

# Stato dei microscopi e prossimi sviluppi

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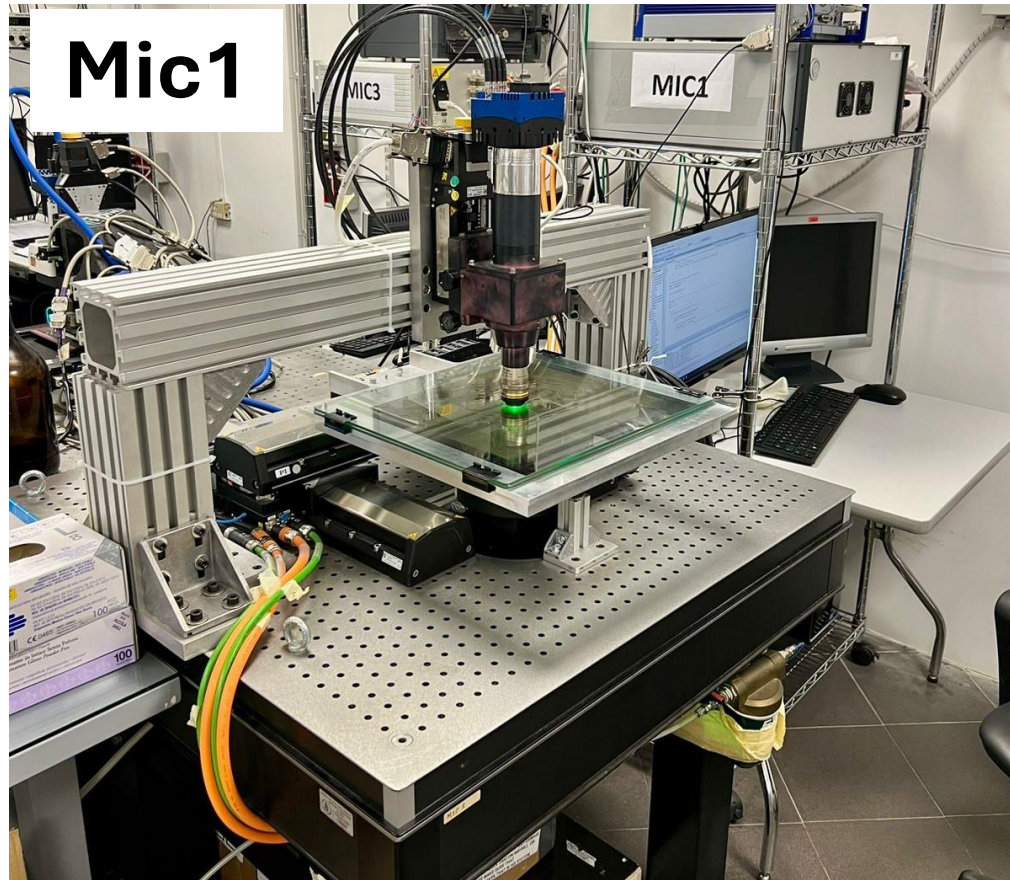
# Outline

- Microscopes status
- Microscopy R&D status
  - Fast scan (Mic1 and mic4)
  - Splitter (mic7)
  - Photo-thermal
- $\gamma$ -exposure update

