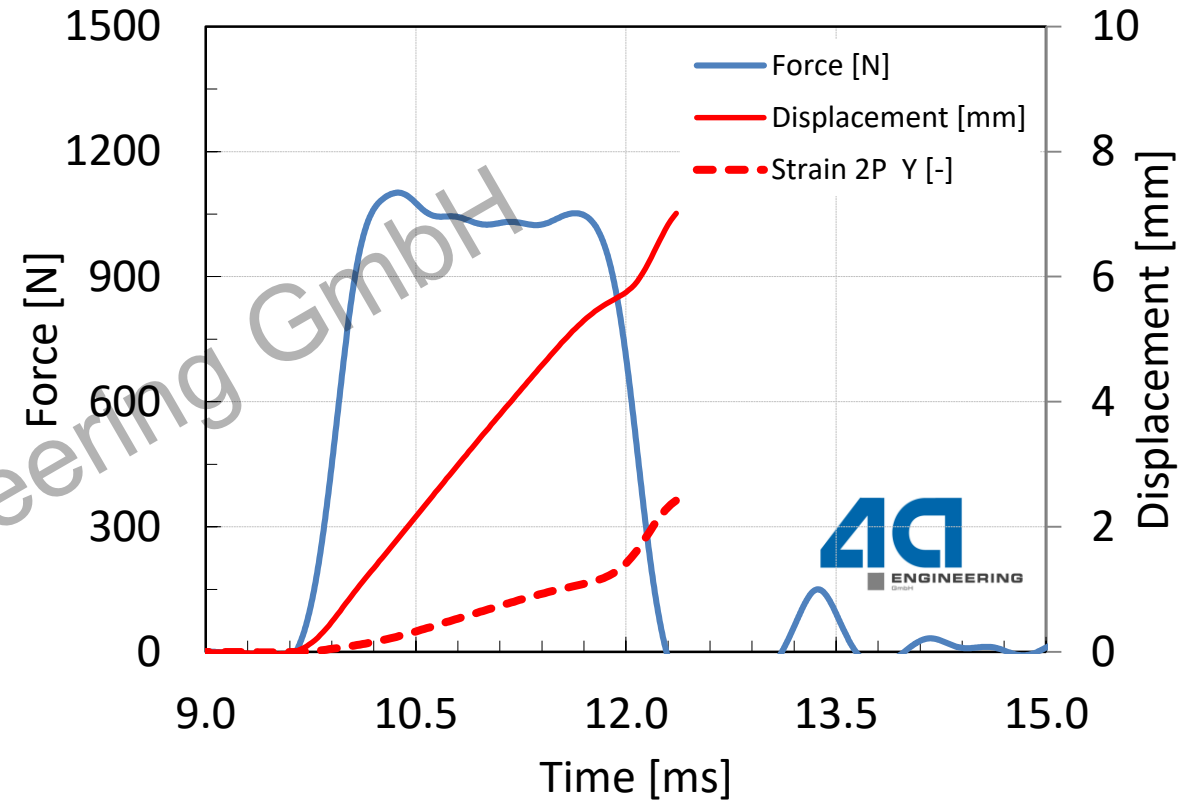
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Measurement technique with DIC
Now it's getting complex, isn't it?

Photron

Time-synchronous data?

✔ **VALIMAT** ⟷ **MERCURY** RT

Testresults

**Integrated 5V Trigger output
at the IMPETUS® pendulum**

I N   P H Y S I C S   W E   T R U S T

Measurement technique with DIC
Now it's getting complex, isn't it?

Position 1
Calibration 1

Position 2
Calibration 2

Calibrated DIC recording?

