

# Design, manufacturing and testing of a compact annular telescope

Karine Mathieu<sup>a</sup>, Jacques Berthon<sup>a</sup>

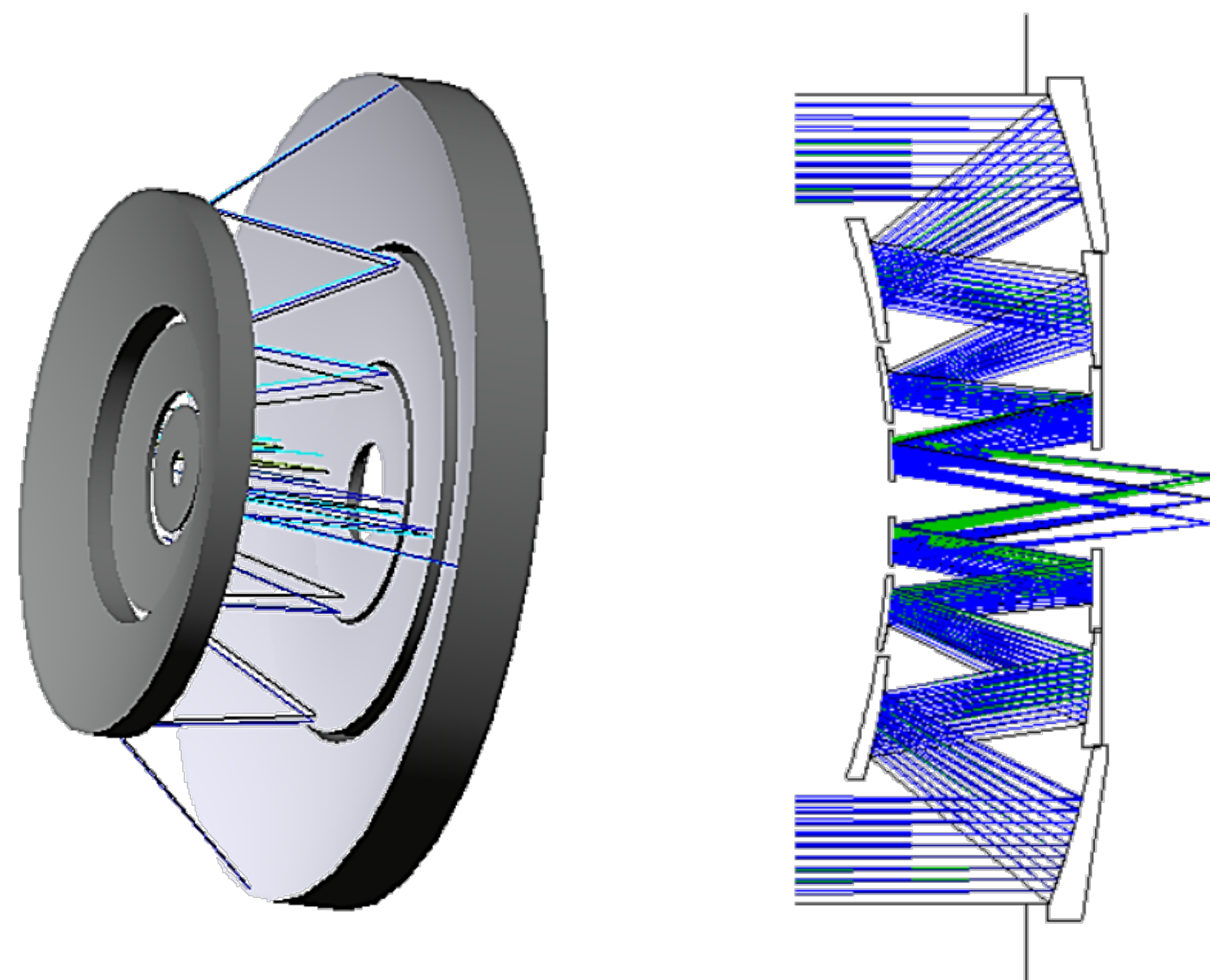