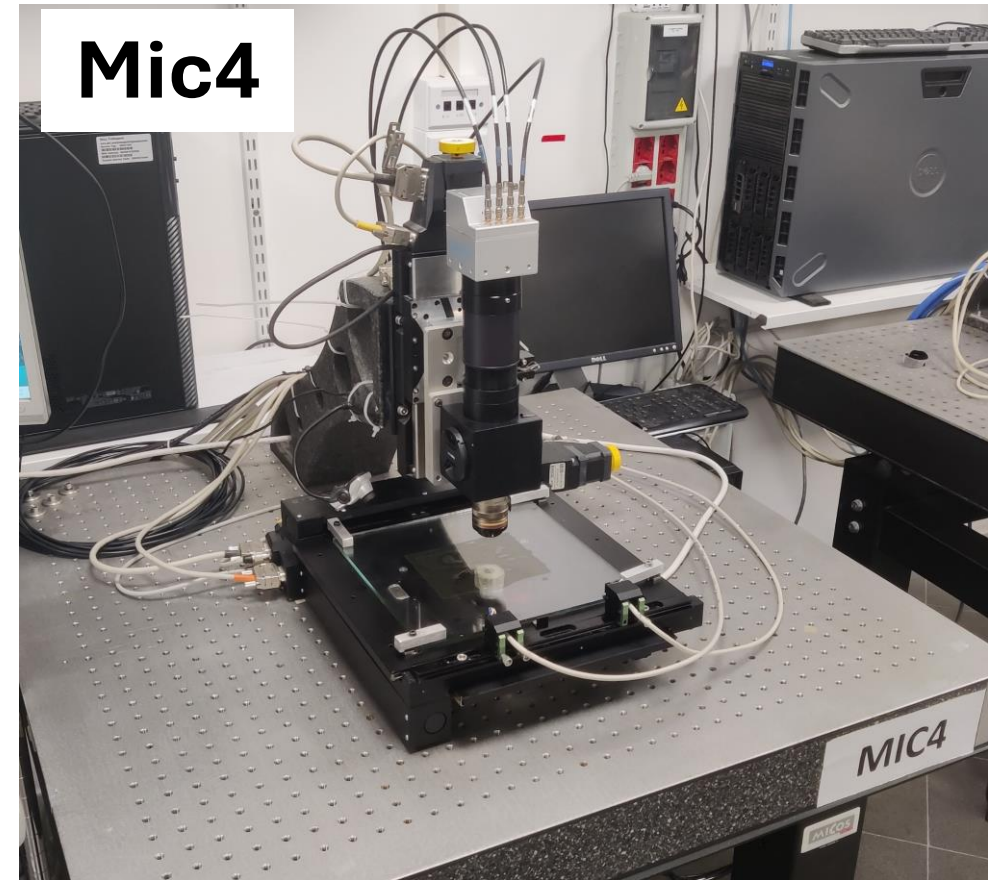
# Microscopes status

Name	Location	Experiment	Hardware	Status/Comments
mic1	1H25	SND	New	Analysis SW development is in progress
mic2	1H25	SND	Standard	
mic3	1H25	SND	Standard	
mic4	1H25	SND	New	Waiting for 10x OL and new Z-stage
mic5	1H25	SND/FOOT	Standard	Glass/revolver maintenance to be done
mic6	2H28	DAMON	Super-res	Old scan PC, overheating problem
mic7	1H25	DAMON	3D super-res	No scan PC
mic8	2H28	DAMON	High-res	
	Tecchio		ESS	Not unpacked yet.
	2H28		NTS	Potentially usable mechanics.

Fast Scan (mic1 and mic4)



- HW control is ready
- Analysis SW development is in progress
- Need new Scan PC (10Gb network)
- Need new illumination system design
- **Waiting for Zhakan**

