

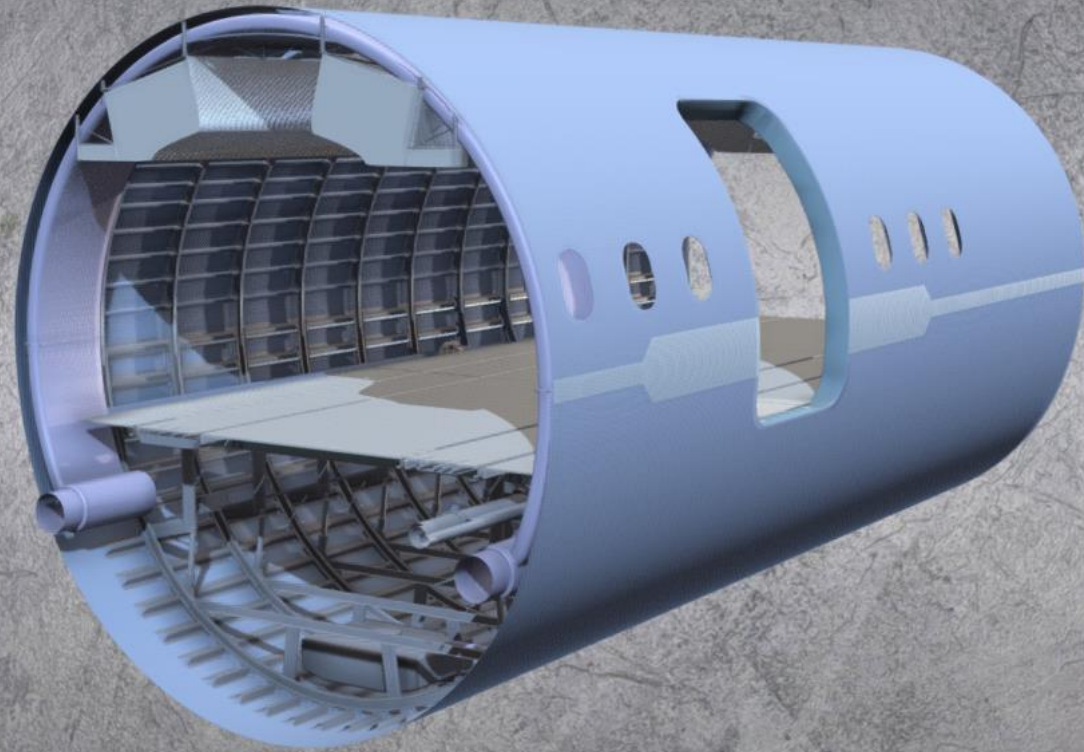
Upscaling of in-situ Automated Fiber Placement with LM-PAEK – from Panel to Fuselage

Olivia Hellbach, Dominik Deden, Lars Brandt, Frederic Fischer
German Aerospace Center (DLR) Augsburg



Knowledge for Tomorrow





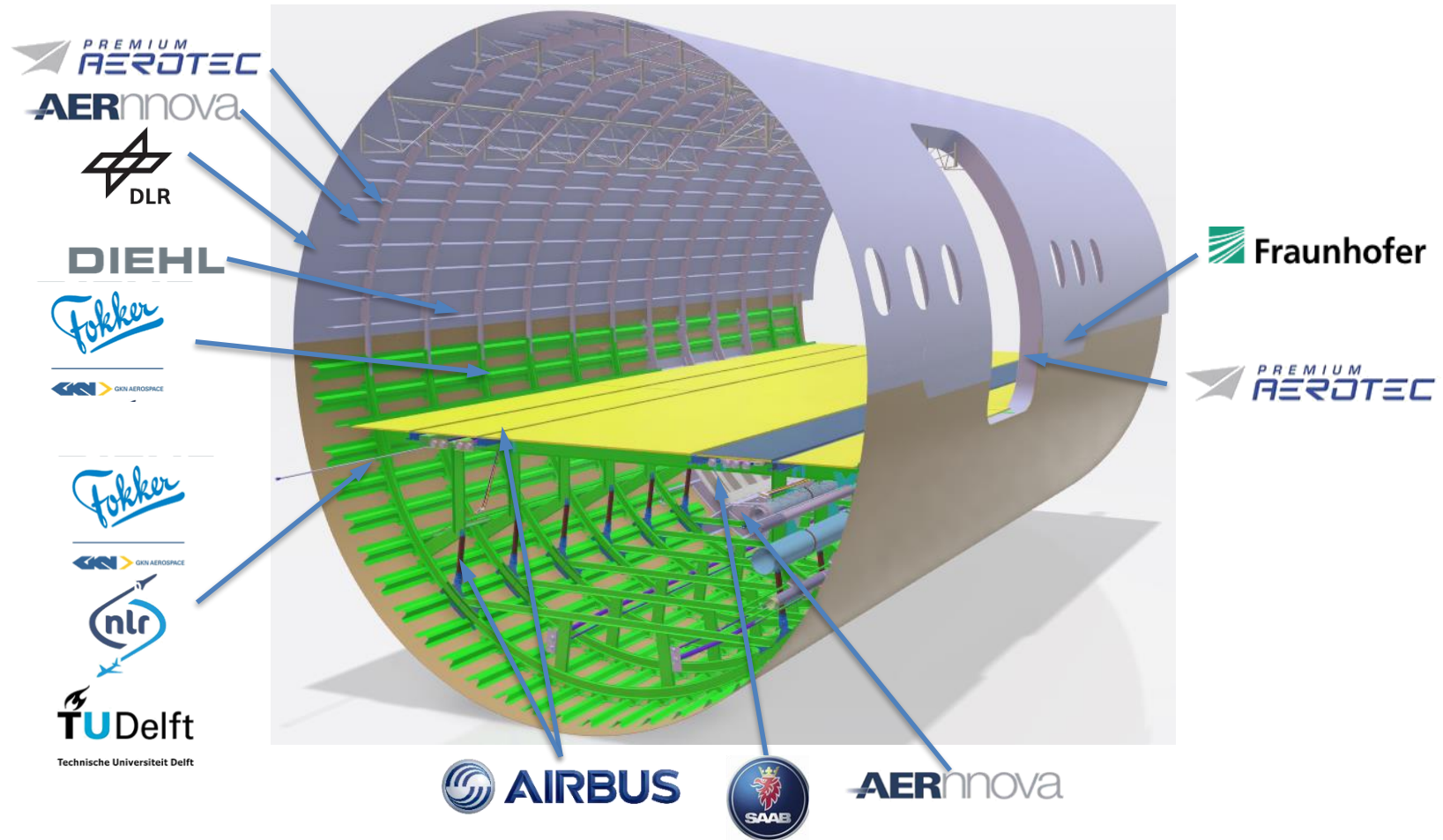
World's largest thermoplastic composite structure

