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PUBLIC PROCUREMENT OF ROUTINE SUPPLIES AND SERVICES
SPECIFIC TECHNICAL SPECIFICATIONS

**For purchase by the Institut des Sciences Moléculaires d'Orsay,
manufacturing , and testing of the electromagnetic prism for the HREELM
column.**

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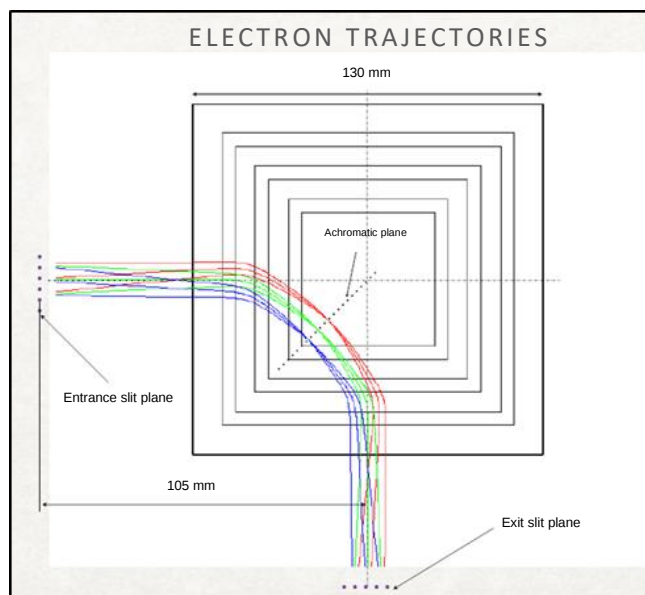
1- Introduction :

The purpose of these Technical Specifications (CCTP) is to enable the Institut des Sciences Moléculaires d'Orsay to conduct an open bidding process for the manufacture of an electromagnetic prism for the very High-Resolution Electron Energy Loss Microscope known as HREELM, described in the 2019 publication (<https://doi.org/10.1016/j.ultramic.2019.112848>)

The project will involve construction of the prism and functional testing using an electron beam with the following characteristics at the image plane 105 mm from the center of the prism: a diameter ranging from 100 μm to 1.5 mm and a convergence angle of approximately ~ 0.25 mrad.

2- Technical Specifications

The image to be captured has a size between **100 μm and 1.5 mm**; the convergence angle must be ≤ 0.25 mrad at the image plane, for a beam energy of **3 keV**. A description of the optics is provided in the article by **M. Mankos, et al.** (*Design for a high-resolution electron energy loss microscope, Ultramicroscopy*, vol. 207, Dec. 2019, 112848 <https://doi.org/10.1016/j.ultramic.2019.112848>). The prism must transmit this image and deflect it by **90 degrees**, without significant aberrations. An aberration is considered significant if it causes blurring or displacement of more than 9 μm on the prism's achromatic plane at any point in the image that occupies an area of no more than 1.5 mm $\times$ 1.5 mm. This aberration limit corresponds to 3 pixels on a 500x500-pixel sensor.

