

Verbundwerkstoffe im (Nutz-)Fahrzeugbau

Web-Seminar CVC-Südwest
26. August 2025
Prof. Dr.-Ing. Joachim Hausmann



Reinforcing Fibres...

✓ extremely high strength

✓ high stiffness

✓ adjustable orientation
for lightweight design
and elastic tailoring

✓ very low density

....impregnated with a....

✓ corrosion and ageing resistant

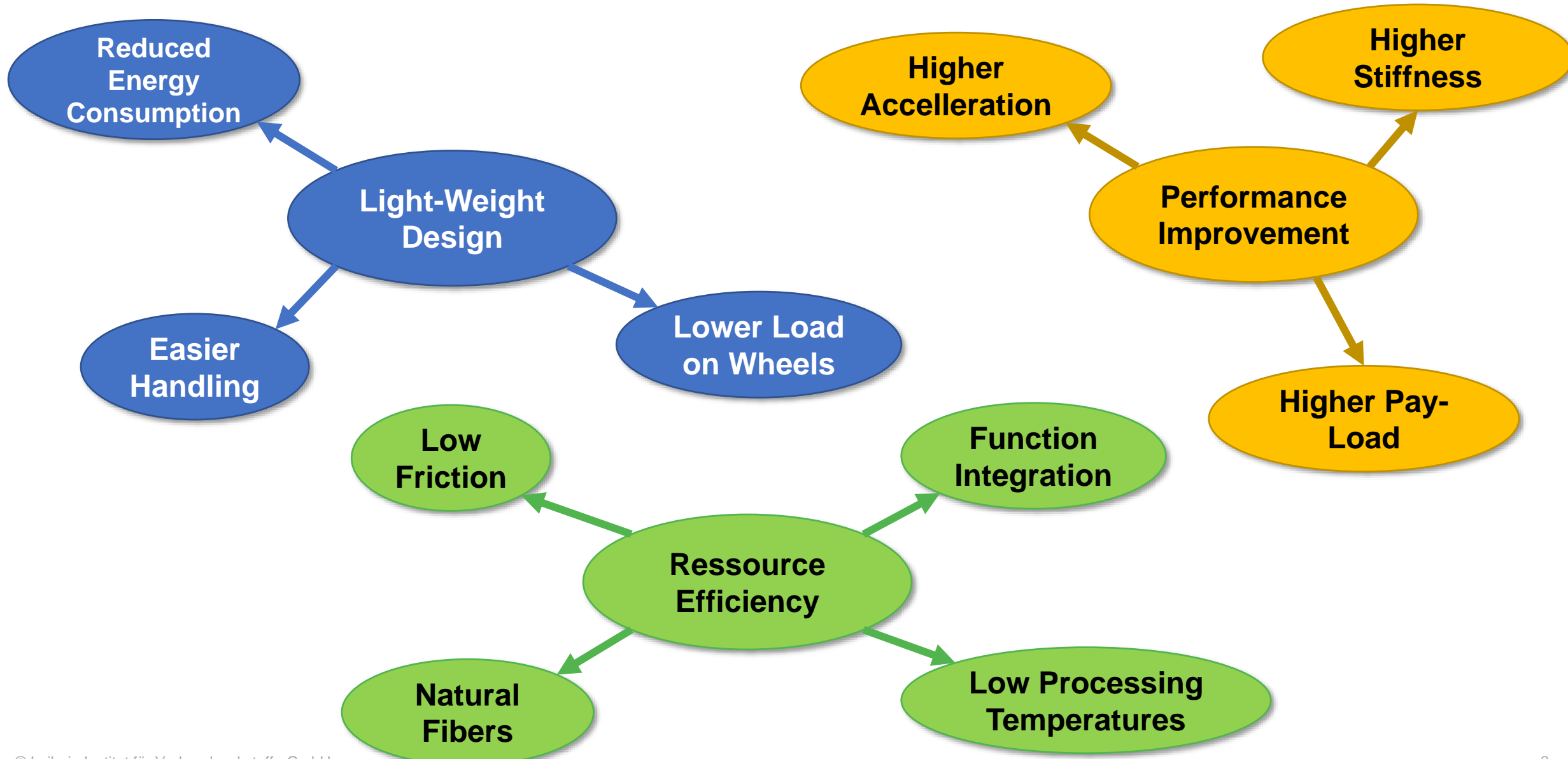
✓ customized physical
and chemical properties