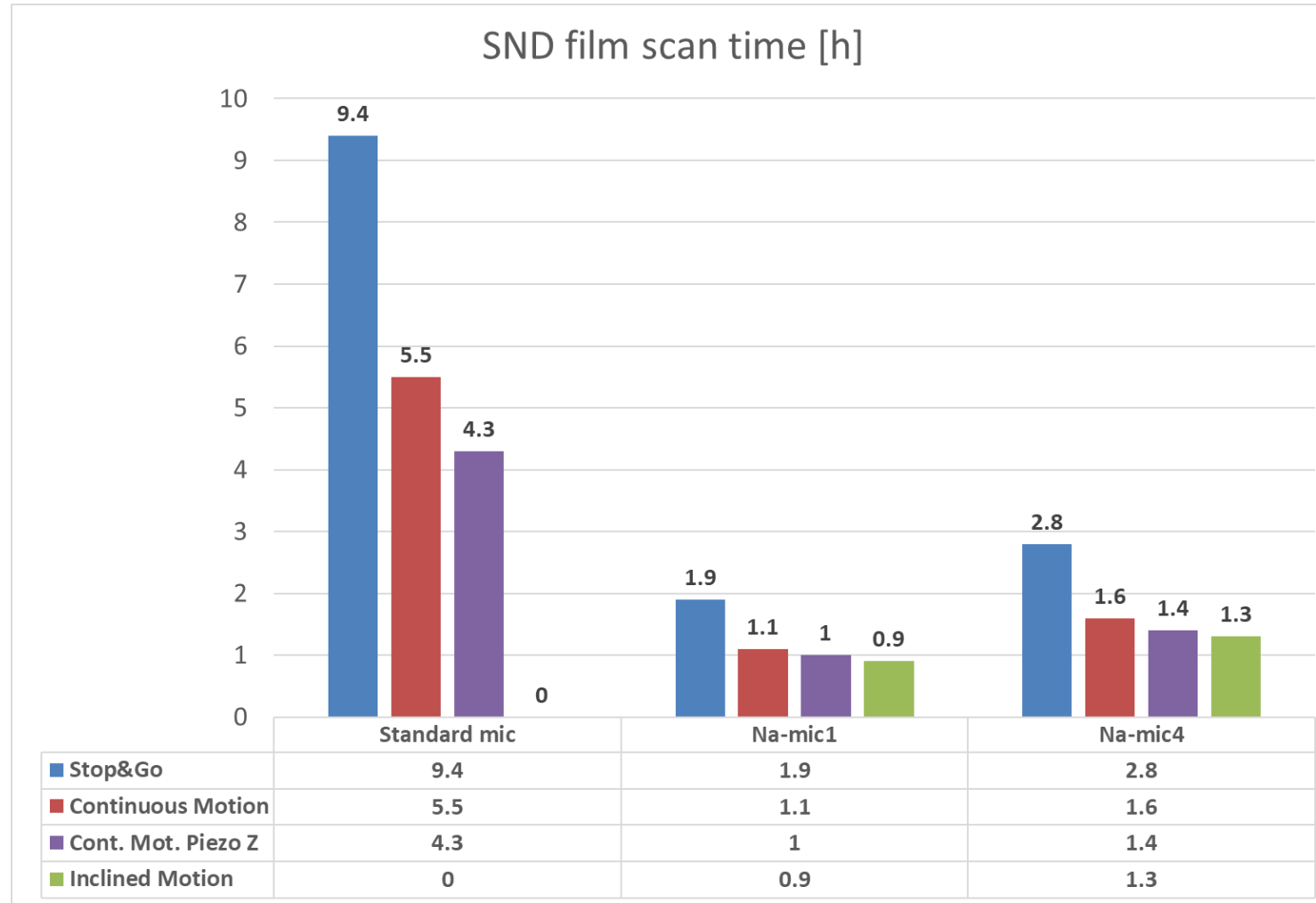


- Standard mechanics (for the moment)
- New XY stage is available
- New Z stage is ordered
- Same (or very similar) electronics as at mic1
- 10x objective lens is ordered
- Need new Scan PC (10Gb network)

# New scanning system development checklist

- ✓ New stage control module – ready
- ✓ Piezo stage control – ready
  - Piezo integration - postponed
- ✓ Light source control & integration – ready
- New cluster reconstruction library
  - ✓ Overcome limit of  $2^{17}$  (=131072) clusters/frame
  - ✓ CPU implementation - ready
  - GPU implementation - in progress
- Microtrack reconstruction library
  - Limit on number of grains in GPU version:  $2^{19}$  (=524288) grains/view
  - View split or new tracking algorithm?
- 10Gb network connection between Scan and Proc PCs
  - 2 new scan PCs
  - ? new Proc PCs? – to be estimated yet
- New Koehler-type illumination system