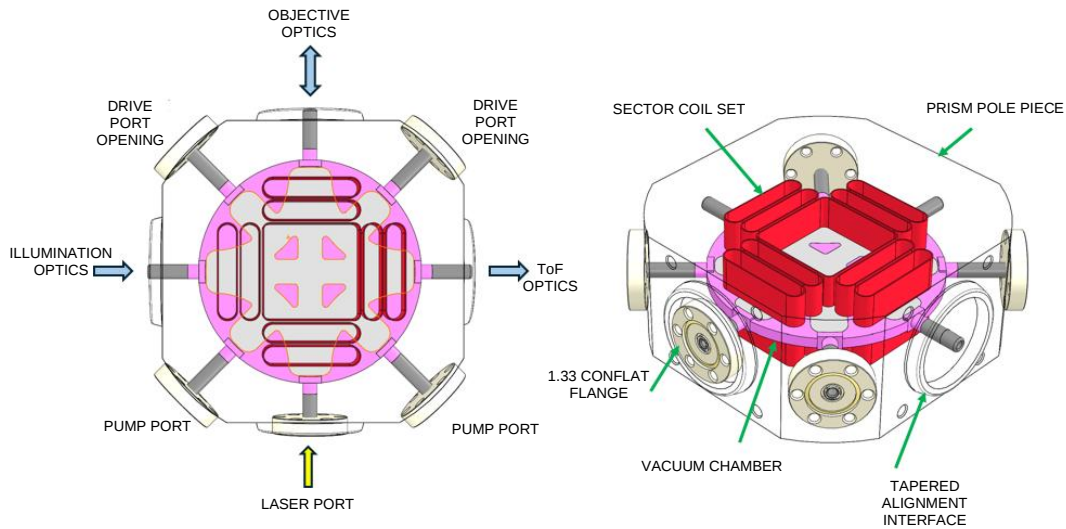


The overall geometry is shown below. A diagram with the exact dimensions will be provided for the project.

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PRISM BASIC LAYOUT



The prism's basic dimensions are 130 mm x 130 mm x 60 mm thick. It consists of four conical mechanical components for aligning the column's optical elements. The tolerances for the geometry of each sector and the parallelism of the prism plates must be $\leq 25 \mu\text{m}$.

A- 3D Model

A 3D model of the prism will be provided to the recipient and remains the exclusive property of ISMO. No transfer of ownership is granted to the holder. These documents are provided solely for the purpose of creating the module's manufacturing drawings. Their use, reproduction, or disclosure to third parties is strictly prohibited, in accordance with intellectual property rights.

B- Manufacturing drawings

The manufacturer will create the manufacturing drawings based on the 3D model provided. They will be provided along with the prism and will be the exclusive property of ISMO. Their use, reproduction, or disclosure to third parties by the owner is strictly prohibited, in accordance with intellectual property rights.

A meeting will need to be scheduled to approve the manufacturing plans before production of the module begins.

C- Magnetic deflection components:

Magnetic deflectors are made of magnetic iron (Iron type, CONSUMET CORE IRON PER ASTM A848, TYPE I, CLASS I) or equivalent (ARMCO® Pure Iron quality) and include the necessary coil assemblies and their controllable power supply electronics.

D- The prism's vacuum chamber:

A vacuum chamber made of non-magnetic material is located inside the magnetic deflector assembly. The pressure in the vacuum chamber will be less than 5×10^{-7} torr, and the chamber will be made of non-magnetic titanium.

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The vacuum chamber has four ports spaced 90° apart for the electron beam to pass through: Three electron beam ports, intended for various external column optics, are sealed with O-rings. A laser port is sealed with a 1.33-inch ConFlat flange. (DN16CF)

The vacuum chamber also has four additional ports spaced 90° apart, offset by 45° from the electron beam ports. These access ports allow for the integration of two pump ports and the positioning of two beam-limiting diaphragms. The diaphragm positioning mechanisms are mechanical or electromechanical and are mounted on 1.33-inch ConFlat flanges.

The tolerances for the geometry of each sector and the parallelism of the prism plates must be $\leq 25 \mu\text{m}$.

Beam diaphragms:

The beam diaphragms are made of a platinum-iridium alloy (95/5). They are interchangeable. They come in the form of strips with holes measuring 5 μm , 20 μm , 50 μm , and 100 μm , as well as holes larger than 1.5 mm, spaced at least 2 mm apart. The diaphragm strips are electrically insulated and connected to an electrode to enable measurement of the beam current.

E- Test bench characterization:

The prism must be tested by the supplier on a test bench. This test bench must include the components necessary for characterizing the prism's performance under vacuum by simulating its end use with an electron beam whose characteristics were specified in the introduction to Part 2. The supplier shall perform all tests and characterization procedures on the test bench provided for this purpose, in accordance with the technical specifications.

Upon completion of these tests, the license holder shall submit a detailed characterization report outlining the measurement conditions, the methods used, the results obtained, and their compliance with expected performance levels. Submission of this report is a mandatory prerequisite for delivery of the instrument.

The characterization system must include the following elements:

- 1) a vacuum pumping system, 2) a detection chamber with a scintillation screen and its camera, 3) an electron gun with its power supplies, with a nominal energy of 3 keV to 5 keV.

The characterization steps must be performed:

I) The magnetic field distribution of all sectors of the prism is mapped in **three stages**: the coils alone, the coils inserted into each pole piece separately (before assembly), and the entire prism once assembled.