The Multifunctional Fuselage Demonstrator (MFFD) project

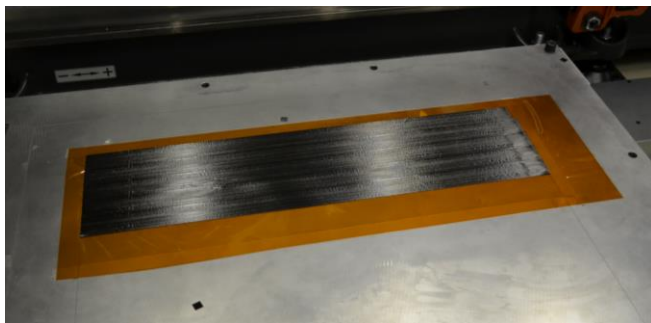
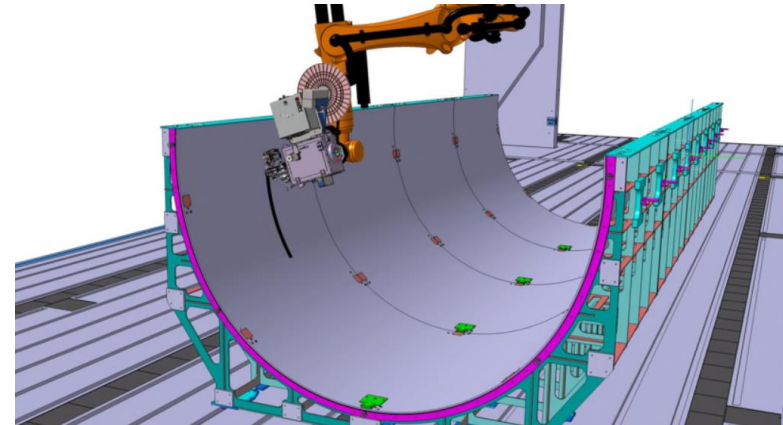
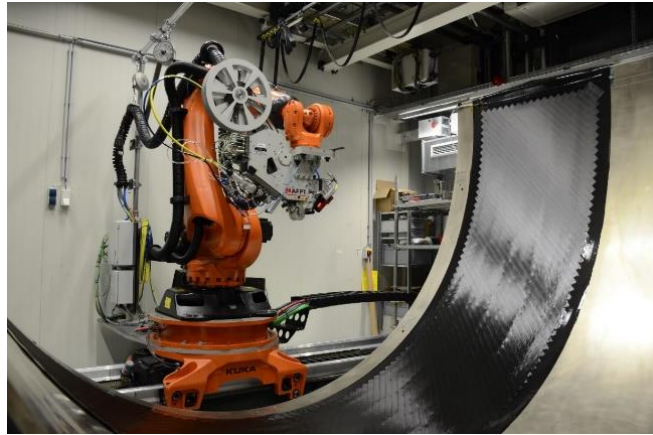
Advantages of a thermoplastic fuselage:

- No size limitations due to oven / autoclave
- Short / no curing time
- Weldability