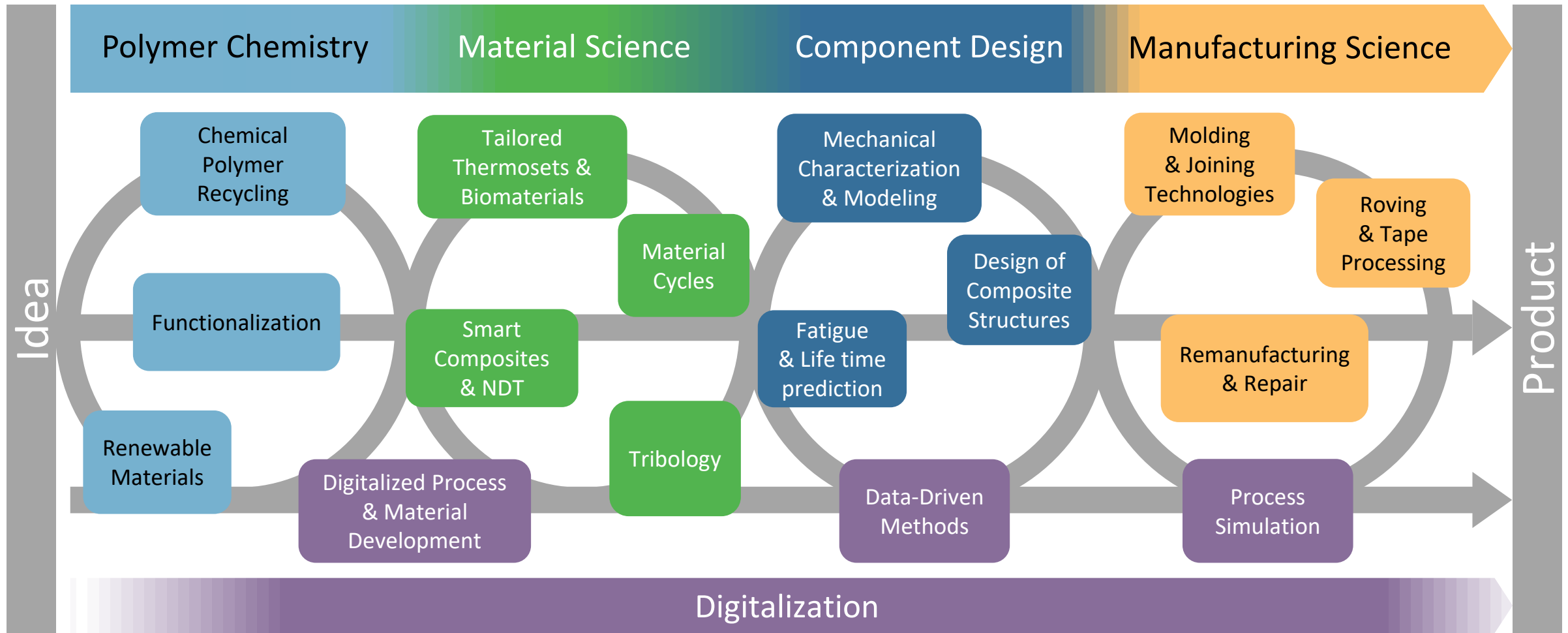
✓ multifunctionality
through doping with additives

✓ high moulding complexity

...Polymer Matrix

✓ multiple formability
and weldability
(thermoplastics)





BMBF-Project „MultiKab“: Lightweight by Multi-Material-Design

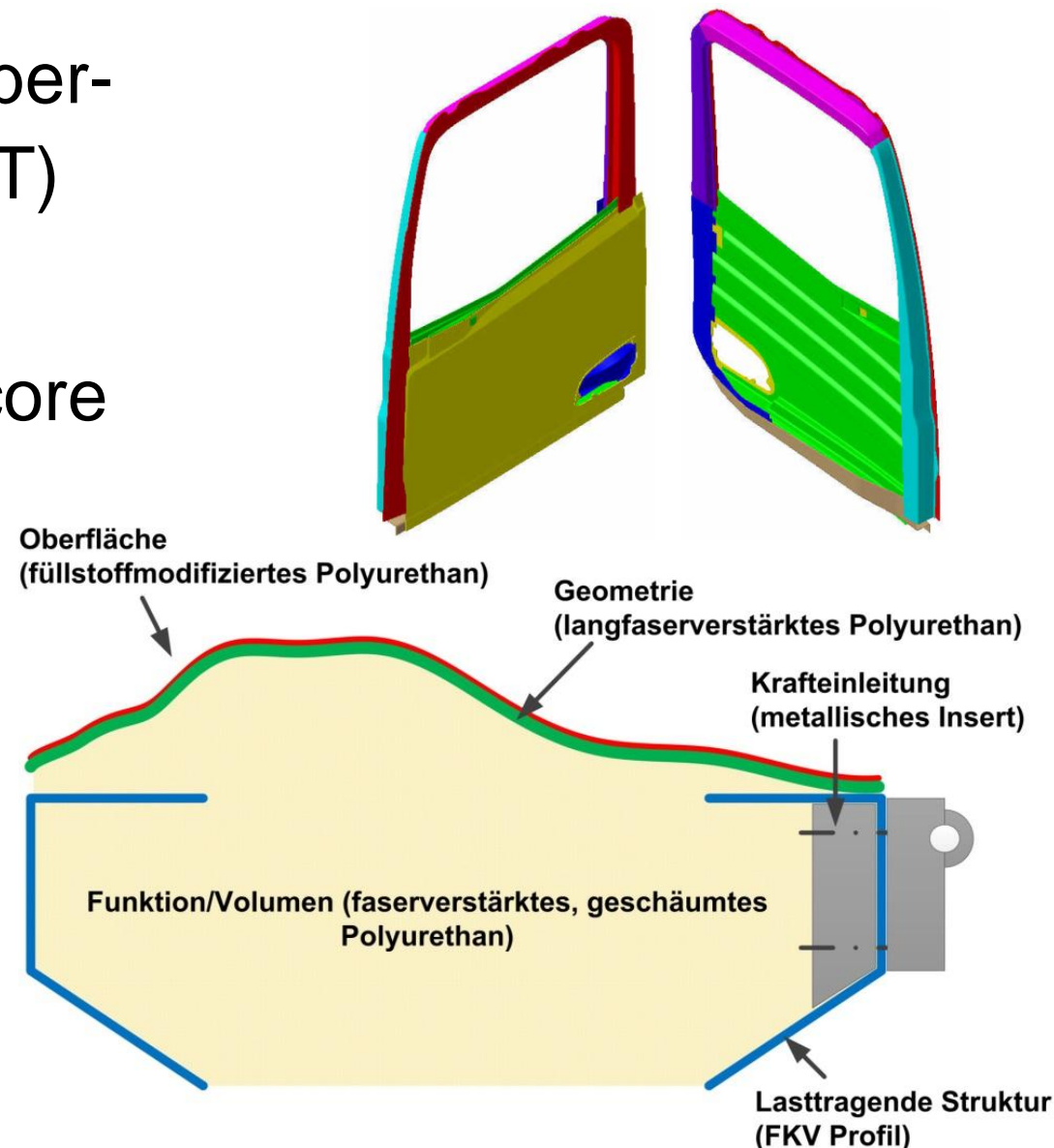


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- Target: Development of weight-optimized cabins for commercial vehicles by multi-material design
- Load specific material selection:
 - Thermoset and thermoplastic matrix
 - foamed, non-reinforced and fiber-reinforced plastics
 - Metallic elements
- Generic components:
 - Farm vehicle: Cabin roof
 - Truck door