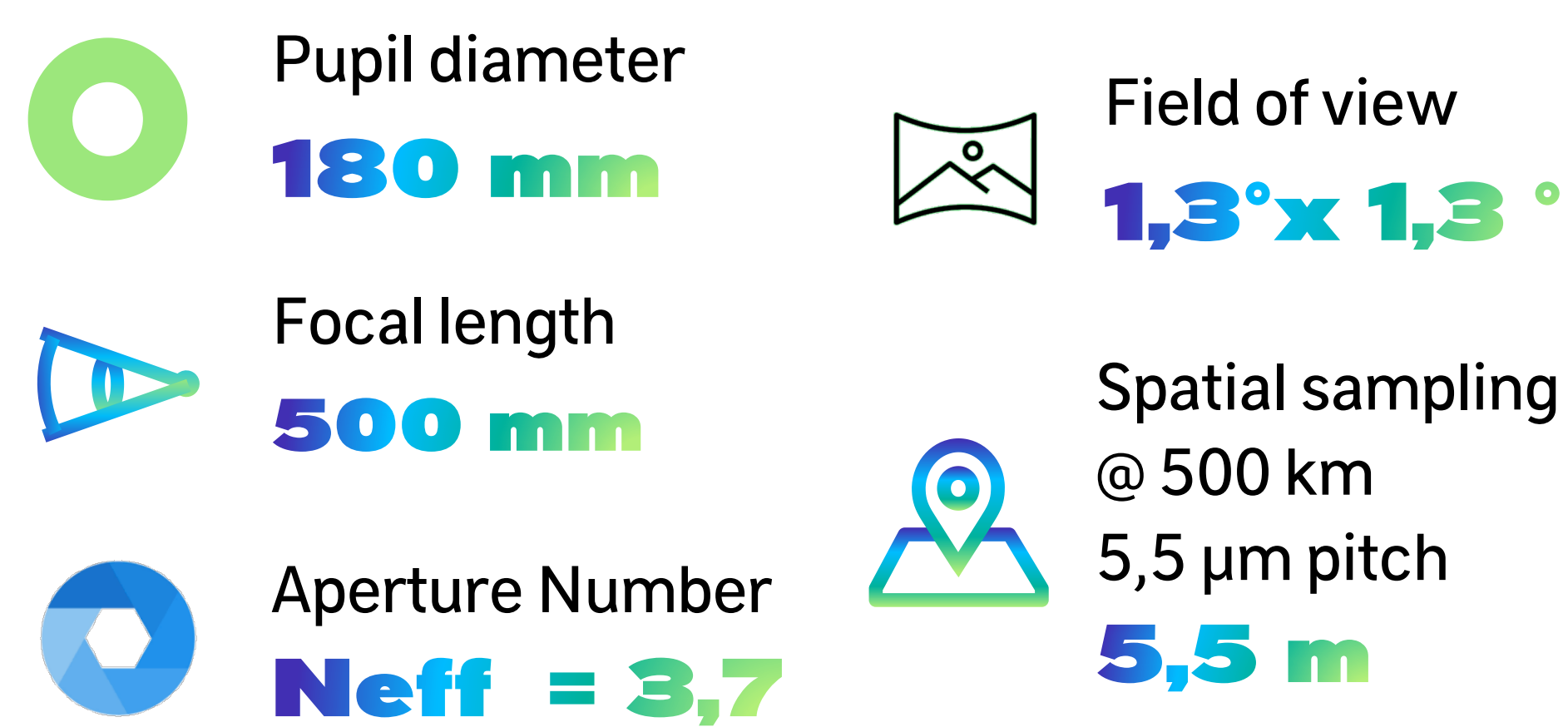
<sup>a</sup>Centre National d'Études Spatiales (CNES), 18 av. Edouard Belin, 31401 Toulouse, France.