 This project was funded by the European Union



From panel to fuselage



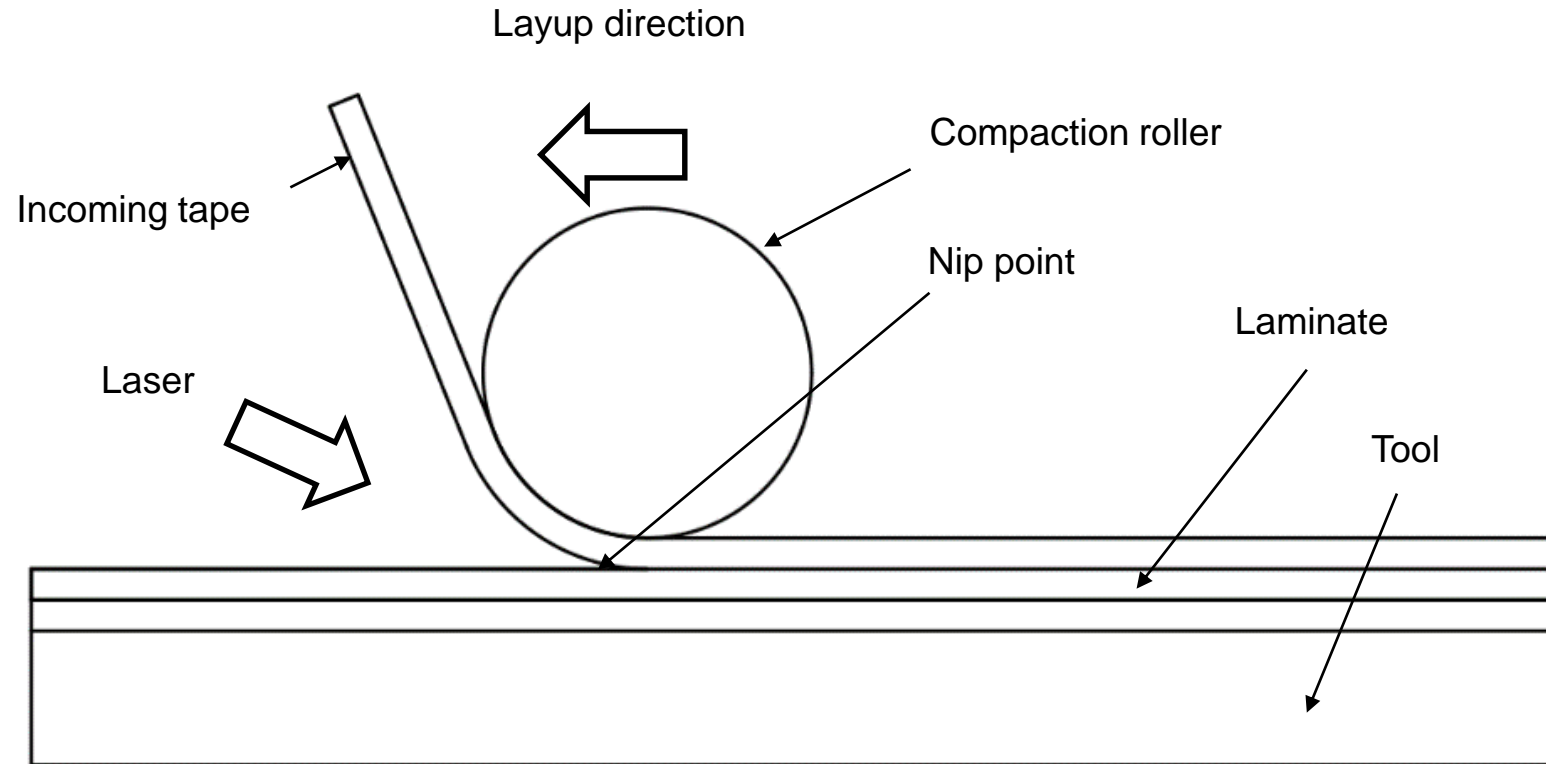
●
2020:
Pre-trials

●
2021:
Test shell
(length: 1 m, diameter: 4 m)

●
2022:
Full-size demonstrator
(length: 8 m, diameter: 4 m)