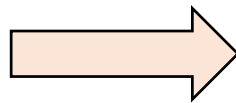
- Load-bearing structures made from fiber-reinforced thermoplastics (GF-PC/PBT)
- Anisotropic fiber orientation
- Sandwich design with PUR-foam as core
- Metallic inserts for load introduction
- Component of fiber-reinforced PUR manufactured by infusion process
→ high design flexibility
- Class A surface by additional PUR surface layer



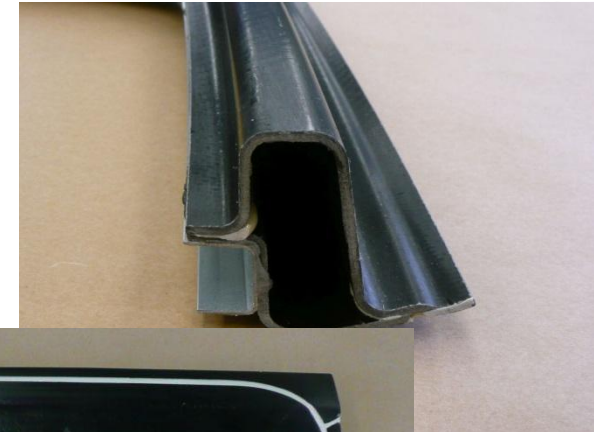
- Weight reduction of 30% along with same costs as metal component
 - Manufacturing process suitable for serial production
 - Reduced assembly effort by integration of functional elements
 - Better crash behavior
- ➔ same applies for cabin roof



Thermo-formed parts



Joined door structure



Composite Materials for Electric Motor Applications, e.g.:

- BMBF-Project „GroAx“
- EU CleanSky JTI “HiTemComFil”



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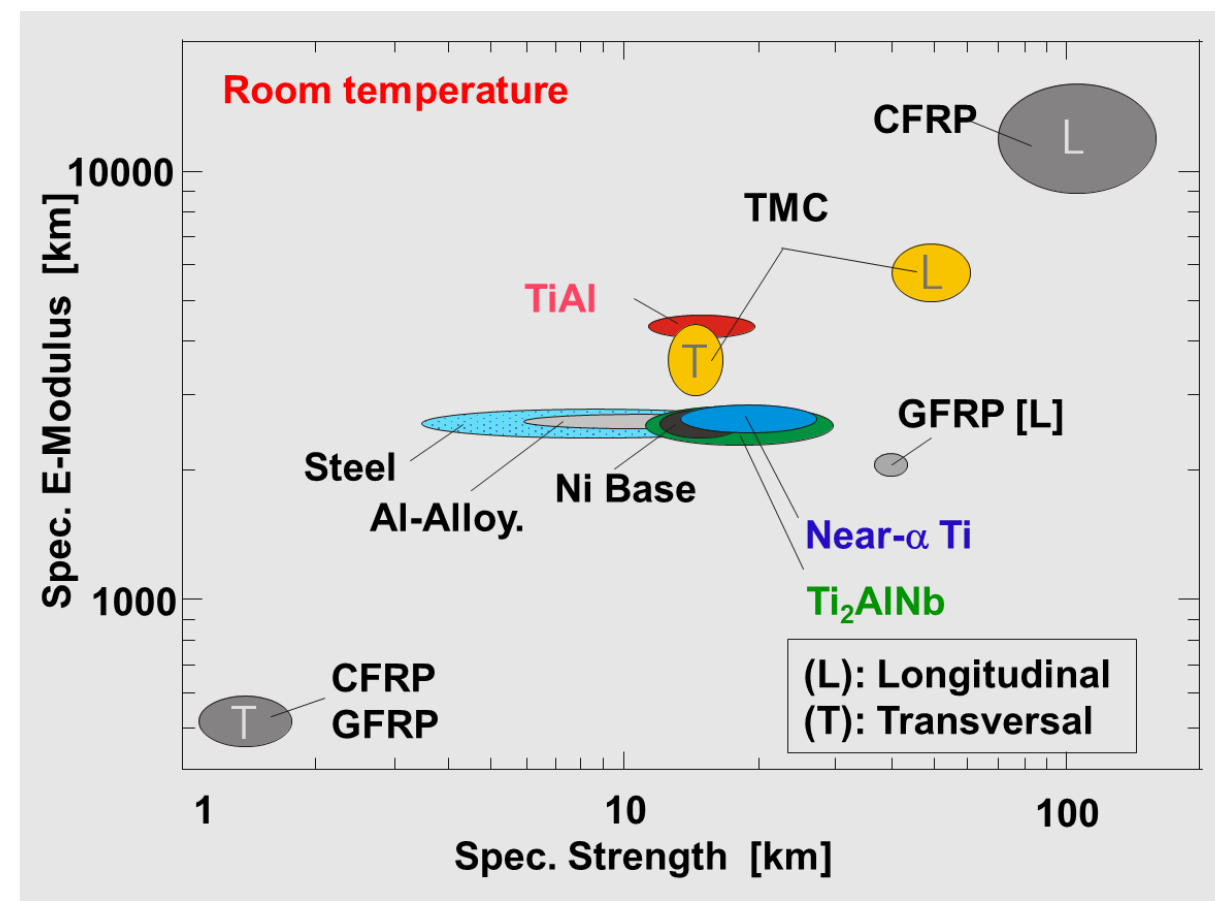
- Intention for usage of composite materials:

- Lower weight
- Higher rotational speed
- Lower mass inertia
- Electro-magnetic permeability
- Electric insulation