# Foreseen microscope performances



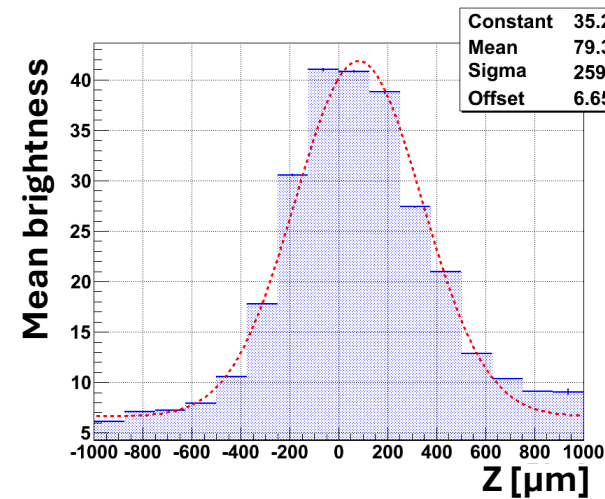
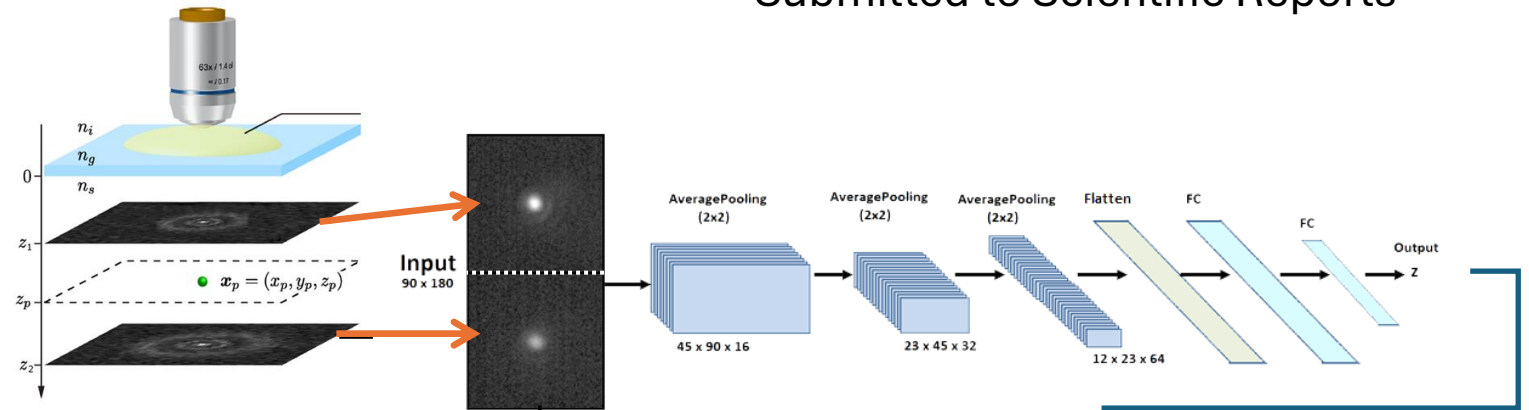
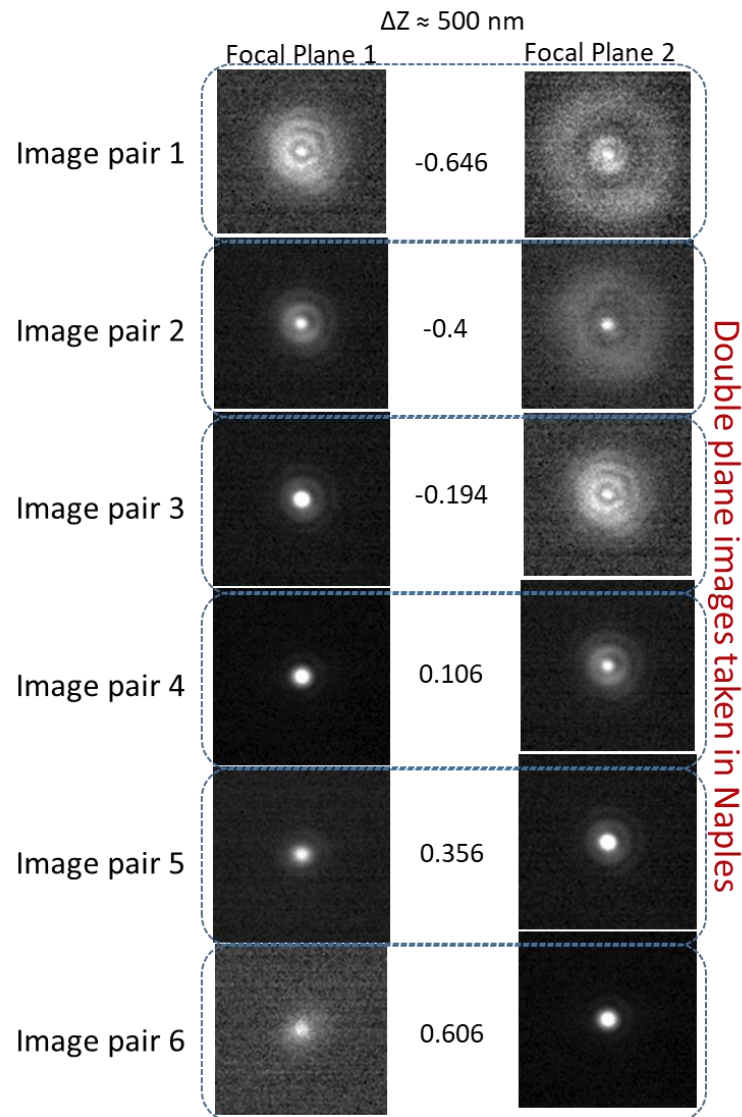
- Na-mic1 ~5 times faster
- Na-mic4 ~3.3 times faster

