



LABORATÓRIO DE INSTRUMENTAÇÃO  
E FÍSICA EXPERIMENTAL DE PARTÍCULAS  
*partículas e tecnologia*

# Laboratory of Optics and Scintillating Materials

Rute Pedro, on behalf of the LOMaC team

Jornadas do LIP | Coimbra | 9 July 2022

## Team and Collaborators

Researchers

A. Gomes  
J. Gentil  
R. Gonçalo  
A. Maio  
R. Pedro

Technicians

L. Gurriana

PhD

D. Guerreiro  
R. Machado  
B. Pereira

Students

MsC.

P. Rato (conc.)  
M. Santos (conc.)  
C. Pereira  
R. Marques

Undergrads  
and  
Trainees

P. Mendes  
~4 internship  
students/year

- Team involved in other LIP groups
- New PhD students and constant flow of Master students/trainees



# LOMaC Capabilities

## Optical instrumentation for Scintillator-based detectors

### R&D

- Scintillator characterisation
- Scintillator-optical fibre coupling
- New plastic scintillating materials

### Characterisation and Quality Control

- Optical fibres
- Photodetectors

### Mass production

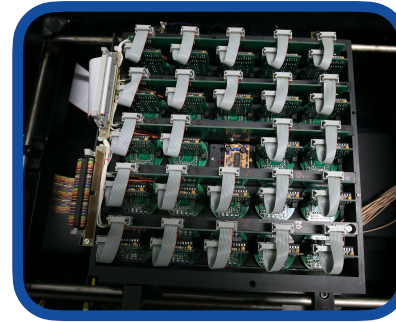
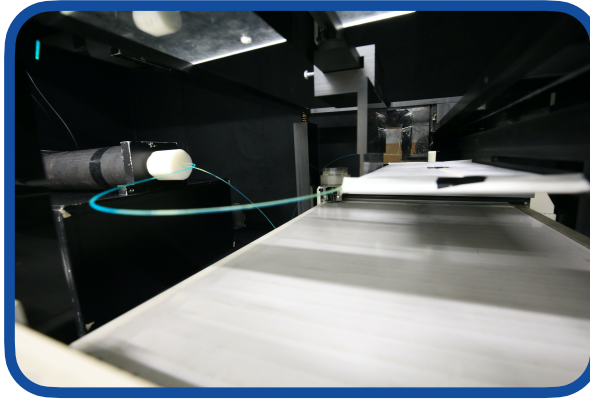
- Optical fibre cut and polish
- Fibre mirroring by Al deposit through magnetron sputtering

# LOMaC Equipment and Infrastructure

## Re-equipment in progress

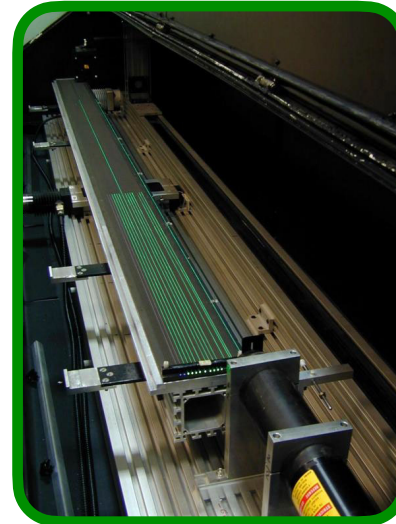
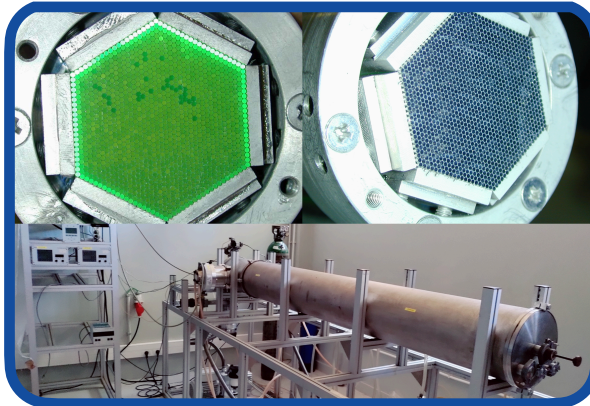
LIP-Lisbon FCUL