1px = 0.072 mm   20.000 mm

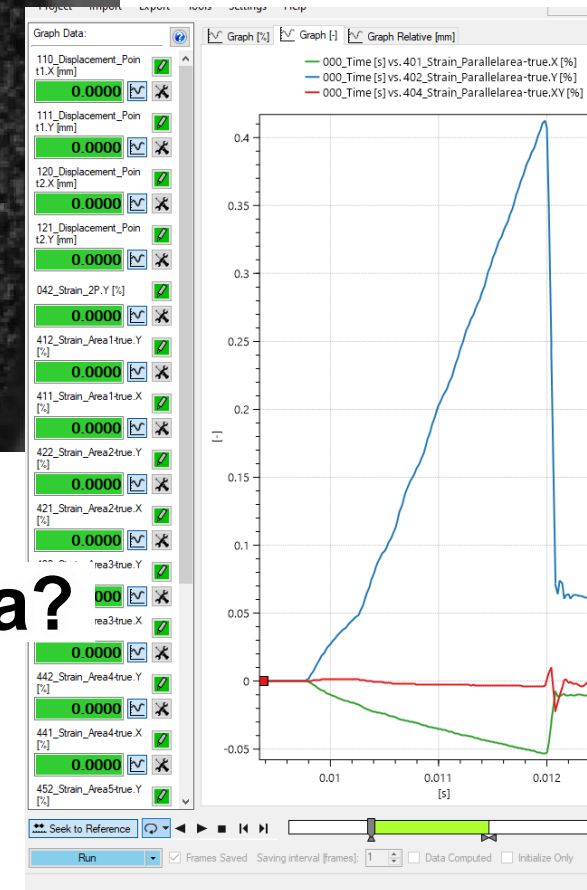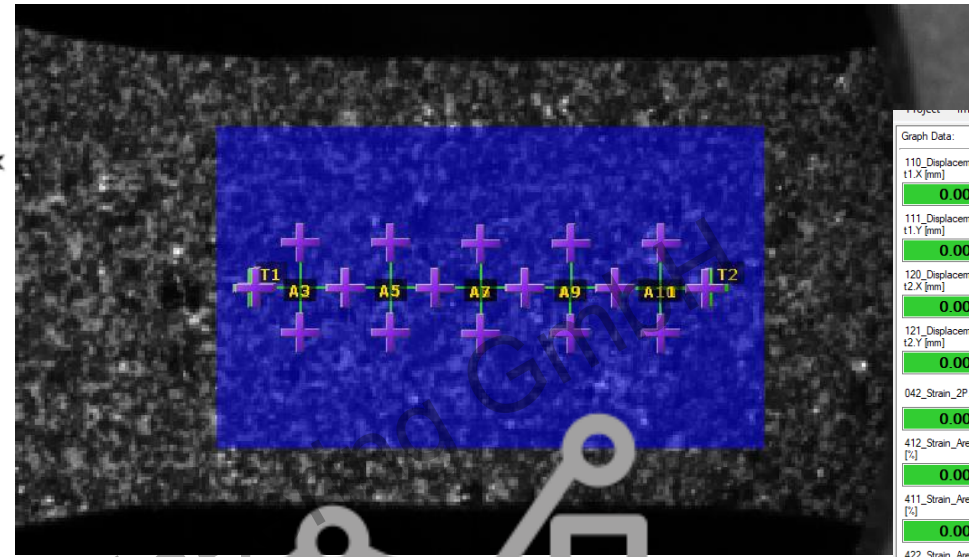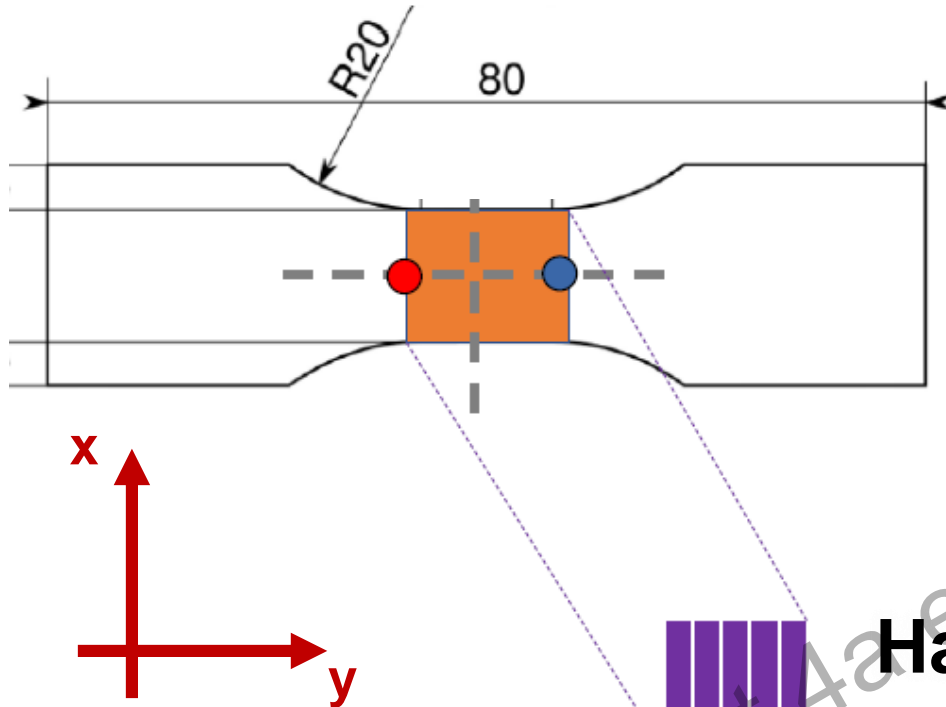**Predefined camera positions attached to the pendulum**

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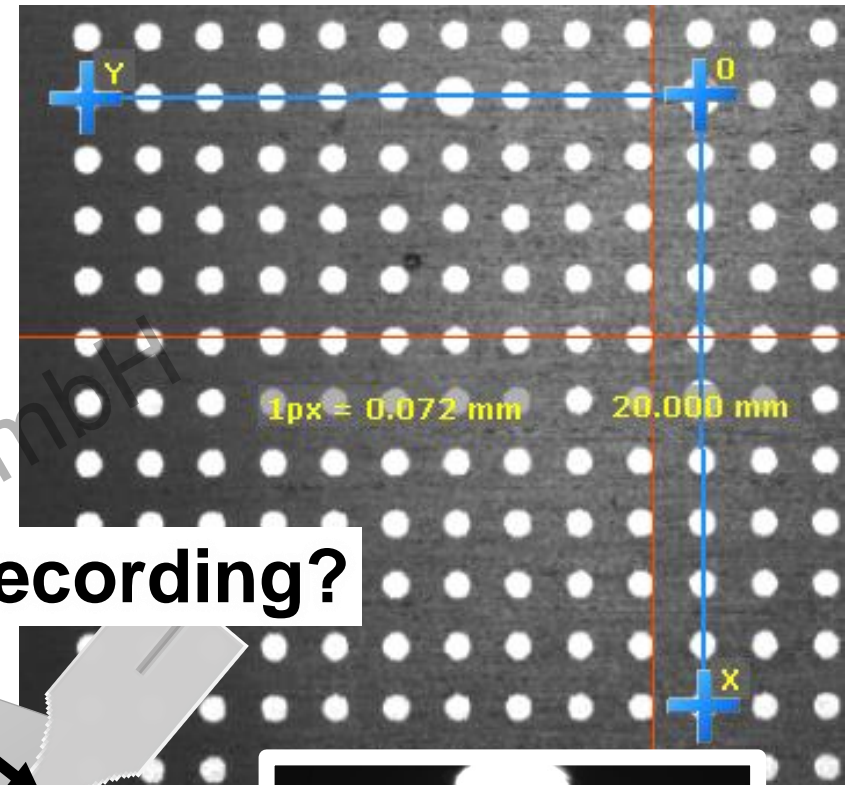
Measurement technique with DIC
Now it's getting complex, isn't it?

