connova
new ways in composites

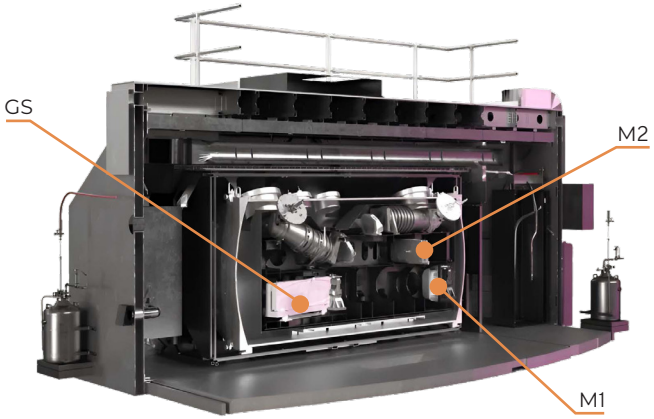
Let us focus the stars together

How composites and our expertise help in one of the most challenging science projects of our time.

Who are we?
Where do we come from?

The question of whether we are alone in the universe has probably occupied humanity since the beginning of time. In the search for extraterrestrial life, the Giant Magellan Telescope (GMT) – one of the most ambitious astronomical projects of our time – will, after its planned commissioning in 2030, offer unique new possibilities and revolutionize our understanding of the universe. With a resolution ten times greater than that of the Hubble Space Telescope, it will be able to observe stars and exoplanets with unprecedented precision. A particular focus will be on Earth-like planets outside our solar system, whose atmospheres will be analyzed for signs of life.

A key instrument of the GMT is the G-CLEF spectrograph – a highly precise measuring device capable of detecting the tiniest changes in starlight. But to achieve the required accuracy, the optical components must be positioned with extreme precision and remain unaffected by external influences. And this is where a seemingly modest but crucial component comes into play – developed and manufactured by specialists from Switzerland.



G-CLEF Spectrograph (Large earth finder)
(Source: https://giantmagellan.org)

Precision in the void: the challenge

The mounting frames for mirrors (M1, M2) and optical gratings (GS) in the G-CLEF spectrograph must not deform, even under extreme conditions. In addition to active vibration isolation of the entire optical unit, this is ensured by the fact that the frame experiences no deformation at all during measurement campaigns in a high-vacuum environment. The component was therefore designed according to the following criteria:

- No thermal expansion (CTE ≈ 0 K-1)
- Maximum stiffness at minimum weight
- Long-term structural stability
- No outgassing in vacuum

Conventional materials reached their limits here – the solution had to rely on advanced composite materials.

Swiss engineering excellence: Connova AG delivers the impossible

Connova AG, based in Villmergen, was selected for its outstanding expertise in the manufacturing of high-precision composite structures and took full responsibility for the entire implementation – from component and process design to construction, material selection, calculation, manufacturing, and quality assurance.

The core of the solution was the use of ultra-high-modulus carbon fibers in a cyanate ester matrix – a material that, when expertly engineered, can achieve the required zero thermal expansion. To mount the optical components and integrate them into the measurement chamber, INVAR36 elements were used – a special nickel-iron alloy with an equally minimal coefficient of thermal expansion.
Connova not only produced the precisely manufactured parts but also developed, in close collaboration with the customer, the necessary verification concepts as well as test setups and fixtures, enabling the component to be successfully tested in a realistic environment for deformation, temperature variations, and vacuum resistance.

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Seldom has the word «highlights» been more suitable than for this project

The Timeline
In just under two years – following a tight and ambitious project schedule – the experts at Connova AG more than exceeded the customer's expectations:

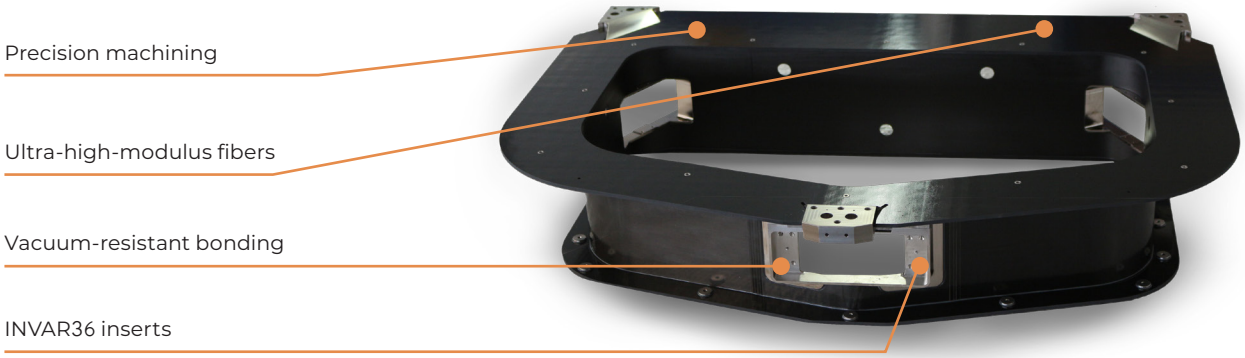
- Initial contact & specification review: summer 2022
- Contract awarded: november 2022
- FEM modelling and CAD development: Q4 2022 – Q2 2023
- Manufacturing and integration: Q3 2023 – Q3 2024
- Final delivery: september 2024