XY-table for scintillator characterisation with 90Sr



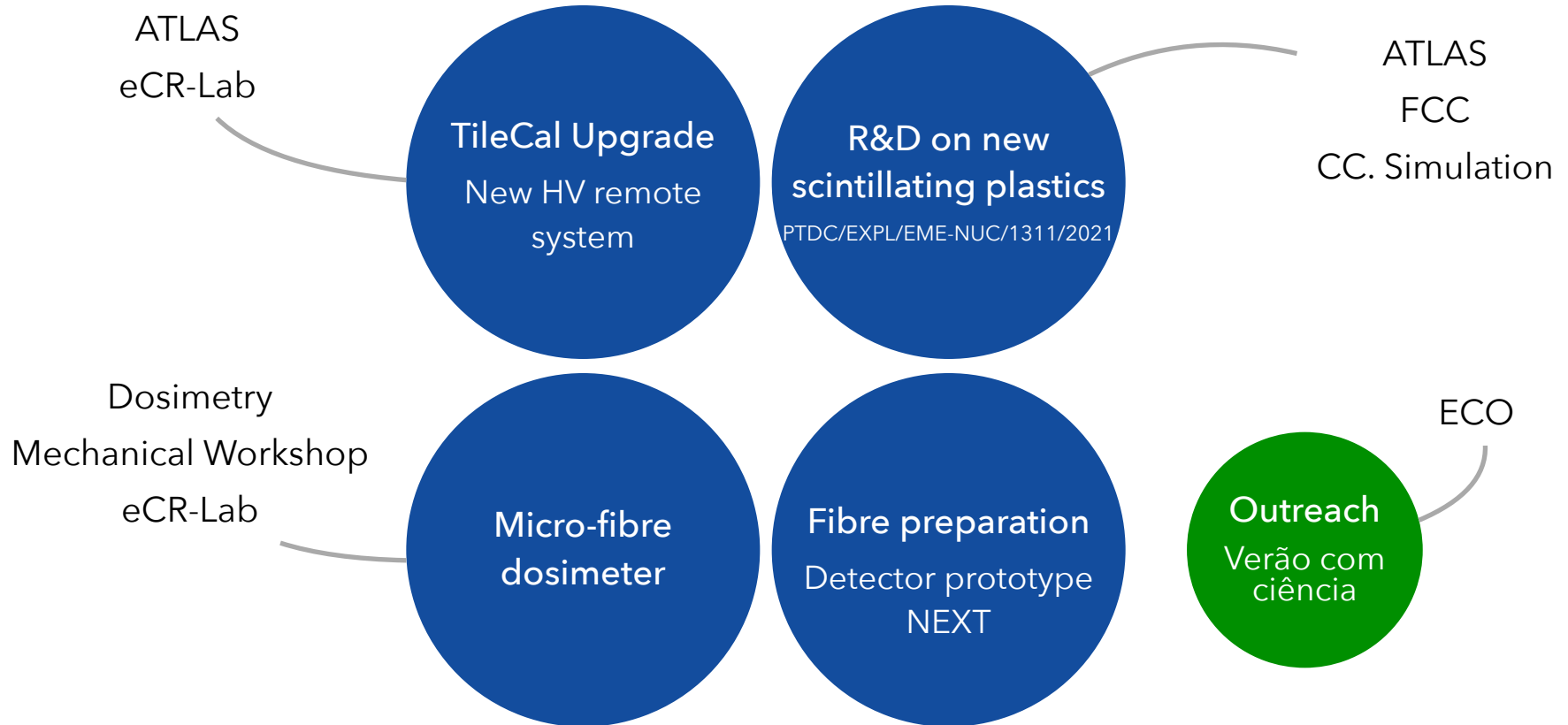
PMT test bench with LED light

Magnetron Sputtering machine

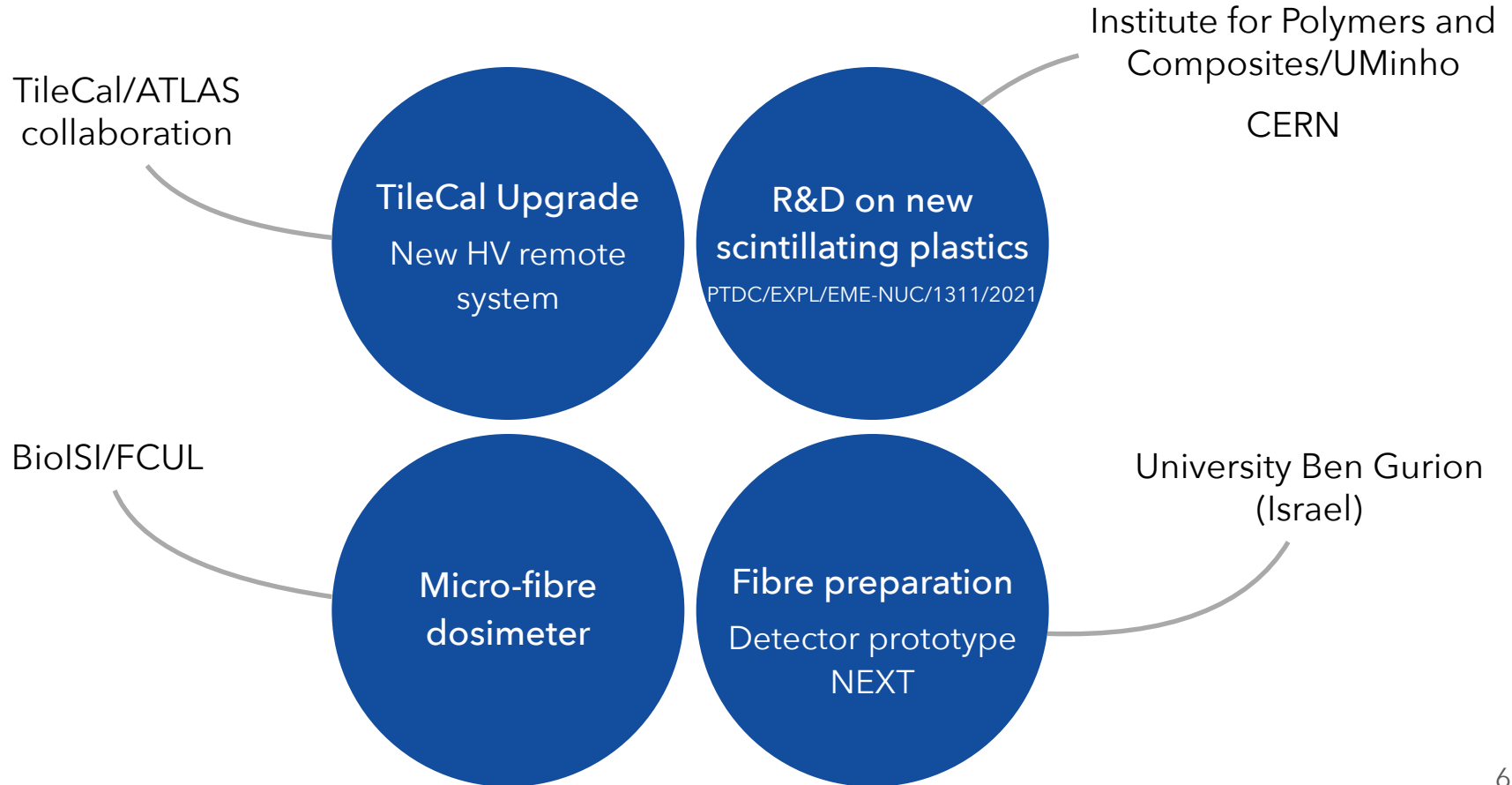


WLS/scintillating Optical fibre characterisation with LED

## Current Projects and Integration at LIP

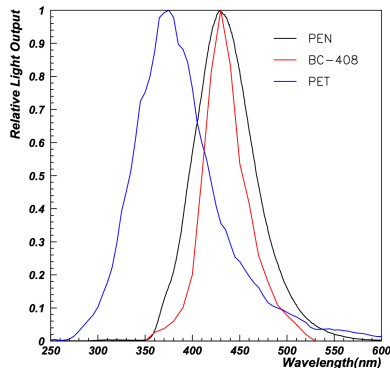


## Current Projects and External Collaborations



# New Plastic Scintillators for future Light-based detectors

## Key R&D on the Roadmap for future particle experiments



### Explore PEN (Polyethylene Naphthalene) and PET (Polyethylene Terephthalate)

- Adequate emission spectra
- Competitive Light yield
- Possibly radiation-harder