Handling the recorded data?
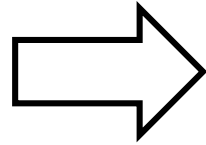
DIC "standard" nomenclature for optical measurement data

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Measurement technique with DIC
It's not complicated!

VALIMAT

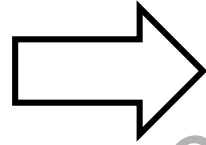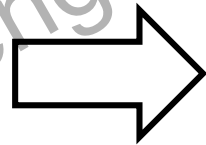| Integrated 5V Trigger output at the IMPETUS® pendulum | ⟹ | **Time-synchronous data!** |

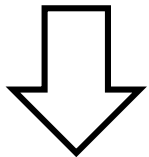| Predefined camera positions attached to the pendulum | ⟹ | **Calibrated DIC recording!** |

| DIC "standard" nomenclature for optical measurement data | ⟹ | **Easy data handling!** |

Efficient dynamic testing!

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Testing procedure

Have to be done manually

- Sample preparation with the speckle pattern

- Attaching the jig to the specimen

- Put the prepared sample at the counter bearing
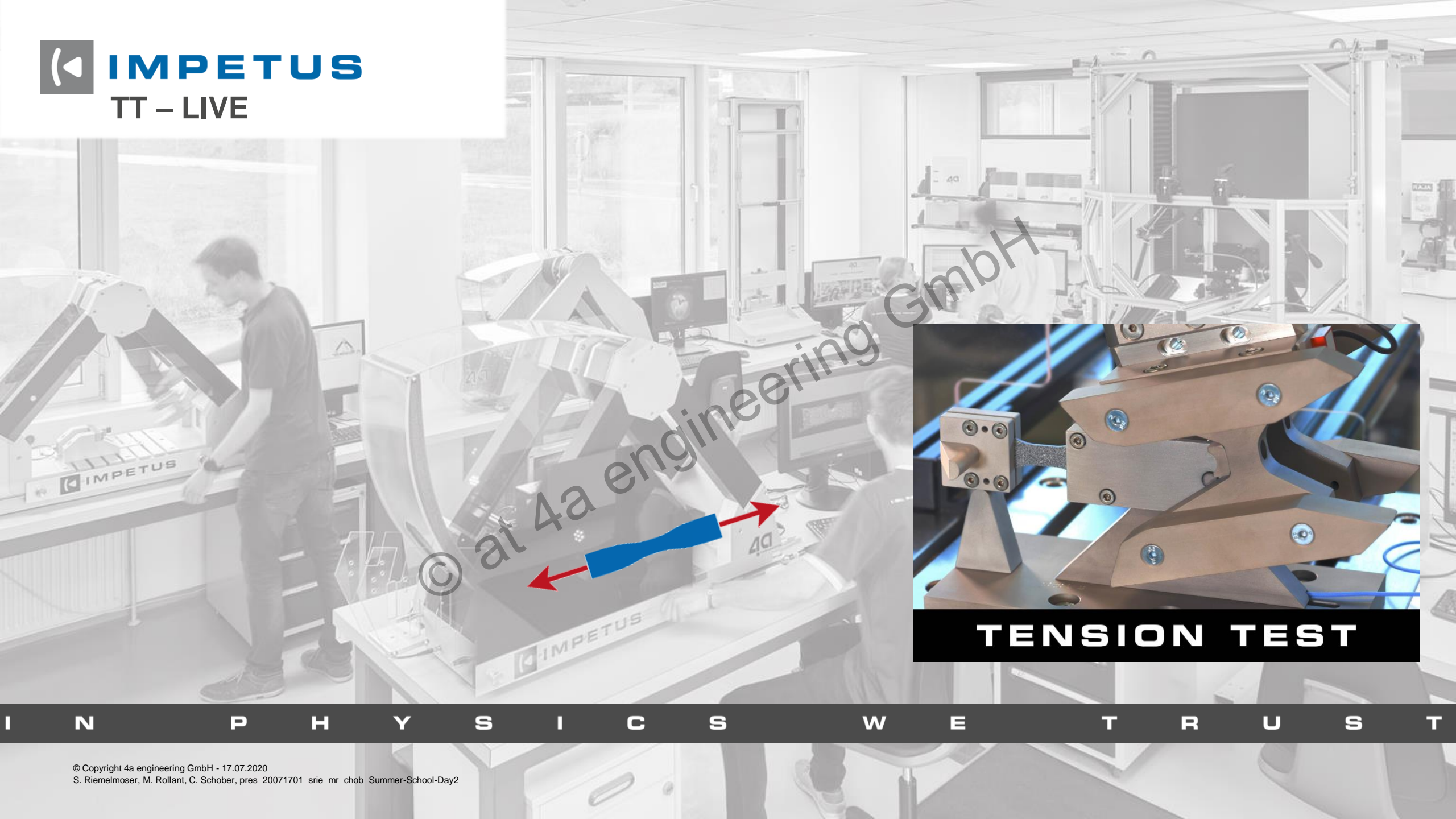
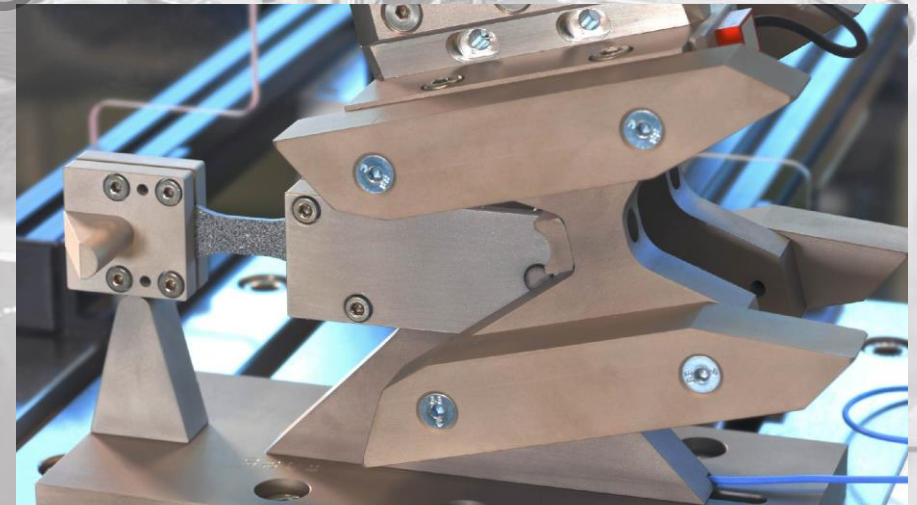- Perform the dynamic tensile test