➔ Reinforcing rings for rotors

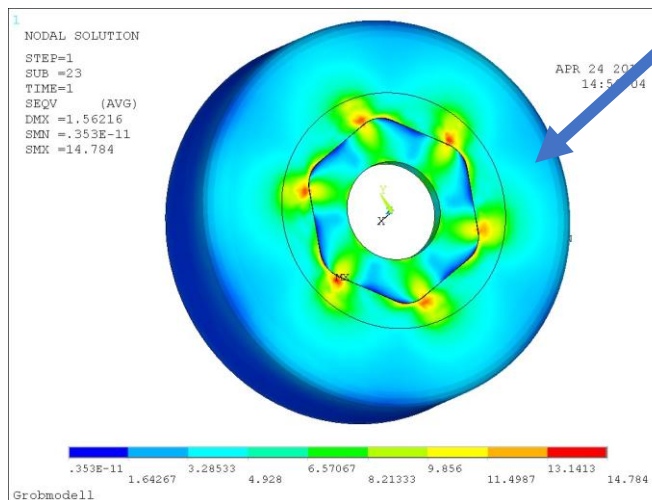
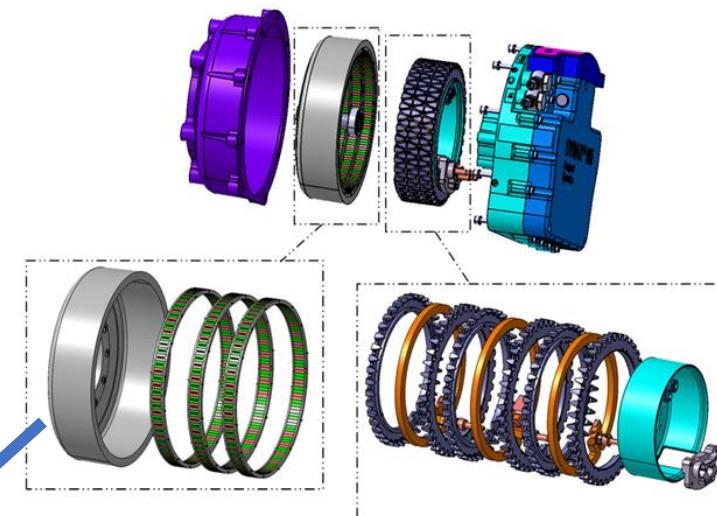
➔ Casings

➔ Split cases



- Target: Development of a rotor casing which supports the magnets and is suitable for efficient serial production
- Solution: Filament wound GFRP rotor with limited radial deformation and optimized load introduction

Motorentechnologie DYNAX®



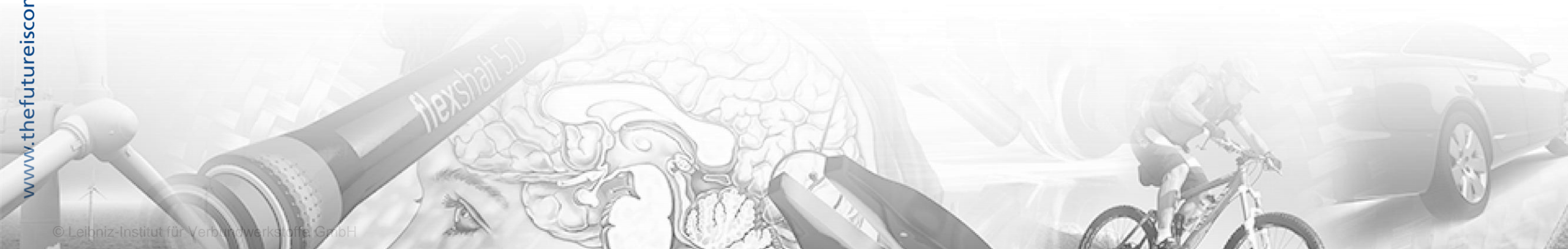
- Application: Rotor for aircraft ventilation system
- Targets:
 - Maximize rotational speed by hoop reinforcement
 - Temperature resistance up to 240°C
 - Avoid cracking of magnets
 - limit radial deformation
 - Automated winding process
- Solution:
 - Hoop winding with stiff fibers and temperature resistant PMI resin
 - Control of internal stresses



Innovative Solutions for Hydrogen Storage in Transport Applications



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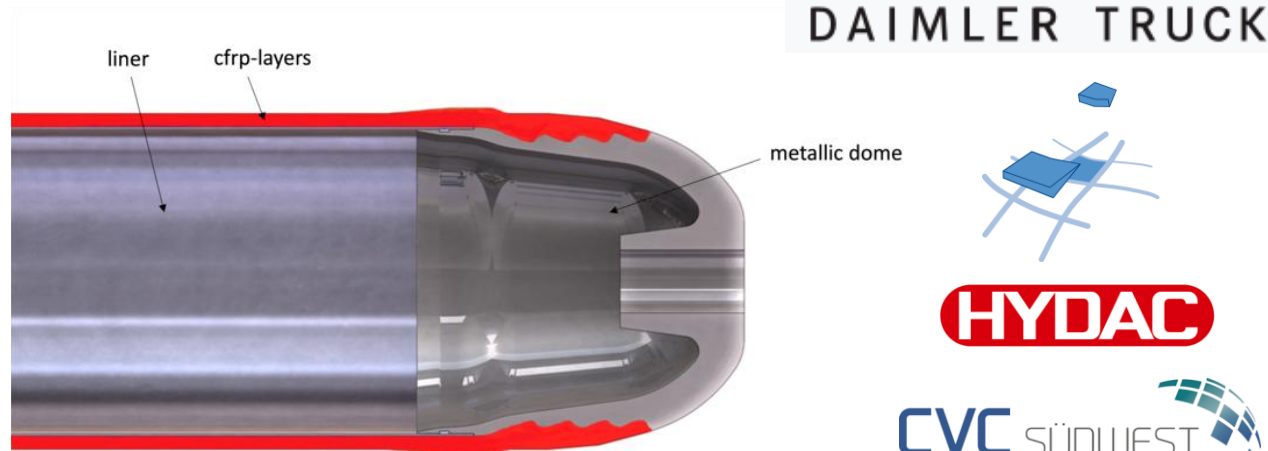
© Daimler Truck AG

