Nanospectroscopy Beamline Safety Instructions

Parent process: PRSI - Procedere in sicurezza

The original updated file is available on the corporate document management system.

Document issuance

This document followed the following process of formalization:

Rev01	1) vengono ora considerate altre categorie di lavoratori, in particolare manutentori e movimentatori (Sez. 3.1), sia nella Sezione 5; 2) vengono citati i documenti DVR per mansioni specifiche (Sez. 3.2) 3) e stato ampliato il paragrafo sulle norme di accesso agli hutch di radioprotezione (Sez. 5, pag 12-13) 4) si fa riferimento a chi si trova in particolari condizioni fisiche, ad esempio gravidanza (Sez. 5.1) 5) sono state aggiunte le Sez 5.7 e 5.11, che descrivono le attivita svolte da manutentori 6) Le Sez 5.16 e 5.21 considerano ora i rischi interferenziali	Draft	22/01/2024	Locatelli Andrea	Approval process
		Validation	22/01/2024	Bavdaz Flavio	
		Verification	22/01/2024	Bavdaz Flavio	
		Verification	22/01/2024	Forgiarini Laura	
		Verification	22/01/2024	Russo Livio	
		Verification	30/01/2024	Cocolo Euro	
		Approval	22/01/2024	Svandrlik Michele	
		Approval	22/01/2024	Franciosi Alfonso	

Record of previous revisions

Rev00	First release	Draft	13/12/2023	Locatelli Andrea
		Validation	13/12/2023	Bavdaz Flavio
		Verification	13/12/2023	Bavdaz Flavio
		Verification	14/12/2023	Cocolo Euro
		Verification	14/12/2023	Russo Livio
		Verification	15/12/2023	Forgiarini Laura
		Approval	13/12/2023	Franciosi Alfonso
		Approval	14/12/2023	Svandrlik Michele

Index

1 Purpose

This document contains information on the main scientific and technical activities carried out at the "Nanospectrocopy" beamline (abbreviated name "NASP") at Elettra - Sincrotrone Trieste S.C.p.A. (hereinafter "Elettra Sincrotrone Trieste" or "Company") and a series of *Operating Instructions* necessary to perform these activities in safe conditions.

This document can be downloaded directly from the beamline website:

https://www.elettra.eu/lightsources/elettra/elettra-beamlines/nanospectroscopy/safety.html

For anything not expressly considered below, reference is made to the laws and regulations in force, and in particular to the LEGISLATIVE DECREE 9 April 2008, no. 81.

2 Persons in charge of safety

The responsibility for the safety of workers operating at the beamline lies with the following subjects:

- the *beamline coordinator*, as *responsible for the Nanospectroscopy activity*.
- the *beamline safety supervisors*, i.e., *the beamline coordinator*, the *beamline scientist* and, in some cases, the postdocs. The persons in charge supervise the various activities carried out on the beamline, ensuring the implementation of the employer's directives and giving instructions for their correct execution. The list of those responsible for the Company's security can be downloaded from the following link:

  https://vuo.elettra.trieste.it/pls/vuo/amm_people.safety_org_chart_printout
- the *Safety Managers*, in the persons of the *Group Coordinators* of the SPEED and IDEAS beamline groups, who organize the work activity of each Group and supervise its proper implementation, with particular attention to prevention and protection measures. Their names can be found on the web page:

  https://www.elettra.eu/it/about/contatti-dei-coordinatori-di-gruppo.html

2.1 Duties of the safety supervisors of the beamline

The beamline or laboratory safety supervisors must ensure that workers (including users, external collaborators, students, trainees, etc.) use the prescribed protective equipment and follow all prescribed safety instructions.

In the absence of the safety supervisor, this responsibility is fulfilled by her/him through the prior information and training of workers and the provision of safety procedures and instructions.

3 Beamline personnel

The names and contact information of the Company designated personnel can be found on the following web page:

https://www.elettra.eu/lightsources/elettra/elettra-beamlines/nanospectroscopy/contacts.html

3.1 Categories of workers

Subject to appropriate training, the following categories of workers are authorized to work at the experimental stations and other parts of the beamline:

- beamline research personnel, namely the *beamline coordinator* (or *beamline responsible*), the *beamline scientists*, and *postdocs*;
- external research staff, and in particular academic or industrial users (*users*), collaborators, fellows from other institutions, graduate students and trainees;
- technical staff of the beamline (i.e., the beamline technicians).
- maintainers: electrical-electronic technical staff, information-technology staff, mechanical-fluid technical staff; technical staff of the Mechanical, Vacuum and Optical Engineering group.
- movers.

Each worker is responsible for taking care of his or her own health and safety and that of other persons in the workplace, on whom the effects of his or her actions or omissions fall, in accordance with his or her training, instructions and means provided by the employer.

3.2 General safety prescriptions and training

Each job category is required to complete the prescribed training courses for the specific activities of the job assignment, made available through the *Virtual Unified Office* (VUO) system.

All are encouraged to consult Elettra's **Risk Assessment Document** (document code: **PVAR-MAN-01**). In addition, electrical maintenance workers should take notice of the recommendations in the **PVAR-SCH-07** document, electrical-electronic technicians of those in the **PVAR-SCH-16** document. mechanic-fludistic technicians of those in the **PVAR-SCH-09** e the **PVAR-SCH-19** documents. Administrative-informatics-project staff should take notice of the information provided in the **PVAR-SCH-03** document.

***Important note**: it is beyond the scope of this document to report in detail on the safety requirements of electrical maintenance workers called upon to carry out routine and extraordinary maintenance operations on distribution electrical panels, or repair interventions on electrical sockets or similar devices, as there are risk assessment documents and specific safety instructions related to their activities. It is strictly prohibited for beamline scientific and technical personnel, as well as external researchers, to engage in any work activities involving electrical installations.*

4 The "Nanospectroscopy" beamline

4.1 Description of the work area

The "*Nanospectroscopy"* beamline (see **Figure 1**) is located inside the "S" building in the area between the wall surrounding the storage ring and the outer corridor near columns 14 and 15. The area occupied by the " *Nanospectroscopy* " beamline and its "NanoESCA" *branchline* is separated from the adjacent beamlines by the escape routes (3) and (6).

