

OPTICAL CONTACTING BY WINLIGHT OPTICS 15 YEARS OF DELIVERIES



PERTUIS (FRANCE) – NOVEMBER 21, 2019



Summary

- Presentation of the company
- Examples of various assemblies
 - To see how to build systems with:
 - Multiple stackings aligned within the optical contacting conditions
 - To see how to mix optical contacting and bonding
 - To present the results on breadboards and real missions

Static Fourier transform interferometer

Slicer breadboard for SNAP

Image slicers for

Image slicers for MUSE

Static Fourier transform interferometers

Bowen image slicer

Image slicer for

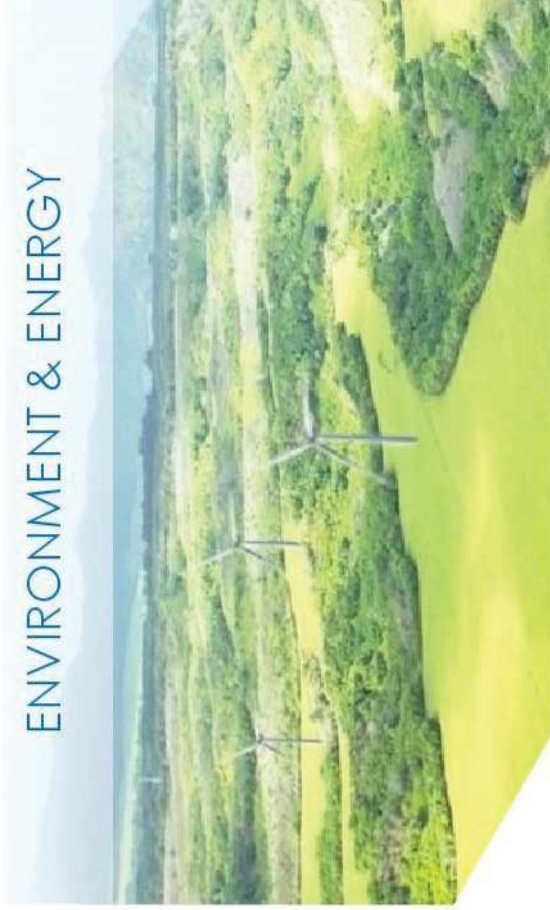
Image slicer for

Pupil slicer for

OGSE telescope simulator for

TWO MAIN SECTORS

ENVIRONMENT & ENERGY



Energy production and optimization
Waste recovery
Emission control services

Public organizations and
financing companies

Industries

INNOVATION & SYSTEMS



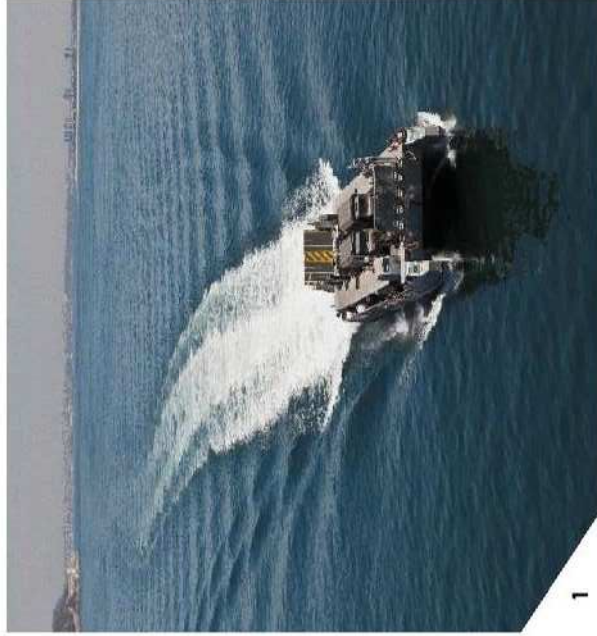
Major high performance systems and fabrication
Equipment and instrumentation systems
Software and innovative engineering