The Highlights at a Glance

- Complex CFRP part geometries produced to extreme tolerances
- 14 INVAR parts per assembly, each requiring distortion-controlled milling and post-processing
- Thermal cycling and vacuum bakeouts in collaboration with the University of Bern
- Rigorous performance verification simulating mission conditions

Our Success Factors

- Specialized composite know-how: Mastery in space-grade materials and hybrid designs
- Simulation-driven engineering: FEM-guided design enabled precision tuning before manufacturing
- Advanced CNC operations: Complex INVAR components required a multi-step machining and thermal workflow
- Collaborative execution: Close interaction with academic and industry partners ensured success at every phase
- Test engineering: profound know-how about applying forces and moments to structures and measuring distortions and displacements in a test environment



CFRP Mounting Frame for Mirror M1
(Source: Connova AG)

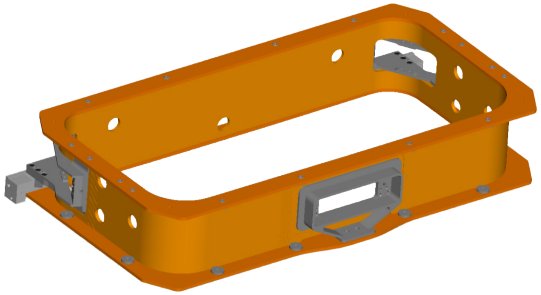
A satisfied customer

Connova delivered the bezel assemblies for M1, M2, and Grating Stabilizer – fully qualified and validated under operational constraints.

Upon final inspection, the client reported outstanding satisfaction:

«We had never seen such flawless composite parts – and we weren't just talking about the finish. The structural test results were simply outstanding.»

– Lead Engineer, G-CLEF Project



CAD model of mounting frame for mirror M2
(Source: Connova AG)

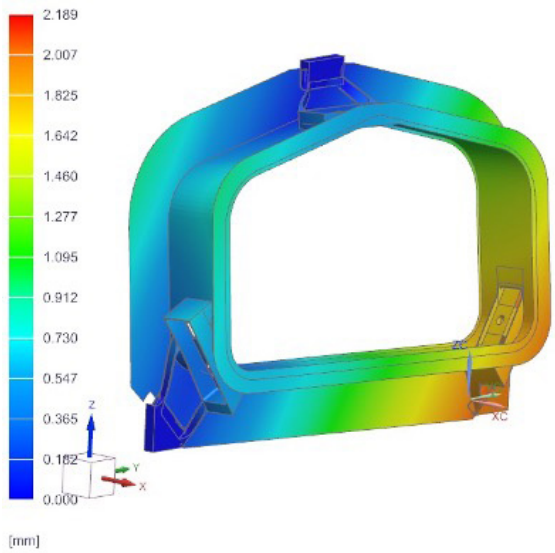
Conclusion: when science demands ultimate precision

With the successful development, manufacturing, testing, and delivery of the components for the mirror mounting frames and the grating stabilizer in the G-CLEF spectrograph, Connova AG makes an essential contribution to the Giant Magellan Telescope.

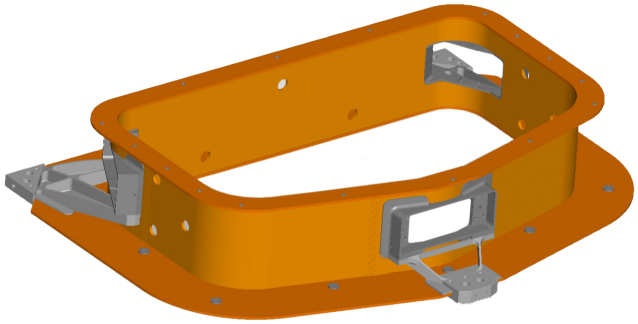
What makes this project so remarkable goes beyond the purely technical challenges. It is the awareness that the combination of modern astronomy and Swiss engineering excellence brings humanity one step closer to one of its oldest dreams: the discovery of extraterrestrial life.

In the search for extraterrestrial life – with swiss precision

The skillful combination of the special properties of carbon fibers with unique Swiss know-how creates the foundation for a one-of-a-kind component in one of the most exciting scientific projects of our time.



deformation analysis at different load cases
(Source: Connova AG)



CAD model of mounting frame for mirror M1
(Source: Connova AG)

About Connova AG

Connova AG – New Ways in Composites - is a leading provider of customer-specific components and custom-tailored services. We solve complex light-weighting challenges for our customers from aviation, space & defence, automotive & racing and many other specialised industries knowing the advantages of composites.
Our products made of fibre-reinforced materials provide economic and technical advantages to clients in their respective end markets.
We are outstanding in terms of ultimate customer orientation, engineering excellence, service mentality, innovative solutions and finally high-quality products and delivery performance. Just Swiss made

The skillful combination of the special properties of carbon fibers with profound Swiss know-how creates the foundation for a unique component in one of the most exciting scientific projects of our time.