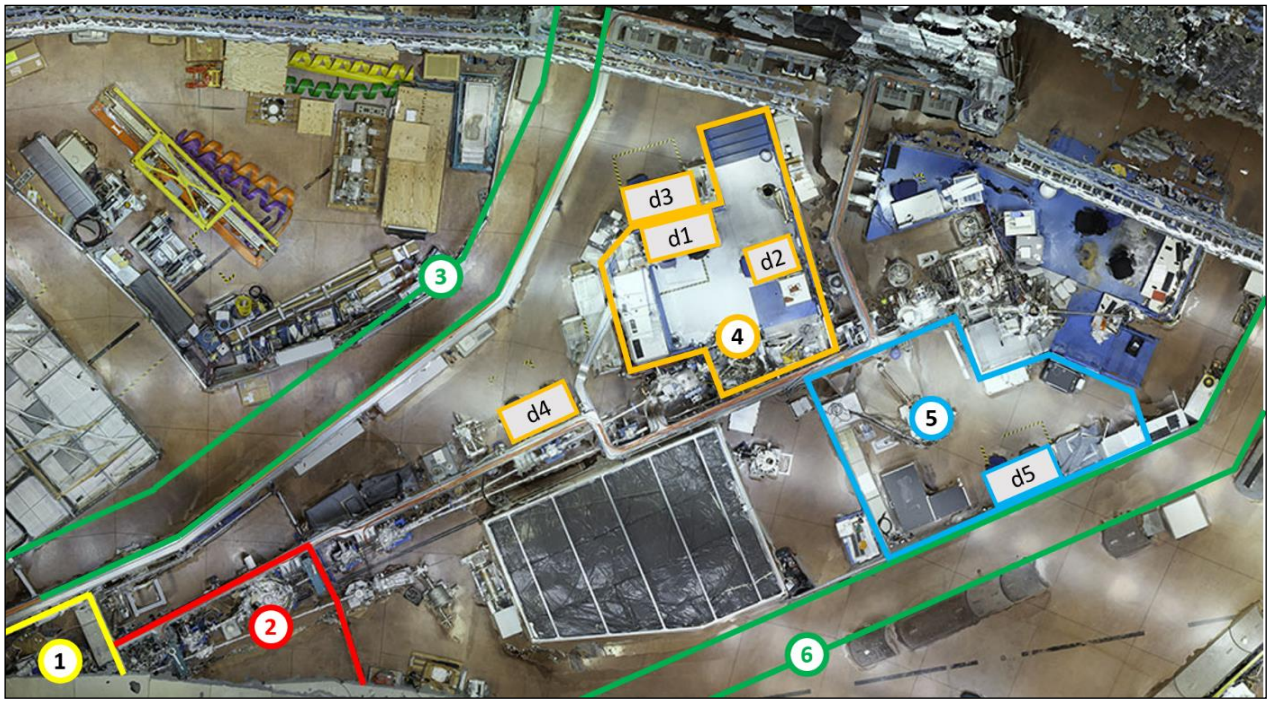

Figure 1: *Plan of the "Nanospectroscopy" beamline.*

Referring to **Figure 1**, the areas marked in **yellow** (1) and **red** (2) correspond to the radiation protection *hutch of* the *front-end* and the safety fence located immediately downstream of the hutch, which contains the monochromator. They can be accessed only by authorized personnel, i.e., by those who have taken the "*radiation protection course for personnel authorized to withdraw keys of the Elettra hutches*" (document code: **GREL-PRO-22**) and are in possession of the code necessary to withdraw the *front-end key* from the *key-safe box* located at the exhibition area.

The areas marked by the **green** lines (highlighted by labels 3 and 6 in **Figure 1**) are escape routes. In particular, escape route (3) connects the *front-end* radiation protection *hutch* to the corridor outside the experimental room. Escape routes should be kept clear of obstructions at all times.

The orange contour in **Figure 1** highlights the elevated platform that houses the "*Nano-spectroscopy"* beamline experimental station (4), at which experiments approved by the Elettra and CERIC-ERIC *Proposal Review Panels* are performed. The area bordered by the **blue contour** identifies the "UHV-MOKE" experimental station, belonging to CERIC-ERIC and maintained in operation by Elettra Sincrotrone Trieste personnel.

The "*Nanospectroscopy*" and "UHV-MOKE" experimental stations have an adequate number of workstations (indicated "d1-d5" in **Figure 1**), at which data acquisition and analysis activities can be carried out during the experiments. Each workstation is equipped with a desk and one or more ergonomic chairs.

Instead, sample preparation and assembly takes place in the ESP4 PT 008 laboratory, where a suitable work table is set up for this purpose.

4.2 Scientific activity of the beamline

The "*Nanospectroscopy"* beamline operates in the 25-1000 eV spectral range and is used by a large and heterogeneous academic community active in the fields of surface and materials science, nanoscience, and solid-state physics, particularly magnetism.

The experimental station of the "*Nanospectroscopy*" beamline houses a full-field *spectroscopic* electron microscope called **SPELEEM** (*Spectroscopic PhotoEmission and Low Energy Electron Microscope*), designed and built by Elmitec GmbH. The SPELEEM exploits the photoemission phenomenon to visualize surfaces, interfaces and thin films of metallic, oxide and semiconductor materials.

The SPELEEM microscope enables a wide range of experimental analytical investigation methods to be performed with structural, chemical and magnetic sensitivity, and in particular:

- Microscopy and diffraction techniques using low-energy electrons as probe:
  - *Low Energy Electron Microscopy* (LEEM)
  - *Microspot Low Energy Electron Diffraction* (μ-LEED)
  - *Electron Energy Loss Spectroscopy* (EELS) and Microscopy.
- Spectro-microscopy techniques using soft X-rays as probe:
  - *X-ray PhotoEmission Electron Microscopy* (X-PEEM)
  - *X-ray Absorption Spectroscopy PhotoEmission Electron Microscopy* (XAS-PEEM)
  - *X-ray Magnetic Circular Dichroism PhotoEmission Electron Microscopy* (XMCD-PEEM)
  - *X-ray Magnetic Linear Dichroism PhotoEmission Electron Microscopy* (XMLD-PEEM)
  - *Microspot X-ray Photoelectron Spectroscopy* (μ-XPS)
  - *Microspot Angle Resolved Photoelectron Spectroscopy* (μ-ARPES)

The beamline is also equipped with a dedicated apparatus for performing Magneto-Optical Kerr Effect (MOKE) magnetometry measurements under ultra-high vacuum conditions ("UHV-MOKE" experimental station).

4.3 Instrumentation available

A list of the main equipment used at the beamline is provided in this Section (the **CE** symbol indicates the special marking required for marketing the products within the European Community).

4.3.1 User and instruction manuals

The manuals of the instrumentation available at the beamline are stored at the beamline in the drawer file cabinet located next to the access ladder to the experimental station, in the rack cabinet located on the elevated platform, and in the drawer file cabinet located near the "UHV-MOKE" experimental station. PDF versions of manuals of the instruments placed in the beamline racks can be downloaded from:

https://drive.elettra.eu/d/d0ede4a21238445e9970/

4.3.2 Beamline vacuum chambers

The beamline vacuum chambers house the synchrotron beam transport optics from the source to the experimental stations of the "*Nanospectroscopy*" and "NanoESCA" *branchlines*, the related manipulators, pressure sensors, ion pumps and various beam diagnostic instruments.