## CONTEXT

COCO is an innovative study with 2 objectives :

- Defining a disruptive optical architecture to significantly improve the compactness of telescopes
- Test a new manufacturing process : the diamond turning point on aluminum

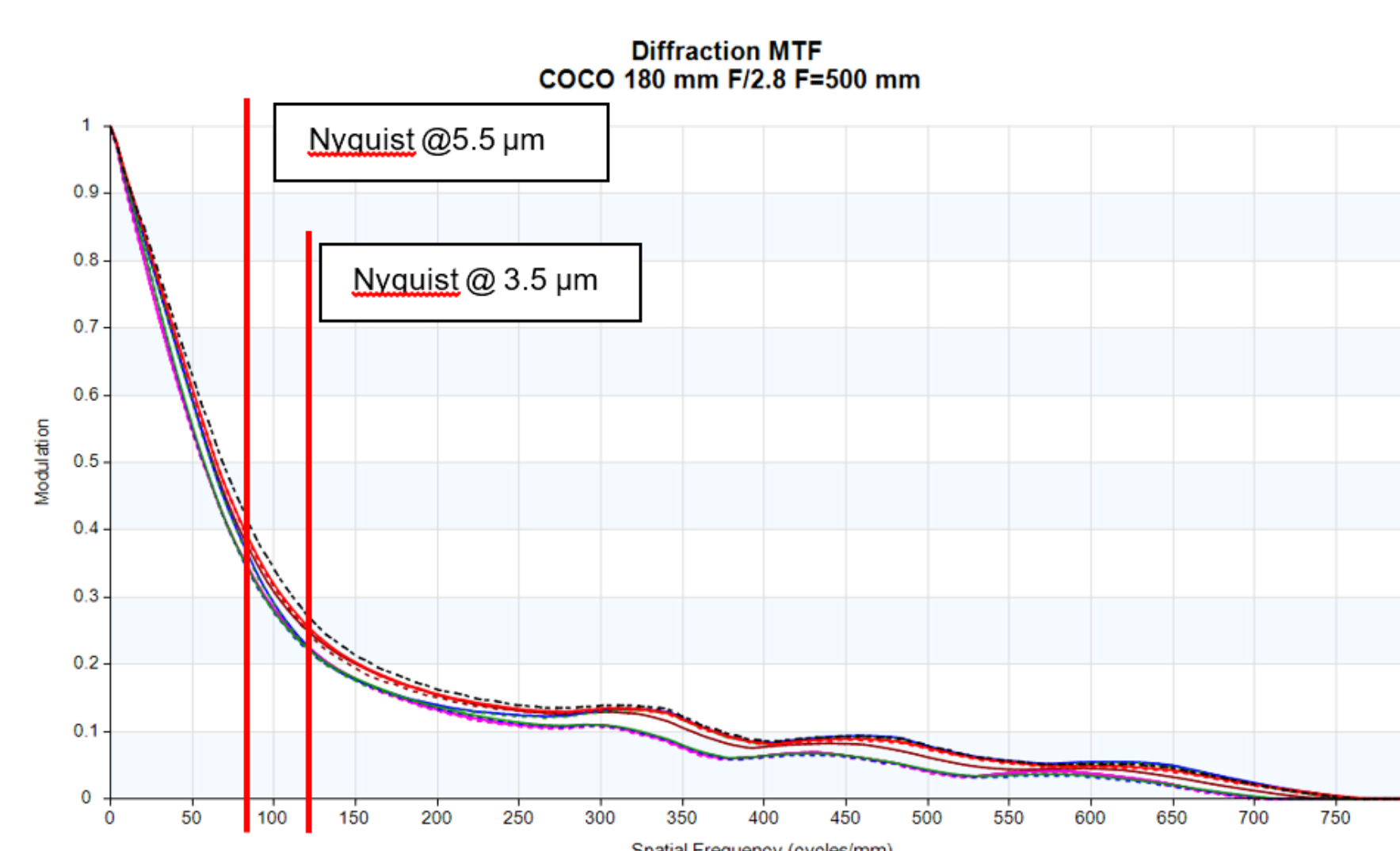
## DESIGN



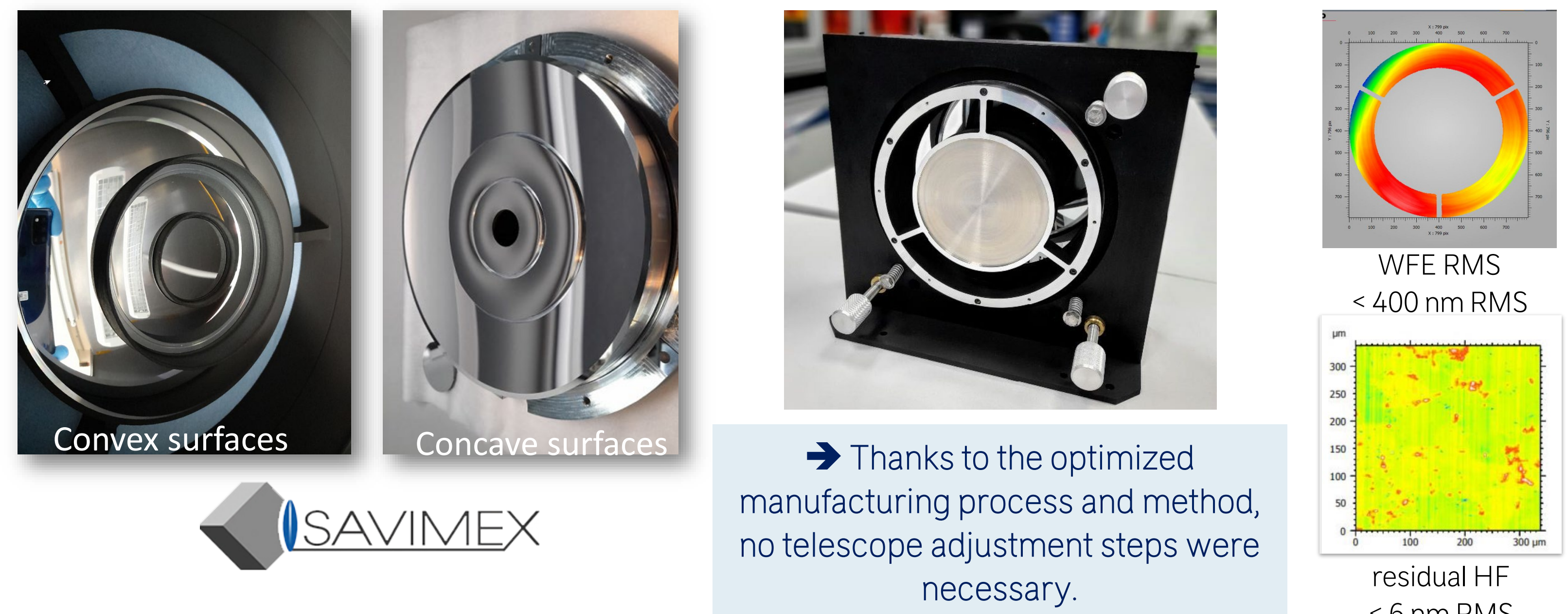
Volume  
**250 x 250 x 140 mm<sup>3</sup>**