Defense
& Security

Nuclear & Big
Science

Other industries

OUR INNOVATION & SYSTEMS OFFERING



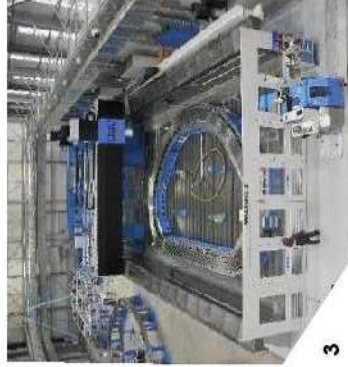
1

1/ L-CAT®, CNIM



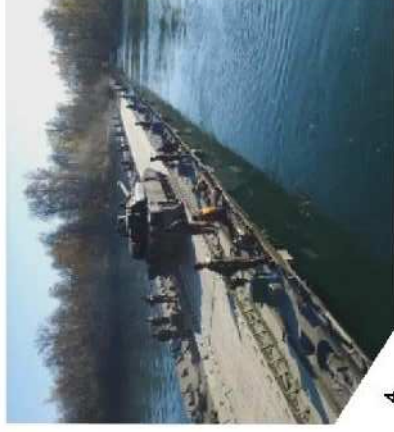
2

2/ Radiation portal monitor - Saphygate®, Bertin



3

3/ Radial plates for ITER, CNIM



4

4/ Motorized Floating Bridge, CNIM



5

5/ Cyber intelligence and cyber security - Bertin



6

6/ Equipment for Megajoule Laser (LMJ)

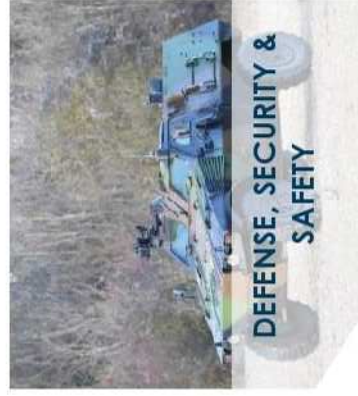


7

7/ Gas detection camera - Second Sight®, Bertin

BERTIN SYSTEMS & INSTRUMENTATION

Detect, observe, measure



DEFENSE, SECURITY & SAFETY

- ▲ CBRN threat detection
- ▲ Optronics
- ▲ Surveillance sensor networks



NUCLEAR & HEALTH PHYSICS

- ▲ Products, systems and services for detection, measurement and identification of ionizing radiation