Splitter (mic7)

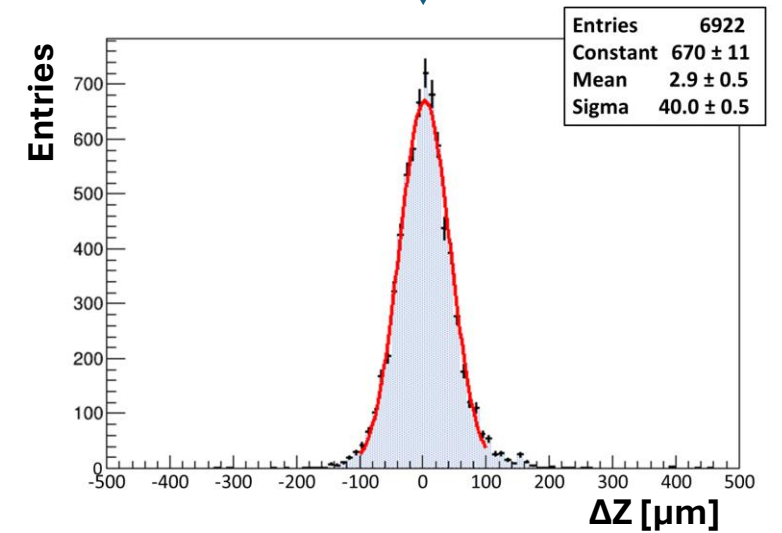


# Deep Learning for High-Accuracy Axial Localization Enabling Nanometric Tracking for Applications in Physics, Medicine, and Space