A list of the vacuum chambers installed on the beamline is reported in the following, in the order from the source to the experimental station:

- Vacuum tube connecting the beamline to the *front-end*
- Vacuum chamber of the Elettra ring FEL mirrors (to be removed at the end of 2024)
- Vacuum chamber of prefocusing mirror (will be replaced during 2025)
- Vacuum chamber of the horizontal slit of the monochromator
- Vacuum chamber of the monochromator entrance slit
- Vacuum chamber with auxiliary horizontal slit (will be installed in 2024)
- Vacuum chamber of the Monochromator
- Vacuum chamber of monochromator exit slit
- Vacuum chamber of the beam deflection mirror to the *branchline* "NanoESCA"
- Auxiliary vacuum chamber for sample and specimen holder preparation
- Intermediate pumping stage of the "*Nanospectroscopy*" *branchline*
- Intermediate pumping stage of the "NanoESCA" *branchline*
- Vacuum chamber of refocusing mirrors of the "*Nanospectroscopy*" *branchline*
- Vacuum chamber of refocusing mirrors of the "*NanoESCA*" *branchline*

4.3.3 Beamline control instrumentation

- *Rack* 1 (radiation protection *hutch* access control), containing the following controllers:
  - 1x Eaton EATS16 Rack Mount Power Supply **(CE)**
  - 1x Custom-made instrumentation enabling access control to the radiation protection *hutch.*
- *Rack* 2 (*front-end* instrumentation control), containing the following controllers:
  - 2x *Heidenhein* Display Unit [obsolete, not in use].
  - 1x VAT *fast closing system*
  - 1x Elettra *custom made PLC* (master unit)
  - 1x Eaton EATS16 Rack Mount Power Supply **(CE)**
- *Rack* 3 (*front-end* instrumentation control), containing the following controllers:
  - 2x *Balzers* TPG 300 **(CE)**
  - 1x *Agilent* 4UHV ion pump controller **(CE)**
  - 2x Elettra *custom made* YAMS *power supply* 24VDC @ 14.6 A
  - 1x Eaton EATS16 *Rack* Mount Power Supply **(CE)**
  - 1x MOXA N-port 5650-8 **(CE)**
- *Rack* "01 ALIM DA QD1N/QD1P" (*beamline* instrumentation control), containing the following controllers:
  - 2x MOXA N-port 5650-8 **(CE)**
  - 5x *Balzers* TPG 300 **(CE)**

- 4x *Agilent 4UHV ion pump controller* **(CE)**
- 1x *Varian Multivac* Power Supply **(CE)**
- 2x Elettra *custom made bunch-marker and beam synchronization unit*
- 2x *Eaton* EATS16 *Rack* Power Supply **(CE)**

- *Rack* "02 ALIM DA QD1N/QD1P" (beamline instrumentation control), containing the following controllers:
  - 1x *Heidenhein* ND780 Display Unit **(CE)**
  - 2x Elettra *custom made YAMS power supply* 24VDC @ 14.6 A
  - 1x Elettra *custom made PLC unit (slave)*
  - 1x *Eaton* EATS16 *Rack* Mount Power Supply **(CE)**
- *Rack* "04 ALIM DA QD1N/QD1P" (monochromator instrumentation control, *bendable* mirrors, and auxiliary sample preparation chamber and sample holder), containing the following instruments:
  - 1x Elettra YAMS *power supply* 24VDC @ 14.6 A
  - 1x *Eaton* EATS16 *Rack* Mount Power Supply **(CE)**
  - 1x FUG 140-1250 Power Supply **(CE)**
  - 1x *Elmitec Evaporation Source* U200
  - 1x *Pfeiffer DualGauge* **(CE)**
  - 1x *Varian* TV70 Turbo V70 Controller **(CE)**
  - 1x *Pfeiffer* DCU 110 Turbo Controller **(CE)**

4.3.4 SPELEEM Microscope

- *Elmitec* SPELEEM III microscope, upgraded with R200 electronic analyzer. The microscope consists of the following parts:
  - Main experimental chamber (MCH) and its pumping system, namely:
    - 1x *Varian Starcell* 300 ion pump
    - 1x *Elmitec* titanium sublimation pump
    - 1x *Edwards* nEXT300D turbo-molecular pump
    - 1x *Pfeiffer* pumping stage unit TSU 071E **(CE)**
  - Optical illumination column, optical imaging column (COL), with R200 electron analyzer and its pumping system consisting of:
    - 1x *Agilent* ion pump VACION PLUS 150 DIODE COMBI
    - 1x NEG SAES pump getters
  - Preparation chamber (PCH) and related pumping system consisting of:
    - 1x *Agilent* Ionic Pump VACION PLUS 20 STARCELL
  - *Fast entry lock* vacuum chamber for inserting specimens into the microscope
    - 1x Agilent TwisTorr 84 FS turbo-molecular pump
    - 1x *Agilent* IDP7 scroll pump **(CE)**

- *Gas-line*
- Focus EFM3 e-beam evaporators
- Various *bake-out* equipment
  - "Variac" controller from *bake-out* on *custom-made* stand (Elettra)
  - *Hemiheating bake-out* tent **(CE)**
  - *Hemiheating* heating tapes **(CE)**
- Dewars
  - 1x Cryo Diffusion mod. RBP 200 VLN (CE)
  - 1x Norhof LN2 microdosing system #915 with 100 L Dewar (CE)

4.3.5 SPELEEM microscope control instrumentation.

- Data acquisition *workstation* named pc-nano-8
- Data analysis *workstation* named pc-nano7
- SPELEEM microscope control *rack*: "LEEM III *High Voltage supply*," containing the following controllers:
  - 1x *Elmitec gun control*
  - 1x *Elettra custom made A2505BS current supply*
  - 1x *Elmitec energy analyzer control*
  - 1x *Elmitec sample heater control*
  - 1x *Elmitec start voltage control*
- Microscope lens control *rack*
  - DC power supply boards of SPELEEM microscope lenses and alignment devices.
- "*Rack* SPELEEM ALIM. DA QD2P" instrumentation, containing the following controllers.
  - 4x ion gauge controllers VACOM/Jevatec **(CE)**
  - 1x Elmitec sample heater (preparation chamber) **(CE)**
  - 1x Elmitec e-beam evaporation source U200 **(CE)**
  - 1x Multimeter TTi 1906 **(CE)**
  - 1x Elmitec stepper motor control
  - 1x Elmitec image intensifier power supply
  - 1x Elmitec Sublimator Pump Controller
  - 1x Agilent 4UHV Ion Pump Controller **(CE)**
  - 3x Agilent IPCMini pump controller (ion pump feeder) **(CE)**
  - 1x Elmitec bake-out controller unit
  - 1x Elmitec LEEM power control unit
- "Rack 03 ALIM. QD2P," containing the following controllers:
  - 1x Varian ion bombardment gun supply 9081-2046
  - 1x LAB/SMP 1150 0-150V/0-8A Power Supply **(CE)**

  - 2x Focus UHV Evaporator Power Supply **(CE)**
  - 1x Parkin Hannifin pulse valve controller
  - 1x Agilent Twis Torr 84 FS AG (turbo pump controller) **(CE)**
  - 1x Balzers TPG 300 controller **(CE)**
  - 1x Custom-made unit containing the IMPAC IGA 140 pyrometer power supply.
  - 1x Custom unit containing synchronization electronics to Elettra's bunch-marker
  - 1x Custom unit to drive pneumatic vacuum valve on the output outlet of the microscope's MCH turbo-molecular pump
- Other instrumentation of the experimental-station
  - 1x Edwards turbo pump controller mod. D397-11-000 **(CE)**
  - 1x Elettra Picoamperometer AH501 (low voltage)
  - 1x IMPAC Pyrometer IGA 140 **(CE)**