SPACE & BIG SCIENCE

- ▲ High-performance optical and optomechanical systems



LIFE SCIENCES

- ▲ Laboratory equipment, kits and reagents



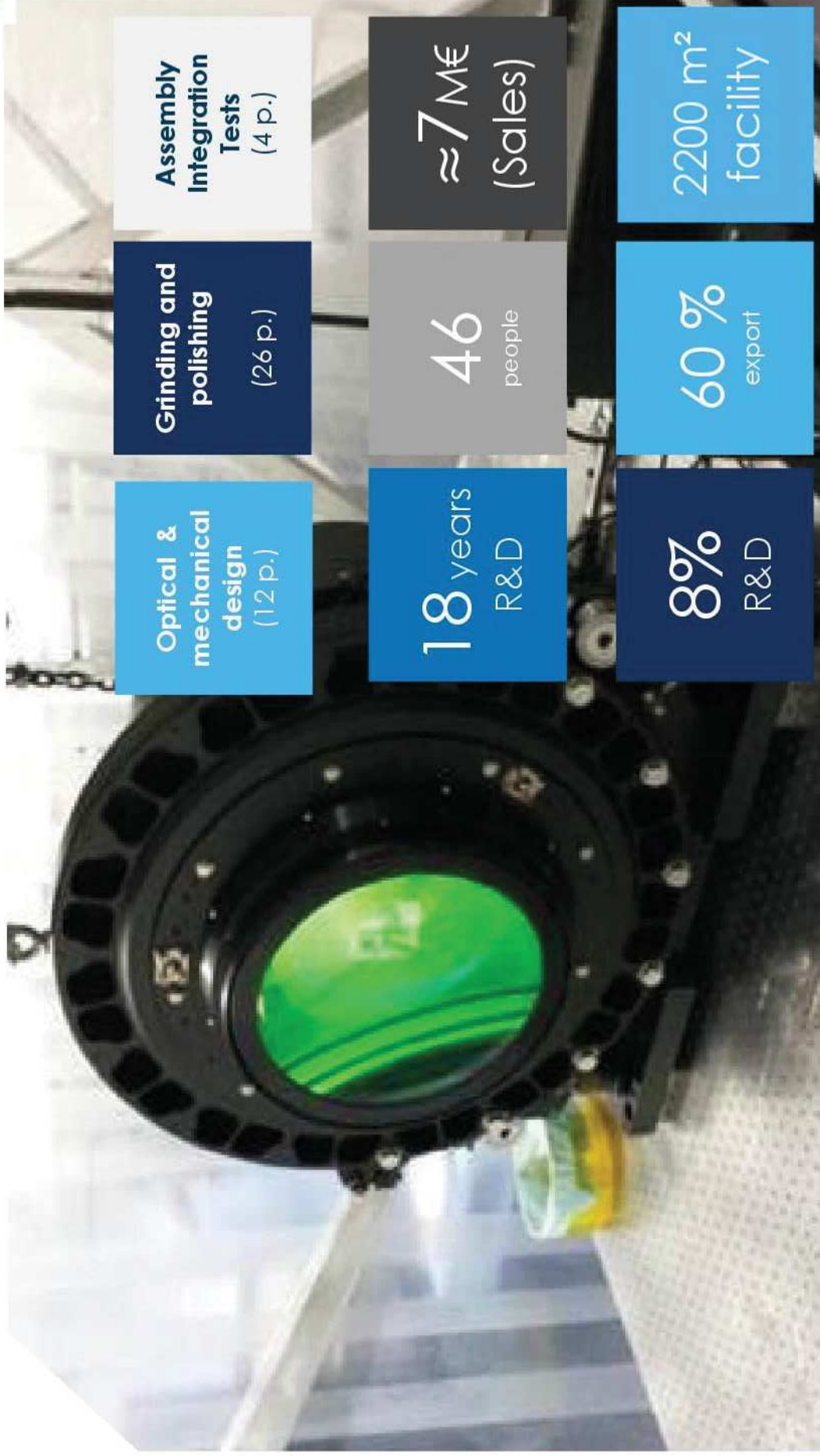
HOSPITAL WASTE MANAGEMENT

- ▲ Systems for treatment of potentially infectious medical waste

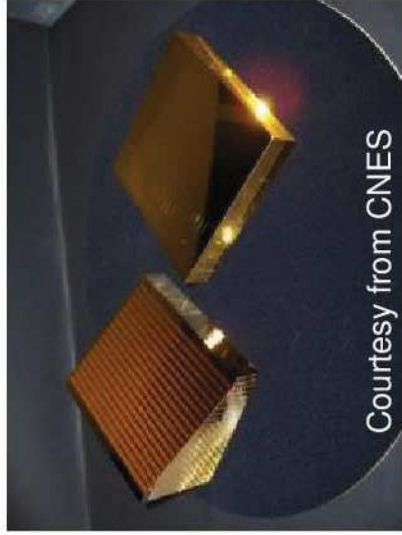


WINLIGHT

OPTICAL SYSTEM DESIGN & MANUFACTURING



The background of the company on image slicer... 2005-2008

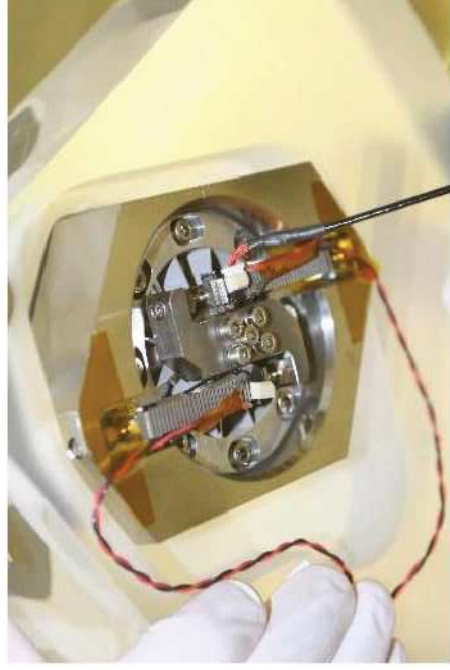


Static Fourier interferometer

Laboratory environment - 293K

2006 – 2008

- Breadboard model dedicated to environmental tests
 - 24 + 19 step mirrors; **Optical contacting technology; Positioning in dynamic conditions**
 - 1 compensator plate glued with mechanism