Targets

- ✓ Lightweight hydrogen tank
- ✓ Storage of gaseous hydrogen (700 bar)
- ✓ Optimum utilization of installation space

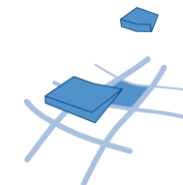
Solution

- ✓ Tubular CFRP-reinforced tank
- ✓ Layer by layer load introduction
- ✓ Adapted winding process



Lightweight hydrogen tank demonstrator

DAIMLER TRUCK



HYDAC

CVC SÜDWEST

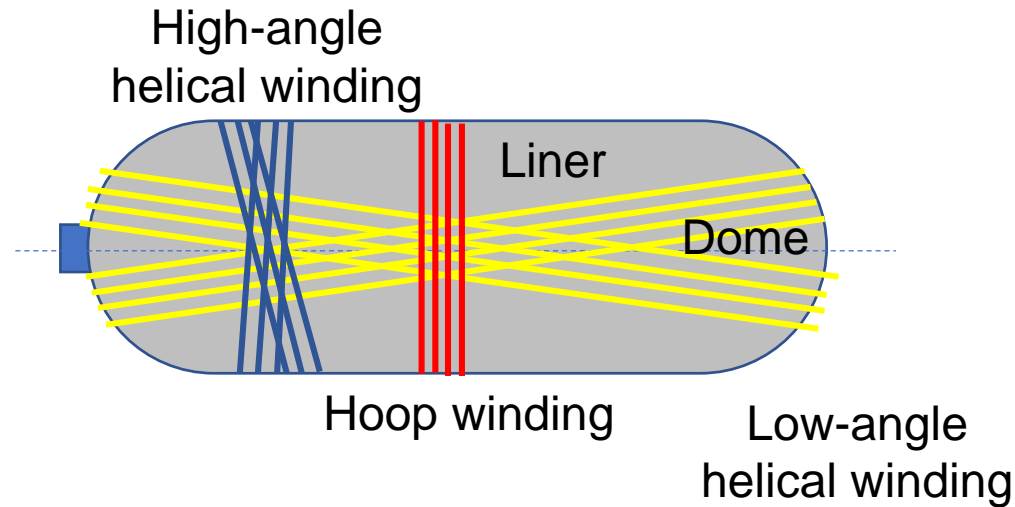


comlet
Engineering your success

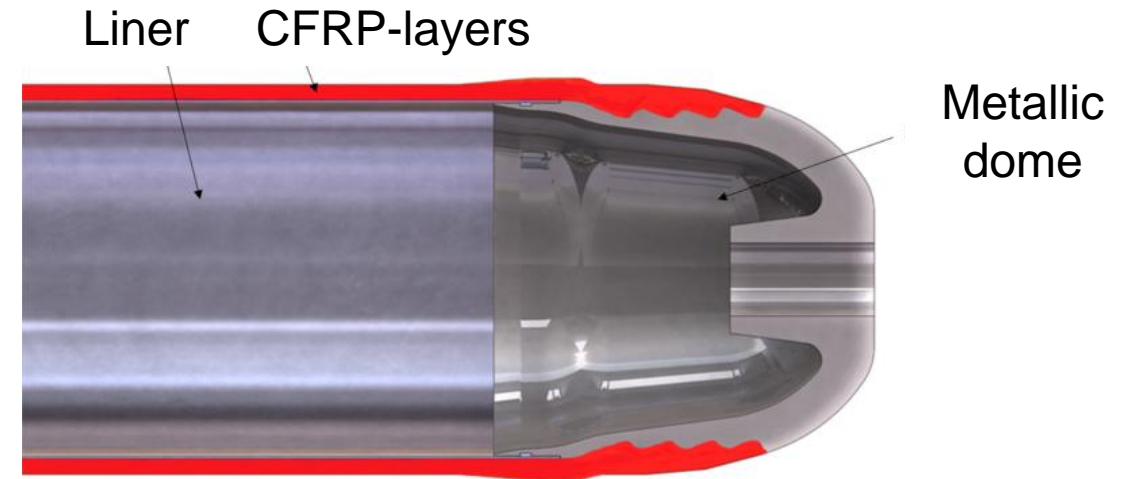
Photonik-Zentrum
Kaiserslautern e.V.

Thomas

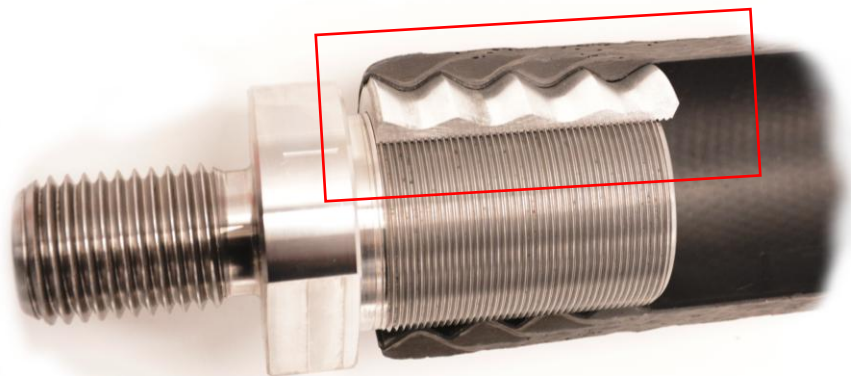
Advantages of the Novel Pressure Vessel Design



- Contains of helical and circumferential layers
- Small vessel diameters are difficult to be winded
- 0°-Layers are difficult to realize
- Need for pre-manufactured liners
- Only small inspection holes possible