### Questions and Goals

- Do PEN and PET blend synergistically?
- Does the addition of luminophores improve scintillation?
- Develop new instruments for scintillator characterization (absolute light yield)
- Set up a scalable manufacturing technique for scintillator production



# New Plastic Scintillators for future Light-based detectors

First samples produced at IPC/UMinho



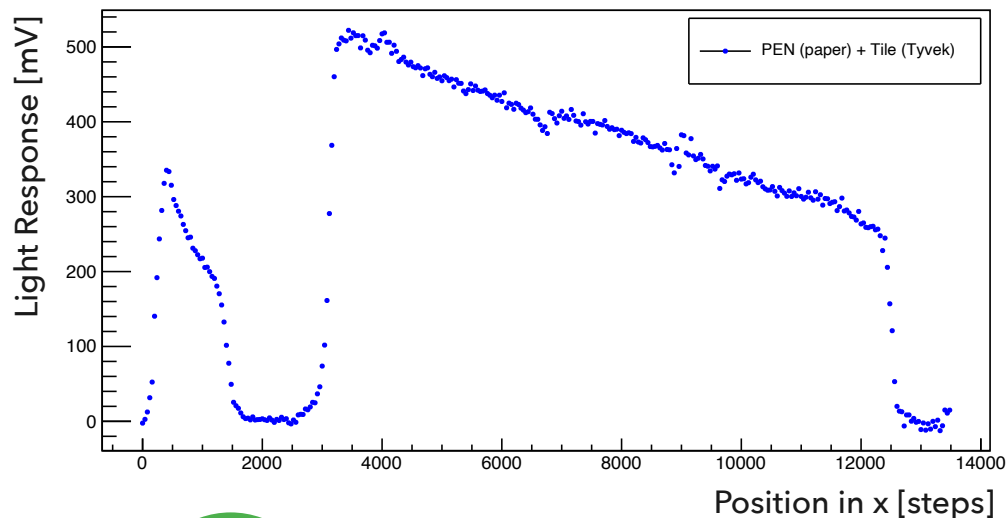
- Injection moulding from PET/PEN granulate

## Next

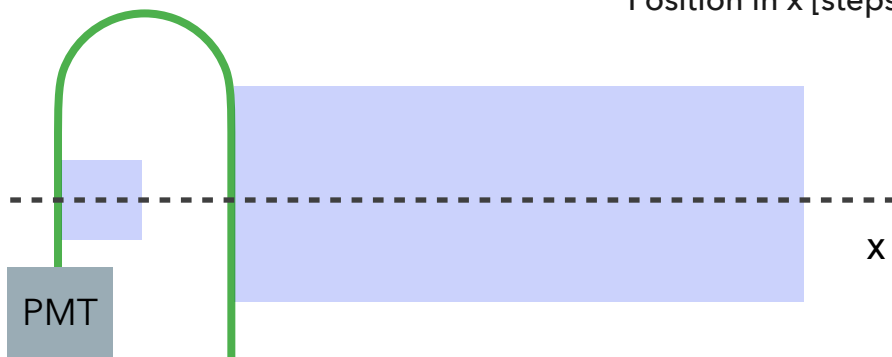
- PET/PEN blends
- Tune machine parameters for more transparency
- Device to measure sample scintillation on site

# New Plastic Scintillators for future Light-based detectors

Preliminary results of sample characterisation at LOMaC



- Scan of a PEN and TileCal scintillator with  $\text{Sr}^{90}$
- PEN light output similar to reference scintillator
- PEN transparency to improve