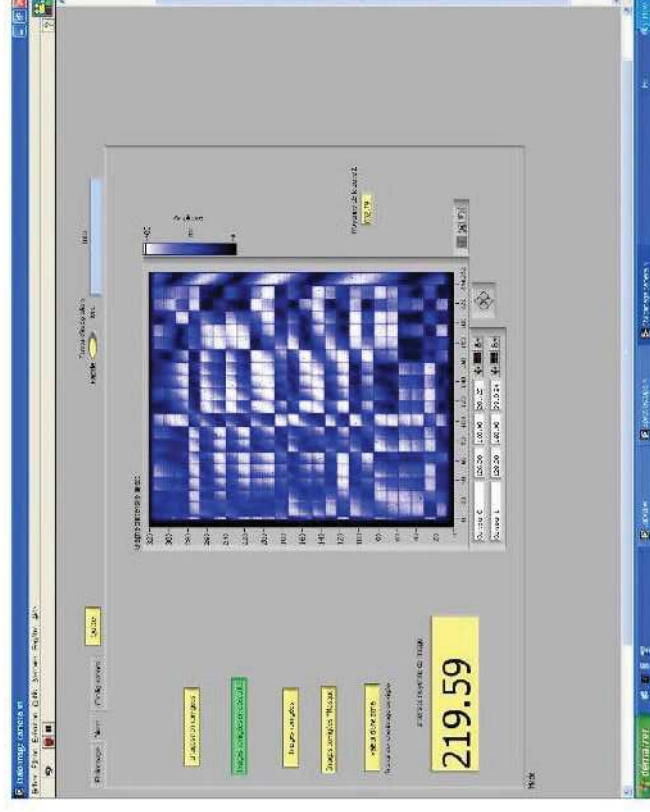
- 3 mechanical holders



Static Fourier interferometer

Laboratory environment - 293K

2006 – 2008



- Positioning
 - $\pm 1 \mu\text{m}$

Example of measurement during the alignment

SNAP image slicer

Space environment - 100K

2006 – 2009

- Engineering model dedicated to environmental tests

- 60 Slices assembly; **Optical contacting technology**
 - Thickness 500µm

- Mechanical holder
 - 3 bipodes



SNAP image slicer

Space environment - 100K

2006 – 2009

▲ Mechanical and thermal tests realized at LAM

- Thermal vacuum : 8 cycles 300°K – 100°K
- Random vibrations : 20Hz – 2000Hz ; 14g RMS

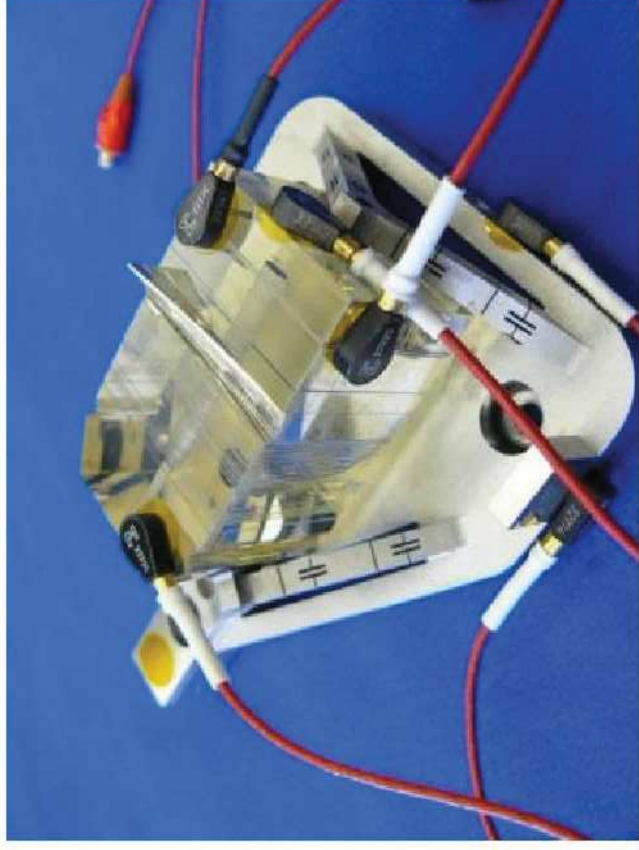


Image Slicer Astronomy– 273K /323K 2006 – 2007

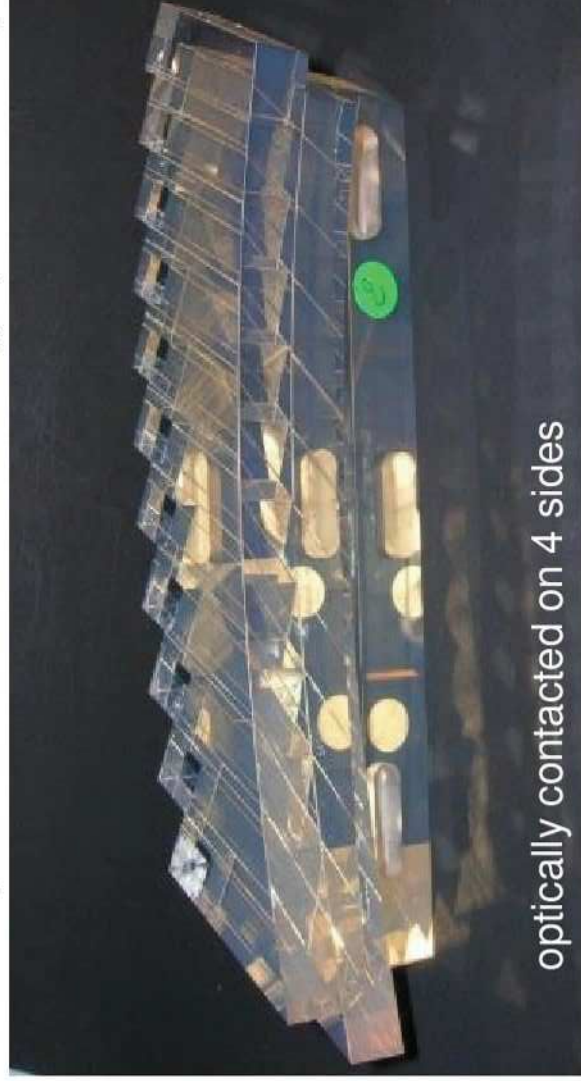
- 93 Zerodur components with **optical contacting technology**
- 44 doublets (glued)
- No mechanical part except at the base plate interface



