M2 internship in Physics and Optical Instrumentation 2027

Build a 3D-printed holographic microscope for tracking particles in soft matter

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Keywords: Experimental physics, optical instrumentation, holographic microscopy, optomechanics, CAD, 3D printing, image acquisition, particle tracking, microrheology, soft materials.

Context: Holographic microscopy uses interference patterns to recover the three-dimensional positions of many particles from a single image, making it a powerful tool for studying transport in soft and heterogeneous materials. The NanoX-funded **MEMTIM** project will use this technique to determine how deformation history creates anisotropy and mechanical memory in mucus. This internship will deliver the new microscope required for these measurements.

M2 project: The student will construct a video holographic microscope from the ground up. The work will include selecting the illumination source, camera, lenses, filters, and optomechanical components; refining the optical layout; and designing custom mounts, adapters, and sample holders in CAD. These parts will be 3D printed, iterated, and integrated with commercial components.

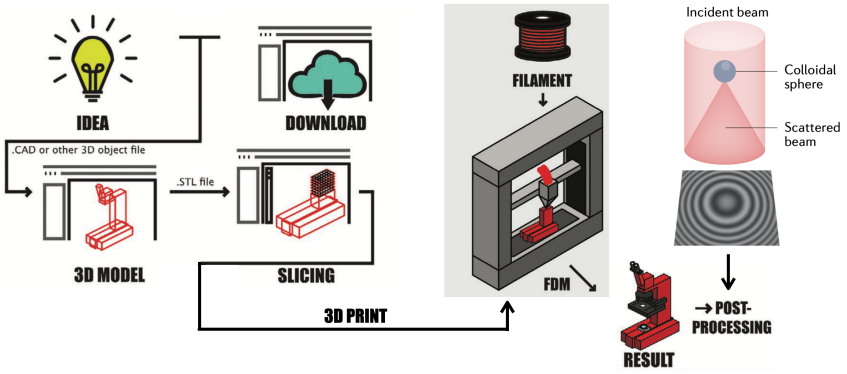

Figure 1: From optical design and 3D-printed optomechanics to a calibrated holographic microscope for volumetric particle tracking in soft matter (figure adapted from [1,3]).

The student will assemble and align the system, adapt image-acquisition and reconstruction routines, and calibrate 3D particle tracking using colloidal samples. The final deliverables will be a functional microscope, reusable CAD files, a documented parts list and alignment procedure, and initial measurements in soft gels.

Training: The intern will gain practical experience in optical design, component selection, CAD, additive manufacturing, assembly, alignment, camera control, calibration, troubleshooting, and quantitative image analysis. The student will take an instrument from its initial design to a working research platform.

Profile: We seek a resourceful M2 student in physics, photonics, instrumentation, engineering, or a related field who enjoys building and improving physical devices. Experience with optics, CAD, 3D printing, electronics, or programming is an advantage but not required. No biology background is necessary.

Practical information and application: The internship will take place at the LPT in Toulouse for up to six months, starting in 2027, in a new laboratory dedicated to holographic microscopy and soft matter. It is funded according to the standard French M2 internship allowance.

To apply, please send a CV, a brief cover letter describing your interest and practical experience, and academic transcripts to W. Ahmed (wylie.ahmed@utoulouse.fr).

Selected references:

1. C. Martin et al., "In-line holographic microscopy with model-based analysis," *Nature Reviews Methods Primers* **2**, 83 (2022), doi:10.1038/s43586-022-00165-z.
2. T. G. Dimiduk et al., "A simple, inexpensive holographic microscope," in *Digital Holography and Three-Dimensional Imaging*, OSA Technical Digest, JMA38 (2010), doi:10.1364/BIOMED.2010.JMA38.
3. M. del Rosario et al., "The field guide to 3D printing in optical microscopy for life sciences," *Advanced Biology* **6**, 2100994 (2022), doi:10.1002/adbi.202100994.