II) The assembled system must be evacuated and checked for leaks.

III) The electron gun must be operated using a test sample (for example, a **fine-mesh grid**) placed in the plane of the prism's entrance slit. An image without magnification must be recorded at the **dispersion plane of the prism** (i.e., at the detector), iv) and then its aberrations are analyzed.

IV) Steps III) and IV) are repeated for each quadrant **of the prism**.

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Additional information and restrictions:

The individual power supplies for the prism coils range from **3 to 20 A·t** (ampere-turns), and the stability of the power supplies (ripple/noise) is **≤ 1 10 ppm**.

The tolerances for the geometry of each sector and the parallelism of the prism plates must be **≤ 25 μm** .

3- Summary of all deliverables:

1. Prism
2. Diaphragms and Their Positioning Mechanisms
3. Manufacturing Plan
4. Controllable direct current (DC) power supplies and cables for powering the prism coils. Optional computer control.
5. Test bench with a vibration-isolated table.
6. Pumping system comprising: a turbo-molecular pump and an ion pump with an automatic vent valve, appropriate cooling, controllers, and associated cables.
7. All components of the vacuum system, including: isolation valves, vacuum fittings, and associated connectors. Ionization gauge with controller and cables.
8. Variable-energy electron gun up to 5 keV, with electrostatic deflection, power supply, and associated cables. Rated for operation at 3 keV. Optional control software.
9. Insulated YAG screen for electron detection, enabling imaging and current measurement. The screen can be positioned over the various ports facing the vacuum beam. The system includes a specially designed camera.
10. Report detailing all requested tests
11. User manual.

4- Delivery, on-site installation, and commissioning

The equipment will be prepared and made available by the contractor for shipment. The CNRS's ULISSE unit will cover the transportation and all associated costs and risks (transportation costs, customs fees, logistics and handling costs, insurance costs, local taxes, and incidental expenses). The Contractor shall be responsible for on-site installation and commissioning. The instrument will be installed in the building (520) of the Institut des Sciences Moléculaires d'Orsay on Level R-1, in the S.N. laboratory, a room maintained at a

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temperature of $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

This instrument will be delivered to the following address:

Institut des Sciences Moléculaires d'Orsay
Université Paris Saclay
Building 520 – André Rivière Street
91405 ORSAY Cedex

There are two ways to access the experimental room on R-1: either through the building's main entrance on the ground floor, using a freight elevator with the following dimensions (L x W x H: $2 \times 1.6 \times 1.90 \text{ m}^3$), or directly through the underground parking garage located on R-1, provided the vehicle is no taller than 3 m.

5- On-site training and testing

The Contractor shall provide on-site training for the device's users before declaring it operational (5 people in total).

This training should include (non-exhaustive list):

- 1- How to adjust the lenses
- 2- How to adjust and change the contrast diaphragms.
- 3- How to perform assembly, disassembly, and maintenance procedures.

During the training, the equipment will be tested by the Contractor to confirm that it meets the requirements and performance standards specified in the technical specifications. The Contractor shall provide a written report to the laboratory, which will approve it within 8 business days. Report approval will serve as the starting point for quality checks and routine services.

6- Documentation

The Contractor shall provide all documentation necessary to operate the equipment optimally and to perform routine maintenance on it. It will inform ISMO of the regulatory inspections to be conducted using the documentation provided.

7- Admission

ISMO will have a period of 8 weeks from the date ISMO confirms that the Contractor has completed all services entrusted to it, excluding the warranty, to perform quality checks and routine maintenance on the instrument in accordance with the technical specifications and performance requirements set forth in the contract.

8- Warranty

The warranty period for the equipment is 12 months, covering all travel expenses, all labor, and all replacement parts, with the exception of consumables (consumables are defined as components with a service life of less than 12 months).

9- Turnaround times

The maximum timeframe for delivery of manufacturing drawings, the manufacture of the

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equipment, and its delivery to the Contractor's premises for the ULISSE unit, including the completion of preliminary factory tests, is 70 weeks from the date of contract award.

Starting from the date of delivery to the site, the maximum timeframe for on-site installation, commissioning, training, and testing of the module is 10 weeks.