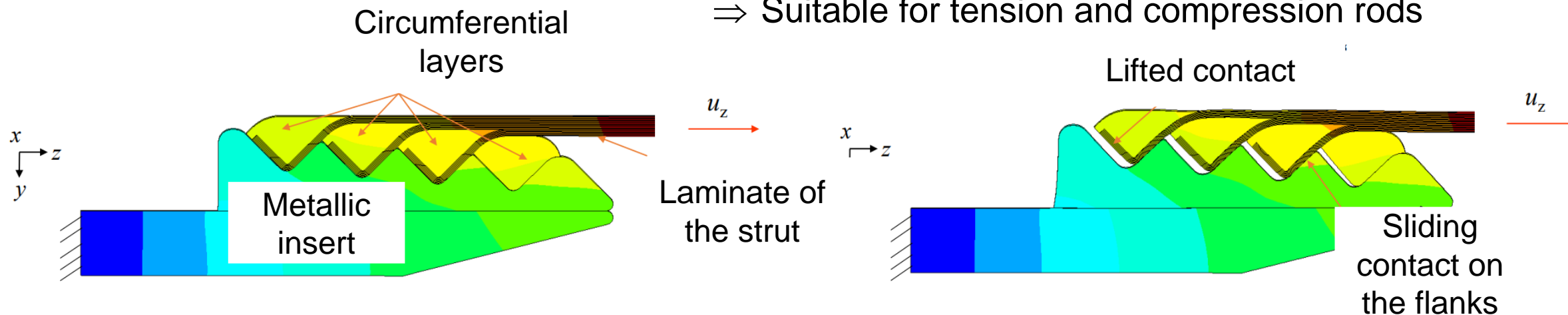


- Contains only of 0°-/90°-Layers
⇒ Usage as a load-bearing structure possible
- Realisation of small vessel diameters (no turning zone)
⇒ Better usage of design space
- Large inspection holes possible
- Usage of a tube as a liner

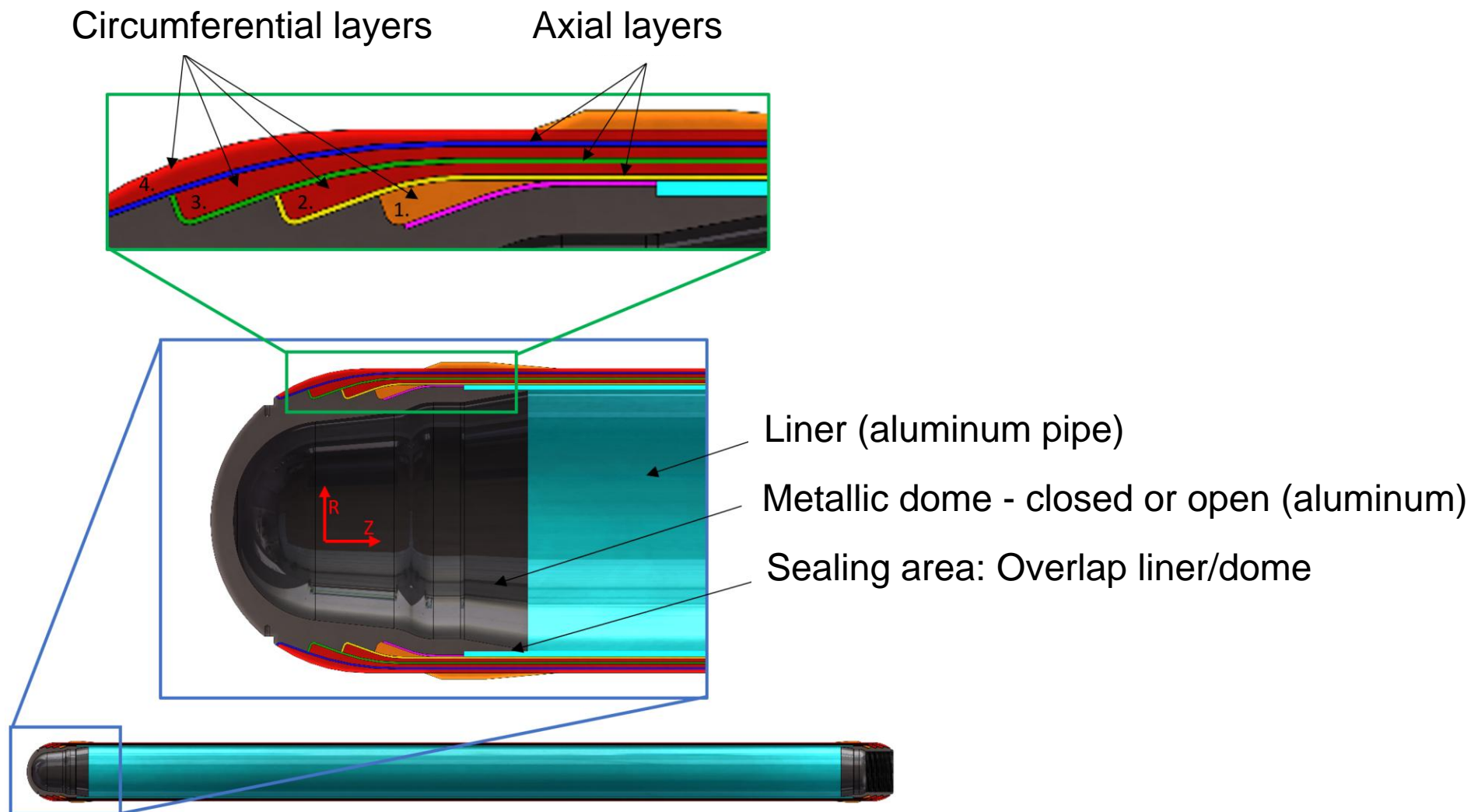


Weight:	910 g incl. metallic inserts
Laminate thickness:	2.5 mm
Length:	540 mm
Diameter:	66 mm
Load bearing:	ca. 250 kN