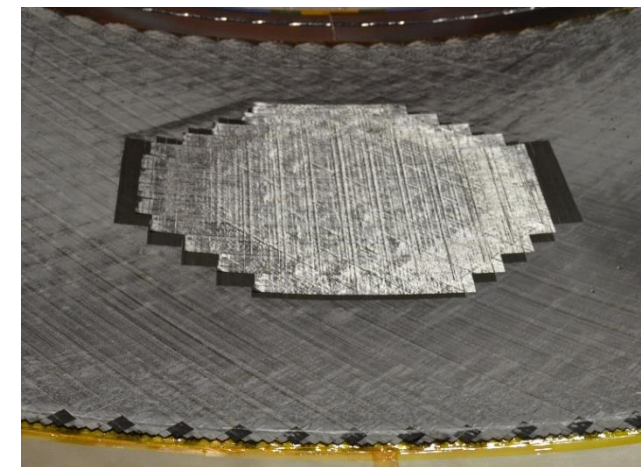
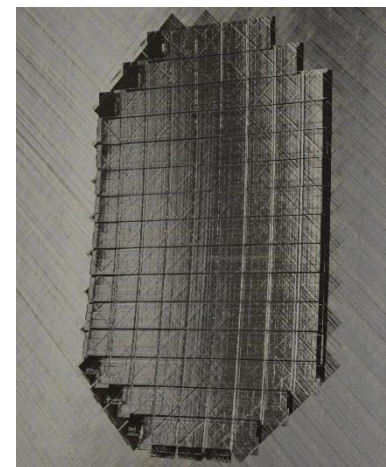
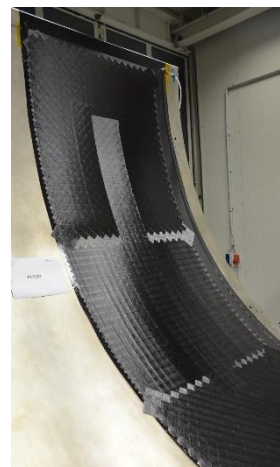
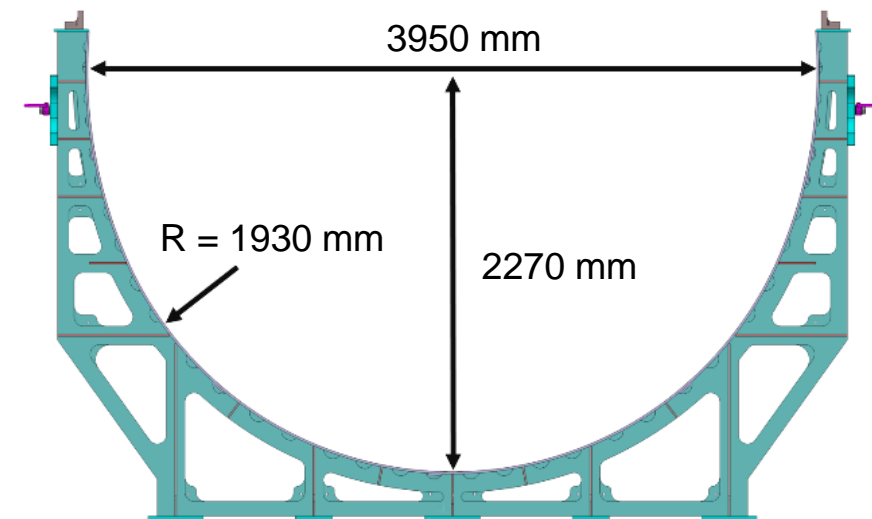
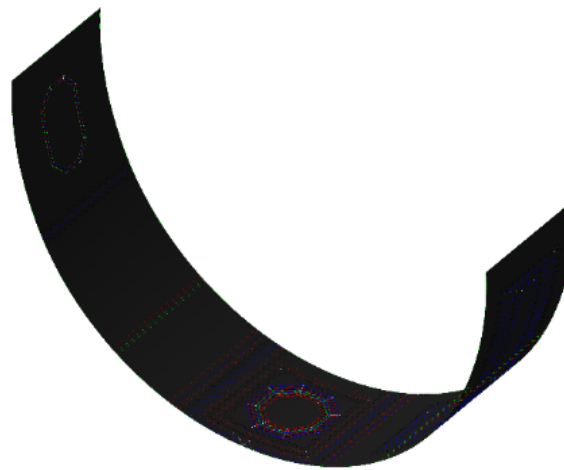


Thermoplastic in-situ AFP



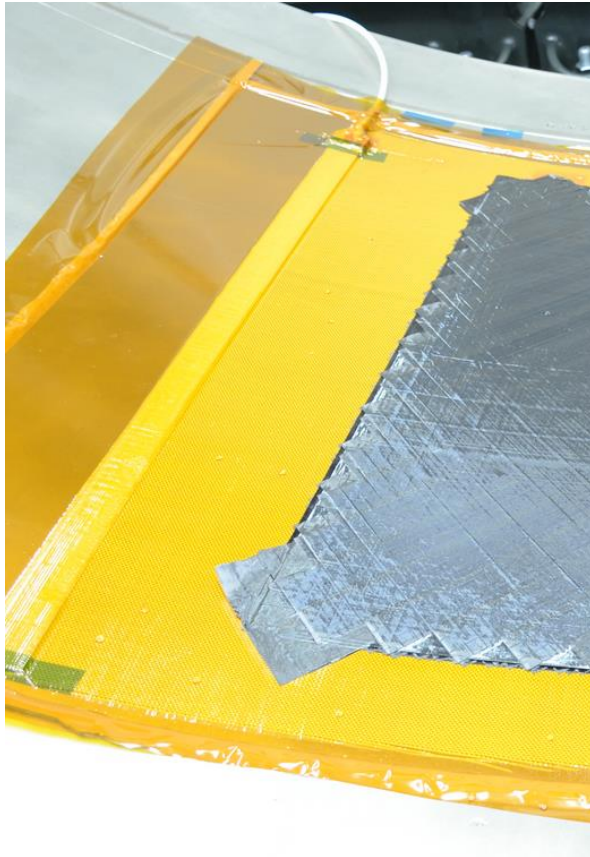
Design

- 98 plies
- 9986 m of LM-PAEK tape
- Angles: 0°, 45°, 90°, 135°
- Estimated weight: 38 kg
- Reinforcements:
 - Rectangular patch
 - Octagonal antenna patch
 - Octagonal center patch