Spectral range  
**VIS, SWIR & IR**

Very compact design with an significant obscuration which implies low modulation at high frequencies.



## FABRICATION



All the mirrors and opto-mechanical parts in aluminum were made by SAVIMEX and each optical surface was machined by Single Point Diamond Turning technology directly into the common substrates.

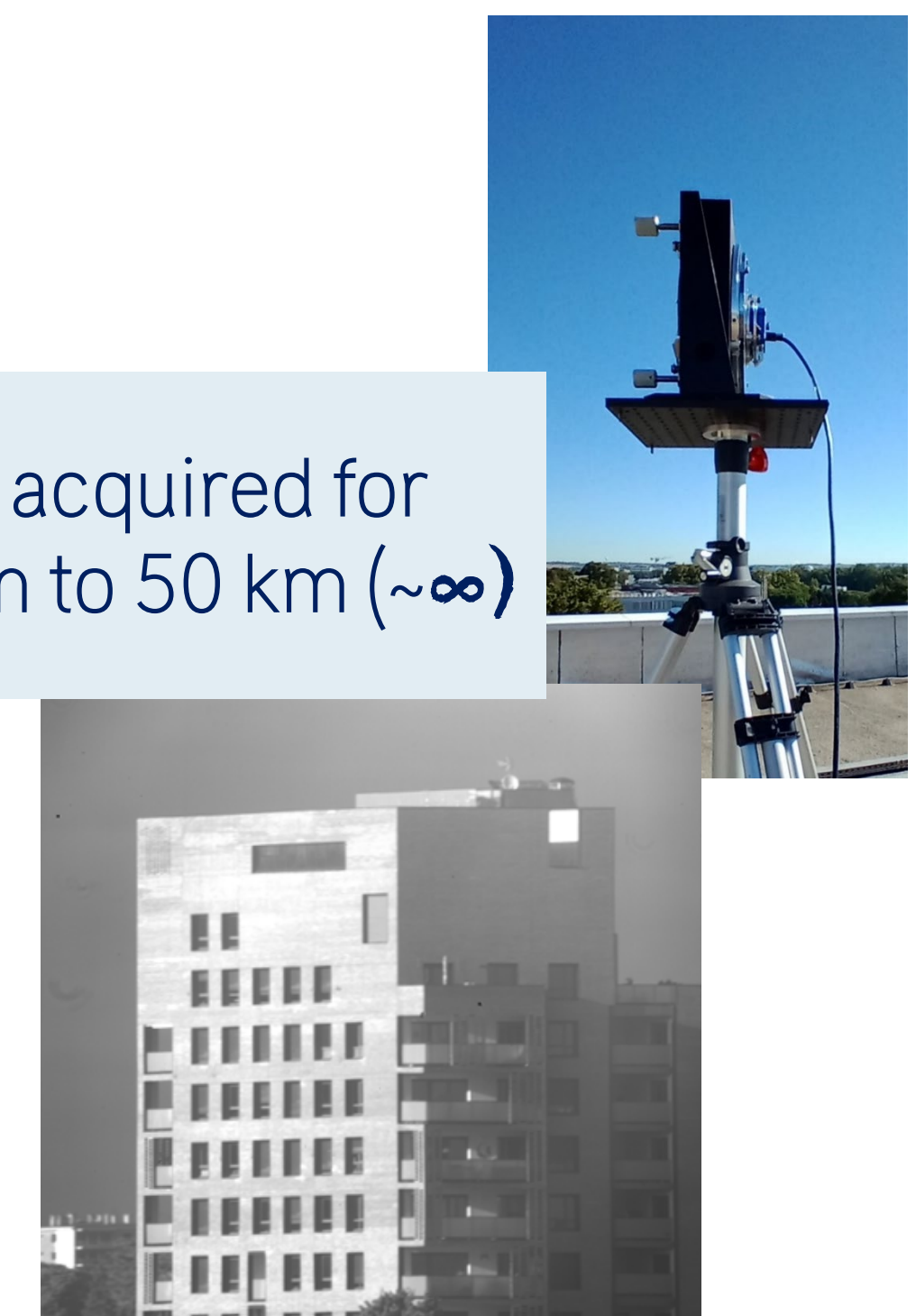
## PERFORMANCES

In the optical laboratory environment several characterizations were carried out with and without sensor in visible range :

- Point Spread Function
- Illumination uniformity
- Focus sensitivity

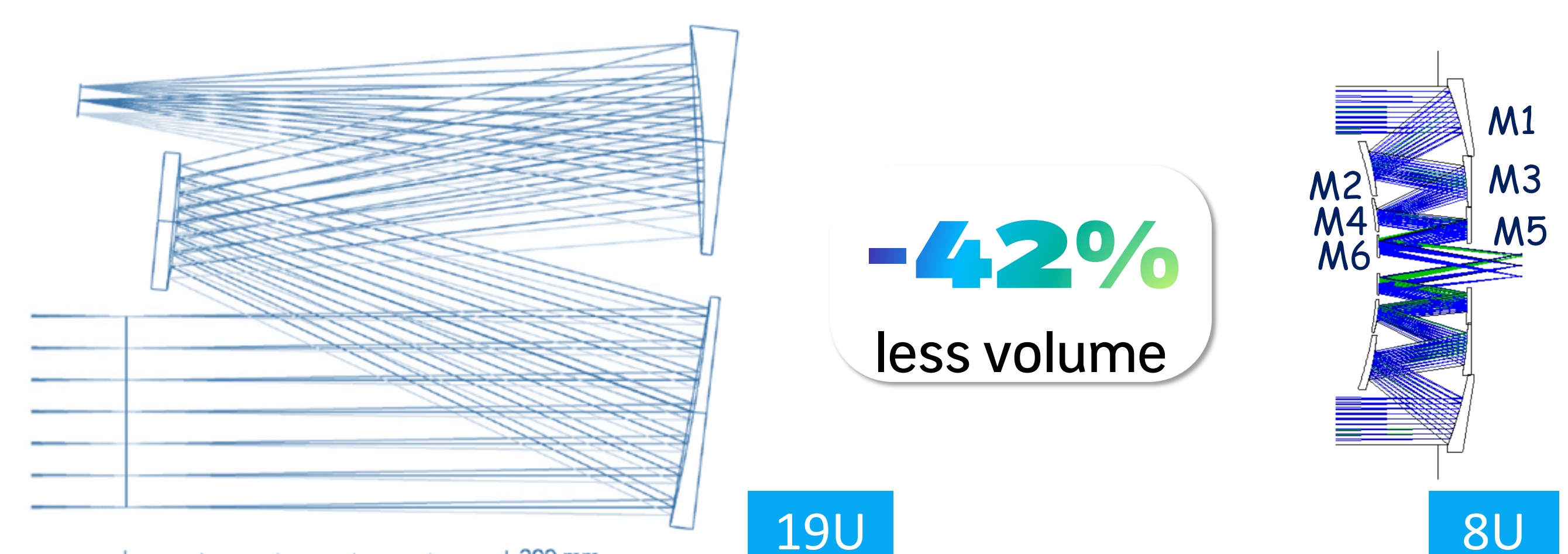
Very good images acquired for distances from 0,6 km to 50 km (~∞)

Several image campaigns were carried out. The first dedicated to optimizing the position of the focal plane. The others were very helpful in determining the quality of the images in a wide variety of scenes and illumination conditions.



## CONCLUSION

- Very short manufacturing process avoiding long polishing step
- Low cost technology
- Compatible with mid-resolution imaging across the full visible and infrared spectral range



For the same focal length, the high obscuration system collects 50% more flux with very significant gain in volume