- Quality after assembly
 - < 150/250nm PTV
 - Rq < 0.6nm RMS
 - Sharp edges

Image Slicer Astronomy– 273K /323K 2006 – 2007

2 x 22 plane mirrors distributed along a parabolic shape



optically contacted on 4 sides

44 slices with sharp edges distributed like spiral staircase



Slices 500 μm thick optically

24 Image Slicers for MUSE Astronomy– 273K /323K 2009 – 2012



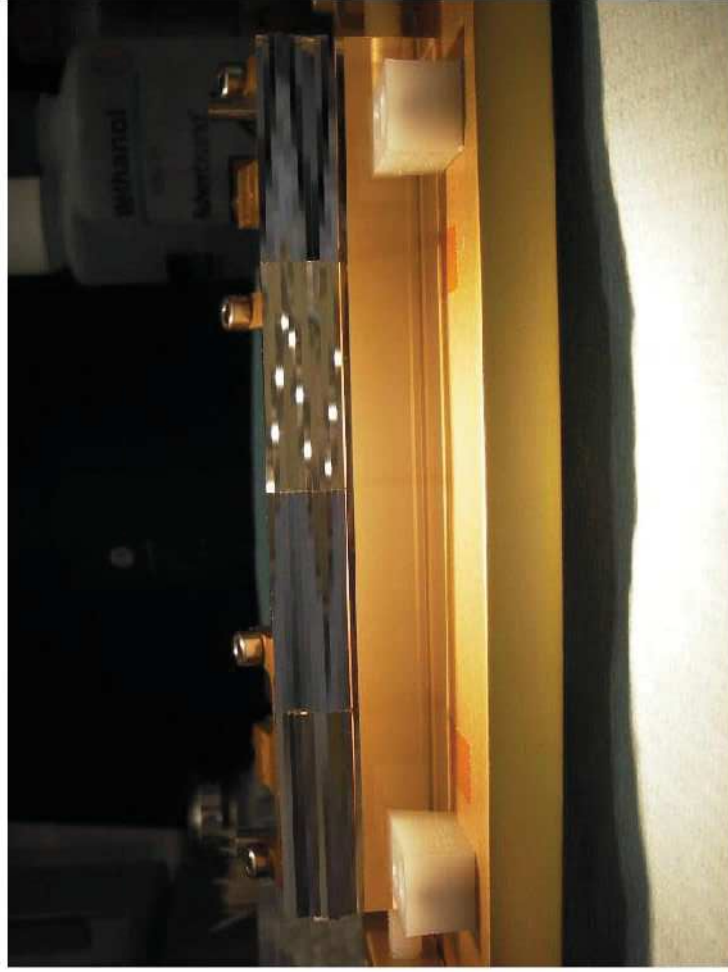
- 1176 Zerodur components
- **Optical contacting technology**
- 1176 Zerodur components glued
- No mechanical part
- Reproducible interfaces
 - (+/-30µm X, Y and Z)
- Quality after assembly
 - < 150/250nm PTV
 - Rq < 0.6nm RMS
 - Sharp edges (**4x 800mm per slicer**)