First ply adhesion

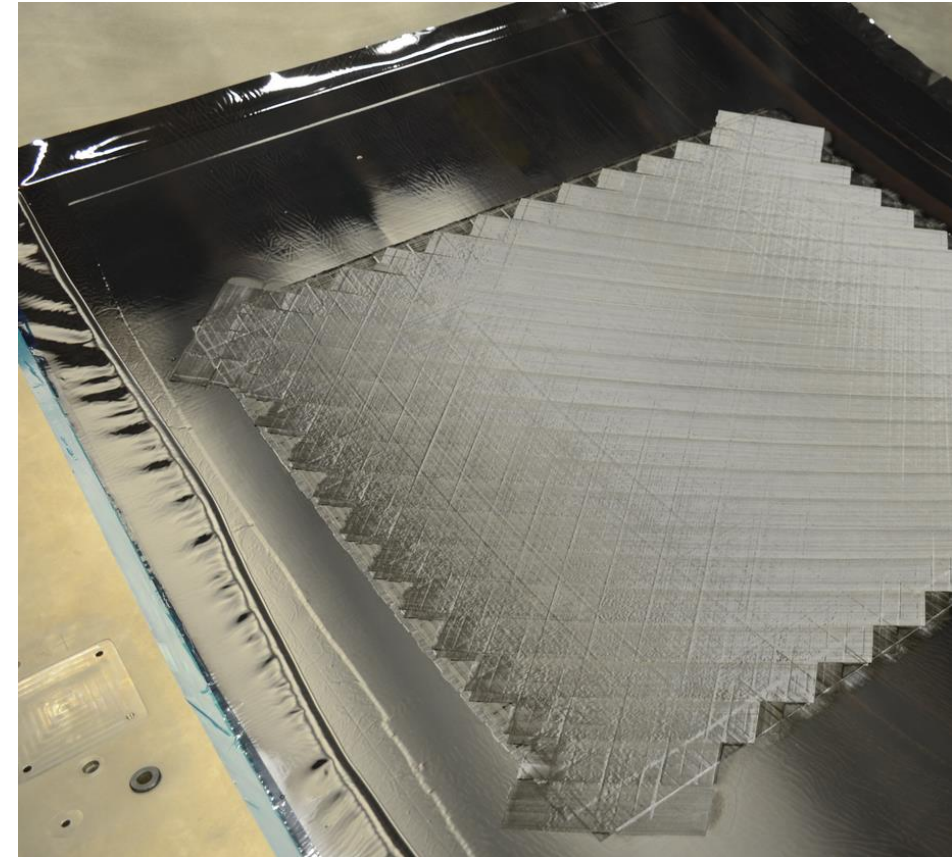
Polyimide foil



Resin foil



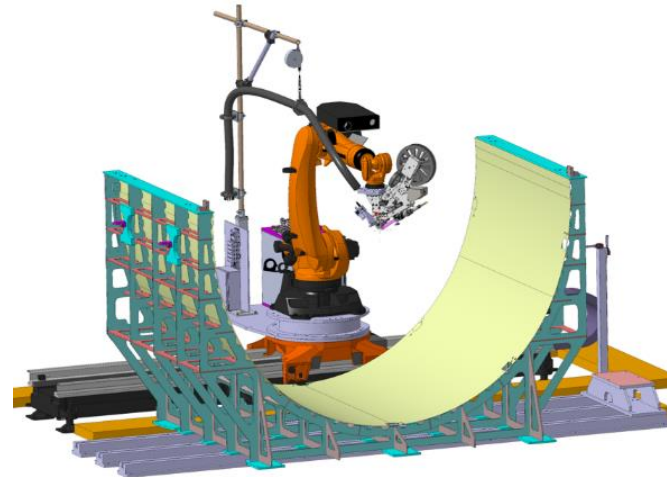
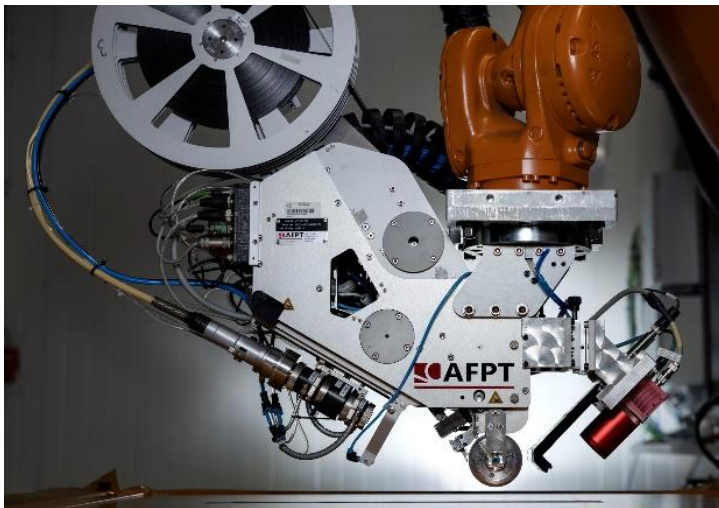
Lightning strike protection (LSP) foil