Additional results at  
the poster session

# Development of a Microdosimeter

## To measure dose at the cell scale in radio-therapy applications

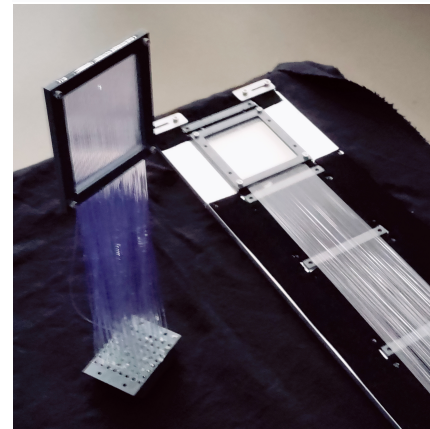
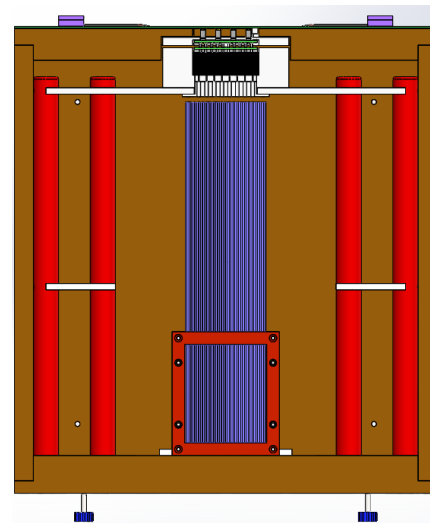
- Employ plastic scintillating fibres of small diameter (0.2 to 1 mm)
- Readout by multi-anode PMT photodetector
- Current prototype uses 1 mm fibres

## Contributed to the system integration at eCR-Lab

- Test setup with 2 fibres + maPMT + 2 readout channels
- MSc Matilde Santos (Concluded)

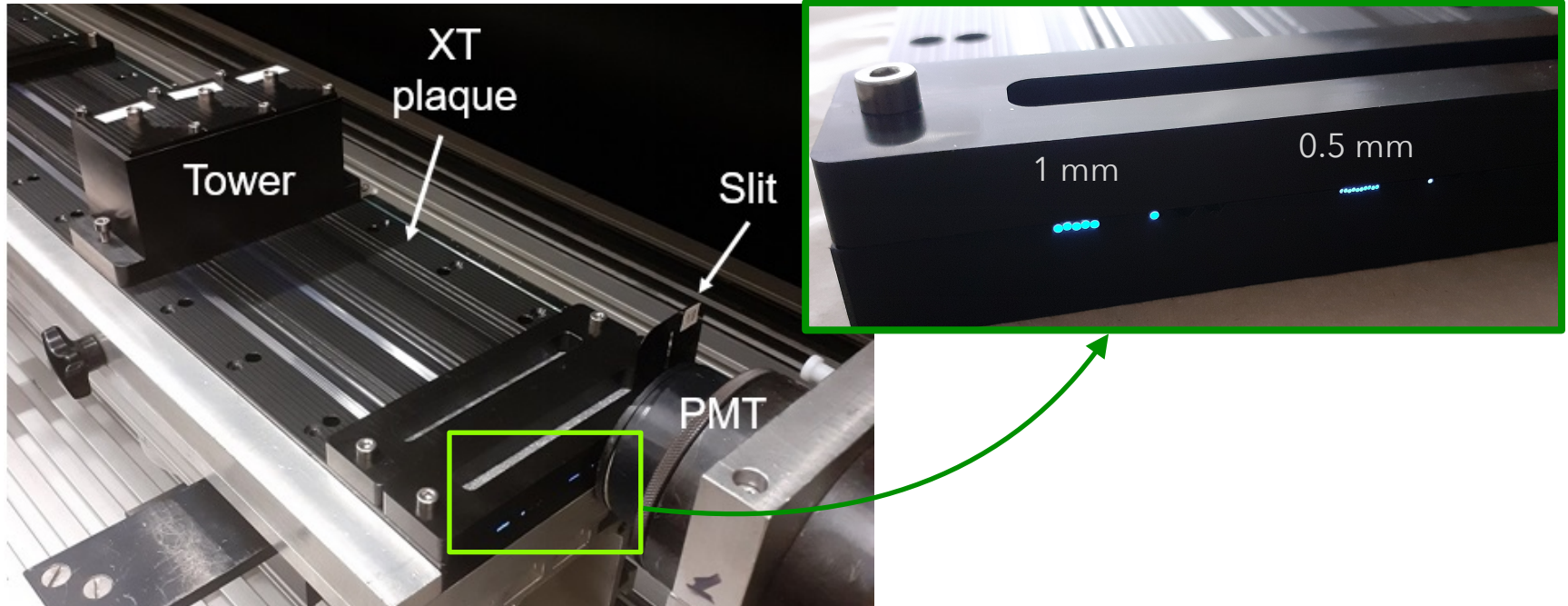
## Assisted prototype mechanical design and construction