Is executed automatically

- Activate the bright lights

- Start the recording of the high-speed camera

- Immediately evaluate the DIC images

- Finally store the recorded data in the VALIMAT database
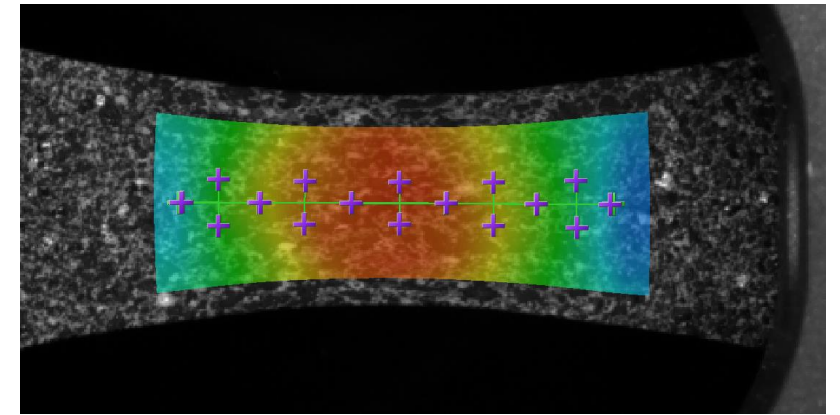
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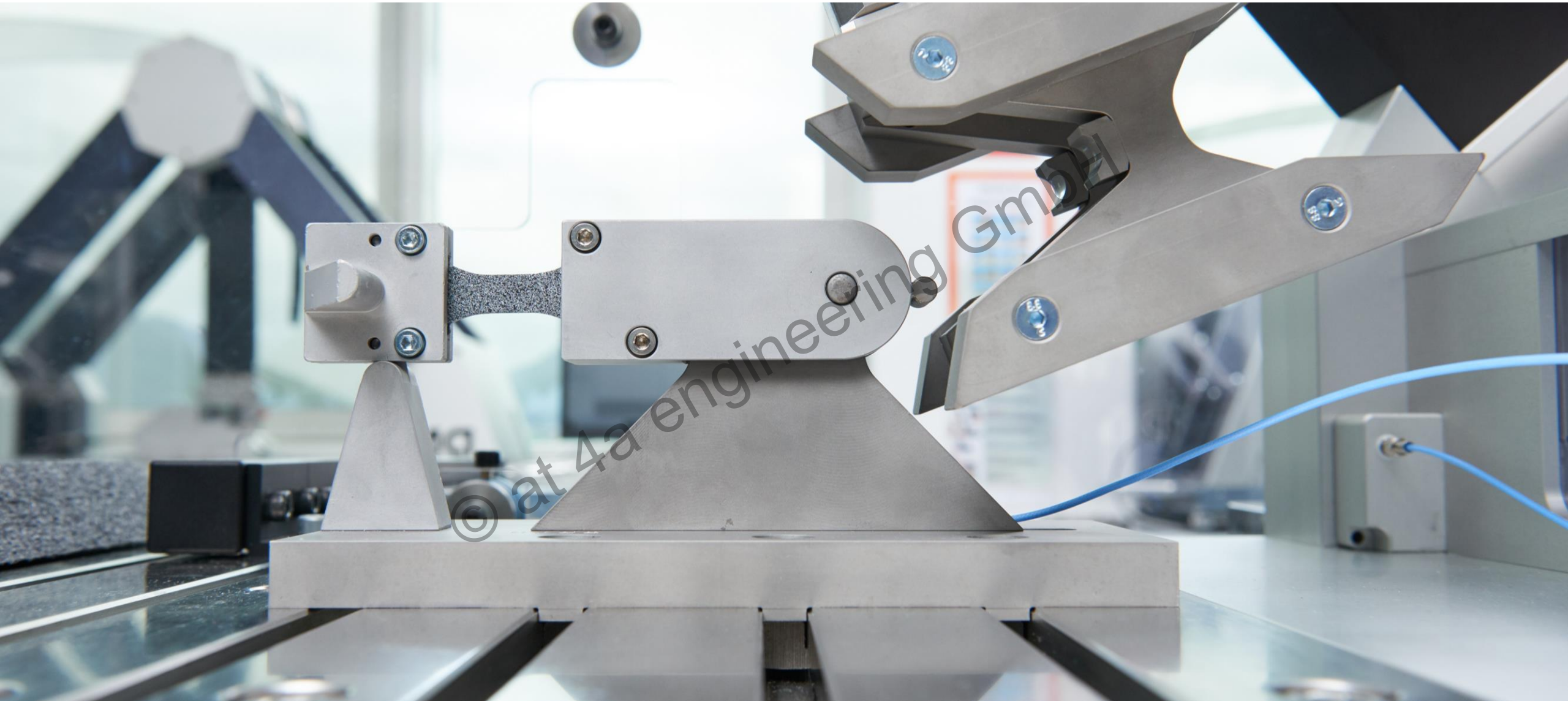
IMPETUS
TT – LIVE