4.3.6 Instrumentation of the experimental station "UHV-MOKE"

- UHV-MOKE vacuum chamber, equipped with:
  - PREVAC Manipulator
  - Ultra high vacuum electromagnet
  - PREVAC e-beam evaporators
  - PREVAC sputter gun
  - Pumping system consisting of:
    - 1x Agilent TwisTorr 305 FS turbo pumps and related accessories **(CE)**
    - 1x Varian Starcell plus 300 ion pump
    - 1x NEG SORB-AC Pump
    - 1x Agilent IDP7 scroll pump **(CE)**
  - Fast entry lock and vacuum bag:
    - 1x Pfeiffer HiPace80 pump and related accessories **(CE)**
    - 1x Vacubrand MV 2NT Membrane Pump **(CE**)
    - 1x SAES NEXTorr Z200 Ionic/NEG Combination Pump **(CE)**
    - 1x SAES NEG controller SIP Power Supply **(CE)**
- PC data acquisition named “PC-MOKE”
- “UHV-MOKE” instrument control rack, containing the following controllers:
  - 1x Ion gauge controllers VACOM/Jevatec **(CE)**
  - 1x PREVAC z-translation controller SMC D14 **(CE)**
  - 1x PREVAC sample temperature controller HEAT 3PS **(CE)**
  - 2x PREVAC e-beam evaporation source EVB 40A-PS
  - 1x PREVAC ion source IS40-PS
  - 1x SAES Getters NEG pump controller **(CE)**
  - 1x Varian Midivac ion pump controller **(CE)**
  - 1x Pfeiffer DCU turbo pump controller **(CE)**
  - 1x Agilent turbo pump controller **(CE)**
  - 1x SAES NEG Capacitorr controller CF35 D200 **(CE)**
  - 1x DELTA bake-out controllers DTB4824 **(CE)**

- "UHV-MOKE" magnetometer:
  - Lasers:
    - 1x Thorlabs Diode laser CPS 635SF **(CE)**
    - 1x Thorlabs HRS015B Stabilized Red HeNe Laser **(CE)**
    - 1 x Thorlabs Laser Diode LDM 405 **(CE)**
  - PEMs:
    - 1x PEM-200 **(EC)**
    - 1x PEM-100 series 1 **(CE)**
  - Detectors:
    - 2x Thorlabs DET100A2 **(CE)**
    - 2X Hinds Instrument DET 200-004 **(CE)**
  - MOKE experimental setup control tools:
    - Thorlabs HRS 15B - HeNe power supply **(CE)**
    - Thorlabs laser diode power supply **(CE)**
    - HINDS instruments Signaloc 2500 lock-in amplifier **(CE)**
    - HINDS instruments SCU100 signal conditioning unit **(CE)**
    - HINDS instruments PEM controller **(CE)**
    - Rigol DS4054 Digital Oscilloscope
- Other instrumentation of the end-station:
  - Hemiheating bake out tents **(EC)**
  - Hemiheating HP-230-01 Fan Heaters **(CE**)
  - Hemiheating heating tapes **(CE)**

4.4 Access to the beamline

External research personnel wishing to perform experiments at the "*Nanospectroscopy*" beamline must fill out an appropriate request for access to the Elettra Sincrotrone Trieste site on the VUO portal and pass the required safety tests. Access to the beamline takes place in a very specific manner, which depends on the category and professional status of the applicant, see **Figure 2**:

Access requests to the laboratory (ONLY FOR USERS)

This link for the access requests to the laboratory is **ONLY FOR USERS**.

Access requests to the laboratory (NOT FOR USERS)

This link for the access requests to the Elettra laboratory is **NOT FOR USERS**, but only for:

- Student final-year@UNI (from Italy),
- PhD student (from Italy),
- Post-doc@UNI (from Italy),
- Student for training,
- Fellowship holder,
- School attendee,
- Attending at Conferences/Lecturer,
- Elettra partner,
- Collaborator,
- Commercial user

***Figure 2**: Types of access requests and categories of applicants*

The main types of access requests are described below:

- **Academic users (*panel-approved proposal*):** submission on the VUO portal of an access request to Elettra's "*Nanospectroscopy*" beamline following the approval of a scientific proposal for beamtime by the Elettra or CERIC-ERIC Proposal Review Panel. The access request is taken up and approved by the Users Office of the facility to which it is addressed.
- **Academic users (*in-house proposal*):** submission on the VUO portal of a request for access to Elettra "*Nanospectroscopy"* beamline as a participant in an internal research proposal, i.e., an "in-house" proposal. The access request is taken up and approved by the Users Office of Elettra Sincrotrone Trieste.
- **Industrial users:** submission on the VUO portal of an access request to the "*Nanospectroscopy"* beamline as a participant in an industrial research proposal managed though the Industrial Liaison Office (ILO). The access request is handled by the ILO.
- **Collaborators and partners**: submission on the VUO portal of an access request to the Elettra Sincrotrone Trieste "*Nanospectroscopy*" beamline as a collaborator or partner. This request is approved by an internal "tutor", namely a staff member of the beamline and then by the Users Office of Elettra Sincrotrone Trieste.
- **Students and trainees, external fellows, PhD students:** submission on the VUO portal of an access request to Elettra Sincrotrone Trieste's "*Nanospectroscopy"* beamline as a student, trainee, external fellow, or PhD student. An agreement (such as a *Memorandum of* Understanding/Convention) between Elettra Sincrotrone Trieste and the institution with which the student/fellow is affiliated must be in place at the time of the request. The request for access is approved by the Human Resources Activity and an internal "tutor", in this specific case a member of the beamline staff.
- **Outside firms:** sending a request to the Prevention and Protection Service (PPS), for example by e-mail, to perform installations or provide services at the "*Nanospectroscopy*" beamline following a procurement request and corresponding order. The contractor is required to provide and update the list of names of personnel who will be going to the Elettra Sincrotrone Trieste site. Entry will be authorized by the SPP Activity, after sending the names of the personnel involved and the license plate of the vehicle with which access to the site will take place. According to current occupational safety regulations (Legislative Decree 81/08 as amended), any activity entrusted to the contractor must be preceded by a mutual exchange of safety documents, see:

  https://www.elettra.eu/activities/spp/information-for-external-firms.html

5 Safety operating instructions

This section lists safety operating instructions related to the main scientific and technical activities performed at the "*Nanospectroscopy"* beamline and related experimental stations. These instructions are based on the following documents available in the corporate documental system.

- **Nanospectroscopy beamline risk assessment summary document (document code: PVAR-SCH-80)**
- **Nanospectroscopy beamline Worker Risk Assessment Sheet (document code: PVAR-SCH-79)**

All members of the beamline staff are responsible for ensuring that the activities specified herein are carried out in accordance with applicable regulations and in accordance with directives issued by the Responsible for the Activity, i.e., the *beamline coordinator*, and the *group coordinator*. Of particular relevance are the provisions concerning the use of the prescribed Personal Protective

Equipment (PPE) detailed in the following.

Regarding the Protection and Safety Standards governing the activities in the Elettra Experimental Hall, we invite the reader to take notice of the document "Radiological Risk in the Elettra Experimental Hall" (document code: **RPFO-SCH-05**). Access to the hutch and the fenced area around the monochromator is allowed only to authorized personnel, see "Key management of Elettra hutches - General rules for beamline personnel" (document code: **GREL-PRO-22**). In order to allow safe access for maintenance personnel working under emergency conditions or on call, any interference hazards should be clearly marked on access doors to these areas. Non-emergency access by unauthorized internal or external personnel, on the other hand, must be agreed upon with the beamline coordinator and always take place in the presence of authorized personnel.

5.1 Special health conditions of the worker.

The performance of certain work activities described below may be incompatible with special physical or medical conditions. Workers are urged to promptly notify the beamline coordinator or the safety supervisor of any resulting limitations.