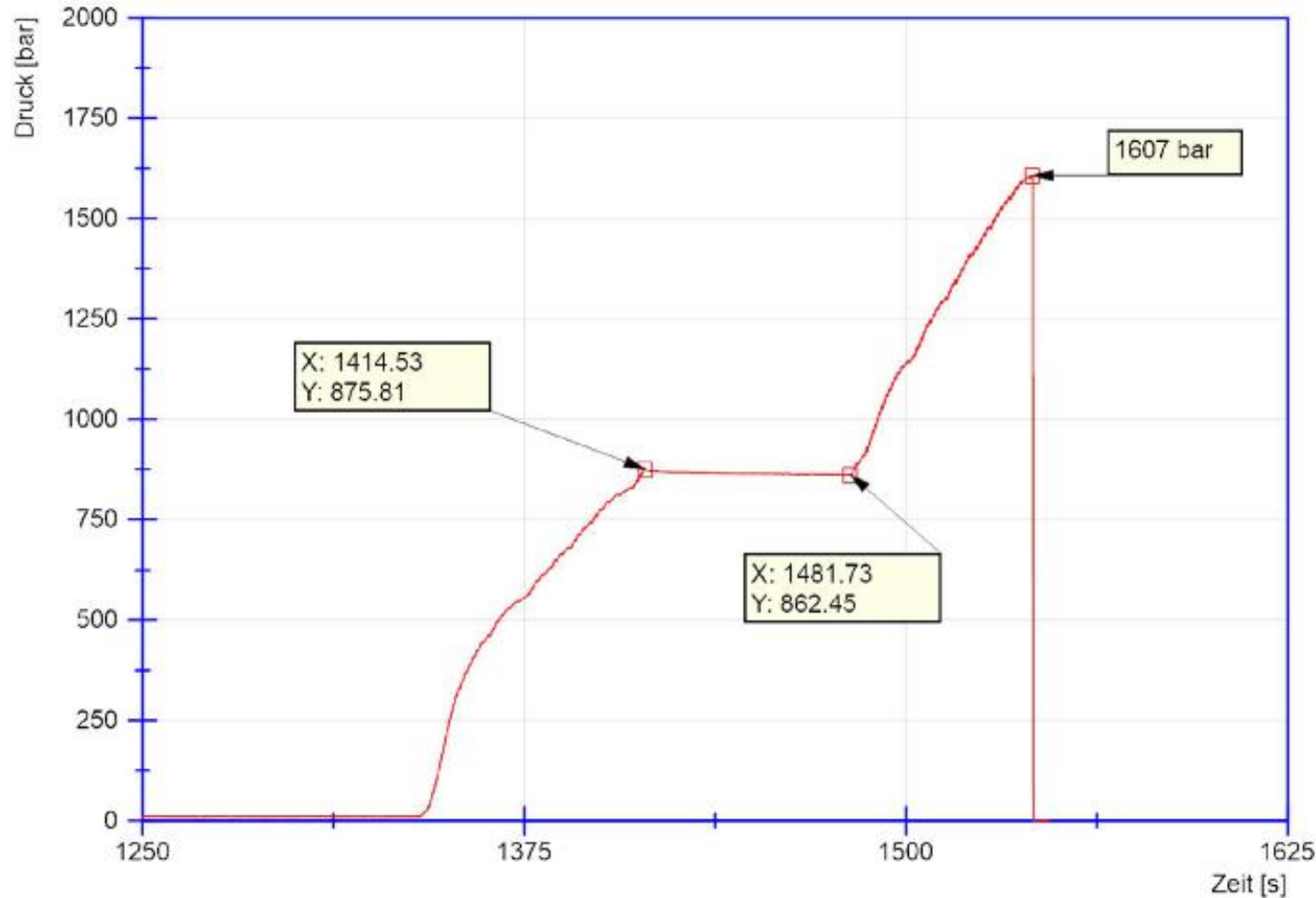
- ⇒ “Layer wise press fit”
- ⇒ Homogeneous load distribution with low stress peaks
- ⇒ Suitable for tension and compression rods



Adaption to Hydrogen Pressure Vessel Design



Burst Pressure Testing of Second Generation



- Inner cone designed as massive part
- Circumferential layers reinforced
- Ca. 1,600 bar achieved (target 1,575 bar)

**R&D-project BMWK - WaVe
(2021-2024)
Partner: Daimler Truck, Hydac ...**

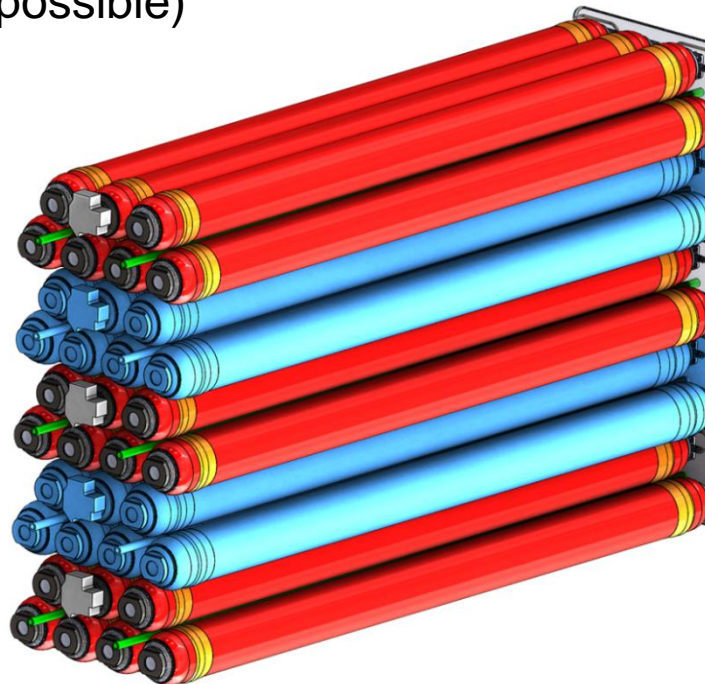


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Source: <https://wave.cvc-suedwest.com/>