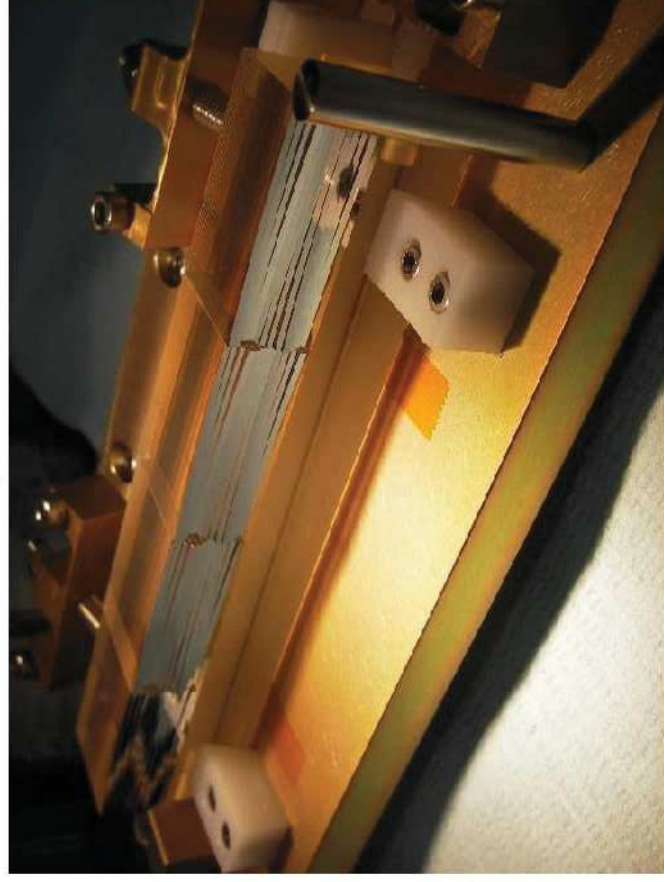
24 x 48 Spherical slices

24 x 48 Spherical Mirrors

24 Image Slicers for MUSE Astronomy– 273K /323K 2009 – 2012



1 slicer = 4x12 Spherical slices



1 Field Splitter for MUSE Astronomy– 273K /323K 2012- 2013

- 54 Fused silica components
 - **24 with optical contacting technology**
- No mechanical parts
- Lenses array assembly to make Cross-talk possible btw the 24 beams
- Location (+/-30µm X, Y and Z)
- Quality after assembly
 - < 250nm PTV
 - Rq < 0.6nm RMS
 - Sharp edges



1 Field Splitter for MUSE Astronomy– 273K /323K 2012- 2013



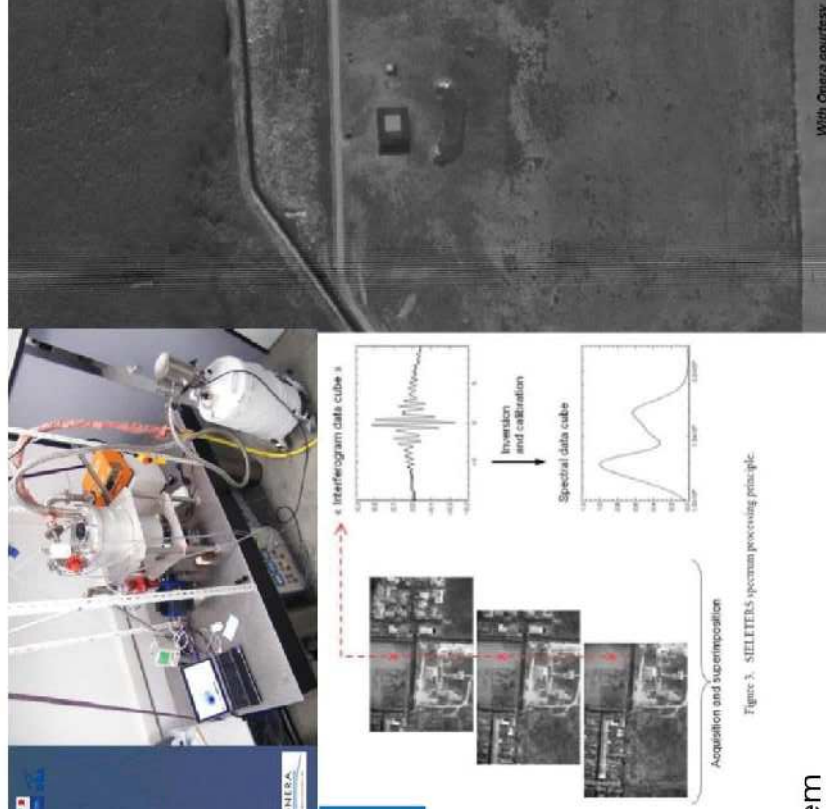
24 x slices of lenses

2 imaging static Fourier transform spectrometers Aircraft environment– 100K /323K 2012- 2013