In the special case of pregnancy conditions, it is recommended that only those activities that can be assimilated to office work (described in Section 5.2), i.e., video terminal activities and in particular data acquisition or data analysis operations, should be performed. Particular attention should be paid to the observance of breaks.

Pregnant or post-partum workers must absolutely refrain from activities that expose them to electrical, chemical or radiological hazards or involve the risk of injury, or the performance of physical exertion. Please refer to the procedure **"Pregnant and Postpartum Workers. Protection from health risks in the workplace"** (document code: **PVAR-IOP-01**).

5.2 Video terminal activities (data acquisition and analysis, etc.)

Task Description: all work activities that require the use of personal computers or workstations, and in particular:

- data acquisition;
- data analysis;
- software development;
- CAD drawing;
- document preparation, e.g. scientific articles, email correspondence, etc.

Associated risks:

- demand for high visual attention in carrying out the operation;
    - no PPE is provided; current regulations require a break d 15 minutes for every 120 minutes of continuous activity;
    - appropriate training must be provided;
- repetitive movements, fixed postures, uncomfortable positions. Skeletal-muscular damage is possible. It is required to:
    - Maintain an ergonomically correct posture;
- slips, falls at level. Possible tripping on access ladder. It is required to:
    - Take special care when climbing up or down the staircase to access the elevated platform of the experimental station.

Video display screen activity may be conducted by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline.

Please note:

- *users, collaborators, fellows, students and trainees may conduct data acquisition activities only after appropriate training by beamline staff. Damage to the instrumentation and thus a negative impact on the outcome of the ongoing experiment is possible. The Company reserves the right to seek compensation for damages incurred in case of negligent or irresponsible conduct.*
- *the activity of data acquisition should not be confused with that of manual operation of the experimental apparatus, which requires more training and experience and may pose risks to the operator.*
- *users cannot change the monochromator gratings, because the area in question is subject to radiation protection with access limited only to authorized personnel.*

5.3 Installation, use and removal of high-voltage instrumentation

Task Description: work activities involving the installation and use of scientific instrumentation whose internal parts can reach voltages from more than 500 volts up to several thousand volts, for example:

- electron beam sample heaters;
- electron beam evaporators;
- ion guns;
- Penning- or Bayard-Alpert-type pressure sensors;
- mass spectrometers (or QMS);
- ion pumps or titanium sublimation pumps;

Associated risks: electrocution. The following requirements should be followed:

- consult the manuals and strictly follow the installation instructions;
- check the integrity of the controller-instrument cabling before installation;
- Make sure not to exceed the maximum permissible curvature of the cables of ion and ion-gauges;
- connect and disconnect the instrument only when the power supply is off;
- follow the instructions for proper grounding of the instrument and its controller.

The activities described above can be carried out by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline;
- maintainers (electrical, electronic, IT and vacuum technicians).

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.4 Installation, use and removal of low voltage instrumentation

Task description: installation, use and removal of scientific instrumentation operating at low voltage (< 50 V). High currents (*), up to 10 A, may be present in some cases. Examples follow:

- capacitive pressure sensors;
- Pirani-type pressure sensors;
- filaments for heating samples or evaporation baskets (*);
- alkaline dispensers (*);
- Knudsen cell type evaporators (*).

Associated risks: burns. Possible explosion due to the electric arc following the accidental interruption of electric circuit continuity. The following requirements should be followed:

- consult the manuals and strictly follow the installation instructions;
- check the integrity of controller-instrument cabling before installation;
- connect and disconnect the instrument only when the power supply is off, being sure that no current is flowing through the cable connecting the controller to the instrument;
- pay special attention to connections between laboratory cables equipped with banana plugs.

The activities described above can be carried out by the following categories of workers:

- research staff of the beamline;
- technical staff of the beamline;
- maintainers (electrical, electronic, IT and vacuum technicians).

Please note:

- *users, employees, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.5 Small repairs of electronic instrumentation

Task Description: replacement of damaged electronic components, such as fuses or capacitors, or replacement of entire electronic boards:

Associated risks: electrocution. The following requirements should be followed*:*

- before carrying out the repair, consult the manuals and strictly follow the instructions therein. Contact the manufacturer if in doubt;
- always disconnect the equipment from the power source before operating on it;
- always pay attention to the residual charge of the capacitors, since it persists even after the instrument is turned off. Wait sufficient time for the capacitors to discharge completely;
- in case of using the soldering iron, choose a suitable workstation. There is a fire hazard from using the soldering iron. Remove flammable objects from the work table. Turn off the soldering iron immediately after completing the repair;
- after completing the repair, inform the beamline coordinator and agree with him/her on the tests to be performed.

Electronic instrumentation repair activities can be performed by the following categories of workers:

- research staff of the beamline;
- technical staff of the beamline;
- maintainers (electrical, electronic, IT and vacuum technicians).

Please note:

- *users, collaborators, fellows, students and trainees ARE NOT AUTHORIZED to carry out this type of activity*.

5.6 Routine or extraordinary maintenance operations in the racks.

Task description: these are repair/replacement of instruments (e.g., controllers and power supplies) installed in the control racks of the beamline or experiment station, or repair/replacement of signal or serial/Ethernet communication cables.

Associated risks: electrocution. The following requirements should be followed:

- strictly observe electrical safety regulations;
- take into account what is stated in Sections 5.3, 5.4 and 5.5.
- before carrying out the installation or repair of any equipment, consult the manuals and scrupulously follow the instructions given therein. Contact the manufacturer if in doubt;
- always disconnect the equipment from the power supply before working on it; if necessary, disconnect the power supply to the rack;
- always pay attention to the residual charge of the capacitors, since it persists even after the instrument is turned off. Wait sufficient time for the capacitors to discharge completely;
- be careful not to damage the cables of other instruments, especially those carrying high voltage (ion gauges, ion pumps); if necessary, turn off these instruments and move or remove their cables;
- after completing the repair, inform the beamline coordinator and agree on the tests to be performed.

Electronic instrumentation repair activities can be performed by the following labor categories:

- beamline research personnel;
- beamline technical personnel;
- maintenance personnel (electrical, electronic, IT and vacuum technicians).

Please note:

- *users, collaborators, fellows, students, and trainees ARE NOT AUTHORIZED to perform this type of activity*.

5.7 Routine and extraordinary electrical maintenance work

Task description: routine maintenance operations of electric appliances, such as:

- electrical repairs in racks or on the electrical distribution boards;
- installation/repair of electrical sockets or socket panels;
- maintenance of electrical panels; testing of proper functioning of circuit breakers.

Associated risk: electrocution. The following requirements should be followed:

- strictly comply with electrical safety regulations;
- take note of the recommendations given in document **PVAR-SCH-07**.

Maintenance activities may only be performed by the following labor categories:

- maintenance workers (electrical-electronic technicians in the Infrastructure Group).