Remarks

- Utilization as “conformable tank”
- Target: Provide enough hydrogen for a complete work day (today with conventional type 4 tanks only a half work day possible)



Supported by:



on the basis of a decision
by the German Bundestag

Other Examples



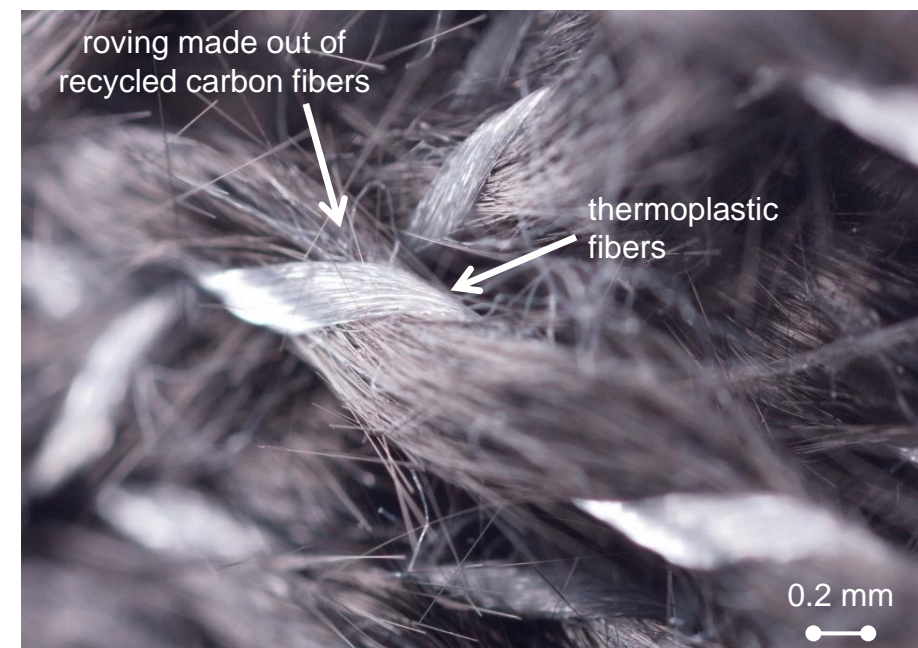
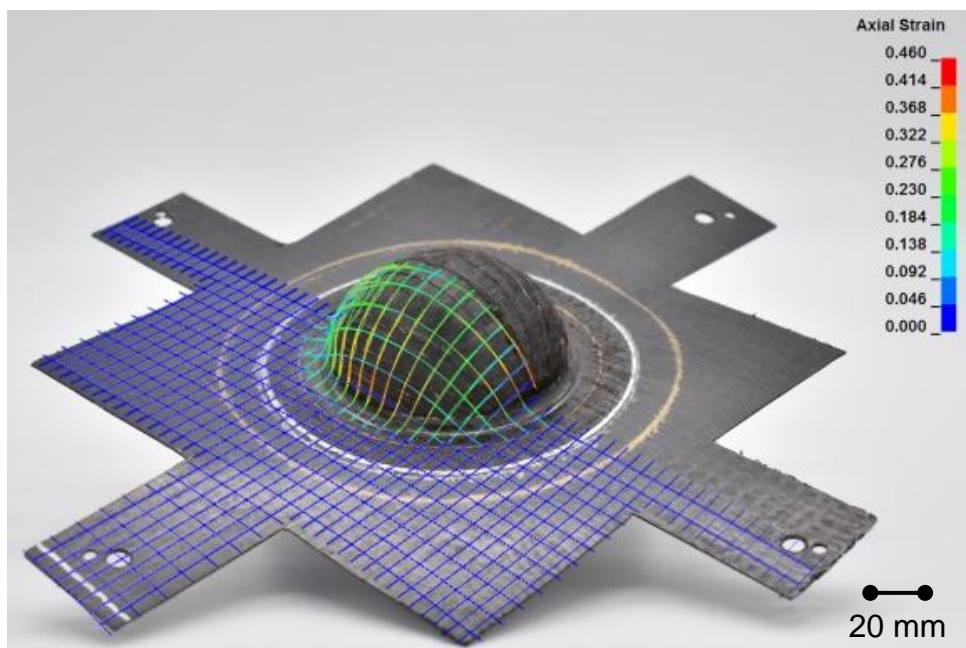
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Key Topic “Energy“

Innovation Example: Low Friction & Wear Tribo Compounds



KOLBENSCHMIDT



Targets

- ✓ Re-use of carbon fibers for the original purpose
- ✓ High strength and stiffness
- ✓ Complex shaped structures

Solution

- ✓ Staple fiber yarns
- ✓ Stabilized with thermoplastic fibers
- ✓ Stamp forming technology

M. Duhovic, P. Mitschang, D. Bhattacharyya: Modelling approach for the prediction of stitch influence during woven fabric draping. Composites - Part A: Applied Science and Manufacturing, Vol 42, Issue 8, (2011)

C. Goergen, D. Schommer, M. Duhovic, P. Mitschang: Deep drawing of organic sheets made of hybrid recycled carbon and thermoplastic polyamide 6 staple fiber yarns. Journal of Thermoplastic Composite Materials (2018)

- Composite materials, i.e. fiber-reinforced polymers provide:
 - light-weight solutions
 - multi-functionality
 - reduced energy consumption
 - corrosion resistance
- Challenges are:
 - profound knowledge on composite materials of development staff
 - cost efficiency
 - serial production technology
 - circularity

... solutions exist and are awaiting for applications!

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and Funding Organisations**

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Composite Aneurysm Clip