

## Upgrade of the LMA infrastructure and progresses for ET mirrors in Lyon

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### A two-part presentation

### LMA upgrade

## substrates and polishing facilities

## News from LMA

## A new very large coating machine...

- to meet ET and CE specifications in term of size / weight
- still able to coat 2 mirrors at the same time
- chamber size: 3.5 × 3.5 × 2.5 m<sup>3</sup> for amorphous IBS coating



# A new very large coating machine...







### Grand coater current capabilities:



### New coater possibilities



### 

 machine to be hosted in a new building linked to the current LMA clean room

Existing LMA building

Extension



### ... inside a new building

- machine to be hosted in a new building linked to the current LMA clean room
- available budget: 12 M€
- expected completion: end of 2026



### Fundings from state and local areas

LYON

**La Région** 

Auvergne-Rhône-Alpes

Liberté • Égalité • Fraternité

République Française

GRAND

**MÉTROPOLE** 

RH NE

LE DÉPARTEMENT

## Anticipating heavier mirrors

- upgraded the handling, cleaning, annealing tools to handle 100 kg mirrors for Advanced Virgo+
- an intermediate step before the 200 kg mirrors for ET



Mobile crane for the clean room



Lifting a 100 kg piece of glass



New mounts for the metrology

# Beyond the coating: substrate growth and polishing

# The cryogenic substrates

- 2 crystalline candidates
  - ▶ silicon
  - ► sapphire
- Very difficult to find large ingots with the required optical properties

- Some interesting properties of sapphire
  transparent at 1064 nm
  1 7x dependent here ailigen
  - 1.7× denser than silicon
  - Young's modulus 2.7× higher





# A strong commitment on sapphire



- with a specialist of crystal growth (K. Lebbou)
- aim: produce ET cryo-compatible substrates in sapphire
- custom made dedicated furnace in commissioning







**1.4 M€** 

small test samples

#### the furnace to melt 500 kg of alumina (49 kg substrate recently achieved, Ø260 mm)

## **Results on smaller parts**

ATAMANANALPLA(Q(QLALAUDVAVAJAJAJANANAJAJA)

- validating the starting raw material and growth parameters
- absorption < 20 ppm / cm consistently achieved (@1064 nm)</li>
- started to measure the birefrigence
- demonstrated fiber production





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Absorption maps



Monocrystalline sapphire fibers



## New horizons on Lyon's site



Substrate



Coating machine

# New horizons on Lyon's site

### Mirror =







Coating machine

Substrate

Polishing

# Polishing: a complex sequential process



Illustration from the LaserOptik catalogue

# Polishing a complex sequential process



### New polishing equipments (compatible all substrate materials)



mechanical

ion beam figuring



7 axis polishing robot for Ø 400 mm (50 kg). Delivery before the end of 2023

Demonstrator of IBF on small substrates with a innovative ion source. To be upgraded this year with a larger chamber and stages

### Conclusion

Large funding secured at Lyon to progress toward ET mirrors.

 new IBS coating machine underway for very large mirrors

development of large sapphire substrates

developing local polishing capabilities