Please note:

- *all other work categories ARE NOT AUTHORIZED to perform this type of activity.*

5.8 Installation/removal of heavy or bulky instrumentation

Description: these are activities that must be performed with the support of the removals personnel. Typically, these are the transport, installation or removal of encumbered or heavy parts of the beamlines instrumentation or experimental stations, for example:

- vacuum chambers;
- manipulators;
- scientific instruments of relevant weight and size;
- ion or turbo-molecular pumps of significant weight and size;

Associated risks: manual handling of loads; shocks, hits, impacts. The following requirements should be followed:

- agree with the beamline coordinator on a plan for safe assembly/disassembly;
- request the intervention of removals personnel;
- always make use of the overhead crane for lifting vacuum chambers and heavy objects. Where it is not possible to intervene with the overhead crane, use a "goat" type lift;
- work in pairs to reduce the load and corresponding strain;
- always wear the prescribed PPE:
  - protective gloves, for example, leather gloves or cut-resistant gloves;
  - safety shoes;
  - protective helmet (only in case of overhead crane use).

The work activities described in this section can be conducted by the following categories of workers:

- research staff of the beamline;
- technical staff of the beamline;
- movers

Please note:

- *users, collaborators, fellows, students and trainees ARE NOT AUTHORIZED to carry out this type of activity*.

5.9 Installation/removal of vacuum equipment and instrumentation

Task Description: installing or removing parts of the instrumentation of the beamlines or corresponding experimental stations, without use of the overhead crane and without support from removals personnel. By way of example, this involves performing the following tasks:

- installation or removal of scientific instruments (weighing up to 20 kg), ion or turbo-molecular pumps, membrane or diaphragm pumps;
- installation or removal of small to medium-sized vacuum instrumentation (weighing up to 20 kg);
- assembly or disassembly of various instrumentation, e.g., manipulators (weighing up to 20 kg);
- installation or removal of instrumentation in *racks* (weighing up to 20 kg);

Associated *risk*:

- manual handling of loads. The following requirements should be followed:
  - work in pairs to reduce the load and corresponding strain;
- shocks, hits, impacts. We recommend:
  - wear the following PPE: protective gloves, for example, leather gloves or cut-resistant gloves.
- slips, falls at level, tripping. It is recommended to:
  - keep the floor free of sharp objects, highlight any obstacle.

These work activities can be carried out by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline;
- maintenance personnel (electrical, electronic, IT and vacuum technicians).

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving proper training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.10 Minor maintenance work on vacuum chambers

Task Description: routine maintenance operations of vacuum chambers and/or their vacuum components, for example:

- installation/removal or assembly/disassembly of instrumentation or parts and components of vacuum systems, e.g., *gate-valves*, *leak valves*, linear manipulators (*z-translators*), pressure sensors, ion cannons;
- opening/closing flanges to allow repairs and routine maintenance operations inside in the vacuum systems of the beamline or experimental stations;

Associated risk: shocks, hits, impacts;

- there are no prescriptions or use of PPE

Maintenance activities can be performed by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline.

Please note:

- users, co-workers, fellows, students and trainees may conduct this type of activity *only after receiving proper training and authorization from the beamline personnel in charge of safety. Instructions received must be followed strictly*.

5.11 Small fluid-mechanical maintenance operations

Task description: minor fluid-mechanical maintenance, such as:

- water leak repairs;
- installation or replacement of faucets, rigid pipes, hoses, and flow switches.

Associated risk: shocks, hits, impacts;

- take notice of the recommendations in the **PVAR-SCH-09 and PVAR-SCH-19** documents.

Associated risk: electrocution;

- take notice of the recommendations in the **PVAR-SCH-07** document and in **Section 6.3**.

Maintenance activities can be performed by the following labor categories:

- maintenance workers (mechanical-fluidistic technicians of the Infrastructure Group).

Please note:

- *all other work categories ARE NOT AUTHORIZED to perform this type of activity.*

5.12 Elevation work on cable trays or vacuum chambers

Task description: operations performed in elevation on ladders or scaffolds, such as:

- laying or removing cables from cable trays;
- maintenance operations of the internal or external parts (e.g., manipulators) of the vacuum chambers of the beamline.

Associated risk: slip or fall from elevated positions. The following requirements should be followed:

  - whenever possible, use a harness and secure to solid supports;
  - work in pairs; one of the two must hold the ladder firmly.

The following **PROHIBITIONS** must also be observed:

  - *work in elevation in positions that allow viewing inside the beamline shielding walls when the beam-stopper is open.*
  - *working at elevation above 3 meters at a distance of less than 5 meters from the ring screens during machine physics shifts.*

Activities related to elevation work can be conducted by the following categories of workers:

- technical staff of the beamline.

Please note:

- *beamline researchers, users, collaborators, fellows, students and trainees ARE NOT AUTHORIZED to carry out this type of activity. The beamline research personnel may assist the technical staff.*

5.13 Cleaning of ultra-high vacuum components and tools

Task description: these are operations carried out in the course of routine or extraordinary maintenance of vacuum chambers and/or their parts and components:

- cleaning of small metal parts, such as parts of specimen holders, manipulators, and sensors. Cleaning is done by immersion in ethyl alcohol or acetone;
- cleaning of the tools used for assembly/disassembly of parts in ultra-high vacuum;
- material removal using filings or sandpaper, resulting in the formation of metal dust.

  Associated *risks*:
  - inhalation of gases or vapors. The following requirements should be followed:
    - avoid prolonged exposure to acetone vapors; if so, work under a fume cupboard;
    - wear latex gloves;
  - inhalation of dust or fibers. The following requirements should be followed:
    - working under a fume cupboard;
    - wear latex gloves and lab coat;
    - wear FFP2 or FFP3 mask during all material removal operations.

Activities related to the cleaning of components and parts for use in ultra-high vacuum can be conducted by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline.

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving proper training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.14 Maintenance of primary pumps

Task description: this is a routine maintenance operation, typically to be carried out once every one to two years, necessary to restore the pristine pumping speed of *scroll*, diaphragm, or diaphragm pumps. Seals/membranes are changed and mechanical cleaning is carried out using brushes, vacuum cleaners, and wet rags.

Associated risks: inhalation of dust. The following requirements should be followed:

- refer to the manual provided with the pump maintenance kit. Follow the manufacturer's recommended instructions;
- work under a fume cupboard or outside;
- wear latex gloves;
- wear FFP2 or FFP3 mask during the entire duration of cleaning operations.

The work activity related to the cleaning of primary pumps can be performed by the following categories of workers:

- technical staff of the beamline.

Please note:

- *The beamline research personnel may assist the technical staff. Users, collaborators, fellows, students and trainees ARE NOT AUTHORIZED to carry out this type of activity.*

5.15 Leak check operations

Task description: search for leaks in vacuum chambers. A quadrupole mass spectrometer and a helium cylinder with a capacity of 16 liters is used.

Associated risks: shocks, hits, impacts. Prescriptions:

- the use of PPE is not expected;
- always use the appropriate trolley for handling the cylinder;
- always secure the cylinder to a fixed structure using the chain with which it is tied to the trolley, in order to prevent it from accidentally tipping over

Leak check operations can be carried out by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline.

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving proper training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.16 Bake-out of vacuum chambers

Task description: to achieve the usual ultra-high vacuum conditions, vacuum chambers are baked out at temperatures typically between 100°C and 150°C. Bake-out preparation consists of the following operations, each of which presents specific risks:

- Assembly and disassembly of the *bake-out* tent.

  Associated risks:

  - shocks, hits, impacts. Prescriptions:
    - PPE is not required;
    - work gloves are recommended. Assembly and disassembly of the tent is easier and safer when working in pairs;
- Use of resistive heaters and tapes.