TENSION TEST

I N   P H Y S I C S   W E   I T   R U S T

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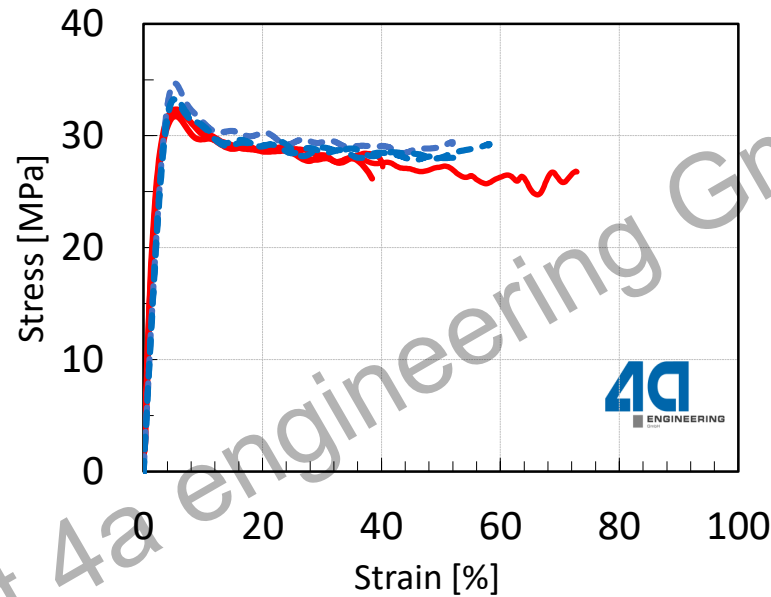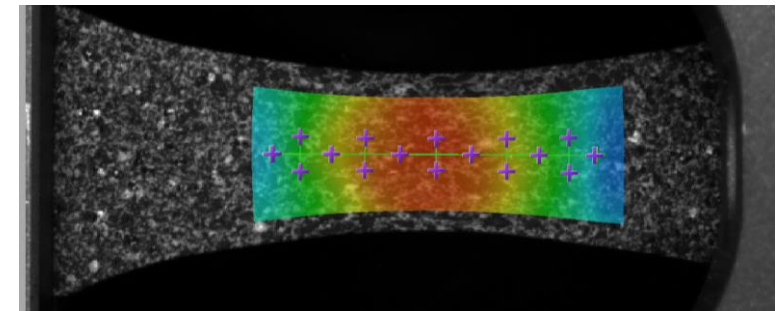
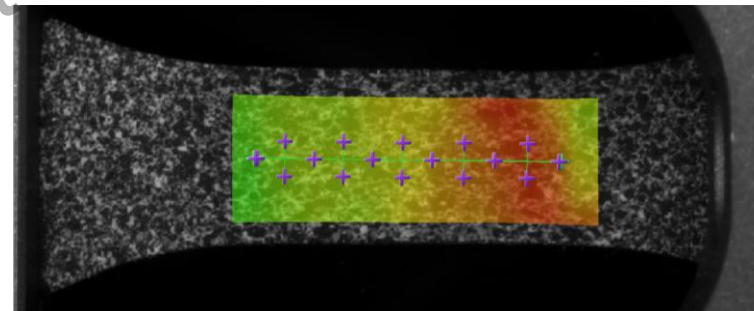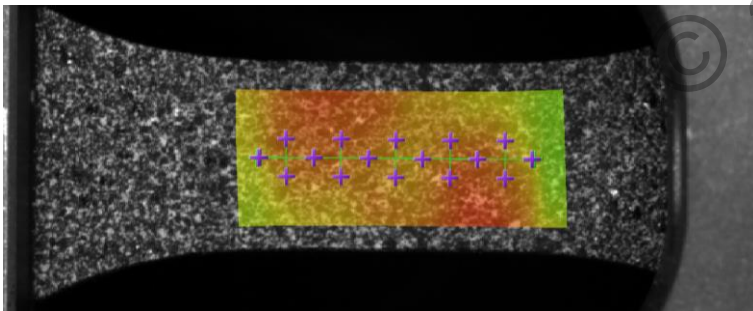# Dynamic tensile test - unreinforced plastic
comparison 4a IMPETUS / external ZWICK