Submitted to Scientific Reports



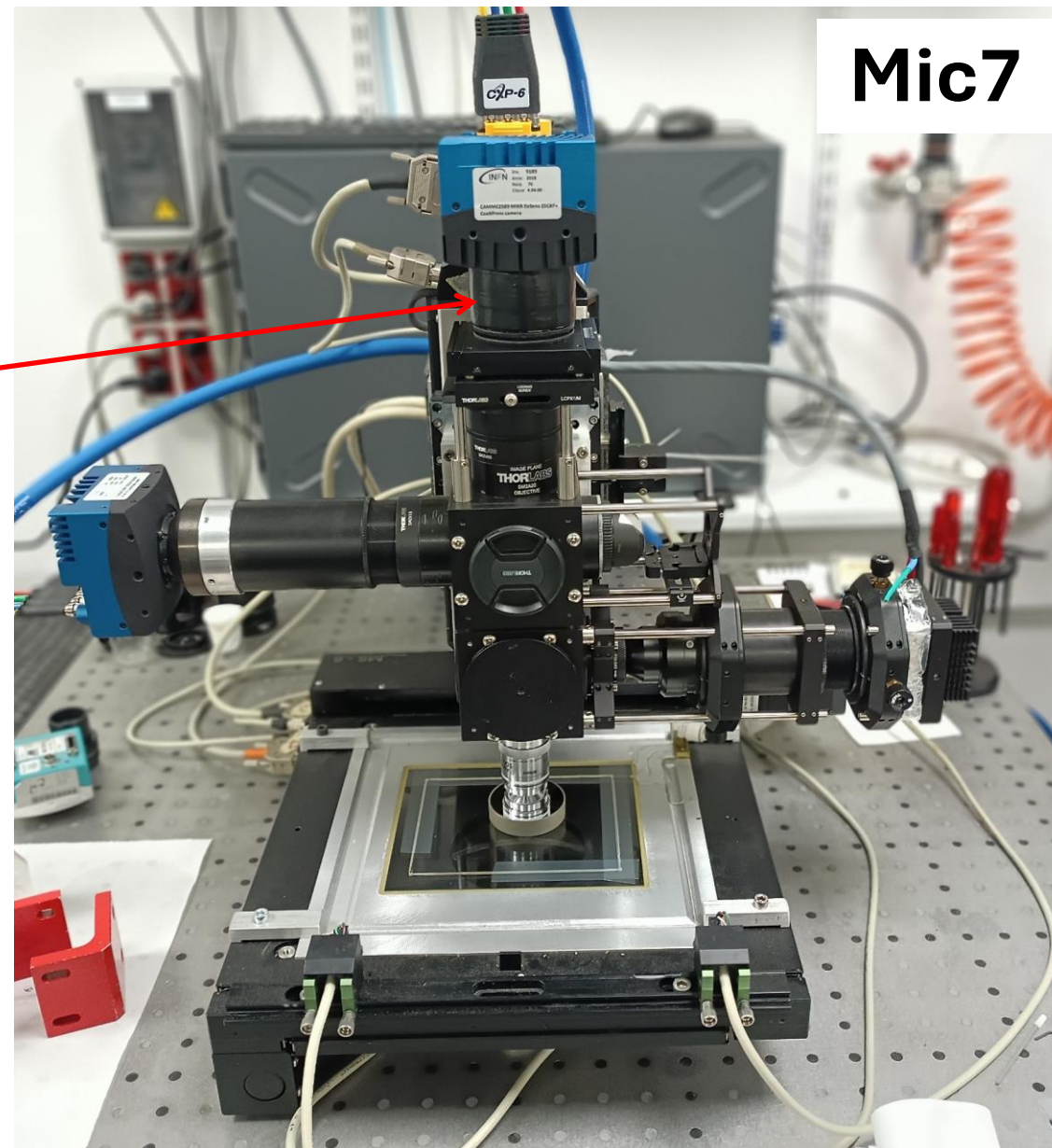
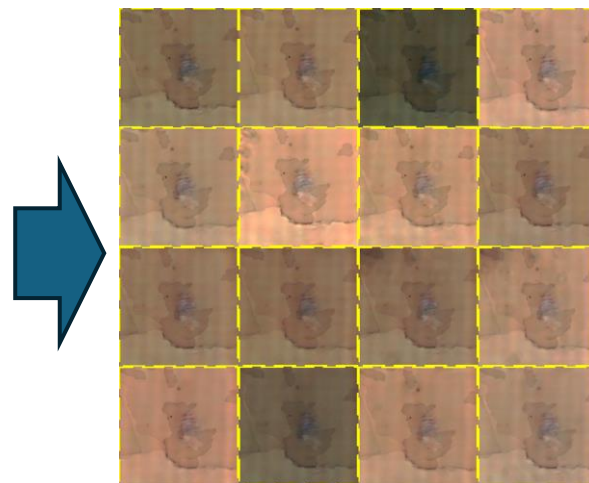
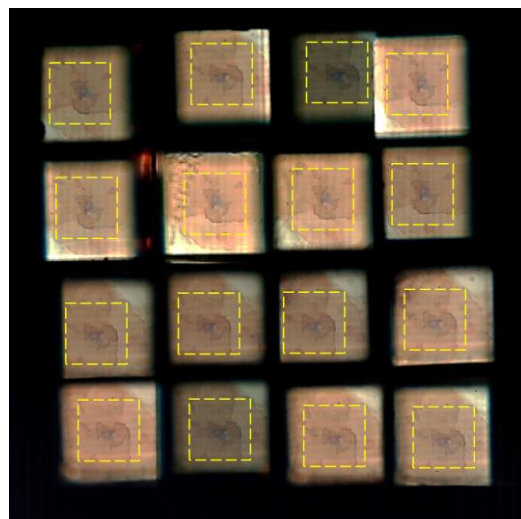
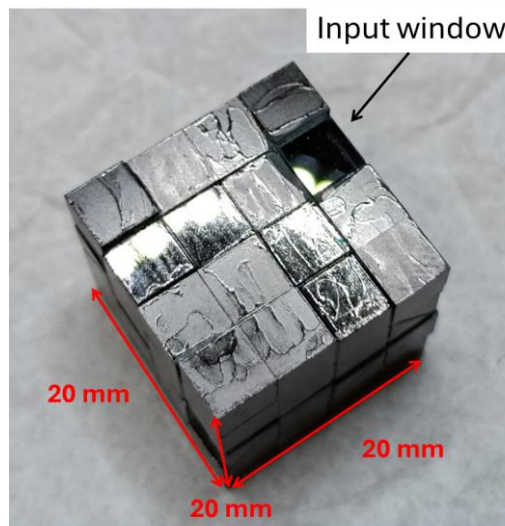
Mean brightness profile along Z