Full Scale T-AFP Manufacturing

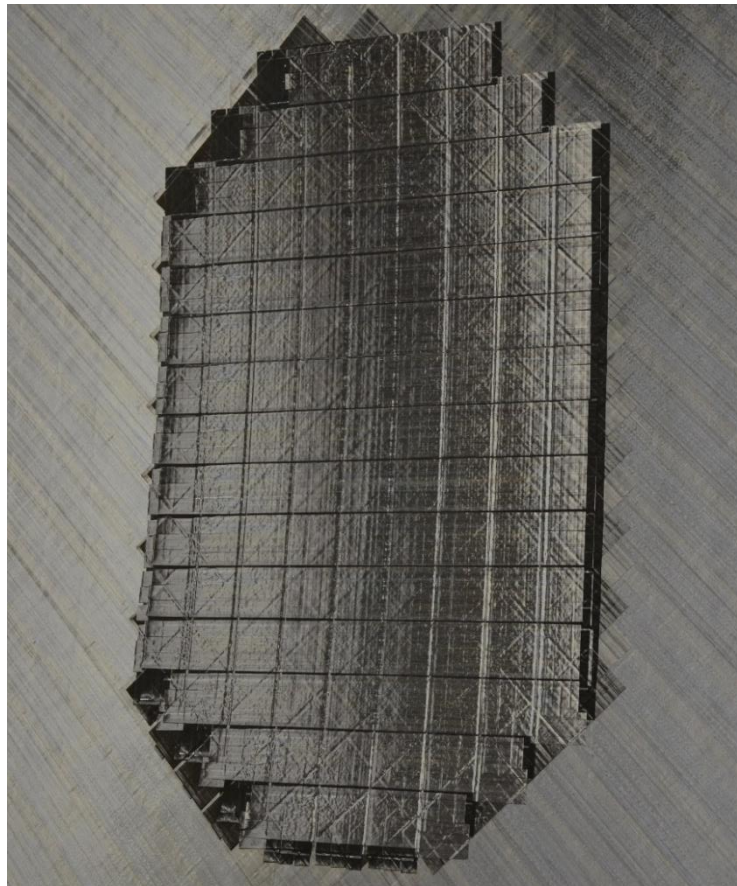
Setup:

- Multi Tow Lay-up Head (MTLH) by AFPT
- Three ½" tapes
- Heat source: 6 kW IR laser
- Lay-up speed: 7.5 m/min



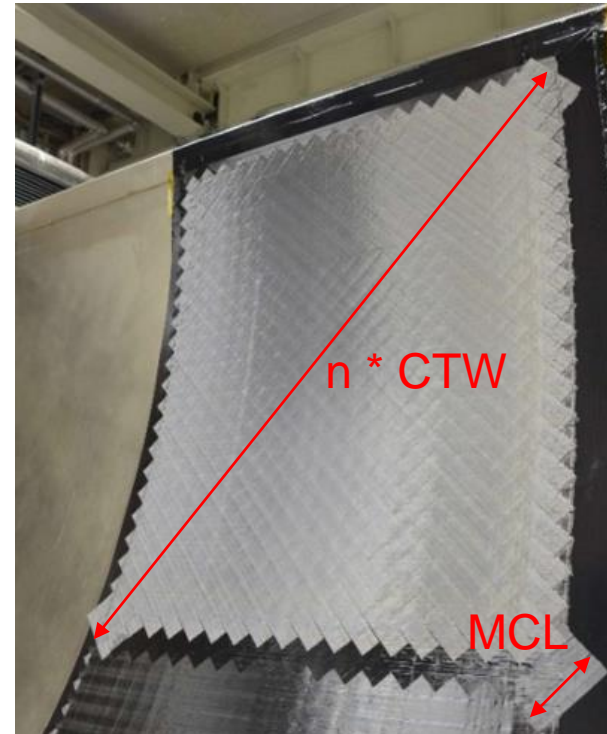
Gap Design Strategies

Inclusion of dispersed gaps



Zero gap/overlap strategy with adjustment of the ply geometry

- Determine consolidated tow width (CTW)
- Determine minimum cut length (MCL)
- Design ply

