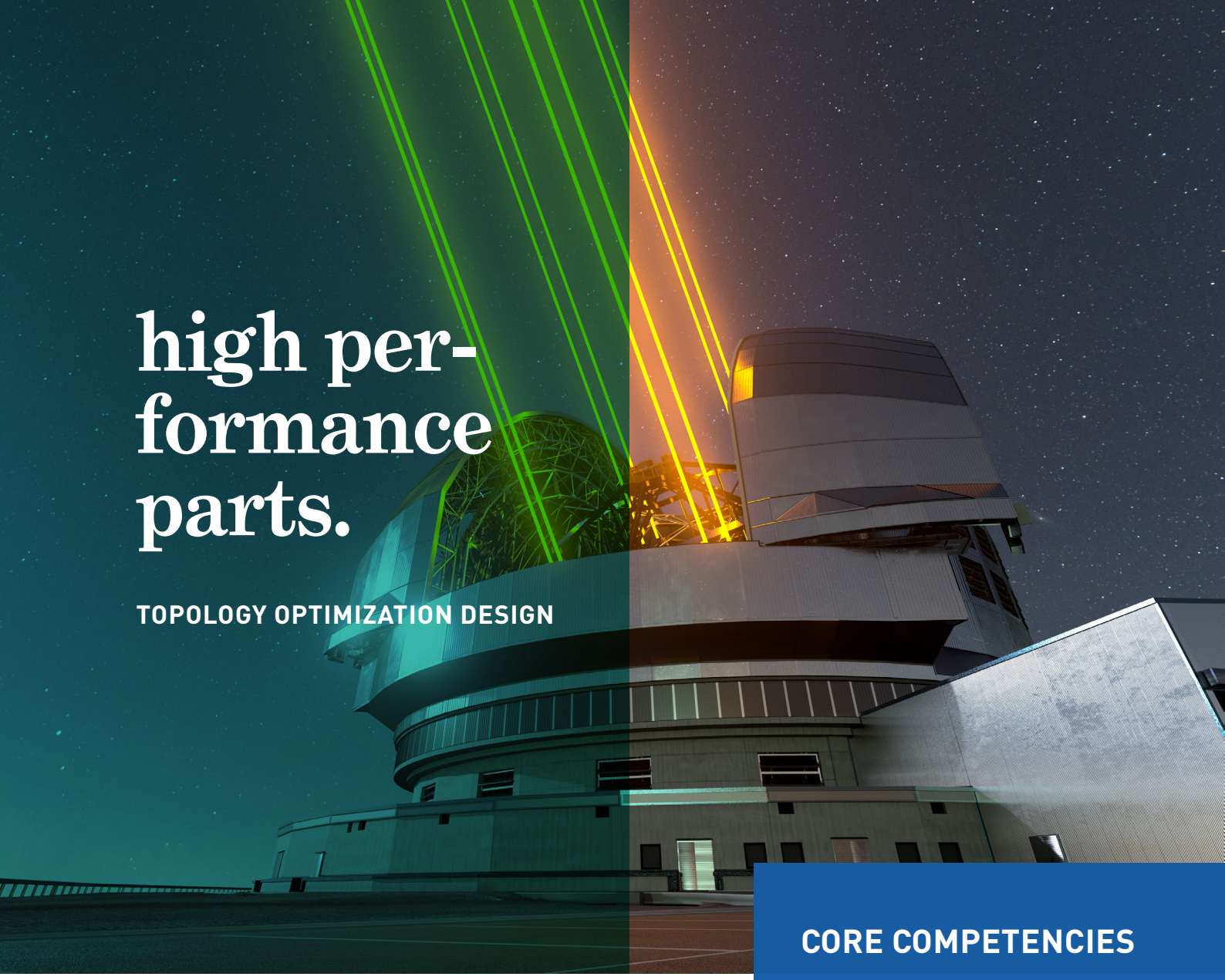

high performance parts.

TOPOLOGY OPTIMIZATION DESIGN

CORE COMPETENCIES

1. High performance, low-cost parts
2. Simulation driven design
3. Additive manufacturing
4. Structural mechanics

Goal

A stainless-steel part for the Extremely Large Telescope (ELT) was designed to be easily fabricated using conventional milling. Its original weight is 4.0kg, which made it highly inconvenient to mount this part.
The question was, "how to make the part lighter, while keeping a certain stiffness?"

A lighter design by further removing material from the heavy part would make the part costly to be produced by milling. The possibility of producing it by 3D printing would therefore be a suitable option. It offers the possibility of free form shaping at a much lower cost and providing a high performance.

Demcon and K3D[1] worked together to design a new part. It was aimed at designing a lighter part using the topology optimization method and looking critically in reducing the costs of the part. In a fruitful collaboration between Demcon and K3D a new part is designed.

Image Credit: ESO/L. Calçada

DEMCON | MULTIPHYSICS

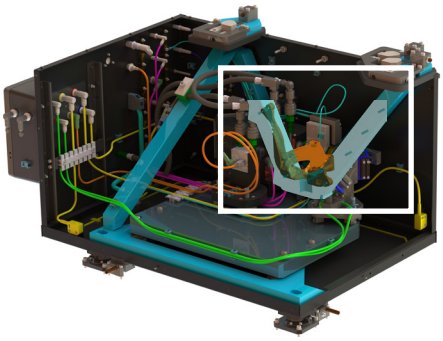

Figure 1 The laser beam conditioning, electronics, control systems for the laser launch telescope (BCDS) where the part is used for

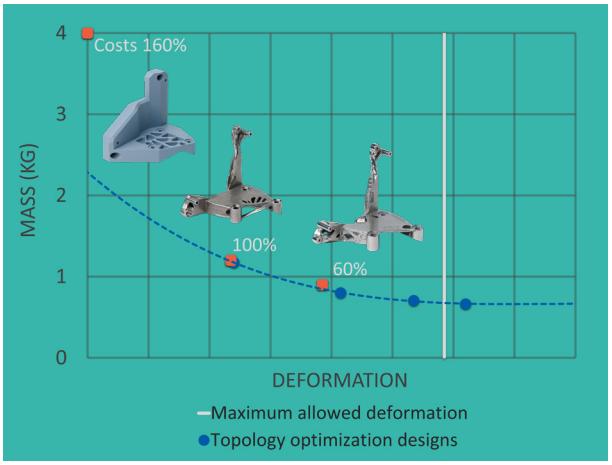

Figure 2 Performance chart of the different designs showing mass versus deformation

Approach

A lower limit was specified for the stiffness of the bracket together with its available space and connection points. This means a limit on the maximum deformation. For the first design iteration the part was optimized using topology optimization considering 4 different loads.

The second design iteration was performed including extensive knowledge of K3D about the printing process. It was investigated how the part can be printed more efficiently without supports and allowing tinniest features of 0.3mm within the design to get the highest performance. These constraints were included in the topology optimization solver.

For both iterations the computer did the designing process and generated shapes which comply with the given constraints.

Result

The first design iteration resulted into a part where its stiffness was optimized for a given mass of 1.2kg, having a weight reduction of 2.8kg.

Second design iteration resulted into a final part of 0.9kg, i.e., an additional mass reduction of 0.3kg or 25%. Moreover, this iteration without printing supports resulted into 50% reduction of the material required for printing and 40% cost reduction.

This fruitful collaboration between DEMCON and K3D clearly shows how we can optimize your part in costs and performance.

Figure 3 Original design produced by milling and iterations 1 and 2 produced by additive manufacturing

References

[1] www.k3d.nl

[2] Colored model print by Rapidcenter (www.rapidcenter.nl)