The Sielers spectral imagers

Hyper spectral imaging system



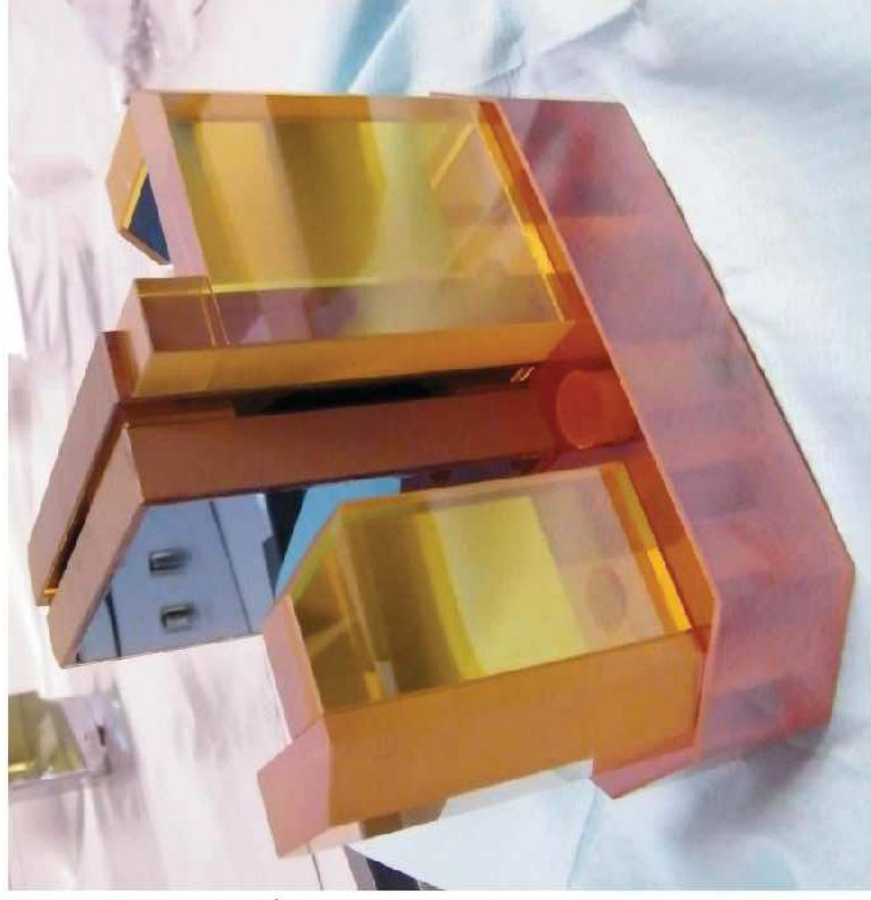
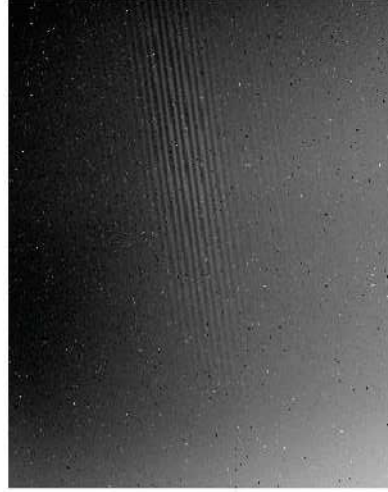
With Onera courtesy

2 imaging static Fourier transform spectrometers

Aircraft environment– 100K /323K

2012- 2013

- 2X 12 ZnSe components
 - **2X 12 with optical contacting technology**
 - **Positioning in dynamic conditions**
- No mechanical parts except for the cryo environment
- Location ($\pm 0,5\mu\text{m}$ X, Y and Z)
- Quality after assembly
 - Centered within 1 fringe shifting



Bowen-Walraven Image Slicer

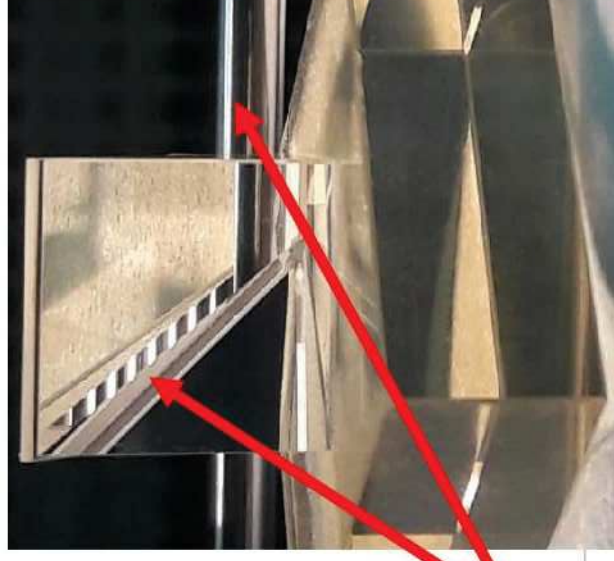
Astronomy– 240K /323K

2012 – 2013



2 prisms and 1 plate 1mm thick **optically contacted**

- Quality after assembly
 - $< 250\text{nm PTV}$
 - $Rq < 0.6\text{nm RMS}$
 - Sharp edges on prisms