Axial localization accuracy = 40 nm

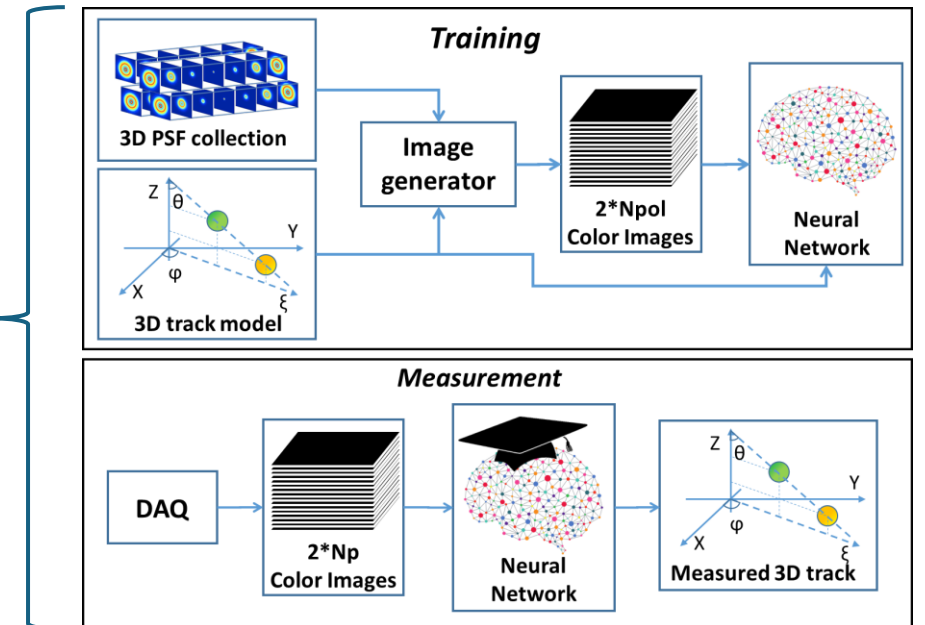
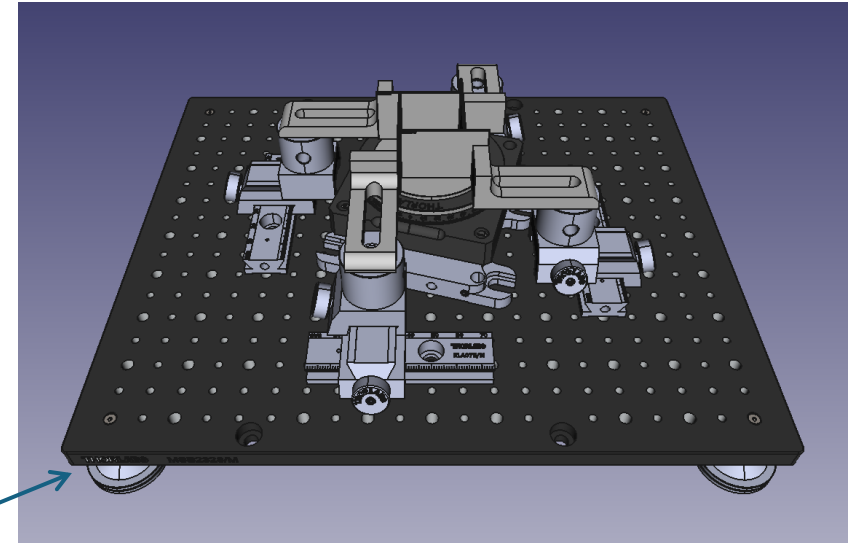
# Test microscope & splitter