- Planes of 0.5-1 mm fibres, system assembly started



## Development of a Microdosimeter

### Measurement of cross-talk between neighboring fibres



- Small effect relative to other intrinsic contributions of the system
- MSc Matilde Santos (Concluded)

# Fibre preparation for NEXT detector prototype

## NEXT searches for neutrinoless double-beta decay (Spain)

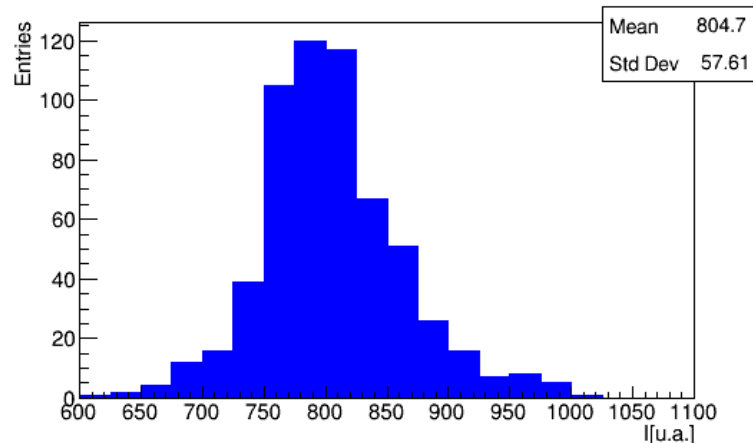
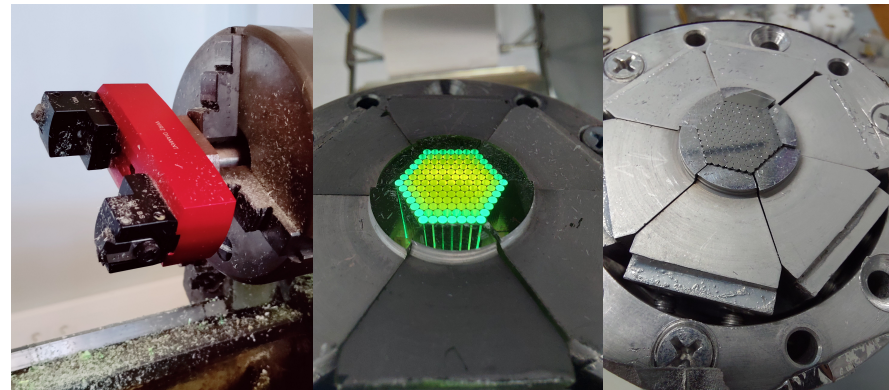
- Participation to the development of new prototype with wavelength-shifting (WLS) fibres
- Readout of primary scintillation in Xe

## Fibre Mirroring

- Cut, polished, aluminized 5 bundles of 127 fibres, 25 cm long
- Recovered lathe for cut and polishing
- Updated pump system of the magnetron sputtering

## Optical characterisation and quality control

- Relative width of light yield:  $\sigma_I / \langle I \rangle \sim 7\%$
- Rejected 30/677 fibres (4%)





# | Highlights

**LOMaC competences have many potencial applications**

**Scintillating materials are an interesting and needed research area**

- Collaboration with IPC/UMinho: new capacity for material R&D and link to industry
- Microdosimetry is a key connection to health applications that should be expanded
- Fostering involvement in international collaborations (Calorimeters for FCC)

# ACKNOWLEDGEMENTS



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