Slicing effect

Image Slicer

Astronomy– 240K /323K

2013 – 2015



- 101 Clear Ceram components; 15 Invar components
- 66 components **optically contacted**
- Motorized stage
- Location (+/-30arcsec RX and RY) ($\pm 50\mu\text{m}$ Z)

Image Slicer

Astronomy– 240K /323K

2013 – 2015



- Quality after assembly
 - < 250nm PTV
 - Rq < 0.6nm RMS
 - Sharp edges (660nm per slicer stack)
- Final test at room temperature
 - WFE, tilts deviations



Image Slicer

Astronomy– 273K /323K 2015 – 2017

- Location ($\pm 30\mu\text{m}$ X, Y and Z)
- **Optically contacted**
- Quality after assembly
 - $< 150\text{nm}$ PTV; $R_q < 0.6\text{nm}$ RMS; Sharp edges

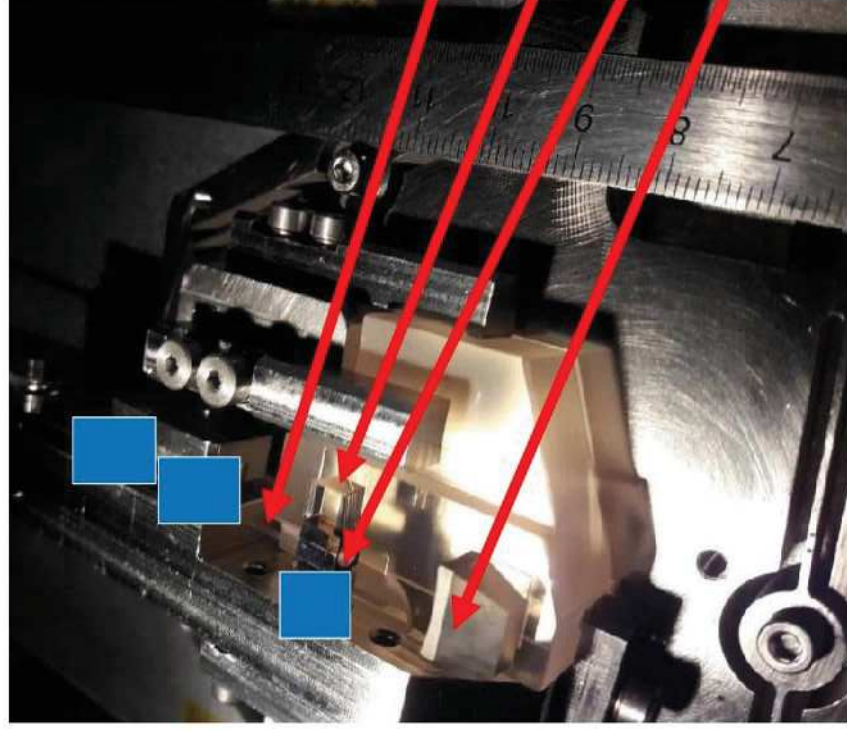


8 x slices 100 μm x 5mm
(Above and below 2 protective plates)

2 X Pupil Slicers

Astronomy– 77K /323K

2014 – 2017



- 23 Zerodur components **optically contacted**
 - **Positioning in dynamic conditions**
- 5 Invar components; 3 Optical Fibers
- Location (+/-15arcsec RX and RY) (+/-30µm Z)
- Quality after assembly
 - WFE < 30nm RMS, Rq < 0.6nm RMS
 - Sharp edges

3 x Optical Fibers Ø 90-200µm

12 x Folding mirrors (slices 110µm x 5mm)

4 Sliced pupil mirrors

1 Collimator mirror

Telescope simulator On ground equipment for space project– 165K /323K 2016 – 2017



- 11 Fused silica components **optically contacted**
- **Positioning in dynamic conditions**
 - 1 off-axis elliptical mirror
 - 1 base plate
 - 2 spacers
 - 1 pinhole (2μm diameter)
 - 1 lens
 - 5 locating mirrors

Telescope simulator On ground equipment for space project– 165K /323K 2016 – 2017

- Location
 - +/- 50µm Z
 - X and Y axis to be compatible with the transmitted WFE
- Transmitted WFE quality after assembly
 - < 27nm RMS

Conclusion

Since the beginning of WINLIGHT:

- Close to 2000 components have been optically contacted
 - An half positioned in dynamic conditions
- Close to 500 breadboards have been contacted
 - For characterization and/or tests

→ Without any damage

And now:

- We follow our processes development
 - To improve the performances withstanding the thermal and mechanical environments

Thank you for your attention

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