  Associated risks:

  - exposure to heat, burns during disassembly due to residual heat. The following requirements should be followed:
    - wear heat protective gloves during disassembly operations
  - electrocution. The following requirements should be followed:
    - always use only **CE**-marked equipment;
    - multimeter verification of the heating tapes electrical integrity before use.

- inhalation of dust/fibers:
  - it is prohibited to use fiber-glass coated heating tapes, or fiber-glass sheets.
- **interference risk: signal with appropriate signs the danger from hot parts in order to prevent burns to personnel assigned to other tasks.**

Work activities related to *bake-out* operations can be conducted by the following categories of workers:

- research staff of the beamline;
- external research staff;
- technical staff of the beamline.

Please note:

- users, co-workers, fellows, students and trainees may conduct this type of activity *only after receiving proper training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.17 Powder sample preparation

Task description: powders or nanoparticles are deposited on metallic or semiconductor samples for example by *spin coating* technique, or by fixing them under pressure.

Associated risks: inhalation of dust and/or fibers. The following requirements should be followed:

- consult the Safety Procedure of the User Support Laboratory;
- consult the safety datasheet of the substance and take necessary precautions;
- carry out the preparations in the Support Laboratory, always working under the fume cupboard;
- wear prescribed PPE: chemistry lab coat, latex gloves, goggles, FFP2 or FFP3 mask during the entire duration of preparation operations.

The work activity related to the powder sample preparation can be carried out by the following categories of workers:

- beamline research staff;

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline personnel in charge of safety. Instructions received should be followed scrupulously.*

5.18 Mounting and insertion of samples into the experimental chambers

Task description: mounting samples on Elmitec sample holders and introducing them into the *fast-entry lock* of the experimental station for pumping and subsequent transfer under high vacuum conditions to the main experimental chamber of the SPELEEM or UHV-MOKE experimental stations.

Associated risks:

- inhalation of dust, fibers. The following requirements should be followed:
  - consult the safety datasheet of the substance and take necessary precautions;
  - use latex gloves; if necessary, wear an FFP2 or FFP3 mask;
- repetitive movements, uncomfortable postures. Temporary incongruous postures may cause

musculoskeletal disorders. There are no special prescriptions.

Sample assembly activity can be conducted by the following categories of workers:

- research staff of the beamline;
- external research staff.

Please note:

- *external research personnel, i.e., users, collaborators, fellows, students and trainees may assemble and insert samples into the experimental chambers only after receiving appropriate training and clearance from the beamline safety supervisors. Instructions received must be followed strictly. Substantial damage to the instrumentation caused by unintentional venting of the experimental apparatus is possible. The Company reserves the right to claim compensation for damages incurred in case of negligent or irresponsible conduct.*

5.19 Activities with cryogenic liquids

Task description: scientific experiments with the SPELEEM microscope or the “UHV-MOKE” apparatus sometimes require cooling the sample by the use of liquid nitrogen cryostats. Operation of a cryostat requires certain preparatory activities to be carried out, each of which is characterized by a specific risk:

- Dewar filling at the distribution station.

  Associated risks:

  - exposure to cold due to accidental contact with low-temperature liquid or gaseous nitrogen. Injuries from frostbite or burns are possible. The following requirements should be followed:
    - wear the following PPE: cryogenic gloves, protective goggles;
    - it is advisable to have taken the "*Azoto Elettra*" course or equivalent course on the use of cryogenic gases and liquids;
    - training and information: refer to **PRSI-PRO-03** Safety Procedure;
    - the level of liquid nitrogen fed into the 100 L Dewar of Norhof LN2 microdosing system #915 must remain at least 18 cm below the NW50 flange.

- Transportation of the *Dewar* to the experimental station.

  Associated risks:

  - shocks, hits, impacts; crushing due to the possible tipping over of the *Dewar* at the access ramp to the Elettra Sincrotrone Trieste experimental room. The following requirements should be followed:
    - training and information: refer to **PRSI-PRO-03** Safety Procedure.

- Connection, use and disconnection of *Dewar* CryoDiffusion or Norhof microdosing system #915 to the experimental station cryostat via liquid nitrogen transfer line.

  Associated risks:

  - shocks, hits, impacts. The following requirements should be followed:
    - Work in pairs during the assembly/disassembly operations of the liquid nitrogen transfer line;
  - overpressure in the Norhof dewar;
    - after lowering the pump in the dewar, remember to connect it to the mains and

check that stand-by mode is active;

- Fill the storage Dewar for max 90% with LN2, leave minimal 18 cm free from top.

- exposure to cold during disassembly operations. The following requirements should be followed:

  use cryogenic gloves;

  strictly follow the instructions in the Norhof LN2 microdosing system #915 user manual.

Work activities related to the operations *of filling, transporting, and connecting Dewars to the cryostat* can be conducted by the following categories of workers:

- research staff of the beamline;
- technical staff of the beamline.

Please note:

- *users, co-workers, students and trainees will be allowed to cooperate in such operations only after receiving appropriate training and authorization from the beamline safety supervisors. Instructions received must be followed scrupulously.*

5.20 Experiments with non-toxic gases

Task description: gas-line preparation, evacuation, and filling using mini-bottles (1-liter capacity at 12-bar pressure) of the following gases: O_2 , H_2 , CO_2 , Ar, Ne, He, CH_4 , $C2H_4$.

Associated risks: not significant. The gases are nontoxic and are used in minute quantities, on the order of a few tens of thousands of L (Langmuir).

Gas-line preparation instructions:

- connect the mini-bottle to the *gas-line*;
- ensure that the drains of all primary pumps are connected to the suction system;
- test the vacuum tightness of the *gas-line* section on which the cylinder is connected;
- fill the gas-line with gas and perform the necessary flushing operations;
- finished the experiment, evacuate *the gas-line* before removing the mini-bottle.

Work activities related to *gas-line* preparation can be carried out by the following categories of workers, subject to appropriate training (damage to the experimental apparatus is possible):

- research staff of the beamline;
- external research staff;
- technical staff of the beamline.

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving proper training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.21 Experiments with toxic or corrosive gases

Task description: installation of pressure regulator on cylinders; connection of cylinder to gas-line; preparation, evacuation and filling of gas-line; gases used: NO, NO_2, NH_3 (contained in 2- or 5-liter volume cylinders) and CO (1-liter mini-bottle).

Associated risks: inhalation of vapors or gases. The experiments are performed under vacuum conditions at pressures below $2\text{-}10^{-6}$ mbar, dosing very low quantities, on the order of a few tens of thousands of L (Langmuir). The following requirements should be followed in order.

***Interference risk*: any gas leaks could affect the nearest laboratories and beamlines. Act with utmost care, strictly observing all the steps listed below:**

- make sure the central gas extraction system is working properly;
- consult the safety data sheet of the gas and take necessary precautions, e.g., use of gas mask;
- in the case of NO, NO_2 , NH_3 one must have a pressure regulator suitable for the gas in use. CO, on the other hand, is available in mini-bottles. The amount of CO contained in the mini-bottles is such that there is no cause for concern, given the volume of Elettra's experimental room;
- mount the pressure regulator on the cylinder by working under a hood or outdoors; work in pairs.
- secure/anchor the cylinder to a solid support located near the gas-line of the experimental station;
- connect the cylinder to the gas-line using steel pipes dia. 6 mm and Swagelok connections®;
- ensure that the drains of all primary pumps are connected to the suction system;
- test the vacuum tightness of the gas-line section on which the gas cylinder is connected;
- fill the line with gas by opening the tap and pressure regulator of the cylinder;
- perform the necessary gas-line flushing operations;
- once the experiment is finished, close the cylinder and evacuate the gas-line. Pump for a long time before venting and detach the cylinder from the gas-line;
- store the cylinder in a safe place, that is, in the outdoor cages dedicated to hazardous gas storage.