Type A, 3m/s

Type B , 3m/s

Type C , 3m/s

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Dynamic tensile testing

longitudinal 2.5 m/s

transversal 2.5 m/s
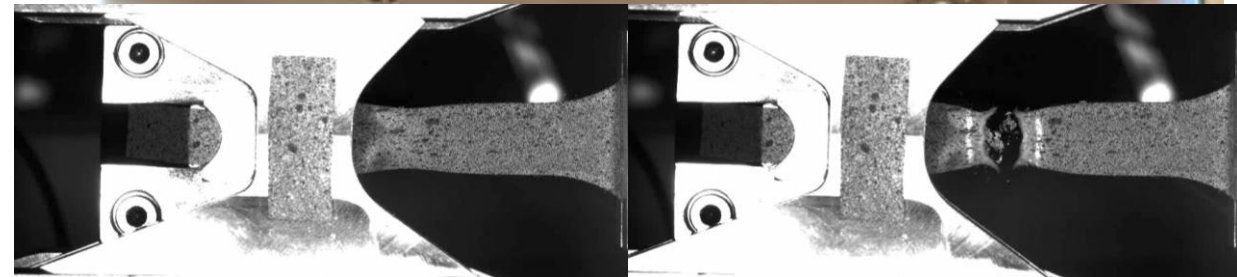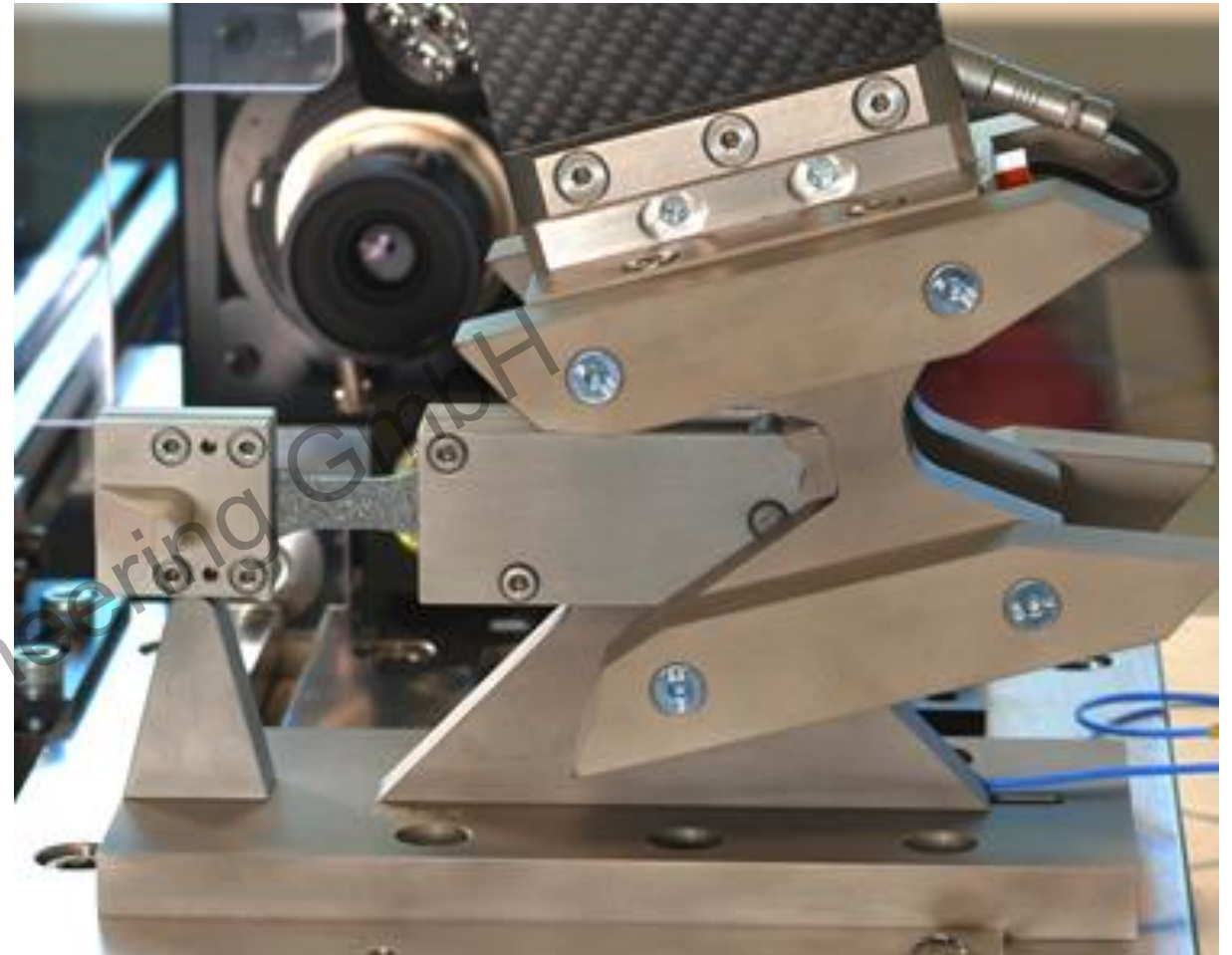