Compact splitter delivered in summer 2024



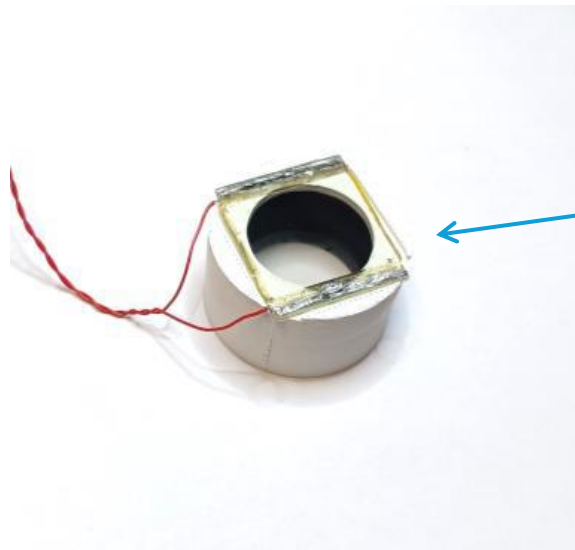
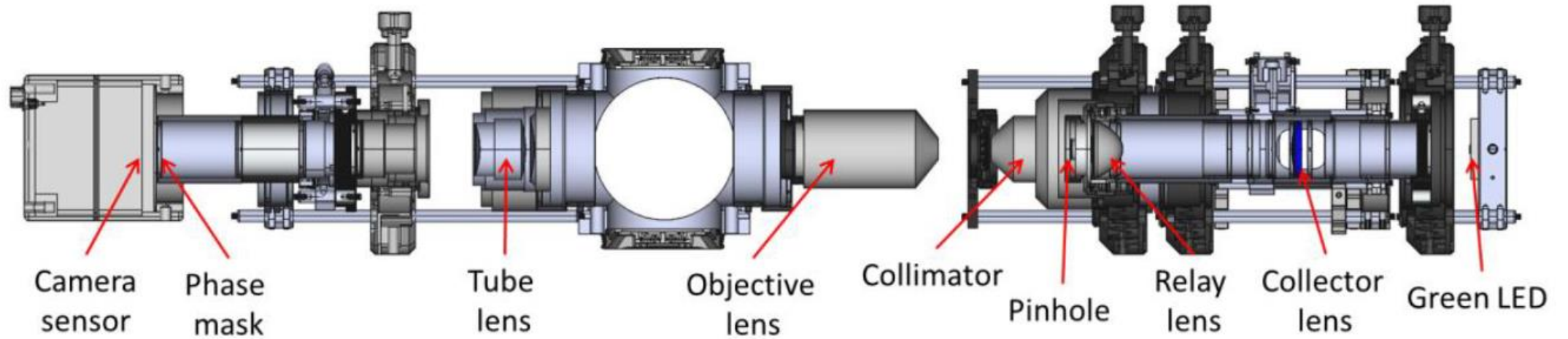
# 3D SR mic development plan

- Splitter produced and delivered
  - Bad alignment reduces usable area to  $\frac{1}{4}$  of design
  - Image quality is satisfactory in 14 (of 16) exit windows
- 4x4 polarizer grid to be produced and glued
  - Tool to fix optical components during glue soldering under UV (Thorlabs, ~2000 euro)
  - Extra material to practice gluing
  - Clean room for final gluing?
- Required for measurement and analysis:
  - Realistic 3D track & filament model in NIT
  - Realistic Image generator with LSPR effect
  - (Original) Neural Network methodology



# Photo-thermal

# 1<sup>st</sup> Phase Photothermal prototype @ Napoli



- Intended for detection of 20 nm silver grains in U-NIT
- Binary phase mask
  - Liquid-crystal-based phase mask produced by Lab. of Photonics UniNa
  - Si-wafer-based phase mask is in production by PhotomaskPORTAL (USA)
- 10W blue laser is available (for grains heating)
- No microscope is assigned
- Useful for DAMON?

$\gamma$ -exposure

# 2024 $\gamma$ -exposure summary

- 4<sup>th</sup> attempt, trying to optimize the emulsion quality
  - Produced 2 films (4-6 Nov. and 2-6 Dec.) from OPERA gel
  - 2 exposures: 3-5 Dec. and 9-10 Dec. (Co-60, Cs-137, Am-241 & Sr-90)
  - 3 developments: 8 Nov., 6 Dec. and 10 Dec.
- High fog level in both films
  - Film 2 was produced with minimal use of red wall lamps and without use of head-torches!
  - Over-aged OPERA gel? (produced **sensitized** in Japan in 2023)
  - Too old developer or other chemical?
- High electron background in both films
  - Film 1: cut and stored for ~1 month in freezer after production
  - Film 2: passed ~1 week between pouring and development
  - After pouring, several days are enough to get excessive levels of electron background
- Conclusions
  - Experience in film production
  - Need fresh, **not sensitized** OPERA gel for film production
  - Sensitization immediately before exposure
  - Development immediately after exposure