In case of accidental gas leakage in large amount, inform the control room (8922) to request evacuation of the experimental room by loudspeaker. If possible intercept the leak and stop it without endangering your own safety. Open the gates of the experimental room to favor air exchange.

All work activities related to gas-line preparation MUST BE performed by the following categories of workers, after adequate training and authorization from the beamline coordinator:

- senior research staff of the beamline;
- technical staff of the beamline.

Please note:

- *users, co-workers, fellows, postdocs, students, trainees, and especially pregnant or post-partum women ARE NOT AUTHORIZED to carry out this type of activity.*

5.22 MOKE experiments with class 3R lasers

Task description: alignment of UHV-MOKE setup for experiments with class 3R laser source.

Associated risks: exposure to non-ionizing radiation. During the optics alignment procedure, reflected light from the laser may be accidentally focused on the retina. The following requirements should be followed in order:

- it is mandatory to wear the following PPE: LASER safety glasses;
- closing the protective enclosures of the optical table as soon as the optical set-up alignment operation is completed.

Experimental activities performed with the UHV-MOKE apparatus can be carried out by the following categories of workers, following appropriate training:

- research staff of the beamline;
- external research staff.

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline safety supervisors. Instructions received must be followed strictly.*

5.23 Maintenance operations on the SPELEEM microscope control rack.

Task description: the microscope control rack is opened at the rear and/or front in order to perform maintenance operations, such as installation/removal/repair of a power supply or a specific scientific instrument used in selected experiments.

Associated risks: shocks, hits, impacts. In the stages of opening and disassembly of the racks, accidental falling of the closure panels may occur. Tools used in disassembly may fall during work. There is no risk of electrocution, since opening the rack panels causes the rack power supply to be cut off. The following requirements should be followed:

- carefully consult the SPELEEM (Elmitec) microscope manuals, available at the end-station
- those assisting the person performing the procedure should not stand in the area adjacent to the rear platform, as they would be exposed to the accidental falling of tools or panels;
- when working near the front of the rack, special attention should be paid to the red insulating rods, which protrude about twenty centimeters from the front panel of the controllers. Risk of injury to face and eyes. Cover the insulating rods with a piece of polystyrene or packing foam, or use protective goggles. Disassemble them if necessary.
- do not tamper with the rack or its internal or external parts.

The experimental activities performed herein described can be carried out by the following categories of workers, following appropriate training:

- research staff of the beamline;
- technical staff of the beamline.

Please note:

- *users, collaborators, fellows, students and trainees ARE NOT AUTHORIZED to conduct this type of activity.*

6 Electrical Safety Standards

Electrical and electronic equipment in operation at the beamline experimental stations expose operators to electrical hazards. This risk is reduced by complying with current regulations and following the guidelines and prohibitions below:

6.1 Recommended electrical safety guidelines

- Comply with safety signs and related regulations.
- Ensure that the electrical system or equipment has the necessary approvals and certifications, if necessary contacting the competent personnel.
- Be sure of the location of the electrical panel supplying power to the area in which you are working so that you can promptly de-energize the system if necessary.
- Use electrical systems in accordance with their intended use and respective operating manuals.
- Ensure that the power cords of electrical appliances are adequately protected from mechanical (passing people, sharp objects, etc.), thermal (heat sources) or chemical (corrosive substances) actions.
- Make sure the power has been turned off before performing any simple operation on the facilities (including changing a bulb) or equipment.
- Always make sure the electrical system is disconnected (after operating the appropriate switch) before unplugging.
- Disconnect the equipment from the power source before starting periodic cleaning.
- Plug the equipment into the nearest outlet, avoiding the use of extension cords as much as possible.
- Do not overload outlets with too many electrical consumers, always checking that the total current load intensity does not exceed the limits of the outlet itself.
- The multiple adapters allowed by the standards are those with only two side sockets. The other type, with a third socket parallel to the plugs, is considered dangerous because it allows multiple sockets to be chained together.
- German-type (Schuko) plugs can be inserted into Italian-type sockets only by means of an adapter that transfers the ground connection made via the side plates to a central plug. It is absolutely forbidden to forcibly insert Schuko plugs into Italian sockets.
- Avoid subjecting all parts of electrical systems to mechanical or impact actions (passing trolleys, etc.).
- When using roller extensions, they must be fully unwound to avoid overheating. In fact, the capacity of the coiled cable is reduced. The capacity of the cable, which must be indicated, must always be respected.
- Do not pull the power cord to disconnect an electrical appliance from the outlet, but use the plug.
- Do not tamper with electrical equipment (qualified personnel must be requested for any need in accordance with company procedures).

6.2 Prohibitions

- Prohibition of tampering with electrical appliances.
- Prohibition to install or use private electrical equipment or materials.

- Prohibition to intervene in case of failure on switchboards or electrical panels.
- Prohibition of covering or concealing the controls and electrical panels with cabinets or other furnishings (allow inspection and timely intervention in case of anomalies).
- Prohibition of removing the protective channels of electric cables.
- Prohibition of overloading outlets with too many electrical consumers, using adapters or multiple outlets.
- Prohibition of depositing flammable substances in the vicinity of equipment.
- Prohibition of depositing containers filled with liquids on the devices.
- Prohibition of exposing equipment to excessive radiation or heat sources.
- Prohibition of preventing proper ventilation of equipment by covering ventilation openings.
- Prohibition of touching facilities and/or equipment if you have wet hands or shoes.
- Prohibition on the use of water for extinguishing fires of electrical origin.

6.3 Behavior to be followed in case of water leakage

The electron beam evaporators and turbo-molecular pump in use at the SPELEEM microscope experimental station require cooling water. Some of the beamline chambers also need water, which is used to cool the monochromator optics, the entrance slits and the prefocusing mirror. Such water is demineralized, and therefore non-conductive.

Given the presence of high voltage in many pieces of equipment, the risk of electrocution cannot be completely ruled out. For this reason, it is important to avoid putting yourself or others in a dangerous condition. The following recommendations must be followed:

1. Consult the beamline safety supervisor, if she/he is on site.
2. Don't get caught up in rush or panic.
3. Avoid stepping on wet areas.
4. Avoid touching wet areas with your hands.
5. Prevent flooding by closing the cooling circuit subject to leakage.
6. DO NOT dry wet areas with paper or rags, unless you have turned off power to all *racks* and utilities. Cordon off the area so as to prevent third parties from accessing it.
7. If the presence of water is limited to the granite platform on which the microscope rests, use dry nitrogen gas to promote its evaporation.

7 Emergency management

Various and of different severity are the emergencies that can happen on the power line. They must be handled according to the company's Emergency Plan (see procedure GEEM-PRO-02-rev03IT).