Celstran® PP-GF30-05
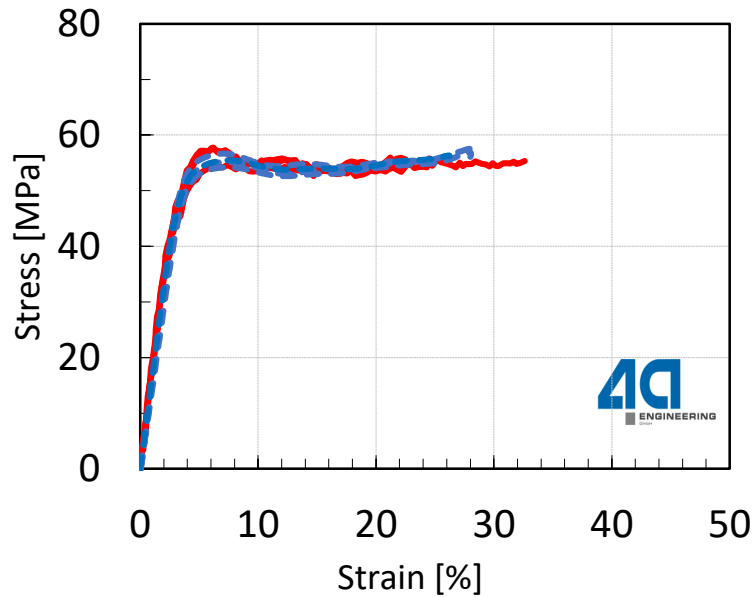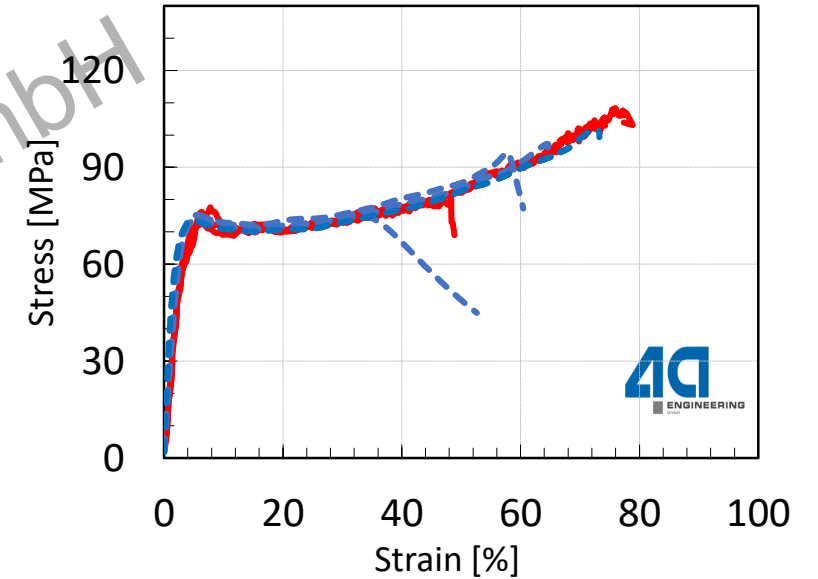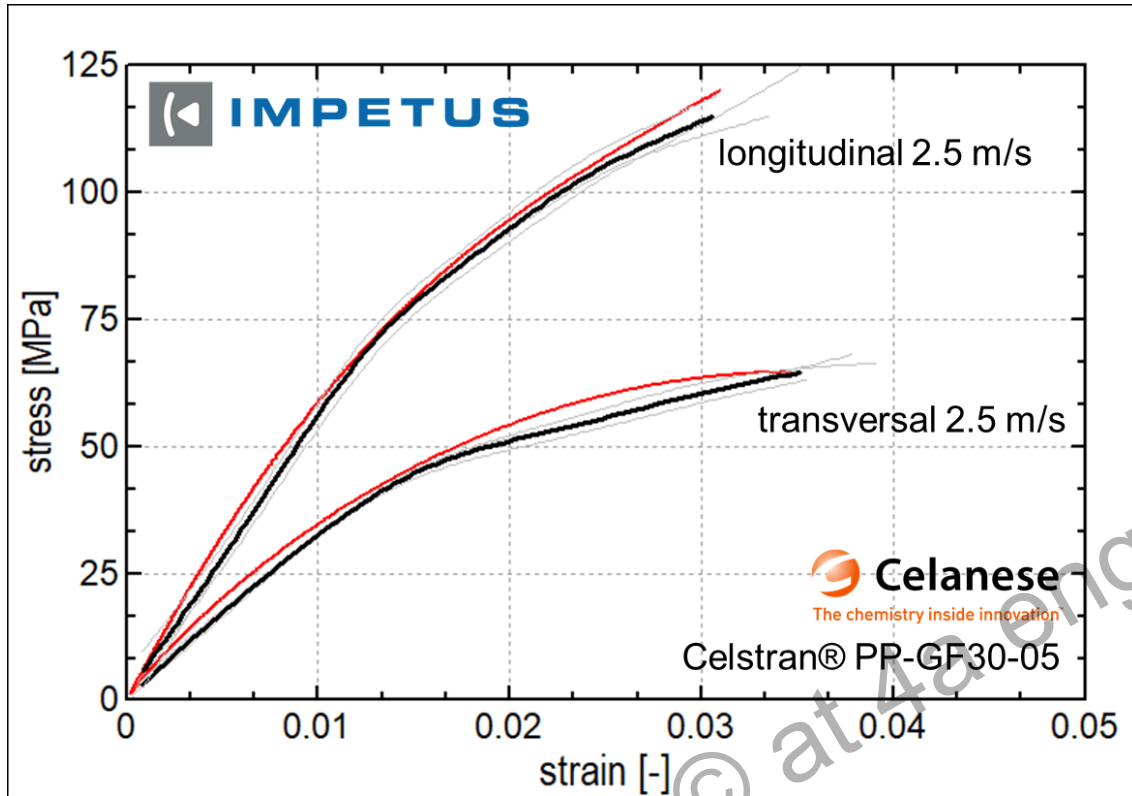
comparison
IMPETUS™ impact tensile versus
classical servo hydraulic test