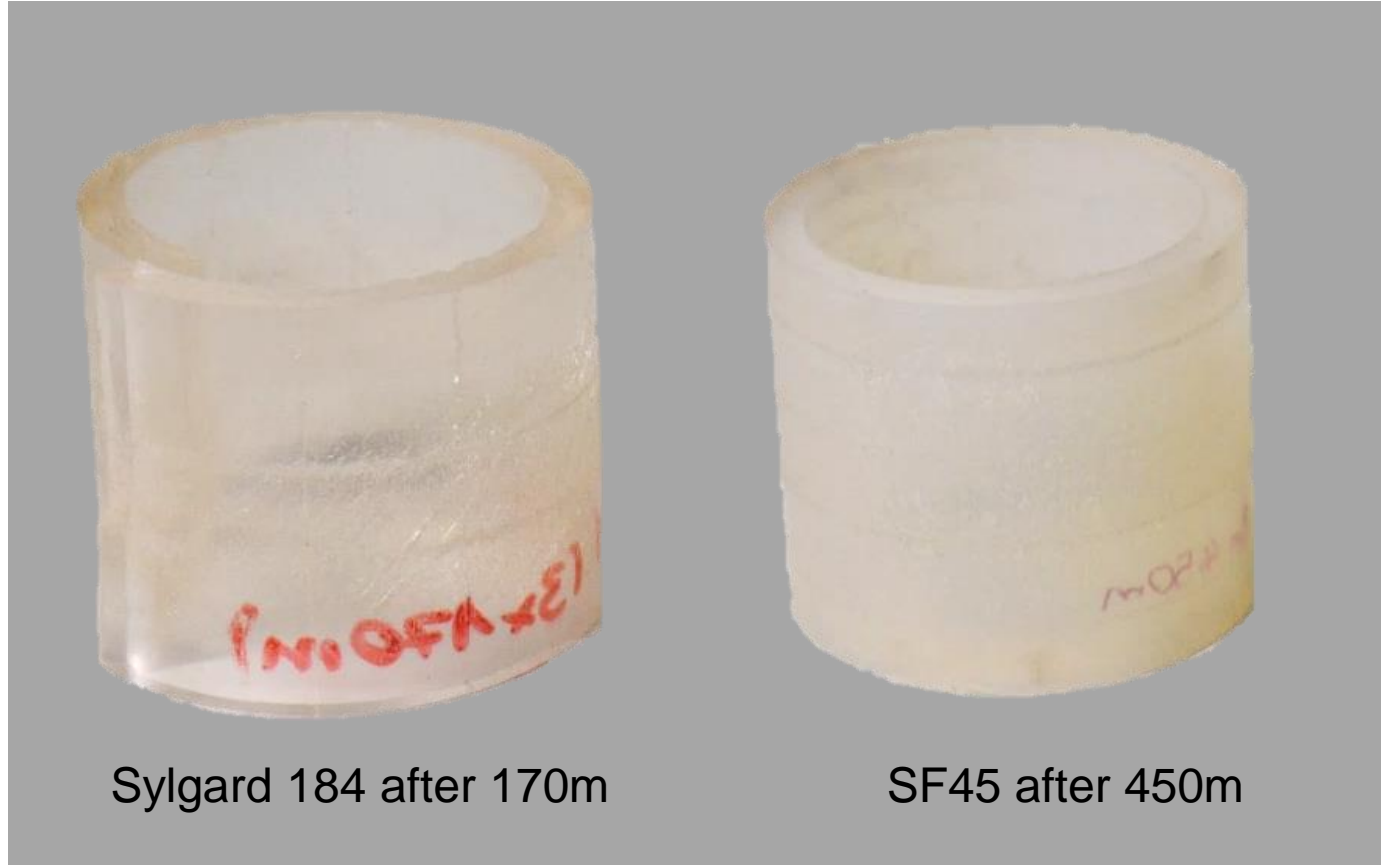


TC1225 LM-PAEK
7.5 m/min
500°C
3 x 1/2" tapes
→ CTW = 41.3 mm

MTLH by AFPT
→ MCL = 150 mm

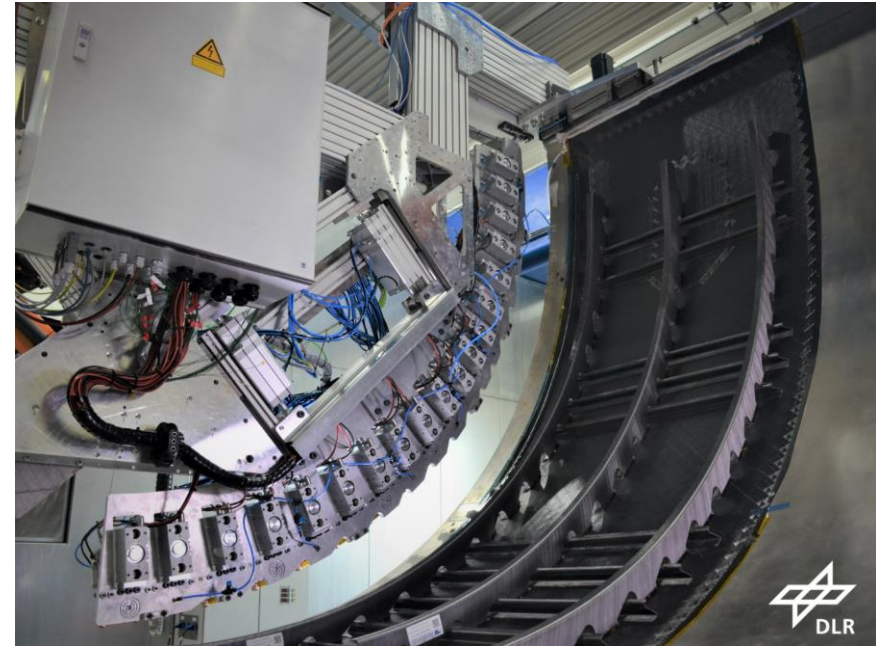


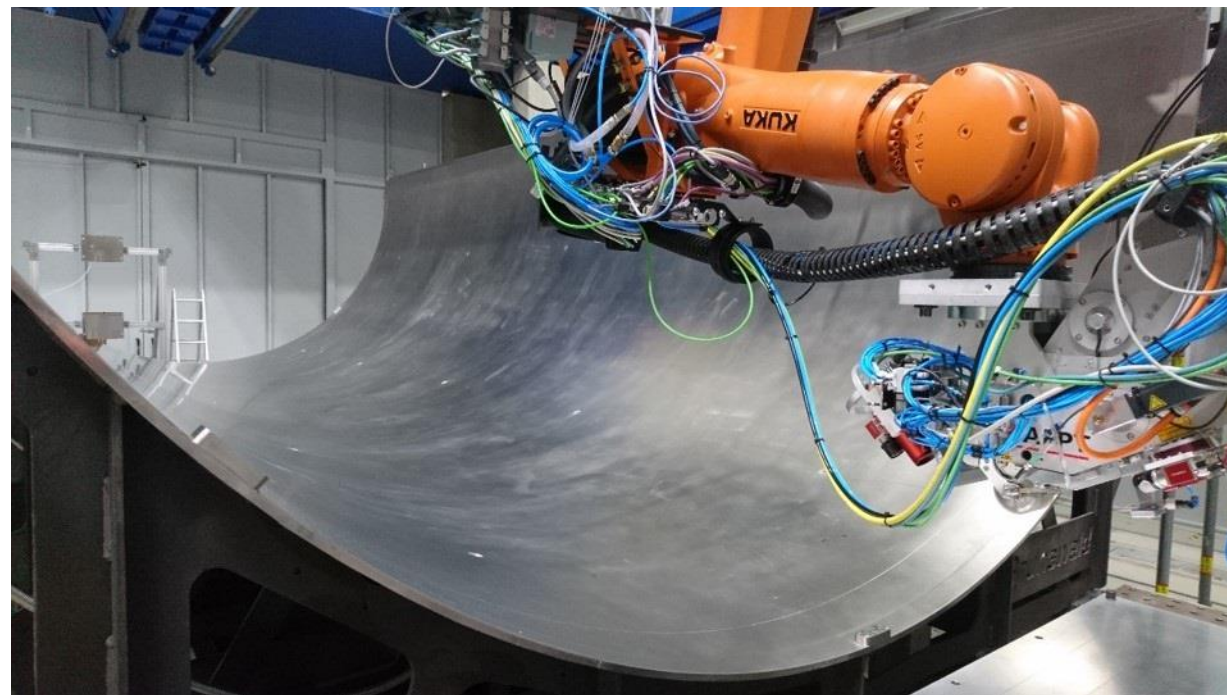
Durability of silicone compaction roller



Conclusion & Outlook

- 9986 m of deployed tape
- Successful application of LSP foil as first ply
- High surface quality of the produced skin with zero gap/overlap strategy
- Still relatively low deployment rate
- Proof of concept for full-scale demonstrator ✓
- Subsequent steps:
 - Integration of stiffeners by welding
 - Build full-scale demonstrator (8 m length)!





Acknowledgement

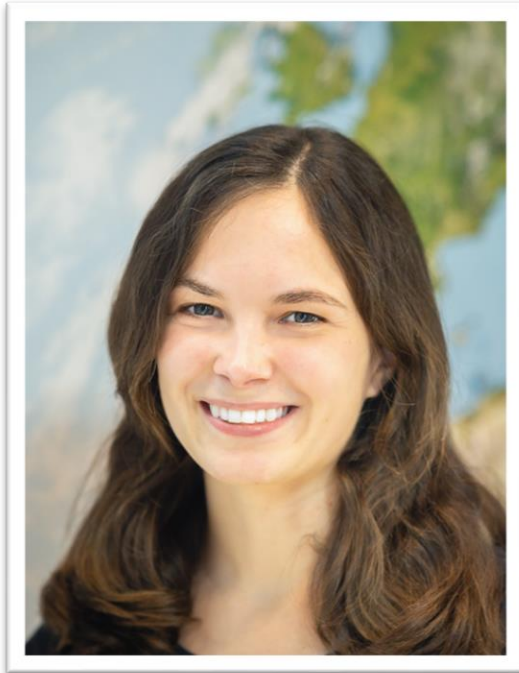
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Disclaimer

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Questions?



Olivia Hellbach
German Aerospace Center (DLR) –
Center for Lightweight Production Technology (ZLP)
Am Technologiezentrum 4
86159 Augsburg, Germany

Olivia.Hellbach@dlr.de
+49 821 319874-1057

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