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Summary

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- Desktop testing device
  - ready to use

- Instrumented high speed testing
  - measured → force / displacement

- Impact speed 0.5 – 4.5 m/s

- Maximal energy up to 50 J

- High speed camera
  - sync. recording

efficient dynamic testing
plastics and composites

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Summer School
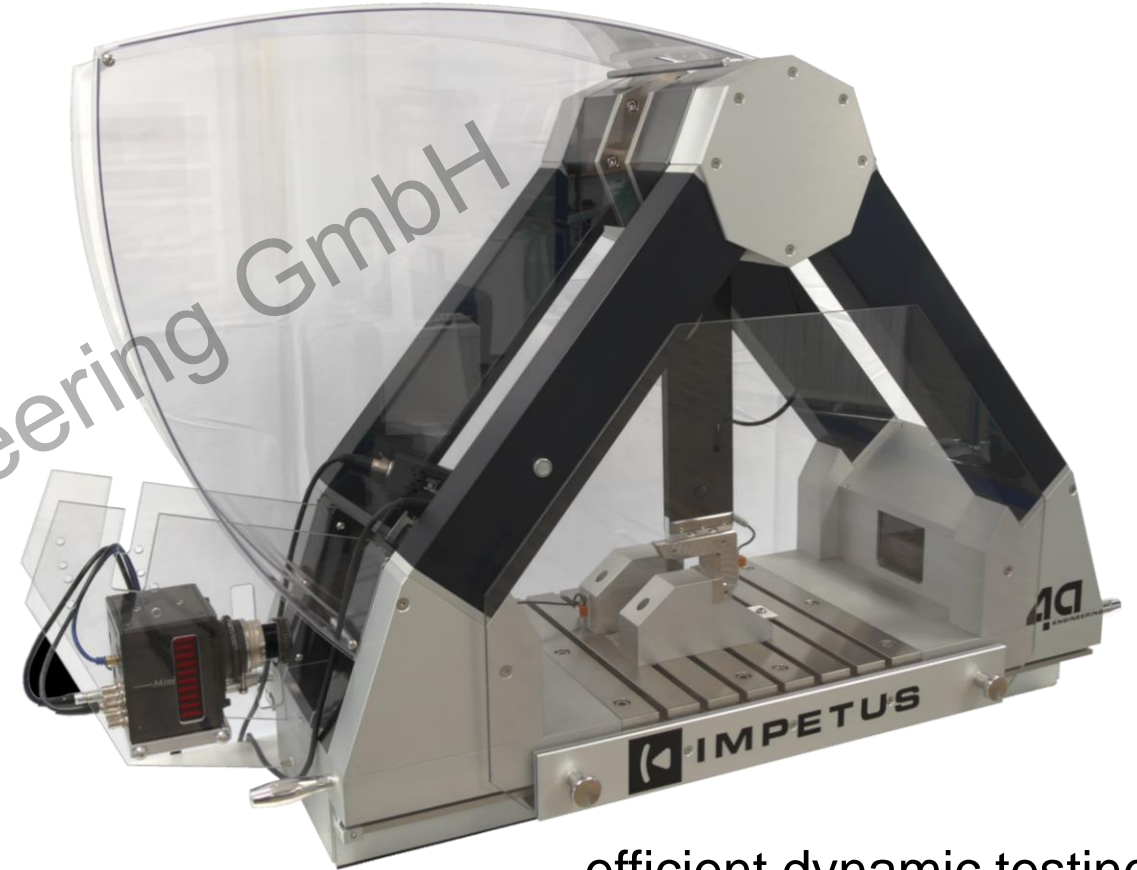
Additional information

presentation – will be provided as PDF as well as recorded stream

trial license – mail with forms link for request (SLA, MAC-ID)

further questions – please contact valimat.support@4a.at

survey – please give your personal

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Thank you for your Attention!

4a summer-school - webinar and training
Material characterization with VALIMAT® and IMPETUS®

SAVE THE DATE
09. July - Material card generation:
vonMises plasticity (*MAT_024),
simple failure, setting up our Autofit

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